The Effects of a Fitness Assessment and Exercise Consultation on Physical Activity Intention and Behaviour in a Socially and Economically Deprived Community: An Application of the Transtheoretical Model of Behaviour Change.

By
Matthew P Lowther,
B.Sc (Honours) Sport Science

being a thesis submitted for the degree of Doctor of Philosophy in the Institute of Biomedical and Life Sciences, Faculty of Medicine, University of Glasgow

June 2000

Abstract

Physical activity (PA) (30 minutes of accumulated moderate intensity PA on most days) can protect against and enhance physical and mental ill-health. Despite this, 60% to 75% of the Scottish population do not meet the current PA recommendations. Those living in socially and economically deprived communities are particularly susceptible to chronic diseases related to sedentary lifestyles. Three studies were conducted as part of this research.

Study One

Aim

To develop a reliable, valid, self-assessing, British, 7-day recall measure of occupational and leisure PA.

Methodology

SPAQ (Scottish Physical Activity Questionnaire) was developed from several pilot studies. To test for reliability, SPAQs (N = 34) were completed on a Monday and the following Wednesday. Thus each questionnaire measured 4 identical days. To establish concurrent validity, 94 participants completed a SPAQ and a stage of exercise behaviour change (SOC) questionnaire. Responses to SPAQ were analysed by SOC.

Results

Occupational PA had a coefficient of repeatability (R) of 55 minutes but leisure PA was more reliable (R=29 minutes). The main variation in occupational PA was walking (R=39.8 minutes). The expected relationship between PA and SOC was observed, demonstrating SPAQ's concurrent validity with the SOC model.

Conclusions

SPAQ is a reliable and valid measure of leisure PA but it's ability to measure occupational PA has to be questioned.

Study Two

Aim

To pilot the procedures necessary to conduct the main study.

Methodology

Sixty-five Police Officers volunteered for a fitness assessment and 10 volunteered for an exercise consultation. Participants completed a SPAQ, SOC and process of change (POC) questionnaire prior to and 6 months after the interventions.

Results and Conclusions

Analysis showed the methodology, although requiring minor adaptations, could be used in the main study. It was estimated that 113 fitness assessment and 50 exercise consultation volunteers would be necessary to detect significant ($p < 0.05$) PA changes at 6 months with a power of 80% in the main study.

Study Three

Aim

To assess the effects of a fitness assessment compared to a control intervention and an exercise consultation compared to a control intervention on PA, SOC and POC over 1 year in a community population high in social and economic deprivation.

Methodology

Three thousand residents of 2 socially and economically deprived communities were invited to volunteer for a fitness assessment or exercise consultation. Fitness assessment volunteers were randomly assigned into an experimental or control group (receiving PA information only) as were exercise consultation volunteers. This produced 4 groups; fitness assessment experimental (FAE, N=112) and control (FAC, N=113) and exercise consultation experimental (ECE, N=73) and control (ECC, N=72). Participants received interventions at baseline and 3 months re-test and were administered PA, SOC and POC questionnaires at baseline, 4 weeks, 3 months, 6 months and 1 year. All participants were offered free exercise vouchers throughout the study.

Results

For those not regularly active (contemplators and preparers), leisure PA initially increased and was maintained to 6 months before falling at 1 year post test. There were few group differences. Only the ECE group reported significantly higher levels of leisure PA at 1 year compared to baseline. SOC mirrored PA, with baseline contemplators and preparers mostly progressing into action, maintaining this to 6 months before regressing back to baseline SOC at 1 year for those not regularly active at baseline. Exercise consultations offered the best chance of study adherence and long-term SOC maintenance. For those regularly active at baseline (actioners and maintainers), leisure PA remained relatively constant across test stages and between groups. Fitness assessments offered the best chance of study adherence and long-term SOC maintenance for those regularly active at baseline. Occupational PA remained constant over test stages and between groups for both baseline activity status conditions.

During the study, 52 people progressed from contemplation to action, 73 from preparation to action, 56 from action to maintenance and 10 regressed from maintenance. Use of all behavioural POC gave the best odds of progression from contemplation to action (odds ratio = 1.21, $p < 0.05$) and self liberation for progression from preparation to action and action to maintenance (odds ratio = 1.21 and 1.36 respectively, $p < 0.05$). A reduction in the behavioural POC significantly increased the chance of relapse from maintenance (odds ratio = 0.82, $p < 0.05$).

Conclusions

For those not regularly active, exercise consultations offer the best chance of long-term PA and SOC adherence. However, PA information alone can also positively affect PA intention and behaviour. For those regularly active, fitness assessments have the greatest positive effect on SOC maintenance. It appears reasonably easy to increase PA in a low-income population, it is more difficult to sustain this increase. Future research should target those who have recently increased PA with interventions based on the POC identified in this study.

Acknowledgement

I would first of all like to sincerely thank Professor Nanette Mutrie, my supervisor at the University of Glasgow for her considerable support, expertise and encouragement throughout my research. I can honestly say I have enjoyed the experience and would like to congratulate her for maintaining her sense of humour, especially when confronted with the endless research problems I seemed to present her with! Sincere thanks must also go to Professor Marion Scott at the University of Glasgow, who, against all the odds, successfully guided me through the numerical minefield commonly referred to as statistics. Thanks also go to Dr Chris Loughlan and Catriona McFarlane for their contributions in developing the physical activity questionnaire used in this thesis.

I would also like to thank the hundreds of volunteers who took part in this research, without whom, the many studies would not have been possible.

Thanks also go to East Ayrshire Council for funding the research but especially to Brian Woodcock, then Director of Leisure Services (now Director of Leisure and Tourism at Aberdeen City Council) for initially "starting the ball rolling" and also to Bill Stafford (Director of Community Services) and John Griffiths (Head of Leisure Services) for their continued financial support. I would also like to thank Mr Denis Craig (Principal Officer of Recreation) and Miss Katie Kelly (Leisure Development Officer), my "line managers", for their support, both occupationally and also socially in the Braehead Public House, when I was often in need of urgent rest and recuperation!

Special thanks and appreciation are reserved for my wife, Jacki, who in the face of my frequent fits of sulking and temper tantrums, and long periods of isolation, successfully organised our entire wedding and honey-moon almost single-handedly! My final and biggest thanks go to the person who ultimately made this research possible. If my mother, Jennifer Margaret Lowther, had not "forcibly encouraged" me to apply for my under-graduate degree, and then supported me throughout the course of the degree, I doubt I would be in the position I am today.

Publications

The following papers have been published or submitted from research presented in this thesis.

Lowther, M. & Mutrie, N. (1996). Reliability and concurrent validity of the Scottish physical activity questionnaire. British Journal of Sports Medicine Abstracts, 30, 368-369.

Lowther, M. & Mutrie, N. (1999). Attracting the general public to physical activity interventions: A comparison of fitness assessments and exercise consultations. Journal of Sports Sciences Abstracts, 17, 58-59.[†]

Lowther, M., Mutrie, N., Loughlan, C.W. & McFarlane, C. (1999). Development of a Scottish physical activity questionnaire: A tool for use in physical activity interventions. British Journal of Sports Medicine, 33, 244-249.

Lowther, M., Mutrie, N. & Scott, M. (2000). The long-term effects of two physical activity interventions on the physical activity of members of the general public who are not regularly active. Journal of Sports Sciences Abstracts, 18, 17-18.[*]

Lowther, M., Mutrie, N. & Scott, M. The identification of key processes of exercise behaviour change associated with stage of exercise behaviour change progression. Accepted for presentation at the British Association of Exercise and Sport Sciences' Annual Conference, Liverpool, 2000, leading to publication in the Journal of Sports Sciences Abstracts.

[†] This research was awarded with best psychology student presentation at the British Association of Sport and Exercise Sciences' annual conference, Worcester, 1998. Based on this research, I was also named "Young Postgraduate Researcher of the Year" in 1998 by the Scottish Institute of Sports Medicine and Sports Science.

[*] This research was awarded with best interdisciplinary student presentation at the British Association of Sport and Exercise Sciences' annual conference, Leeds, 1999.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

Chapter 1

INTRODUCTION AND STATEMENT OF PROBLEM

Introduction

This chapter is designed to set the scene for the current research and outline why it was undertaken. The first of five sections summarises the relationship between physical activity and health and briefly reviews Scotland's health and physical activity statistics. The next section introduces the theory behind behaviour change and presents several physical activity interventions designed to bring about behaviour change. The third section outlines the current problem and demonstrates the need for the research presented in this thesis. The fourth section outlines the structure of three separate studies undertaken to address the problem, clearly defining aims and objectives for each study and highlights the significance of the research. The final section explores limitations that existed within the research. Certain sections are reviewed more fully in the next chapter, but the aim of the current chapter is to set the backdrop to the study and clearly outline why the investigation was conducted, drawing upon relevant research where necessary.

It is important to clearly define key terms and phrases used within the research. Although full operational definitions are set out at the beginning of the following chapter it may be helpful to summarise them here. *Physical activity* is any bodily movement performed by skeletal muscles, and as such, everybody performs it but the amount and kind is subject to personal choice (Casperson, Powell, and Christenson, 1985). *Exercise* is a sub-set of physical activity that is planned and structured and done to enhance or maintain physical fitness (U.S. Department of Health and Human Services, 1999). *Physical fitness* is a set of attributes a person has and can be enhanced through physical activity and exercise. Physical fitness has two components, performance related fitness (i.e. speed, agility and skill) and health related fitness (cardiorespiratory and muscular endurance, muscular strength, body composition and flexibility) (Casperson et al.). *Health* is more complex to define, given it's multi-dimensional nature (Downie, Fyfe, and Tannahill, 1996). Downie et al. have proposed a comprehensive model of health, containing both positive and negative factors. The positive factors include well-being and fitness whilst the negative factors encompass disease, illness, deformity, unwanted states, injury, disability and handicap. The positive and negative factors are seen as having interconnecting physical, mental and social elements.

Physical Activity, Physical Fitness and Health

In 1996 the United States Surgeon General collated all of the available evidence relating to physical activity, physical fitness and health. This report is currently the most authoritative available (Vuori, 1998). The relationship between physical activity, physical fitness and health is reviewed in detail in the following chapter but to summarise, there is strong evidence that participation in regular physical activity is inversely related to all cause mortality and specifically coronary heart disease (CHD) mortality (Blair, 1994). The evidence is not as convincing for the protective ability of physical activity for strokes, but there is certainly a strong association (Kohl and McKenzie, 1994). Physical activity has also been associated with an enhancement of the blood lipid profile (Durstine and Haskell, 1994) and been shown not only to protect against hypertension (Paffenbarger, Jung, Leung and Hyde 1991) but also to help sufferers to reduce it (Kelley and McClellan, 1994). The risk of developing colon cancer is considerably reduced in those more active (Lee, 1994) as is the risk of developing non-insulin dependent diabetes mellitus (Manson et al., 1991). Regular physical activity can also help control obesity (Ballor and Keesey, 1991) and help ease the symptoms of several respiratory diseases (Bundgard, 1985, Blomquist, Freyschuss, Wimal, and Strandric, 1986, Lertzman and Cherniack, 1976) and osteoarthritis (Ettinger and Afable, 1994). It can also reduce the risk of osteoporosis (Recker et al., 1992) and of falling (Tinetti et al., 1994) or fracturing bones (Jaglal, Kreiger and Darlington, 1993) in later life. Finally, physical activity can reduce trait and state anxiety (Petruzello, Landers, and Salazar, 1993) and depression (Craft and Landers, 1998) and protect against the onset of depression (Paffenbarger, Lee, and Leung, 1994). It can also enhance positive mood (Stephens and Craig, 1990), well-being (Moses, Steptoe, Mathews, and Edwards, 1989), self-esteem (MacAuley, 1994), cognitive function (Mutrie and Thin, 1992) and health related quality of life (Rejeski, Brawley and Shumaker, 1996).

The quantity, type, duration and frequency of activity is related to the specific outcome required. For example, a beneficial increased rise in HDL cholesterol has been shown to be associated with exercise training only (US Department for Health and Human Services, 1996). In general however, the research suggests that moderate intensity physical activity taken regularly can protect against and help control many conditions relating to ill-health. Further, this relationship is thought to be causal (US Department of Health and Human Services) and the research suggests a dose response relationship where sedentary individuals increasing their activity level will experience a greater *rise* in health benefit than those already active increasing their activity by the same amount (although those already regularly active will have a greater absolute health benefit) (Haskell, 1994). These findings have prompted the American College of Sports Medicine and Centres for Disease Control (Pate et al., 1995) to release "active living" guidelines which encourage the accumulation of at least 30 minutes of moderate intensity activity on most days of the week. These recommendations are primarily aimed at sedentary people and encourage the adoption of "everyday" activities such as walking, stair climbing and gardening. Shephard (1997), after reviewing many active living studies, concludes that lifestyle activities can have a marked effect on many health related conditions, this being especially true for the elderly, sedentary and obese.

Despite the proven link between inactivity and ill-health, it is estimated that at least 60% and possibly as many as 75% of the Scottish population are not active enough to meet even the minimum amount of activity recommended for a health benefit (Scottish Health Survey, 1997). The levels of inactivity in Scotland may contribute to the nation's poor health statistics. The Scottish population has a lower life expectancy compared to the majority of the western world

(World Health Statistics, 1991) and the highest mortality rates from strokes, coronary heart disease and cancer (World Health Statistics).

It is often thought that there is a social class gradient in physical activity, with those in the lower social classes being less active. However, the evidence for this in a British population is conflicting. Whilst the Allied Dunbar National Fitness Survey (1992) supports the notion, the Scottish Health Survey (1997) suggests that those in the lower social classes are more active. What seems to be clearer however is that the social classes differ in their type of activity. The Scottish Health Survey showed that those in the lower social classes were more occupationally active compared to those in the higher social classes who were more active in their leisure time. These findings are consistent with similar English surveys (Health and Lifestyle Survey, 1992). As discussed in the following chapter, this then has health implications. Leisure time physical activity may be viewed as a positive experience compared to occupational physical activity which could be viewed as a negative experience.

It has also been shown that higher percentages of people who are unemployed or "are looking for work" were classed as sedentary and lower percentages classed as regularly active at moderate intensity level or above compared to their counterparts who were in work (Hoinville, 1995). In addition, it has been shown that lower income populations are less likely to visit their doctor and receive less advice from their doctor on preventative health practices such as physical activity (Billings et al., 1993), and are less likely to utilise services aimed at ill-health prevention (Macintyre, 1994). These populations also exhibit other elevated risk factors, such as smoking, excessive alcohol consumption, poor diet and unsafe sex (Macintyre) and suffer higher levels of mental health problems (Health Education Board for Scotland, 1998).

Given the findings reported above, it is perhaps not surprising that low-income populations are more likely than other populations to have chronic diseases related to sedentary lifestyles (U.S. Department of Health and Human Services, 1990). Increasing physical activity in these populations can have a significant effect on health, and specifically quality of life (Taylor, Baranowski, and Rohm Young, 1998). It is therefore crucial that physical activity interventions target this population (Marcus, Owen, Forsyth, Cavill, and Fridinger, 1998). The studies reported in this thesis investigate the effects of two interventions on a community based population's physical activity. This population has been designated as "an area of priority treatment" by the Government, given it's high levels of both social and economic deprivation.

A potential problem with physical activity research is how physical activity is assessed (Wareham and Rennie, 1998). For example, objective measures such as heart rate monitoring or motion sensor analysis, although giving an accurate measure of physical activity, may be expensive (Montoye, Kemper, Saris, and Washburn, 1996) and need to be administered in a laboratory (Williams, Klesges, Hanson, and Eck, 1989), making them unsuitable for large field based studies. In contrast, subjective measures such as recall questionnaires and activity diaries are relatively cheap to produce and require less equipment than objective measures, making their use more practical in field based studies (Williams et al.). However, as they are open to a person's perceptions and biases they may be a less accurate measurement tool (Wareham and Rennie). A possible answer is to validate subjective measures by objective measures. Although this validation method is widespread, problems exist, mainly with finding a "gold standard" objective measure (Wareham and Rennie). With regard to recall questionnaires, a recent report has highlighted the need for researchers to tackle the area of validating and standardising existing tools (Scottish Forum for Public Medicine, 1996).

Changing Behaviour

Clearly, the nation's physical activity behaviour needs to be changed. Many theories have been proposed to try and explain and predict behaviour change (Godin, 1994) but no one theory can fully account for all health related behaviour change. One model, the transtheoretical model (TTM) (Prochaska, 1979), explores how core constructs from other theories, such as self-efficacy and decisional balance, can be integrated within a transtheoretical approach. The TTM contains four core constructs. The first is the stages of change which is the central organising construct of the TTM (Prochaska and Velicer, 1997a). It suggests that individuals attempting to change behaviour move through a series of stages: precontemplation (not intending to make change), contemplation (considering a change), preparation (making small changes), action (actively involved in behaviour change) and maintenance (sustaining change over time). The second construct is the processes of change. The processes are the covert and overt strategies people use when moving through the stages. Ten processes of change have been identified (Prochaska). The final two constructs are self-efficacy (the degree of confidence for a specific behaviour change) and decisional balance ("weighing up" the pros and cons of the behaviour change). The TTM has been applied to exercise behaviour (Marcus, Rossi, Selby, Niaura, and Abrams, 1992b). A particular strength of this model is that it can identify sedentary individuals. Interventions can then target the specific processes people use when progressing through these early stages. However, there are very few longitudinal studies that have identified which processes to target.

The TTM model was chosen for use in this thesis as it allowed for an appropriate classification of participants into activity groups (i.e. regularly active and not regularly active). It was also chosen because it can offer an understanding of the processes people use when changing their physical activity behaviour. In addition, although the stages aspect of the TTM has been studied extensively and successfully applied to exercise, the processes construct has been less well studied, particularly in longitudinal studies with British populations.

Two commonly used physical activity interventions are the fitness assessment and exercise consultation. Given the accumulating evidence of the relationship between physical fitness and health, there has been a wave of interest in health related fitness (Sykes, 1989). Normally, a fitness assessment (often called a fitness test) involves the measurement of height, weight, blood pressure, strength, flexibility, lung capacity and cardio-respiratory fitness (Sykes, 1989). These results are then compared to age and gender related "norms" to produce an overall fitness profile. This profile is then used to produce an exercise programme geared to the person's capabilities. Often, exercise goals are geared towards enhancing the person's fitness profile.

The use of fitness assessments has proven to be extremely popular and widespread (Health Education Authority, 1992). Fitness assessments have also become commercialised with the development of computers loaded with software programmes such as "Fitech" (1990a). These packages allow for "discrete, frequent and immediate feedback of information, meaning critical information is no longer bound by site and time-specificity" (Dirkin, 1994). The Fitech package is used by nearly 1000 organisations (J. Mellor, Director of Fitech, personal communication, October, 1997) from local authorities to multi-national companies to monitor, promote and increase exercise. Many occupational groups such as the Police, Fire and Prison services use assessments as a screening service and many organisations feature health and fitness screening as a welfare benefit for their employees (Sykes, 1989). Fitness assessments are also used extensively in schools to increase exercise levels (Fox and Biddle, 1988). EUROFIT (1983) was developed to standardise and accurately assess physical fitness in children with a view to encouraging exercise participation. Fitech (1990b) have also developed a software package for use with school children.

Exercise consultations are a one to one intervention that require no assessment of physical fitness. Instead, they involve a discussion regarding issues in relation to becoming more physically active on a regular basis. Guidelines for conducting an exercise consultation have been released (Loughlan and Mutrie, 1995a) and recommend an exploration of exercise history (to establish likes / dislikes), a discussion about the advantages and disadvantages of change, any barriers to change, social support available, goal setting and relapse prevention. As with fitness assessments, the use of motivational interviewing and exercise consultations are becoming common place. The Royal Air Force is currently integrating "motivational counseling" into it's physical activity promotion. It aims for long-term behaviour change towards a more active lifestyle and healthier diet. According to Flight Lieutenant Brett Nichols (1999), who runs the RAF School of Physical Training's Research and Development Department, "unfortunately because we have a fitness test, people get the impression that the goal is to pass the test...actually the goal is to be more active all the time and to get all the health benefits" (p.21). The Royal Navy, the Police, the Northern Ireland Prison service, and the Belgian and Dutch airs forces are also planning to introduce the scheme (Nicholls). Many GP referral schemes also employ exercise consultations as a means of initiating behaviour change as do many exercise promotion projects. Exercise consultations have been supported by many researchers (Loughlan and Mutrie, 1997, Patrick et al, 1994, Wankel et al, 1994).

Despite the popularity of fitness assessments and exercise consultations, their long-term effect on physical activity is unclear.

Statement of Problem

King et al. (1992) state that there is a need to "evaluate methods of physical activity assessment and intervention designed to increase individual adoption, maintenance, and relapse prevention of physical activity in the clinical setting, worksite setting and various community settings" (p. 232).

From a public health stand point there are two key physical activity questions that need to be answered. First, how do we get sedentary people active? Second, how do we keep active people active? These two questions form the backbone of this thesis.

Despite the amount of physical activity research conducted in recent years, many problems, limitations and gaps in research exist (as the next chapter will highlight). This thesis attempts to address some of these areas, hopefully making the answer to the two research questions cited above slightly clearer. The specific problem areas the thesis will tackle are as follows:

(a) There is currently no valid, self-assessing, British physical activity recall questionnaire available that measures both occupational and leisure time physical activity.

(b) Despite the popularity of fitness assessments and exercise consultations, their long-term effect on physical activity is unclear (Sykes, 1989, Harris, Casperson, DeFriese, and Estes, 1989).

(c) Although various authors have advocated the need for ongoing support (e.g. Loughlan and Mutrie, 1997), few studies have investigated the effect of offering a re-test intervention.

(d) The majority of intervention studies have focussed on how to get sedentary people active. Whilst this is of major public health importance, it is also vital that people who are currently active, remain active. Few studies have examined the effects of interventions on this group of the population.

(e) Few studies, specifically longitudinal studies, have attempted to identify dominant processes of exercise behaviour change when movement is made through the stages of exercise behaviour change.

(f) Few studies have evaluated the effectiveness of physical activity interventions using a free-living population. Most physical activity research has been conducted with specific populations such as young and middle-aged white middle class males (Vuori, 1998).

(g) Few studies have focused on low income populations

Structure of Research

Study One

A series of investigations were undertaken. Their aim was to produce a reliable, valid, self-assessing, 7 day recall measure of occupational and leisure time physical activity. The specific objectives of study one were to produce a questionnaire that:

(a) measured the previous week's leisure time and occupational physical activity
(b) recorded stage of exercise behaviour change
(c) was relatively quick and easy to complete
(d) showed good reliability and validity
(e) was practical for use with large subject numbers
(f) was self-assessing so it could be administered by post.

The investigations were conducted with a variety of local groups in the town of Kilmarnock, Scotland.

Study Two

The aim of this study was to assess the feasibility and practicality of measuring the effects of a fitness assessment or exercise consultation on a person's physical activity, stage of exercise behaviour change and processes of exercise behaviour change. The specific objectives for the study were as follows:

(a) to assess subject participation rates and questionnaire return rates
(b) to assess the percentages and characteristics of respondents who would prefer either a fitness assessment or exercise consultation as their intervention
(c) to pilot procedures involved in a "Fitech" fitness assessment
(d) to pilot procedures involved in an exercise consultation
(e) to pilot procedures necessary to measure changes in dependant variables
(f) to estimate the sample size required for the main study
(g) to analyse data.

The study was conducted with Strathclyde Police Officers at Kilmarnock Police Station, which is the divisional headquarters for East Ayrshire.

Study Three

This was the main study of the thesis. Study three's aims can be split into four sections, each with their own specific objectives:

Section One - Pre-intervention Analysis

The aim of this section was to attract participants to the study and analyse the characteristics of volunteers and randomly assign them to study groups. The objectives of the section were as follows:

(a) to randomly assign study volunteers into either an experimental or control group, based on their intervention choice

(b) based on pilot study analysis, to initially conduct at least one hundred and thirteen fitness assessment experimental and control interventions and at least fifty exercise consultation experimental and control interventions
(c) to ensure that participants had been successfully randomised into study groups (i.e. comparing experimental with control groups), based on their sex, age, height, weight and stage of exercise behaviour change
(d) to compare all study volunteers on the basis of their age and sex
(e) to compare volunteers for each intervention on the basis of their sex, age, height, weight and stage of exercise behaviour change
(f) to analyse differences in gender, intervention group and age for those people applying and turning up for their intervention choice (it was anticipated that some participants failed to turn up for their intervention)
(g) to analyse any group differences in intervention expectations
(h) to analyse pre-intervention relationships between stage of exercise behaviour change, processes of exercise behaviour change and physical activity.

Section Two - Analysis of Intervention Effects on Physical Activity

The aim of this section was to assess the impact of the interventions on participant's physical activity. The specific section objectives were as follows:
(a) to compare the four intervention groups on the basis of drop-out rates at each measurement period (baseline, 4 weeks, 3 months, 6 months and 1 year post test) for those regularly active and not regularly active at baseline
(b) to analyse leisure time and occupational physical activity separately
(c) at baseline (i.e. before interventions) to analyse any physical activity differences between intervention groups, between not regularly active and regularly active participants and for a combination of intervention group and activity status (i.e. interaction)
(d) to compare the immediate intervention effect (comparison of baseline, 4 weeks and 3 months post test) on physical activity for those regularly and non regularly active at baseline
(e) to compare the intervention re-test effect (comparison of 3 months, 6 months and 1 year post test) on physical activity for those regularly and non regularly active at baseline
(f) to compare the long term intervention effect (comparison of baseline to 1 year post test) on physical activity for those regularly and non regularly active at baseline
(g) to analyse any changes in health related fitness in fitness assessment group and any changes in weight in remaining three study groups at three months post test (i.e. intervention re-test).

Section Three - Analysis of Intervention Effects on Stage of Exercise Behaviour Change.

The aim of this section was to assess the impact of the interventions on participant's stage of exercise behaviour change. The specific section objectives were as follows:

(a) to compare the immediate intervention effect (comparison of baseline, 4 weeks and 3 months post test) on stage of exercise behaviour change for those regularly and non regularly active at baseline

(b) to compare the intervention re-test effect (comparison of 3 months, 6 months and 1 year post test) on stage of exercise behaviour change for those regularly and non regularly active at baseline

(c) to compare the long term intervention effect (comparison of baseline to 1 year post test) on stage of exercise behaviour change for those regularly and not regularly active at baseline

Section Four - Analysis of Intervention Effects on Processes of Exercise Behaviour Change.

The aim of this section was to assess if any processes of exercise behaviour change were dominant when participant's shifted in their stage of exercise behaviour change. The specific section objectives were as follows:

(a) to directly compare the immediate intervention effect (baseline to four weeks) on the processes of exercise behaviour change for contemplators, preparers, actioners and maintainers.

(b) to identify any dominant processes of exercise behaviour change when progress is made through the stages of exercise behaviour change

(c) to establish which processes of exercise behaviour change, if any, correspond with regression from the maintenance stage of exercise behaviour change.

Study three was conducted with residents of two Kilmarnock housing estates called Shortlees and Riccarton, each having a population of around two thousand. Shortlees and Riccarton suffer high levels of deprivation and have been classed as "areas of priority treatment" by the Government. Kilmarnock is a prominent town within Ayrshire, South Central Scotland, and falls under the remit of Ayrshire and Arran Health Board.

These three studies were designed to address the gaps and limitations in existing research and to shed light on the two physical activity research questions (stated earlier) which are of great public health importance. A valid and reliable measure of recent occupational and leisure time physical activity that was self-assessing and British culture bound was developed. This questionnaire was then used to assess the long-term (up to one year) effects of two commonly used, but rarely evaluated, interventions on the activity levels of both regularly active and non regularly active residents of a socially and economically deprived community. Participants were invited to volunteer for one of two interventions and, based on this choice, they were randomly assigned into either an experimental or control group. Changes in participant's stages of exercise behaviour change were recorded over time and related to changes in participant's use of the processes of exercise behaviour change.

Significance of the Research

This research aims to provide researchers with a valid and reliable self-assessing measure of short-term occupational and leisure time physical activity. It will also help to determine the effectiveness of using a fitness assessment and exercise consultation to promote and maintain physical activity in those who appear to need it the most (i.e. a socially and economically deprived community) and help identify the kind of people who would volunteer for a community based physical activity promotion programme. Finally, it will also identify key processes of exercise behaviour change people use when progressing through the stages of exercise behaviour change. This will allow specific interventions to be developed that can target progress from each stage of exercise behaviour change.

Study Delimitations

Self-Selection of Participants

Volunteers were given the choice of which intervention they would prefer, and on the basis of this choice, randomly assigned into either an experimental or control group. This may have affected the internal validity of the study as any differences observed between groups throughout the course of the study may have been caused by intervention group differences at baseline. To check for this, pre-intervention analysis was conducted to determine any physical activity differences between study groups. In addition, to check that participants had been successfully randomised into experimental and control groups, a series of pre-intervention comparisons were conducted to assess any experimental / control group differences for both interventions. The current methodology was used because it was able to identify any differences between people attracted to either an exercise consultation or fitness assessment. This allowed for conclusions to be drawn as to whether either intervention can be used to target specific populations.

Group Interactions and Expectations

Given that all participants lived in one of two "tight knit" communities it is highly probable that participants discussed their interventions. This may have biased the groups and especially the control groups. To try and combat this, the control group were offered a "limited" intervention, consisting of information relating to physical activity and were offered the same incentives to take part in the study. All interventions were conducted in the same building and were conducted by the same researcher. In order to assess any difference between study groups in terms of their study expectations, a questionnaire was administered to all participants prior to their interventions.

Generalisation (External Validity)

Given that the main study was conducted with a specific population, it could be argued that it is hard to apply the results to any other populations. However, the study population was a sample of the general population that was high in unemployment and economic deprivation. This suggests that removing the cost barrier to exercise would allow the results to be generalised to the wider population. Removing this barrier would also allow for a realistic comparison of interventions. For example, participants receiving one of the interventions may have wanted to greatly increase their activity but may not have been able to afford to. In contrast, a different intervention may have had no effect on it's participants. These two scenarios would produce no difference in the outcome measures despite differences in the interventions. To attempt to remove the cost barrier to exercise, free exercise vouchers were offered to all intervention and control groups.

Physical Activity Measurement

Due to practicalities (mainly participant numbers and cost) and methodological considerations (participants were required to self-assess their physical activity), physical activity was measured by self-report questionnaire. Although some researchers are of the opinion that subjective physical activity measures are less accurate than objective measures (e.g. Montoye et al., 1996), the questionnaire used in the present study was fully tested for reliability and concurrent validity. It was also tested for criterion validity by comparing it to an objective physical activity measure.

Chapter 2

LITERATURE REVIEW

Introduction

The overall aims of this chapter are to provide a comprehensive background to the thesis and to identify specific limitations and gaps within physical activity research. This will be done by critically reviewing all relevant research, enabling conclusions to be drawn on a number of important issues, but specifically the current level of Scotland's health and the role physical activity can play in improving it.

The chapter begins with the operational definitions of certain key phrases and terms. Scotland's health is then reviewed and the link between physical activity and health examined. The chapter then explores the current physical activity levels in Scotland before reviewing several theories which have been proposed to understand the processes involved when a person changes their behaviour. In particular, the "stages of exercise behaviour change" or transtheoretical model is analysed and it's use in physical activity research critically examined. Physical activity interventions are then reviewed and the choice of the study's dependent variables explained. The chapter concludes with a re-statement of the problem and significance of the research. The literature was searched from 1979 - 1999 using Social Citation Index and Embase via BIDS, Sport Discuss and Medline using "key words" appropriate to the section being searched. Extensive searches of the internet were also conducted, prominent web sites being the Health Education Board for Scotland, the British Medical Association, the World Health Organisation, the American College of Sports Medicine and the U.S. Department of Health and Human Services and Centres for Disease Control and Prevention.

Operational Definitions

Before a review of the relevant literature is conducted, it is important to clearly define certain terms. According to Biddle and Mutrie (1997), all too often in the area of physical activity research, terminology is confused. In addition, certain terms such as physical activity, exercise and physical fitness are used interchangeably (Casperson et al., 1985). Standardised terminology allows like to be compared with like, aiding the understanding of the relationships that exist between physical activity, exercise, physical fitness and health (Casperson et al.).

Physical Activity

Physical activity has been defined as "any bodily movement produced by skeletal muscles that results in an expenditure of energy (expressed as kilocalories) and includes a broad range of occupational, leisure time and routine daily activities" (U.S. Department of Health and Human Services, 1999, p.16). Everybody therefore performs physical activity but the amount and kind of activity is largely subject to personal choice (Casperson et al., 1985).

Physical activity can be categorised in a variety of ways but probably the most commonly used and simplest is to segment it into activity that occurs while sleeping, at work, and at leisure (Montoye, 1975). Each main component can be further divided into a subset of components (Casperson et al., 1985). For example, leisure time physical activity can be subdivided into sports, conditioning activities, household tasks (Folsum et al., 1985) and other activities such as walking. Physical activity is also commonly described as having three dimensions: duration, frequency and intensity (Montote et al., 1996). The duration concerns the length of time an activity is performed, the frequency the number of times an activity is performed within a given time period and the intensity dimension concerns the rate at which an activity is performed.

It is clear from even these basic components / dimensions that an almost endless set of possibilities exist for classifying physical activity. For example a subset of leisure time physical activity could include sport. "Sport" could be further divided into different sports such as squash. Squash obviously has a duration, frequency and intensity dimension. This potential for an almost endless set of classifications has led to the frequent use in physical activity research and promotion of terms simplified to encompass all components and dimensions of physical activity. Terms commonly used are "moderate intensity" physical activity, "vigorous intensity" physical activity and "regular" physical activity. The reasons these terms are so prevalent is that they relate to the amount of physical activity generally recognised as being beneficial to health (the specific health related physical activity recommendations will be reviewed later in the chapter - p.35). Moderate intensity physical activity refers to a level of effort equivalent to a "perceived exertion" of 11 to 14 on the Borg scale, any activity that burns 3.5 to 7 kilocalories per minute or the effort a healthy individual might expend while briskly mowing the lawn, dancing, swimming, or cycling on level terrain for example (U.S. Department of Health and Human Services, 1999). Vigorous intensity physical activity refers to a level of expenditure that is equivalent to a "perceived exertion"of 15 or greater on the Borg scale, any activity that burns more than 7 kilocalories per minute or the effort a healthy individual might expend when jogging, chopping wood or cycling uphill for example (U.S. Department of Health and Human Services). Physical activity has been classed as regular if it is performed five or more days of the week if it is moderate, or three or more days of the week if it is vigorous (U.S. Department of Health and Human Services).

Exercise

The term "exercise" has been used interchangeably with physical activity (Taylor, 1983). However, although containing common elements such as the fact that both involve bodily movement, both result in energy expenditure and both are positively correlated with physical fitness (Casperson et al., 1985), exercise is in fact a subset of physical activity. Exercise is physical activity that is planned or structured, and is done to improve or maintain physical fitness (U.S. Department of Health and Human Services, 1999). For example, a person casually walking to the shops for a paper would only be performing physical activity. However, that same person deliberately walking at an increased pace from their house to the shops, possibly with a view to "burning up" calories, would be performing exercise as well as physical activity. This distinction seems trivial but as already mentioned, it is important that terms are clearly defined so comparisons can be made and relationships examined. In some cases, the distinction between physical activity and exercise is especially important. For example, people frequently perceive the term "exercise" negatively and the term "physical activity" positively (Centres for Disease Control and Prevention and the American College of Sports Medicine, 1995). Therefore, when promoting physical activity with the general public for example, it is important the correct term is used.

Physical Fitness

Physical fitness has been defined as "a set of attributes that people have or achieve that relates to the ability to perform physical activity" (Casperson et al., 1985, p.129). Unlike physical activity and exercise therefore, which are a result of specific movements performed by an individual, physical fitness is determined by a combination of regular activity and genetically inherited ability (U.S. Department of Health and Human Services, 1999). In simple terms, physical fitness is something you *have* (or may not have), physical activity and exercise are things that you *do*.

Physical fitness is generally thought to have two components: one relating to athletic or sporting ability and the other relating to health (Bouchard and Stephens, 1994). The link between physical fitness and sporting ability is clearly evident. Performance related fitness includes a variety of components such as high lactate level tolerance, explosive leg power, lower and upper body muscular endurance (Gledhill, 1990) and more general components such as power, agility, speed, coordination, balance and reaction time (Casperson et al., 1985). It is clear that the potential for achieving a high level of sporting performance will be increased if a person holds a high level of the specific fitness component related to that sport. For example, a person holding a high level of lactate tolerance will be at an advantage in the 400m hurdles track event, compared to someone having a lesser lactate tolerance. In keeping with the definition of physical fitness given in the previous paragraph, specific performance related fitness components are both inherited and can be increased by specific training programmes.

Health related fitness contains five separate components: cardiorespiratory endurance, muscular endurance, muscular strength, body composition and flexibility (Casperson et al.). These components are positively or negatively affected by physical activity and directly relate to health status (Loughlan, 1995). For this reason, it has been suggested that health related physical fitness is more important to public health than the athletic ability component (Casperson et al.). Again, as with the performance-related components, the health related fitness components are both inherited and can be improved by training.

Health

In 1958 the World Health Organisation (WHO) defined health as "a state of complete, mental and social well-being and not merely the absence of disease or infirmity". This early definition, although heavily criticized (Downie, Tannahill, and Tannahill, 1996), recognises that health is not just related to physical factors (such as disease and illness) but it also encompasses other factors such as social, psychological and environmental dimensions (Loughlan, 1995). This has also been recognised by Scott-Samual (1998) who suggests that health is socially constructed. He argues that "health is a condition in which people achieve control over their lives due to the equitable distribution of power and resources" (p.4). Labonte (1995) has developed a socio - environmental model of health. As with the WHO definition, this model sees health related not just to physical factors such as illness and behavioural factors such as smoking or inactivity, but his model also includes psychosocial risk factors such as social isolation, low self confidence and powerlessness and "risk conditions" such as poverty, poor education and stressful working environments. Further determinants of health have also been suggested. Dahlgren and Whitehead (1995) include wider socio-environmental factors such as housing, working conditions, social and community networks, and local environment. The Government also recognise that health is not just concerned with the absence of disease. The Scottish Office Department of Health's Consultation Document, Working Together for a Healthier Scotland (1998) refers to social and economic circumstances affecting health, with poverty, unemployment, poor housing, environmental factors such as pollution and access to health services and amenities being prominent. It also refers to life circumstances, stating "the circumstances in which we live closely affect our risk of poor health and our prospects of good health and well-being. So, too, do culture, fashion, the mass media, peer influences and social isolation or marginalisation. Good general education – not just health education – is a foundation for good health" (p.23).

Downie et al. (1996) have proposed a comprehensive model of health, incorporating many of the elements previously mentioned. They argue that health has both a positive and negative dimension. The positive dimension contains two elements, well-being and fitness. According to Downie et al., well-being incorporates subjective well-being, which is a measure of a person's mood or level of happiness. It is situation specific and may be affected by such factors as being in love, exercise, good weather and alcohol. Well-being also contains a "good life" component, which is the underlying indicator of well-being. It can be brought about by acquiring lifeskills and achieving autonomy or empowerment (Downie et al.). Fitness, in relation to positive health, focuses on physical attributes, such as strength, stamina, suppleness and skills and is related a person's ability to perform specific tasks important to that person (Downie et al.). Negative health, or ill-health, according to Downie et al., has seven elements, six of which can be split into subjective and objective elements. The subjective elements are illness and discomfort whilst the objective elements are disease, injury, handicap and deformity. The final element of ill-health, which links the strands of the subjective and objective elements, is defined by Downie et al. as "unwanted states". Illness may not always be percieved as negative, if for example it prevents a child from going to school. Similarly, pain after exercise may be thought as being due to "a good workout", and may be viewed positively. Thus for the six components to be defined under the ill-health umbrella, they must be "unwanted" by the person. Downie et al. argue that the two positive elements are interconnected as are the seven negative elements. Further, they see the positive and negative elements as being interconnected, both having physical, mental and social components. Figure 1 summarises Downie et al's model.

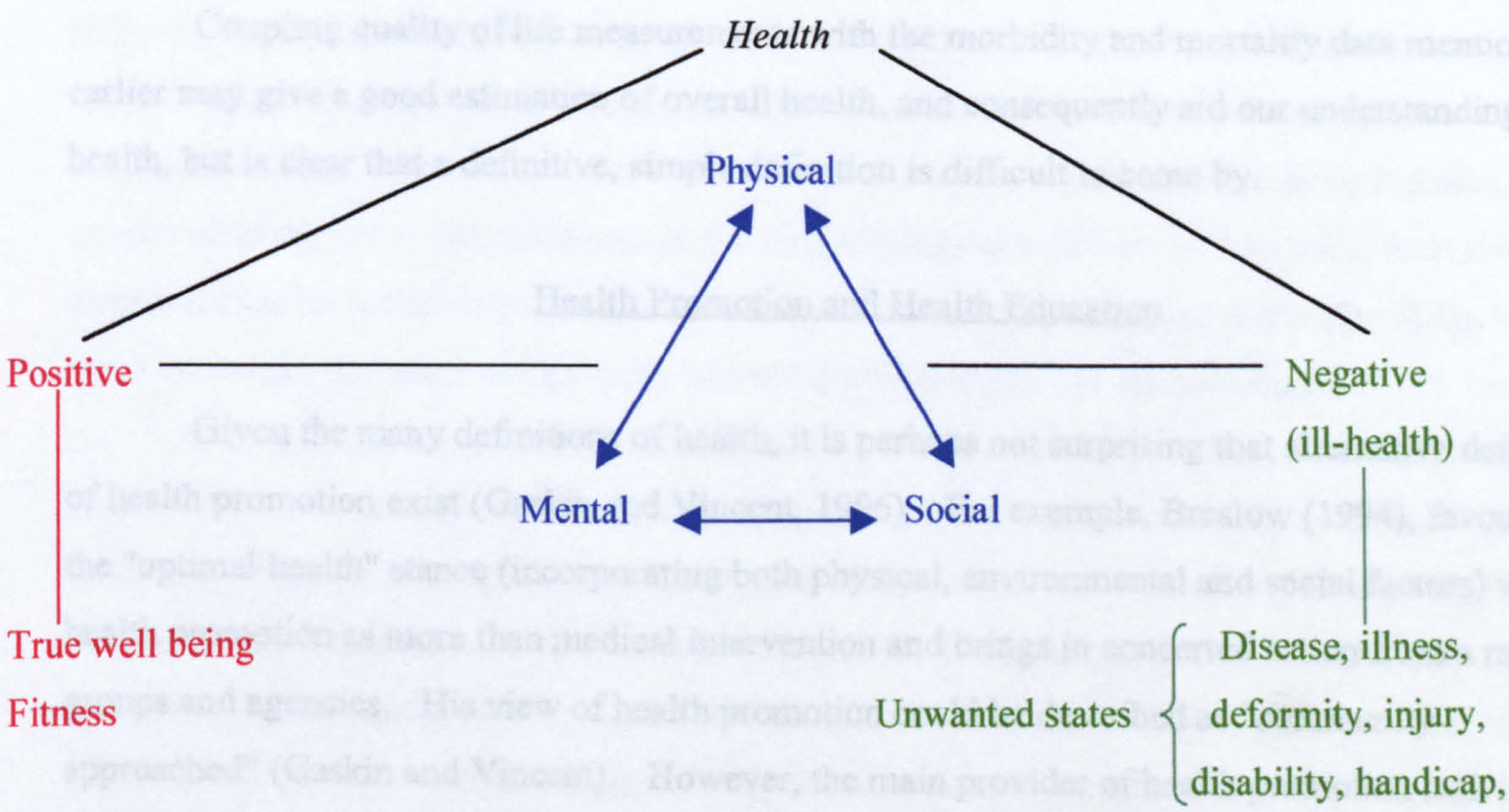


Figure 1. A model of health as proposed by Downie et al. (1996).

Scott-Samual (1995) is also of the opinion that health is not purely an objective measure, but is open to personal, subjective perception. According to Scott-Samual, when people are asked about health, they refer to security, happiness and quality of life. He argues what is healthy to one person may be perceived as unhealthy to another. For the majority of the general population therefore, health is closely related to their perceived quality of life.

Due to the multi-dimensional nature of health, its measurement is extremely difficult. It is important however that health can be measured so that health improvement programmes can be evaluated and the nation's health monitored. Traditionally, medical outcomes in clinical research are morbidity and mortality (Rejeski et al., 1996) but as already outlined, health incorporates many wider dimensions. This is recognised in the literature with recent developments underscoring the importance of augmenting these outcomes (Rejeski et al.). Quality of life, or more specifically, health related quality of life (HRQL), is now generally accepted as an appropriate measure of treatment efficacy in most clinical research (Rejeski et al.). HRQL represents a restricted concept of quality of life (Fries and Spitz, 1990) concerning only those aspects that may be measured in a clinical situation. Wenger and Furberg's (1990) definition of HRQL encompasses "those attributes valued by patients, including: resultant comfort or sense of well-being; the extent to which they were able to maintain reasonable physical, emotional, and intellectual function; and the degree to which they retained their ability to participate in valued activities with the family, in the workplace, and in the community" (p.335).

Similar to HRQL is the quality adjusted life year (QALY). The QALY approach weights years in life by the quality of life experienced in those years (Department of Health, 1995). Like the HRQL model, QALY is also multi-dimensional, incorporating components such as pain, disability, anxiety and the ability to carry out normal, everyday tasks (Department of Health). These components are then given a weighting and summed for an overall score.

Coupling quality of life measurements with the morbidity and mortality data mentioned earlier may give a good estimation of overall health, and consequently aid our understanding of health, but is clear that a definitive, simple definition is difficult to come by.

Health Promotion and Health Education

Given the many definitions of health, it is perhaps not surprising that alternative definitions of health promotion exist (Gaskin and Vincent, 1996). For example, Breslow (1994), favouring the "optimal health" stance (incorporating both physical, environmental and social factors) views health promotion as more than medical intervention and brings in concerted action from a range of groups and agencies. His view of health promotion could be described as "community approached" (Gaskin and Vincent). However, the main provider of health promotion activities is the NHS. These activities often ignore the social context in which choices are made and cannot tackle wider influences (Gaskin and Vincent), so not fully delivering a "community based approach".

Downie et al. (1996) define health promotion as a process which "comprises efforts to enhance positive health and prevent ill-health, through the overlapping spheres of health education, disease prevention and health protection" (p.2). Disease prevention is self-explanatory. Health protection is concerned with legal and fiscal controls, and other policies and regulations aimed at the prevention of ill-health (Loughlan, 1995). Health education has been defined as the process of transmission and / or acquisition of knowledge and skills necessary for survival and the improvement of quality of life (Baric, 1991). It is the process of educating the community and the relevant service providers as to the benefits and mechanisms of enhancing health. Downie et al. have summed up the overall goal of health promotion as being "the balanced enhancement of physical, mental, and social facets of positive health, coupled with the prevention of physical, mental and social ill-health" (p.26).

Health promotion is therefore an umbrella term for a wide range of activities which enhance health. A fundamental characteristic of health promotion is that it seeks to empower people to take increased control over aspects of their lives which affect their health (Health Education Authority, 1995). Health education is a vital component of health promotion (The Scottish Office, 1991) aiming to ensure that people are well informed, are able to make health related choices and act upon those choices. It also aims to raise awareness within public and private organisations as to the importance of gearing policies and strategies towards the enhancement of health (Health Education Authority).

Scotland's Health

As already established, the multi-dimensional nature of health makes its measurement difficult. Often, the positive dimension is neglected (Downie et al., 1996). Most reviews of the nation's health tend to focus on the disease and illness aspects and their causes (e.g. The Scottish Health Survey, 1997) and only review a small number of the many components that make up quality of life (such as life circumstances and psychological well-being). As such, this review of Scotland's health is mainly restricted to an analysis of mortality rates and disease profiling but where possible, the wider components that make up quality of life are considered.

Scotland has long been considered the sick country of Europe. Both Scottish males and females have a lower life expectancy than almost all other European countries (World Health Statistics, 1991). Scotland also has the highest death rates in the Western world from the so called "big three" (The Scottish Office Department of Health, 1998) causes of death; strokes, coronary heart disease and cancer (World Health Statistics). In 1996, cancer (25%), coronary heart disease (24.1%) and cerebrovascular disease (mainly strokes - 11.8%) caused 61% of the total number of deaths in Scotland (Registrar General for Scotland, 1996). Not surprisingly, the NHS has identified these causes of death as a major priority in Scotland (The Scottish Office Department of Health). Comparing Scotland to England, the Scottish Health Survey (1997) also showed that the prevalence of respiratory disease symptoms was considerably higher in Scotland. At a more localised level, the picture for Ayrshire and Arran is just as depressing. In his 1998 Public Health Report (1998a), Ayrshire and Arran Health Board's Director of Public Health reported that in those aged between 15-64 years, the main causes of death were cancer (30%) and coronary heart disease (27%). In addition, Smith, Crombie, Tunstall Pedoe, Groden, and McHardy (1989) revealed that coronary heart disease mortality rates were higher in Ayrshire and Arran compared to the Scottish average. In 1997, the standardised mortality rate for Ayrshire and Arran was 112 (Director of Public Health, Ayrshire and Arran Health Board). The standardised mortality rate is the number of actual deaths as a percentage of the number of expected deaths. The number of expected deaths is based on what would be found, on average, in similar populations. The rate in Scotland is taken to be the standard (100). Thus, in 1997, there were 12% more deaths in Ayrshire and Arran than expected, compared to the average for Scotland.

The situation is improving however. From 1986 to 1996, the number of deaths from coronary heart disease per 100,000 of the population below the age of 65 years has progressively fallen each year contributing to an overall reduction in mortality rates of 40% (The Scottish Office Department of Health, 1998). The pattern for cancer mortality rates also shows a similar trend but the reduction has been more modest (reduction of 11% - The Scottish Office Department of Health). Life expectancy for both males and females has also slowly increased. In 1942 males could expect to live, on average, to the age of 61 years. The figure for females was 70 years. By 1990, this had increased to 71 years for males and 77 years for females (The Scottish Office, 1992). In Ayrshire and Arran, deaths from coronary heart disease and cancer have also fallen over the past twenty years (Director of Public Health, Ayrshire and Arran Health Board, 1996) as have the standardised mortality rates (Director of Public Health, Ayrshire and Arran Health Board, 1998a). In addition, although Scotland's health record is poor when compared to other industrialised Western countries, it has to be remembered that compared to the rest of the world, Scotland compares favorably. For example, the life expectancy in some areas of Africa is 28 years (WHO, 2000). Also, the number of healthy years of life expected for someone living within the United Kingdom is 71.7 years (WHO, 2000). A similar figure for many African countries is 20-30 years (e.g. Sierra Leone, 25.9 years) (WHO, 2000).

It is difficult to assess Scotland's health in terms of quality of life because as mentioned earlier, most health reviews focus on disease and illness and not specifically on quality of life models such as HRQL and QALY. However, some of these reviews recognise that health is multi-dimensional. For example the Scottish Office Department of Health's Consultation Document, Working Together for a Healthier Scotland (1998) states that "good health is not just the absence of disease. It has to do with the way we live, the quality of our life and our environment" (p.vii). By examining factors such as mental health and so called "life circumstances" (i.e. housing, unemployment, local environment) a general picture of quality of life can be drawn.

In relation to mental health, about one quarter of the Scottish population will experience some mental distress, with 90% of these people suffering from either depression or anxiety (The Scottish Office, 1998). The Scottish Forum for Public Health Medicine (SNAP, 1994) has also reported that mental health problems are the most common problems reported to a GP and it has been estimated that the cost of treating mental disorders in Britain accounts for up to 20% of the total NHS expenditure, or £4 billion pound per annum (Department of Health, 1992). In addition, Scottish suicide rates have been gradually increasing, this being particular prominent among 15-29 year olds. In 1983, the rate stood at 17.8 per 100,000. By 1993, this rate stood at 29.6 per 100,000 (McLoone, 1996). There is little evidence however to suggest that mental health illness occurs any more frequently in Scotland compared to other industrialised countries (The Scottish Office, 1998) although the Scottish Health Survey (1997) did highlight some differences when comparing Scotland to England. Using the General Health Questionnaire (GHQ - which assesses the general psychological well-being of informants), it found that Scottish males aged between 35-

44 years were less likely to have a high GHQ score compared to their English counterparts. Similarly, Scottish women aged between 16-24 years and 55-64 years were less likely to have a high GHQ score compared to similar age groups in England. In relation to Ayrshire and Arran, the survey indicated no difference in GHQ scores when compared to other areas of Scotland.

In relation to life circumstances, unemployment in Scotland currently stands at 5% compared to the British average of 4% (figures for November, 1999 - The Scottish Office, personal communication, December, 1999). In Ayrshire and Arran, the rate stands at 8.4 % (figures for November, 1999 - The Scottish Office, personal communication, December, 1999). Unemployment in itself can bring with it despair, poverty and low self esteem, triggering tobacco use and alcohol / drug abuse as a means of consolation (The Scottish Office, 1998). There is strong evidence for the link between unemployment and a deterioration of mental health (Fryer and Payne, 1986). Housing conditions can negatively affect health, cold and dampness can worsen respiratory illness and generally impair well-being. In 1996, the Scottish House Condition Survey reported that 25% of all dwellings in Scotland were judged to suffer from problems of dampness or condensation.

In relation to the link between deprivation and ill-health, the Black report (1982) showed that a social class gradient existed with those more affluent people suffering lower death rates from causes such as stillbirth, accidents, cancers, respiratory disease and cardiovascular disease as well as experiencing less illness and premature death than the disadvantaged groups. Further studies have vindicated the Black Report with Carstairs and Morris (1991) showing that people in areas of high deprivation under the age of 65 years display patterns of mortality that greatly exceed their counterparts in more affluent areas. Castairs and Morris have also shown that socio-economic determinants of adult health may date from very early life, including before birth. Cancer and cardio-vascular disease are also negatively related to social class with those in lower deprivation categories (representing more affluent areas) having lower standardised mortality rates for cancer and coronary heart disease than those in the higher deprivation categories (The Scottish Office, 1998). Macintyre (1994) reported similar findings but also demonstrated an inverse relationship between ill-health and socio-economic status for HIV / AIDS, accidents and dental and oral health, reporting a stepwise relationship where each successive lower social group suffered progressively higher levels of ill-health. The link between social class and mental health has also been established. Meltzer, Gill, Petticrew, and Hinds (1994) reported that in 1993-1994 the rate for the prevalence of neurotic disorder for British males increased from 60 per 100,000 in social class 1 (representing the least socially deprived) to 129 per 100,000 in social class 5. A similar pattern was evident for women but alarmingly, the rates reported were much higher (155 per 100,000 in social class 1 compared to 247 per 100,000 in social class 2). Clearly, the gender differences have implications for programme development and service delivery (Health Education Board for Scotland, 1998). The imbalance in the proportion of sufferers across the social class spectrum also appears to be manifested in suicide rates. McLoone (1996), reported that in 1993, the suicide rates in 15-29 year olds living in deprived areas was about double that of those living in more affluent areas.

There is little data that directly compares Scotland against other countries for levels of deprivation but when comparing Ayrshire and Arran to Scotland, it has been shown that levels within Ayrshire and Arran are considerably higher (Director of Public Health, Ayrshire and Arran Health Board, 1996).

So called "lifestyle factors" (The Scottish Office, 1998) such as smoking, poor diet and inactivity are also known to have a negative effect on health. In relation to cigarette smoking, the Scottish Health Survey (1997) reported that 34% of Scottish males smoked, compared to 32% of English males. This difference was more marked in women however, with 36% of Scottish women smoking compared to 30% of English women. The figures for Ayrshire and Arran show no gender difference, with both 32% of males and females smoking (Ayrshire and Arran Health Board, 1998b). In relation to the Scottish diet, the James Report (1993) confirmed the very poor balance of the nation's diet and its damaging effects on health. In general, the Scottish diet is deficient in certain vitamins and fibre and contains too much saturated fat, sugar and salt. Once again, the Scottish Health Survey showed that the Scottish diet does not compare favorably to that of England, with the Scots tending to eat less fruit and vegetables and more biscuits, sweets and salt. Scotland's physical activity levels will be reviewed in detail later in the chapter, but in short, approximately 60% of the population do not do enough physical activity to gain a health benefit (The Scottish Health Survey). A similar proportion is evident within Ayrshire and Arran (56% - Ayrshire and Arran Health Board, 1998b). This compares to 50% in England (The Scottish Health survey).

As previously outlined, there appears to be an inverse relationship between socio-economic status and ill-health. A possible explanation is that these communities often exhibit elevated risk factors or "lifestyle factors" (e.g. smoking, excessive alcohol consumption, poor diet, lack of exercise, unsafe sex, low uptake of preventive services) (Macintyre, 1994, The Scottish Office, 1998). Coupled with poorer "life circumstances" (i.e. unemployment, housing condition, access to facilities) it is perhaps not surprising that communities suffering higher levels of deprivation also suffer higher levels of ill-health.

In summary, Scotland's health is slowly improving and can be classed as good when compared to many other countries of the world (e.g. South America, Africa, Asia). However, compared to most other Western, industrialised countries, the Scottish population has a lower life expectancy and higher death rates from coronary heart disease, cancer and strokes. A possible explanation for this could be due to the so called "lifestyle factors". Scotland smokes more, eats less healthily and is less active than its neighbour South of the border. Further, in general, those in lower socio-economic groups suffer higher levels of ill-health. It appears this is due to a combination of life circumstances (such as high unemployment and poor housing conditions) and an increased prevalence of risk factors (such as smoking, alcohol / drug consumption, poor diet).

Physical Activity, Physical Fitness and Health

Physical activity as a means to enhance health has been practiced for many centuries (US Department of Health and Human Services, 1996). It is only relatively recently (within the last 40 years) that scientific evidence has emerged to support this notion. The first half of this review attempts to summarise the current available evidence on the benefits to health of physical activity and physical fitness whilst the second half outlines the levels of physical activity and physical fitness that have been recommended to achieve a health benefit.

Currently, the most authoritative review of the effects of physical activity and physical fitness on health is the US Surgeon General's Report on Physical Activity and Health (US Department of Health and Human Services, 1996) (Vuori, 1998) which collates and draws conclusions from the most recent scientific evidence. Consequently, the report is used in this section to provide sub-headings that detail the effects of physical activity on a variety of health related measures. The information from the Surgeon General's Report is expanded upon using additional research where necessary and some health aspects that are not dealt with in the Surgeon General's Report are reviewed.

Mortality

The Surgeon General's Report (1996) concludes that regular physical activity is associated with lower mortality rates. Generally, studies examining the association of physical activity or physical fitness with total mortality have used two different strategies (Lee and Paffenbarger, 1996). Investigators have either classified participants according to physical activity or physical fitness levels and then examined mortality rates within each category. Alternatively, they have examined mortality rates for participants who have and have not changed their physical activity levels over time. With respect to the first category, Morris, Everitt, Pollard, Chave, and Semmence (1980) studied British Civil Servants between 1968 to 1977. During the first two years of the study, participants (17,944 males aged 40 – 65 years) were asked to complete an activity survey every Monday morning detailing the previous weeks Friday and Saturday physical activity. Participants were then classified as not having or having engaged in vigorous exercise. During follow up, the mortality rate in those who were not vigorously active (8.4%) was double that of those who were (4.2%). Similar findings have been reported. In a series of large scale population studies, Paffenbarger, Hyde, Wing, and Hsieh, (1986) and Paffenbarger et al., (1993a) used over 15000 former Harvard college students who at the start of the study (1977) were aged between 45-84 years. Analysis at the end of the study (1988) revealed that when taking into account confounding variables such as age, smoking and family history, risk of death was one-quarter lower among the intermediately active participants, and one-third lower among the most active participants, compared with the least active participants. With respect to aerobic fitness, several studies have also demonstrated lower mortality rates with higher fitness levels (Sandvic et al., 1993, Blair et al., 1989).

Fewer studies have examined mortality rates for participants who have and have not changed their physical activity levels over time. In one such study, The Harvard Alumni Health Study (1993) (described previously), 10629 participants aged 45-84 years in 1977 had previously provided physical activity information in either 1962 or 1966. These participants provided similar information in 1977 and were followed to 1985. Analysis showed that participants who changed from being inactive (< 2000 kcal/wk) to active (> 2000 kcal/wk) had about the same mortality rate as participants who were active at both time points. In regard to intensity of activity, participants who did not engage in any moderately vigorous activities (requiring > 4.5 METSs) in 1962/1966 but did so in 1977 had a 23% lower mortality rate than those who never reported such activities.

Coronary Heart Disease

The Surgeon General's Report (1996) concludes that regular physical activity or cardiorespiratory fitness decreases the risk of coronary heart disease (CHD) mortality. In 1987, Powell, Thompson, Casperson, and Kendrick conducted an extensive review of the literature relating to physical activity and the incidence of CHD. Initially, 121 articles representing 54 studies were identified. These studies were reviewed and depending on certain criteria (e.g. incidence rates, relative risks, odds ratios or mortality ratios could be calculated) 43 studies underwent a more detailed review. Powell et al. concluded that physical activity is inversely and causally related to the incidence of CHD. They calculated the relative risk (the ratio between the incidence rate of disease and death in the exposed [sedentary] and the unexposed [active] groups – a relative risk of 1 equals no difference in risk; more than 1 equals an increased risk) of CHD associated with inactivity which ranged from 1.5 to 2.4, with a median of about 1.9. That is, the risk of CHD morbidity is about double in those who are physically inactive compared to those who are more active.

More recent reviews have drawn similar conclusions. A review of studies published between 1987 and 1992 (Blair, 1994) confirmed and reinforced the view that there is a causal link. Further, Whaley and Blair (1995) reviewed 18 studies published since 1990 and 17 of them showed an inverse association between physical activity or fitness and risk of CHD.

Virtually all recent mortality studies on cardiorespiratory fitness have adjusted for confounding variables such as blood pressure, blood glucose, lipid levels, family history, obesity, health status and age (Blair, 1997). In order to evaluate the independent relative risk of a number of risk factors for all cause mortality (not just CHD) Blair et al (1996) followed 32421 participants between 1970 and 1989. At baseline, participant's were assessed for personal and family health history, current health status, health habits, anthropometry, resting ECG, blood chemistry, blood pressure, and fitness level and were followed until either they died (cause of death was recorded) or until the end of the study in 1989. Initial findings showed that low fitness level, smoking, elevated systolic blood pressure, elevated serum cholesterol level, and poor health status (abnormal ECG or chronic illness) were all significantly associated with cardiovascular (CVD) mortality and all-cause mortality. The relative risk due to low fitness (1.52) was similar to that of smoking (1.65) suggesting that becoming fit has a similar effect on reduction in mortality as stopping smoking (Blair et al.). They next calculated the death rates for all cause mortality and CVD mortality in cross-tabulation analyses, using 3 levels of fitness (low, moderate and high) and 2 categories of the other mortality predictors (smoking [nonsmoker, smoker], systolic blood pressure [<140mmHg, >140mmHg], serum cholesterol level [<6.2 mmol/L, >6.2 mmol/L and health status [healthy, unhealthy]). Results showed that for all cause mortality, an inverse gradient of risk across fitness groups existed for each category of the other mortality predictors (i.e. as fitness increased, mortality decreased for each category of each mortality predictor). Also, for each activity level, mortality rates were higher for those who smoked, had elevated systolic blood pressure, elevated serum cholesterol levels and who were unhealthy. Similar results were found for CVD mortality. Blair et al. then grouped three mortality predictors (smoking and elevated blood pressure and cholesterol levels) and cross tabulated these with the fitness groups (enabling analysis of mortality rates between fitness groups for a combination of 1, 2 or 3 other risk factors). They found that high fit persons with multiple predictors had lower death rates than low-fit persons who had no other predictors. In other words, moderate or high levels of fitness seem to provide protection against the force of combinations of other mortality predictors.

Strokes

The Surgeon General's Report (1996) concludes that the existing data are not conclusive regarding the relationship between physical activity and stroke. Of fourteen studies that were found to examine this, only eight found an inverse relationship. However, although the relationship between physical activity and stroke has not yet been established beyond doubt, two recent reviews conclude that the evidence points towards a strong association (Blair, 1992, Kohl and McKenzie, 1994).

Blood Cholesterol

Although exercise has been claimed to lower circulating concentrations of cholesterol, it is likely that this occurred as a result of associated weight loss and dietary change (The Royal College of Physicians, 1991). Indeed, of more than 60 studies examining the effects of physical activity on blood cholesterol levels, over half found that exercise training is associated with a beneficial rise in HDL cholesterol (US Department of Health and Human Services, 1996). Studies have also shown that even small bouts of physical activity can enhance the blood lipid profile (Durstine and Haskell, 1994).

High Blood Pressure

Physical activity has been shown to reduce the risk of developing hypertension in later years. Following male college graduates over a fourteen year period, Paffenbarger et al. (1991) found that participants who competed in vigorous sports had between a 19% and 30% reduction in the risk of developing hypertension. Aerobic exercise has also been shown to reduce blood pressure in those who suffer from hypertension. Two independent meta-analyses (Arroll and Beaglehole, 1992 and Kelley and McClellan, 1994) concluded that aerobic exercise decreases both diastolic and systolic blood pressure by about 6-7mmHg. Smaller reductions (3-6mmHg) have been achieved in groups with blood pressure in the normal range (Fagard, 1994). Ebrahim and Smith (1998) conducted a systematic review and meta-analysis of randomised controlled trials investigating the effects of several non-pharmocological interventions (i.e. salt reduction, weight reduction, stress reduction, exercise and alcohol reduction) on blood pressure. They concluded that most of the studies were of poor methodological design and biases often tended to increase the changes in blood pressure observed. Despite this, of the eight trials focusing on exercise, Ebrahim and Smith reported net decreases in systolic and diastolic blood pressures of 0.8 and 3.7 mmHg respectively (i.e. intervention group difference minus control group difference) for those hypertensive sufferers. These changes failed to reach significance however.

Cancer

Much of the research examining the link between inactivity and cancer has so far focussed on cancer of the colon. Lee (1994) conducted a review of 27 such studies and found that in 20 of them, an inverse association between physical activity and risk of cancer of the colon was reported. Based on these studies, it is estimated that the most sedentary people have between 1.2 to 3.6 times the colon cancer risk of the most active.

Many of the studies that have analysed colon cancer have also studied rectal cancer as a separate outcome (US Department of Health and Human Services, 1996). Of 13 studies analysing occupational physical activity, 10 reported no association with rectal cancer (US Department of Health and Human Services). Similarly, of 6 studies analysing either leisure time or total physical activity, no associations were reported (US Department of Health and Human Services). It can be concluded that there is little or no evidence to suggest a link between physical inactivity and rectal cancer.

With regard to breast cancer, the evidence for an association with physical activity is inconsistent. Several studies have reported a significant inverse relationship between physical activity and breast cancer (e.g. Bernstein et al., 1994 and Mittendorf et al., 1995). In contrast, several studies have reported no such relationship (e.g. Paffenbarger, Hyde, and Wing, 1987 and Albanes, Blair, and Taylor, 1989). Similar inconsistent findings have also been found when prostate and testicular cancer have been examined (US Department of Health and Human Services, 1996).

Diabetes

The effect of physical activity on non-insulin-dependent diabetes mellitus (NIDDM) has been widely researched. Probably the clearest evidence for the use of physical activity is an effort to prevent the development of NIDDM (Kriska, Blair, and Pereira, 1994). In one study, when over 8000 American women from the Nurses' health study cohort were followed for a period of 8 years, a reduction in the age-adjusted relative risk (0.67) for developing NIDDM was found in those participants who exercised at least once per week (Manson et al., 1991). Similar findings were found for men (Manson et al., 1992). It is clear from the research that physical activity can protect against NIDDM. Most reviewers also feel that physical activity can help in the treatment of NIDDM but not all agree, mainly due to methodological reasons (Schwartz, 1997).

There have been far fewer studies on the effects of exercise in insulin dependent diabetes mellitus (IDDM). Given that approximately 90% of those people with diabetes have NIDDM (Krall and Beaser 1989) this is perhaps not surprising. Due to the scarcity of relevant research in this area, there is no data at present to suggest that exercise can delay or mitigate the onset of IDDM (Schwartz, 1997), but one study has found that for people who have developed IDDM, increased physical activity appears to be protective against cardiovascular disease (Giacca et al., 1994).

Obesity

Many studies have been conducted on the role of physical activity in controlling body weight. It is clear that without regular physical activity, weight control can usually not be achieved (Byers, 1995). Over the past two decades, two comprehensive meta-analysis (Ballor and Keesey, 1991 and Epstein and Wing, 1980) have concluded that physical activity can promote fat loss whilst preserving or increasing lean body mass, the rate of weight loss is proportional to the frequency and duration of activity and that a combination of dieting and physical activity is more successful in achieving weight loss than dieting alone.

Respiratory Disease

Physical activity can benefit people with a wide range of respiratory complaints. Most asthmatics benefit from exercise (Bundgaard, 1985) although a minority of severe asthmatics are distressed by vigorous exercise. Some children with cystic fibrosis gain as much benefit from exercise as they do from physiotherapy (Blomquist et al., 1986) and research suggests that physical activity training programmes may increase the exercise tolerance of people suffering from chronic bronchitis or emphysema (Lertzman and Cherniack, 1976).

Osteoarthritis and Osteoporosis

In relation to osteoarthritis (the degeneration of cartilage and new growth of bone around the joint area), it is not known whether an active lifestyle can offer protection against its development (US Department of Health and Human Services, 1996). Studies have shown however that some sports (e.g. soccer, weight lifting and competitive athletics) are associated with the development of osteoarthritis (Kujala et al., 1995) although sports-related injuries rather than the physical activity may have been the cause (US Department of Health and Human Services). For people who have already developed osteoarthritis, evidence suggests that regular moderate exercise can relieve the symptoms (Ettinger and Afable 1994).

Osteoporosis, characterised by decreased bone mass and structural deterioration of bone tissue, usually affects older persons (Cummings, Kelsey, Nevitt, and O'Dowd, 1985). Development of osteoporosis is thought to be related to three factors; deficient bone mass at physical maturity, failure to maintain bone mass during the third and fourth decades of life and the bone loss that begins in the fourth and fifth decades of life (US Department of Health and Human Services, 1996). Studies have shown that increase in bone mass in University students is related to higher levels of physical activity (Recker et al., 1992) and that prolonged bed rest or immobility results in rapid reductions in bone density (Krølner, Toft, Nielsen, and Tøndevold, 1983). Thus it appears that physical activity may enhance bone mass, or at least maintain it, whereas physical inactivity is associated with a decline in bone mass.

Fractures and Falling

There is a certain degree of evidence which suggests that physical activity (both past and present) can prevent against bone fractures, in particular fractures of the hip (Jaglal, Kreiger, Darlington 1993). In addition, research also suggests that physical activity can help protect the elderly from falls (Tinetti et al., 1994), possibly by improving muscle strength, functional capacity, gait, balance, and reaction time (US Department of Health and Human Services, 1996).

Mental Health and Quality of Life

As discussed earlier, mental health is an integral component of overall health. Mental, social, and physical health are inextricably linked, with social and physical health circumstances impacting on mental health and vice versa (Downie et al., 1996). The term "mental health" has been used inconsistently over the years (Health Education Board for Scotland, 1998), partly because "anything and everything to do with mental health and mental illness is subsumed under the term "mental health"" (Tudor, 1996, p.3). Tudor has defined mental health as "a generic term which describes an integrative approach embracing affective, behavioural, cognitive, physiological, sociopolitical and spiratual health" (p.26) and a variety of other mental health definitions have been proposed (Health Education Board for Scotland, 1998). However, MacDonald and O'Hara (1996) have suggested it may be unhelpful to define mental health as they argue succinct definitions may fail to take account of the broad spectrum of mental health components.

The effects of physical activity on physiological functioning (as reviewed earlier) has been widely researched. However, less attention has been paid to psychological outcomes of exercise (Mutrie, 1997). This has in part been due to the reluctance of the medical community to view the philosophy that mind and body are interconnected (Rejeski and Thomson, 1993), although this situation is changing (Rejeski and Thomson). The way we view our bodies, and the "performance" of our bodies, undoubtedly has an affect on our mental health and vice versa. As Rejeski and Thomson suggest, "there is ample evidence that physical abilities and physical conception of the self play an integral role in mental health" (p.7). Further, Fox (1997) suggests "what we feel about our physical abilities and our appearance and how important these matters are to us determine our physical identities" (p.v). As already outlined, many models of health also recognise the relationship between physical and mental health.

In relation to physical activity and it's effect on mental health, research has focussed around two main areas; the role of physical activity in reducing negative mental health and it's ability to enhance positive mental health. Negative mental health refers to conditions such as anxiety, depression and schizophrenia and positive mental health refers to such feelings as general well-being, mood and self esteem as well as cognitive functioning.

In relation to anxiety, regular, particularly rhythmic exercise has been found to produce reductions, with the greatest effects seen in people who were both unfit and highly anxious (Landers and Petruzello, 1994). Aerobic exercise training has been shown to reduce the levels of trait anxiety (a general feeling of anxiety), (Petruzello et al., 1993) and single exercise sessions can produce reductions in state anxiety (situation specific feelings of anxiety) (Crocker and Grozelle, 1991).

Exercise has also been found to reduce the risk of developing depression. For example, in the Harvard alumni study reported earlier (Paffenbarger, Lee, Leung 1994) level of reported physical activity in 1962 or 1966 was found to be inversely proportional to self reported physiciandiagnosed depression in 1988. Similarly, Camacho, Roberts, Lazarus, Kaplan, and Cohen (1991) reported a relationship between inactivity and incidence of depression. In 1965, baseline data was collected on depression and physical activity (classifieds as low, medium or high) for a large Californian population. Follow up in 1974 showed the relative risk (1.8 for men, 1.7 for women) of developing depression was significantly greater in the low activity group. Further follow up in 1983 showed that those who were inactive in 1965 but were active in 1974 were at no greater risk of developing depression in 1983 than those continually active. In contrast, for those active in 1965 but inactive in 1974, the odds of developing depression was 1.6 times more likely than those continually active.

Exercise has also been shown to be an effective treatment for depression. In 1998, Craft and Landers conducted a meta-analysis to examine the effects of exercise on clinical depression and depression resulting from mental illness. After reviewing thirty studies, they reported an average effect size of 0.72 (i.e the groups receiving exercise were different from those not receiving exercise by 0.72 standard deviations on the measure of depression), which was significantly different ($p < 0.05$) from zero. They also reported no difference in the effect on depression when comparing aerobic to non-aerobic exercise, and no difference in effect size when exercise was compared to more traditional forms of treatment, such as individual or group psychotherapy and behavioural interventions. As with anxiety, Craft and Landers also reported greatest effect sizes for those participants suffering the highest levels of depression. Despite the encouraging findings of Craft and Landers, Dishman (1995) has criticised the use of meta-analysis for drawing conclusions in this area, arguing that there are too few studies with similar designs and methodologies. Mutire (in press) conducted a review of studies in which exercise had been used to treat clinically defined depression and included only those studies with the best design features. Ten "key" studies were identified. Mutrie concludes that although more research is required in this area, results confirmed the wider meta-analysis of Craft and Landers, and as such, she suggests the conclusions drawn from this analysis can be viewed with confidence. She further concludes that the link between depression and exercise (both in terms of prevention and treatment) is causal and there appears to be no negative effects of exercise on depression.

It also appears that exercise can help reduce the symptoms associated with scizophrenia. Chamove (1988) studied the effects of exercise on 40 long-term schizophrenic patients and reported that patients who had exercised showed fewer psychotic features, fewer movement disorders, were less irritable, depressed, retarded and tense, and showed more social interest and competence. Similarly, Faulkner and Sparkes (1999) reported that a 10 – week exercise programme of twice weekly sessions reduced schizophrenic patients' perceptions of auditory hallucinations, raised self-esteem and improved sleep patterns and general behaviour. Interestingly, they reported that it was the *process* of exercising (i.e. social interaction), rather than the exercise itself, that was influential in causing the changes. They concluded that exercise should be offered as an adjunct treatment in psychiatric rehabilitation.

The majority of research on the effects of exercise on negative mental health has tended to focus on clinical populations (as reported above) (Mutrie and Biddle, 1995). However, there is accumulating evidence that the effects are similar for non-clinical populations. Mutrie and Biddle reviewed the area of exercise and mental health in non-clinical populations. They analysed the results of five meta-analytic reviews of the area and reported effect sizes of 0.24 for state anxiety, 0.34 for trait anxiety and a range from 0.53 to 0.55 for depression. Mutrie and Biddle conclude that although most of the effect sizes were in the moderate range, the effects of exercise on negative mental health have shown positive results in the non-clinical population. They further conclude however that more research is required to refine the exact nature of these effects.

In regard to the effects of physical activity on positive mental health, research suggests that exercise can enhance well-being. Well-being is a general term often used in exercise psychology that embraces a number of psychological states. Psychological well-being, or emotional function, has been used to describe both negative (e.g. anxiety and depression) and positive (e.g. mood and self-esteem) affective states (Rejeski et al., 1996). A positive relationship has been reported between physical activity and psychological well-being. Stephens and Craig (1990) conducted a nation-wide survey of approximately 4000 Canadians and found that those who reported higher levels of physical activity had a more positive mood than those reporting lower amounts of activity. Similarly, in a cross sectional secondary analysis of two Canadian and two US surveys conducted between 1971 and 1981, Stephens (1988) associated physical activity with fewer symptoms of anxiety and depression and with higher positive mood and general well-being. It also appears that the type of exercise is important. Moses et al. (1989) compared the effect of high intensity exercise (70-75% of maximum heart rate), moderate intensity exercise (60% of maximum heart rate) and a strengthening - stretching placebo control group on psychological well-being. Results showed that only the moderate intensity group demonstrated improved psychological well-being. Clearly, if the intensity of the exercise is too high, improvements in well-being may not occur (Moses et al.) which has obvious implications for those designing exercise programmes.

Self-esteem is often regarded as the single most important measure of psychological well-being (Biddle, 1995). It is the awareness of good possessed by the person, or the degree to which the person believes they are an "OK" person (Fox, 1997). Self-esteem is related to the term self-concept which concerns the individual as known to the individual (Fox). Examples could include "I am a father", "I am a friend" (Fox). Where self concept is a picture of the person's identity, self-esteem is a picture of their own worth (Fox). Self-esteem has been found to be positively associated with exercise in children (MacAuley, 1994) and has also been positively related to different types of exercise (Ossip-Klein et al., 1989), with aerobic exercise (Gruber, 1986) and weight training (Ewart, 1989) being shown to be particularly beneficial. Further, Berger and McInman (1993) have shown that greatest benefits were accrued by those with the lowest self-esteem. Aerobic exercise has also been shown to enhance self-concept (Roviaro, Holmes, and Holmsten, 1984) and it is has been suggested that physical activity may be linked to more specific dimensions of self-concept, such as health perceptions or feelings of increased coordination (Marsh, Richards, Johnson, Roche, and Tremayne, 1994).

Physical activity has also been shown to be strongly associated with cognitive / neuropsychological performance (Dustman, Emmerson, and Shearer, 1994). In 1992, Mutrie and Thin demonstrated improved cognitive functioning (computer target location task) after 7 minutes of cycle ergometer exercising at either 30%, 50% or 70% VO_2 max. Similar results have been found after a 10.5 mile treadmill run (Jones and Cale, 1989). Regular exercise may also reduce memory loss in older adults (Thomas, Landers, Salazar, and Etnier, 1994), although despite this, it is not clear whether exercise has a long-term effect on cognitive functioning (Rejeski et al., 1996). Similarly, it is not known if different intensities of exercise have differing effects (Rejeski et al.). There are many factors that need to be considered in this area of research, such as the state of fatigue of the participant and the motivation to continue performing the task at the best possible level (Mutrie and Biddle, 1995). Clearly, more research in this area is required.

Rejeski, Brawley and Shumaker (1996) have conducted a thorough review of the literature concerning HRQL and physical activity. They site many studies that constitute either direct support (i.e. specifically examining several HRQL concepts or targeting HRQL as a primary outcome) or indirect support (i.e. research that constitute an indirect evidence of a link between physical activity and HRQL). They have shown that physical activity has significant potential to influence HRQL with the most direct effects in the areas of physical and psychological well-being, perceived physical function, and cognitive function.

Adverse Effects of Physical Activity

It is clear that physical activity and physical fitness is strongly associated with good health. However, it also has to be recognised that physical activity may have a negative effect on health. These concerns relate to four main areas; risk of heart attacks, accidents and injuries, "wear and tear" of joints, muscles, tendons and ligaments and negative psychological aspects of exercise. Thompson and Fahrenbach (1994) have conducted a review of the research concerning the risk of physical activity to the cardiovascular system and conclude that for those people who already suffer from heart disease, vigorous exercise causes a transient increase in the risk of cardiac death. However, these risks are short term and the net effect of regular exercise is to decrease the risk of cardiac death (US Department of Health and Human Services, 1996).

With regard to injuries, it is true that sudden stressful movements (such as serving in tennis) or repetitive, traumatic contacts with the ground or other objects (such as jogging or kicking a football) can result in musculoskeletal injuries. However, these kinds of injuries are often confined to specific sports (US Department of Health and Human Services, 1996) and the risk from performing "everyday" moderate physical activity is negligible.

With regard to "wear and tear", as mentioned earlier, some sports may enhance the development of osteoarthritis but as was suggested, this may be the result of sports related injury. There is little or no evidence to suggest that regular, moderate intensity physical activity has any detrimental effect on the general "wear and tear" of the body in either the short or long term. In fact, an active lifestyle, especially for older people, has been found to be beneficial in improving musculo-skeletal function and strength, which in turn helps prevent falls and maintain independence for daily living (Blair, 1992). Generally, physical health problems associated with physical activity are due mainly to sports that require speed and power and include body contact and occasions where people who are unaccustomed to exercise try to do too much too soon (Vuori, 1998). Thus, all physical complications of physical activity can be kept low by exercising sensibly (Vuori).

The most notable negative effect of exercise on mental health is the area of exercise dependence. Exercise dependence, or addiction to exercise, may cause both physical and psychological problems such as tiredness, chronic injury, relationship problems and eating disorders (Veale and Le Ferve, 1988). It has been characterised by a frequency of at least one exercise session per day, shows a consistent daily or weekly pattern, is compulsive and is associated with withdrawal symptoms if there is an interruption to the normal routine (Veale, 1987). The incidence of exercise dependence is unknown thus the potential effect on public health is not known (Mutrie and Biddle, 1995). Clearly, further research is required to establish the causes, incidence and treatment of exercise addiction. A further mental health problem associated with exercise is that of the intensity component. As reviewed earlier in the chapter, Moses et al. (1989) showed that if the intensity of the exercise is too high, psychological well-being scores may decrease. Again, this has obvious implications for those designing exercise programmes and those individuals considering embarking on an exercise regime.

Generalisability of Health Benefits of Physical Activity

Much of the evidence of the health benefits of physical activity is based on studies involving young and middle-aged white middle-class males (Vuori, 1998). Further, the majority of these studies have been conducted in America. For example, as reported earlier, much of the mortality and hypertension data was derived from Harvard college students. Although Vuori reports that there is culminating evidence to suggest that most of the effects of physical activity on health can be seen in both sexes and within a wide age range, the issue of generalisability remains. For example, do black people and those from ethnic minorities show similar relationships between ill-health and physical activity as those previously reported? Similarly, are those socially and economically deprived communities more at risk from leading a sedentary lifestyle? Clearly, more research is required in this area to provide a comprehensive picture of the relationship between physical activity and health in a variety of populations.

Nature, Causality and Dose

In general, aerobic or endurance activities have been traditionally considered as the most beneficial to health (Vuori, 1998). It has to be noted however, that not all health benefits are related to these kinds of activities. For example, walking and cycling are not considered to be beneficial in enhancing bone density (Vuori). For this reason, specific health benefits relate to specific activities, but in general, regular, moderate intensity physical activity can be viewed as having a positive effect on health.

The Surgeon General's Report (1996) subjected the evidence of a health benefit to Hill's (1965) classic criteria for assessing causality. The evidence was reviewed for strength of association, consistency of findings, temporality, bilogical gradient, biological plausibility and experimental evidence. The Surgeon General's Report states "it is reasonable to conclude that physical activity is causally related to health outcomes" (p.145). That is, physical inactivity is a cause of poor health.

In relation to the amount or "dose" of activity required to derive a health benefit, as with the nature of the activity, this depends on the health benefit under question. However, in general, the evidence reviewed by the Surgeon General's Report (1996) indicates a "dose-response" relationship. That is, as physical activity increases, the health benefit increases. In general however, this relationship is not thought to be linear. In 1994, Haskell, after reviewing all of the relevant evidence, proposed a theoretical "dose-response" curve. This curve suggests that increases in activity for people who do little or no activity will produce a greater health benefit rise than similar increases for people who are more active. Put simply, "the health benefits gained from increased physical activity depend on the initial activity level. Sedentary individuals are expected to benefit most from increasing their physical activity level" (Pate et al., 1995, p.404). This theoretical dose response relationship has been endorsed by the American College of Sports Medicine (ACSM) and Centres for Disease Control (Pate et al.) and is the basis for the current health related physical activity recommendations.

Recommendations

In 1978, the ACSM released a position statement entitled "the recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults". The objective of this position statement was to outline the exercise needed for developing and maintaining cardiorespiratory fitness and body composition in healthy adults (ACSM, 1978). In 1990, this position statement was updated to include a recommendation for the development of muscular strength and endurance and small changes were made to the cardiorespiratory recommendation. What resulted, for the cardiorespiratory component, was the traditional, well known recommendation: frequency of training 3-5 days per week; intensity of training 60-90% of maximum heart rate; a duration of training of 15-60 minutes per session; and the type or mode of activity being the rhythmical and aerobic use of large muscle groups as running-jogging, walking- and hiking (Haskell, 1994).

The "traditional" recommendation from the ACSM (1990) focused on maintaining or improving physical fitness. In 1995, in conjunction with the Centres for Disease Control and Prevention (CDC), the ACSM decided to once again review the recommendations, due mainly to two reasons. Firstly, the ACSM recognised that the traditional recommendations may have been misinterpreted to mean that to gain a health benefit, you must undertake vigorous, continuous exercise (Pate et al., 1995) so not "appealing" to most sedentary people. Secondly, continuing evidence was emerging as to the benefits of small bouts of low to moderate intensity physical activity. The ACSM and CDC (1995) physical activity recommendations suggest that "every....adult should accumulate 30 minutes or more of moderate-intensity exercise on most, preferably all, days of the week" (Pate et al., p.404). These recommendations emphasise the benefits of moderate-intensity physical activity that can be accumulated in relatively short bouts. They are designed to encourage an "active living" approach to life. Therefore, the recommended 30 minutes of activity per day can be accumulated from activities such as walking, gardening, housework and "DIY", as long as the intensity corresponds to that of brisk walking (i.e. 3-6 METS). As mentioned earlier, the ACSM and CDC endorsed Haskell's (1994) dose response curve. It is hoped therefore that the current recommendations will encourage more sedentary people to adopt a more "active life".

It has to be noted that the active living recommendations were not intended to supersede but compliment previous recommendations (Pate et al., 1995). The traditional recommendations (ACSM, 1990) are still applicable but are designed more for enhancement and maintenance of physical fitness. The active living recommendations are designed to enhance health through physical activity. This is recognised in the ACSM (1998a) most recent position stand in which they combine both sets of recommendations, advocating a "sliding scale" of physical activity / exercise, based on a person's "needs, goals and abilities". Whilst they continue to recommend the "traditional" exercise intensity, frequency and duration of activity for maintenance and improvement of physical fitness, they recognise that health benefits can be achieved at lower intensities, and that these lower intensity bouts can be accumulated through the day. By advocating this sliding scale of activity, the recommendations apply to all groups within the population from those who are sedentary to those who are regularly active. The ACSM (1998a) hope that this will "encourage a lifetime of physical activity" (p.975).

It is also worth noting that the ACSM have also released position statements aimed at particular subject groups (e.g. Diabetes Mellitus and Exercise, 1997 and Exercise and Physical Activity for Older adults, 1998b). The particular recommendations for these subject groups is beyond the scope of this review however.

The Promotion of Physical Activity

Although specific physical activity interventions will be reviewed later in this chapter, it may be informative here to review the area of "active living" promotion.

Both the English Health Education Authority (HEA) and the Scottish Health Education Board for Scotland (HEBS) have incorporated the current active living physical activity recommendations in two separate national initiatives. Both the "Active for Life" (HEA, 1996a) and the "Hassle Free Exercise" (HEBS, 1994) campaigns are predominately aimed at sedentary people and focus on increasing "everyday" activities such as walking, gardening and DIY. Both these campaigns have incorporated the national media to promote the active living message. To date, only the HEBS campaign has undergone a formal evaluation. This campaign promoted walking by employing Gavin Hastings, a famous Scottish international rugby player, to appear in a 40 second television advertisement, promoting the benefits of walking. Wimbush, MacGregor and Fraser (1998) report that the advertisement had a notable positive impact on knowledge about walking as a form of exercise but no impact on walking behaviour. The campaign also involved a "helpline" for people to phone up for more information and advice. 48% of these callers, followed up after one year, claimed to be more active. In 1999, Cavill reviewed the research concerning national campaigns in promoting physical activity and concluded that "national physical activity campaigns can help to change levels of knowledge and attitudes regarding physical activity, but they have limited short term impact on behaviour" (p.51).

With regard to specific studies on active living, Hillsdon and Thorogood (1996) conducted a comprehensive review of randomised control trials of physical activity promotion. They concluded that trials that were able to demonstrate significant increases in activity involved exercise that was home based, of moderate intensity and involved walking. In addition, walking from home was more successful than exercise which relied on attendance at structured exercise sessions. In 1996, Blamey, Mutrie and Atchison attempted to encourage stair use as opposed to escalator use in a Glasgow city centre underground station by placing posters reading "stay healthy, save time, take the stairs" in prominent positions around the stairs and escalators. They found that the percentage of people using the stairs increased from 8% at baseline to 15-17% during the intervention. In 1999, Dunn et al. reported the results of a project (known as "project active") which compared the 24-month intervention effects of a lifestyle physical activity programme with traditional structured exercise on improving physical activity, cardiorespiratory fitness and cardiovascular disease risk factors. Results showed that both groups had significant and comparable improvements in physical activity and cardirespiratory fitness and similar reductions in blood pressure. Similar results were observed when a diet plus lifestyle activity programme was compared to a diet plus structured aerobic exercise programme for the reduction in body weight of obese women (Anderson et al., 1999). Results showed both programmes were just as successful at reducing overall body weight. The results of these studies indicate that a lifestyle approach to promoting physical activity can be as effective and has similar health benefits as a traditional structured exercise programme. Given that this lifestyle approach is more likely to "appeal" to the sedentary population, and the fact that the sedentary population will benefit most from increases in physical activity, the active living promotion approach offers real potential to improve health.

This view is in contrast to that of Winett (1998). He argues that the current active living guidelines are of little use to physical activity promotion. With regard to the recommendations he recognises that any activity is better than no activity but states "what is incorrect is the notion that performing just any activity will enhance fitness, strength or body composition" (p.210). Instead, he argues the benefits of high intensity training programmes in promoting physical activity. However, Winett seems to have misunderstood the reasons for releasing the current guidelines and what adherence to the recommendations will produce.

First of all, the recommendations do not claim to enhance fitness, strength or body composition. They are designed to protect against ill-health. Second, advocators of active living have never argued that people should only follow these guidelines. As already outlined, the active living recommendations are not meant to replace the previous ones, but augment them. The current recommendations offer a starting point for people who would never normally achieve the exercise recommendations. For these people, improving "fitness, strength and body composition" is not important, providing a protection against disease is, a point Winett seems to have misunderstand. When these people are achieving a basic level of activity to provide a health benefit, they should be encouraged to do more, hopefully eventually achieving the "exercise" recommendations. Third, various surveys have shown that prior to the current recommendations release, physical activity levels were low, suggesting that the traditional "exercise" recommendations (advocated by Winett) were not being followed. This was one of the reasons why the current recommendations were released (Pate et al., 1995). Finally, he assumes that the population is not adhering to the current guidelines, concluding they do not have their desired effect. However, the current active living recommendations were only published in 1995 so it is too early to judge their impact. Early signs from active living research, as described earlier, suggest promoting the recommendations can increase physical activity.

Overall Health Gain in the Population

In relation to coronary heart disease, as reported earlier, Blair et al. (1996) showed that the relative risk of a sedentary lifestyle was equivalent to smoking cigarettes and that this risk was greater than excess body weight or elevated cholesterol and blood pressure. From a public health point of view, it may be more appropriate to encourage a physically active lifestyle rather than putting emphasis on a further improvement of the dietary habits or on a reduction of body weight (Mechelen, 1997). In addition, given that approximately 30% of the population smoke compared to

60% who do not do enough physical activity (Scottish Health Survey, 1997), it is not surprising that physical activity has been described as "public health's best buy" (Morris, 1994, Mechelen).

For England and Wales, Nicholl, Coleman, and Blazier (1994) estimate that if the whole population were to exercise sufficiently, just under one third of all CHD incidence, one quarter of stroke incidence, just under one-quarter of NIDDM in the over 45 year olds and just over half the hip fractures in the over 45 year olds would be avoided. Similarly, Powell and Blair (1994) estimate that in the United States of America, sedentary living is responsible for about one-third of deaths due to CHD, colon cancer and diabetes. There is no reason to suggest that similar statistics are not applicable to Scotland. In fact, given Scotland's poor health record, it is reasonable to assume that the country would derive a greater health benefit if the sedentary population became active.

To summarise, physical activity or physical fitness has been shown to be associated with a reduced risk of all-cause mortality and CHD mortality, a beneficial rise in HDL cholesterol, a reduction in high blood pressure and a protective effect against high blood pressure, a protection against some site specific cancers, mainly colon cancer, a protective effect against NIDDM and a reduction in NIDDM, a reduction in body weight, positive effects on certain respiratory diseases, positive effects on ostoearthritis and osteoporosis, a reduction in the number of fractures and falls in the elderly and a positive effect on mental health and quality of life. These benefits greatly outweigh the negligible adverse effects of physical activity. Physical activity appears to be causally related to the benefits mentioned and it appears that these benefits follow a dose response relationship where health gains are more prominent for sedentary people who become more active compared to those who are already active. This is reflected in the current physical activity recommendations which advocate accumulating at least 30 minutes of moderate intensity physical activity on most days of the week. This active living approach appears to be as successful in promoting physical activity compared to the more traditional "exercise" approach and is more likely to "appeal" to the sedentary population. Finally, it appears that physical activity promotion offers "today's best buy in public health".

Scotland's Physical Activity

The most recent national health survey was conducted in 1995 (The Scottish Health Survey, 1997) which attempted to measure certain aspects of Scotland's health. Interviews were conducted with 7932 people aged between 16 and 64 years. These interviews contained a section relating to physical activity. Three types of activity were covered in the questionnaire: activity at home (i.e. housework, gardening, and DIY), sports and exercise and activity at work. For each type of activity, informants were allocated to a level of intensity and a level of frequency. From this, informants were classified into one of six activity levels;

Level 5	Three or more occasions of vigorous activity per week
Level 4	Three or more occasions of a mixture of vigorous and moderate activity per week
Level 3	Three or more occasions of moderate activity per week
Level 2	More than one, less than three, occasions of moderate or vigorous activity per week
Level 1	One occasion of moderate or vigorous activity per week or less
Level 0	No occasions of moderate or vigorous activity per week

Note. Moderate intensity = activities with an energy cost of at least 5 kcal/minute but less than 7.5kcal/minute. Vigorous intensity = activities with an energy cost of at least 7.5kcal/minute.

Figure 2. plots the proportions of males and females in each activity category.

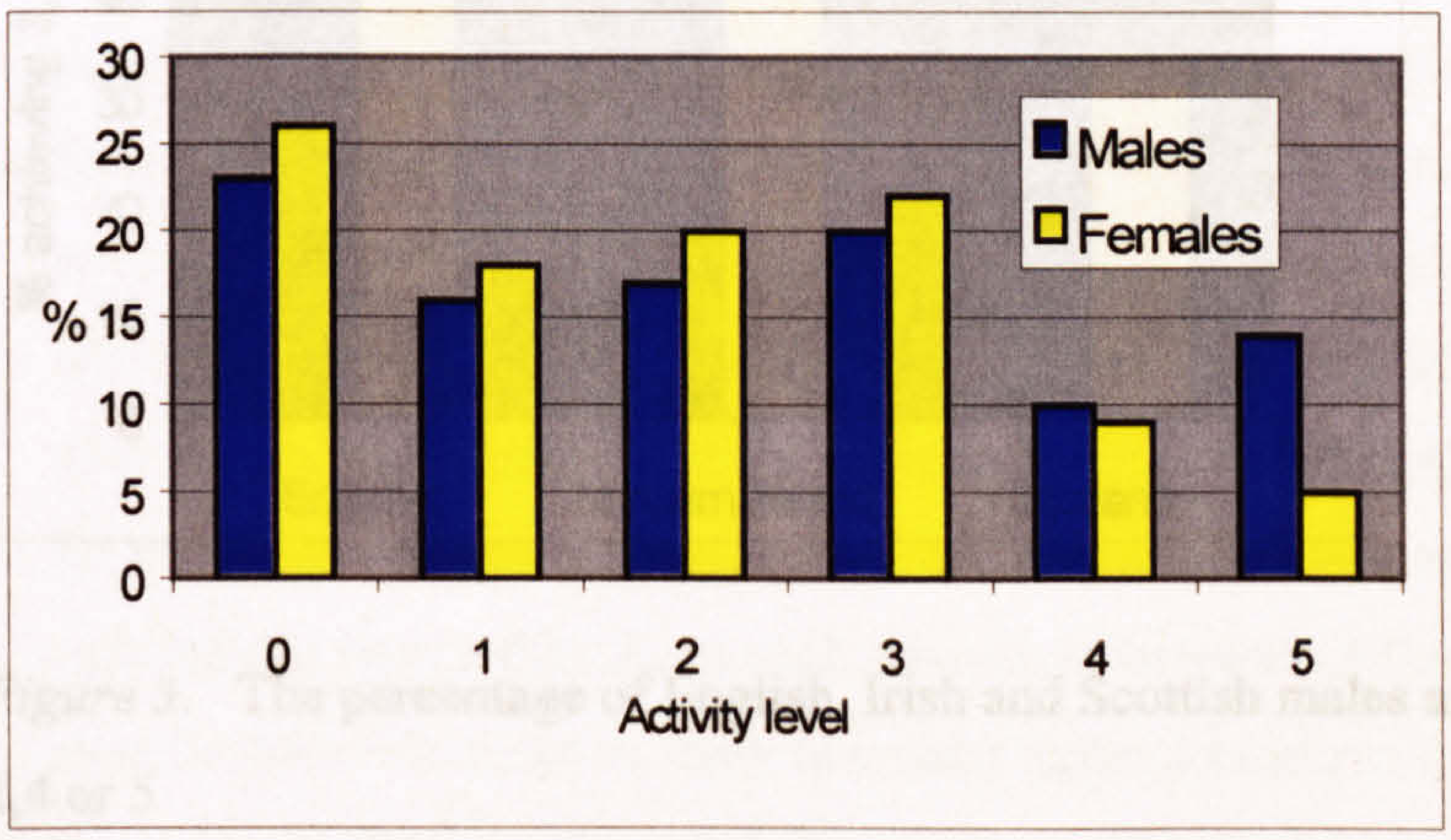


Figure 2. The proportion of males and females in each activity category
Note. Activity categories relate to those given above, data from Scottish Health Survey, 1997, *The Scottish Health Survey, 1995*. Edinburgh: Her Majesties Stationary Office.

The survey found that few informants (14% of men and 5% of women) were active to level 5, which is the level of maximum health benefit. With regard to the active living physical activity guidelines (Pate et al., 1995) for the minimum amount of physical activity recommended for a health benefit, it can be seen that levels 4 and 5 would meet the recommendations. The survey found that 24% of men and 14% of women were active to levels 4 and 5. It could be argued that level three also meets the current recommendations although these relate to moderate physical activity on "most, preferably all days of the week", not "three or more occasions per week". Even taking into account level 3, the survey found that less than half of men (44%) and just over a third of women (35%) were active to levels 3, 4 and 5. In other words, based on the survey results, approximately 60% of the Scottish population are not doing enough physical activity to even meet the minimum recommendations for a health benefit. In addition, the survey found that the largest percentage for any of the six categories for both men and women was those in the 0 category. Just under one-quarter of men (23%) and just over one-quarter of women (26%) reported no occasions of moderate or vigorous activity per week.

It is possible to compare the results of the Scottish Health Survey with those from the 1994 Health Survey for England (Colhoun and Prescott-Clarke, 1996) and the Northern Ireland Health and Activity Survey (1993), although extreme caution is necessary owing to the different questions, response categories and methods of classification used in the surveys. Given this, figure 3. plots the percentage of people achieving activity levels 3, 4 or 5 (i.e. meeting current activity recommendations).

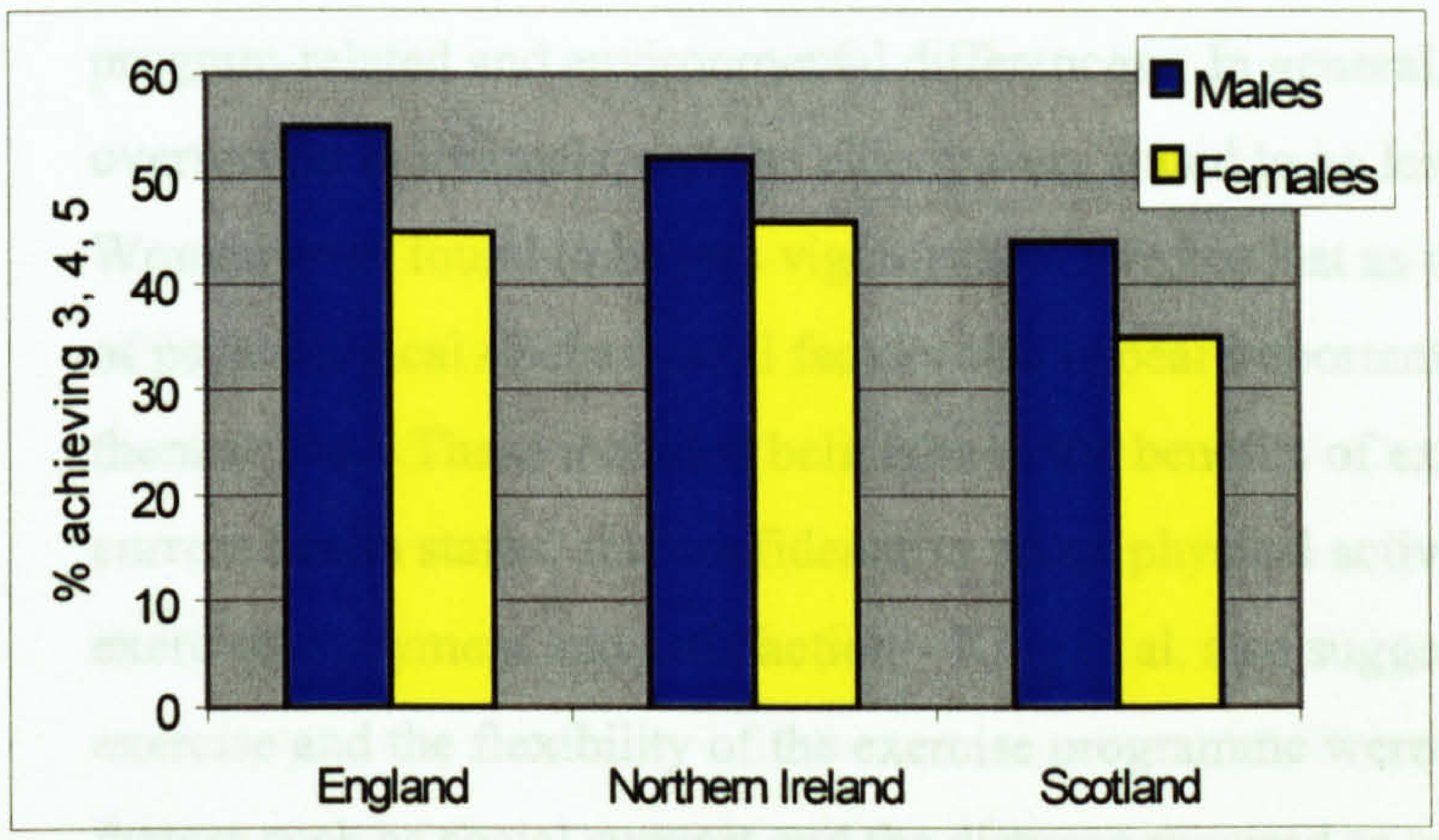


Figure 3. The percentage of English, Irish and Scottish males and females in activity categories 3,4 or 5

Note. (data from H. Colhoun, and P. Prescott-Clarke, 1996, *Health Survey For England 1994*. London: Her Majesties Stationary Office, Northern Ireland Health & Activity Survey, 1993. Belfast: Her Majesties Stationary Office and The Scottish Health Survey, 1997, *The Scottish Health Survey, 1995*. Edinburgh: Her Majesties Stationary Office).

Figure 3. shows that the smallest percentage of people meeting the current physical activity recommendations are Scottish females. They are closely followed by Scottish males. In total, figure 3. shows that approximately 50% of the English and Northern Irish populations do enough physical activity to expect a health benefit. This compares to only 40% of the Scottish population. Further comparison of the surveys revealed a similar trend for the percentage of males and females reporting no periods of activity. Twenty three percent of Scottish males and 26% of Scottish females fell into this category compared to 21% and 20% of Northern Irish males and females respectively. Further, the percentage of English males and females reporting no periods of physical activity (12% and 11% respectively) was about half that of their Scottish counterparts.

In relation to physical activity levels in Ayrshire and Arran, data is available from the recently conducted "Adult Health and Lifestyle Survey" (Ayrshire and Arran Health Board, 1998b). A 1.5% stratified random sample of the adult population of Ayrshire and Arran was selected with a total of 4232 16-75 year olds being sent a survey questionnaire. Using self reported physical activity levels, the survey found that 56% of the sample did not undertake regular physical activity (defined as "taking exercise, sport or heavy work 2-3 times a week or walking for at least 20 minutes on four or more days a week") which is comparable to the Scottish Health Survey (1997) data.

Determinants of Physical Activity

So far this review has highlighted the public health importance of getting people active and keeping them active. Some people are more predisposed to being active than others. King et al. (1992) reviewed the physical activity determinant literature and reported a number of personal, program-related and environmental differences. In general, black women, the less well educated, overweight individuals, and the elderly were found to be less active than their counterparts. Women were found to be less vigorously active but just as moderately active as males. A variety of psychological / behavioural factors also appear important in getting people active and keeping them active. These included beliefs as to the benefits of exercise, peoples perception of their current health status, self confidence to adopt physical activity, self-motivation and perceived exercise enjoyment and satisfaction. King et al. also suggest that monetary and time costs of exercise and the flexibility of the exercise programme were also important as were environmental factors such as social support and the distance required to travel to reach exercise facilities. The conclusions reported by King et al. are mainly based on American, young to middle-aged adult men so there is a question mark over their generalisation to the British population.

Physical Activity and Social Class

There appears to be confusion in the literature as to whether those in lower social classes are more or less active than those in higher social classes. For example, the Allied Dunbar National Fitness Survey (Health Education Authority and The Sports Council, 1992) was conducted with 6000 English adults (over 16 years of age) and examined a range of factors relating to lifestyle and health. The study showed that those in the lower social classes tended to participate in smaller amounts of total physical activity (i.e. leisure time plus occupational activity). The study also showed that when housing tenure was used as the social indicator, 28% of men and 23% of women living in council accommodation reported having a sedentary lifestyle. This equated to 15% of males and 14% of females in owner occupied homes and 14% of males and 19% of females in privately rented homes.

The Ayrshire and Arran Adult Health and Lifestyle Survey (1998b) draws similar conclusions. It found a close association between physical activity and socio-economic group with those in the higher socio-economic groups reporting more physical activity (leisure time plus occupational) than those in lower groups. In addition, perceived levels of fitness also varied according to socio-economic group with the percentage of those perceiving themselves to be unfit increasing as socio-economic status decreased. In contrast, those perceiving themselves to be fit decreased as socio-economic status decreased.

The Scottish Health Survey (1997) reports opposite findings. The survey based social class on the informant's own social class rather than that of the chief income earner (as activity at work can contribute to an informant's overall activity level) and coded respondents as 1 for professional occupations, 2 for managerial and technical occupations, 3 for skilled occupations (subdivided into manual [M] and non-manual [NM]), 4 for partly skilled occupations and 5 for unskilled occupations. Results showed that among men, those in NM social classes (in this case, NM social class referred to classifications 1, 2 and 3 [NM]), were least likely to achieve activity levels 3-5 (40% in social classes 1 and 2 and 38% in social class 3NM compared with 47% in social classes 3M and 51% in social classes 4 and 5). A different pattern was evident for women with those in social class 3NM least likely to reach activity level 3-5 and those in the remaining social classes showing similar percentages (42% in social classes 1 and 2 and 30% in social class 3NM compared with 41% in social classes 3M and 38% in social classes 4 and 5).

The reasons why the surveys appear to offer conflicting findings is unclear. It is possible that different classifications for physical activity type, frequency, intensity and duration and social class may cause variations between surveys (Scottish Health Survey, 1997). It is also possible that different populations caused variations (England was compared with Scotland). Whatever the reasons, the surveys highlight the difficulty in accurately measuring "free living" physical activity and stress the need for standardised, valid assessment techniques to be used in future national surveys. This will not only allow for consistent monitoring of the nation's physical activity but will also allow for an accurate comparison between nations.

As discussed, whether there is a difference between the social classes in the *total* amount of physical activity performed is unclear. What seems more apparent however is that the kind of activity varies according to social class. The Scottish Health Survey (1997) found that in general, those people in lower social classes tended to do more occupational physical activity than those in higher social classes, reflecting their predominantly manual labour orientated occupations (25% of social classes 4 and 5 reported moderate levels or above of occupational physical activity, compared to 21% in 3M, 7% in 3NM and 6% in social classes 1 and 2). In contrast, those in the higher social classes tended to do more sports and exercise (62% for social classes 1 and 2, 65% for 3NM, 52% for 3M, and 48% for social classes 4 and 5). These findings are consistent with national surveys which focus on leisure time physical activity only, such as the Health and Lifestyle Survey (1992), which consistently show that lower social classes tend to be less active in their leisure time. This is perhaps unsurprising. Given that they are more occupationally active, they may feel less inclined to also be active in their leisure time, whereas those in higher social classes who have been inactive through their working day may feel more like being active in their leisure time. Another possible explanation is the cost of exercise. Those in higher social classes have a larger disposable income compared to those in the lower social classes, who may see exercising as an unaffordable "luxury".

These findings suggest that although the higher social classes tend to do less occupational physical activity, they compensate by doing more leisure time activity. This then suggests that all social classes should expect similar physical activity related health benefits (given that total activity is equal to the sum of occupational and leisure time physical activity). This may not be the case however. Those who participate in predominantly leisure time activity presumably choose the kind of activity most suited to them, do it because they enjoy it, choose where and when they do it and get something positive from it. However, occupational physical activity may be seen as a "chore", out-with the direct control of the person. Consequently, leisure time activity could be viewed as a positive experience compared to occupational activity, which may be viewed as a negative experience. This then has health implications. Health, as mentioned earlier, is a holistic state, incorporating both positive and negative health (Downie et al., 1996).

It has also been shown that higher percentages of people who are unemployed or "are looking for work" were classed as sedentary and lower percentages classed as regularly active at moderate intensity level or above compared to their counterparts who were in work (Hoinville, 1995). In addition, it has been shown that lower income populations are less likely to visit their doctor and receive less advice from their doctor on preventative health practices such as physical activity (Billings et al., 1993) and are less likely to utilise services aimed at ill-health prevention (Macintyre, 1994).

Given the findings reported above, and the fact that as discussed earlier in the chapter, low income populations are more likely to exhibit other elevated risk factors (Macintyre, 1994) and suffer higher levels of mental health problems (Health Education for Scotland, 1998), it is perhaps not surprising that low-income populations are more likely than other populations to have chronic diseases related to sedentary lifestyles (U.S. Department of Health and Human Services, 1990). It is clear that increasing physical activity in these populations can have a significant effect on health, and specifically quality of life (Taylor et al., 1998). It is therefore crucial that physical activity interventions target this population (Marcus, Owen, Forsyth, Cavill, and Fridinger, 1998).

Behaviour Change: Theory and Practice

The previous sections have shown that physical activity can both protect against and help reduce ill-health but, despite this, Scotland still remains on the whole, inactive. This undoubtedly is a contributory factor in Scotland's unenviable position as having some of the worst health statistics in the western world. It is of major public health importance therefore to change the nation's physical activity behaviour.

Behaviour Change Theory

In order to change behaviour, both the individual and the individual's environment need to be considered (Green and Raeburn, 1990). Many social-cognitive models of behaviour change have been proposed which attempt to take account of the person and various social factors. Examples of these include the health belief model (Becker and Maiman, 1975), the protection motivation theory (Rogers, 1975) the theory of reasoned action (Fishbein and Ajzen, 1975) and the theory of interpersonal behaviour (Triandis, 1977). These postulate that health related behaviours (such as physical activity) can either be understood in relation to their potential to protect against disease or to improve health (health belief model and the protection motivation theory), or by analysing factors such as expectations of self efficacy, attitudes and intention toward exercising, perceived barriers and past behaviour, analysing them in terms of their social dimensions (theory of reasoned action and theory of interpersonal behaviour). For example, Smith and Biddle (1999) used 291 participants in 3 separate studies to test the theories of Reasoned Action and Planned Behaviour. The first study showed that with 96 members of a health club, the structure of the Theory of Reasoned Action (TRA) was supported although the prediction of intention and behaviour (number of visits per week 4 months post test) was weak. In an extension to the first study, the second study used 155 district council employees to test the Theory of Planned Behaviour (TPB - similar to TRA but also including a "percieved behavioural control" component). Using a self report questionnaire, the study showed that the attitude and percieved behavioural control components of the TPB were useful for the prediction of intention and behaviour. Predicting sedentary behaviour from the model was less clear however and authors recommend further testing. In the final study, 40 sedentary adults were administered a 90 minute intervention each week for 10 weeks. Results showed that intentions to be active were associated with the planned behaviour variables.

Despite their prevalence, a number of question marks have emerged over the usefulness of social-cognitive theories for the understanding of exercise behaviour due mainly to methodological reasons (e.g. lack of respect for the theoretical assumptions underlying a given theory and problems in the operational definition of variables) (Godin, 1994). In addition, it has been suggested that these models fail to draw fully on relevant social theory (Bunton, 1991).

Many theories, such as the subjected utility theory (Edwards, 1961) and the conflict theory (Janis and Mann, 1977) also fall under the umbrella of decision theory. Decisional balance is based on a theoretical model of decision making, involving a comparison of the perceived benefits and costs of the given behaviour (Marcus, Simkin, Rossi, and Pinto, 1996). Studies have shown that use of a decisional balance sheet (designed to help individuals systematically consider the pros and cons associated with each course of action) can increase exercise-programme attendance (Wankel, Yardley and Graham, 1985).

The Transtheoretical Model of Behaviour Change

The previous chapter introduced the transtheoretical model (TTM) of behaviour change. Chapter one also outlined that the TTM was chosen for use in this thesis because it allowed for an easy classification of participants into activity groups (i.e. regularly active and not regularly active). It was also chosen because it can offer an understanding of the processes people use when changing their physical activity behaviour. In addition, as the next section will show, although the stages aspect of the TTM has been studied extensively and successfully applied to exercise, the processes construct has been less well studied, particularly in longitudinal studies with British populations. The next section comprehensively reviews TTM research and relates this to physical activity where possible.

The TTM developed from a comparative analysis of leading theories of psychotherapy and behaviour change. As Prochaska and Velicer (1997b) state, "the goal was a systematic integration of a field that had fragmented into more than 300 theories of psychotherapy" (p.38). From this review, 10 distinct strategies or "processes" (Prochaska, 1979) were identified that people used when successfully modifying a problem behaviour. In 1982, Prochaska and DiClemente conducted an empirical analysis which compared self changers to smokers in professional treatment. They assessed how frequently each group used the 10 processes of change and found that the self changers were progressing through a series of "stages" (Prochaska and DiClemente, 1983). Initially it was thought that progress through the stages was linear (Prochaska, 1989), but more recently a spiral pattern of change has been reported (Prochaska, DiClemente, and Norcross, 1992), recognising that people may relapse on several occasions whilst trying to change behaviour. Some people it appears may never achieve a permanent change in behaviour, continually cycling through behaviour change and relapse.

The TTM has evolved to encompass four core constructs: the stages of change, the processes of change, decisional balance and self-efficacy. The majority of early work with the TTM centred around negative behaviours such as smoking. However, it has been suggested that theoretical models such as the TTM can also be applied to positive behaviours such as physical activity adoption (Prochaska and Marcus, 1994). It is important that dynamic models such as the TTM are applied to physical activity as it is a dynamic behaviour, involving both adoption and maintenance (Marcus, Rossi, Selby, Niaura, and Abrams, 1992b). In addition, researchers such as Sonstroem (1988), have recommended that process models such as the TTM be applied to exercise behaviour. The following sections outline the four core constructs of the TTM and apply them, where possible, to physical activity behaviour.

Physical Activity and the Transtheoretical Model

Stages of change is the central organising construct of the TTM (Prochaska and Velicer, 1997a) and is important because it represents the temporal dimension in which change unfolds. Such constructs as self-efficacy and decisional balance lack a temporal dimension or a sense of directionality. The stages of change, unlike many previous behaviour change theories, construes change as a process involving progress (and regression) through a series of stages (Prochaska and Velicer, 1997a). These stages have been applied in the field of physical activity (Marcus et al., 1992b) to form the "stages of exercise behaviour change".

In the precontemplation stage, sedentary people have no intention of becoming more active in the next six months (six months because this is about as far in the future as people anticipate making a behaviour change – Prochaska and Marcus, 1994). Precontemplators evaluate the pros of inactivity as greater than the cons and consequently, precontemplation is a very stable stage (up to two years in smokers) (Velicer, DiClemente, Prochaska, and Brandenburg, 1985).

In the contemplation stage of change, like the precontemplation stage, individuals are still sedentary but unlike precontemplators, they intend to become more active in the next six months. Contemplators see the pros and cons of inactivity as about equal, leading to ambivalence about changing (Prochaska and Velicer, 1997b). Consequently, despite the intention to change, contemplation is also a stable stage.

The preparation stage signifies that the person is intending to become more active in the very near future, usually the next month. They typically make plans or prepare (hence preparation) for this (such as joining a gym or buying appropriate clothing) and in some cases may even have begun to exercise more, hence this stage has both intentional and behavioural criteria. Preparers rate the cons of inactivity as greater than the pros. In comparison to precontemplation and contemplation, preparation is an unstable stage with a greater likelihood of physical activity adoption in the next six months. However, there is also a possibility of regression back into precontemplation or contemplation.

Action is the "busiest" stage of change. Here, the individual has made an overt behaviour change in the past six months, in line with recognised criteria associated with that behaviour. For example, in relation to physical activity, the person may have met the current physical activity recommendations (ACSM, 1998a). If they had not met these recommendations, but increased their activity, they would still be classed as preparers. Obviously, in this stage, people rate the pros of activity as greater than the cons. Action is the least stable stage and is also when people are at most risk from relapse (Prochaska and Marcus, 1994).

The maintenance stage occurs when the individual has met the criterion behaviour (become regularly physical active) for longer than six months. Maintenance is a period of continual change, with the individual working to prevent relapse. In comparison to the action stage, maintenance is stable, but there is still risk of relapse.

Prochaska and DiClemente (1983) refer to the final stage as termination. This stage is very stable, with no temptation to return to the problem behaviour. For smokers, it is estimated that they remain in the maintenance stage for approximately five years before becoming terminators (Prochaska and Marcus, 1994). However, with physical activity, there is a question mark over whether individuals can ever reach termination or continually have to work to maintain regular exercise (Prochaska and Marcus). For this reason, in relation to physical activity, this stage is often ignored.

As with negative behaviours, progress through the stages is not always linear but cyclic as many individuals may relapse and need repeated attempts to become regularly active (Marcus et al., 1992b).

The relationship between the stages of exercise behaviour change and self-reported physical activity will be reviewed in more detail in a following section but research has shown that self-report questionnaires can distinguish between the stages of exercise behaviour change (Cardinal, 1993, Wyse, Mercer, Ashford, Buxton and Gleeson, 1995, Burn, Naylor and Page, 1999). Cardinal also showed that predicted cardiorespiratory fitness could distinguish between the stages of exercise behaviour change. These results demonstrate the concurrent validity of the stages construct of the TTM applied to physical activity.

The processes of change are the covert and overt strategies people use when moving through the stages of change over time. In this respect, the processes represent a set of independent variables that people use when changing their behaviour. As earlier outlined, these processes were derived from a diversity of therapy systems including behavioural, cognitive, existential, experimental, gestalt, humanistic, interpersonal, psychodynamic, and radical therapies (Prochaska and Marcus, 1994). As with the stages of change, Marcus et al. (1992b) showed that the ten processes of change could be generalised to exercise behaviour and that these processes can be organised in a hierarchical manner consisting of two higher order constructs, experiential and behavioural. Table 1. gives the ten processes of change, their definition related to physical activity and sub-groups them into either experiential or behavioural processes.

Table 1.

The ten processes of change related to physical activity

Process of change	Definition related to physical activity
Experiential	
Consciousness Raising	Efforts by the person to gain information and understanding about exercise and it's benefits
Dramatic Relief	Experiences and expressions of feelings about inactivity and the consequences of inactivity
Environmental Reevaluation	Consideration of how inactivity is related to the person's physical and social environment
Self Reevaluation	Reappraisal of how the person feels (emotionally and cognitively) about themselves and physical activity
Social Liberation	Awareness of the person as to the availability of physical activity alternatives (such as active commuting) in society
Behavioural	
Counterconditioning	Substituting alternative behaviour to the sedentary behaviour (i.e. becoming more active)
Helping Relationships	Trusting and using the support of others whilst becoming physically active
Reinforcement Management	The person rewards themselves or gets rewarded by others when exercising
Self Liberation	A commitment to and a belief that the person can continue to exercise
Stimulus Control	Controlling stimulus that can cause physical inactivity such as the removal of labour saving devices or the provision of stimulus to increase activity such as the provision of exercise posters

Note. Adapted from "The Stages and Processes of Exercise Adoption and Maintenance in a Worksite Sample" by B.H. Marcus; J.S. Rossi; V.C. Selby; R.S. Niarua, and D.B. Abrams, 1992, *11*(6), p387. Copyright 1992 by the American Psychological Association.

Use of the processes of change is closely associated to the person's stage of change. The experiential dimension categorises each change process as operating either at the level of the individual's experience or environment (DiClemente and Prochaska, 1982) and the experiential processes have been shown to be more important in understanding and predicting progress in the early stages of change (DiClemente et al., 1991). In contrast, the behavioural dimension categorises change processes according to their primary mode of application: i.e. therapies which rely on verbal interaction or behavioural manipulation (DiClemente and Prochaska). The behavioural processes of change have been shown to be more important in understanding and predicting movement in the latter stages of change (Prochaska and Marcus, 1994).

Marcus and colleagues (1992b) have demonstrated similar relationships between the stages and processes of exercise behaviour change as reported above, but have also identified some important differences. First, with smoking cessation, use of the behavioural processes tended to peak with actioners, with maintainers reporting less use (Prochaska, Velicer, Guadagnoli, and Rossi, 1991). Whilst in the physical activity analysis, actioners and maintainers both used the behavioural processes more than the other three stages (Marcus et al.). The second main difference relates to use of the experiential processes. Smokers in the preparation stage used the experiential processes most (Prochaska et al.). In contrast, for exercise adoption, the actioners were found to use the experiential processes more than the other four stages (Marcus et al.). The reason for this difference in the two behaviours use of the processes is unknown. A possibility could be that as already mentioned, the TTM was developed from a negative behaviour, smoking, which requires cessation. However, physical activity is a positive behaviour so the change in behaviour from being sedentary to being regularly active requires acquisition. Marcus et al. however state that more research is required before this possibility can be substantiated.

One limitation of the Marcus et al. (1992b) study was that it was cross-sectional. This means that changes in a person's use of the processes when progression or regression through the stages is made cannot be established, it can only be surmised. In 1996, Marcus, King, Clark, Pinto, and Bock conducted a longitudinal study with 314 male and female employees of two worksites. Stage and process of exercise behaviour change were measured at baseline and 6 month follow up. No interventions were administered as the researchers wished to examine any changes in process use with "natural" shifts in stage of exercise behaviour change. At 6 months post test, subjects were placed into one of four groups: stable sedentary (baseline precontemplators and contemplators remaining in that stage at 6 months post test) stable active (baseline preparers, actioners or maintainers remaining in that stage at 6 months post test, adopters (baseline precontemplators or contemplators progressing at least one stage) and relapsers (baseline preparers, actioners or maintainers regressing back into either contemplation or contemplation). Results showed that both stable groups remained unchanged in process use. However, adopters significantly increased their use of all processes of change except social liberation, relapsers significantly decreased their use of all five behavioural processes of change and their use of one of the experiential processes (dramatic relief). Marcus et al. concluded that these results could be used to target specific processes to induce behaviour change. Whilst this may be the case, their results showed nine of the processes significantly improved. This would suggest that all nine of these processes should be targeted, which may prove impractical. Analysis was conducted with one-way repeated measures multivariate analysis with follow up univariate analysis. It may have been more informative to conduct a factor analysis or regression analysis to determine the *most important* processes when people shifted in their stage of exercise behaviour change.

One British longitudinal study utilising a factor analysis was conducted by Woods, Mutrie, and Scott (1999). 1353 university students in either the precontemplator, contemplator or preparer stage of exercise behaviour change participated in the study. The processes of change and stage of change were measured at baseline and 7 months post test. Factor analysis revealed that self liberation and reinforcement management were important in progression from precontemplation, dramatic relief and consciousness raising important in progression from contemplation and reinforcement management and self-reevaluation were found to be important in progression from preparation.

The third core construct of the TTM is decisional balance which relates to the individuals weighing up of the pros and cons of changing their behaviour. Originally, the TTM drew upon the decision making model of Janis and Mann (1977) which involved balancing eight central constructs: instrumental benefits to self and others, instrumental costs to self and others, approval from self and others and disapproval from self and others. These eight constructs were developed into a much simpler two-factor structure, namely the pros and cons or the benefits and costs of specific behaviours (Velicer et al., 1985). The pros and cons appear to be particularly relevant for understanding and predicting movement in the first three stages (DiClemente et al., 1991) but during the action and maintenance stages, these decisional balance measures are far less prominent predictors. As mentioned in the description of the stages of change, pros and cons are viewed as having differing levels of importance according to a person's stage of change. In relation to physical activity, studies have consistently shown that the reasons for being inactive outweighed those for being active in the precontemplation and contemplation stages, were in balance in the preparation stage and reasons for being active outweighed those for being inactive in the action and maintenance stages of exercise behaviour change (Marcus and Owen, 1992). Similar results have been observed in the British population (Naylor, McKenna, Barnes, and Christopher, 1995).

The fourth core construct of the TTM is self-efficacy. Self-efficacy is the situation-specific confidence people have that they can abstain from a problem behaviour (Prochaska and Velicer, 1997b). Applied to physical activity, this may involve a person's confidence that they can overcome barriers to exercise such as time, money and ability for example and adopt a physically active lifestyle. This construct was integrated into the TTM from Bandura's self efficacy theory (1977, 1982). In general, as progression is made through the stages of change, self-efficacy is seen to increase (Prochaska and Marcus, 1994).

In relation to self-efficacy and physical activity, Marcus and Owen (1992) examined the relationship between stage of exercise behaviour change and self-efficacy in a cross-sectional analysis of 1093 US employees and 801 Australian employees. Results showed that self-efficacy reliably differentiated most stages in a manner consistent with the findings of DiClemente, Prochaska, and Gilbertini, (1985). Similarly, Armstrong, Sallis, Hovell, and Hofstetter (1993) found that self-efficacy was not only a significant predictor of future exercise, but it was of equal magnitude to that of baseline stage of change. Similar findings have been found in the British population. Mutrie and Caddell (1994) classified 180 British insurance company employees by stage of exercise behaviour change. Self-efficacy scores were also recorded. Results showed that maintainers had significantly higher self-efficacy scores compared to the other stages and contemplators had significantly lower scores compared to the other stages (precontemplator scores not reported as only two were classified). Preparers and actioners had similar scores. (The self-efficacy construct has been shown to be the strongest correlate and predictor of both present and future exercise behaviour (Sallis et al., 1986, 1989, and Sallis, Hovell, and Hoftstetter, 1992)).

A further construct has also been incorporated within the TTM, that of temptation (Prochaska and Velicer, 1997b). Temptation reflects the individual's desire to engage in a behaviour when in the midst of difficult situations including emotional distress, positive social situations, and cravings (Velicer, DiClemente, Rossi, and Prochaska, 1990). Temptation appears to be inversely related to self-efficacy. As progress is made through the stages, temptation is seen to decrease (Prochaska and Marcus, 1994). The cross over between self-efficacy and temptation occurs around the action stage, explaining the high risk of relapse in this stage. Given that "temptation" is more applicable to negative behaviours such as smoking and alcohol abuse, there has been little work conducted to explore the relationship between physical activity and temptation.

The TTM recognises that different processes are used at different stages. Thus successful change depends upon engaging the right process at the right stage. According to the TTM, tailoring interventions to match a person's stage of change is essential (Marcus and Owen, 1992). In 1992, Marcus et al. (1992a) targeted physical activity contemplators, preparers and actioners with tailored interventions. Results showed that after the six-week intervention, 62% of contemplators had progressed at least one stage of change. Similarly, 61% of preparers progressed into action whilst only 4% regressed into contemplation. In addition, only 10% of actioners relapsed to an earlier stage. Although these results support the idea of stage-matched interventions, the lack of a control group and the fact that a randomly selected experimental group was not employed reduce the validity and generalisibility of these findings.

A similar study employing randomly selected participants and a control group was conducted by Peterson and Aldana (1998). Employees of a large telecommunications company were randomly selected to receive a letter asking them to participate in the study and a baseline questionnaire (including stage of change and physical activity measures). 784 employees returned the baseline measures and were randomly assigned into one of three groups, a control group (receiving no intervention), a stage-based intervention group (receiving two pages of written messages tailored to their stage of change) and a generic intervention group (receiving non-tailored materials based on the Surgeon General's Report, 1996). Six weeks after baseline analysis, participants were sent a follow-up questionnaire. Results showed that the stage matched intervention group significantly increased physical activity after six weeks (13% increase). The generic group also significantly increased, but only by 1%. The control group showed a significant decrease of 8%. Further analysis revealed that participants in the stage-matched group were less likely to regress or remain in the same stage and more likely to progress compared to those in the generic group. A similar finding was evident when the generic group was compared to the control group. Similar findings have been reported by Marcus, Emmons and Simkin-Silverman (1998).

Woods, Mutrie, and Scott (2000) examined the effectiveness of a mail-delivered, self-instructional, stage-matched intervention (for precontemplators, contemplators) in increasing physical activity in 459 British students. Participants were randomly assigned to either an experimental group (receiving the stage-matched interventions) or a control group (receiving general physical activity information) and completed stage and processes of exercise behaviour change questionnaires at baseline, 7 months post-test and 19 months post-test. Results showed that at 7 months post-test significantly more of the intervention group (80%) than the controls (68%) had progressed in their stage of change. Similar results were found when the 19 months post-test data were compared to baseline (31% of intervention group improved compared to 27% of control group).

These results offer strong support for stage matched interventions. Researchers and clinicians at San Diego State University recognised the potential of stage-matched interventions. With support from the Centres for Disease Control and Prevention and the Association of Teachers of Preventive Medicine, they developed project PACE (Physician-Based Assessment and Counseling for Exercise) (Long et al., 1992). Project PACE aims to develop programmes and materials primary care physicians can use when counseling apparently healthy adults about the adoption and maintenance of regular physical activity. The PACE materials include tools for measurement of physical activity, stage of exercise behaviour change and physical activity related risk of cardiac events. Three brief structured counseling protocols are also included, designed to be effective at each stage of readiness to change.

Calfas et al. (1996) have evaluated project PACE in a clinical setting. Seventeen physicians interested in the promotion of physical actvity were recruited to the study. The physicians were divided into either a control or experimental group and matched on medical practice variables. Two hundred and seventy five sedentary patients (defined as engaging in vigorous or moderate intensity physical activity less than three times per week or moderate activities less than 2hr per week) were assigned to the same condition (i.e. control or experimental) as their practitioner. Baseline measures of physical activity and stage of exercise behaviour change were recorded. The control patients received a non-related counseling session (to control for the effects of contact with the researchers), the experimental group received a stage-matched intervention. Six weeks post test, baseline measures were repeated and results showed significant intervention effects for walking (+37 min/wk for intervention group, +7 min/wk for control group) and PACE assessment score (11-item assessment to determine current interest in and level of activity). In addition, 52% of the intervention group moved from contemplation to action compared to only 12% of the control group. Although this study was not randomised (the researchers wished to only recruit physicians interested in physical activity promotion) and was of short duration (6 weeks), the results offer evidence as to the success of the PACE project and stage-matched interventions.

Project PACE is an example of how primary care has embraced the TTM. Primary health care providers have been identified as a significant resource for the promotion of regular physical activity (Pender, Sallis, Long, and Calfas, 1994). In 1993, the Health Education Authority commissioned research into the extent of primary health care promotion of physical activity in England. Biddle, Fox and Edmunds, (1994) located 121 existing "GP referral schemes" (typically, a general practitioner "refers" potential beneficiaries of regular exercise to an exercise professional who "prescribes" an exercise programme) and found a further 52 were planned. Recently, the number of similar schemes in the UK has burgeoned (Clarke and Eves, 1997). Stage-matched interventions are now becoming an integral part of many GP referral schemes. For example, one such scheme in Glasgow (Greater Glasgow Health Board, 1998) offers precontemplators advice on physical activity and contemplators and preparers exercise counseling sessions and appropriate exercise prescriptions. Many other local health authorities have also incorporated the TTM (most commonly the stages construct) into their health promotion programmes and the Health Education Authority also recognise the value of incorporating the TTM into physical activity promotion. In 1996 (1996b), they released guidance notes on the promotion of physical activity aimed at the primary health care sector. These guidance notes explain how the TTM can be used to aid the adoption and maintenance of physical activity with the general public. Laitakari (1998) also believes the TTM has a prominent role to play in health promotion and health education, offering "conceptual and pragmatic benefits" (p.37).

Despite the evidence as to the effectiveness of the TTM in understanding and predicting behaviour change, it has recently come under criticism, most notably from Bandura (1997). These criticisms have been addressed by Prochaska and Velicer (1997c) who argue that Bandura has misinterpreted and misapplied the TTM. Initially, Bandura argues that human behaviour is too multifaceted to be categorised into a few discrete stages. Prochaska and Velicer refute this, claiming that Bandura has made the common mistake of analysing the TTM only in terms of stages of change. As Prochaska and Velicer point out, stage of change is not a theory in itself, it is a variable. Only when all the core constructs of the TTM are taken together, can the complexities of human behaviour be understood.

Bandura (1997) also argues that the TTM is not a genuine stage theory as it violates the three cardinal defining properties, qualitative transformations across stages, invariant sequence of change and nonreversibility. This is based on his view that people do not show qualitative change (i.e. personal attributes at one stage are transformed into qualitatively different ones at the next stage of a fixed sequence) when progressing through the stages. Rather in the early stages, they differ only in their intention and in the latter stages, differ only in the regularity or duration of behavioural adoption (i.e the maintenance stage is merely an extension of the action stage). In relation to the second and third "cardinal" stage defining properties, Bandura argues that they are violated because progress through the stages is not necessarily "invariant" (i.e. stages can be missed out as when a contemplator progresses straight into action) and the stages of change allows for relapse to a previous stage, so not being "nonreversible". Prochaska and Velicer (1997c) again dismiss this criticism on the grounds that Bandura has mistakenly assumed that there are universal criteria (i.e. the three "cardinal defining properties") for stage theories. As Prochaska and Velicer comment, many recognised stage theories assume that people can and do return to earlier stages of functioning.

Bandura (1997) also suggests that the stages model is not a "dynamic process model", arguing it is merely descriptive and categorises people into different stages. He argues the TTM offers no explanation of the specific determinants and intervening mechanisms that govern behaviour change. Prochaska and Velicer (1997c) counter this by arguing that the TTM was originally developed from a series of processes people used to alter their behaviour. Analysing these processes, it was discovered that people moved through a number of stages. The stage variable is not a substitute for the process variable therefore. Rather, whilst the stages construct is mainly descriptive (the early stages are also predictive, Cardinal, 1997a), the processes construct offers an insight into the specific determinants and intervening mechanisms that govern behaviour change.

Bandura (1997) also criticises the TTM because many of the theories it is derived from are incompatible. For example, behaviourists and cognitivists views on behaviour change prescription could be considered as contradictory and incompatible, but the TTM incorporates both theories. However, as Prochaska and Velicer (1997c) point out, just because the proponents of these theories believe they are incompatible, this is not necessarily so. Prochaska and Velicer comment "thousands of ordinary people have taught us that apparently incompatible processes from competing theories can be integrated in the change process when applied at appropriate stages" (p.11).

Finally, Bandura (1997) criticises the TTM for creating circularity of explanation and prediction. For example, he suggests that presence in the maintenance stage does not offer any long-term prediction about the person's behaviour. "To ask whether high stage status foretells enduring change is to ask whether good maintainers (maintenance stage) are good maintainers" (Bandura, p. 10). But as Prochaska and Velicer (1997c) comment, the latter stages of the stages construct have never claimed to predict behavioural outcome. Only the first three stages claim to have any predictive power.

With regard to the debate over the effectiveness of the TTM in behaviour change theory, Samuelson (1997) is a supporter of the model. He recognises the criticisms leveled by Bandura (1997) and states that they may be of "intellectual interest" but also states that they provide little practical value. Of some of Bandura's criticisms, Samuelson suggests that they may be more esoteric than pragmatic. In his view, the stages of change concept "is the most important theoretical health promotion development of the decade" (p. 13).

Prochaska and Velicer (1997c) take the view that Bandura's (and others) criticism stems from a simple misunderstanding of the model. Stages of change is one component of the TTM, it is not another name for the TTM. This basic misunderstanding was also evident in a recent paper reviewing the "Stages of Change Model and it's Use in Health Promotion" (Bunton, Baldwin and Flynn, unpublished). Before a word of the paper is read, it appears the model has already been misinterpreted, titling it the "Stages of Change" model and not the TTM. Further analysis of the article confirms this misunderstanding. The paper criticises the TTM (or more specifically, the stages construct) on a number of separate issues, most of which were raised by Bandura (1997) and consequently have already been addressed.

Given the increasing adoption of the TTM by health care providers, Ashworth (1997) also sounds a note of caution. After reviewing the literature in the area, she accepts that stage-matched interventions offer potential but concludes further research is required, and is cautious about the realistic implementation of such programmes. For stage-matched interventions to be successful in the domain of health promotion, she argues, staff who carry out these programmes may need to be intensively trained, and that this level of training may be higher than originally expected (Ashworth). Whilst this may be the case (physicians often cite a lack of perceived effectiveness as a counselor and a lack of training as barriers to physician based counseling - Calfas et al., 1996), this may be true of any new intervention programme and is not necessarily a weakness of stage-matched interventions.

Whitehead (1997) suggests that ethical issues also need to be considered when incorporating stage-matched interventions into current practice. She argues that in some instances, the model is being used in the name of efficiency, with scarce resources being targeted at those who are most likely to change (i.e. contemplators and preparers) at the expense of those who are less likely to change (i.e. precontemplators). She cites Loughlan and Mutrie (1997) as an example of this. Loughlan and Mutrie argued that using the TTM, specific interventions could be targeted at different stages, they themselves focussing on the contemplation and preparation stages. However, Loughlan and Mutrie did not advocate "giving up" on precontemplators as Whitehead suggests. Loughlan and Mutrie were carrying out a scientific research study (not a general public health promotion programme) and were merely trying to protect the internal validity of their study by minimising drop-out (Loughlan and Mutrie). Given this however, Whitehead does make an important point, that those involved in designing and implementing stage-matched interventions should be careful not to concentrate on any one group just because it is easiest to do so. Rather, physical activity promotion in the public health domain should focus on stage-matched interventions that target all sedentary individuals (i.e. precontemplators as well as contemplators and preparers).

The TTM is being applied to an increasing range of behaviours including smoking, drug abuse, weight control, dietary fat reduction, safer sex, condom use, physical activity, sunscreen use, radon testing, delinquency reduction, mammography screening, and physicians practicing preventive medicine (Prochaska and Velicer, 1997a). The specific applications of the TTM to these behaviours is beyond the scope of this review but similarities between all twelve behaviours has been reported (Prochaska et al., 1994). It is the wide applicability of the TTM that is seen as one of its strengths (Ashworth, 1997).

In summary, there are many theories and models that have been proposed to either describe, explain or predict human behaviour. However, no one theory can fully account for health related behaviour change. The TTM systematically integrated over 300 theories of psychotherapy and has identified ten processes of change that people use when successfully progressing through five stages of behaviour change. Use of the processes of change is strongly related to stage of change. Progress through the stages is not linear, it is cyclic, with many possible repeated attempts necessary before the behaviour change is observed and maintained. The TTM contains two further main constructs, self-efficacy (relating to a person's confidence of achieving behaviour change) and decisional balance (relating to a "weighing up" of the pros and cons of the behaviour). The TTM has come under recent criticism but this has been strongly refuted. The TTM is currently being applied to a wide range of behaviours and has been successfully applied to physical activity. Research shows that interventions targeted at specific stages can be more effective than generic interventions in increasing physical activity and progressing participants through the stages. These stage-matched interventions are becoming increasingly popular, especially with health care providers. However, questions have been raised regarding the degree of training required and ethical issues involved when stage-matched interventions are used in the health service setting.

Physical Activity Interventions

This review has shown so far that from a public health point of view, it is important to get people active and keep them active. Although some groups may be more predisposed to physical activity than others, it is clear the population is not active enough to achieve a health benefit. Clearly, physical activity interventions are required.

An intervention is "a set of targeted activities designed to foster increased physical activity in a population" (King et al., 1992, p.227)). There are a diverse range of interventions, some targeting individuals, some targeting large numbers, others are designed for specific populations whist some are generic in nature, some are based on theories of behaviour change, some are not. Previous sections of this review have highlighted the relative success of interventions matched to stage of exercise behaviour change and when geared towards promoting "active living". In support of this, in a recent review of 10 randomised control trials examining physical activity interventions, Hillsdon, Thorogood, Anstiss, and Morris (1995) reported that for increasing and sustaining physical activity levels in sedentary subjects, a number of common features were important, including promotion of home based, unsupervised, informal exercise programmes, aimed at promoting moderate intensity exercise. Similar results were found by Dishman and Buckworth (1996) in a wider meta-analysis of 127 studies. They also found use of behavioural modification important. They concluded that physical activity can be increased by intervention.

Two interventions that are used frequently in Britain to increase physical activity are the fitness assessment and the exercise consultation.

Fitness Assessment

As discussed in chapter one, the use of fitness assessments is now commonplace. Fitness assessments have been described as "a highly effective and practical approach to fitness promotion, creating awareness, providing personal data and stimulating informed action" (Sykes, p. 191). It has also been claimed that fitness assessments "motivate participants by setting individualised, reasonable, attainable fitness goals" (Brenner, 1996, p.26). Similarly, EUROFIT (1983) claim assessing children's fitness can help develop a positive attitude, becoming "better motivated to maintain or improve his or her fitness" (p.9). Heartbeat Wales (1987), a national health promotion campaign, also describe fitness assessments as a "powerful motivational tool".

Despite their popularity, and the claims of their benefits, there is a scarcity of research investigating the effects of a fitness assessment. The claims made by the authors in the previous paragraph are general statements, not backed up by appropriate research. For example, Fox and Biddle (1988) state that "the premise that regular fitness testing stimulates youngsters to increase their exercise levels and improve their fitness....has yet to be tested" (p.47). Indeed, they go on to suggest that in the least fit children (those who most need exercise), fitness testing may reduce motivation. In addition, as mentioned above, Brenner (1996) claims that fitness tests are "motivating". However, she later goes on to say that motivational interviewing skills are an important component of a fitness assessment, making them "accurate and motivating". It is unclear therefore whether it is the actual fitness assessment that is motivating or the motivational interview.

Some of the research that has been conducted with fitness assessments has severe limitations. For example, Tregoning, Gent, and Stephenson (1990) examined the effects of a fitness assessment on 412 manual and non-manual workers. Three months after receiving the assessments, subjects completed a questionnaire, including an activity section. Analysis showed that the manual workers responded significantly better than non-manual workers, and overall, 67% of subjects said they had changed their exercise level. However, no control group was employed in the study, and the activity assessment was an invalidated, self-report question which simply asked if the subjects had adhered to the physical activity recommendations offered at the intervention. Similar, uncontrolled studies have been reported (e.g. Bruce, DeRoven, and Hossack, 1980).

More methodologically sound studies examining the effectiveness of fitness assessments are generally inconclusive. For example, Godin, Desharnais, Jobin, and Cook (1987) found that the Canadian home fitness test and health hazard appraisal (which predicts probability of dying within the next 10 years from potentially preventable causes) had no impact on intentions to be more active or actual exercise behaviour at three months post test. In contrast, Desharnais, Godin, and Jobin (1987) found that the Canadian home fitness test and evalu*life technique (the Canadian version of the health hazard appraisal) were effective in convincing highly susceptible people (i.e. scoring poorly on the tests) that indeed they were exposed to a threatening condition. Intention to exercise remained strong for these subjects after three months compared to subjects who were not highly susceptible (i.e. scored well on the tests). Further studies examining the combined effect of health risk appraisal, fitness assessments and educational interventions generally show small increases in physical activity three months post test which are lost at six months post test (e.g. Reid and Morgan 1979).

A recently conducted study by Loughlan and Mutrie (1997) analysed the effect of either a fitness assessment, exercise consultation or control intervention (giving subjects information on physical activity) on the leisure time physical activity of 179 previously sedentary hospital employees. They found significant increases in physical activity at three months and six months post-test (although activity peaked at three months and started to fall) in all three groups, with no group differences. In other words, merely giving subjects physical activity information appeared to have the same effect on leisure time physical activity as a fitness assessment.

Loughlan and Mutrie's (1997) study did not utilise a computer software programme to conduct the fitness assessment. One study has been reported which analysed the effect of a Fitech fitness assessment. Turner (1991) administered the Fitech fitness assessment to 575 employees of the Paymaster General's Office. Seventy percent (N = 403) of employees were followed up at three months and 7% (N = 43) at twelve months and asked if they were "taking more exercise". Results showed 61% (N = 246) of the three month sample and 79% (N = 34) of the twelve month sample indicated that they had. However, as with much of the fitness assessment research, major limitations existed within the study. No control group was employed, active and inactive participants were grouped together (these two groups may respond differently to a fitness assessment), the measure of activity was an invalidated, vague question, and only small percentages of the sample were followed up (especially at one-year post-test).

It can be concluded that the research supporting fitness assessments is weak, with evaluation hampered by unsubstantiated reports, containing mostly anecdotal accounts and poorly designed studies (Sykes, 1989). Some more methodologically sound studies (such as Loughlan and Mutrie, 1997) report modest success using fitness assessments but generally results are inconclusive.

Despite their popularity, there also appears to be certain problems and limitations associated with fitness assessments. Firstly, the reliability and validity of some of the test procedures commonly used has been questioned. For example, Sykes (1989) points out that for the measurement of body fat, techniques may be variable and lack of operator expertise may be a major limiting factor. Similar concerns were also expressed for blood pressure measurement and the sub-maximal assessment of cardio-respiratory fitness.

A second possible criticism in the current use of fitness assessments is that results are often compared to norm-referenced standards. "Norms" represent how a population group, usually a reference group such as a nationwide sample, performed on a specific test (Safrit, 1995). The scores of any participant can then be compared to these norms to evaluate "performance". However, these norms are often derived from international populations (Sykes, 1989) such as Canada (Canadian Public Health Association, 1977, 1979, Jette, 1976) and America (Siri, 1961, Corbin, Dowell, Lindsay, and Tolson, 1978). As can be seen, they are often also outdated. This then questions whether these norms can be generalised to the current British population. Even if more recent, British populations are used to produce the norm-referenced standard (such as Hussey, 1984, Sykes, 1986), there are still national variations. For example, as discussed earlier in the chapter, the Scottish are the most inactive population in Britain (Scottish Health Survey, 1997) and are thought to have the worst diet (The James Report, 1993). This would suggest they are the least fit and most over weight. If a Scottish person was then compared to norms generated for an English population for example, they may score below the average. However, if compared to the Scottish population, they may score above the average. It may be more informative to compare a person against their local population. Unfortunately however, the availability of British based norms, let alone locally derived norms, is limited hence the reliance on international data.

A further problem relating to norms is that they are frequently used to measure "performance" of each health related fitness component measured by classifying the individual according to a five point scale: poor, below average, average, good, excellent (Sykes, 1989). Even if the norms are derived from an individual's local population, this practice may be ineffective or even de-motivating. For example, a person who habitually does little or no physical activity is not likely to score well on the assessment. It is also possible that the assessment will merely confirm what the person is already likely to know (i.e. they are not as fit as they could be). It could be argued that this would motivate the person to become more active. However, Whitehead and Corbin (1991) have shown that with children, intrinsic motivation after fitness testing declined in those told they were in the lowest 20%. For those in the highest 20%, intrinsic motivation increased. Intrinsic motivation (i.e. the person is motivated by internal factors such as fun and enjoyment), as opposed to extrinsic motivation (i.e. the person is motivated by external factors such as threats or rewards) is recommended for higher levels of exercise intention and sustained involvement (Biddle, 1994). It can be concluded from the Whitehead and Corbin (1991) study that fitness assessments are intrinsically motivating - but only if you do well. Inversely, they are de-motivating if you do not do well, implying their use for sedentary people should be questioned. Fox and Biddle (1988) also suggest that if a child continually scores poorly on an assessment, they may well develop feelings of helplessness and low self-esteem, again leading to poor motivation and even avoidance of all physical activity. The same may be true for adults.

A further potential criticism in the use of fitness assessments is that re-testing is often involved, with a view to providing "reinforcement, motivation and encouragement to continue a more active lifestyle" (Sykes, 1989, p.195). This may only be the case if an improvement is seen. As discussed earlier in the chapter, physical fitness will only be improved by doing *exercise*. It is unlikely that a person adhering to the active living guidelines will show any significant improvement in health related fitness. In some cases, if no improvement is seen and the person has been doing regular physical activity, this may be a de-motivating factor. Similarly, the sensitivity of fitness testing equipment has also been questioned (Loughlan, 1995). Even if the person has been *exercising* regularly, if the equipment is not sensitive enough to pick up small changes in a person's fitness, then this again could be de-motivating. In addition, if some of the assessment procedures lack validity or reliability (as discussed earlier), then re-tests may highlight differences that have not occurred and vice versa. A further problem with re-testing is that fluctuations in adipose tissue alone may account for changes in aerobic fitness scores (Loughlan). Despite these potential problems associated with re-testing, to the authors knowledge, no studies have examined the effects of a fitness assessment re-test.

Another limitation of fitness assessments lies in the fact that researchers (e.g. Brenner, 1996 and Sykes, 1989) encourage screening for medical problems, such as coronary heart disease risk factors prior to an assessment. Whilst this is sensible advice, at best, it may eliminate people who would benefit from physical activity, but at worst, if used incorrectly, Sykes points out that fitness assessments may actually be unsafe. Even for people with no medical problems, fitness assessments have the potential to cause injury if used inappropriately. For example, some strength testing procedures require maximum effort and flexibility assessment normally requires maximum stretch capability. These tests therefore expose the participant to potential risk if not administered correctly (Sykes).

A final potential limiting factor associated with fitness assessments is cost. Conducting a computer software led assessment can be expensive. Including the software, it can be estimated that to supply the equipment necessary to conduct the most basic assessment would cost around £3000.00 (excluding the cost of the computer) (Fitech, 1996). Even conducting an assessment without the computer and associated software requires specialist equipment and may still be expensive.

A potential benefit of a fitness assessment is that it may help to attract participants to a health promotion programme. For example, in the 1984 Liverpool Garden Festival, it was estimated that over 11,000 people were fitness tested (Ashton and Seymor, 1992). Fitness assessments have been used to initially attract people's attention to other health promotion programmes such as smoking and diet (Health Education Authority, 1992). In addition, as opposed to motivating sedentary people to become more active, fitness assessments may be more appropriately targeted at people who are already exercising regularly, enabling performance to be monitored and adjustments to training programmes made (Fulcher, 1994). It has also been suggested that fitness assessments may help people *maintain* activity (Loughlan and Mutrie, 1997) as opposed to *adopting* it, although no studies were found examining this. Fitness assessments may also be particularly useful as an educational tool (Sykes, 1989, Fox and Biddle, 1988, Smith, 1989).

Fitness assessments are also used extensively by the private sector and it has been reported that they can have a dramatic effect on membership. For example, the "Fitness Factory" is a private health club that invested in the "Gymtek" fitness assessment unit. Smith (1989) reports that following the systems introduction, membership increased nearly three-fold. Smith lists four goals for the Fitness Factory testing operation. The first is client / staff interaction, which is designed to encourage the development of a positive relationship between client and staff member. The second is exercise adherence. Smith suggests that conducting a fitness assessment may enhance exercise adherence. The third goal relates to marketing and sales. The Fitness Factory uses their fitness assessment as a marketing and sales tool, emphasising it's health education role as well as the fact that it is novel, "eye catching" (pp.73) and can offer personal, individualised advice. Finally, Smith refers to the physiological goals. As well as using the results of the assessment to screen for medical problems, to design exercise programmes and to chart the success of these programmes, the Fitness Factory uses the fitness assessments as an educational tool. For example, people can learn simple things such as why their heart rate increases during exercise or that body weight tells you little about body composition (Smith). Smith concludes that "the P.E. profession could learn a great detail from the commercial sector on fitness testing" (pp.73). He also recognises however that "more research is needed into the format of fitness test procedures to ensure that they act as motivators rather than as barriers to increased activity levels" (pp.73).

In summary, the use fitness assessments is popular and widespread, with computer software programmes often being employed. Despite their popularity and claims as to their benefits, they have received little scientific examination. Much of the research that has been conducted has severe limitations, and studies with more robust methodologies report modest findings or generally inconclusive findings. Fitness assessments may increase initial motivation levels in some people, increase exercise knowledge, help attract participants to health promotion campaigns, be of use for designing and monitoring exercise programmes and may be of use for sustaining long term exercise maintenance. However, they suffer many inherent problems and limitations, they can also be expensive, require specialised equipment, may be unsuitable for promoting active living, reject some people who would benefit from exercise, be unsafe if administered incorrectly and may actually de-motivate some people. There is a need however for further research in this area (Fox and Biddle 1988, Health Education Authority 1992, Sykes 1989, Smith, 1989), particularly with computer software led assessments.

Exercise Consultation

Exercise consultations are based on the concept of motivational interviewing. Motivational interviewing originated from work with problem drinkers. Miller (1978) found that a control group receiving "some encouragement and advice, and a take home self-help book" showed excellent improvements in their drinking habits after three months, comparable to that for clients who had received a series of 10 intensive therapy sessions. Further studies showed similar results with a series of 18 therapy sessions (e.g. Miller and Taylor, 1980). After analysing their control treatment condition, and several comparable "brief interventions" also reporting "success", Miller identified several key elements. These included systematic feedback, stressed the individual's personal responsibility for change, offered relevant advice and a "menu" of different ways change could be accomplished, counselors expressed empathy with clients and the interventions contained elements that were likely to increase self-efficacy in clients. In 1983, Miller published a concept paper that outlined his notion of motivational interviewing. In the ensuing years, the concepts set out by Miller (1983) were appealing to practitioners and in some countries were becoming almost common place (Miller, 1996).

Motivational interviewing is "a directive, client-centered counseling style for eliciting behaviour change by helping clients to explore and resolve ambivalence" (Rollnick and Miller, 1995, p.325) and represents a blend of cognitive-behavioural principles and motivational theory organised into a systematic intervention approach (Miller and Rollnick, 1991). Guided by Miller's early work, five basic principles of motivational interviewing have been proposed. The first relates to an "expression of empathy". The interviewer seeks to reassure the client that they understand the problem and its associated consequences. The second principle, "develop discrepancy", involves showing to the client that there is a discrepancy between their present behaviour and their desired goal. The third ("avoid argumentation") and fourth ("roll with resistance") principles are connected. They relate to an avoidance of confrontation, such as when the interviewer asserts the need for change while the client avoids it. In addition, resistance is not confronted directly, but deflected so that a continuous dialogue is possible. The final principle is "self-efficacy" and is centred around increasing the client's confidence that they can modify the given behaviour and maintain this change. Whilst motivational interviewing shows promise with addictive behaviours (Saunders, Wilkinson, and Philips, 1995) it has only recently been applied to exercise (Marcus et al., 1996).

In 1986, Long and Haney compared a control group to a group receiving exercise counseling from a trained counselor. All subjects were previously sedentary women and results showed the counseling group were more likely to adopt an active lifestyle compared to the control group.

An evaluation of project PACE (Calfas et al., 1996), as described earlier, showed that compared to controls, intervention patients reported increased walking and a greater increase in readiness to adopt physical activity. The PACE intervention involves a 5-minute physician led counseling session specifically matched to the patient's stage of exercise behaviour change. The intervention is "designed to alter social and psychological factors known to influence physical activity such as increased social support, increased self-efficacy, reduced perceived barriers, and increased awareness of the benefits of activity" (Calfas et al., 1996, p.227). In a similar study reported by Marcus et al (1997), 63 precontemplators, contemplators and preparers attending their local general practitioner were divided into a control group (received usual care) and experimental group (receiving exercise counseling and self-help materials). Physical activity was measured by self-report questionnaire prior to the interventions and six weeks after the interventions. Experimental participants received a follow up intervention four weeks after the initial test. Results showed that both groups increased their physical activity level but those receiving the exercise counselling reported the greatest increases. However, these results have to be viewed with caution given the relatively small numbers in each group (after drop outs, experimental = 19, control = 25) and the fact that the counselling group received two interventions, the control group only one.

Another project described earlier in the review, *Project Active* (Dunn et al., 1999), randomly assigned 235 previously sedentary men and women into either a "lifestyle counseling" intervention or a "structured exercise" intervention. The counseling intervention promoted the current active living guidelines in a way uniquely adapted to the person's lifestyle. The participants received small group counseling on cognitive and behavioural strategies known to be related to physical activity behaviour. They were encouraged to progress in a manner best suited for their level of motivational readiness to change. The structured exercise group received a traditional exercise prescription based on ACSM (1990) guidelines. All participants received 6 months of intensive intervention and 18 months of maintenance intervention. Results showed that the counseling intervention group showed comparable improvements in physical activity, cardiorespiratory fitness, blood pressure and body fat percentage as the structured exercise class.

In a study designed to evaluate the effectiveness of combinations of three methods to promote physical activity, Harland et al. (1999) randomly assigned 523 general practice patients into one of five study groups. These consisted of a control group (receiving feedback on baseline assessment of a range of health related fitness measures and physical advice and information), a brief intervention group (as control but receiving one motivational interview within two weeks post baseline), a brief intervention group with incentives (as before but participants received 30 exercise vouchers) an intensive intervention group (as control but participants received 6 motivational interviews over 12 weeks post baseline) and an intensive intervention group with incentives (as control plus 6 interviews and 30 exercise vouchers). A health visitor trained in motivational interviewing delivered all interventions, each taking approximately 40 minutes. Physical activity was measured at baseline, 12 weeks and 1 year post test. Results showed that more participants in the intervention groups increased physical activity at 12 weeks compared to controls but differences between intervention groups were not significant. All physical activity fell to baseline levels 1 year post test. Although the study demonstrated short term effectiveness of motivational interviewing, the authors concluded that brief interventions promoting physical activity that are used by many schemes in the UK are of questionable effectiveness. However, there were certain limitations evident in the research. First of all, physical activity was assessed using an outdated, invalidated questionnaire (shortened version of Allied Dunbar National Fitness Survey, HEA and The Sports Council, 1992). Second, no reference was made to the current active living guidelines. It may have been informative (and highlighted potential group differences) to have assessed if participants achieved the recommendations after the interventions. Third, the authors concluded that brief interventions were of questionable effectiveness. None of the interventions used, including the control, could be described as "brief". These limitations mean that the conclusions drawn from the research are misleading and that the research is not applicable to the recent developments in active living.

Given the positive findings reported for exercise counseling, the CDC and ACSM (1993) encouraged all health care professionals to incorporate activity counseling into their daily work programmes. The previous paragraphs have highlighted the use of motivational interviewing or exercise counseling in promoting physical activity. However, the type or duration of the interview / counseling session may vary widely. For this reason, after reviewing health related exercise interventions, King et al. (1992) called for "a standardised... counseling protocol for physical activity promotion" (p.228).

In 1995, Loughlan and Mutrie (1995a) released guidelines aimed at health professionals conducting an exercise consultation (they preferred consultation to counseling as they argued it better describes the procedure). These comprehensive guidelines included advice about the skills required for the person delivering the consultation (including communication, non-verbal and listening skills, empathy and exercise / behaviour change knowledge) and for the setting of the consultation (i.e. it should not be conducted in a laboratory or medical setting and should be a welcoming, non-threatening room with "comfortable" chairs and no physical barriers [e.g. tables] between participant and consultant). The consultation involves the following components: identification of stage of exercise behaviour change and previous / present exercise likes and dislikes, a decisional balance procedure examining benefits and barriers to exercise, an examination of the social support open to the participant, a review of local exercise opportunities available, a goal setting exercise (short, medium and long-term) and a relapse prevention component. Loughlan and Mutrie's proposed consultation aims to encourage the patient to adhere to the current active living recommendations. It is based on motivational interviewing and draws on the most successful strategies and theories proposed to change people's physical activity behaviour. As previously discussed, Loughlan and Mutrie (1997) showed increases in physical activity using their exercise consultation over six months in previously sedentary adults. These results were comparable to a group receiving a fitness assessment. However, one difference between the groups was recorded. For participants classified as preparers at baseline, there was a significant positive difference between the exercise consultation and fitness assessment groups between 3 months post test and 6 months post test. There is some evidence therefore that exercise consultations are more effective beyond three months. The exercise consultation also has the advantage of not requiring costly equipment (as the fitness assessment does).

The format outlined by Loughlan and Mutrie (1995a) has also been evaluated in a community setting. Farnham and Mutrie (1998) assessed 305 volunteers to a community health project for baseline measures in well-being, coping assets, coping defecits, leisure time physical activity and weight. All participants received an exercise consultation and were re-assessed for baseline measures six-months post-test. Results showed considerable improvements in all dependent variables and an increase in the usage of a local sports hall. The study did not contain a control group however, so the results have to be viewed with caution.

Further support for the use of counselling as an intervention comes from Ebrahim and Smith (1997). They conducted a systematic review and meta-analysis of randomised controlled trials of multiple risk factor interventions for preventing coronary heart disease and reducing associated risk factors. They concluded that although in general, changes in risk factors were modest and the effects on mortality insignificant, interventions using personal or family counselling and education were more effective at reducing risk factors in high risk hypertensive populations.

As outlined in the previous chapter, the use of motivational interviewing and exercise consultations are becoming widespread.

In summary, as with fitness assessments, the research base for exercise consultations / motivational interviewing for exercise behaviour change is small. However, available evidence reports encouraging findings in the use of these techniques in promoting physical activity. They are also relatively cheap to administer, may be particularly suitable for sedentary individuals and are particularly useful in the promotion of the current active living guidelines.

Dependent Variables

The main aim of this thesis is to assess the long-term effect of two physical activity interventions on the physical activity, stage of exercise behaviour change and processes of exercise behaviour change. These are the studies dependent variables. The following sections examine the most commonly used methods of measuring these variables. The review is used to select the most appropriate dependent variable measure, given the requirements of the thesis.

Physical Activity Measurement

As discussed earlier, physical activity is a complex behaviour with many sub-categories such as leisure and occupational and dimensions such as intensity, duration and frequency. This has meant that its measurement has always proven difficult (Williams, Klesges, Hanson, and Eck, 1989). Despite this, numerous methods of measuring physical activity and it's components have been developed, each with characteristic advantages and disadvantages (Davies, 1992). In general terms, the types of measurement can be split into either objective or subjective measurement. As the name implies, objective measures are undistorted by a person's emotions and biases as they are independent of the person's perceptions. Examples include heart rate monitoring, whole body calorimetry, behavioural observation and time / motion analysis, radioisotope analysis and motion sensor analysis. Objective measures are generally thought to provide instant, highly accurate information on a range of physiological variables (which can then be converted into relevant units such as energy expenditure). The Caltrac motion sensor (Hemokinetics, 1993) has been shown to be a highly reliable (Broskoski, Pivarnik, and Morrow, 1991) and valid (Maliszewski, Freedson, Ebbeling, Crusse-Meyer, and Kastango, 1991) objective measure of energy expenditure.

Similarly, a relatively new technique called doubly labeled water has already been termed the "gold standard" for assessing energy expenditure in real-life situations (Montoye et al., 1996). Doubly labeled water is a method whereby a quantity of water is consumed that contains raised concentrations of hydrogen and oxygen isotopes. From the difference in elimination rates from the body (principally as sweat and urine) of the two isotopes, the bodies production of carbon dioxide can be calculated, hence an estimation of their energy expenditure be determined. The accuracy of the doubly labeled water technique has been estimated to be between 1% to 3% (Montoye et al.).

Despite the advantages of objective measures, the equipment involved is often expensive (for doubly labeled water, this has been estimated at $400 - $600 per subject - Montoye et al., 1996), making the cost of large scale studies prohibitive (Laporte, Montoye, and Casperson, 1985). The use of these measures also often requires considerable researcher interaction, which can create a source of bias and they often need to be conducted in the laboratory for accurate measurement (Williams et al., 1989) making their use in large field studies unrealistic. In addition, objective forms of measurement often cannot distinguish between different types of activity (Loughlan, 1995).

Subjective forms of physical activity measurement are related to the person's perceptions and emotions and include a range of techniques such as diaries / daily logs, interviews, questionnaires, surveys, job classifications and focus groups. In general, subjective methods require less equipment than objective measures, making them cheaper and more practical for use in field studies (Williams et al., 1989). They also require lower subject cooperation and less researcher / subject interaction time and can be activity specific. Subjective methods also have limitations however. Participants may not accurately recall their activities, tending to overestimate duration, frequency or intensity (Montoye et al., 1996). In addition, as the description implies, these techniques are open to the subjective impression of the participant which in turn might reduce reliability. However, as the following sections will show, various recall questionnaires have shown good validity compared to objective measures of physical activity and good test, re-test reliability.

Although the majority of subjective measures have been used to successfully record physical activity, recall questionnaires have been suggested as the most pragmatic for use with free living adult populations (Lamb and Brodie, 1991). As they are recall procedures they cannot affect activity (unless subjects know in advance they will be completing one), are easily copied and as such are particularly practical for use in large population studies (Laporte et al., 1985, Montoye et al., 1996) and in postal surveys. They are also the tools most commonly used to measure physical activity (Washburn and Montoye, 1986).

Physical activity questionnaires are as diverse as physical behaviour. Some measure short-term physical activity (e.g. adapted 7 day recall questionnaire, Loughlan and Mutrie, 1996), some measure long-term (e.g. Tecumseh and Minnesota Questionnaire measures habitual physical over the previous year, Reiff et al., 1967). Some measure intensity of activity (e.g. Stanford questionnaire, Blair et al., 1985), some don't (e.g. Health Insurance Plan of New York Questionnaire, Shapiro, Weinblatt, Frank, Sagar, and Densen, 1963). Some physical activity questionnaires are interview led (e.g. Lipid Research Clinics Questionnaire, Gordon, Witztum, Hunninghake, Gates, and Glueck, 1983) but some are self-administered (e.g. Paffenbarger / Harvard Alumni questionnaire, Paffenbarger, Blair, Lee, and Hyde, 1993b). Questionnaires also differ in the type of activity measured (e.g. Godin questionnaire measures only leisure time physical activity, Godin and Shephard, 1985, whereas Framingham, Massachusetts questionnaire measures both leisure and occupational physical activity, Dannenburg and Wilson, 1989) and in their target populations (e.g. a modified version of the Stanford questionnaire has been used to measure physical activity in older adults, Hellman, Williams, and Thalken, 1996).

In order to be an effective measure of physical activity, questionnaires need to be reliable and valid (Blair et al., 1985). However, there is high degree of variability as to the known validity and reliability of recall questionnaires (Jacobs, Ainsworth, Hartman, and Leon, 1993). This may be either due to the fact that as shown in the previous paragraph, questionnaires have been developed to measure a diversity of physical activity behaviour, different methodologies have been used for the assessment of reliability and validity (Wareham and Rennie, 1998) or some questionnaires are valid and reliable, some are not.

Reliability is assessed by comparing multiple measurements under similar conditions. A wide range of correlation coefficients have been reported for a variety of questionnaires but it seems that the longer the period between test and re-test, the weaker the relationship between the two measures. For example, using the Tecumseh occupational questionnaire, Jacobs et al. (1993)

found a test, re-test correlation coefficient of 0.92 with 1 week between administrations and 0.69 with 12 weeks intervening. Similar results have also been found (Blair et al., 1991).

One methodological problem with reliability research, and a possible explanation for the discrepancy in reliability data referred to, is that two different bouts of physical are being measured (i.e. test and re-test). Although physical activity is *relatively* stable in the short term, it is questionable whether the studies differentiate between the reliability of the questionnaire or the consistency of participants activity levels (Lamb and Brodie, 1990).

In nearly all analyses found, Pearson's product moment or Spearman's rank order correlation coefficients have been used for the assessment of reliability. However, as Bland and Altman (1986) point out, these tests measure the association and not necessarily the agreement between two measures. For example, in a test, re-test situation, if the measurement device becomes uncalebrated by a factor of three for example between test and re-test, the re-test scores will be highly associated with the test scores (they will be exactly three times the test scores) but it is clear the two methods will show no agreement in what they have measured (they will disagree by a factor of 3). Bland and Altman have proposed an alternative technique which uses the standard deviation of the difference between the two methods to produce upper and lower limits of agreement between the two measures. These limits of agreement have not been extensively used but Booth, Owen, Bauman, and Gore (1996) have found around 80% agreement between 14 days of recall.

The validity of a questionnaire is normally determined by comparing its measurement of a bout of physical activity with that of another (or several others) tools. Ideally, both methods should use the same frame of reference (e.g. both measure energy expenditure) (Wareham and Rennie, 1998) but many validity studies have not done this, creating a potential source of variation. For example, Godin, Jobin, and Bouillon (1986) validated their self-report questionnaire against various physiological factors such as body fat, maximum oxygen uptake and muscular endurance. As Jacobs et al. (1993) have pointed out however, measures such as these are almost exclusively related to heavy intensity activity.

Many studies have used other physical activity questionnaires or activity diaries as methods of validation. For example, Pols et al. (1997) used a four-times-repeated 3-day activity diary to evaluate the validity of a questionnaire designed to estimate daily energy expenditure, reporting significant correlation's between the two measures. However, as Wareham and Rennie (1998) point out, this merely says that both measurement techniques are related (again, it cannot be said that they agree because a correlation was used) but this does not necessarily mean either or both are valid. In addition, Wareham and Rennie suggest that comparing one subjective measure to another is likely to produce correlated error. If it is easier to recall leisure time physical activity for example, then both measures will be biased towards this.

Objective validation measures offer an alternative as they are generally considered to be more accurate. Most of the objective measures discussed earlier have been used as questionnaire validation tools but movement sensor devices are probably the most common method (Williams et al., 1989). These devices have been described as having "the greatest potential for providing quantitative data regarding the physical forces associated with behaviour" (Tryon, 1985, p.261) and have been shown to accurately measure energy expenditure in the laboratory (Melanson and Freedson, 1995), require relatively little time and effort on the part of the researcher or subject to operate (Laporte et al., 1985) and are small and unobtrusive so they do not interfere with physical activity participation (Laporte et al.). However, the criticisms leveled at objective measures in general, outlined earlier, also hold for movement sensors. They can be expensive, cannot distinguish between different activities and question marks have been raised over their ability to function in a field study environment (Williams et al.).

This lack of a "gold standard" physical activity measure has proven to be the thorn in the side of validation studies and is another potential source of the variation in recall questionnaire's validity (Wareham and Rennie, 1998). It is like the chicken and egg situation. If you compare your measure against another, what has that measure been validated against? Recently, doubly labeled water has been suggested as a "gold standard" measure of physical activity (Montoye et al., 1996) as it has been shown to be highly accurate (Montoye et al.) and applicable in a field study environment (Delany, Schoellor, Hoyt, Askew, and Sharp, 1989) and has been used successfully in validation studies (e.g. Bratteby, Sandhagen, Fan, and Samuelson, (1997). However, it is still very expensive making its use in large-scale studies unrealistic.

It can be concluded that many physical activity questionnaires exist measuring a diversity of physical activity behaviours, but no one questionnaire can measure all dimensions (Jacobs et al., 1993). For a variety of reasons questionnaires report varying levels of reliability and validity. This does not mean however that recall questionnaires are not an acceptable way of measuring physical activity. It simply means that when a questionnaire is selected, careful consideration of *what* it measures is required and *how* its reliability and validity have been established is required.

Selection of a Suitable Physical Activity Measure for the Current Study

The main study of this thesis requires a self-assessing measurement of recent occupational and leisure time physical activity to be used with a potentially large community based population. Objective measures were therefore considered to be impractical. Of the subjective measures, only short-term recall questionnaires fulfilled the requirements of the study. To assess "recent" physical activity a 7-day recall was considered necessary. Several days of record are needed to provide a representative sample (Blair et al., 1985) and Gretebeck and Montoye (1992) suggested at least five or six days (including both weekdays and weekends) had to be included. Baranowski et al. (1999) have also shown that both weekdays and weekends are important for reliably assessing physical activity. They also showed that approximately one week of analysis was required to assess physical activity with a reliability intraclass correlation of 0.7 and that this level of reliability increased with the number of days assessed. Measurement over two weeks has been proposed (Lamb and Brodie, 1991) but other research has questioned whether humans can accurately recall information over this time period (Baranowski, 1988).

One of the most commonly used 7 day recall questionnaires that measures both occupational and leisure time physical activity is the Stanford 7 day activity recall questionnaire (Blair et al., 1985). Various studies have shown this interview led questionnaire to be a valid measure of physical activity, comparing it against doubly labeled water, monitoring devices, caloric intake, other questionnaires and physical fitness of respondents (Montoye et al., 1996). However, correlation coefficients have been reported for the reliability (and not limits of agreement) and the reliability studies have used two separate bouts of activity (Montoye et al.). In addition, the language in the questionnaire is North American culture bound so it may not be practical for a British population. Loughlan and Mutrie (1996) have adapted the 7-day recall for use with a British population but they were only interested in leisure time physical activity. Although they reported the questionnaire showed good reliability ($r = 0.76$ over two weeks) there is limited evidence available as to the validity of their adapted 7-day recall questionnaire. In addition, both the Stanford and the Loughlan and Mutrie questionnaires required to be administered by interview. The current study requires a self assessed questionnaire.

Given all of the above factors it was therefore decided to use both the Stanford and the Loughlan and Mutrie questionnaires as the base to develop a self-assessing, 7-day recall questionnaire that could measure both occupational and leisure time physical activity. The development of this questionnaire will be reported in the next chapter.

Measurement of Stage of Exercise Behaviour Change

There have been a variety of tools developed to categorise people by their stage of exercise behaviour change. These can be divided into those which use algorithms and those which use a continuous measure. An algorithm is a short measure and categirises people into a discrete stage whereas a continuous measure gathers information on all stages for each individual and classifies them into groups based on their stage profile (Reed, Velicer, Prochaska, Rossi, and Marcus, 1997). Whilst both methods have been shown to successfully classify people by stage of exercise behaviour change, algorithms are the most commonly used (Reed et al.).

Algorithms can contain single or multiple questions and there have been a variety of different response formats (including 5-point Likert scale, true/false and 5-choice scale) used for assessing stage of exercise behaviour change (Reed et al., 1997). The description of physical activity given to respondents also differs, with some measures being more detailed than others. Using three unrelated studies, Reed et al. retrospectively compared 8 algorithms that differed in their description of the stages as well as their definitions of exercise and response formats. They found several differences between the measures, and recommended that algorithms used to classify people by stage of exercise behaviour change should clearly describe the stages of change and use a complete definition of physical activity that includes intensity, duration and frequency. They also suggested that either a 5-choice or a true / false response format is effective in assessing stage.

In 1992 Marcus et al. (1992b) devised a five-point scale for the classification of stage of exercise behaviour change. In a separate study, Marcus, Selby, Niaura, and Rossi (1992c) demonstrated the reliability of the questionnaire reporting the Kappa index of reliability over a 2-week period as being 0.78. Preliminary evidence of the questionnaire's concurrent validity was offered by Marcus and Simkin (1993) who compared it to the 7-day recall physical activity questionnaire (Blair, 1984). Results showed that those subjects classified as actioners and maintainers reported significantly more vigorous intensity physical activity than preparers and significantly more vigorous and moderate intensity physical activity than pre-contemplators and contemplators. Preparers also reported significantly more vigorous and moderate intensity physical activity than contemplators and pre-contemplators. Similar results have been reported for the Godin Leisure Time Physical Activity Questionnaire (Godin and Shephard, 1985) with a British population (Wyse et al, 1995).

This "expected relationship" between physical activity and the stages of exercise behaviour change has also been demonstrated in the British population. Wyse et al. (1995), using 244 young adults, compared the stages of exercise behaviour change scale to 3 self-reported physical activity questionnaires. Results showed that differentiation was possible on the scores of each questionnaire. The relationship expected between activity and stage of exercise behaviour change was observed for moderate and vigorous intensity physical activity.

Concerns have been expressed however over the use of self-report questionnaires to validate the stages of exercise behaviour change measure (Cardinal, 1997b). Many researchers, such as Marcus and Simkin (1994), have proposed it be validated against objective measures. In one such study, Cardinal compared a 5-point stage of exercise behaviour change questionnaire to VO2 max and body mass index and found a significant relationship, with actioners and maintainers having higher VO2 max's and lower body mass indexes. The study also compared the questionnaire to self-efficacy scores and found a similar relationship. Marcus and Owen (1992) have also reported a significant relationship between their measure of stage of exercise behaviour change and instruments measuring self-efficacy and decision making.

Selection of a Suitable Stage of Exercise Behaviour Change Questionnaire for the Current Study

The main study of this thesis examines the effect of two physical activity interventions on physical activity and stage and processes of change. In order to assess the effectiveness of the interventions in increasing "everyday activity", in line with current physical activity "active living" recommendations, the measurement tools used have to be sensitive to this.

Marcus et al. (1992b) originally suggested that regular exercise meant three or more sessions each week for at least 20 minutes per session. This definition does not take account of the current active living recommendations. Loughlan and Mutrie (1995b) have adapted the definition of exercise to include general physical activity such as walking and gardening and Mutrie, Loughlan, Campbell, Marsden, and Carron (1997) have reported 32% - 48% in action and maintenance and 41%-52% in contemplation and preparation stages from various British populations such as NHS staff, students, and diabetic patients. Given that this version fulfills Reed et al. (1997) recommendations, that associated versions have proven to be reliable and valid, that it is designed to be sensitive to the most recent physical activity recommendations, and that it can be used with a British population, Loughlan and Mutrie's adapted stage of exercise behaviour change questionnaire was selected for use in the study.

Measurement of the Processes of Exercise Behaviour Change

As previously mentioned, Marcus et al. (1992b) developed a scale to measure ten processes of exercise behaviour change. Initially, 110 items were generated based on definitions from the TTM. Content validity was established by having three PhD qualified judges classify the items according to the conceptual definitions of the 10 process of change given in table 2.1. 65 items received agreement from the judges and were retained for questionnaire development and analysis. 1172 male and female subjects, recruited as part of a worksite health promotion programme, were instructed to think back over the previous month and rate the frequency of occurrence of each item on a 5-point Likert scale ranging from never (1) to repeatedly (5). Subjects also completed a stage of exercise behaviour change questionnaire.

The subjects were randomly split into two samples, the first was used for questionnaire development, the second for cross-validation and model testing. Initial item analysis was based on an examination of the distributions for the 65 items identified in the content validity study. A series of statistical analyses were conducted to identify poorly functioning items which reduced the number of items to 39, four for each of the ten processes, with the exception of dramatic relief which initially contained three items.

The responses of sample 2 to the 39 items were analysed. Compared to four other hypothetical models representing different conceptualisations of the structure of the processes, a maximum liklihood confirmatory factor analysis showed that a model which was able to discriminate among the 10 processes of change and where the 10 processes were allowed to be correlated, produced the best fit of the data. The results compared well to those of a similar analysis conducted with sample 1, indicating good cross-validation. Further analysis also revealed that compared to a one-hierarchical-factor model, a two hierarchical factors model, representing the experiential and behavioural processes, fitted the data significantly better.

As reported earlier, further analysis was also conducted by examining the relation between the processes and stages of exercise behaviour change and Marcus et al. (1992b) found similar results as those reported for smoking cessation (Prochaska et al., 1991).

As already outlined, the main limitation of the study was that it was based on a cross-sectional sample of subjects using self-report data. Marcus et al. (1992b) state that this was partly due to the large sample and the desire to develop the model in a similar manner to that which proved successful in the area of smoking cessation. Despite this limitation, Marcus et al. concluded that the underlying constructs derived from smoking cessation and other addictive behaviours can be generalised to exercise behaviour.

Compared to the other constructs of the TTM, there is a scarcity of process of change research, and in particular, use of the processes of exercise behaviour change questionnaire. As previously outlined, in two longitudinal studies, Marcus et al. (1996) and Woods et al. (1999) successfully used Marcus et al's (1992b) processes of exercise behaviour change scale to identify significant process changes (in the case of Marcus et al., 1996) and dominant processes use (in the case of Woods et al.) when progress was made from the early stages of exercise behaviour change. Given that Marcus et al's processes of exercise behaviour change questionnaire has been successfully applied, and to a British population, it was selected for use in the current research.

Summary of Problem and Significance of Research

This chapter has highlighted a variety of limitations and gaps within physical activity research. To summarise, there is currently no valid and reliable, British, self-assessing measure of occupational and leisure time physical activity. In addition, despite the popularity of fitness assessments and exercise consultations, few long-term studies have examined their effect on physical activity and most intervention studies have concentrated on raising activity levels in sedentary individuals and tended to ignore the question of how to *keep* people active. Further, few physical activity studies have been conducted with socially deprived populations, despite the fact that these communities often suffer large health inequalities. Finally, few longitudinal studies have identified dominant processes of exercise behaviour change associated with progress through the stages of exercise behaviour change. This thesis attempts to address these areas and clarify the answer to two important public health questions. Firstly, how do we get sedentary people active? Secondly, how do we keep active people active?

Chapter 3

STUDY ONE :
The development of a physical activity questionnaire

Various local groups, Kilmarnock
March 1996 - July 1996

Introduction

The previous chapter highlighted the need for a practical questionnaire that can accurately monitor physical activity in a number of specific situations. As one of the overall aims of the present thesis was to analyse the effect of various physical activity interventions on a person's occupational and leisure time physical activity, it was the aim of this study to develop a comprehensive short-term physical activity recall questionnaire. Another aim of the thesis was to assess the effect of the interventions on a person's stage of exercise behaviour change. Thus a section of the questionnaire included the measurement of a person's stage of exercise behaviour of change.

The specific objectives for the study were to produce a questionnaire that:

(a.) measured the previous week's leisure time and occupational physical activity

(b.) recorded stage of exercise behaviour change

(c.) was relatively quick and easy to complete

(d.) showed good reliability and validity

(e.) was practical for use with large subject numbers

(f.) could be administered by post.

It was decided to name the questionnaire SPAQ, standing for the "Scottish Physical Activity Questionnaire". The starting point for the creation of SPAQ was to select a similar instrument which could be developed to meet the specific aim of the study and it was decided that the seven day recall questionnaire (Loughlan and Mutrie, 1996 - appendix A) used in a similar exercise study be chosen for this purpose. This questionnaire was selected for two main reasons. Firstly, as was highlighted in the previous chapter, the questionnaire was shown to be a reliable instrument for measuring short term, leisure time physical activity (Loughlan and Mutrie). Secondly, the majority of the piloting work for this questionnaire had been done with a similar population to the one that was to be used in the present study thus the wording and layout would not have to be significantly changed to meet the requirements of a specific population.

Once this questionnaire had been selected, three main changes were made to produce an initial draft questionnaire. Firstly, as discussed in the previous chapter, the questionnaire used in the Loughlan and Mutrie (1996) study is only concerned with leisure time physical activity and although it did allow for comparison of leisure time physical activity with the current physical activity recommendations, it is evident that these "active living" guidelines can also be achieved whilst at work (or indeed, an accumulation of leisure time and occupational physical activity could meet the recommendations). It was therefore decided to include occupational physical activity by creating specific sections on both contracted physical activity such as manual labour and volitional physical activity such as walking or stair climbing. In this way, total physical activity could be calculated.

Secondly, the Loughlan and Mutrie (1996) questionnaire was originally developed from Blair et al's (1985) 7-day recall questionnaire and consequently required a structured interview for completion. However, a basic requirement for SPAQ in the present study was that it be self-assessing, allowing it to be used in a postal survey. As Blair et al. state that the need for the Stanford PA questionnaire to be interview led was to "help participants estimate the intensity of various activities" (p.795) it was considered that simplifying the intensity component of the questionnaire would allow it to be used in postal surveys. The Stanford PA questionnaire requires participants to estimate the number of hours in the past week spent in either sleep, moderate, hard and very hard PA. It was decided to simplify this by asking participants only to include activities which are at least moderate intensity or above (they are given a list of activities which may or may not be included). In this respect, although SPAQ was not intended to directly measure energy expenditure, it is fair to assume that physical activity measured by the questionnaire will be related to energy expenditure.

The final change to the questionnaire was the addition of a section for the measurement of the stages of exercise behaviour change by including Loughlan and Mutrie's (1995b) adapted stages of exercise behaviour change questionnaire as described in the previous chapter.

The initial draft was printed onto both sides of an A3 sheet of paper folded in the middle to produce four A4 size separate pages. The first page was concerned with personal details, the middle two with the activity recall section and the back page with the stage of exercise behaviour change section. An additional section for participant feedback was also included at the end of the questionnaire. An example of the first draft SPAQ is given in appendix B. This draft was then piloted with two local community groups and the feedback gained was used to adapt the questionnaire which was then re-piloted with members of the general public and employees of East Ayrshire Council. The methodology and results of these pilot studies are given in appendixes C and D.

After making a few minor adaptations to the draft questionnaire, it was assessed for reliability and concurrent validity. The following two sections of this chapter report the methodology and results of each of these studies respectively. The chapter is concluded with a discussion of the results.

STUDY I

Introduction

Appendixes C and D outline the initial piloting studies for SPAQ. From these studies, a final draft of the questionnaire was produced (appendix E) and it was the aim of this study to analyse it for test re-test reliability.

Methodology

Subjects

A total of 34 people took part in the study. Eighteen participants (mean age = 33, SD = 12 years) were regular members of an aerobics class and 16 participants (mean age = 33, SD = 11.1 years) were members of the public who had volunteered for an exercise promotion project. Two (11%) of the aerobics class were male, 16 (89%) were female. Seven (44%) of the general public group were male, 9 (56%) were female.

Instruments

Physical Activity Questionnaire

SPAQ (appendix E), developed from initial pilot study analysis, was used to assess the previous weeks occupational and leisure time physical activity.

Procedures

A total of 100 SPAQ's were distributed to 2 groups. Two distinct groups were targeted in an effort to assess the reliability of the questionnaire across a broad range of physical activity levels. The first group consisted of 2 well-established aerobics classes. It was part of the main researcher's duties as the Healthy Lifestyle Officer for East Ayrshire Council to provide exercise classes for residents of 2 housing estates, namely Shortlees and Riccarton. Two such aerobics classes had been operating from the local community centre for approximately 2 years, one on a Monday afternoon, the other on a Wednesday evening. Both classes were extremely popular with average attendance regularly above 50 and a large majority of the Monday class also attended the Wednesday class. At the beginning of the Monday class the whole group (N = 54) were issued with the questionnaire (test questionnaire) and the purpose of the study was explained. They were invited to participate in the study but it was made clear that they were in no way obligated to do so. Confidentiality of results was also ensured. They were then told that if they wished to participate in the study they should complete the questionnaire for the previous week's physical activity (i.e. from Sunday back to the previous Monday) at the end of the class and leave completed questionnaires on a table for collection. Completed questionnaires were scored at a later date. On the following Wednesday all volunteers who had completed a questionnaire on the previous Monday and who were in attendance were issued with an identical questionnaire (re-test questionnaire) and verbally instructed to complete it for the previous 7 day's physical activity (i.e. from Tuesday back to the previous Wednesday) at the end of the class. This resulted in both test and re-test questionnaires measuring the same five day's physical activity i.e. the Sunday, Saturday, Friday, Thursday and Wednesday of the previous week. However, the recall results for the Wednesday were not included for reliability analysis as the re-test questionnaire was issued on the Wednesday evening and although specific instruction was given it could not be ensured that participants were noting the previous Wednesday's physical activity as opposed to the current day's physical activity. As a result reliability data was produced for four days.

The second group consisted of members of the public who had volunteered for an exercise promotion project. As an employee of East Ayrshire Council it was part of the main researcher's duties to promote physical activity with the general public. As part of this, all residents of Shortlees and Riccarton were routinely mailed application forms (appendix F) for a health and fitness club called *Ricclees* which was initiated in March, 1995. People were invited to apply for membership of the club and after submitting the application were sent a letter inviting them to attend a local Community Centre for an initial consultation (the details of the consultation are not necessary at this stage). Following the consultation the person was issued with a membership card that entitled them to certain discounts at local leisure facilities. From the inception of *Ricclees* health and fitness club to the beginning of the study approximately 200 residents of Shortlees and Riccarton had applied for membership. Fifty-three of these members were randomly selected for participation in the study. From the alphabetical list of *Ricclees* members, every fourth participant was selected. However, it later appeared that seven of these members had already indicated that they did not wish to continue their *Ricclees* membership and so 46 members were invited to take part in the study by mail. The procedures followed for this group were identical to the aerobics group other than participants were mailed the test SPAQ first class on the Thursday prior to the test day (Monday) with a covering letter offering instructions and similarly mailed the re-test SPAQ first class on the Monday for completion on the following Wednesday, again with a covering letter offering instruction.

Data Analysis

To assess the reliability of SPAQ, Bland and Altman's (1986) "limits of agreement" technique was used. Ninety-five percent confidence intervals were then calculated for these limits.

Results

A total of 29 (54%) test questionnaires were returned from the aerobics class and 24 (52%) from the general public, giving a total of 53 (53%) test questionnaires returned. Of the 29 aerobics class participants, 19 (66%) returned the re-test questionnaire and of the 24 members of the public, 16 (67%) returned the re-test questionnaire. This resulted in a total of 35 (66%) of the re-test questionnaires being returned. One aerobics class re-test questionnaire differed from the original test questionnaire by over 5 hours, this difference being more than 10 times the standard deviation of the mean differences of the remaining 34 participants (26.5 minutes - table 3.) suggesting that the participant had not completed the questionnaire correctly on one or both occasions and as such this participant was excluded from analysis.

Total Physical activity

Descriptive statistics for all participants total physical activity minus the exclusion as mentioned in the previous paragraph are shown in table 2. Results reported are those measured over the four overlapping days and are displayed in minutes.

Table 2.

Total physical activity descriptive statistics for test and re-test questionnaires measured over the four overlapping days displayed in minutes for all participants.

Measurement	Descriptive Statistics (minutes)					
Questionnaire	N	Mean	Median	SD	Min	Max
Test	34	587.5	437.5	464.6	45.0	1950.0
Re-test	34	590.6	425	469.1	55.0	1960.0

Table 2. shows that a broad range of physical activity was reported. A one-sample t-test performed on the differences between test and re-test results revealed that there were no significant differences in physical activity ($t = 0.68$, df, 33, $p = 0.5$). Figure 4. shows the relationship between test and re-test results for the group as a whole measured in minutes over the four overlapping days.

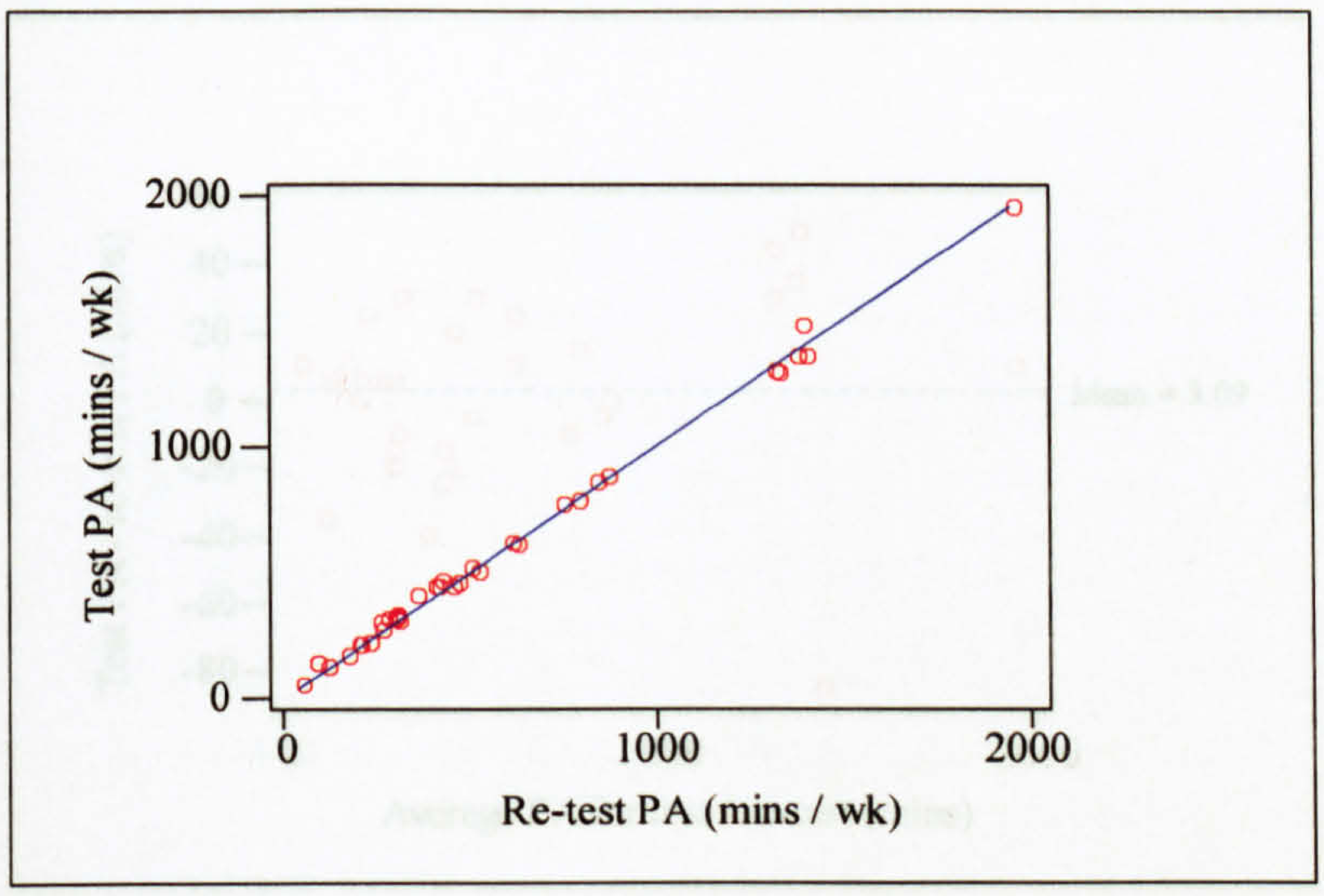


Figure 4. The relationship between test / re-test questionnaires for all participants displayed in minutes as measured over the four overlapping days.

Figure 4. shows that the relationship between test and re-test results appears to be very strong with a correlation coefficient of 0.998 showing a significant relationship (critical value = 0.436, $p < 0.01$; 32 *df*). Traditionally, it would be concluded from this highly significant correlation co-efficient that SPAQ is an extremely reliable instrument. However, Bland and Altman (1986) have queried the use of the product - moment correlation coefficient (r) for determining reliability. They argue that the r-value merely measures the strength of a relation between two variables and not necessarily the agreement between them. According to Bland and Altman, you will only get 100% agreement between two variables if, when plotted against each other, all points lie along the line of equality (i.e. gradient 1.0). This would obviously elicit an r-value of 1.0. However, it is possible to have a perfect r-value of 1.0 when the points do not lie along the line of equality (and therefore not in total agreement) when for example the gradient of the line is 2.0. Bland and Altman have suggested the use of the coefficient of repeatability (R) for assessing reliability.

The first stage in calculating R is to plot the differences between the test and re-test results against the average of the test and re-test results for each participant (figure 5.).

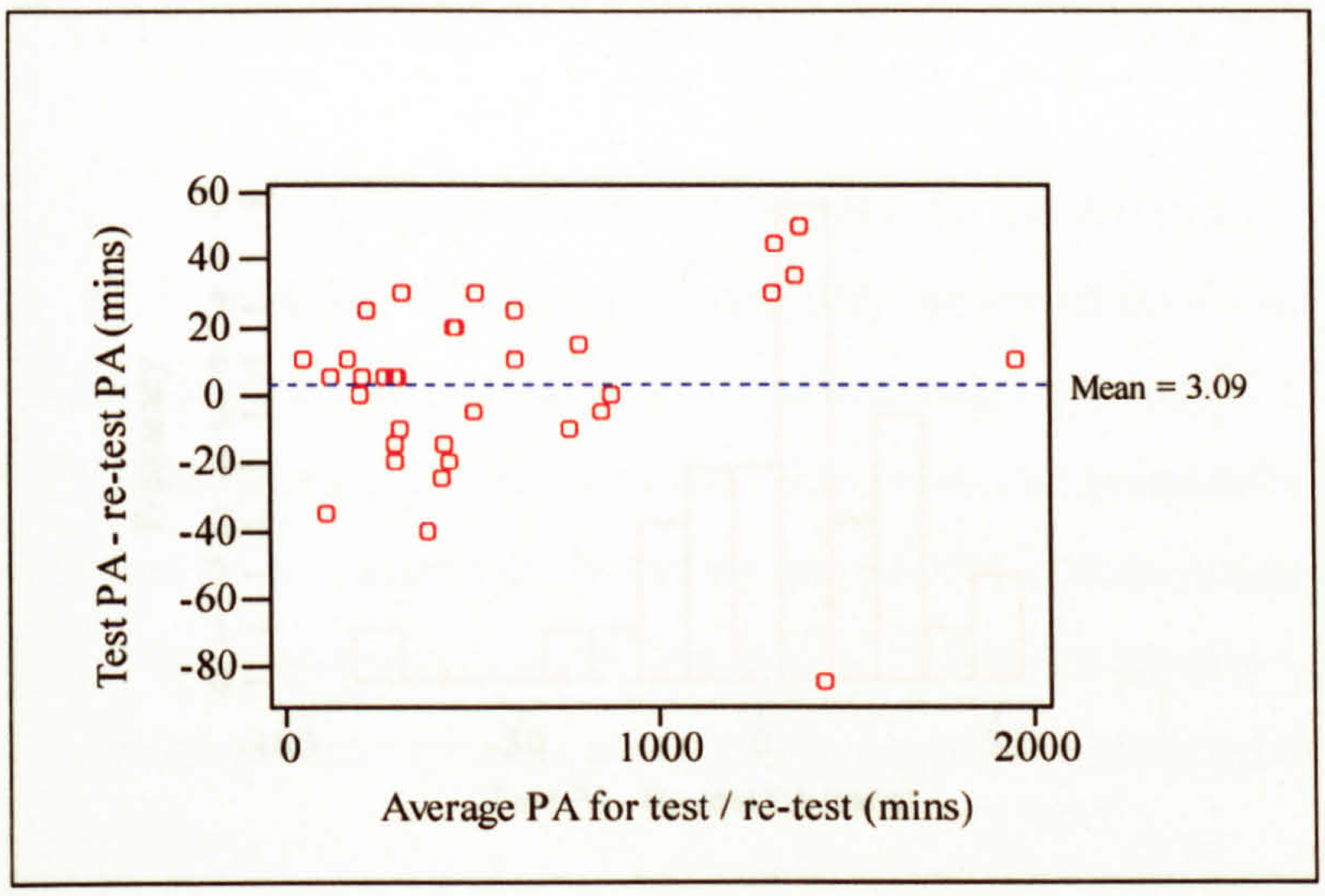


Figure 5. The differences in test and re-test results (minutes) plotted against the average scores for the test and re-test results (minutes)

The next step is to calculate the mean and standard deviation of the differences. Table 3. displays the descriptive statistics for the differences between test and re-test physical activity in minutes for all participants.

Table 3.

Descriptive statistics for the differences between test and re-test physical activity (minutes) for all subjects.

Mean Difference (M.D.) (minutes)	Standard error Of M.D. (minutes)	Standard deviation Of M.D. (minutes)	M.D. + 2SD (minutes)	M.D. - 2SD (minutes)
3.09	4.54	26.5	56.09	-49.91

For the present study, the mean difference is 3.09 minutes and the standard deviation 26.5 minutes. As the same method of measurement was used the mean difference should not be significantly different to zero (if it was, the data could not be used for analysis as clearly it would not be reliable) (Bland and Altman, 1986). The earlier one sample t-test confirmed no significant difference. Under a normal distribution, 95% of the differences should be less than two standard deviations from the mean difference, this being adopted by the British Standards Institution (British Standards Institution, 1979) as the definition of R. Figure 6. plots the distribution of differences for test and re-test questionnaires.

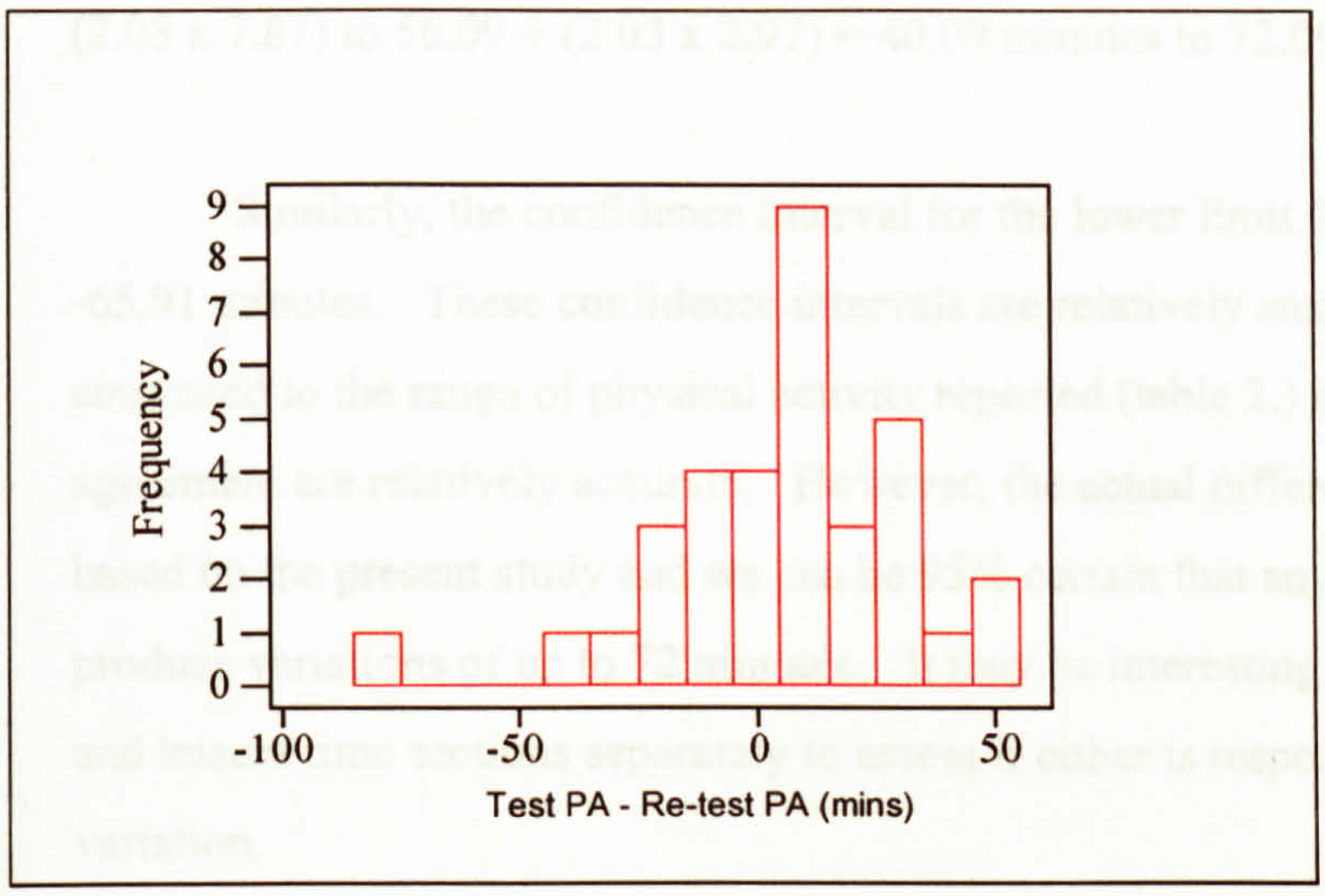


Figure 6. The distribution of differences for test and re-test questionnaires (minutes)

Figure 6. shows that the differences follow a normal distribution (an Anderson – Darling normality test confirmed this; A-squared = 0.436, p = 0.281) and as we have already established are not significantly different from zero, R for the present study is 53 minutes (i.e. twice the standard deviation of the differences). This means that 95% of the differences in the questionnaire from one measurement to the next (under similar conditions) would be between -49.91 minutes (mean difference minus R) and 56.09 minutes (mean difference plus R). These are what Bland and Altman (1986) call the limits of agreement.

However, these limits are only approximations based on the present data and a second sample may well give different results. For this reason Bland and Altman (1986) suggest calculating confidence intervals for each limit to identify how precise our limits are. Confidence intervals for the upper and lower limits of agreement can be calculated from the standard error (SE) of the mean difference (MD) plus or minus two standard deviations (SD). The SE of the MD plus or minus two times the SD is approximately equal to the square root of three times the SD all squared divided by the sample size (N) (Bland and Altman). For the present data, the SE of the MD plus or minus two times the SD is 7.87 ($\sqrt{}$ (3 x 26.5 ^{2} / 34). The next step is to determine the appropriate point of the t distribution with N – 1 degrees of freedom for the 95% confidence level. The confidence interval will be from the observed value (i.e the limit of agreement) minus t times the SE of the observed value to the observed value plus t times the SE of the observed value (Bland and Altman). Thus confidence intervals for the upper limit of agreement for the total physical activity data are as follows;

SE of MD + / - 2SD = 7.87 (i.e. $\sqrt{}$ (3 x 26.5 ^{2} / 34)

t = 2.03 for 33 degrees of freedom

Thus the confidence interval for the upper limit of agreement (56.09 minutes) is 56.09 - (2.03 x 7.87) to 56.09 + (2.03 x 2.97) = 40.09 minutes to 72.09 minutes

Similarly, the confidence interval for the lower limit (-49.91 minutes) is -33.91 minutes to -65.91 minutes. These confidence intervals are relatively small (approximately 30 minutes) compared to the range of physical activity reported (table 2.) suggesting that the limits of agreement are relatively accurate. However, the actual difference may be as much as 56 minutes based on the present study and we can be 95% certain that any subsequent questionnaires may produce variations of up to 72 minutes. It may be interesting to examine SPAQ's occupational and leisure time sections separately to assess if either is responsible for this potentially large variation.

Occupational Physical Activity

The questionnaire has three sections which deal with occupational physical activity ; walking at work, manual labour at work and housework. Table 4. shows the descriptive statistics for the occupational physical activity at test and re-test for all participants.

Table 4.

Descriptive statistics for test and re-test questionnaires for occupational physical activity (minutes).

Measurement	Descriptive Statistics For Occupational PA (minutes)					
Questionnaire	N	Mean	Median	SD	Min	Max
Test	34	306.9	192.5	301.3	45	1475
Re-test	34	313.4	197.5	303.4	55	1460

A one sample t-test confirmed no significant difference between test and re-test questionnaires ($t = 1.38$, $df = 33$, $p = 0.18$). Figure 7. plots the differences between the test and re-test results against the average of the test and re-test results for each participant.

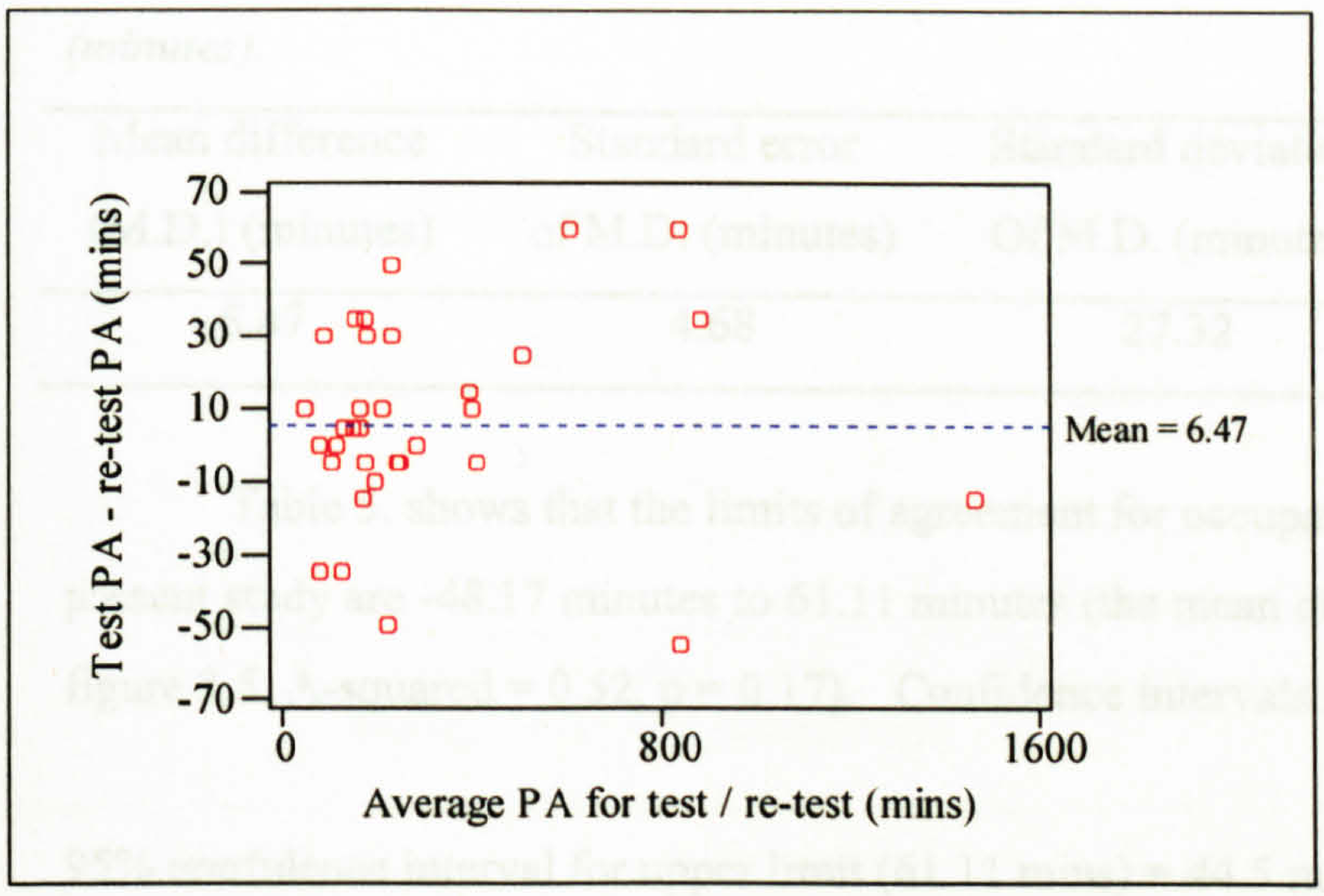


Figure 7. The differences in test and re-test results (minutes) plotted against the average scores for the test and re-test results (minutes) for occupational physical activity

Figure 8. plots the distribution of differences for test and re-test questionnaires (mins / wk)

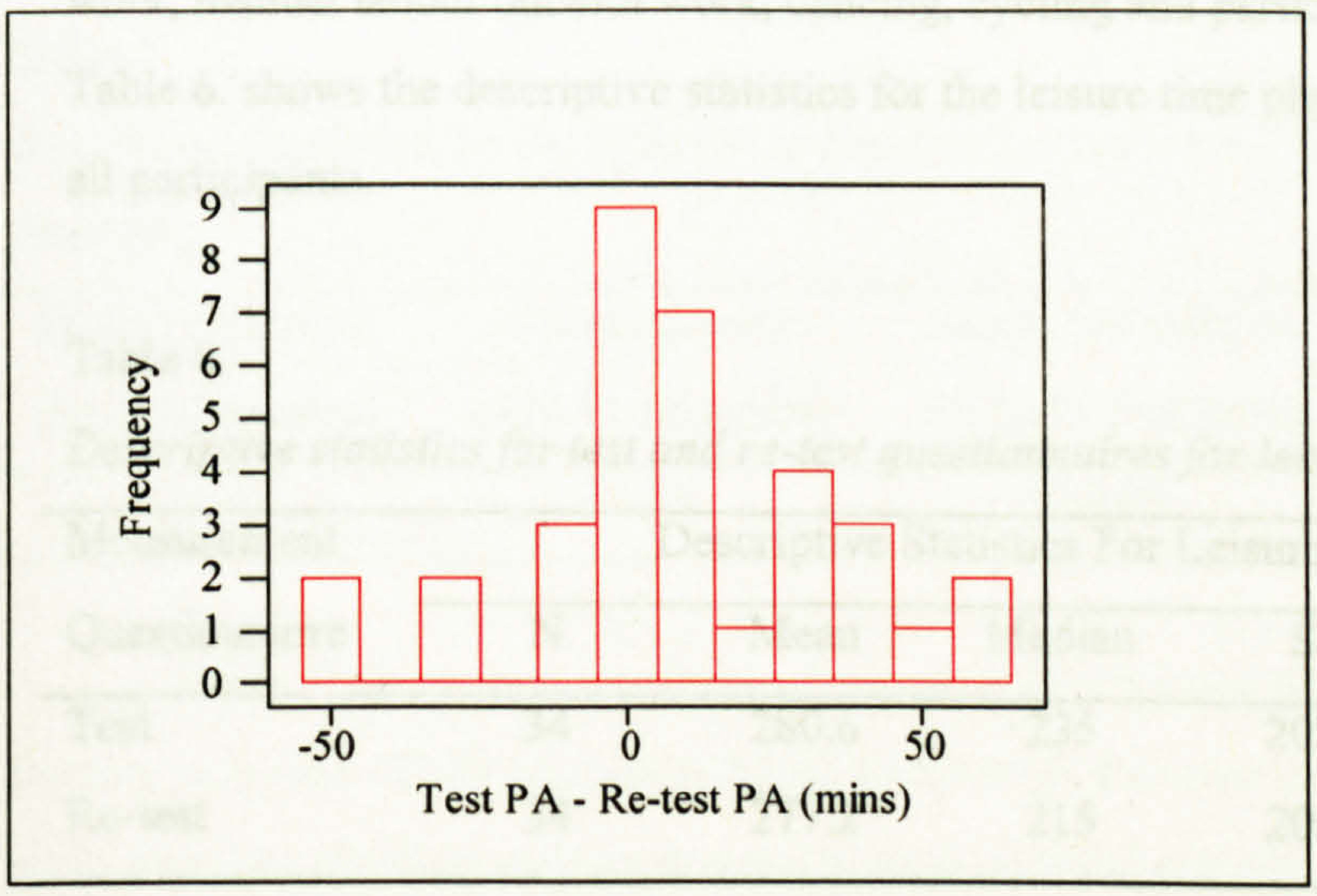


Figure 8. The distribution of differences for test and re-test questionnaires for occupational physical activity (mins / wk)

Table 5. displays the descriptive statistics for the differences between test and re-test occupational physical activity in minutes.

Table 5.

Descriptive statistics for the differences between test and re-test occupational physical activity (minutes).

Mean difference (M.D.) (minutes)	Standard error of M.D. (minutes)	Standard deviation Of M.D. (minutes)	M.D. + 2SD (minutes)	M.D. - 2SD (minutes)
6.47	4.68	27.32	61.11	-48.17

Table 5. shows that the limits of agreement for occupational physical activity based on the present study are -48.17 minutes to 61.11 minutes (the mean differences are normally distributed – figure 3.5, A-squared = 0.52, p = 0.17). Confidence intervals for each limit are as follows:

95% confidence interval for upper limit (61.11 mins) = 44.5 mins to 77.8 mins
95% confidence interval for lower limit (-48.17 mins) = -31.5 mins to -64.8 mins

Leisure Time Physical Activity

SPAQ has five sections which deal with leisure time physical activity ; walking outwith work, manual labour outwith work, dancing, cycling and participating in a sport or leisure activity. Table 6. shows the descriptive statistics for the leisure time physical activity at test and re-test for all participants.

Table 6.

Descriptive statistics for test and re-test questionnaires for leisure time physical activity (minutes).

Measurement	Descriptive Statistics For Leisure Time PA (minutes)					
Questionnaire	N	Mean	Median	SD	Min	Max
Test	34	280.6	235	209.7	0	790
Re-test	34	277.2	215	208.5	0	810

As with total and occupational physical activity, a one sample t-test confirmed no significant difference between test and re-test questionnaires (t = -1.35, df = 33, p = 0.19). Figure 9. plots the differences between the test and re-test results against the average of the test and re-test results for each participant for leisure physical activity.

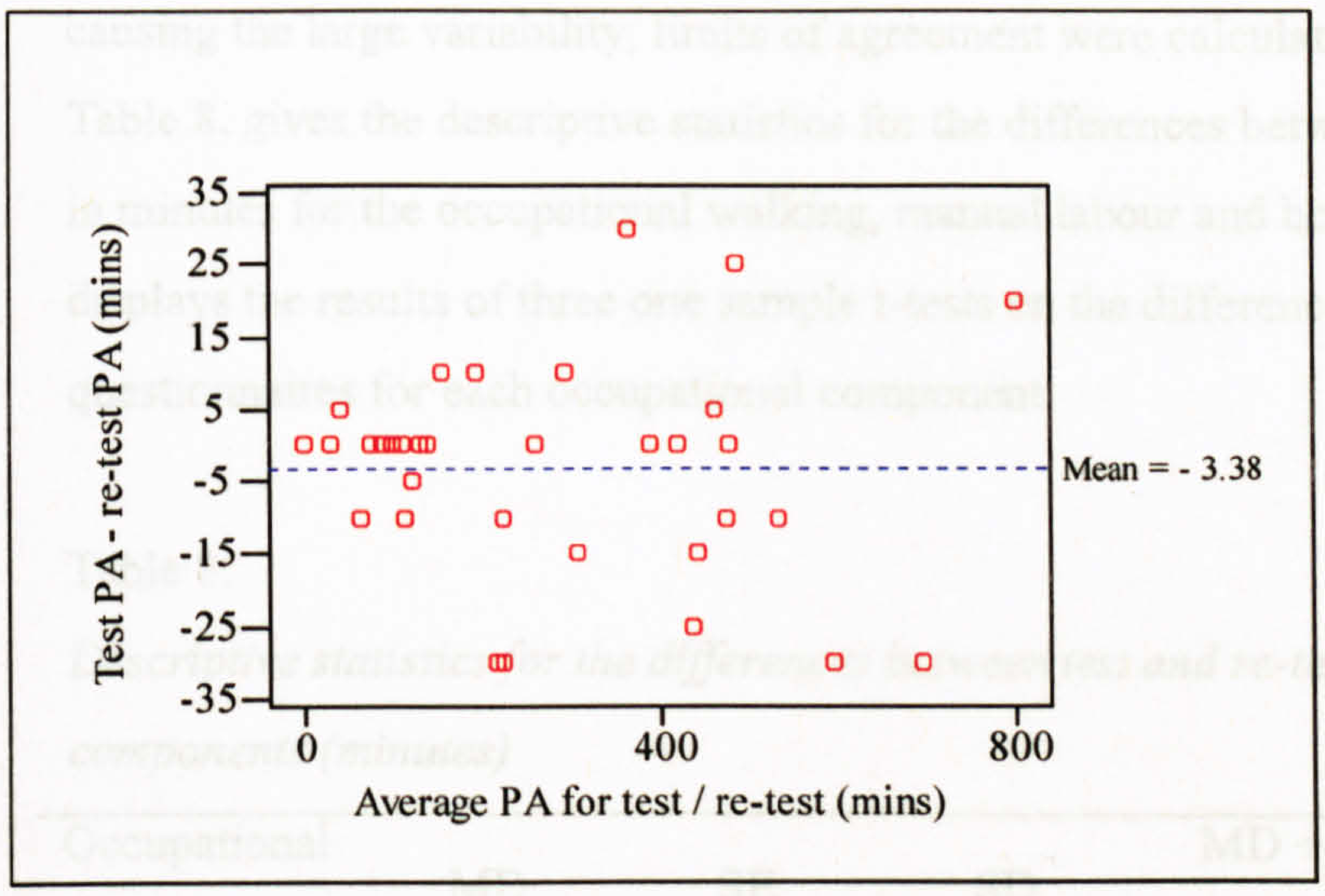


Figure 9. The differences in test and re-test results (minutes) plotted against the average scores for the test and re-test results (minutes) for leisure time physical activity.

Table 7. displays the descriptive statistics for the differences between test and re-test leisure time physical activity in minutes.

Table 7.
Descriptive statistics for the differences between test and re-test leisure time physical activity (minutes).

Mean Difference (M.D.) (minutes)	Standard error of M.D. (minutes)	Standard deviation Of M.D. (minutes)	M.D. + 2SD (minutes)	M.D. – 2SD (minutes)
-3.38	2.51	14.65	25.92	-32.68

Table 7. shows that the limits of agreement for leisure time physical activity based on the present study are -32.68 minutes to 25.92 minutes (in this case it is reasonable to assume normality as leisure time physical activity is equal to total physical activity minus occupational physical activity, both showing normality). Confidence intervals for each limit are as follows;

95% confidence interval for upper limit (25.92 mins) = 17.02 mins to 34.8 mins

95% confidence interval for lower limit (-32.68 mins) = -23.8 mins to -41.58 mins

These results indicate that subsequent questionnaires may over or under estimate leisure time physical activity by only as much as 40 minutes compared to nearly twice that for occupational physical activity. It appears therefore that the questionnaire is more reliable for measuring leisure time physical activity compared to occupational physical activity.

To investigate if any one component of the occupational physical activity section was causing the large variability, limits of agreement were calculated for each separate component. Table 8. gives the descriptive statistics for the differences between test and re-test physical activity in minutes for the occupational walking, manual labour and housework sections. The table also displays the results of three one sample t-tests on the difference between test and re-test questionnaires for each occupational component.

Table 8.

Descriptive statistics for the differences between test and re-test occupational physical activity components (minutes)

Occupational Component	MD	SE	SD	MD + 2SD	MD – 2SD	t	p
Walking	-4.71	3.42	19.92	35.13	-44.55	-1.38	0.18
Man Labour	0.15	1.17	6.8	13.75	-13.45	0.13	0.9
Housework	-2.21	1.73	10.09	17.97	-22.39	-1.27	0.21

Note. MD = Mean difference, SE = standard error of MD, SD = standard deviation of MD

Table 8. again confirms no significant difference between test and re-test questionnaires for any of the occupational physical activity components. It is again reasonable to assume normality for each component as total occupational physical showed good normality. Table 8. also reports the limits of agreement for each component. Confidence intervals for each limit were calculated and are as follows;

<u>Occupational Walking</u>

95% confidence interval for upper limit (35.13 mins) = 23.11 mins to 47.15 mins

95% confidence interval for lower limit (-44.55 mins) = -32.53 mins to –56.57 mins

<u>Occupational Manual Labour</u>

95% confidence interval for upper limit (13.75 mins) = 9.65 mins to 17.85 mins

95% confidence interval for lower limit (-13.45 mins) = -9.35 mins to –17.55 mins

<u>Housework</u>

95% confidence interval for upper limit (17.97 mins) = 11.88 mins to 24.06 mins

95% confidence interval for lower limit (-22.39 mins) = -16.3 mins to –28.48 mins

These results show that occupational walking has by far the largest limits of agreement, with possible variations of up to 57 minutes. This suggests that the large variation in total occupational physical activity was mainly due to the large variation in the occupational walking component.

When studying figures 5, 7 and 9 there appears to be no obvious relation between the difference of test and re-test results and the mean of test and re-test results for any of the sections (i.e. leisure time, occupational or total physical activity) suggesting that SPAQ is no less reliable for large amounts of reported physical activity compared to smaller amounts.

STUDY II

Introduction

This study concerned itself with the validation of SPAQ. As discussed in chapter two, a physical activity questionnaire can be used to assess the concurrent validity the stages of exercise behaviour change. It was the aim of this study to demonstrate the concurrent validity of the questionnaire with the stage of exercise behaviour change model.

Methodology

Subjects

In order to collect data for all the stages of exercise behaviour change a range of study groups were targeted. A total of 94 people participated in the study which included 29 regular members of an aerobics class (mean age = 33, SD = 10.8 years), 44 members of the public who had volunteered for an exercise project (mean age = 35, SD = 12.2 years) and 21 users of a local community centre (mean age = 35 years, SD = 11.8 years). Five (17%) of the aerobics class were male, 24 (83%) were female, 16 (36%) of the general public group were male, 28 (64%) were female and 6 (29%) of the community centre users were male, 15 (71%) were female.

Instruments

Physical Activity / Stage of Exercise Behaviour Change Questionnaire.

SPAQ was used to record participant's previous seven days physical activity and stage of exercise behaviour change.

Procedures

A total of 200 SPAQ's were distributed to 3 study groups. The first group consisted of those 29 participants from the aerobics class who had returned the test questionnaire in study one. The second group consisted of current members of *Ricclees* health and fitness club. As well as the 46 test questionnaires that were mailed to members in study one an additional 50 questionnaires were mailed to existing members in this study. A covering letter was also sent explaining the purpose of the study and the procedure to be followed. The final group consisted of users of a local community / leisure centre called the Hunter Centre in the North West of Kilmarnock. Fifty questionnaires were given to the staff who agreed to leave them in a prominent position in the centre. The staff also agreed to encourage users of the facility to complete and return them. A clearly marked box was placed at the reception for this purpose.

Each questionnaire returned was scored for the previous week's total, occupational and leisure time physical activity (minutes) and stage of exercise behaviour change.

Data Analysis

To determine concurrent validity, a one way analysis of variance was used to determine if any significant differences existed between stages of exercise behaviour change for total, leisure time and occupational physical activity. Prior to conducting the analysis of variance tests, homogeneity of variance was tested for with a Levene's test and normality was tested for with an Anderson Darling test. Where significant effects were found, Bonferroni multiple comparisons were used to identify which stages of exercise behaviour change differed.

Results

A total of 94 (47%) questionnaires were returned. The aerobics class returned 29 questionnaires (54%), the general public returned 44 questionnaires (46%) and the community centre group returned 21 questionnaires (42%).

Total Physical Activity

Descriptive statistics for the total amount of physical activity (mins / wk) for each stage of exercise behaviour change are given in table 9.

Descriptive statistics for total physical activity (mins / wk) for each stage of exercise behaviour change.

	Descriptive Statistics for total physical activity (mins / wk)						
Stage of Change	N	%	Mean	Median	SD	Min	Max
Pre-contemplation	9	10	452	450	248	105	750
Contemplation	15	16	395	320	243	70	800
Preparation	13	14	672	645	307	245	1260
Action	21	22	1016	870	547	360	2540
Maintenance	36	38	1234	917	835	310	3390

Figure 10. gives a box plot for each stage of exercise behaviour change for total physical activity.

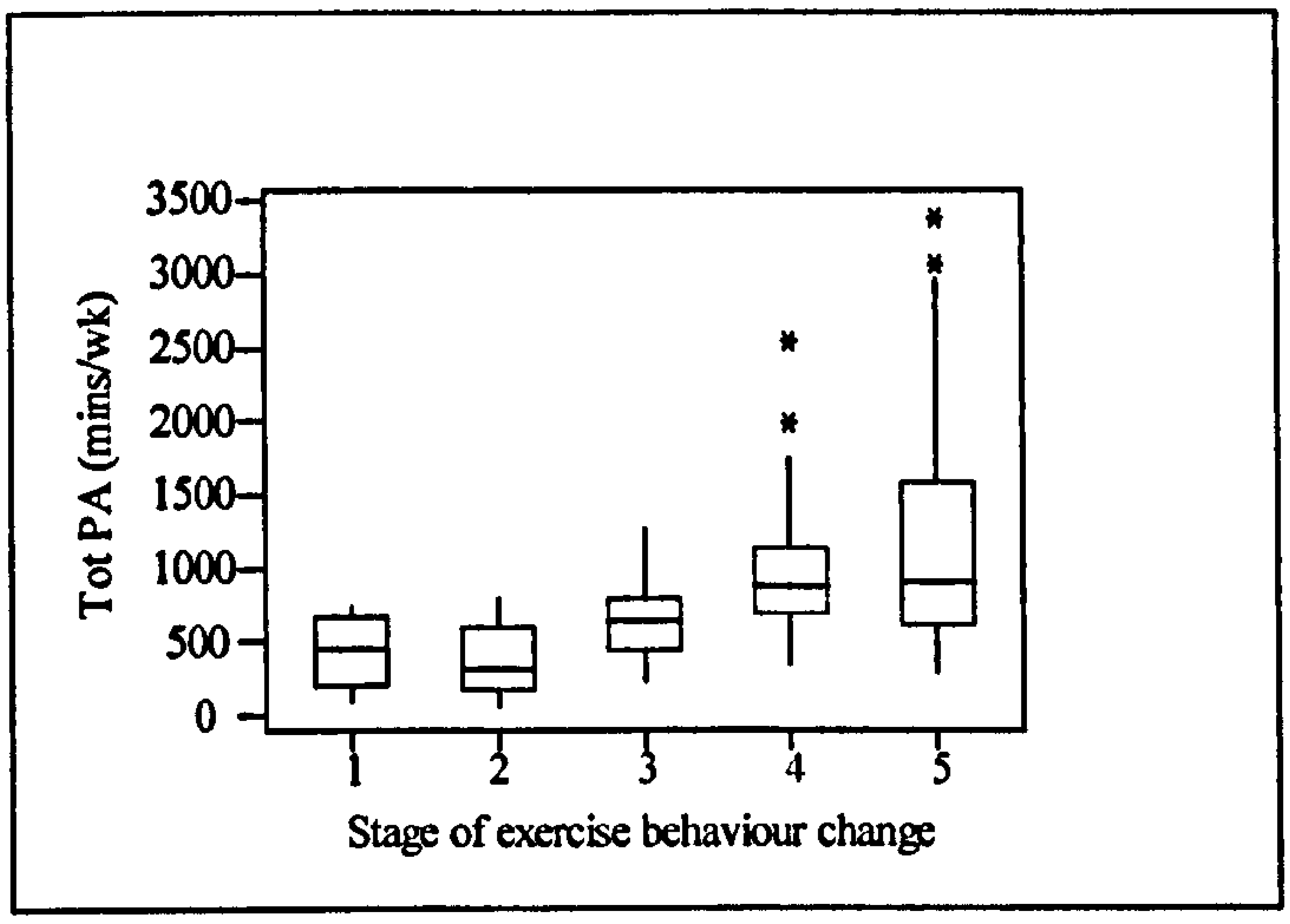


Figure10. Boxplot of total physical activity (mins / wk) for each stage of exercise behaviour change

Note. 1 = precontemplation, 2 = contemplation, 3 = preparation, 4 = action, 5 = maintenance.

Figure 10. shows that total physical activity is higher in the latter stages of exercise behaviour change. Figure 10. also shows however that those in the maintenance stage of exercise behaviour change appear to be reporting a wider range of physical activity. Indeed, a Levene's test for homogeneity of variance showed a significant difference in the variance in physical activity between stages of exercise behaviour change (test statistic = 3.21, $p = 0.017$). There are also several outliers. A series of Anderson Darling normality tests showed that all data in the first 3 stages were normally distributed (precontemplators, $A^2 = 0.3$, $p = 0.51$; contemplators, $A^2 = 0.38$, $p = 0.37$, preparers, $A^2 = 0.62$, $p = 0.085$). However, data for the actioners and maintainers was not ($A^2 = 1.12$, $p < 0.05$ and $A^2 = 2.25$, $p < 0.05$ respectively). It is possible that taking the logarithm of the data could enhance the homeneity of variance and improve the normality of the

actioners and maintainers data. Figure 11 gives boxplots for each stage of exercise behaviour change for the logarithm of total physical activity.

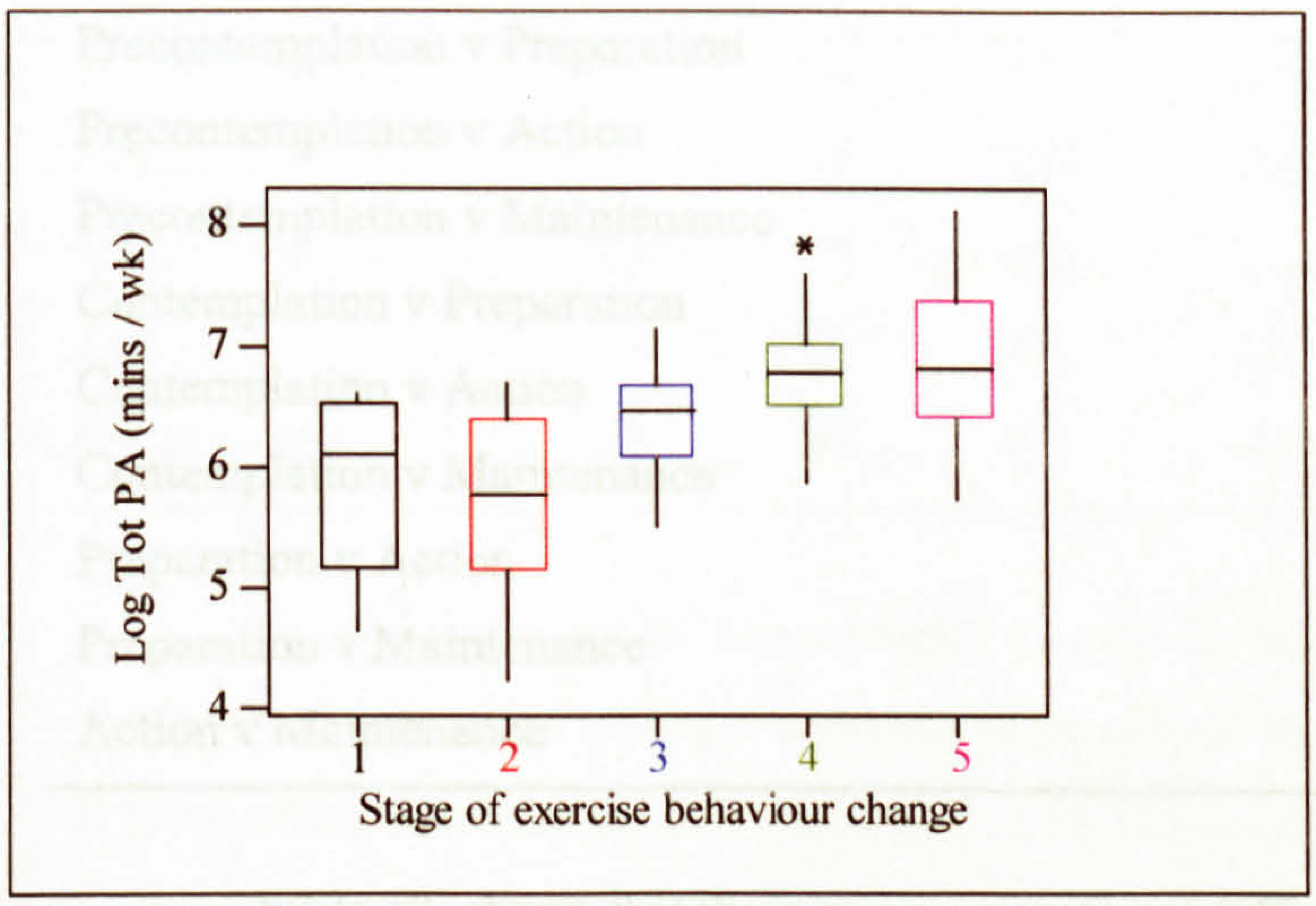


Figure 11. Boxplots for each stage of exercise behaviour change for the logarithm of total physical activity

Note. 1 = precontemplation, 2 = contemplation, 3 = preparation, 4 = action, 5 = maintenance.

Figure 11. shows that taking logarithms has reduced the number of outliers in the action and maintenance stages of exercise behaviour change. Two Anderson Darling normality tests on the log of total physical activity for the actioners and maintainers revealed a normal distribution for both ($A^2 = 0.35$, $p = 0.43$ and $A^2 = 0.53$, $p = 0.17$ respectively). Figure 11. also shows that the variance appears to be more homogenous across the stages of exercise behaviour change. Indeed, a Barttlet's test (the data is now normally distributed) for the homogeneity of variance showed no significant difference in the variance in physical activity between stages of exercise behaviour change (test statistic = 5.11, p = 0.28).

A one way analysis of variance confirmed significant differences between stages of exercise behaviour change for the log of total physical activity ($F = 13.11$, $df = 93$, $p < 0.05$). A series of Bonferroni multiple comparisons were conducted to examine where these significant inter stage differences occurred. Table 10. reports the results of these comparisons.

Table 10.

Bonferroni multiple comparison to determine significant inter stage differences for the log of total physical activity

Stage of exercise behaviour change	95% Confidence Interval
Precontemplation v Contemplation	-0.59, 0.89
Precontemplation v Preparation	-1.23, 0.26
Precontemplation v Action	-1.6, -0.19
Precontemplation v Maintenance	-1.68, -0.36
Contemplation v Preparation	-1.33, 0.013
Contemplation v Action	-1.65, -0.45
Contemplation v Maintenance	-1.71, -0.63
Preparation v Action	-1.02, 0.24
Preparation v Maintenance	-1.08, 0.06
Action v Maintenance	-0.61, 0.37

Table 10. shows that there was no significant difference between precontemplators and contemplators and between actioners and maintainers. However, actioners reported significantly more physical activity than precontemplators and contemplators as did maintainers. Preparers did not differ significantly from any other stage of exercise behaviour change. These results suggest the physical activity recall section of the questionnaire has concurrent validity with the stage of exercise behaviour change model as it demonstrates the relationship expected as described in chapter two.

Due to the differences seen in leisure time and occupational physical activity in study one it was decided to analyse any differences between the two which may have occurred in the present study. Tables 11. and 12. give the descriptive statistics for leisure and occupational physical activity respectively for each stage of exercise behaviour change.

Table 11.

Descriptive statistics for leisure time physical activity (mins / wk) for each stage of exercise behaviour change

Stage of exercise	Descriptive Statistics for leisure physical activity (mins / wk)						
behaviour change	N	%	Mean	Median	SD	Min	Max
Pre-contemplation	9	10	115	130	68	0	210
Contemplation	15	16	88	70	64	0	240
Preparation	13	14	266	270	94	95	460
Action	21	22	529	510	275	130	1140
Maintenance	36	38	589	480	384	130	2010

Table 12.

Descriptive statistics for occupational physical activity (mins / wk) for each stage of exercise behaviour change.

Stage of exercise behaviour change	Descriptive Statistics for occupational physical activity (mins/wk)						
	N	%	Mean	Median	SD	Min	Max
Pre-contemplation	9	10	337	360	224	0	610
Contemplation	15	16	307	250	215	0	730
Preparation	13	14	406	310	313	0	1140
Action	21	22	487	420	392	0	1440
Maintenance	36	38	645	402	661	0	2400

Two Levene's test for homogeneity of variance were conducted for leisure time physical activity (test statistic = 3.67, $p < 0.05$) and occupational physical activity (test statistic = 1.56, $p = 0.19$) showing that only the occupational data had homogeneity of variance. Taking the logarithm of the leisure time physical activity data significantly improved the homogeneity of the data (test statistic = 0.34, $p = 0.85$). For the leisure time physical activity data, a series of Anderson Darling Normality tests confirmed that the data was normally distributed for each stage of exercise behaviour change when taking the logarithms (precontemplators, $A^2 = 0.66$, $p = 0.06$, contemplators, $A^2 = 0.32$, $p = 0.51$, preparers, $A^2 = 0.41$, $p = 0.29$, actioners, $A^2 = 0.35$, $p = 0.43$, maintainers, $A^2 = 0.53$, $p = 0.17$). For the occupational physical activity data, only the action and maintenance stages failed to show normality for the actual data (precontemplators, $A^2 = 0.25$, $p = 0.66$, contemplators, $A^2 = 0.28$, $p = 0.61$, preparers, $A^2 = 0.73$, $p = 0.051$, actioners, $A^2 = 1.27$, $p < 0.05$, maintainers, $A^2 = 3.63$, $p < 0.05$). Taking logarithms in these cases did not improve the normality (actioners, $A^2 = 1.72$, $p < 0.05$, maintainers, $A^2 = 1.12$, $p < 0.05$).

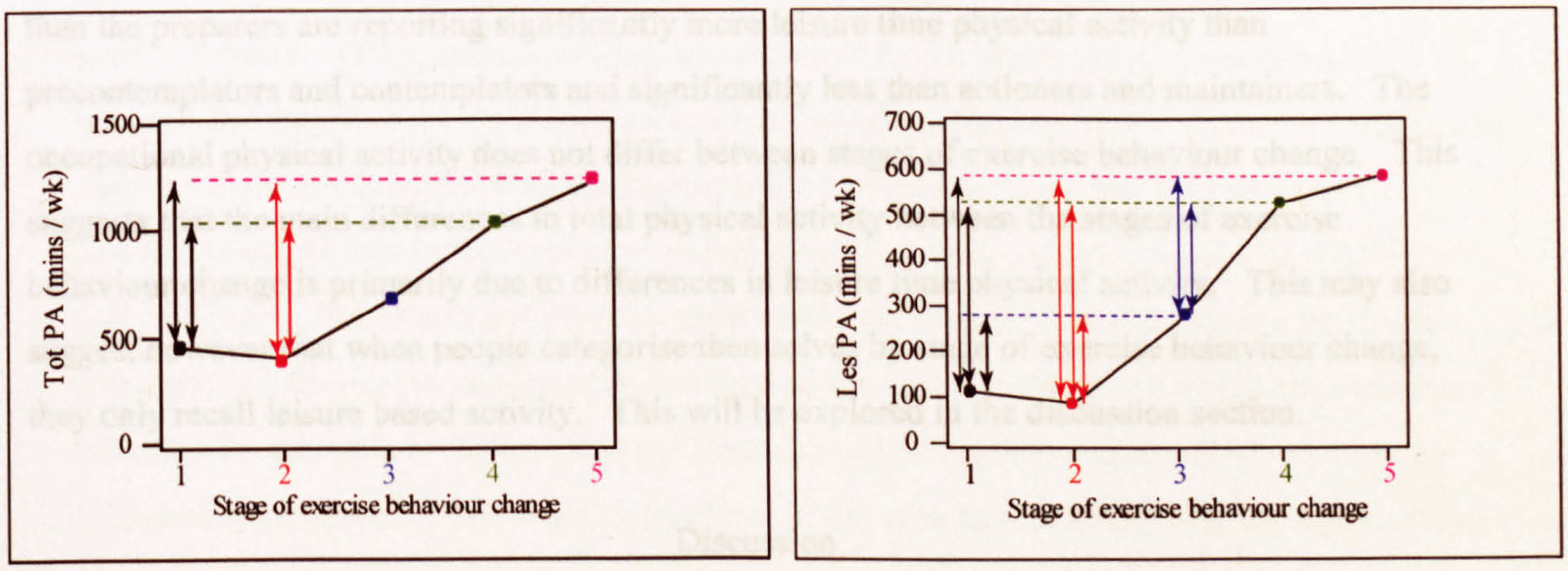
A one way analysis of variance confirmed significant differences between stages of exercise behaviour change for the log of leisure time physical activity ($F = 36.45$, $df = 92$, $p < 0.05$). A one way analysis of variance was also conducted for the occupational physical activity data and found no significant inter-stage differences ($F = 1.81$, $df = 92$, $p = 0.13$). Given that the actioner and maintainer data did not show normality, the appropriate non parametric test was also conducted. The results of a Kruskal-Wallis test again indicated no significant difference ($H = 3.51$, $p = 0.48$).

A series of Bonferroni multiple comparisons were conducted to examine significant inter stage differences for the logarithm of the leisure time physical activity data. Table 13. reports the results of these comparisons.

Bonferroni multiple comparison to determine significant inter stage differences for the log of leisure time physical activity

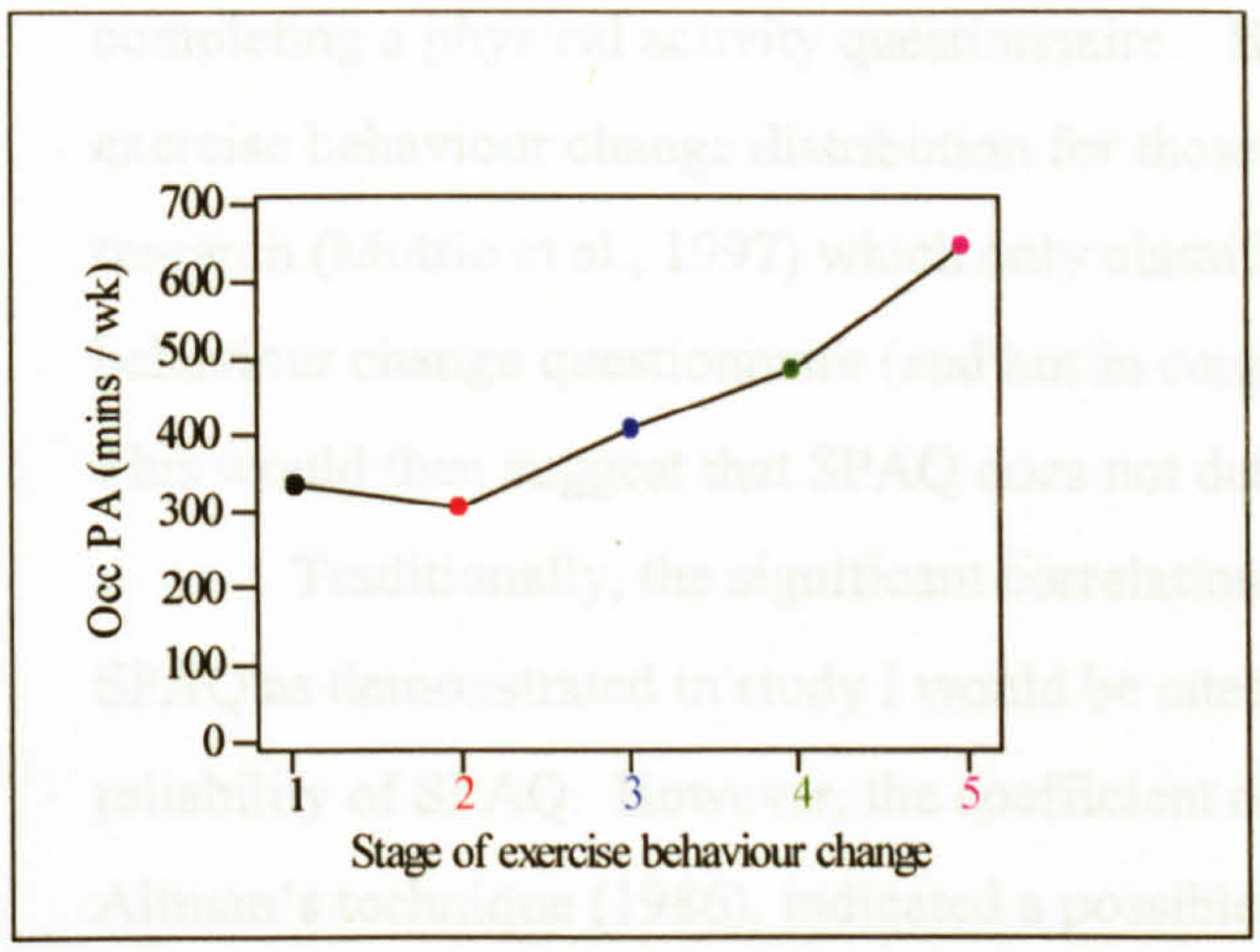
Stage of exercise behaviour change	Confidence Interval
Precontemplation v Contemplation	-0.35, 1.05
Precontemplation v Preparation	-1.52, -0.09
Precontemplation v Action	-2.08, -0.77
Precontemplation v Maintenance	-2.11, -0.89
Contemplation v Preparation	-1.79, -0.53
Contemplation v Action	-2.35, -1.21
Contemplation v Maintenance	-2.37, -1.34
Preparation v Action	-1.2, -0.04
Preparation v Maintenance	-1.23, -0.17
Action v Maintenance	-0.53, -0.38

Table 13. shows that precontemplators and contemplators do not differ in their leisure time physical activity. This is also the case for actioners and maintainers. However, table 13. shows that there are significant differences for all other pairs of stages. Figure 12. plots the means of total, occupational and leisure time physical activity for each stage of exercise behaviour change.



(a.) Total Physical Activity

(b.) Leisure Time Physical Activity



(c.) Occupational Physical Activity

Figure 12. The relationship between stage of exercise behaviour change and total, occupational and leisure time physical activity means (mins / wk).

Note. 1 = precontemplation, 2 = contemplation, 3 = preparation, 4 = action, 5 = maintenance, arrows indicate significant differences between stages, $p < 0.05$.

Figure 12. (a.) – 12. (c.) shows that the relationship between leisure time physical activity and stage of exercise behaviour change is almost identical to that of total physical activity, other than the preparers are reporting significantly more leisure time physical activity than precontemplators and contemplators and significantly less than actioners and maintainers. The occupational physical activity does not differ between stages of exercise behaviour change. This suggests that the main differences in total physical activity between the stages of exercise behaviour change is primarily due to differences in leisure time physical activity. This may also suggest however that when people categorise themselves by stage of exercise behaviour change, they only recall leisure based activity. This will be explored in the discussion section.

Discussion

Analysis of the feedback given in the initial pilot studies (appendix C) revealed that SPAQ was quick (approximately 10 minutes) and easy to complete. Additionally, as the bulk of the results obtained in all studies were based on questionnaires that were not completed in an interview situation, it appears that SPAQ can be used for postal surveys and, as it is easily copied, is also practical for use with large numbers.

In addition, approximately 50% of all questionnaires issued were returned which is comparable with other research (Mutrie and Caddell, 1994), suggesting that SPAQ does not present any specific barriers to completion. This is also evident in study II. It may have been the case that those who participate in small amounts of physical activity be "embarrassed" about completing a physical activity questionnaire. However, study II demonstrated that the stage of exercise behaviour change distribution for those people who volunteered was comparable to other research (Mutrie et al., 1997) which only classified participants by using a stage of exercise behaviour change questionnaire (and not in conjunction with a physical activity questionnaire). This would then suggest that SPAQ does not deter any specific group of the population.

Traditionally, the significant correlation coefficient (0.998) of test verses re-test results for SPAQ as demonstrated in study I would be cited as overwhelming evidence of the test - re-test reliability of SPAQ. However, the coefficient of repeatability (R), established using Bland and Altman's technique (1986), indicated a possible variation of up to 53 minutes in total physical activity using the same data. This study is therefore a clear example of the point being made by Bland and Altman. It is clear from figure 4. (and the significant correlation coefficient) the 2 measurements are highly related but it is also clear from figure 5. (and the limits of agreement) that they are not in total agreement.

Study I found that variations of around 1 hour are possible when comparing 1 measurement to the next for total physical activity. The study also showed that leisure time physical activity may vary by approximately 30 minutes compared to occupational physical activity which may vary by as much as 80 minutes. It is clear therefore that variations in total physical activity were mainly caused by variations in occupational physical activity. Study I also showed that within occupational physical activity, both manual labour and housework showed good reliability. Occupational walking was shown to be the major cause of variation in occupational physical activity, having a potential variation of up to 1 hour. However, this in itself does not make occupational walking "non-reliable". Indeed, calculating the test / retest correlation coefficient for occupational walking yields a highly significant result ($r = 0.997$, $p < 0.01$). Clearly, this shows that even the most unreliable section of SPAQ shows a far stronger *relationship* between repeated measures compared to other questionnaires which are considered reliable - for example $r = 0.84$ – Stanford PA recall (Blair, Haskell and Ho, 1985, reported by Williams et al. 1989). This would *suggest* that SPAQ is in turn more reliable, but as there is no evidence of similar questionnaires being analysed with the limits of agreement technique, it is impossible to substantiate this conclusion. Indeed, it would be interesting to note what level of agreement existed between two physical activity questionnaires that elicited a correlation coefficient of 0.84.

The methodology of the present study allows confidence that any variations in physical activity from test to retest are caused by SPAQ as the same period of PA has been analysed. Some comparable research has chosen to re-administer the questionnaire within one month of the original completion (Williams et al.). Although physical activity is *relatively* stable over this time period it is not certain that any differences observed are due to the questionnaire and not to differences in actual physical activity. A potential problem with the current methodology is that only four days of a seven day recall questionnaire have been analysed. However, as the questions and recall procedures are identical for the three days not analysed compared to the four that were, it is reasonable to assume that a similar level of reliability would have been produced if these three days had been included. Another potential problem is that completion of the retest SPAQ may have been affected by memory of completion of the first. Whilst this could have occurred to some extent, this criticism could also be levelled at methodologies that require re-administration within a few of weeks. The current methodology, whilst potentially suffering the same "memory problem" as similar research, at least removes any potential problems caused by analysing two separate bouts of physical activity.

Study two indicated that SPAQ has strong concurrent validity with the stage of exercise behaviour change model. Again, it is interesting to note how each physical activity component (leisure and occupational) contributed to the inter - stage variations in total physical activity. It appeared that occupational physical activity didn't significantly alter by stages of exercise behaviour change. However, actioners and maintainers reported significantly more leisure physical activity than pre-contemplators and contemplators, with preparers reporting significantly more leisure physical activity than precontemplators and contemplators and less than actioners and maintainers. A possible explanation is that due to the constraints of employment, most people are unable to accumulate significant amounts of physical activity whilst at work. A further explanation, as mentioned earlier in the chapter, is that when people are categorising themselves by stage of exercise behaviour change, they are only recalling leisure time physical activity and not occupational physical activity. This is possible as the description for "regular physical activity" given in the stages of exercise behaviour change questionnaire focuses on activities which would be predominately done in a person's leisure time (e.g. weight training, aerobics, sport, gardening). Although some of the activities described are possible whilst at work (e.g. walking), the description does not specifically target occupational physical activity. This then questions the validity of the occupational section of SPAQ.

SPAQ has also undergone testing for criterion validity. As part of a Master of Science degree at Glasgow University, McFarlane (1996) compared the energy expenditure data of 34 participants who wore a Caltrac motion sensor (Hemokinetics, Madison, W1) for four days with the results of SPAQ as completed by the participants over the same four days. Results showed that initially, there was little or no correlation between minutes of recorded physical activity and kilocalories recorded by Caltrac ($r = 0.1294$). However, after reviewing the recorded data it appeared that the walking at work component of the questionnaire's occupational physical activity section created data sets that were much higher than the rest suggesting that it may have been over-estimated. This concurs with the reliability study in the present study which showed that occupational walking was far less reliably recalled than the other sections of the questionnaire.

McFarlane (1996) therefore analysed the relationship between Caltrac and the questionnaire minus the occupational walking component. When this was done, the correlation improved to $r = 0.34$. Additionally, when further analysing the data, it appeared that 4 extreme sets existed. One of the participants (who was the heaviest at 203lb) recorded a high activity kilocalorie count in comparison to recorded minutes which may have had some bearing on the Caltrac's calculation of the resting metabolic rate (RMR) (Caltrac technical application note, 1993), possibly under-estimating his RMR. On contacting the other volunteers, 1 had injured her leg, and was carrying out resistance training for rehabilitation, which may not be detected by the Caltrac (Haskell et al., 1993) and for the 2 other participants, errors were detected in the extreme values recorded (both had reported problems with the functioning of their Caltrac unit). McFarlane reported that major problems existed with these 4 participant's data. Analysing the relationship between the questionnaire (minus occupational walking) and the remaining 26 data sets produced a correlation of 0.52 ($p<0.01$).

As already outlined, occupational walking was the least reliably recalled section of SPAQ. This question mark over occupational walking was also evident in the McFarlane (1996) study. Only when this category was removed was a significant correlation found. After communicating with participants in the study, McFarlane (1996) reported that the main problem with this category was that bouts of standing were being included. For example, a shop manager reported seven hours of walking at work. According to McFarlane (1996), it is unlikely, knowing her environment, that she was walking for seven hours.

In the McFarlane (1996) study, there was initially a very low correlation coefficient of 0.13 when SPAQ was compared to a more objective measure of physical activity. There are several possible explanations for this. First, as has been reported, occupational walking showed a large variation between test and re-test. Errors also existed in four of the respondent's data. Indeed, when corrections were made for both of these observations, a significant relationship was found. In addition to SPAQ's limitations (mainly occupational walking), Caltrac undoubtedly has it's limitations for use in this kind of research. For example, some activities such as resistance training may not be detected by Caltrac (Haskell et al.,1993), but are by the PA questionnaire. Additionally, Tryon (1985) has shown that a number of subject characteristics may affect the Caltrac reading and it has also been suggested that the precise placement of the unit is essential for accurate measurement (Williams et al., 1989). However, until a "gold standard" physical activity measure for use in field studies is identified, the use of motion sensors is the next best thing.

Conclusions

SPAQ has shown to be quick and easy to complete and practical for use with large numbers in a variety of situations (including postal surveys). The leisure time component of SPAQ has been shown to be reliable and hold strong concurrent validity with the stage of exercise behaviour change model. The occupational physical activity component is not as reliably measured by SPAQ as the leisure time component however, and there is a question mark over the concurrent validity of occupational physical activity when using the stages of exercise behaviour change. McFarlane (1996) has also demonstrated that SPAQ holds criterion validity, but it has to be recognised that the evidence was not overwhelming, this being partly due to limitations in SPAQ (again, occupational physical activity) and partly to limitations in Caltrac. It is evident nonetheless that compared to similar physical activity recall questionnaires, there is strong evidence that SPAQ shows superior reliability and validity.

Recommendations for use of SPAQ

The leisure time section of SPAQ is reliable, and has shown good concurrent and criterion validity. In contrast, question marks exist over the reliability, concurrent and criterion validity of the occupational section of SPAQ. As total physical activity measured by SPAQ is simply a sum of leisure time and occupational physical activity, total physical activity will therefore hold similar limitations to occupational physical activity. It is therefore recommended that future studies using SPAQ be cautious when dealing with occupational and total physical activity. Where possible, leisure time physical activity should be measured and analysed.

Further recommendations relate to the development of SPAQ. If SPAQ is to be a useful tool in the monitoring of the current "active living" physical activity guidelines, it has to be able to deal with all physical activity components. For this reason, the stage of exercise behaviour change questionnaire utilised by SPAQ needs to be adapted to specifically include occupational physical activity. This then needs to be assessed for validity (i.e. is the questionnaire still a valid measure of stage of exercise behaviour change when occupational physical activity is included). The activity recall format of SPAQ also needs to be adapted to refine it's ability to record occupational physical activity, and in particular, occupational walking.

Chapter 4

STUDY TWO :
Piloting of procedures

Kilmarnock Police Station, Kilmarnock
August 1996 - April 1997

Introduction

The aim of this study was to assess the feasibility and practicality of measuring the effects of a fitness assessment or exercise consultation on a person's physical activity, stage of exercise behaviour change and processes of exercise behaviour change. This will allow recommendations to be made for the main study.

The specific objectives for the study were as follows:

(a.) to assess participation rates and questionnaire return rates

(b.) to assess the percentages and characteristics of respondents who would prefer either a fitness assessment or exercise consultation as their intervention

(c.) to pilot procedures involved in a "Fitech" fitness assessment

(d.) to pilot procedures involved in an exercise consultation

(e.) to pilot procedures necessary to measure changes in dependant variables

(f.) to estimate the sample size required for the main study

The study was conducted with Strathclyde Police Officers at Kilmarnock Police Station, which is the divisional headquarters for East Ayrshire. Strathclyde Police were contacted for this study because they were able to provide a large potential subject number, were able to offer suitable accommodation in the Police Station which could be used for the interventions, the Police Station was within close proximity of the main researcher and the Police Station employed a Health and Safety Officer who was enthusiastic about the study and consequently could offer valuable assistance to the main researcher, mainly in recruitment and dissemination of information.

After describing the methodology and results the chapter is concluded with a discussion of the findings and recommendations for the main study.

Methodology

Subjects

A total of 75 Strathclyde Police Officers (mean age = 37, SD = 7.63 years) participated in the study, 63 (84%) were male, 12 (16%) were female.

Instruments

Dependent Variables

Physical activity.

SPAQ, as described in the previous chapter was used to assess the previous seven days of physical activity. It has to be noted that the recommendations made at the end of chapter three for SPAQ could not be further developed due to time constraints. The limitations of SPAQ were considered in the present study however.

Stage of exercise behaviour change.

SPAQ contains a section for the measurement of a person's stage of exercise behaviour change as outlined in the previous chapter.

Processes of exercise behaviour change.

The processes of exercise behaviour change questionnaire developed by Marcus et al. (1992b) described in chapter two was selected to measure processes of exercise behaviour change.

Formal Consent Form

Prior to their intervention, those participants who had opted for a fitness assessment were required to complete a formal consent form (appendix G). This included instructions about the assessment, a section for them to note any previous / current illnesses / injuries, medical conditions or any current drugs they may be taking and a section containing a physical activity readiness questionnaire. This questionnaire detailed several conditions / circumstances where written medical approval should have been sought before the assessment could be undertaken (in the present study, no person suffered from any such condition). Participants were required to complete all sections of the form before signing and dating it.

Fitness Assessment

Morphological assessment.

The participant was asked to remove their shoes and any non-essential clothing (i.e. jacket, sweatshirt) before being invited to stand on a set of weighing scales (Seca Personal Scale 760 Automatic Precision). Their weight was recorded to the nearest 0.5 kilograms by reading off the relevant scale. The person was then invited to stand upright against a stadiometer (Seca, 220) with their legs together, hands to their sides and head facing forward. The measuring boom of the stadiometer was then lowered until just touching the person's head. Their height was recorded to the nearest centimetre by reading off the relevant scale. Dividing the weight of the person by the square of their height elicited their body mass index (Roche, Guo, Chumlea, Tyleshevski, and Siervogel, 1996).

Blood pressure and resting heart rate.

An automatic digital blood pressure monitor (Omron, HEM- 703CP) was used to assess participant's systolic and diastolic blood pressures and their resting heart rates. The procedures followed were those described by Sykes (1989) and are outlined in the "Fitech" reference manual (1993). Participants were sat in a chair and instructed to rest quietly for two or three minutes after which the sphygmomanometer cuff was applied to they're upper left arm. Three measurements were taken separated by approximately one minute and the lowest value obtained for resting pulse and systolic and diastolic blood pressures were recorded to the nearest mmHg. In accordance with Sykes it was considered before the assessments that if systolic blood pressure exceeded 160 mmHg or diastolic exceeded 110mmHg the person was to be advised that they should consult their doctor and that the cardio-respiratory component of the assessment would not be undertaken. In the present study all participants' systolic and diastolic heart rates were below these recommended thresholds.

Flexibility.

A flexibility board (supplied by Fitech) was used to assess flexibility. It consisted of a rectangular box with a measurement scale (cm increments) placed on the top surface which protruded 35.5 cm from the edge of the box (producing an "overhang"). The procedures followed were those set out in the "Fitech" reference manual (1993) and those outlined by Sykes (1989). Participants were advised to limber up, paying particular attention to stretching the hamstring muscle group. When they had sufficiently warmed -up they were instructed to sit on the floor with legs straight and feet (without footwear) placed against the stop board of the flexibility board in such a way as the "overhang" of the scale faced toward them. They were then instructed to slowly reach, with both hands level, down the scale as far as they could go without bending their legs and without undue pain or exertion. They were instructed to breathe out as they reached, holding the fully stretched position for three seconds. All participants were given three attempts and the maximum distance reached was recorded to the nearest cm.

Grip strength.

A grip strength dynamometer (Takei, 5101) was used to assess grip strength. Again the procedures followed were those set in the "Fitech" instruction manual (1993) and those outlined by Sykes (1989). In accordance with the manufacturers instructions the dynamometer handle was adjusted to suit the size of the hand. Participants were then instructed to hold the dynamometer out to their side and squeeze maximally as they brought their arm down to their side taking care not to touch their body. They were given three attempts with each hand, the best score of which was recorded to the nearest kg.

Leg and back strength.

A leg and back dynamometer (Takei, 5102) was used to assess leg and back strength. The procedures followed were those set out in the "Fitech" reference manual (1993). Participants were instructed to stand on the foot plate of the dynamometer and the chain length was adjusted so that the their arms and back were straight and their legs slightly bent. They were instructed to pull upwards on the handle as hard as possible using the legs, back, shoulders and arms in a co-ordinated movement. The best score from three attempts was recorded to the nearest Kg

Lung capacity.

A micro spirometer (Micro Plus, MS03) was used to assess peak flow rate. The procedures followed were those set out in the "Fitech" reference manual (1993) and the manufacturer's guidebook. Participants were asked to remove any tight fitting clothing before taking a deep breath and completely filling their lungs. They then placed the spirometer's mouthpiece into their mouth ensuring an air tight seal before blowing out as hard and as fast as possible for approximately six seconds (an audible count was given so that they knew when to stop). After a brief recovery the test was repeated. The best peak flow score of the two attempts was recorded to the nearest litre per minute.

Cardio-respiratory assessment

The Astrand (1977) sub-maximal cycle ergometer test was used to assess participant's cardio-respiratory fitness by estimating their VO2 max. The full procedure for the test is laid out in the "Fitech" reference manual (1993). The saddle height of a cycle ergometer (Monark 818 E) was adjusted to suit each participant who were instructed to warm-up for approximately 1 minute by pedalling at 50rpm at a workload of *1kp*. The test was initiated after ensuring the participants were relaxed and happy to continue. The first 3 minutes of the test was used to raise their heart rate to above 120bpm by systematically increasing the resistance every minute while instructing participants to maintain a pedal rate of 50rpm. Pulse rate was taken by a heart rate monitor (Polar Sport Tester 200). Participants were then required to sustain this level of exertion for the final 3 minutes of the test achieving steady state conditions. The final workload (in *kp*) and the participant's mean heart rate in the last minute were entered into a lap top computer loaded with the "Fitech" software (as discussed in chapter 2) which then calculated the person's estimated V02 max (mls 0_2 / min) by utilising the Astrand and Rhyming nomogram (1954). From morphological data already entered into the computer the "Fitech" programme could automatically calculate the person's weight adjusted estimated VO2 max (mls / 0_2 / Kg / min).

- Fitness assessment analysis.

As was discussed in chapter one, a lap-top computer (Toshiba, T1950 CT) loaded with the "Fitech body management" software was used to analyse the results of the fitness assessments so immediate feedback could be given relating to "performance".

Exercise Consultation

Morphological assessment.

The procedures used to assess participant's height and weight (and consequently body mass index) were identical to those described for the fitness assessment group.

Exercise interview.

The exercise consultations were conducted in accordance with guidelines issued by Loughlan and Mutrie (1995a) which were described in chapter two. An exercise consultation reference sheet (appendix H) was produced to record relevant information such as personal details, morphological data and the person's relevant responses to the various components of the consultation. The reference sheet also offered various prompts to aid the interviewer develop appropriate responses.

Information Booklet

An eight page information and questionnaire booklet was produced (appendix I) and consisted of the following sections:

Page 1. Title and covering letter offering general information about the project and what would be involved. The person's confidentiality was ensured, a short description was given of what would be involved in a fitness assessment / exercise consultation and the letter was concluded with a description of how the project would be developed.

Page 2. Personal details followed by a section giving the person the opportunity to volunteer for either a fitness assessment or exercise consultation.

Page 3. Stage of exercise behaviour change questionnaire as described in the "instruments" section.

Pages 4. and 5. SPAQ as described in the "instruments" section.

Pages 6. and 7. Processes of exercise behaviour change questionnaire as described in the instruments section. The final section of page seven instructed participants what to do with the completed booklet.

Page 8. A scoring sheet so the researcher could record all the information from the questionnaires on one page.

Procedures

Two hundred information booklets were given to Kilmarnock Police Force's Health and Safety Officer who distributed them to fellow officers of Kilmarnock Police Station via the internal mailing system. All booklets were returned to the Health and Safety Officer and were scored by the main researcher. A list of those participants who would prefer a fitness assessment and those who would prefer an exercise consultation was then given to the Health and Safety Officer who agreed to arrange a time and date with volunteers for their chosen intervention.

Prior to the start of the study, ethical approval was sought and subsequently granted from the University of Glasgow's interim ethics committee for non-clinical research involving human subjects.

Fitness Assessment

All fitness assessments were conducted in the Police Station's gymnasium. Prior to the fitness assessment participants completed a formal consent form as described in the instruments section. The procedures to be followed, confidentiality and the purpose of the study were explained to participants and after they had indicated they were happy to continue, the assessment was started by measuring the person's height and weight. Following this blood pressure and resting heart rate were recorded and the person's flexibility, grip strength, leg and back strength and peak flow rate were measured before concluding the assessment with the cardio-respiratory assessment. The results of each participant's assessment were entered into a lap top computer, which compared them to pre-programmed "norms" (as discussed in chapter one). The computer could then graphically demonstrate their "performance" on each of the assessment components measured. This analysis was then discussed with each person by analysing each particular component and explaining why it was important to their overall fitness and how this component could be improved. Particular attention was given to components that were "average" or "below average". Participants were encouraged to set themselves targets based on their performance. For example if a person had a body mass index above that recommended their target was to lose weight or if a person's stamina was classed as "poor" that person was encouraged to try and improve this aspect.

At the end of the intervention it was explained to participants that they would be sent another physical activity recall questionnaire, stage of exercise behaviour change questionnaire and processes of exercise behaviour change questionnaire in approximately six months. They were thanked and were free to go. Shortly after the assessment a full report of the results and recommendations were produced and sent along with the booklet "Hassle Free Exercise"(Health Education Board for Scotland, 1994) to the person via the internal mailing system.

<u>Exercise Consultation</u>

All consultations were conducted in accordance with the guidelines issued by Loughlan and Mutrie (1995a). Consultations were conducted in a private room containing two "comfortable" chairs, a small coffee table and several potted plants. Throughout the consultations, the researcher attempted to convey an open posture (i.e. not crossing arms or legs or turning away) and concentrated on making the person feel relaxed (by being interested in what they had to say and by trying to empathise i.e. by showing that either the researcher or somebody that the researcher new had had a similar experience).

Prior to the exercise consultation the purpose of the study, the procedure that was to be followed and confidentiality was explained to participants. After they had indicated they were happy to continue the consultations were initiated by recording height and weight. Following this, participants were encouraged to list any physical activity they were either doing at present or had done in the past in order to establish any likes and dislikes. The person was then asked to complete a decisional balance sheet, which made them think of any possible benefits or drawbacks from being more active. If the researcher could see the person was having problems identifying any gains or losses they would "prompt" them and offer possible suggestions. The overall aim of this section was to make the participant form the opinion that the benefits of being more active far out-weighed the drawbacks. The next stage of the consultation focussed on any barriers the person may have had to being more active. The most commonly cited barriers were time and money. The researcher then had to try and identify how best the person could overcome these obstacles. For example, if a person claimed not to be able to afford local leisure centre prices then the benefits and the kinds of activity that can be done for free i.e. walking, cycling (if cycle owner), jogging, gardening were explained to them. The penultimate section of the consultation dealt with any support that could be offered to the person by their family or friends. It was important to instil into the person that "they were not alone". If they struggled to think of an appropriate person who they could rely on to offer support they were encouraged to try and join a beginners exercise class so they could meet like-minded people who could offer support. The final stage of the consultation concerned itself with the participant setting themselves specific goals. They were encouraged to set short-term goals (within the next week or so), intermediate goals (within the next couple of months) and long term goals (anything up to a year). The researcher tried to ensure that all goals were achievable and desired by the participant. Following the consultation it was explained to participants that in approximately six months they would be sent a physical activity recall questionnaire, a stage of exercise behaviour change questionnaire and a processes of exercise behaviour change questionnaire. Participants were then thanked and were free to go. Shortly after the consultation participants were sent a copy of the booklet "Hassle Free Exercise" (Health Education Board for Scotland, 1994) via the internal mailing system and a"goal record sheet" (appendix J) which detailed their short, medium and long term goals.

Approximately six months after each intervention participants were sent a copy of SPAQ and the processes of exercise behaviour change questionnaire via the internal mailing system and invited to complete the questionnaires. A covering letter detailing why they were being sent the questionnaires and what to do with them when they had been completed was also sent. All returned questionnaires were scored by the main researcher at a later date.

Data Analysis

Pre-intervention Analysis

A one sample t-test was used to test for a significant difference in the ages of those applying for each intervention. Chi squared tests of association (χ^2) were used to determine differences in the proportion of those applying for either intervention, the ratio of males to females applying for each intervention and in the proportions in each stage of exercise behaviour change when comparing intervention choice.

Pre-intervention relationships between the stages and processes of exercise behaviour change, and physical activity.

A one way analysis of variance was used to determine if any significant differences existed between stages of exercise behaviour change for total, leisure time and occupational physical activity. Prior to conducting the analysis of variance tests, homogeneity of variance was tested for with a Levene's test and normality was tested for with an Anderson Darling test. Where significant effects were found, Bonferroni multiple comparisons were used to identify which stages of exercise behaviour change differed.

To test for differences between stages of exercise behaviour change for the experiential and behavioural processes of exercise behaviour change, two non-parametric Kruskal Wallis tests were performed. Where an effect was found, follow up Mann-Whitney tests were used to identify significant stage differences. In order to test for any difference between experiential and behavioural processes for each stage of exercise behaviour change, four Wilcoxon matched pairs tests were conducted.

Test and Six Month Re-test Questionnaire Analysis

To assess the effect of the interventions on stage of exercise behaviour change, two Wald's tests for marginal homogeneity were conducted. To try and combat the problem of low expected cell counts, caused by relatively small numbers in some groups, the stage of exercise behaviour change data was pooled into one of two categories. At test, all those in the contemplator and preparer stages of exercise behaviour change (i.e. not regularly active) were placed in a "negative" category, all those in the actioner and maintainer stages (i.e. regularly active) were placed in a "positive" category. At re-test, all those baseline contemplators and preparers *remaining* in these stages continued to be placed in the negative category. In addition, any participant *relapsing* from any stage of exercise behaviour change from test to re-test were also placed in the negative category. In contrast, baseline actioners and maintainers remaining in these stages at re-test continued to be placed in the positive category. Participants who had *progressed* in their stage of exercise behaviour change were also placed in the positive category. It would also be tempting to place those participants who dropped out of the study into the negative category as this could be interpreted as a negative result. However, it is impossible to determine whether in fact that person has regressed in their stage of exercise behaviour change. For this reason, analysis was only conducted for participants remaining in the study at six months re-test.

Two way repeated measures analysis of variance tests with one within (test stage) factor and one between subject factors (intervention group) were used to identify significant main effects for intervention group and test stage and the interaction for total, leisure time and occupational physical activity. No significant effects were observed.

To assess if the interventions had a similar effect on the processes of exercise behaviour change, a series of Mann-Whitney tests were conducted to compare the change in process use by the fitness assessment group when progress was made through the stages to the change in process use by the exercise consultation group when similar progress was made.

In relation to the identification of key processes of exercise behaviour change associated with stage progression, initially, a linear discriminant analysis was used to determine the discriminatory power of the processes of change in differentiating between those who were likely to progress from each stage of change and those who were not. A binary logistic regression was then used to identify processes of change that were significant predictors of stage of change progression.

Estimation of Sample Size for Main Study

The mean difference and the standard deviation of this difference between test and re-test for each intervention group was used to determine the standardised difference. For a power of 80% and a 95% significance level, this was used to estimate the sample size required for each intervention group in the main study.

Results

Pre-intervention Analysis

Of the 200 information and questionnaire booklets originally issued a total of 79 (40%) were returned. The results of 4 of the booklets were not used in the study as the information given in one booklet was illegible, all or parts of the questionnaires were not completed in 2 of the booklets and 1 respondent specifically requested that they did not want to participate in the study. Descriptive statistics for the remaining 75 participants with respect to age is given in table 14.

Table 14.

Descriptive statistics for all participants and of each intervention group for age.

All Participants			Fitness Assessment			Exercise Consultation		
N	Mean	SD	N	Mean	SD	N	Mean	SD
75	37.03	7.63	65	36.82	7.53	10	38.4	8.54

A two sample t-test revealed that the mean ages for each intervention group as shown in table 14. were not significantly different ($t = 0.55$, $df = 11$, $p = 0.59$).

The distribution of participants with respect to gender is given in table 15.

Table 15.

Distribution of all participants and of each intervention group for gender.

Gender	All Participants		Fitness Assessment		Exercise Consultation	
	N	%	N	%	N	%
Males	63	84	54	83	9	90
Females	12	16	11	17	1	10

Table 15. shows that of the 75 participants who participated in the study, 63 (84%) were male, 12 (16%) were female. At first this may sound like a very uneven distribution but when it is considered that the ratio of male to female officers within the station was approximately 4 to 1 (verbal communication with the Health and Safety Officer) a possible explanation is offered. Chi square analysis showed that the ratio of males to females applying for each intervention was not significantly different ($\chi^2 = 0.31$, $df = 1$, $p = 0.58$).

Table 15. also shows that 65 respondents (87%) volunteered for a fitness assessment compared to only 10 (13%) for an exercise consultation. A Chi-square test analysis revealed that

this difference was significant ($\chi^2 = 56.7$, df = 1, $p<0.05$) suggesting that significantly more volunteers preferred a fitness assessment as their intervention. Possible explanations for this are offered in the discussion section.

Stage of Exercise Behaviour Change

The distribution of all participants and of each intervention group to stage of exercise behaviour change is shown in table 16.

Table 16.

Distribution of each intervention group to stage of exercise behaviour change at baseline.

Stage of exercise behaviour change	All Participants		Fitness Assessment		Exercise Consultation	
	N	%	N	%	N	%
Pre-contemplation	0	0	0	0	0	0
Contemplation	8	11	5	8	3	30
Preparation	14	18	8	12	6	60
Action	15	20	15	23	0	0
Maintenance	38	51	37	57	1	10

Analysis of the stage of exercise behaviour change distribution for each intervention group in the present study shown in table 16. reveals that 9 (90%) of the participants that applied for an exercise consultation were either contemplators or preparers compared to only 1 (10%) participant that was a maintainer. In contrast, 52 (80%) of those applying for a fitness assessment were in either the action or maintenance stage of exercise behaviour compared to only 13 (20%) participants in either the contemplation or preparation stage. A chi-square test conducted to determine any difference in the proportions of those not regularly active (i.e. contemplators and preparers) compared to those regularly active (i.e. actioners and maintainers) applying for either intervention showed a highly significant difference ($\chi^2 = 20.49$, df = 1, $p<0.05$). Thus it appears that choice of intervention is highly related to stage of exercise behaviour change. Follow up Bonferroni interval analysis revealed that exercise consultations were between 49% and 91% more likely to attract those not regularly active compared to fitness assessments which were between 49% and 91% more likely to attract those regularly active (CI's = 0.49, 0.91).

As the pre - intervention relationships between the stages of exercise behaviour change, the processes of exercise behaviour change and physical activity are not of great importance to this study they are outlined in appendix K.

Fitness Assessment / Exercise Consultation

Of the 65 participants who had volunteered for a fitness assessment, 42 (65%) were eventually tested. Of the 10 who had requested an exercise consultation, 8 (80%) attended their intervention. Chi square analysis revealed no significant difference between the ratio of those attending and those not attending when comparing intervention groups ($\chi^2 = 0.92$, df = 1 , p = 0.34).

Each fitness assessment and exercise consultation took approximately 30 minutes to complete. There were no problems with the format of either intervention with all participants agreeing to participate and the general consensus was that they had found their respective intervention interesting and a worthwhile experience.

Test and Six Month Re-test Questionnaire Analysis

Of the 42 participants who attended the fitness assessment 26 (62%) returned the 6 month re-test physical activity and processes of exercise behaviour change questionnaires compared to all (100%) of the exercise consultation participants. Chi square analysis revealed that the difference between the ratio of those returning and those not returning the six month questionnaires was significant when comparing intervention groups ($\chi^2 = 5.5$, df = 1 , $p < 0.05$).

Stage of Exercise Behaviour Change

Table 17. reports the stage of exercise behaviour change at test and re-test of those participants remaining in the study at re-test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories, as described earlier in the data analysis section on page 111.

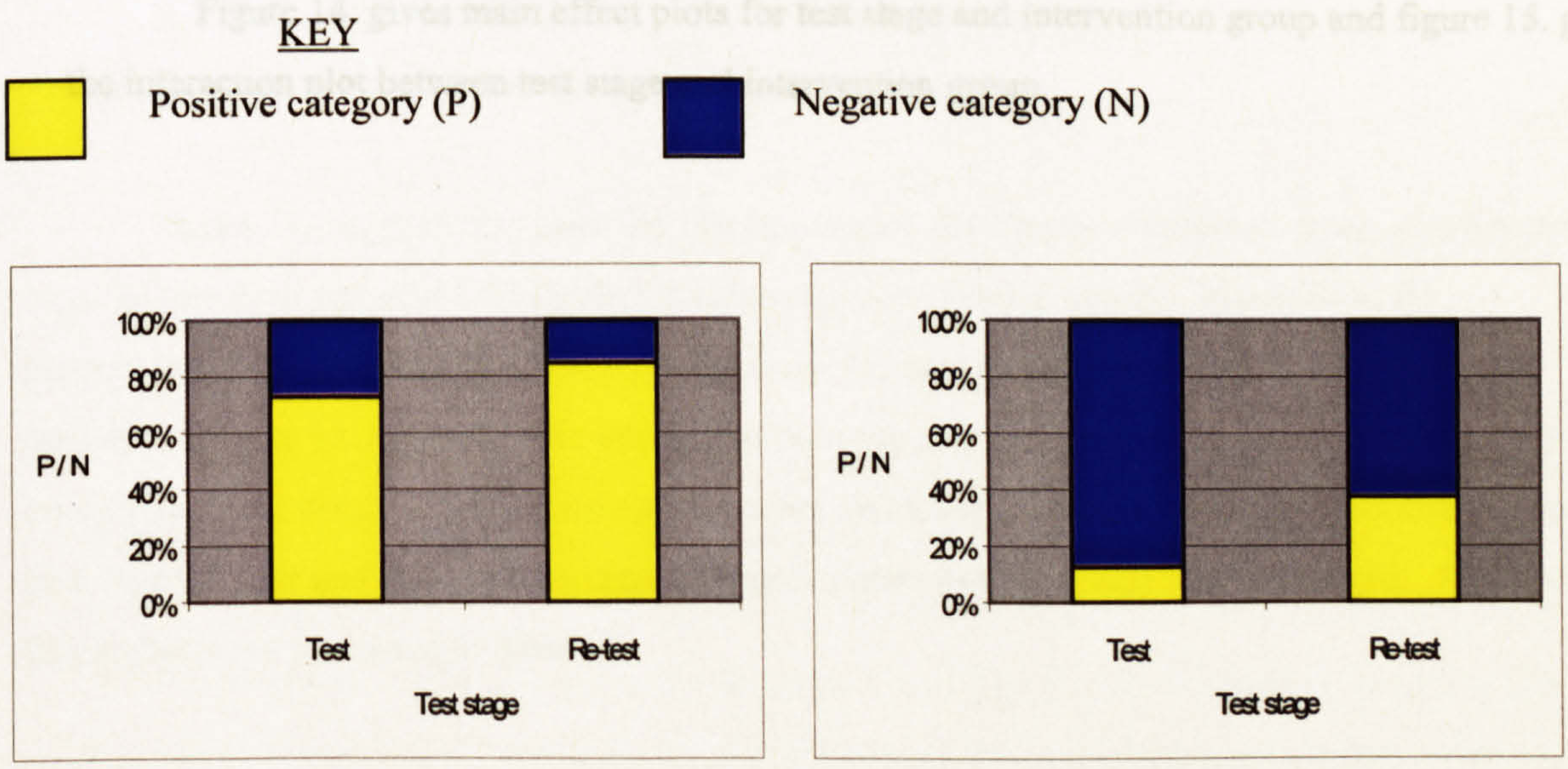
Table 17.

The stage of exercise behaviour change at test and re-test of those participants remaining in the study at six months re-test for each study group

Study Group	SOC	Test stage: Test N	Test %	Re-test N	Re-test %
	2	2	8	1	4
	3	5	19	3	11
Fitness	4	6	23	8	31
Assessment	5	13	50	14	54
	P	19	73	22	85
	N	7	27	4	15
	2	2	25	1	12.5
	3	5	62.5	4	50
Exercise	4	0	0	2	25
Consultation	5	1	12.5	1	12.5
	P	1	12.5	3	37.5
	N	7	87.5	5	62.5

Note. SOC = stage of exercise behaviour change, 2 = contemplation, 3 = preparation, 4 = action, 5 maintenance, P = positive category, N = negative category

Figure 13.a and 13.b plot the percentage of participants in each category (positive or negative) for each test stage for the fitness assessment group and the exercise consultation group respectively.



(a.) Fitness assessment (N = 26) (b.) Exercise consultation (N = 8)

Figure 13. The percentage of those participants in each category (positive or negative) at each test stage for each intervention group.

Figure 13. confirms the earlier observation from table 16. that stage of exercise behaviour change is highly related to intervention choice (clearly, contemplators and preparers favour an exercise consultation compared to actioners and maintainers who favour a fitness assessment).

Figure 13. also shows that each intervention has had a positive effect on stage of exercise behaviour change at six months. However, two Wald's test for marginal homogeneity showed no significant change in the distribution of positive to negative categories when comparing test stages for either group (fitness assessment, test statistic = 3.39, df = 1, p = 0.07; exercise consultation, test statistic = 2.67, df = 1, p = 0.10).

Physical Activity

Leisure time physical activity.

Table 18. gives the descriptive statistics for leisure time physical activity for each intervention group at test (for those participants returning re-test questionnaire) and six month re-test.

Table 18.

Descriptive statistics for leisure time physical activity (mins / wk) for each intervention group at test (for those participants returning re-test questionnaire) and six month re-test.

Physical Activity	Fitness Assessment (mins/wk)			Exercise Consultation (mins/wk)		
Time Period	N	Mean	SD	N	Mean	SD
Test	26	670.8	318.9	8	565.0	343.1
Re-test	26	715.0	310.9	8	656.0	316.0

Figure 14. gives main effect plots for test stage and intervention group and figure 15. gives the interaction plot between test stage and intervention group.

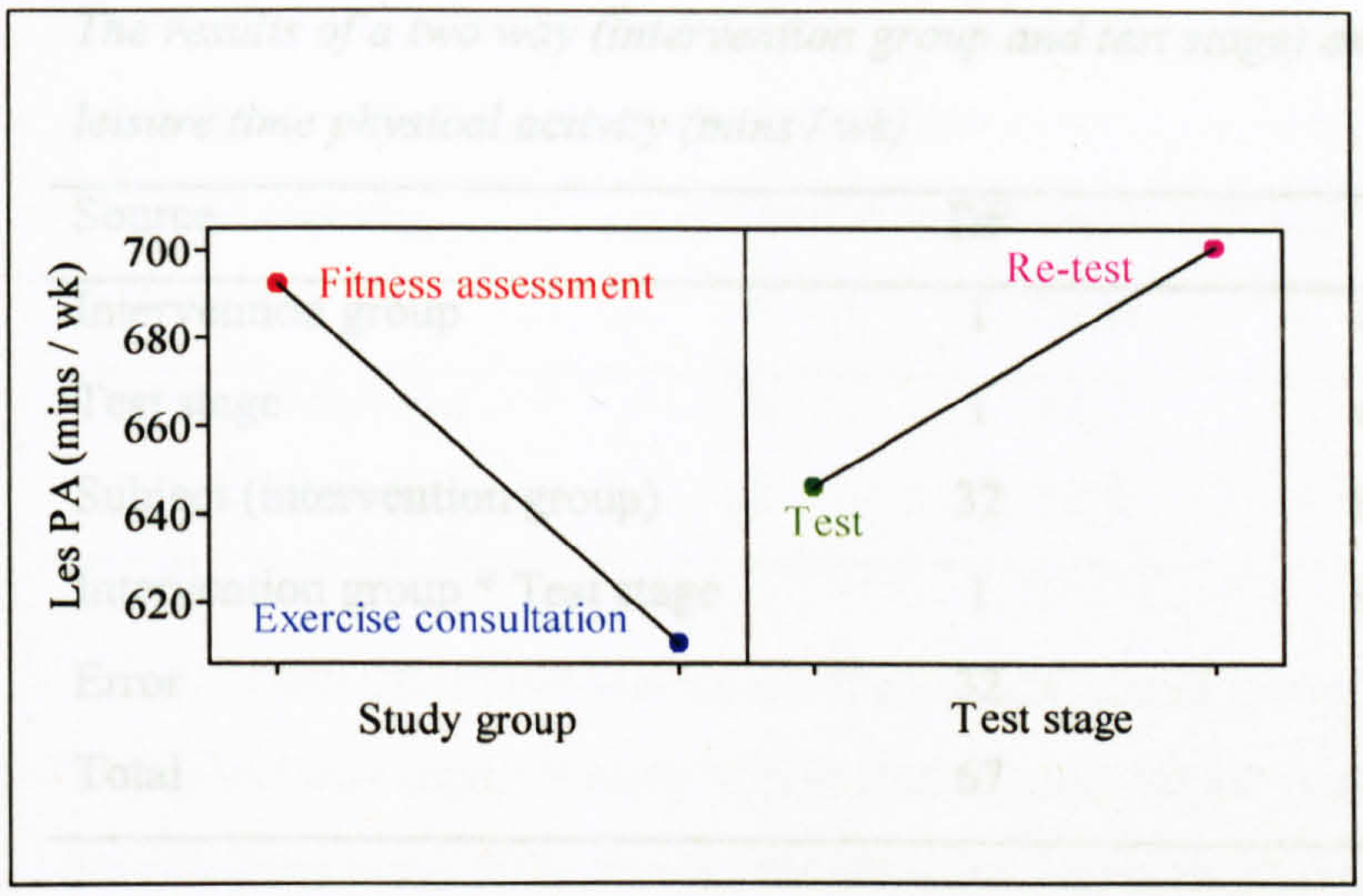


Figure 14. Main effect plots for test stage and intervention group

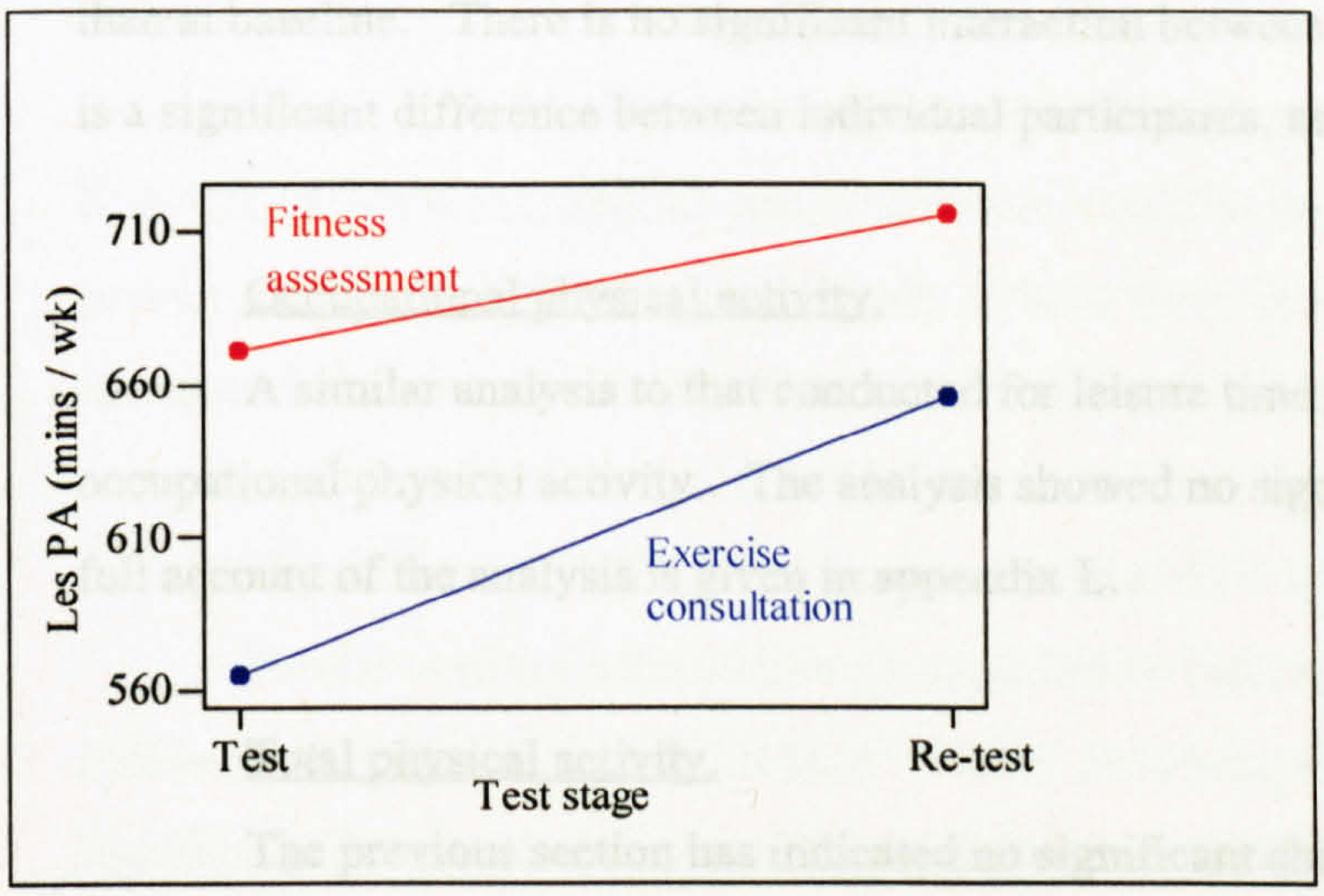


Figure 15. Interaction plot for test stage and intervention group

Figure 14. suggests that over the two test stages, the fitness assessment group are reporting more leisure time physical activity than the exercise consultation group. In addition, the participants as a whole appear to be reporting more leisure time physical activity at six months post test. Figure 15. suggests little interaction between test stage and study group. To formally investigate these observations, a two way repeated measures analysis of variance with one within (test stage) factor and one between subject factors (intervention group) was conducted. Results of this analysis are presented in table 19.

Table 19.

The results of a two way (intervention group and test stage) analysis of variance performed on leisure time physical activity (mins / wk)

Source	DF	F	P
Intervention group	1	0.44	0.51
Test stage	1	4.07	0.052
Subject (intervention group)	32	13.84	< 0.05
Intervention group * Test stage	1	0.48	0.49
Error	32	/	/
Total	67	/	/

Table 19. shows no significant main effect for intervention group but there is evidence that the group as a whole are reporting significantly more leisure time physical activity at six months than at baseline. There is no significant interaction between test stage and study group but there is a significant difference between individual participants, as expected.

Occupational physical activity.

A similar analysis to that conducted for leisure time physical activity was conducted for occupational physical activity. The analysis showed no significant main effects or interaction. A full account of the analysis is given in appendix L.

Total physical activity.

The previous section has indicated no significant change in either group's occupational physical activity over the two test stages. As total physical activity is obtained by adding occupational and leisure time physical activity this would suggest that changes in total physical activity will simply mirror changes in leisure time physical activity.

Estimation of Sample Size For Main Study

The results of the present study can be used to estimate the sample size required in the main study. The principal aim of the main study is to determine if the interventions significantly increase physical activity. To estimate the sample size needed, a comparison of paired sample means is required. Table 20. gives the descriptive statistics for the differences in leisure time physical activity from test to re-test for all participants returning re-test questionnaires (leisure time physical activity was used as the previous chapter has shown it more reliable and valid than occupational and hence total physical activity).

Table 20.

Descriptive statistics for the differences in leisure time physical activity from test to re-test for all participants returning re-test questionnaires

Physical Activity	Total Physical Activity (mins/wk)		
Difference	N	Mean	SD
Fitness Assessment	26	44.2	161.9
Exercise Consultation	8	90.6	176.8

Table 20. shows that for the fitness assessment group, the mean difference between test and re-test was approximately 45 minutes and the standard deviation approximately 160 minutes. Dividing the mean difference by the standard deviation produces the standardised difference (45 / 160 = 0.3). Using a 1 sided test (an increase in physical activity was observed and is anticipated in the main study) with a power of 80% (i.e. a probability of 0.8 of correctly identifying a real difference of 45 mins / wk between test and re-test) and a 0.05 significance level, a standardised difference of 0.3 would indicate a sample size of 70 to be required (Machin and Campbell, 1987). However, this is the number of participants that would be required at 6 months post-test. The present study indicated that approximately 62% of those attending their initial fitness assessment remained at 6 months post test. This means that for a difference of 45 minutes per week in leisure time physical activity to be detectable at six months post test for the fitness assessment group requires approximately 113 original participants (i.e. 62% of 113 = 70).

For the exercise consultation group, it can be calculated from table 20. that the standardised difference is 0.5 (i.e. 90.6 / 176.8), indicating that for a power of 80% at the 0.05 significance level, a sample size of 26 would be required (Machin and Campbell, 1987). Despite the fact that all original participants receiving an exercise consultation remained at 6 months post-test, to err on the side of caution, it is recommended that at least 50 participants are recruited for the exercise consultation group.

As the main study will utilise 2 control groups (one for each intervention), it is recommended that at least 113 participants initially receive a fitness assessment and 113 a fitness assessment control intervention. Similarly, it is recommended that at least 50 participants initially receive an exercise consultation and 50 an exercise consultation control intervention.

Processes of Exercise Behaviour Change

This section attempts to identify key processes associated with stage of exercise behaviour change progression. In order to group all participants (i.e. from both intervention groups) together to do this, it is important to establish any differences between intervention groups. If any differences existed, it would be difficult to group all participants together. It is possible that the interventions may have had a different effect on the processes of exercise behaviour change given their nature. For example, the fitness assessment is *health related* and may therefore affect those processes which are also health related such as dramatic relief. In contrast, a section of the exercise consultation focuses on the potential support that is available to the participant from family or friends. It is possible therefore that this could have a significant effect on the process of helping relationships for example.

A series of Mann Whitney test were conducted to identify any differences between intervention groups for all those participants who progressed in their stage of exercise behaviour change. The results of these analyses showed no difference between intervention groups for any of the ten processes of exercise behaviour change. These analyses are reported in appendix M.

Identification of Dominant Processes of Exercise Behaviour Change When Progress is Made Through the Stages of Exercise Behaviour Change

When a person progresses in their stage of exercise behaviour change, there are four possibilities; contemplation to either preparation or action (note it is impossible for a contemplator to progress straight into maintenance- they will progress through action first), preparation to action (again it is impossible for progress straight into maintenance) and action into maintenance. The following section reports the analyses conducted to identify dominant processes of exercise behaviour change when a person progresses. Ideally, analysis would be conducted for progression from each stage of exercise behaviour change. However, in the present study, only two contemplators progressed (of those participants returning re-test questionnaires). Participants were therefore grouped into not regularly active at baseline (i.e. contemplators and preparers) and regularly active at baseline (i.e. actioners and maintainers).

Not regularly active at baseline.

In total, seven progressions in stage of exercise behaviour change were made for those not regularly active at baseline. Similarly, seven participants not regularly active at baseline maintained their stage of exercise behaviour change at re-test. To initially gain a subjective impression, figures 16. and 17. give boxplots for the median experiential and behavioural processes of exercise behaviour change respectively plotted against those participants who did and did not improve their stage of exercise behaviour change.

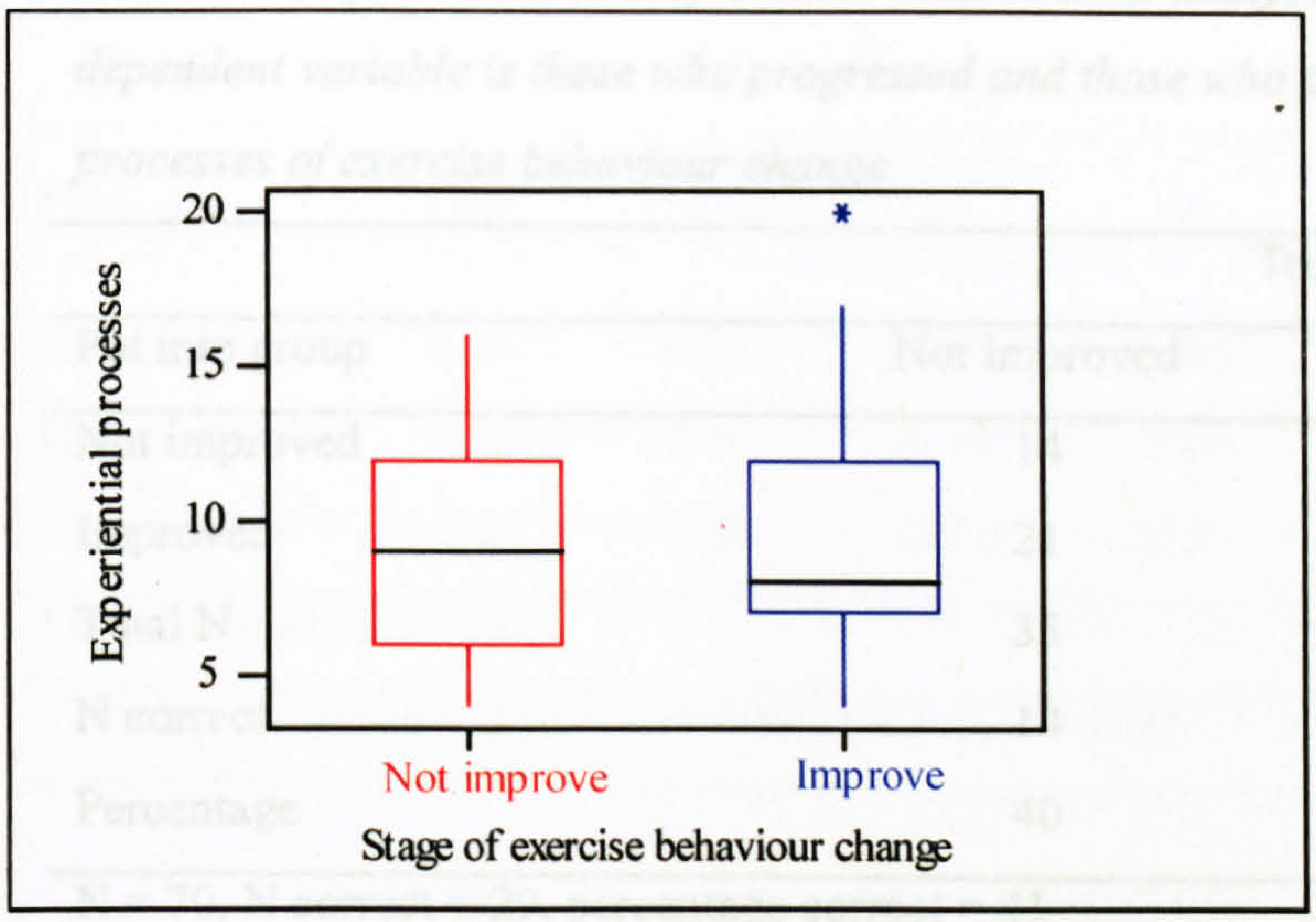


Figure 16. Experiential processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

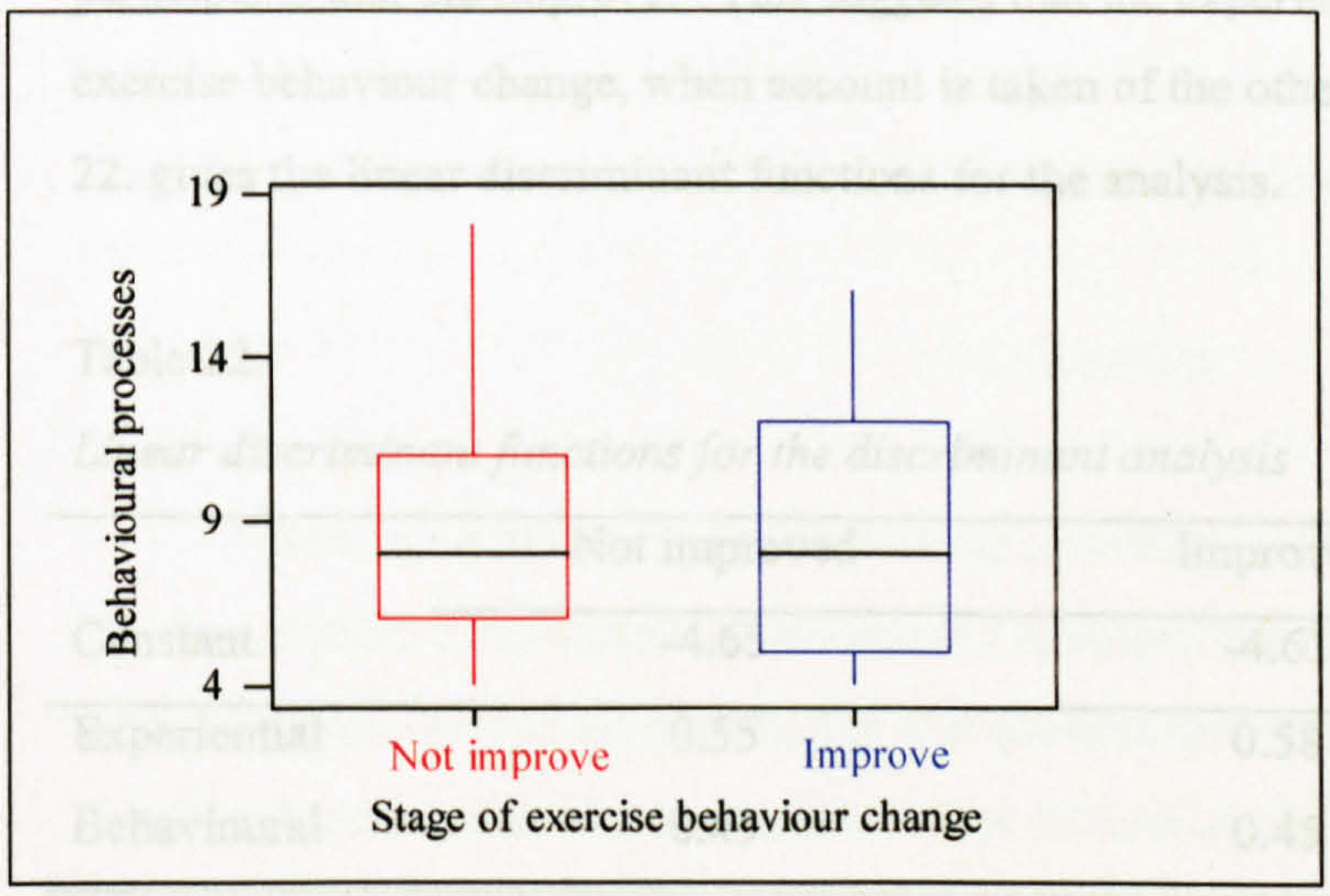


Figure 17. Behavioural processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

It appears from figures 16. and 17. that neither experiential nor behavioural processes of exercise behaviour are good discriminators. To test how well the experiential and behavioural processes of exercise behaviour change could identify those who improved and those who did not, a linear discriminant analysis using cross validation was conducted. Table 21. reports the misclassification matrix for this analysis.

Table 21.

The misclassification matrix of a linear discriminant analysis using cross validation where the dependent variable is those who progressed and those who didn't and the independent variable is the processes of exercise behaviour change

	True group	
Put into group	Not improved	Improved
Not improved	14	20
Improved	21	15
Total N	35	35
N correct	14	15
Percentage	40	43

N = 70, N correct = 29, percentage correct = 41

Table 21. shows that the model correctly identified only 41% of participants. Further, it shows that 40% of those not improving were classified correctly compared to 43% of those participants that did improve. This suggests that the experiential and behavioural processes of exercise behaviour change, when account is taken of the other, are not good discriminators. Table 22. gives the linear discriminant functions for the analysis.

Table 22.

Linear discriminant functions for the discriminant analysis

	Not improved	Improved
Constant	-4.65	-4.61
Experiential	0.55	0.58
Behavioural	0.49	0.45

Table 22. suggests that neither the experiential or behavioural processes of exercise behaviour change were any more important than the other in the contribution to the performance of the classifier.

In order to establish if either the experiential or behavioural processes of exercise behaviour change could be used to predict progression, a binary logistic regression analysis was conducted. Table 23. reports the logistic regression table for the experiential and behavioural processes of exercise behaviour change.

Table 23.

Logistic regression table for the experiential and behavioural processes of exercise behaviour change

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	0.04	0.77	0.06	0.96	/	/	/
Experiential	0.04	0.07	0.47	0.64	1.03	0.90	1.19
Behavioural	-0.04	0.07	-0.59	0.56	0.96	0.83	1.10
Log – likelihood = -48.30							
Test that all slopes are zero: G = 0.44, DF = 2, P = 0.80							

Table 23. shows that neither experiential nor behavioural processes of exercise behaviour change are significant predictors of progression, as both p values are greater than 0.05 and both sets of 95% confidence intervals contain 1.0.

Regularly active at baseline.

Only one baseline actioner returning a re-test questionnaire progressed into maintenance. Therefore it is impractical for a formal analysis to be conducted.

Discussion

The aim of this study was to pilot the procedures necessary to conduct the main study. The first objective concerned the assessment of subject participation rates and questionnaire return rates. Initially, 40% of all information and questionnaire booklets issued were returned. This response rate is similar to comparable studies (Mutrie and Caddell, 1994, Loughlan and Mutrie, 1997). Only 3 of the booklets were not completed correctly, suggesting that participants had no difficulties with the instructions offered in the booklet and the questionnaires, thus it appears the questionnaires can be used in postal surveys. Of the 75 participants volunteering for the study, 50 (67%) actually attended their chosen intervention. There was no significant difference between the percentage of those attending the fitness assessment (65%) and those attending the exercise consultation (80%). In general, all intervention participation rates observed have to be treated with a certain degree of caution. All participants were serving Police Officers and it was often the case that they were called away with relatively short notice. Thus participation was not always under the control of the volunteer.

Thirty-four (68%) of those participants attending the initial intervention returned the re-test questionnaire. In this case, the percentage of returned re-test questionnaires was significantly higher for the exercise consultation group (100%) compared to the fitness assessment group

(62%). This finding has to be viewed with caution however as there were only 8 original participants in the exercise consultation group compared to 42 in the fitness assessment group. If a significant group difference does exist, a possible explanation could be that the majority of the fitness assessment group were either actioners or maintainers at test, thus it was difficult for them to significantly increase their level of physical activity (this may be interpreted by them as a failure, deterring completion of re-test questionnaire). However, the exercise consultation group predominantly consisted of contemplators and preparers at test. For this group, increases in physical activity were more achievable so it is possible that this group had a greater feeling of "success". Clearly, this needs to be studied further in the main study.

The second objective of the study was to assess the percentages and characteristics of respondents volunteering for the study and specifically, those volunteering for either a fitness assessment or exercise consultation. Initial analysis revealed that there was no significant difference in the ages of respondents applying for either a fitness assessment or exercise consultation. However, significantly more males applied for the study than females, but as was mentioned earlier in the chapter, there were approximately four times as many males in the Police Station as females, offering a probable explanation. Further analysis revealed that both interventions attracted comparable proportions of males and females.

With respect to the stage of exercise behaviour change, comparison with comparable research (Mutrie et al., 1997) shows that the present study attracted a far higher proportion of people who were regularly active (71% in the present study compared to 40% [averaged] in the Mutrie et al. study). This difference probably reflects the fact that all participants in the present study were serving Police Officers who would be expected to be regularly active.

With respect to the percentages applying for a fitness assessment compared to an exercise consultation, analysis revealed that significantly more participants volunteered for a fitness assessment. A possible explanation for this could be that further analysis showed intervention choice was highly related to stage of exercise behaviour change with those not regularly active preferring an exercise consultation and those regularly active a fitness assessment. It is logical that a person who is already regularly active will not be attracted to an intervention specifically designed to increase physical activity in those not regularly active (i.e. an exercise consultation). It follows that they would be more interested in ascertaining if their current level of physical activity is reflected in their fitness level. In contrast, it is also logical that those not regularly active would be attracted to an intervention designed for predominantly sedentary people and not to an intervention that could possibly highlight their poor level of fitness as a result of inactivity. It has already been established that the study attracted a far higher percentage of regularly active participants.

The next two study objectives were to pilot the procedures involved in a fitness assessment and exercise consultation. As mentioned in the results section, both interventions took approximately half an hour to complete and there appeared to be no problems with the format of either intervention. All volunteers agreed to participate after the nature of the intervention had been explained and the general consensus among participants was that they had found their respective intervention a worthwhile experience.

The final study objective concerned the methodology. The first section of the results analysed the pre-intervention relationships between the dependant variables and is reported in appendix K. The methodology used in the study allowed for comparison of pre-intervention relationships between the stages of exercise behaviour change and physical activity and between the stages and processes of exercise behaviour change. Analysis showed that the relationship expected between physical activity and the stages of exercise behaviour change was evident for leisure time physical activity and total physical activity but not for occupational physical activity. These results concur with those of the previous chapter that changes in total physical activity are almost exclusively due to changes in leisure time physical activity. Further, a possible explanation why the expected relationship did not exist for occupational physical is that a person has relatively little "control" over their activity level whilst at work. All Police Officers have similar responsibilities and duties and so it would be difficult for an actioner to be significantly more active than a contemplator for example whilst at work. It is also possible that, as mentioned in the previous study, participants only recall leisure time physical activity when completing the stages of exercise behaviour change. This and the fact that question marks exist over the reliability and criterion validity of SPAQ for occupational physical activity, means that the results for occupational and hence total physical activity have to be viewed with caution.

Pre-intervention analysis of the relationship between the stages and processes of exercise behaviour change showed that both contemplators and preparers used the experiential processes significantly more than the behavioural processes of exercise behaviour change. Use of the experiential processes increased in the action and maintenance stages of exercise behaviour change, but not significantly. In contrast, actioners and maintainers were using the behavioural processes significantly more than the contemplators and preparers. Use of the experiential and behavioural processes of exercise behaviour change did not differ for either actioners or maintainers. These results indicate that the experiential processes of exercise behaviour change are more widely used in the early stages of exercise behaviour change. However, it appears that use of the behavioural processes greatly increase in the latter stages of exercise behaviour change. These results are consistent with comparable research (Marcus et al., 1992b).

The next section of the results concerned changes in the dependent variables from test to six month re-test. The methodology used in the present study allowed for a simple test, re-test comparison for stage of exercise behaviour change, physical activity and processes of exercise behaviour change. Analysis showed that at baseline, the majority of fitness assessment participants were placed in the "positive" category for stage of exercise behaviour change (i.e. they were in either the actioner or maintainer stages at baseline). In contrast, at baseline, the majority of exercise consultation participants were placed in the "negative" category (i.e. the majority were in either the contemplation or preparation stages of exercise behaviour change). At six months post test, all baseline actioners and maintainers remaining in that stage at six months were placed in the positive category. Similarly, all those participants who progressed at least one stage of change from baseline to six months were also placed in the positive category. In contrast, at six months post test, all those baseline contemplators and preparers who remained in these stages at six months were placed in the negative category. Similarly, any participant regressing in their stage of change from test to re-test was also placed in the negative category. By comparing the ratios of the positive to negative categories at test to re-test, can give an estimation of the overall effect of the interventions on stage of exercise behaviour change. Analysis showed that these ratios increased for both intervention groups (although not significantly) suggesting both interventions had a positive effect on stage of exercise behaviour change.

It is possible that the interventions could have had a different effect on those not regularly active (contemplators and preparers) and those regularly active (actioners and maintainers) as already mentioned, the exercise consultation is geared towards increasing physical activity in those people who are not regularly active. In contrast, the fitness assessment may be more beneficial to those people who are regularly active. Splitting each intervention group into regularly active at test and not regularly active at test and analysing each for changes in the proportion of participants in the negative and positive categories for stage of exercise behaviour change may have provided further valuable information about the effects of each intervention on stage of exercise behaviour change. As already mentioned, *maintenance* is desired for the latter stages of exercise behaviour change whereas *progression* is desired for the earlier stages. Analysing both together could mask any individual significant result. In the present study however, the numbers in the stages of exercise behaviour change in each intervention group did not allow for such an analysis.

The current methodology only allows comparison between test and six months post test. It is possible that important changes in stage of exercise behaviour change occurred shortly after the interventions but after six months returned to test levels, possibly explaining the fact that no significant changes in stage of exercise behaviour change were evident.

In relation to changes in physical activity, analysis revealed that neither intervention group significantly changed in their leisure time occupational or total physical activity from test to re-test. This is perhaps to be expected given no significant change in stage of exercise behaviour change. Again, significant changes shortly after the interventions may have occurred, returning to test levels after six months. Indeed, the work of Loughlan and Mutrie (1997) supports this assumption. As reported in chapter two, Loughlan and Mutrie conducted an investigation to determine the effects of a fitness assessment or exercise consultation on physical activity. They found that immediately following the interventions, physical activity greatly increased, peaked at three months post-test and then fell six-months post test.

With regard to the processes of exercise behaviour change, analysis of those not regularly active at test showed that there were no significant differences between intervention groups for changes in the experiential and behavioural processes from test to re-test. This finding has to be viewed with caution however, given the relatively small numbers in each intervention group. The fact that only one participant regularly active at test progressed to re-test meant that a similar analysis could not be conducted for participants regularly active at test.

With respect to those not regularly active at test, analysis revealed that the experiential and behavioural processes of exercise behaviour change were not good discriminators for participants progressing in their stage of exercise behaviour change compared to those remaining in the same stage of exercise behaviour change. Similarly, further analysis showed that they could not be used to accurately predict progression. The small number of participants in the progression group could offer a possible explanation. Once again, the fact that only one progression was made for the group regularly active at test meant that a similar analysis for this group could not be conducted.

Conclusions

The response rate of 40% was similar to comparable research suggesting that the methodology did not deter volunteers. It appeared that the questionnaires were relatively easy to complete suggesting that they can be used in postal surveys. Approximately two thirds of those applying for the study attended their intervention with no significant difference in the proportion of participants attending either intervention. There were no significant differences in either the age or gender of those applying for either intervention but the exercise consultation attracted significantly more participants who were not regularly active. In contrast, the fitness assessment attracted significantly more participants who were regularly active. The exercise consultation group returned significantly more (100%) of the re-test questionnaires compared to the fitness assessment group (68%). There were no problems with the delivery of either intervention with both lasting approximately 30 minutes. The methodology used in the study allowed for analysis of pre-intervention relationships between dependant variables and for a simple comparison of intervention groups from test to re-test. The fact that 6 months separated measurement periods however meant that important changes in dependant variables could have been missed. The small numbers in some of the statistical analyses could have affected the results and the absence of a control group meant that any changes in the dependant variables observed could not be attributed to the interventions.

Recommendations For Main Study

1. In order to determine if any observed changes in the studies' dependent variables could be attributed to the interventions, it is recommended that two control groups (one for each intervention) be utilised.
2. To conduct at least 113 interventions for the fitness assessment experimental and fitness assessment control groups.
3. To conduct at least 50 interventions for the exercise consultation experimental and exercise consultation control groups.
4. As the present study did not attract these numbers, it is recommended that potential volunteers are offered incentives for participation in the main study.
5. As discussed in chapter two, few studies have examined the effects of re-test interventions on dependent variables. It is therefore recommended that a re-test intervention be offered at three months. This time period is recommended as Loughlan and Mutrie (1997) showed that this is when physical activity peaks following similar interventions. The re-test intervention may help participants to maintain activity past this time point.
6. To measure dependent variables at regular intervals i.e. pre-test, four weeks post test, three months post test, six months post test and one year post test. This will allow a comprehensive, long-term picture of changes in dependent variables to be built up.
7. Fitness assessment and exercise consultation procedures to be unchanged with the exception of adding an intervention "expectation" questionnaire to both interventions and a goal record sheet to the fitness assessment intervention.
8. A representative subject group, preferably community based, to be used.

Chapter 5

STUDY THREE :
The impact of fitness assessments and exercise consultations on a low income community based population's stage of exercise behaviour change, processes of exercise behaviour change and physical activity levels

Shortlees and Riccarton, Kilmarnock
May 1997 - September 1998

Introduction

Studies one and two developed and piloted the instruments and procedures necessary to achieve the aims of study three. These aims can be split into four sections, each with their own specific objectives:

Section One - Pre-intervention Analysis

The aim of this section was to attract participants to the study and analyse the characteristics of volunteers and randomly assign them to study groups. The objectives of the section were as follows:

(a) to randomly assign fitness assessment volunteers into either an experimental or control group and exercise consultation volunteers into either an experimental or control group

(b) based on pilot study analysis, to initially conduct at least 113 fitness assessment experimental and control interventions and at least 50 exercise consultation experimental and control interventions

(c) to check that participants had been successfully randomised into study groups (i.e. comparing experimental with control groups), based on their sex, age, height, weight and stage of exercise behaviour change

(d) to compare all study volunteers on the basis of their age and sex

(e) to compare volunteers for each intervention on the basis of their sex, age, height, weight and stage of exercise behaviour change

(f) to analyse differences in gender, intervention group and age for those people applying and turning up for their intervention (some participants failed to turn up for their intervention)

(g) to analyse any group differences in intervention expectations

(h) to analyse pre-intervention relationships between stage of exercise behaviour change, processes of exercise behaviour change and physical activity.

Section Two - Analysis of Intervention Effects on Physical Activity

The aim of this section was to assess the impact of the interventions on participant's physical activity. The specific section objectives were as follows:

(a) to compare the four intervention groups on the basis of drop-out rates at each measurement period (baseline, 4 weeks, 3 months, 6 months and 1 year post test) for those regularly active and not regularly active at baseline

(b) to analyse leisure time and occupational physical activity separately

(c) at baseline (i.e. before interventions) to analyse any physical activity differences between intervention groups, between not regularly active and regularly active participants and for a combination of intervention group and activity status (i.e. interaction)
(d) to compare the immediate intervention effect (comparison of baseline, 4 weeks and 3 months post test) on physical activity for those regularly and non regularly active at baseline
(e) to compare the intervention re-test effect (comparison of 3 months, 6 months and 1 year post test) on physical activity for those regularly and non regularly active at baseline
(f) to compare the long term intervention effect (comparison of baseline to 1 year post test) on physical activity for those regularly and non regularly active at baseline
(g) to analyse any changes in health related fitness in fitness assessment group and any changes in weight in remaining three study groups at three months post test (i.e. intervention re-test).

<u>Section Three - Analysis of Intervention Effects on Stage of Exercise Behaviour Change</u>

The aim of this section was to assess the impact of the interventions on participant's stage of exercise behaviour change. The specific section objectives were as follows:
(a) to compare the immediate intervention effect (comparison of baseline, 4 weeks and 3 months post test) on stage of exercise behaviour change for those regularly and non regularly active at baseline
(b) to compare the intervention re-test effect (comparison of 3 months, 6 months and 1 year post test) on stage of exercise behaviour change for those regularly and non regularly active at baseline
(c) to compare the long term intervention effect (comparison of baseline to 1 year post test) on stage of exercise behaviour change for those regularly and non regularly active at baseline.

<u>Section Four - Analysis of Intervention Effects on Processes of Exercise Behaviour Change</u>

The aim of this section was to assess if any processes of exercise behaviour change were dominant when participant's shifted in their stage of exercise behaviour change. The specific section objectives were as follows:
(a) to directly compare the immediate intervention effect (baseline to four weeks) on the processes of exercise behaviour change for contemplators, preparers, actioners and maintainers.
(b) to identify any dominant processes of exercise behaviour change when progress is made through the stages of exercise behaviour change
(c) to establish which processes of exercise behaviour change, if any, correspond with regression from the maintenance stage of exercise behaviour change.

Study three was conducted with residents of two Kilmarnock housing estates called Shortlees and Riccarton, each having a population of around two thousand. Shortlees and

Riccarton are designated as areas of priority treatment by the Government because they are high in unemployment and social deprivation. They were chosen for the study because of three reasons. First, as was discussed in chapter two, areas high in deprivation suffer the highest levels of ill-health (The Black Report, 1982). This may be partly explained by the fact that these areas are also known to have the highest levels of inactivity (Allied Dunbar National Fitness Survey, 1992). By selecting an area high in social deprivation, the study could therefore assess the impact of two physical activity interventions in an environment where such interventions would be most beneficial. The second reason the area was chosen was that the potential recruitment base was a large (approaching 4000) "community based" population. Finally, there was a community centre based between the two areas that could provide the necessary accommodation for the interventions.

The methodology of stage three is described and the results analysed.

Methodology

Subjects

Three hundred and seventy residents of Shortlees and Riccarton volunteered for the study (mean age = 40.9 years, SD = 17.0 years). Two hundred and thirty five (64%) were female (mean age = 41.9 years, SD = 17.0 years), 135 (36%) were male (mean age = 38.3 years, SD = 17.0 years).

Instruments

Dependent Variables

Physical activity.

SPAQ was professionally produced by a local printers (appendix N) and used to measure the previous seven days' occupational, leisure time and total physical activity.

Stage of exercise behaviour change.

SPAQ contains a section for measuring stage of exercise behaviour change (Loughlan and Mutrie, 1995b).

Processes of exercise behaviour change.

The processes of exercise behaviour change questionnaire used in study two was professionally produced by a local printers (appendix O).

Independent Variables

Fitness assessment.

The fitness assessment protocol was identical to that described in study two.

Exercise consultation.

The exercise consultation protocol was identical to that described in study two.

Control record sheet.

A control record sheet identical to the exercise consultation reference sheet used in study two was used to record the control groups' morphological data and personal details.

Expectation Questionnaire

An expectation questionnaire (appendix P) developed for use in a similar study (Loughlan, 1995) was used to measure the degree to which participants thought their respective intervention would effect their intention to become more physically active and their actual physical activity level. Participants were required to rate on a five point scale (ranging from "not at all" to "greatly") how their intervention would alter their intention to be more active and their actual physical activity level.

"Ricclees" Health and Fitness Club Application Forms

As was described in chapter three, a health and fitness project called *Ricclees* provided residents of Shortlees and Riccarton with a basic health and fitness service such as aerobic class provision and a fitness assessment service. *Ricclees* health and fitness club was amended so that new members could take part in the present study (existing members continued to receive the same service and were not included in the study). Potential members could volunteer for either a fitness assessment or an exercise consultation by ticking an appropriate box on the application form. Following their interventions, members were offered exercise vouchers entitling them to free access twice per week to any two activities from a list of golf (only one free entry per week), badminton, swimming or workouts at a local health and fitness suite. On production of a valid *Ricclees* membership card, members could exchange the voucher for one session of the designated activity. Amended *Ricclees* health and fitness club application forms (appendix Q) were designed and produced professionally by a local printers. The application form described what is involved in either a fitness assessment or exercise consultation, the benefits of joining the club, how to apply and who is eligible for which activities (only those people falling into a concessionary category could receive exercise vouchers for the health and fitness suite). The forms also contained a tear off section which the person returned if they wished to apply for membership. This noted personal details, concessionary categories and the person's intervention choice.

Procedures

Figure 18 gives the experimental design of the study. Three thousand amended *Ricclees* application forms were delivered by the Royal Mail's leaflet drop service to residents of Shortlees and Riccarton. All application forms returned were split into two piles, those applying for a fitness

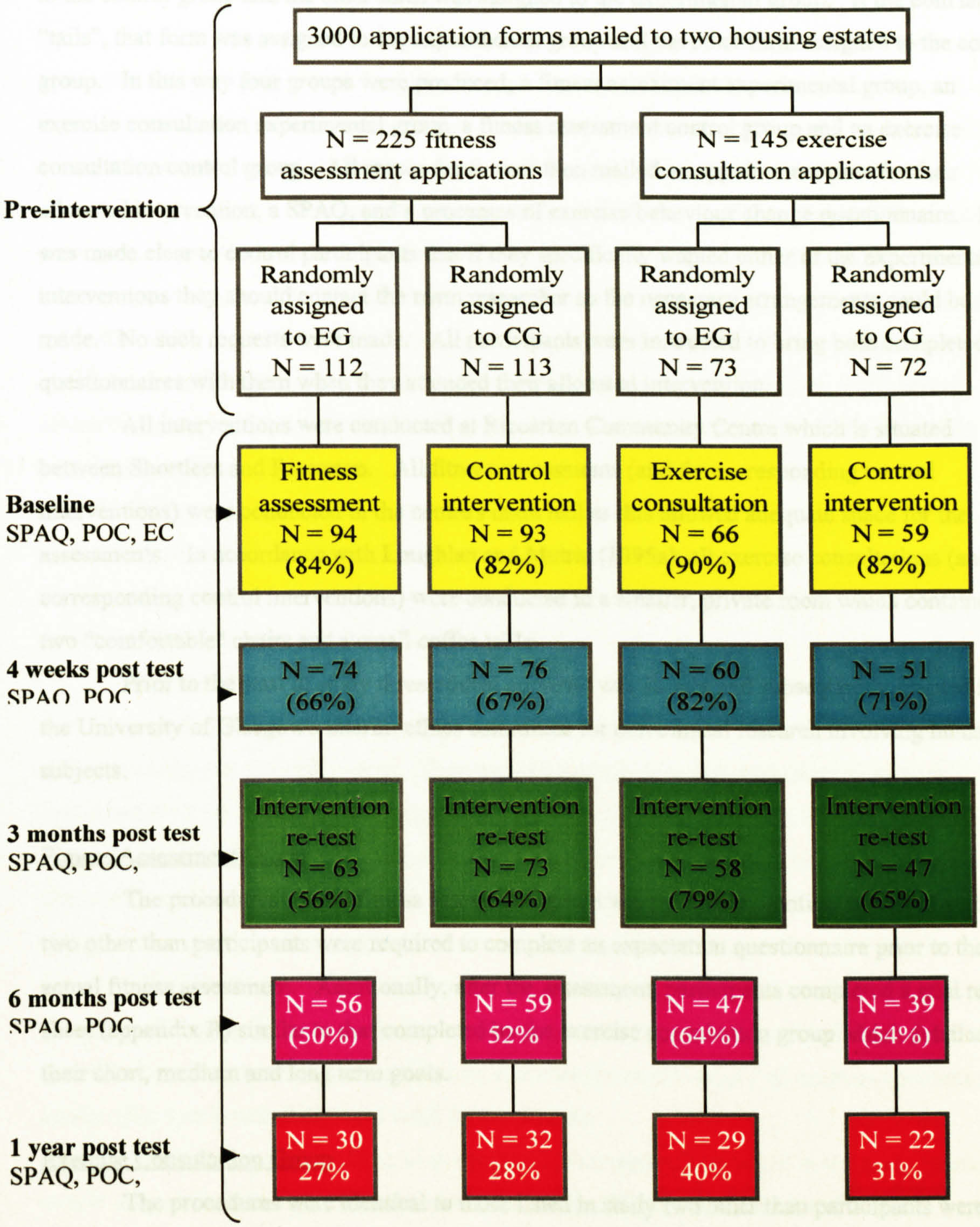


Figure 18. The experimental design of study 3

Note. EG = experimental group, CG = control group, POCQ = Processes of exercise behaviour change questionnaire, EQ = Expectation questionnaire.

assessment as their intervention and those applying for an exercise consultation. Respondents were then randomly assigned into either an experimental or control group by selecting two forms from a particular pile (either the fitness assessment or exercise consultation pile) and nominating one of the forms to act in a coin toss situation. If the coin landed "heads", that form was assigned to the control group and the other form was assigned to the experimental group. If the coin landed "tails", that form was assigned to the experimental group and the other form assigned to the control group. In this way four groups were produced; a fitness assessment experimental group, an exercise consultation experimental group, a fitness assessment control group and an exercise consultation control group. All respondents were then mailed an appointment time for their allocated intervention, a SPAQ, and a processes of exercise behaviour change questionnaire. It was made clear to control participants that if they specifically wanted either of the experimental interventions they should contact the main researcher so the necessary arrangements could be made. No such requests were made. All participants were instructed to bring both completed questionnaires with them when they attended their allocated intervention.

All interventions were conducted at Riccarton Community Centre which is situated between Shortlees and Riccarton. All fitness assessments (and the corresponding control interventions) were conducted in the centre's main hall as this allowed adequate space for the assessments. In accordance with Loughlan and Mutrie (1995a), all exercise consultations (and the corresponding control interventions) were conducted in a smaller, private room which contained two "comfortable" chairs and a small coffee table.

Prior to the start of study three ethical approval was sought and subsequently granted from the University of Glasgow's interim ethics committee for non clinical research involving human subjects.

Fitness Assessment Group

The procedures for the fitness assessment group were virtually identical to that of study two other than participants were required to complete an expectation questionnaire prior to the actual fitness assessment. Additionally, after the assessment, participants completed a goal record sheet (appendix R) similar to that completed by the exercise consultation group which detailed their short, medium and long term goals.

Exercise Consultation Group

The procedures were identical to those listed in study two other than participants were required to complete an expectation questionnaire prior to the consultation.

Control Groups

Members of both control groups were welcomed and the purpose of the study explained. Personal details were recorded and participants were asked to complete an expectation questionnaire. Their height and weight were then measured.

At the end of each intervention (including control interventions), participants were asked which two activities they would like exercise vouchers for. They were offered the choice of either swimming at a local leisure centre, badminton at a local community centre, golf at a local golf course or entry into a local fitness suite (with the exception of those who did not fall into a concessionary category - these people were not offered entry into the fitness suite). Participants photographs were then taken to validate their *Ricclees* membership cards. On the following day, all participants were mailed a *Ricclees* membership card valid for six months, a copy of the "Hassle free execrise" booklet (Health Education Board For Scotland, 1994), a *Ricclees* information booklet (appendix S) and a four week supply of their chosen exercise vouchers. The fitness assessment group were also mailed their fitness assessment report and goal record cards. The exercise consultation group were also mailed their goal record cards.

After approximately four weeks (coinciding with the expiry of the exercise vouchers) participants were mailed a SPAQ and a processes of exercise behaviour change questionnaire with the instruction that if they returned the completed questionnaires they would receive a further two month supply of exercise vouchers.

After a further two months, continuing participants were written to and invited for a "re-test". Again they were required to bring completed SPAQ's and processes of exercise behaviour change questionnaires to the re-test. They were also advised that all those attending the re-test would receive a further three month supply of exercise vouchers. The procedures for each re-test intervention were identical to the original other than photographs were not taken and the expectation questionnaire was not administered. Participants were also asked if they wished to change their chosen exercise vouchers.

After a further three months all continuing participants were again mailed a SPAQ and a processes of exercise behaviour change questionnaire with the instruction that if they returned the completed questionnaires they would be sent a further six month supply of exercise vouchers and another *Ricclees* membership card valid for six months.

One year post intervention, all participants who were still involved in the study (some people dropped out throughout the course of the study - this will be detailed in the results section), were mailed a SPAQ and a processes of exercise behaviour change questionnaire together with a letter thanking them for their involvement in the study. They were also advised that if they returned the questionnaires, they would be sent a complimentary T-shirt.

Data Analysis

Section One – Pre-intervention Analysis

Analysis of those applying for the study.

Chi squared tests of association (χ^2) were used to examine relationships between the gender and intervention choice of those initially applying for the study. A two way analysis of variance (sex by intervention group) was conducted for age to determine significant differences in age between intervention choice and between sexes and also to identify if any difference between intervention groups was similar between sexes (i.e. the interaction).

Analysis of those attending their intervention.

A series of chi squared tests of association were conducted to examine any differences in the age, sex and intervention group between those attending and those not attending their intervention.

Differences between those participants applying for each intervention.

Two sample t-tests were used to identify differences in height and weight between those applying for either intervention. A chi squared test of association was used to examine differences in the proportions in stage of exercise of exercise behaviour between those applying for either intervention.

Randomisation.

To test if there was any difference between experimental and control groups for each intervention, for age, height and weight, a series of two-sample t-tests were conducted. To test for differences in the proportions of males and females in each group (i.e. experimental and control) and the distribution of the stages of exercise behaviour change, chi squared tests of association were used.

Expectation effect.

To investigate any differences in intention to change and actual change between intervention groups, two Kruskal Wallis tests were conducted. Where significant effects were found, Mann-Whitney tests were used to identify significant group differences.

Pre-intervention relationships between the stages and processes of exercise behaviour change and physical activity.

A one way analysis of variance was used to determine if any significant differences existed between stages of exercise behaviour change for total, leisure time and occupational physical activity. Where significant effects were found, Bonferroni multiple comparisons were used to identify which stages of exercise behaviour change differed.

To test for differences between stages of exercise behaviour change for the experiential and behavioural processes of exercise behaviour change, two non-parametric Kruskal Wallis tests were performed. Where an effect was found, follow up Mann-Whitney tests were used to identify significant stage differences. In order to test for any difference between experiential and behavioural processes for each stage of exercise behaviour change, four Wilcoxon matched pairs tests were conducted.

Section Two - Analysis of Drop-out Rates and Intervention Effects on Physical Activity

Drop out rates.

To test for differences between study groups for drop-out rates at each study test stage, a series of chi squared tests of association were conducted. Where differences were found, Bonferroni confidence intervals were calculated to identify which groups differed at each test stage.

Intervention effects on physical activity.

Leisure time, occupational and total physical activity were analysed separately. At baseline, a two way analysis of variance (intervention group and activity status) was conducted on physical activity to determine significant main effects for intervention group (i.e. FAE, FAC, ECE, and ECC) and for activity status (i.e. non regularly active and regularly active) and to determine if any differences between activity status were consistent across the intervention groups (i.e. the interaction).

To determine the immediate intervention effects (i.e. over baseline, 4 weeks and 3 months post test), a two way repeated measures analysis of variance with one within (test stage) factor and one between subject factors (intervention group) for physical activity was used to identify significant main effects for test stage and intervention group, and the interaction, for both those non regularly and regularly active at baseline. Significant main effects for test stage were followed up with Bonferroni multiple comparisons for repeated measures. Significant main effects for intervention groups were followed up with Bonferroni multiple comparisons. No significant interactions between test stage and intervention group were evident. For the repeated measures analysis, homogeneity of covariance was tested for with a Mauchly sphericity test. Where data failed this test (i.e. $p < 0.05$), the analysis of variance was modified to make it more conservative by conducting a Greenhouse - Geiser analysis (i.e the Epsilon corrected averaged F).

A similar set of analyses were conducted to examine the effect of the re-test interventions (i.e. 3 months, 6 months and 1 year post test analysis). To assess the long-term intervention effect, a series of one sample t-tests were used to compare baseline physical activity with 1 year post test physical activity for each intervention group.

Changes in health related fitness.

To assess the changes in health related fitness from baseline to three-month re-test, a series of one sample t-tests were conducted.

Section Three – Intervention Effects on the Stage of Exercise Behaviour Change.

As in the previous chapter, to try and combat the problem of low expected cell counts, caused by relatively small numbers in some groups, the stage of exercise behaviour change data was again pooled into either a positive or negative category. At baseline, all those in the contemplator and preparer stages of exercise behaviour change (i.e. not regularly active) were placed in a "negative" category, all those in the actioner and maintainer stages (i.e. regularly active) were placed in a "positive" category. At subsequent test stages, all those contemplators and preparers *remaining* in these stages continued to be placed in the negative category. In addition, any participant *relapsing* from any stage of exercise behaviour change between subsequent test stages were also placed in the negative category. In contrast, baseline actioners and maintainers remaining in these stages at subsequent test stages continued to be placed in the positive category. Participants who had *progressed* in their stage of exercise behaviour change between test stages were also placed in the positive category. It would also be tempting to place those participants who dropped out of the study into the negative category as this could be interpreted as a negative result. However, it is impossible to determine whether in fact that person has regressed in their stage of exercise behaviour change. For this reason, analysis is only conducted for participants remaining in the study at three months (for the immediate intervention effect) and one year post test (for the intervention re-test and long-term effect).

In addition, to highlight any differences within activity status groups, the stages of exercise behaviour change were also pooled into not regularly active at baseline (contemplators and preparers) and regularly active at baseline (actioners and maintainers) and analysed separately. It has to be noted that in this case, it is possible for a person to remain in the not regularly active group but be placed in the positive category at a subsequent test stage. This would happen if a contemplator progressed to preparation.

For the immediate intervention effect (i.e. baseline to 3 months post test analysis) four Wald's tests for marginal homogeneity were conducted to identify any differences in the proportion of participants in the positive and negative categories at three months post test compared to baseline for each intervention group. Where significant differences were found, Bonferroni intervals identified differences in proportions for each intervention group. To assess if differences in the distribution of participants in the positive and negative categories were evident between study groups when comparing test stages, three chi squared tests of association were conducted. Follow up Bonferroni intervals were calculated to identify significant intervention group differences.

A similar set of analyses were conducted for the intervention re-test (i.e. 3 months, 6 months and 1 year post test) and long term effect (i.e. baseline to 1 year comparison).

Section Four – Intervention effects on the Processes of Exercise Behaviour Change

To initially assess if there was any difference between intervention groups for use of each process of exercise behaviour change for each stage of exercise behaviour change, a series of Kruskal Wallis test were conducted on the median process score for each intervention group for each stage of change.

To assess if the interventions had a similar effect on the processes of exercise behaviour change, a series of Kruskal Wallis tests were conducted to compare the change in process use between the intervention groups when progress was made through similar stages of exercise behaviour change.

In relation to the identification of key processes of exercise behaviour change associated with stage progression, initially, a linear discriminant analysis was used to determine the discriminatory power of the processes of change in differentiating between those who were likely to progress from each stage of change and those who were not. A binary logistic regression was then used to identify processes of change that were significant predictors of stage of change progression. Similar analysis was conducted to identify key predictors of regression from the maintenance stage of exercise behaviour change.

Results

The results are split into four sections, corresponding to those sections outlined at the beginning of this chapter.

Section One – Pre-intervention Analysis

This section is concerned with a pre-intervention analysis. The aim and specific objectives of the section are detailed at the start of this chapter.

Analysis of all Returned Application Forms

Response rate and group differences.

In total, of the 3000 amended *Ricclees* application forms sent out to Shortlees and Riccarton, 370 were returned giving an overall response rate of 12.3%. Table 24. gives the descriptive statistics for those people returning completed application forms.

Table 24.

Descriptive statistics for those people returning completed application forms.

			Age (years)				
Sex	N	%	Mean	Median	SD	Min	Max
Male	135	36.5	38.3	34	17	17	77
Female	235	63.5	41.9	38	17	16	80

Figure 19. gives boxplots of ages for females and males returning application forms.

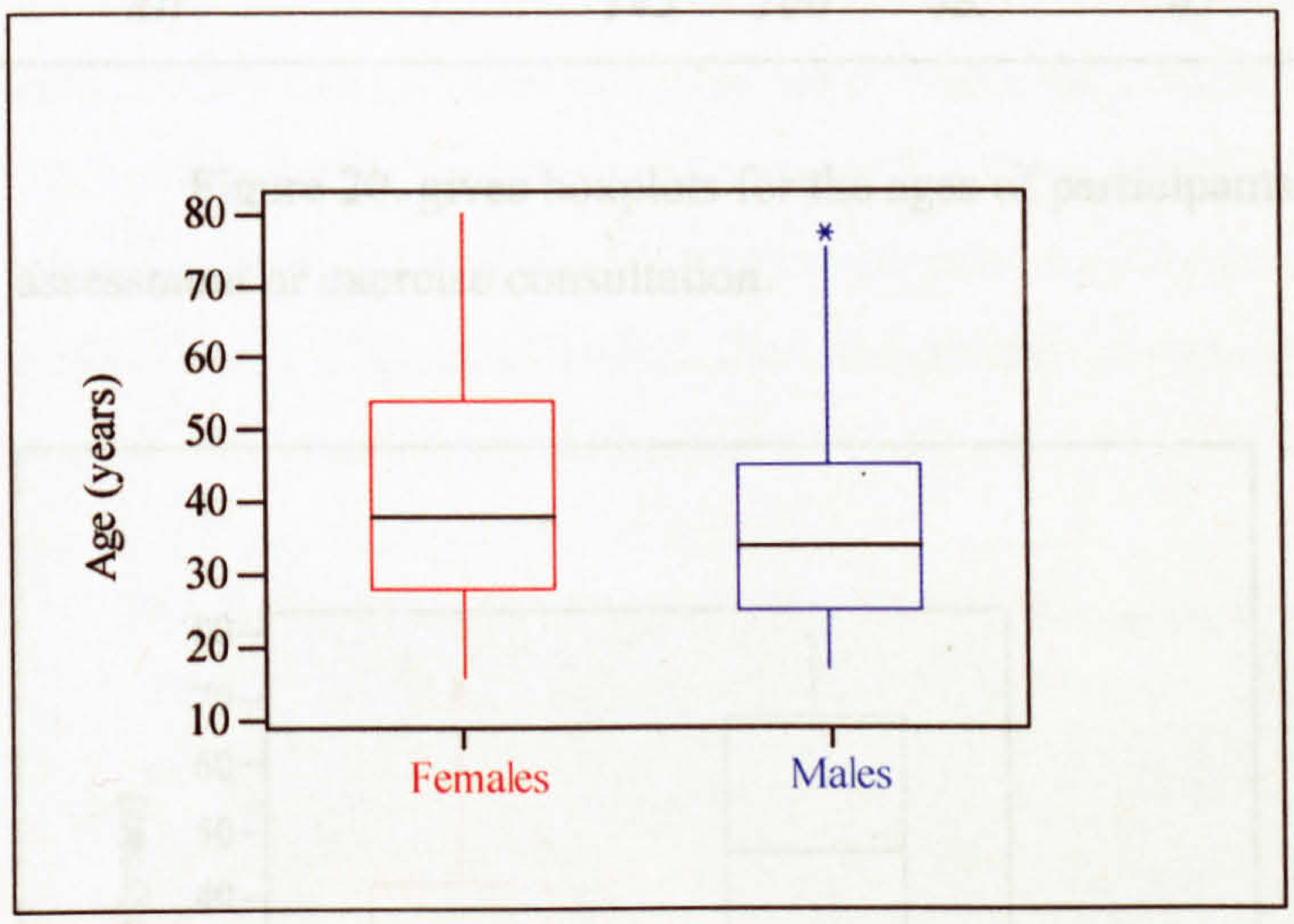


Figure 19. Boxplots of ages for females and males returning completed application forms

Figure 19. shows that the age of both females and males appear to be normally distributed. It also suggests that the females applying for the study are slightly older than the males. A two sample t-test revealed that this difference almost reached significance at the 95% level (t = 1.95, df, 279, p = 0.053). Table 24. also shows that nearly twice as many respondents were female. A chi square analysis confirmed that this difference was significant ($\chi^2 = 27$; df = 1, p<0.05).

Of the 370 people who returned questionnaires, 225 (61%) volunteered for a fitness assessment compared to 145 (39%) who volunteered for an exercise consultation. A chi square analysis revealed that this difference was significant ($\chi^2 = 17.3$; df = 1, p<0.05). Table 25. gives the descriptive statistics for each intervention group.

Table 25.

Descriptive statistics for the fitness assessment and exercise consultation groups.

				Age (years)				
Group	Sex	N	%	Mean	Median	SD	Min	Max
Fitness	Male	94	42	33.9	32	13.7	17	67
Assessment	Female	131	58	36.3	34	14.7	16	72
All	/	*225*	*100*	*35.3*	*33*	*14.3*	*16*	*72*
Exercise	Male	41	28	48.4	48	19.4	18	77
Consultation	Female	104	72	48.8	47	17.2	16	80
All	/	*145*	*100*	*48.7*	*47*	*17.7*	*16*	*80*

Figure 20. gives boxplots for the ages of participants volunteering for either a fitness assessment or exercise consultation.

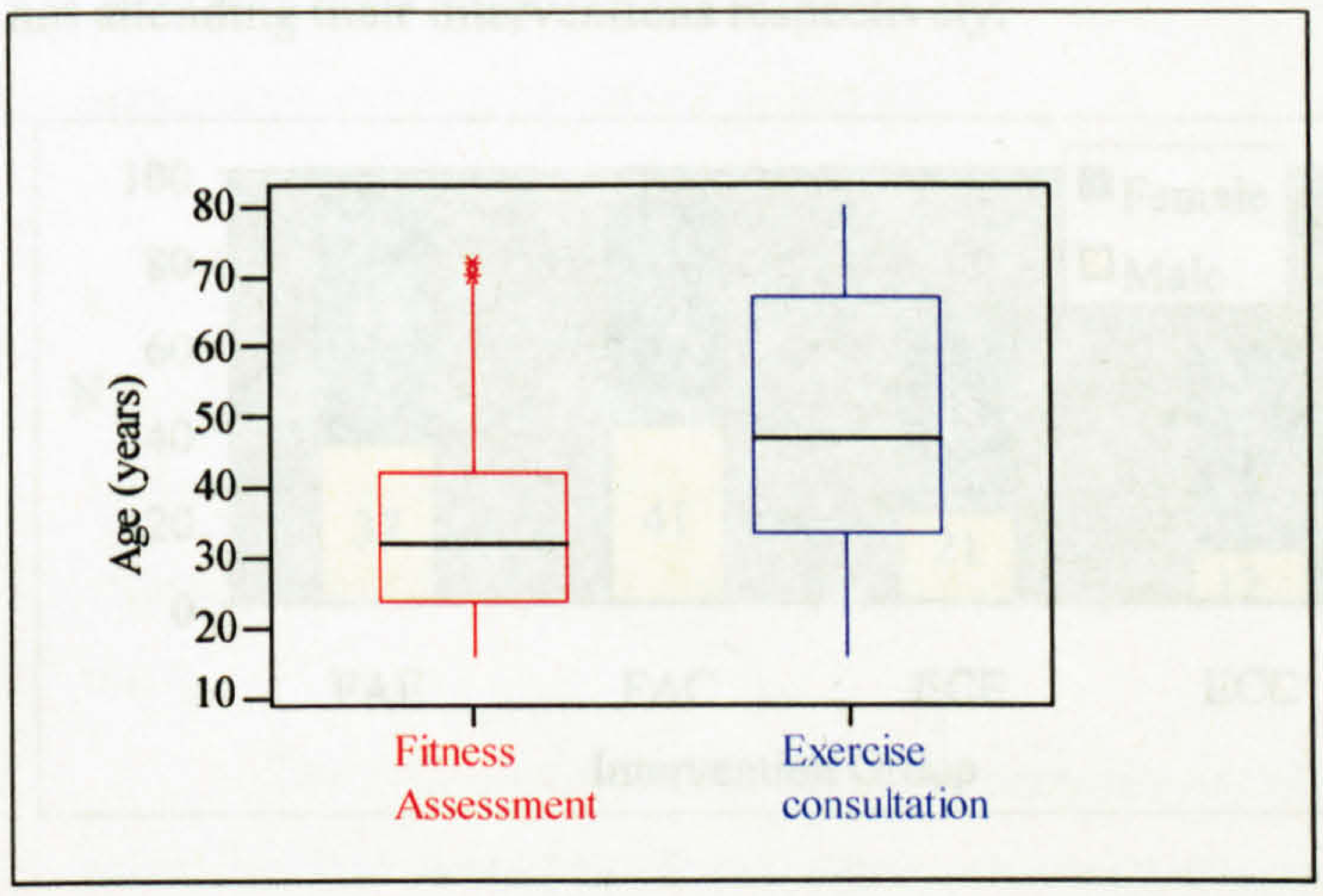


Figure 20. Boxplots of ages for participants volunteering for either a fitness assessment or exercise consultation

Figure 20. shows that the data is normally distributed and indicates that those applying for an exercise consultation are older than those applying for a fitness assessment. A two way analysis of variance (sex by intervention group) performed on age, indicated a significant main effect for intervention group ($F = 56.56$, $p < 0.05$), confirming the subjective impression gained from figure 20. There was no main effect for sex ($F = 0.62$, $p = 0.43$) and no significant interaction ($F = 0.33$, $p = 0.57$). Thus females applying for an exercise consultation were older than females applying for a fitness assessment. The same was true for males.

Table 25. also shows that both interventions attracted more females than males and two chi square tests revealed that these differences were significant (fitness assessment: $\chi^2 = 6.08$; df, 1, $p<0.05$, exercise consultation: $\chi^2 = 27.4$; df, 1, $p<0.05$). Given that significantly more females applied for the study, this result is not too unexpected. However, analysing the female group

separately, a chi square test revealed that there was no significant difference in the number of females applying for a fitness assessment (N=131, 56%) compared to the number applying for an exercise consultation (N=104, 44%), (χ^2 = 3.1; df ,1, p = 0.078). In contrast, the number of males applying for a fitness assessment (N=94, 70%) was significantly higher than the number applying for an exercise consultation (N=41, 30%), (χ^2 = 27.4; df = 1, p<0.05).

Analysis of Those People Attending Their Initial Intervention

As was detailed in the procedures section, all 370 respondents were randomly assigned into an experimental or control group, based on their favoured intervention. This resulted in the formation of 4 study groups; fitness assessment experimental, fitness assessment control, exercise consultation experimental and exercise consultation control. Of the 370 people invited to attend, 58 (16%) failed to keep their appointment. Tables 1 and 2 in appendix T give the descriptive statistics for the 312 people (84%) who attended their intervention, and the 58 (16%) who did not respectively. Figures 21 and 22 show the number of male and female participants attending and not attending their interventions respectively.

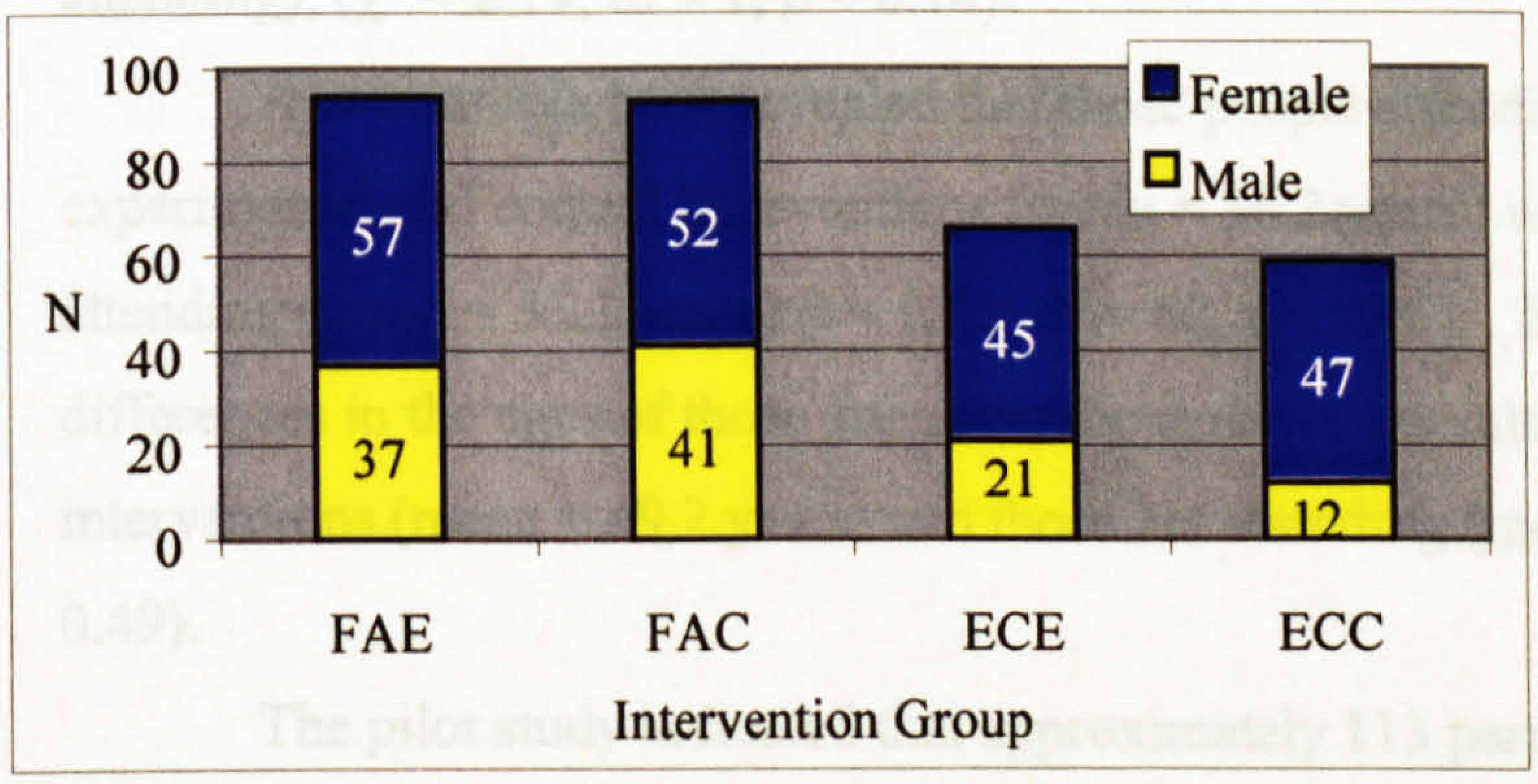


Figure 21. The number of males and females attending initial intervention.

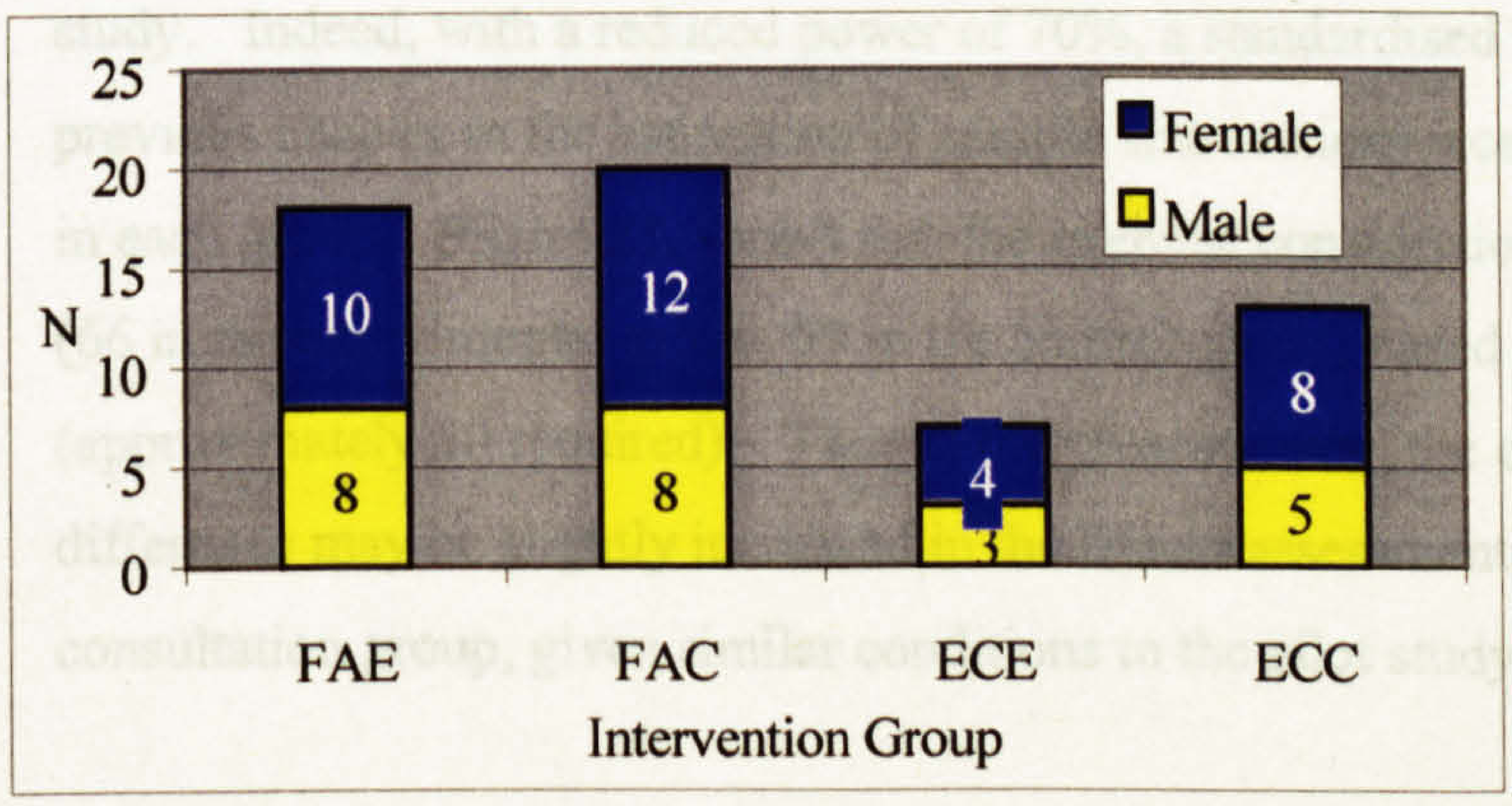


Figure 22. The number of males and females not attending initial intervention.

Figure 21. shows that in total, 201 females (86%) attended their intervention. Figure 22. shows that 34 females (14%) did not attend their allocated intervention. Cross tabulating this result with that of the males (82% and 18% respectively), chi square analysis revealed that the proportion of those attending and those not attending their intervention was not significantly different between females and males ($\chi^2 = 0.71$; df, 1, $p = 0.39$).

Similarly, chi square analysis showed that the proportion of those attending and not attending who had applied for a fitness assessment (experimental plus control group; total attended, 187, total not attended, 38) was not significantly different from the proportion of those attending and not attending who had applied for an exercise consultation (125 and 20 respectively), ($\chi^2 = 0.64$; df, 1, $p = 0.42$).

Figure 21. shows that of those participants randomly assigned to the fitness assessment experimental group, 94 attended their intervention compared to 18 who did not (figure 22.). Cross tabulating this with the proportion of the fitness assessment control group attending (93) and not attending (20), chi square analysis showed no significant difference ($\chi^2 = 0.11$; df = 1p = 0.75). A similar result was obtained when the exercise consultation experimental group (66 attending, 7 not attending) was compared to the exercise consultation control group (59 attending, 13 not attending), ($\chi^2 = 2.19$; df = 1, $p = 0.14$).

A two sample t test revealed that those people attending the fitness assessment experimental and control interventions (mean = 36.2 years) were significantly older than those not attending (mean = 31.1 years) ($t = 0.23$; df = 60, $p < 0.05$). However, there were no significant differences in the ages of those attending the exercise consultation experimental and control interventions (mean = 49.2 years) and those not attending (mean = 45.9 years) ($t = 0.7$; df = 24, $p = 0.49$).

The pilot study indicated that approximately 113 participants would be required to be initially administered the fitness assessment experimental and control interventions. Figure 21. indicates that 94 were tested in the experimental group and 93 received a control intervention. This in effect reduces the probability of detecting a similar difference to that observed in the pilot study. Indeed, with a reduced power of 70%, a standardised difference of 0.3 (as calculated in the previous chapter in the estimation of sample size section) would require only 87 initial participants in each group. Figure 21. shows that the exercise consultation groups recruited adequate numbers (66 in the experimental group, 59 in the control group) based on pilot study analysis (approximately 50 required). Thus in the present study, the chance of not detecting an actual difference may be slightly increased in the fitness assessment group compared to the exercise consultation group, given similar conditions to the pilot study.

Check for Successful Randomisation

All of the 312 people who turned up for their appointment completed a SPAQ and processes of change questionnaire. Their heights and weights were also measured. From their application forms, their preferred intervention, sex and age were already known. This meant that for each person attending their initial appointment, baseline data could be gathered on a range of factors. In order to test if randomisation into either the experimental or control groups had been successful, a number of these factors were used to analyse any differences between intervention groups. Table 26. shows the descriptive statistics for the factors used in the analysis for the experimental and control groups for each intervention.

Table 26.

Descriptive statistics for the factors used to test for success of randomisation into the experimental and control groups for each intervention

	Factor											
	Sex		Age (years)		Height (inches)		Weight (lbs)		SOC			
Group	M	F	Mean	SD	Mean	SD	Mean	SD	2	3	4	5
FAE	37	57	34.7	12.9	66.4	4.1	165.8	30.2	21	22	21	30
FAC	41	52	37.7	16	66.6	4.1	160.4	32	26	19	23	25
ECE	21	45	46.3	17.7	65.4	4	153.3	32.7	18	23	11	14
ECC	12	47	52.3	16.9	64.4	3.1	164	39.3	17	17	8	17

Note. SOC = stage of exercise behaviour change, 2 = contemplators, 3 = preparers, 4 = actioners, 5 = maintainers, FAE = fitness assessment experimental group, FAC = fitness assessment control group, ECE = exercise consultation experimental group, ECC = exercise consultation control group.

From table 26., comparing the proportion of males to females in the fitness assessment experimental group (37 : 57 respectively) with the proportion in the fitness assessment control group (41 : 52 respectively), a chi square test revealed no significant difference ($\chi^2 = 0.43$; df = 1, p = 0.51). A similar result was found for the exercise consultation experimental group (21 : 45) compared to the exercise consultation control group (12 : 47), ($\chi^2 = 2.11$; df = 1, p = 0.15).

Table 27 reports the results of six two sample t-tests, conducted to analyse differences between each intervention's experimental and control groups for age, height and weight.

Table 27.

The results of a series of t-tests conducted to examine differences in the age, height and weight between experimental and control groups for each intervention

	Age			Height			Weight		
Group	t	df	P	t	df	P	T	df	P
FAE vs FAC	1.43	176	0.15	0.26	184	0.79	1.19	184	0.23
ECE vs ECC	1.93	122	0.06	1.57	120	0.12	1.65	113	0.1

Note. FAE = fitness assessment experimental group, FAC = fitness assessment control group, ECE = exercise consultation experimental group, ECC = exercise consultation control group.

Table 27. confirms that no significant differences (at the 95% confidence level) existed between each intervention's experimental and control groups for age, height and weight.

Table 26. also gives the number of respondents in each stage of exercise behaviour change for each group. Two chi-square tests comparing the distribution of stage of exercise behaviour change between experimental and control groups for each intervention revealed no significant differences (FAE vs FAC, $\chi^2 = 1.29$; df = 3, p = 0.73; ECE vs ECC, $\chi^2 = 1.31$; df = 3, p = 0.73).

Differences Between Those Respondents Applying for a Fitness Assessment and Those Applying for an Exercise Consultation.

The first part of the results section has highlighted some interesting differences in the sex and age of those respondents applying for a fitness assessment compared to those applying for an exercise consultation. As previously mentioned, more baseline information can be obtained from those people turning up for their intervention. Given that sex and age differences exist between those applying for each intervention it may be interesting to analyse any differences in their height, weight or stage of exercise behaviour change. Table 28. shows the descriptive statistics for those people who applied for and consequently turned up for each intervention for height, weight and stage of exercise behaviour change (note that for the purposes of analysis, each intervention group contains both experimental and control groups).

Table 28.

Descriptive statistics for those people keeping their initial appointment

		Height (cm)			Weight (Kg)			SOC			
Group	N	Me	Md	SD	Me	Md	SD	2	3	4	5
Fitness Assessment	187	168.9	167.6	10.2	74.1	72.6	14.1	47	41	44	55
Exercise Consultation	125	164.8	162.6	9.4	71.9	66.3	16.4	35	40	19	31

Note. Me = Mean, Md = median, SD = standard deviation, SOC = stage of exercise behaviour change, 2 = contemplators, 3 = preparers, 4 = actioners, 5 = maintainers.

Two, two sample t-tests were conducted to examine any significant differences between the groups for either height or weight. The results of the first t-test revealed that the fitness assessment group were significantly taller than the exercise consultation group (t = 3.56, df = 285, $p < 0.05$). The second test revealed no significant difference in the groups weight (t = 1.2, df = 238, p = 0.13). In terms of stage of exercise behaviour change, table 28. shows that of all the 312 people attending their allocated intervention, 82 (26%) classed themselves as contemplators, 81 (26%) as preparers, 63 (20%) as actioners and 86 (28%) as maintainers. A chi square analysis revealed that the difference in the stage of exercise behaviour change distribution between those applying for a fitness assessment and those applying for an exercise consultation just failed to reach significance at the 95% confidence level ($\chi^2 = 6.32$; df 3, $p = 0.097$). However, if the stages of exercise behaviour change are grouped into either inactive (contemplators and preparers) or active (actioners and maintainers) for each intervention, chi square analysis shows that there is a significant difference between the groups ($\chi^2 = 5.03$; df = 1, $p < 0.05$). Follow up analysis with Bonferroni intervals, calculated for the difference between the two study groups for proportions in the regularly active and not regularly active groups showed that the exercise consultation group was likely to attract between 2% and 23% more people who were not regularly active (CI's = 0.017, 0.23). In contrast, the fitness assessment group was likely to attract between 2% and 23% more people who were regularly active (CI's = - 0.23, - 0.017).

Results of Expectation Questionnaires

As mentioned earlier in the chapter, the expectation questionnaires contained five score dimensions ranging from "not at all" to "greatly". Each dimension was given a score rating, ranging from minus two for the "not at all" category to zero for the "unchanged" category to plus two for the "greatly" category. Table 29. gives the mean scores for each study group for each questionnaire component.

Table 29.

The mean scores for the expectation effect for each questionnaire component for each study group

Study Group	Intention to change	Actual change
Fitness assessment experimental	1.52	1.29
Fitness assessment control	0.74	0.88
Exercise consultation experimental	1.5	1.36
Exercise consultation control	0.64	0.66

In order to formerly investigate any differences in intention to change and actual change between intervention groups, two Kruskal Wallis tests were conducted. Significant intervention group differences were observed for both intention to change ($H = 68.4$, $p < 0.05$) and actual change ($H = 42.8$, $p < 0.05$). Follow up Mann Whitney analysis showed that for both intention to change (IC) and actual change (AC), no significant differences existed between experimental groups and between control groups but both experimental groups reported significantly higher scores than both control groups (IC: FAE vs FAC, $W = 10964$, $p < 0.035$, FAE vs ECC, $W = 8711$, $p < 0.035$, ECE vs FAC, $W = 5991$, $p < 0.035$, ECE vs ECC, $W = 5163$, $p < 0.035$, AC: FAE vs FAC, $W = 10079$, $p < 0.035$, FAE vs ECC, $W = 8395$, $p < 0.035$, ECE vs FAC, $W = 6412$, $p < 0.035$, ECE vs ECC, $W = 5052$, $p < 0.035$) (note that a modified p value at the 96.5% level is used to assess significance to take account of multiple comparisons).

Pre - intervention Relationships Between the Stages and Process of Exercise Behaviour Change and Physical Activity.

Stage of exercise behaviour change and physical activity.

Table 30. reports the descriptive statistics for stage of exercise behaviour change and physical activity for all respondents attending their initial appointment.

Table 30.

Descriptive statistics for stage of exercise behaviour change and physical activity (mins / wk) for all respondents attending initial appointments

			Physical Activity (mins / wk)								
			Occupational			Leisure time			Total		
SOC	N	%	Me	Md	SD	Me	Md	SD	Me	Md	SD
2	82	26	251	200	207.5	202	190	191.8	453	410	246.8
3	81	26	294.3	220	240.9	253.8	205	175.6	548.1	450	312.8
4	63	20	347.1	210	376.4	579.8	510	301.3	927	810	482.1
5	86	28	336.7	225	384.3	587.4	600	280	924.1	875	467.8

Note. SOC = stage of exercise behaviour change, Me = Mean, Md = median, SD = standard deviation, SOC = stage of exercise behaviour change, 2 = contemplators, 3 = preparers, 4 = actioners, 5 = maintainers.

Figures 23., 24. and 25. show boxplots of occupational, leisure time and total physical activity respectively for each stage of exercise behaviour change.

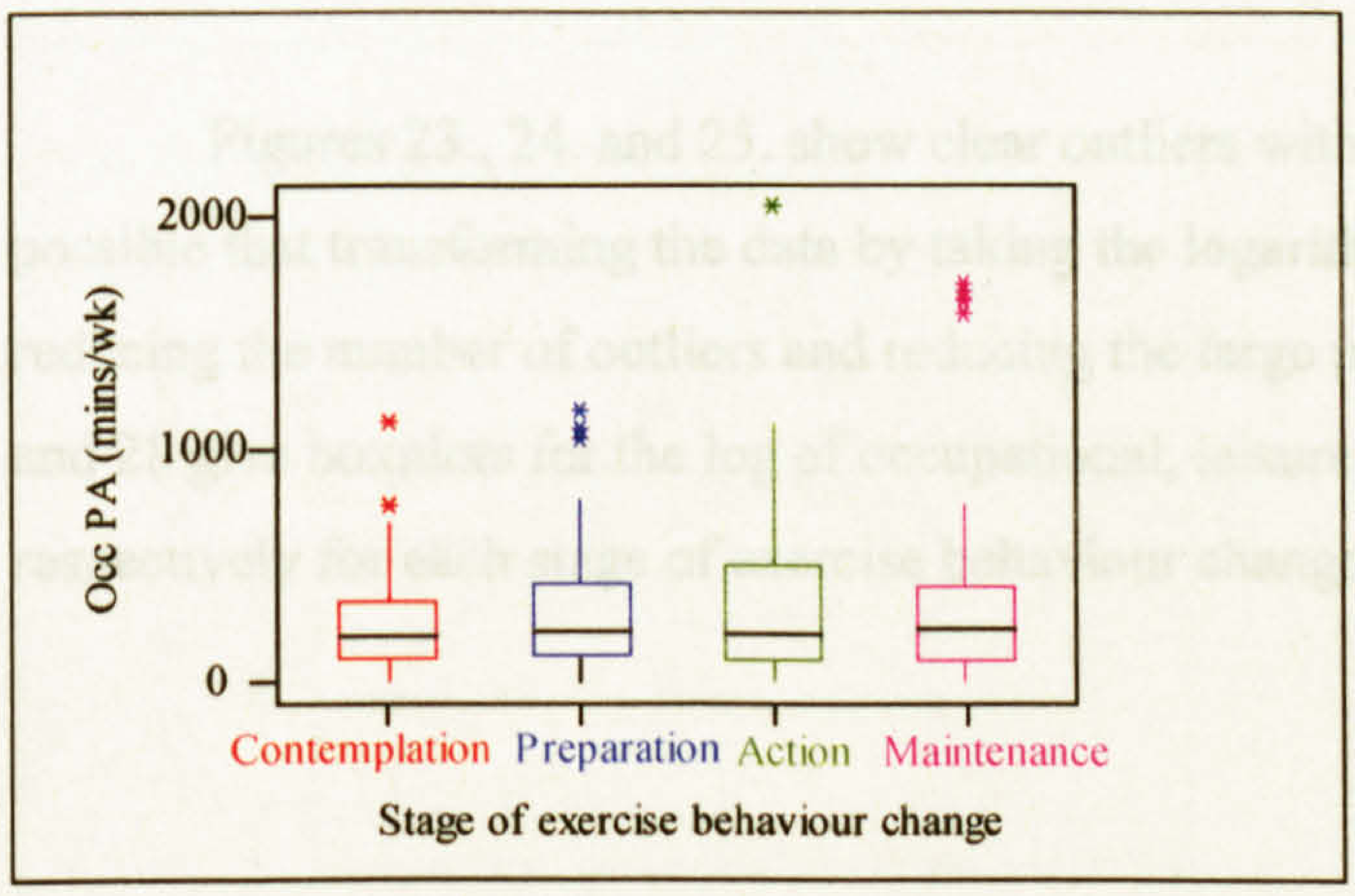


Figure 23. Boxplot of occupational physical activity verses stage of exercise behaviour change

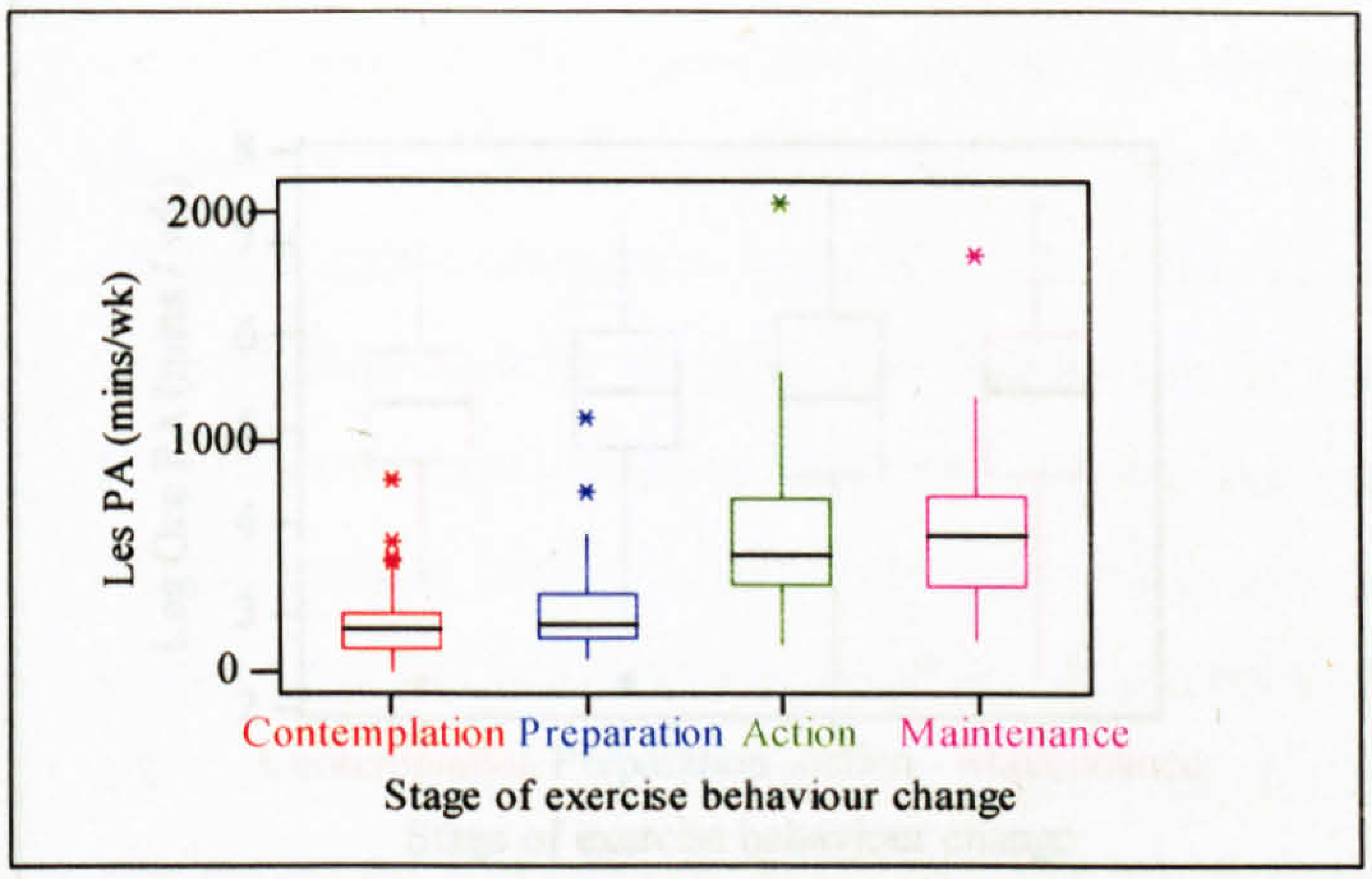


Figure 24. Boxplot of leisure time physical activity verses stage of exercise behaviour change

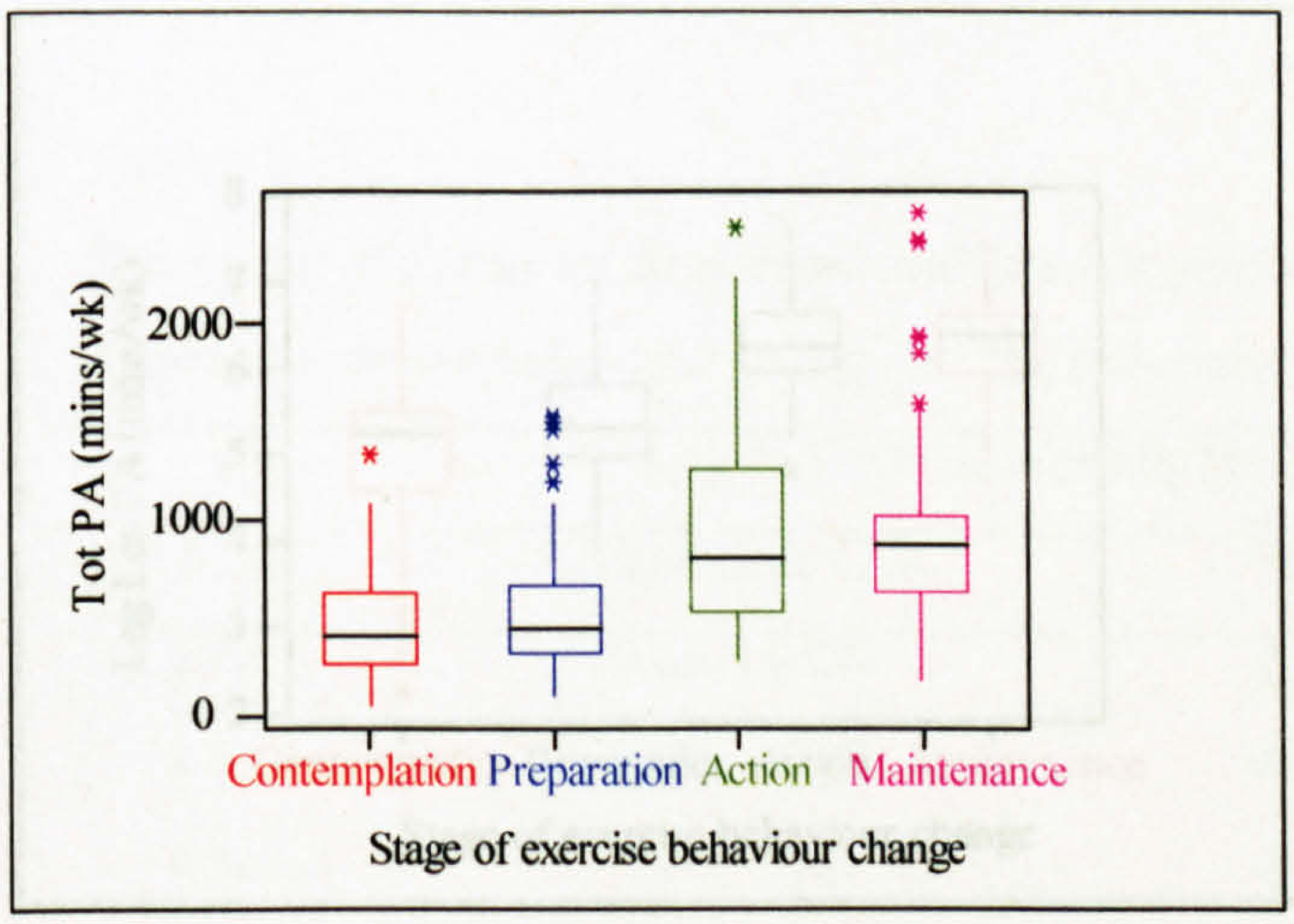


Figure 25. Boxplot of total physical activity verses stage of exercise behaviour change

Figures 23., 24. and 25. show clear outliers within each physical activity category. It is possible that transforming the data by taking the logarithms may enhance the data's normality by reducing the number of outliers and reducing the large positive "tails" observed. Figures 26, 27 and 28 give boxplots for the log of occupational, leisure time and total physical activity respectively for each stage of exercise behaviour change.

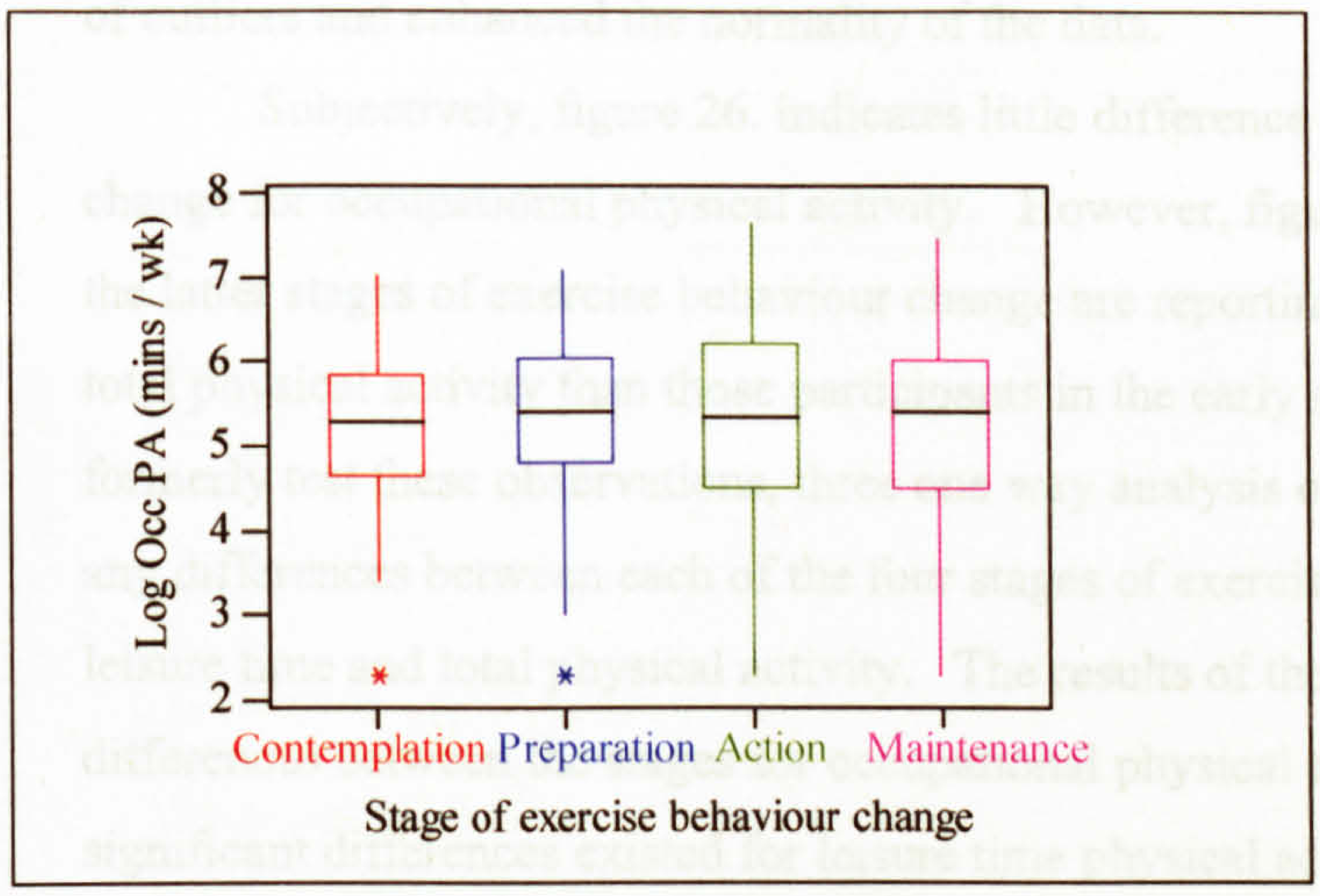


Figure 26. Boxplot of log occupational physical activity verses stage of exercise behaviour change

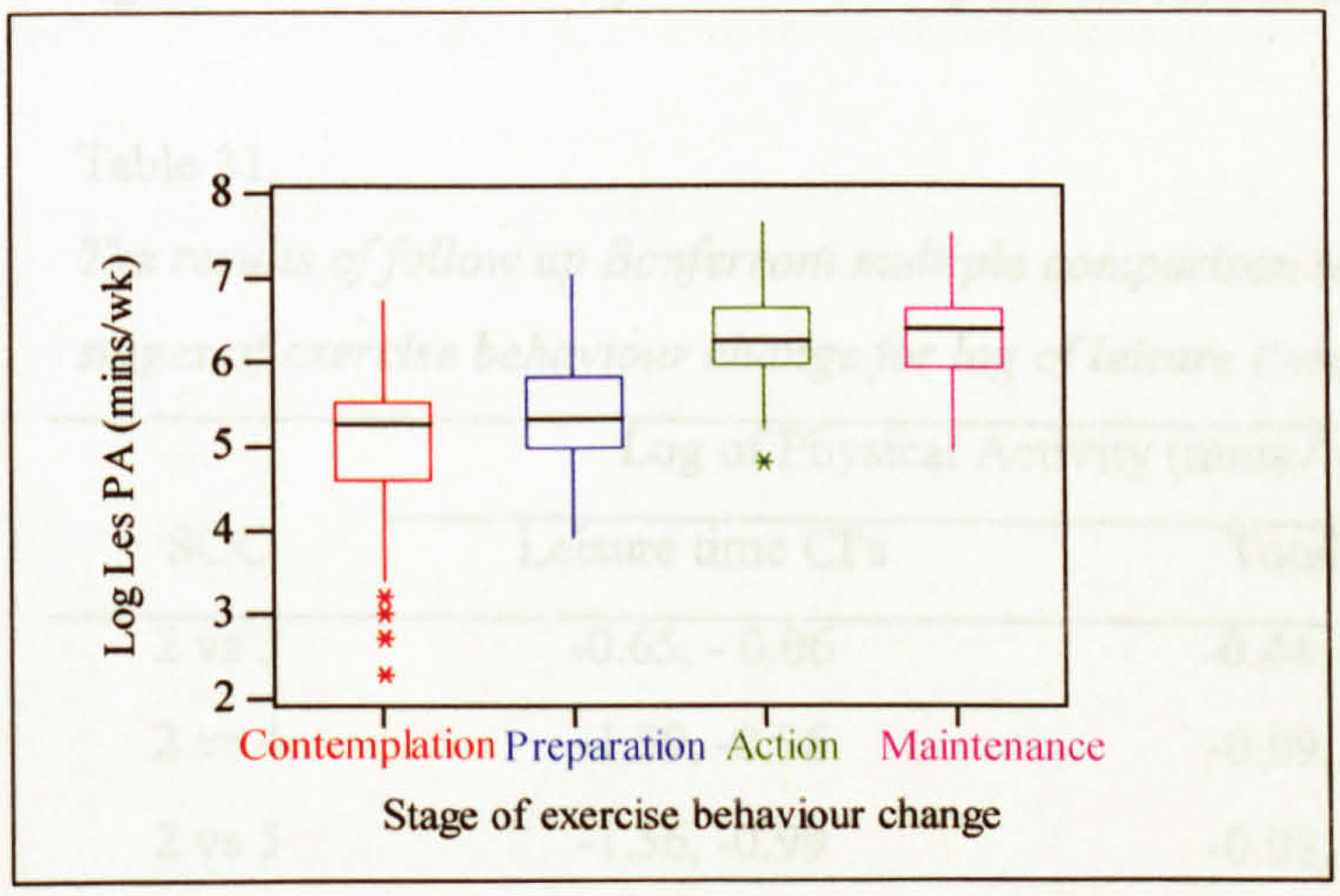


Figure 27. Boxplot of log leisure time physical activity verses stage of exercise behaviour change

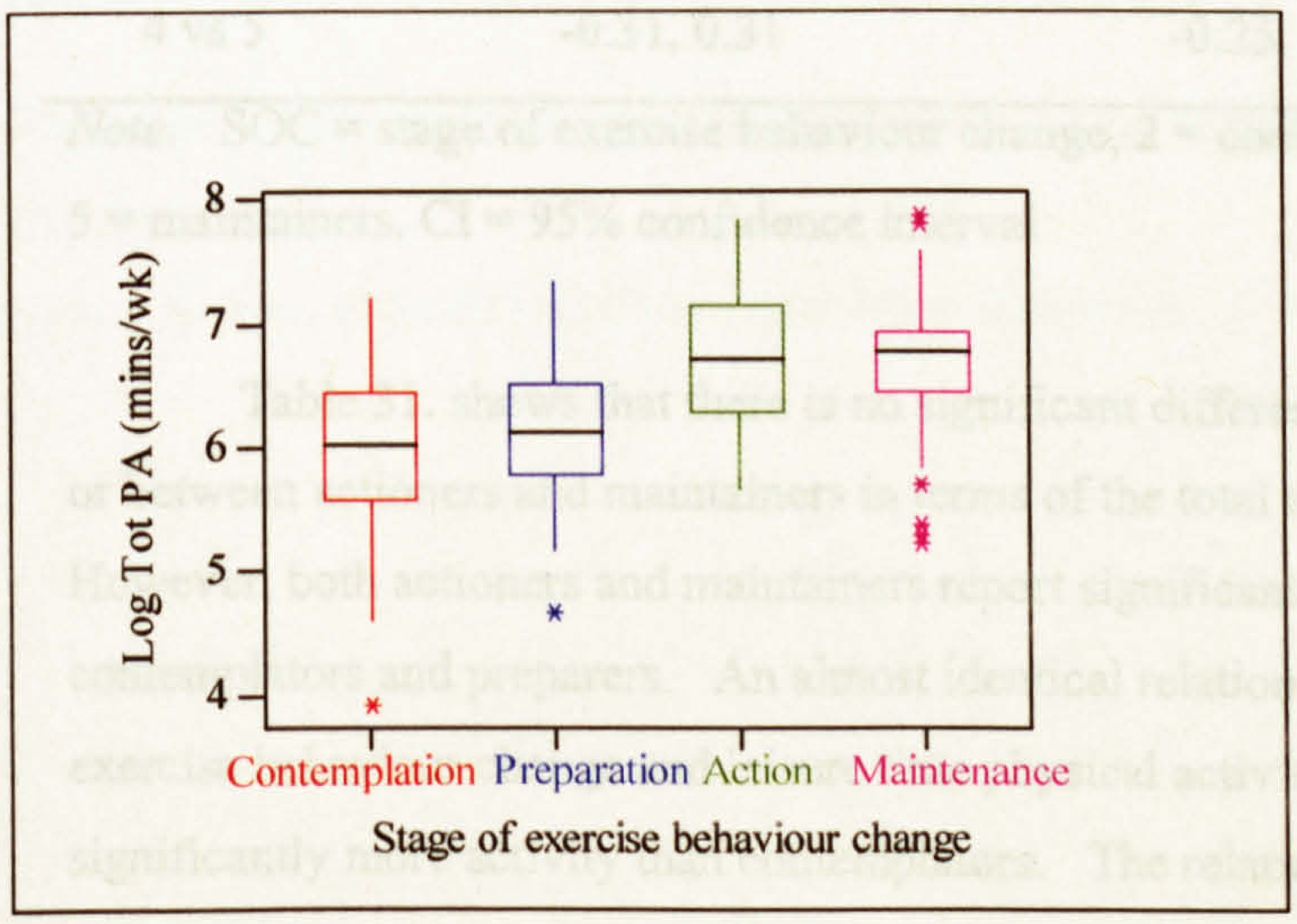


Figure 28. Boxplot of total physical activity verses stage of exercise behaviour change

It is clear from figures 26., 27. and 28. that taking the logarithms has reduced the number of outliers and enhanced the normality of the data.

Subjectively, figure 26. indicates little difference between the stages of exercise behaviour change for occupational physical activity. However, figures 27. and 28. suggest that participants in the latter stages of exercise behaviour change are reporting more leisure time and consequently more total physical activity than those participants in the early stages of exercise behaviour change. To formerly test these observations, three one way analysis of variance tests were conducted to analyse any differences between each of the four stages of exercise behaviour change for log of occupational, leisure time and total physical activity. The results of the tests revealed that there were no significant differences between the stages for occupational physical activity ($F = 0.57$, $df = 311$, $p = 0.64$), but significant differences existed for leisure time physical activity ($F = 68.96$, $df = 311$, $p < 0.05$) and total physical activity ($F = 38.94$, $df = 311$, $p < 0.05$). Follow up Bonferroni multiple comparison tests were conducted with the logs of leisure time and total physical activity to examine where these significant differences lay. Table 31. reports the results of these tests.

Table 31.

The results of follow up Bonferroni multiple comparison tests to identify significant differences between stages of exercise behaviour change for log of leisure time and total physical activity

	Log of Physical Activity (mins / wk)	
SOC	Leisure time CI's	Total CI's
2 vs 3	-0.65, - 0.06	-0.44, 0.017
2 vs 4	-1.59, -0.96	-0.99, -0.51
2 vs 5	-1.56, -0.99	-0.98, -0.53
3 vs 4	-1.23, -0.6	-0.79, -0.29
3 vs 5	-1.21, -0.63	-0.77, -0.32
4 vs 5	-0.31, 0.31	-0.25, 0.24

Note. SOC = stage of exercise behaviour change, 2 = contemplators, 3 = preparers, 4 = actioners, 5 = maintainers, CI = 95% confidence interval

Table 31. shows that there is no significant difference between contemplators and preparers or between actioners and maintainers in terms of the total amount of physical activity reported. However, both actioners and maintainers report significantly more total physical activity than both contemplators and preparers. An almost identical relationship exists between the stages of exercise behaviour change and leisure time physical activity except that preparers are reporting significantly more activity than contemplators. The relationships between stage of exercise behaviour change and total, leisure time and occupational physical activity are given in figures 29., 30. and 31. respectively.

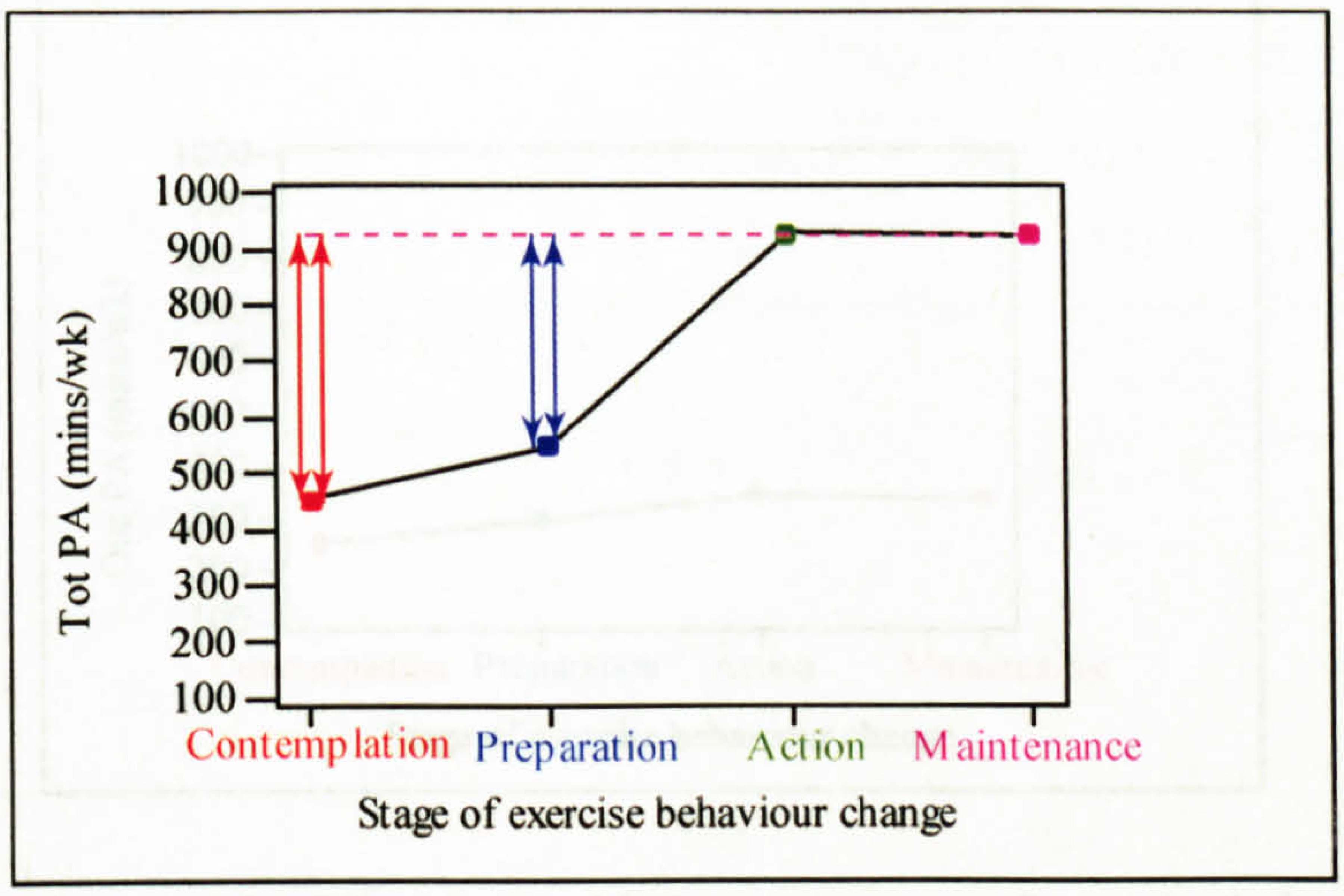


Figure 29. The relationship between stage of exercise behaviour change and total physical activity.

Note. Arrows indicate significant inter-stage differences $p < 0.05$

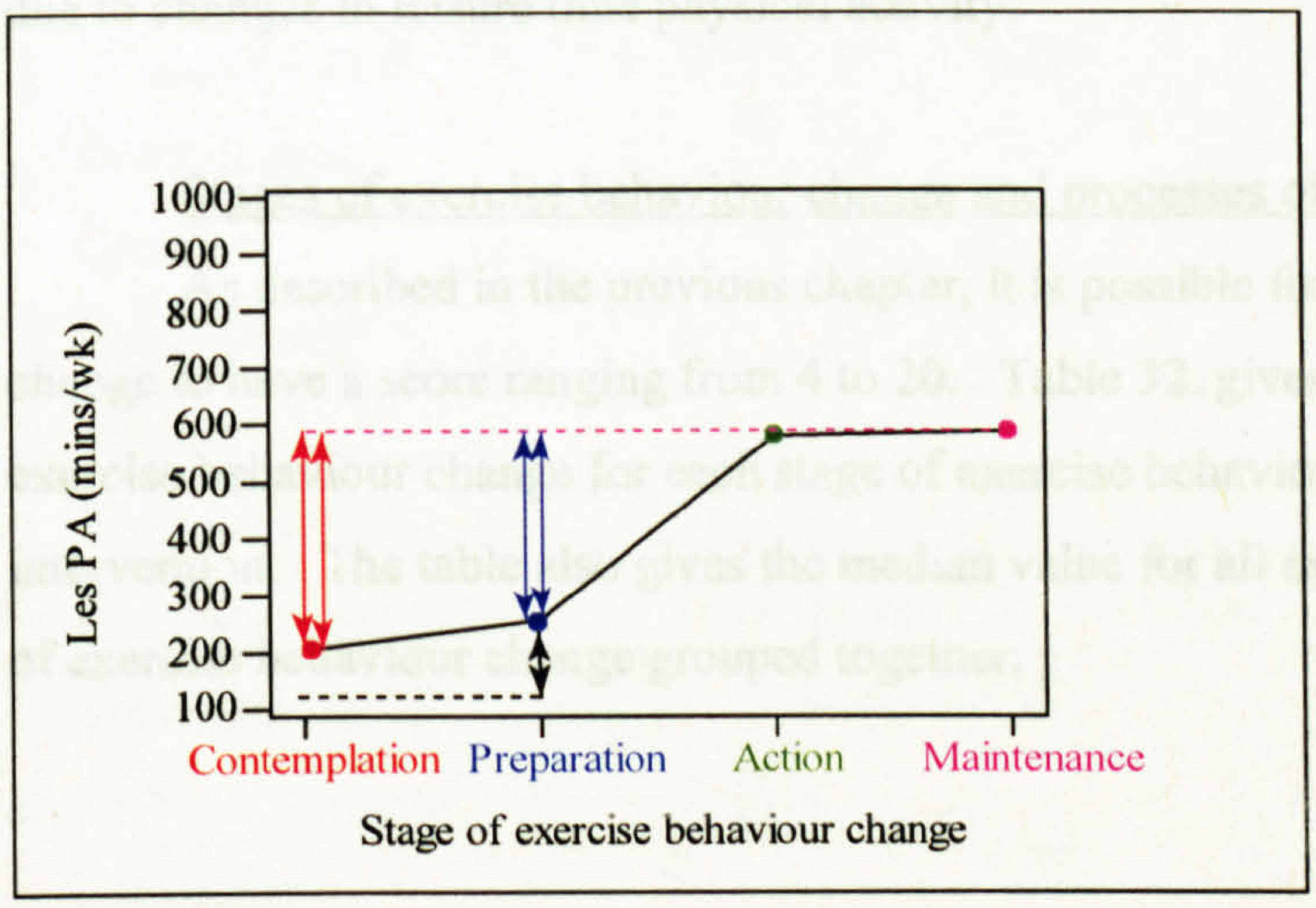


Figure 30. The relationship between stage of exercise behaviour change and leisure physical activity

Note. Arrows indicate significant inter-stage differences $p < 0.05$

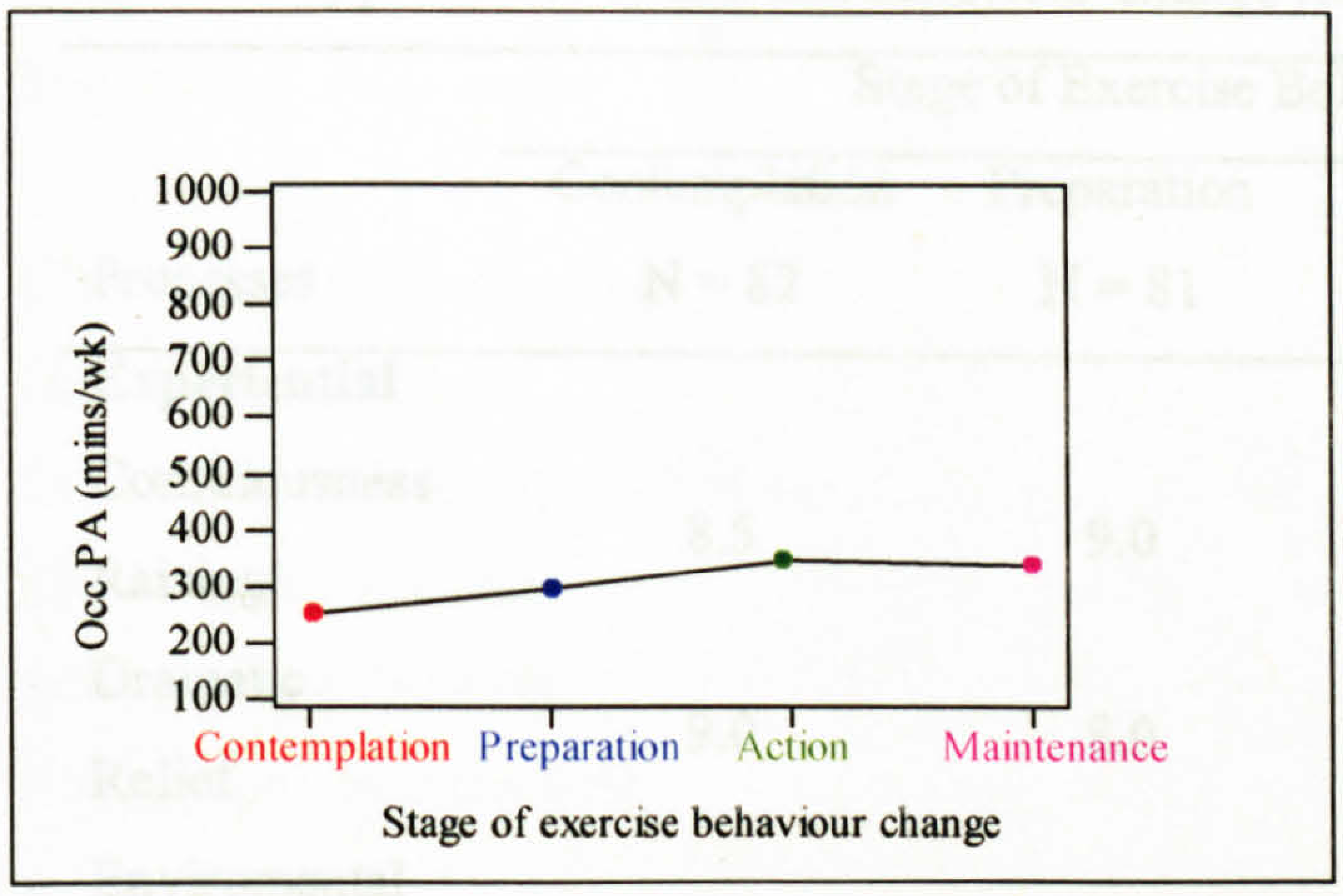


Figure 31. The relationship between stage of exercise behaviour change and occupational physical activity

Figures 29., 30. and 31. show again, that changes in total physical activity are almost exclusively due to changes in leisure time physical activity.

<u>Stages of exercise behaviour change and processes of exercise behaviour change.</u>

As described in the previous chapter, it is possible for each process of exercise behaviour change to have a score ranging from 4 to 20. Table 32. gives the medians for the processes of exercise behaviour change for each stage of exercise behaviour change for all those attending their intervention. The table also gives the median value for all experiential and behavioural processes of exercise behaviour change grouped together.

Table 32.

Medians of processes of exercise behaviour change for each stage of exercise behaviour change.

	Stage of Exercise Behaviour Change			
	Contemplation	Preparation	Action	Maintainance
Processes	N = 82	N = 81	N = 63	N = 86
Experiential				
Consciousness Raising	8.5	9.0	13.0	13.0
Dramatic Relief	9.0	8.0	12.0	9.0
Enviromental Reevaluation	10.0	10.0	13.0	10.0
Self Reevaluation	12.0	12.0	15.0	12.0
Social Liberation	9.0	8.0	11.0	10.0
All experiential	10.0	10.0	12.0	11.0
Behavioural				
Counter-Conditioning	8.0	10.0	15.0	15.0
Helping Relationships	8.0	8.0	11.0	12.0
Reinforcement Management	8.0	8.0	12.0	12.0
Self Liberation	9.0	11.0	15.0	15.5
Stimulus Control	6.0	7.0	9.0	10.0
All behavioural	8.0	9.0	13.0	14.0

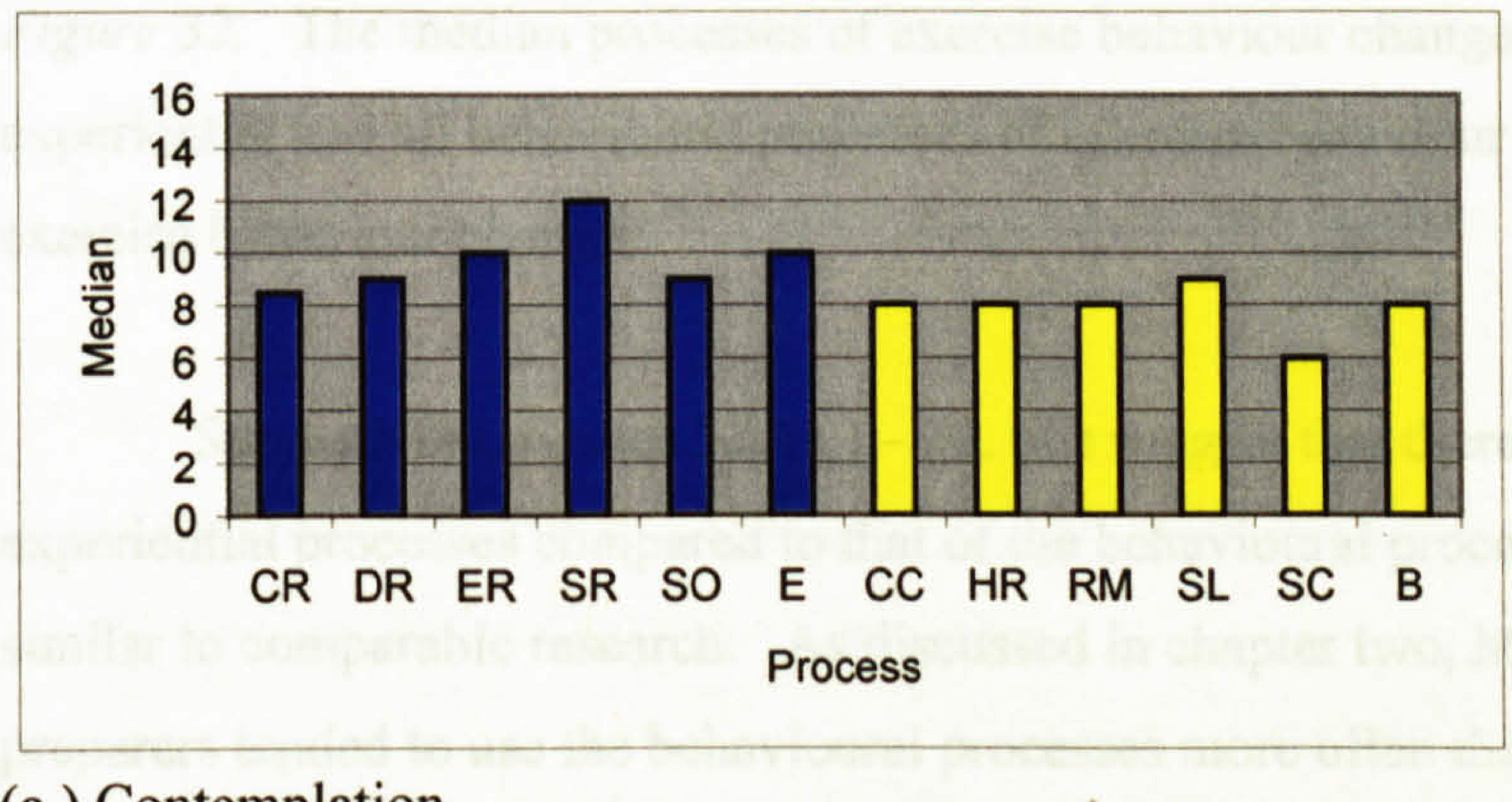
Figures 32. (a.) – 32. (d.) plot the median process of exercise behaviour change scores for each stage of exercise behaviour change as well as the median scores of all experiential and behavioural processes of exercise behaviour change for each stage of exercise behaviour change.

KEY

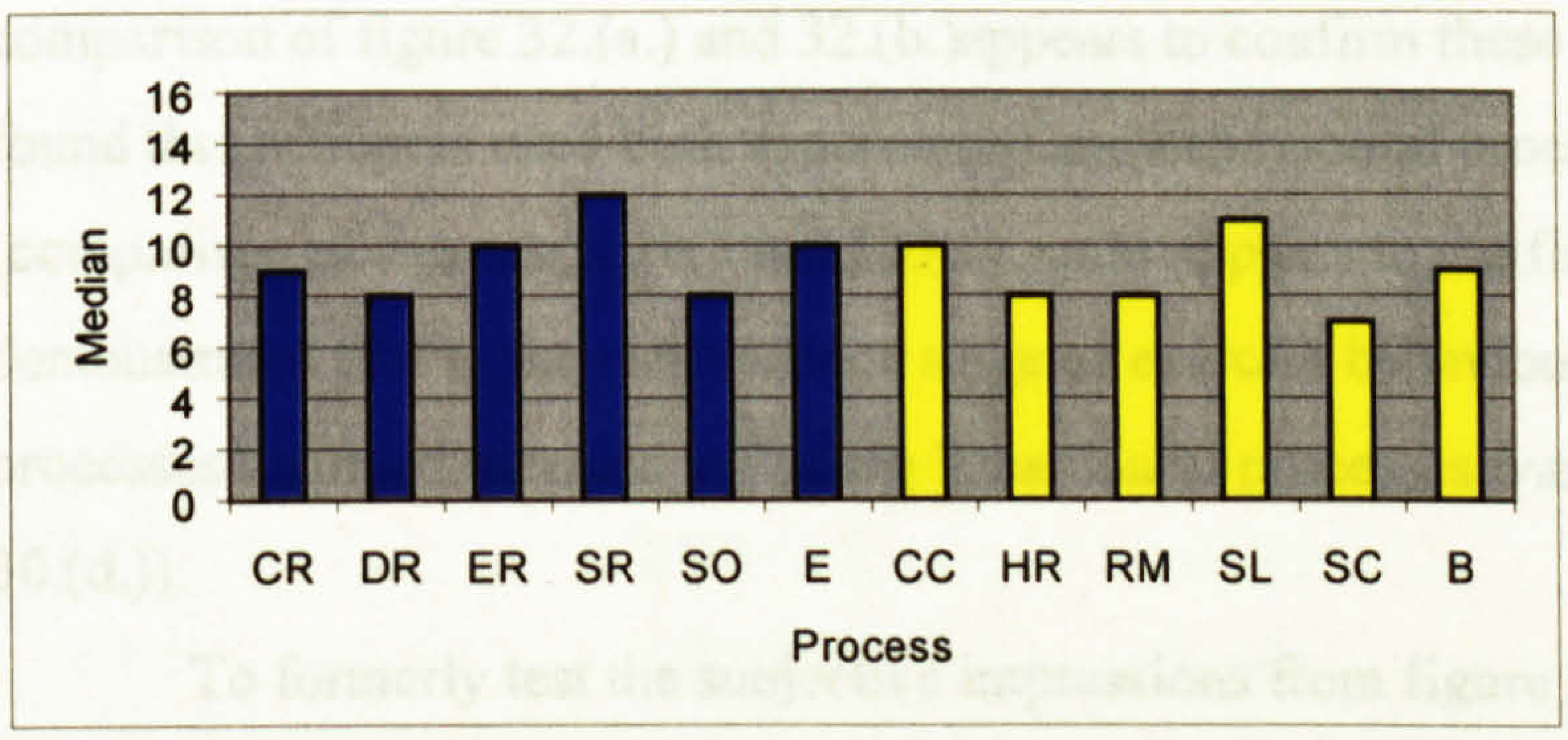
Experiential Processes = *Behavioural Processes* =

CR = Conciousness Raising
DR = Dramatic Relief
ER = Environmental Reevaluation
SR = Self Reevaluation
SO = Social Liberation
E = All experiential scores

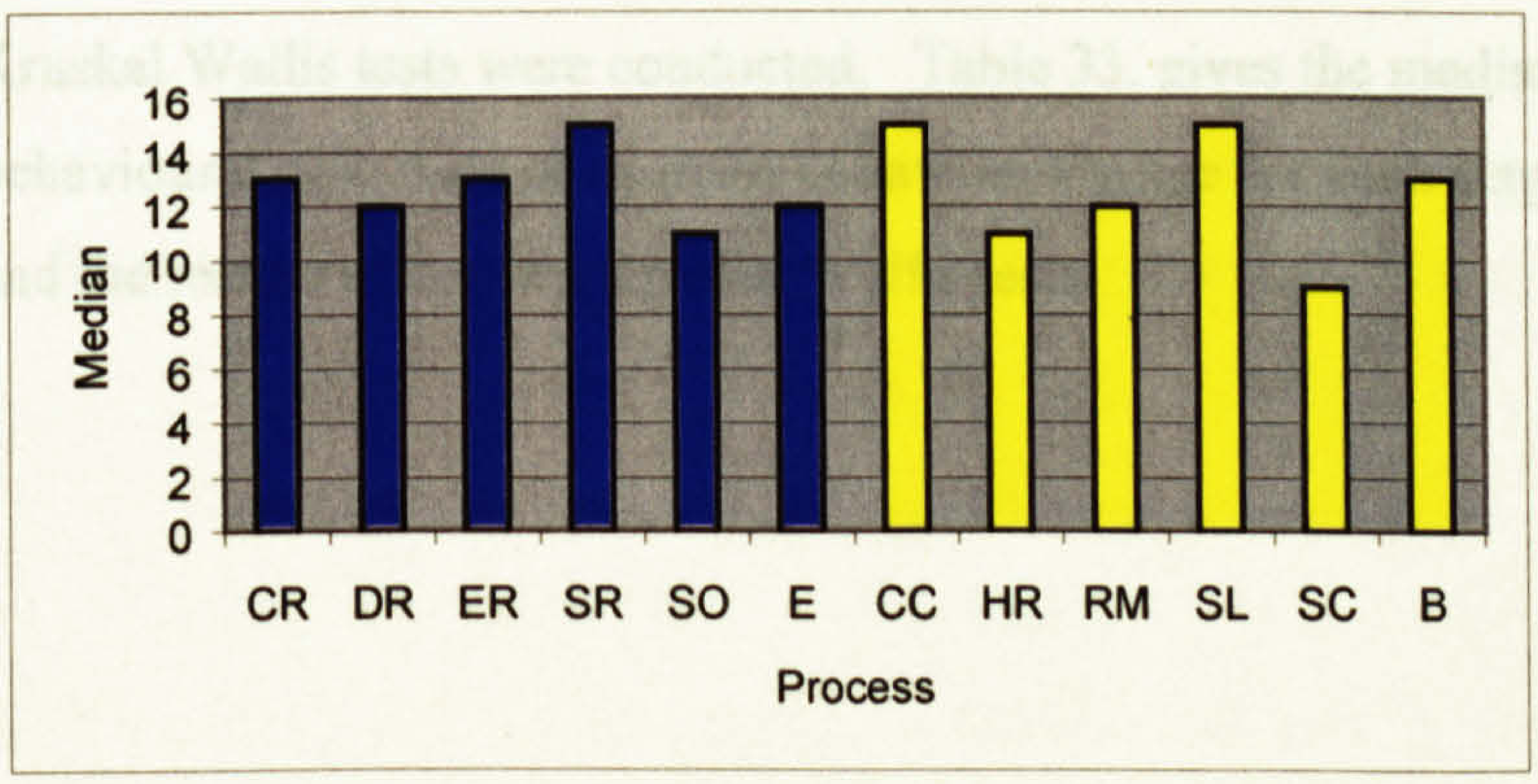
CC = Counter Conditioning
HR = Helping Relationships
RM = Reinforcement Management
SL = Self Liberation
SC = Stimulus Control
B = All behavioural scores



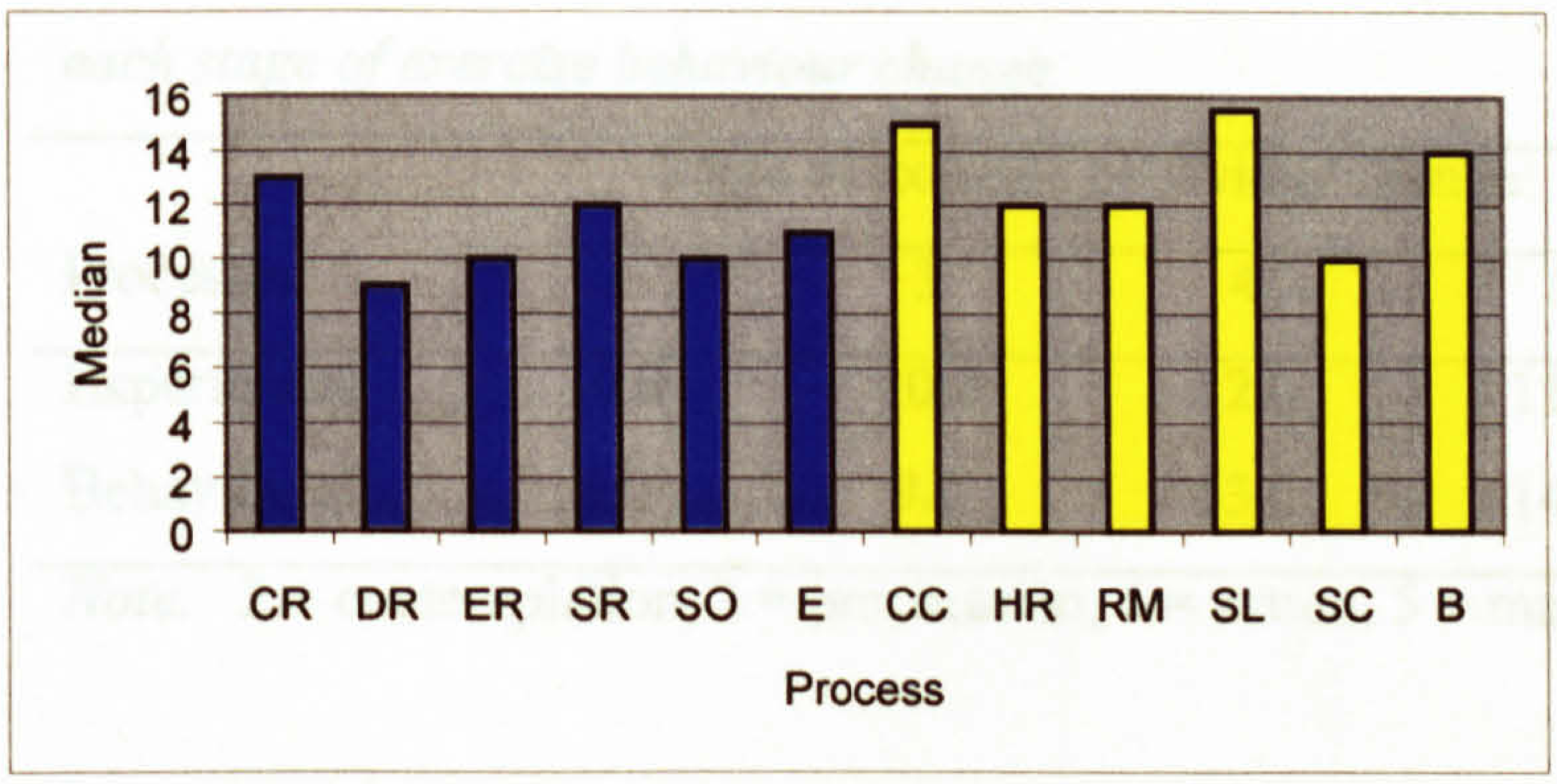
(a.) Contemplation



(b.) Preparation



(c.) Action



(d.) Maintenance

Figure 32. The median processes of exercise behaviour change scores and the median of all experiential and all behavioural processes of exercise behaviour change scores for each stage of exercise behaviour change

Subjectively, figures 32. (a.) – 32. (d.) suggest that there are differences in the trends of the experiential processes compared to that of the behavioural processes and that these trends are similar to comparable research. As discussed in chapter two, Marcus et al. (1992b) showed that preparers tended to use the behavioural processes more often than contemplators. In contrast, they showed that contemplators and preparers didn't differ in their use of the experiential processes (a comparison of figure 32.(a.) and 32.(b.)appears to confirm these findings). Marcus et al. also found that actioners used both experiential and behavioural processes more than preparers (comparison of figures 32.(b.) and 32.(c.) again appears to confirm this). Finally, Marcus et al. demonstrated that in the maintenance stage of exercise behaviour change, use of the experiential processes declined whereas use of the behavioural processes was maintained (figures 32.(c.) and 30.(d.)).

To formerly test the subjective impressions from figure 32., two sets of analyses were conducted. Firstly, to assess if there was any significant differences between stages of exercise behaviour change for the experiential and behavioural processes of exercise behaviour change, two Kruskal Wallis tests were conducted. Table 33. gives the median values for all experiential and behavioural processes of exercise behaviour change for each stage of exercise behaviour change and the results of the two Kruskal Wallis tests.

Table 33.

The median values for all experiential and behavioural processes of exercise behaviour change for each stage of exercise behaviour change

	Stage of exercise behaviour change				Kruskal	
Processes	2	3	4	5	Wallis	P
Experiential	10.0	10.0	12.0	11.0	68.77	< 0.05
Behavioural	8.0	9.0	13.0	14.0	275.68	< 0.05

Note. 2 = contemplation, 3 = preparation, 4 = action, 5 = maintenance.

Table 33. shows that significant inter stage differences exist for both the experiential and behavioural processes of exercise behaviour change. In order to identify which stages of exercise behaviour change differed for each set of processes, a series of Mann Whitney tests were conducted. Table 34. reports the results of these tests. (Note that a modified p value at the 96.5% level is used to assess significance to take account of multiple comparisons).

Table 34.

A series of Mann Whitney tests conducted to identify significant inter-stage differences for each set of processes of exercise behaviour change.

	Processes of exercise behaviour change			
	Experiential		Behavioural	
SOC	W	p	W	p
2 v 3	170727.5	0.30	156245.5	< 0.035
2 v 4	129662.5	< 0.035	114753.0	< 0.035
2 v 5	164182.5	< 0.035	127222.0	< 0.035
3 v 4	124766.5	< 0.035	117929.0	< 0.035
3 v 5	158041.5	< 0.035	131354.0	< 0.035
4 v 5	130951.0	< 0.035	114785.5	0.35

Note. SOC = stage of exercise behaviour change, 2 = contemplation, 3 = preparation, 4 = action, 5 = maintenance.

Figures 33. and 34. plot the relationship between stage of exercise behaviour change and the experiential and behavioural processes of exercise behaviour change respectively.

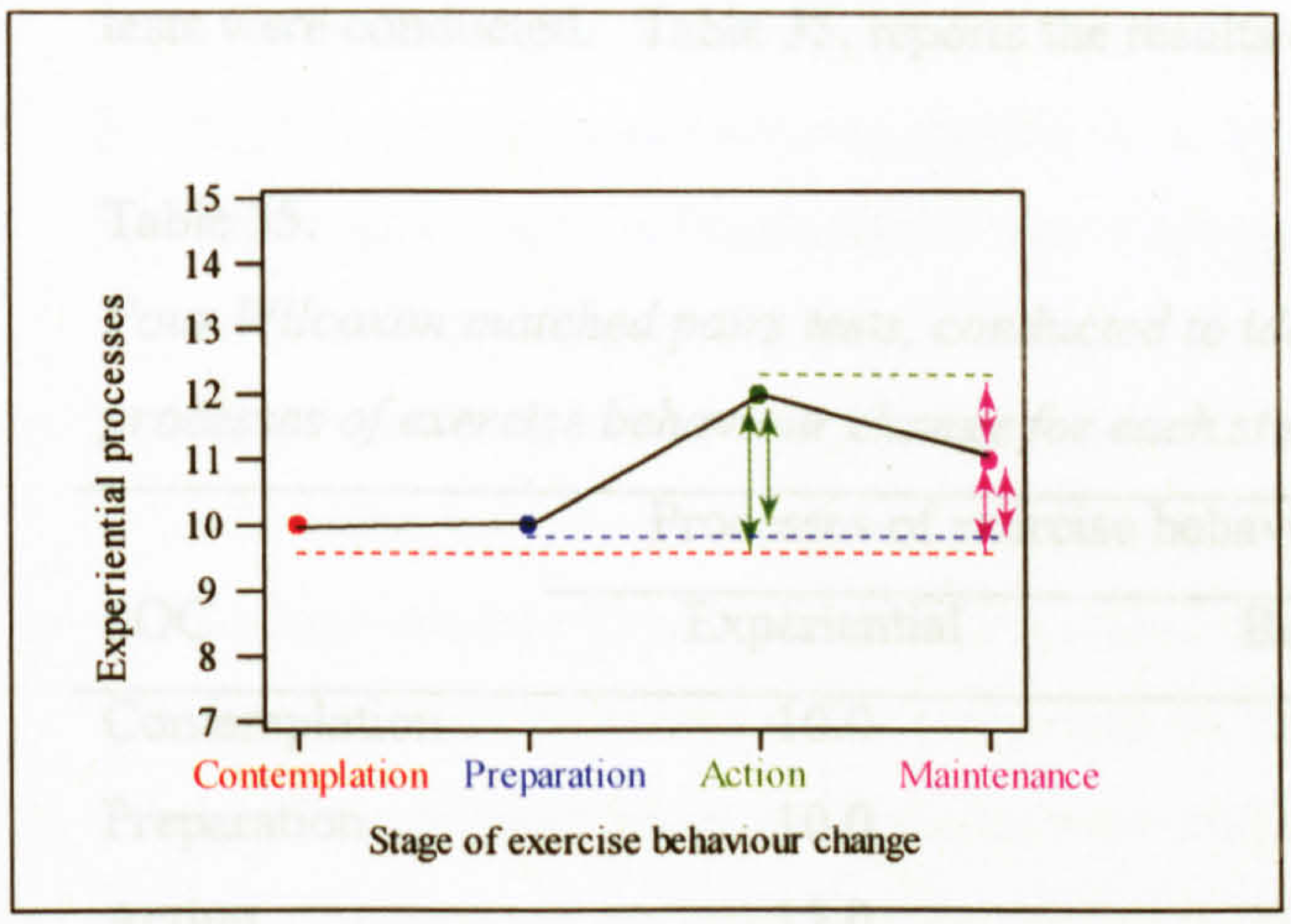


Figure 33. The relationship between the stages and experiential processes of exercise behaviour change

Note. Arrows indicate significant inter-stage differences ($p < 0.05$).

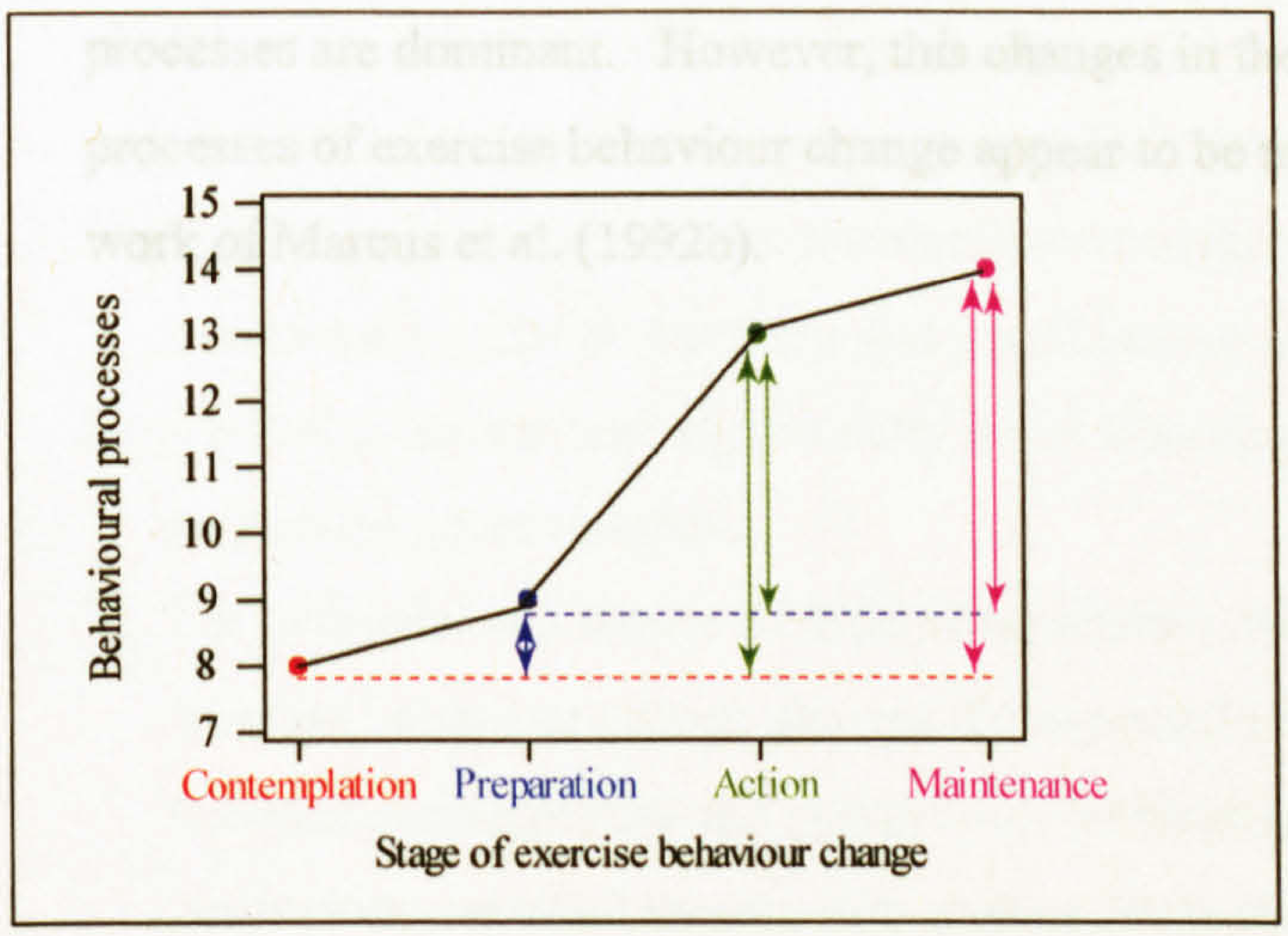


Figure 34. The relationship between the stages and behavioural processes of exercise behaviour change

Note. Arrows indicate significant inter-stage differences ($p < 0.05$).

Table 34. and figures 33. and 34. confirm the subjective impression from figure 32. and the work of Marcus et al. (1992b). There is no significant difference between contemplators and preparers for use of the experiential processes but preparers are using the behavioural processes more. In general, use of all the processes of exercise behaviour change significantly increase in the latter stages of exercise behaviour change. However, as identified by Marcus et al., use of the experiential processes peak in the action stage of exercise behaviour change and fall in the maintenance stage (a significant fall was observed). However, the behavioural processes are maintained into the maintenance stage of exercise behaviour change (no significant change was observed).

In order to assess if there was any significant difference between experiential processes and behavioural processes for each stage of exercise behaviour change, four Wilcoxon matched pairs tests were conducted. Table 35. reports the results of these analyses.

Table 35.

Four Wilcoxon matched pairs tests, conducted to identify significant differences between sets of processes of exercise behaviour change for each stage of exercise behaviour change

	Processes of exercise behaviour change		Test	
SOC	Experiential	Behavioural	Statistic	P
Contemplation	10.0	8.0	50118.5	< 0.05
Preparation	10.0	9.0	39101.0	< 0.05
Action	12.0	13.0	18396.0	0.52
Maintenance	11.0	14.0	20852.5	< 0.05

Note. SOC = stages of exercise behaviour change

Table 35. indicates that in the early stages of exercise behaviour change, the experiential processes are dominant. However, this changes in the latter stages where the behavioural processes of exercise behaviour change appear to be more important. This again confirms the work of Marcus et al. (1992b).

<u>Summary of Results from Section One</u>

1. Overall response rate of 12.3%.
2. Significantly more females applied for the study than males.
3. Significantly more participants applied for a fitness assessment.
4. Those applying for a fitness assessment were significantly younger than those applying for an exercise consultation.
5. Significantly more males applied for a fitness assessment than an exercise consultation. No difference in the numbers of females applying for either intervention.
6. Sixteen percent of applicants failed to attend their initial intervention.
7. No significant difference in the proportion of those attending and those not attending their intervention when males and females were compared, when intervention choice was compared and when control and experimental groups were compared.
8. Those not attending fitness assessment interventions were significantly younger than those attending. No difference in age for the exercise consultation interventions.
9. Regarding randomisation, no significant difference between experimental and corresponding control groups for sex, age, height, weight and stage of exercise behaviour change.
10. Fitness assessments attracted significantly more regularly active participants, exercise consultations significantly more non-regularly active participants.
11. Those applying for a fitness assessment were significantly taller than those applying for an exercise consultation but there was no difference in the groups' weights.
12. Control groups scored significantly lower than experimental groups on both elements of the expectation questionnaire.
13. For both total and leisure time physical activity, the pre-intervention relationship with stage of exercise behaviour change showed the expected relationship i.e. no significant difference between contemplators and preparers or between action and maintainers but both actioners and maintainers reported significantly more activity than both contemplators and preparers. There were no significant inter-stage differences for occupational physical activity.
14. With regard to the processes of exercise behaviour change, actioners and maintainers used both experiential and behavioural processes significantly more than contemplators and preparers. Experiential process use was greater in the action stage compared to the maintenance stage but behavioural process use did not differ between these two stages. In general, experiential process use appeared particularly important to those who were in the early stages of change at baseline but behavioural process use appeared more important to those in the latter stages at baseline.

Section Two – Analysis of Drop-out Rates and Intervention Effects on Physical Activity

The aims of this section were to assess the impact of the interventions on study drop-out rates and on participant's physical activity. The specific objectives of the section were detailed at the beginning of this chapter.

Analysis of Drop-out Rates at Each Measurement Period

As described in the procedures section, participants were required to complete a SPAQ and a process of exercise behaviour change questionnaire at five test stages; pre-intervention, four week post intervention, three month post intervention (participants also received an intervention retest), six month post intervention and one year post intervention. As the study progressed, several participants dropped out at each of the test stages.

Drop out rates for those not regularly active at baseline.

Table 36. gives the drop out rates for each study group at each test stage for those not regularly active at baseline (i.e. contemplators and preparers).

Table 36.

Drop out rates for each study group at each test stage for those not regularly active at baseline

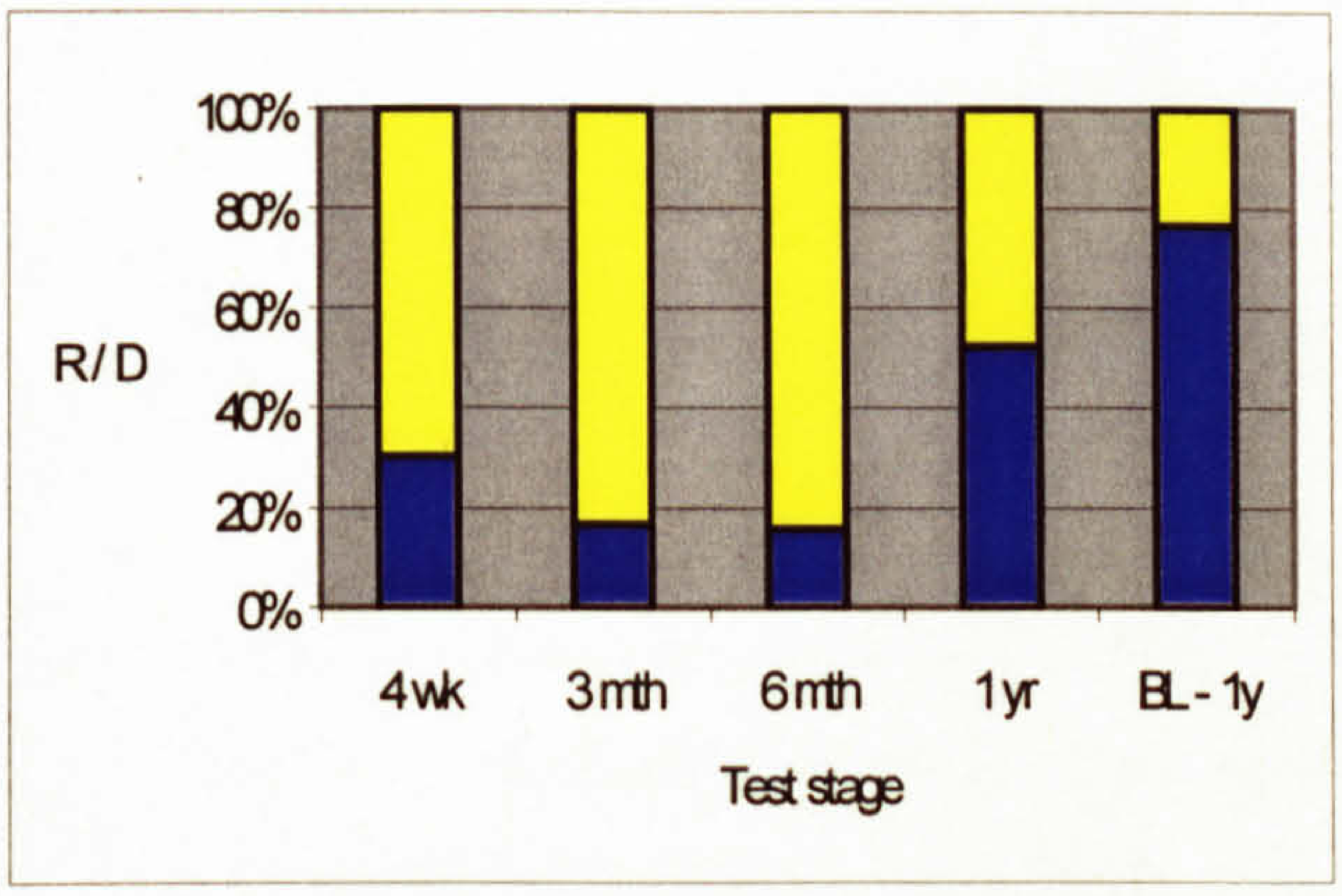
		Test stage									
		4 weeks		3 months		6 months		1 year		BL - 1 year	
Study group	D / R	N	%	N	%	N	%	N	%	N	%
FAE (N = 43)	D	13	30	5	17	4	16	11	52	33	77
	R	30	70	25	83	21	84	10	48	10	23
FAC (N = 45)	D	8	18	2	5	7	20	12	43	29	64
	R	37	82	35	95	28	80	16	57	16	36
ECE (N = 41)	D	1	2	1	2.5	6	15	11	33	19	46
	R	40	98	39	97.5	33	85	22	67	22	54
ECC (N = 34)	D	5	15	2	7	4	15	9	39	20	59
	R	29	85	27	93	23	85	14	61	14	41

Note. D = dropped out, R = remaining in the study at that test stage, BL - 1 year = baseline to 1 year analysis.

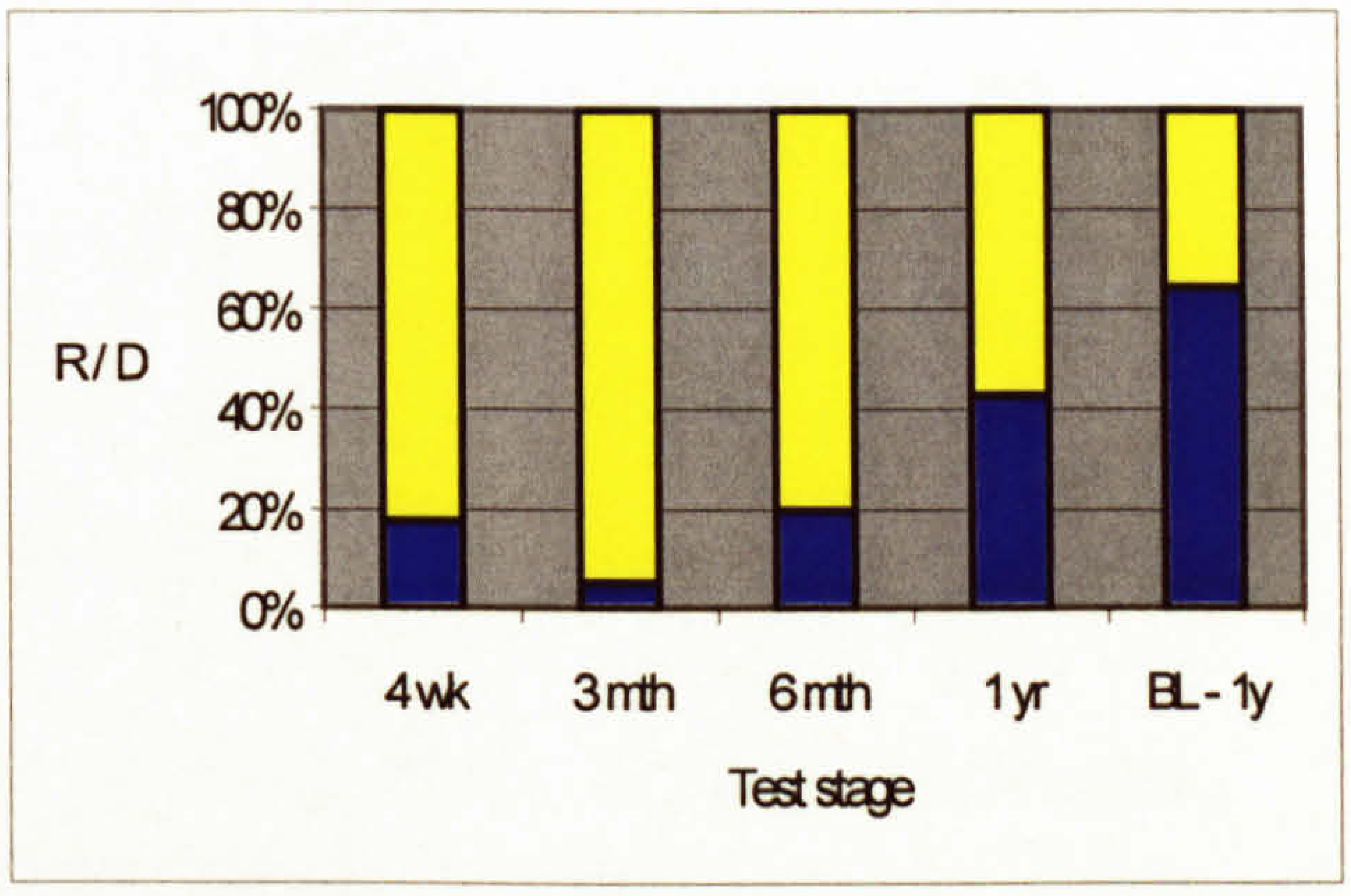
Figure 35. plots the percentage in each category (D or R) for each study group at each test stage.

KEY

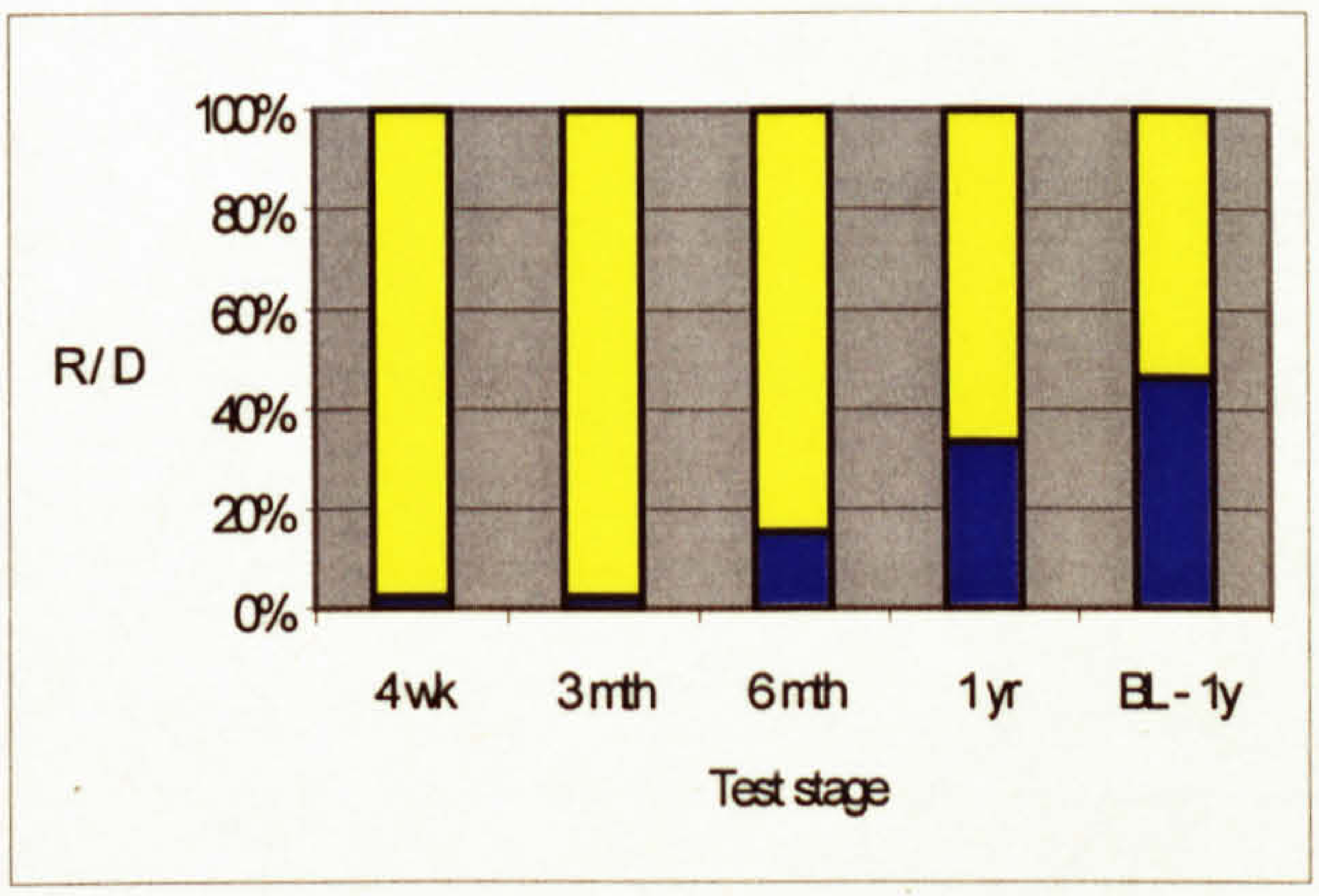
Remaining in study (R) Dropping out of study (D)



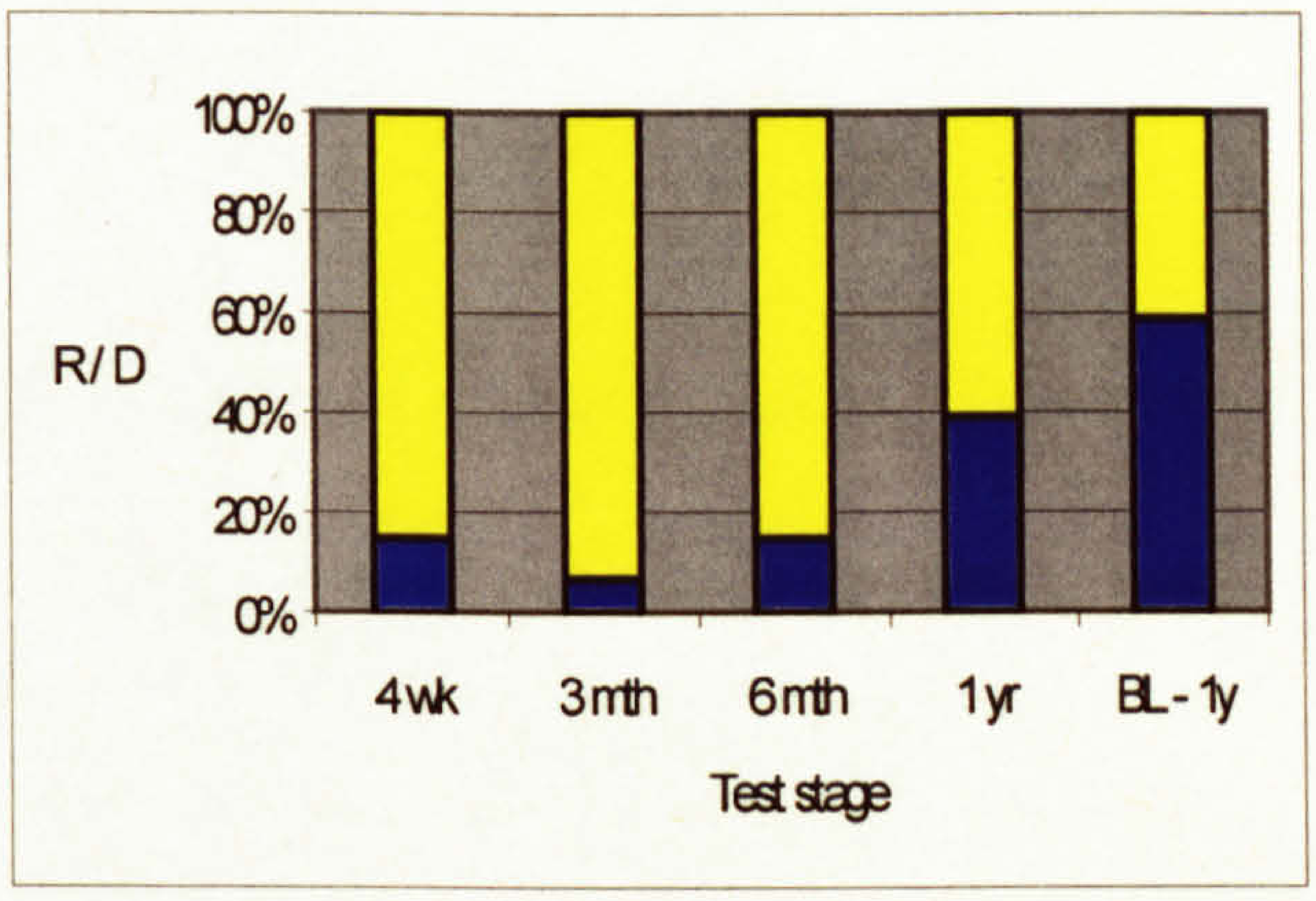
(a.) Fitness assessment experimental



(b.) Fitness assessment control



(c.) Exercise consultation experimental



(d.) Exercise consultation control

Figure 35. The percentage of those not regularly active at baseline in each category (R or D) at each test stage for each study group.

Note. SOC = stage of exercise behaviour change, BL - 1y = baseline to 1 year comparison

Figure 35. shows that the drop out rates for the exercise consultation experimental group appear to be lower than the other three groups at four weeks and three months post test. To analyse differences in drop out rates between study groups at each test stage, five chi square tests were conducted. Table 37. reports the results of the tests.

Table 37.

The results of five chi square tests conducted to examine differences in drop out rates between study groups at each test stage

Study group	χ^2 statistic	DF	P
4 weeks	11.86	3	< 0.05
3 months	5.42	3	0.14
6 months	0.4	3	0.94
1 year	2	3	0.57
Baseline – 1 year	8.49	3	< 0.05

Table 37. indicates that there is a significant difference between at least two of the groups for the proportion who have dropped out compared to those remaining in the study at the four weeks test stage and when comparing baseline to one year post test. To identify which study groups differed at these two test stages, a series of Bonferroni confidence intervals were calculated to assess differences between study groups for those dropping out of the study for each of the test stages. Table 38. reports the results of these analyses.

Table 38.

Bonferroni intervals for the difference between study groups for those dropping out of the study at each test stage

	Test stage	
Study group	4 weeks	Baseline – 1 year
FAE – FAC	*-0.36, 0.11*	*-0.38, 0.13*
ECE – ECC	*-0.05, 0.29*	*-0.18, 0.43*
FAE – ECE	-0.47, -0.08	-0.57, -0.04
FAE – ECC	-0.4, 0.09	-0.38, 0.13
FAC – ECE	-0.32, 0.01	-0.46, 0.10
FAC – ECC	-0.25, 0.19	-0.35, 0.24

Note. The first two italicised rows of the table represent the comparison's *within* each randomised control trial, the remaining rows, the *between* trials comparisons

Table 38. shows that only the 2 experimental groups differ at each test stage for the proportion of drop outs. The table indicates that at 4 weeks post test, it is likely that there will be anywhere from 8% to 47% more drop outs in the fitness assessment experimental group compared to the exercise consultation experimental group. Over the course of the whole study, it is likely that anywhere between 4% and 57% more drop outs will occur in the fitness assessment experimental group compared to the exercise consultation experimental group.

Drop out rates for those regularly active at baseline.

Table 39. gives the drop out rates for each study group at each test stage for those regularly active at baseline.

Table 39.

Drop out rates for each study group at each test stage for those regularly active at baseline

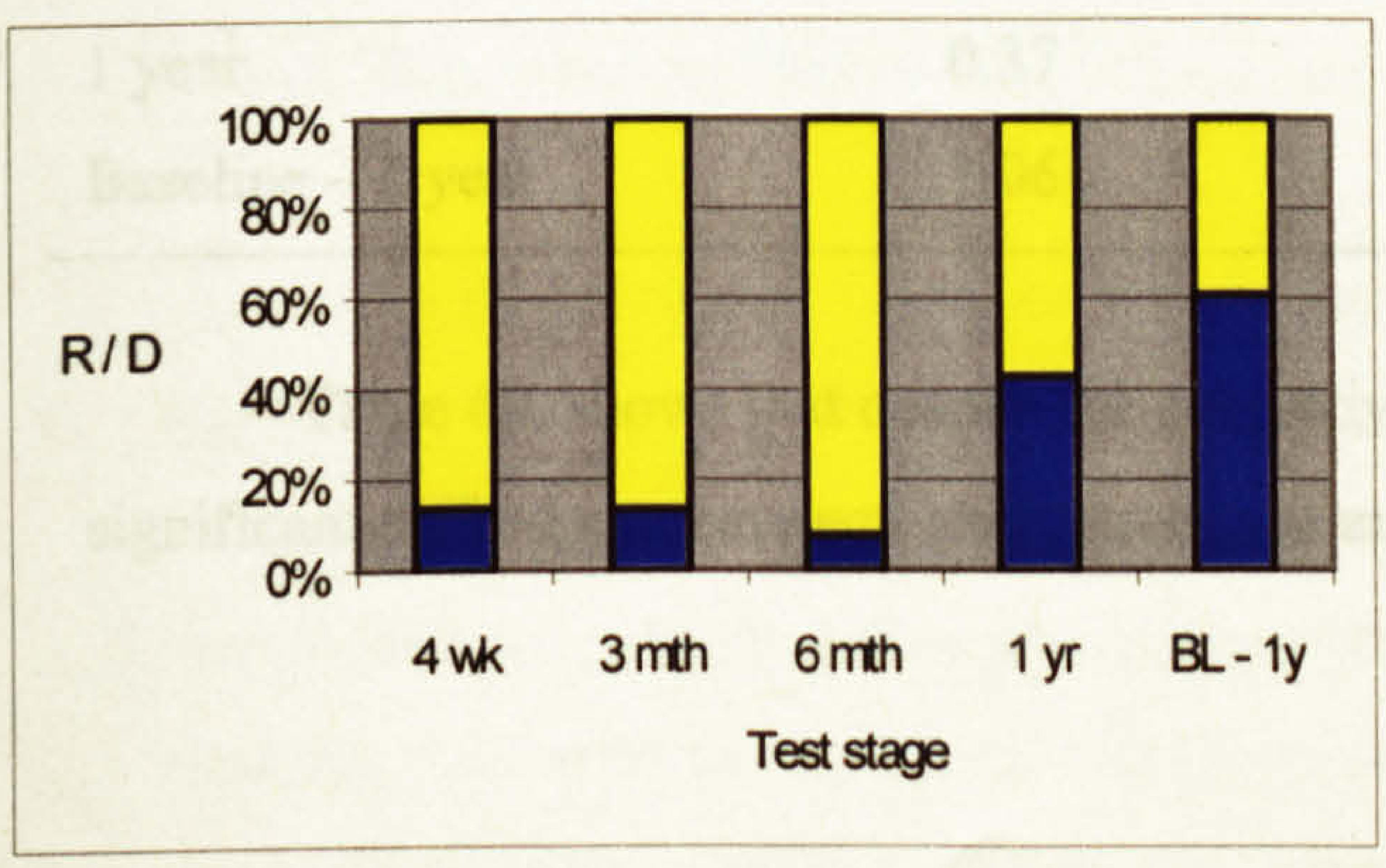
		Test stage									
		4 weeks		3 months		6 months		1 year		BL - 1 year	
Study group	D / R	N	%	N	%	N	%	N	%	N	%
FAE (N = 51)	D	7	14	6	14	3	8	15	43	31	61
	R	44	86	38	86	35	92	20	57	20	39
FAC (N = 48)	D	9	19	1	3	7	18	15	48	32	67
	R	39	81	38	97	31	82	16	52	16	33
ECE (N = 25)	D	5	20	1	5	5	26	7	50	18	72
	R	20	80	19	95	14	74	7	50	7	28
ECC (N = 25)	D	3	12	2	9	4	20	8	50	17	68
	R	22	88	20	91	16	80	8	50	8	32

Note. D = dropped out, R = remaining in the study at that test stage, BL - 1 year = baseline to 1 year analysis

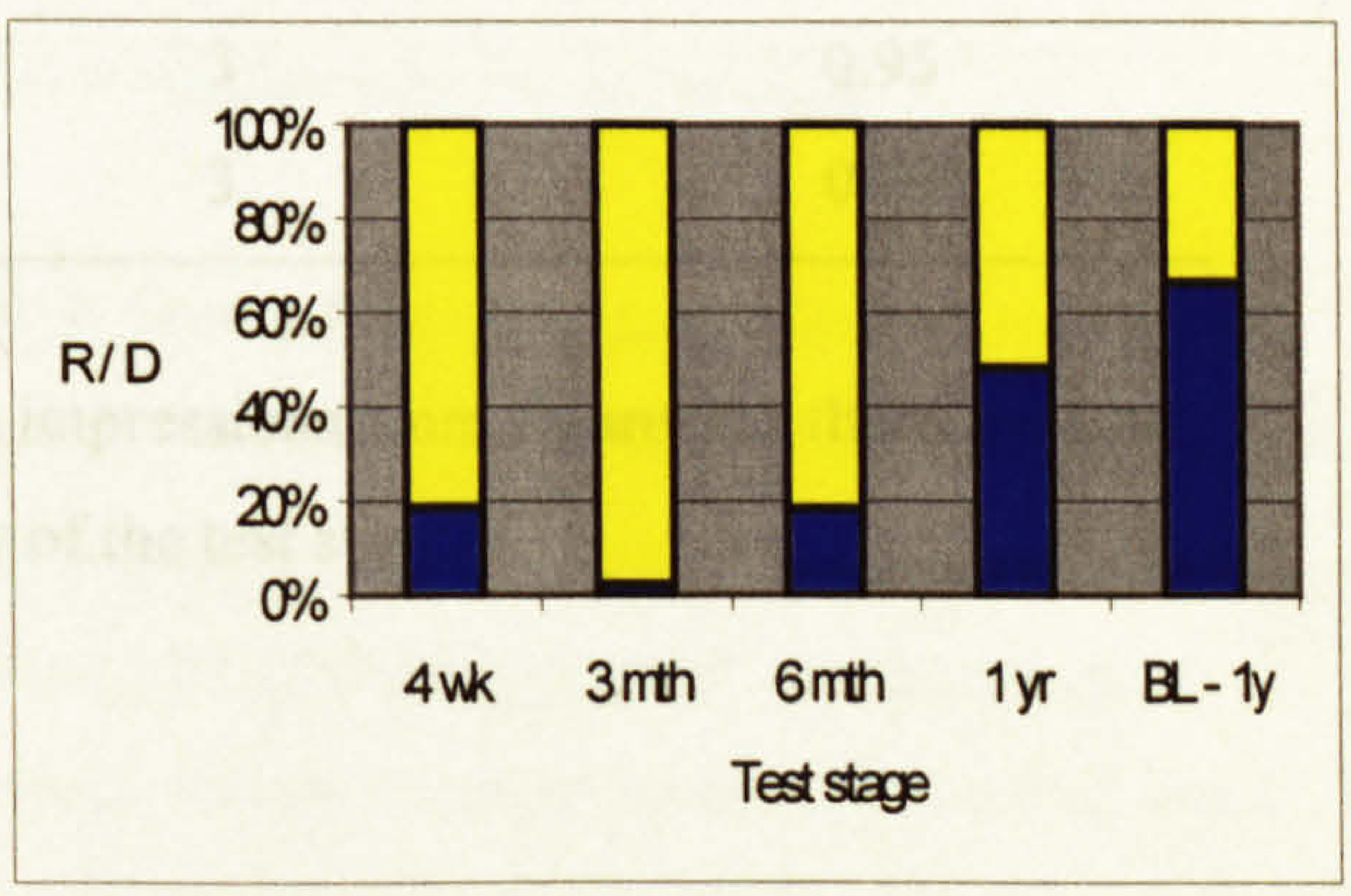
Figure 36. plots the percentage of those regularly active at baseline in each category (R or D) at each test stage for each study group.

KEY

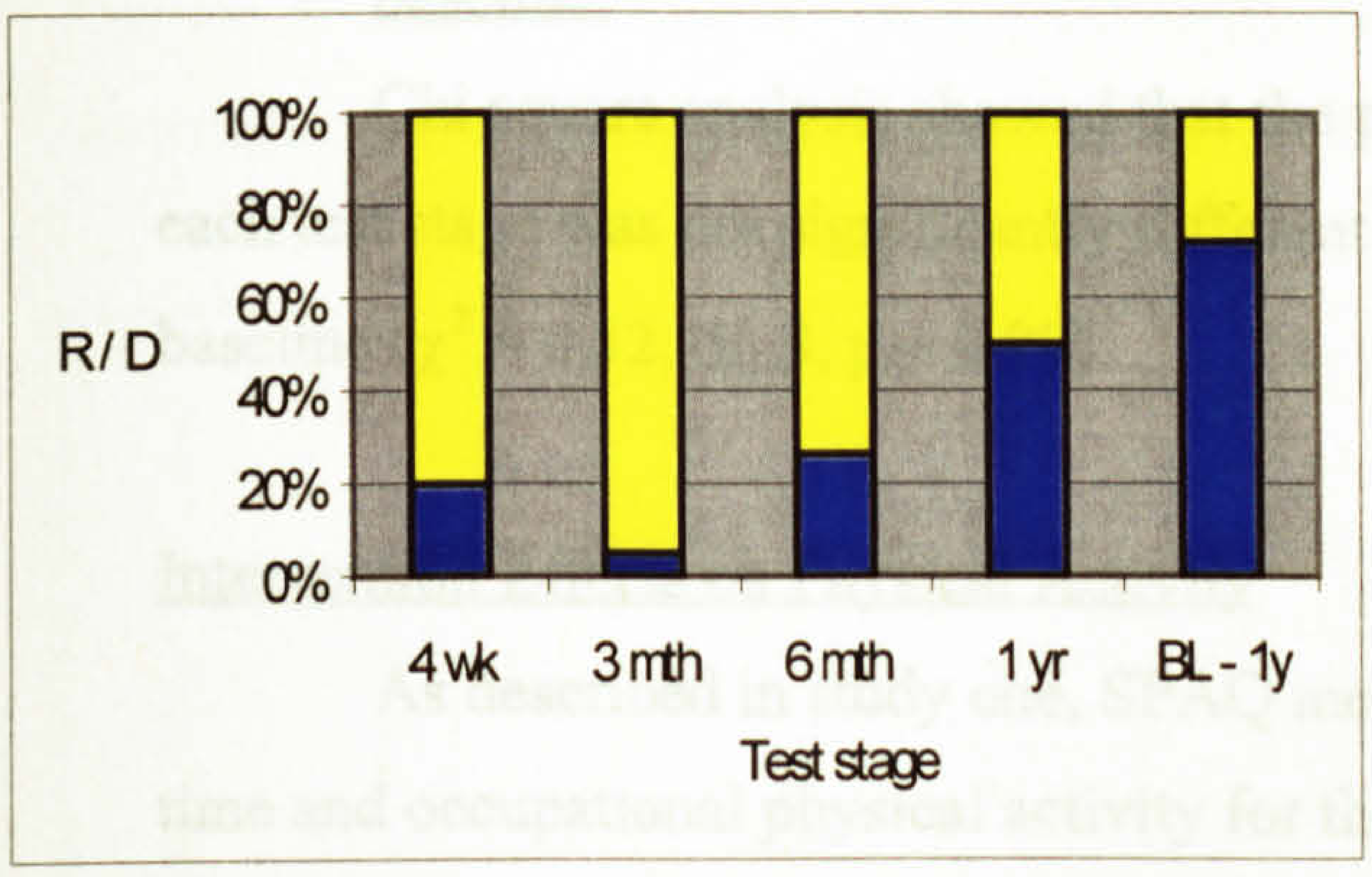
Remaining in study (R) Dropping out of study (D)

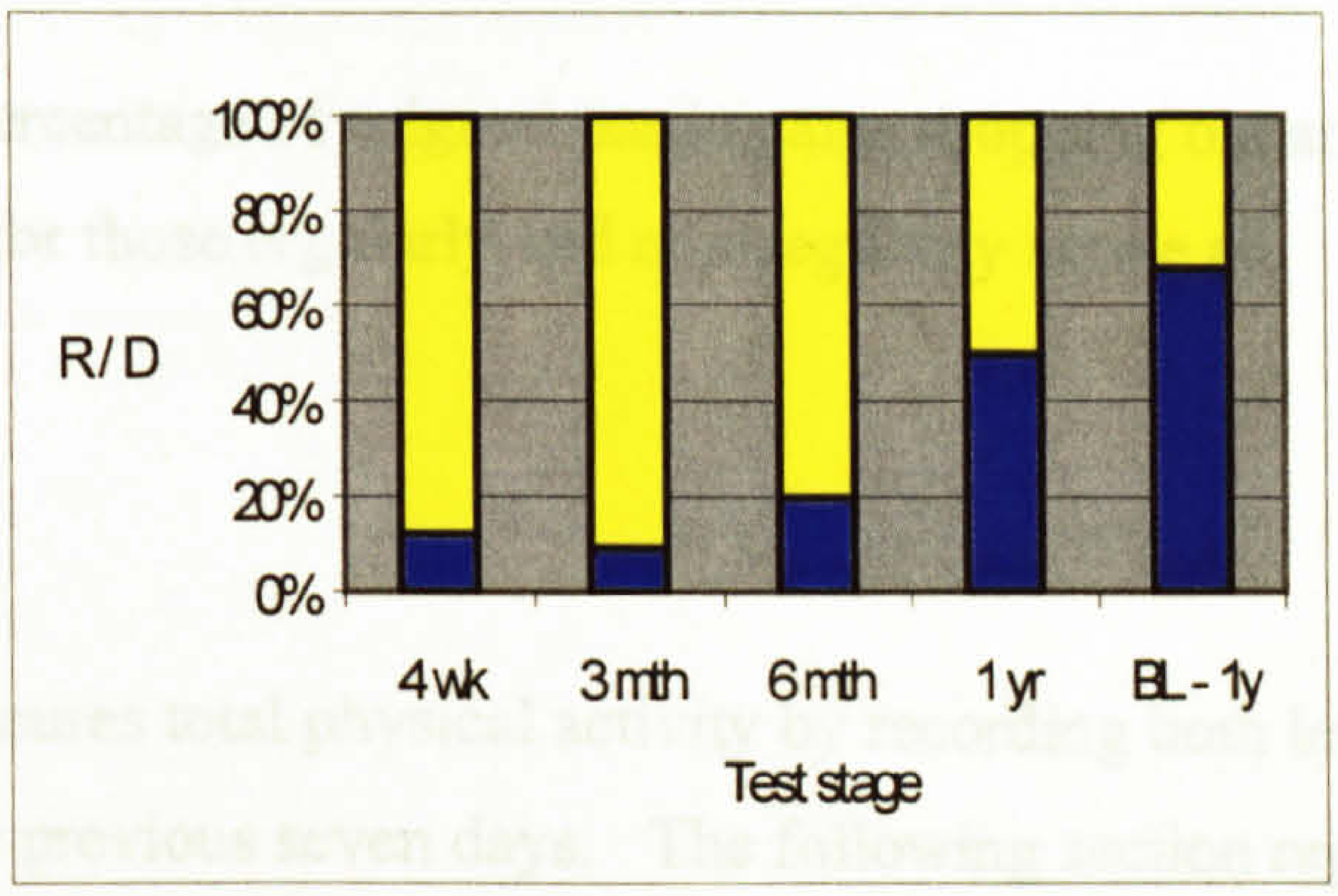


(a.) Fitness assessment experimental



(b.) Fitness assessment control





(c.) Exercise consultation experimental (d.) Exercise consultation control

Figure 36. The percentage of those regularly active at baseline in each category (R or D) at each test stage for each study group

Note. SOC = stage of exercise behaviour change, BL - 1y = baseline to 1 year comparison

Figure 36. shows that the drop out rates for the fitness assessment control group, and both exercise consultation groups at each test stage appear to be similar. The fitness assessment experimental group show similar drop outs at baseline and one year post but more drop outs at three months and less at six months post test. To analyse differences in drop out rates between study groups at each test stage, five chi square tests were conducted. Table 40. reports the results of the tests.

Table 40.

The results of five chi square tests conducted to examine differences in drop out rates between study groups at each test stage

Study group	χ^2 statistic	DF	P
4 weeks	1.06	3	0.79
3 months	3.75	3	0.29
6 months	3.65	3	0.3
1 year	0.37	3	0.95
Baseline – 1 year	1.06	3	0.79

Table 40. shows that despite the subjective impressions from figure 36., there were no significant differences between study groups at any of the test stages.

Comparison of drop out rates for those regularly active and non regularly active at baseline.

Chi square analysis showed that the percentage of original participants dropping out at each test stage was not significantly different for those regularly and non-regularly active at baseline ($\chi^2 = 0.12$, df, 3, $p = 0.99$).

Intervention Effects on Physical Activity

As described in study one, SPAQ measures total physical activity by recording both leisure time and occupational physical activity for the previous seven days. The following section reports the effects of each intervention on leisure time and occupational physical activity and hence total physical activity.

Leisure time physical activity.

Baseline analysis

Table 41. gives basic descriptive statistics for leisure time physical activity for each test study group at baseline.

Table 41.

Descriptive statistics for leisure time physical activity (mins / wk) for each study group at baseline

Study Group	Activity Status	Baseline Leisure time PA (mins/wk)			
		N	Mean	Median	SD
FAE	NRA	43	256.3	200.0	215.1
	RA	51	563.4	540.0	323.6
FAC	NRA	45	282.6	250.0	165.8
	RA	48	610.8	580.0	300.8
ECE	NRA	41	194.5	185.0	116.8
	RA	25	594.0	610.0	244.7
ECC	NRA	34	159.1	150.0	95.4
	RA	25	565.8	600.0	233.1

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Table 41. reports the initial physical activity levels at baseline of participants regularly active and not regularly active for each intervention. At baseline, there are three main questions to be answered. First, are those regularly active participants reporting significantly more activity than those non regularly active participants (as would be expected), second, are there any significant differences in physical activity participation between intervention groups, and finally, is there any significant interaction between intervention group and activity status at baseline? A two way analysis of variance will be used to answer these questions. The first step is to plot the data.

Figures 37. and 38. show boxplots for activity status (i.e. regularly active / not regularly active) and intervention group respectively plotted against leisure time physical activity.

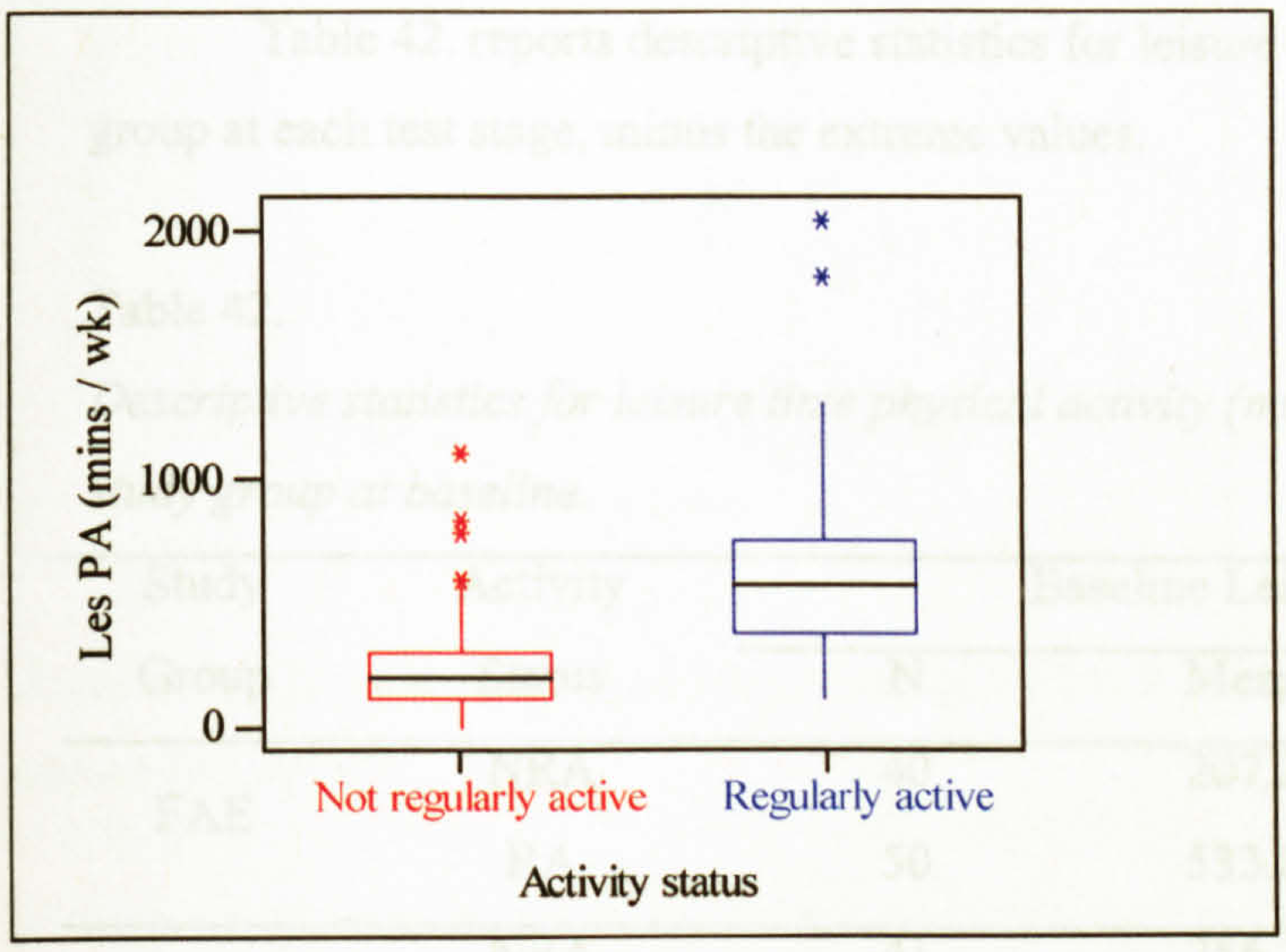


Figure 37. Boxplot of activity status against leisure time physical activity at baseline (mins / wk)

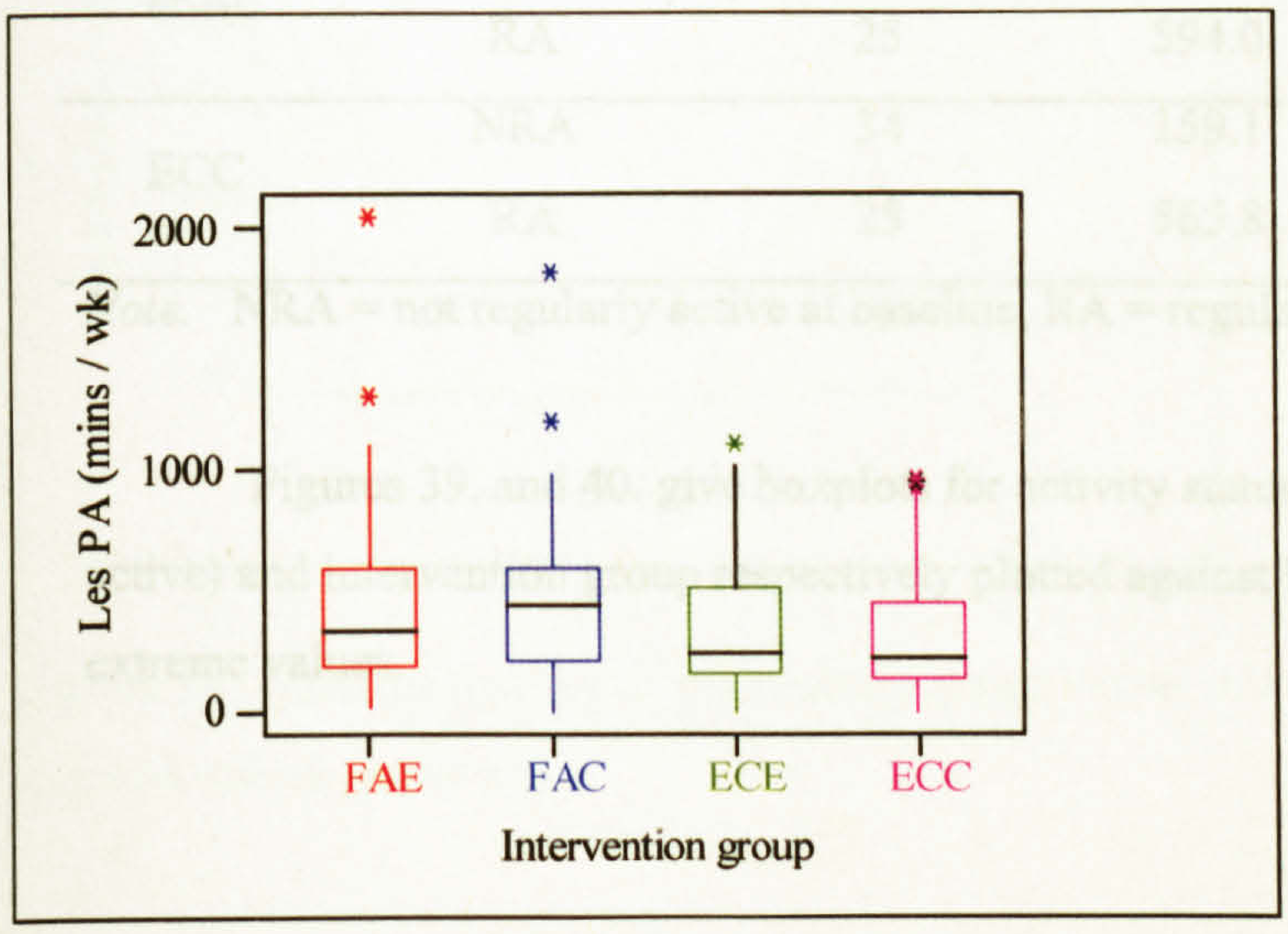


Figure 38. Boxplot of intervention group against leisure time physical activity at baseline (mins/wk)

Figure 37. shows that the data for both the inactive and the active participants is positively skewed. This is because of extreme values of physical activity being reported by some participants in each activity status group. With respect to the inactive group, 8 of the participants reported well in excess of 500 minutes of physical activity per week. Clearly, these people cannot be classed as inactive. With respect to the regularly active participants, 2 reported in excess of 1500 minutes of physical activity per week.

It is clear from figures 37. and 38. that removing the extreme sets of data would enhance the normality of the data, as without the extreme values, the graphs show good symmetry. In addition, following these participants throughout the course of the study, they continue to report higher amounts of physical activity than their counterparts. This suggests that if these sets of data are removed, the effect on the overall pattern of physical activity throughout the study will be minimal as these participants consistently report higher amounts of physical activity.

Table 42. reports descriptive statistics for leisure time physical activity for each study group at each test stage, minus the extreme values.

Table 42.

Descriptive statistics for leisure time physical activity (mins / wk) minus extreme values for each study group at baseline.

Study Group	Activity Status	Baseline Leisure time PA (mins/wk) N	Mean	Median	SD
FAE	NRA	40	207.2	197.5	113.6
	RA	50	533.8	540.0	247.3
FAC	NRA	41	256.1	220.0	148.7
	RA	47	585.3	570.0	246.1
ECE	NRA	40	185.3	185.0	101.9
	RA	25	594.0	610.0	244.7
ECC	NRA	34	159.1	150.0	95.4
	RA	25	565.8	600.0	233.1

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Figures 39. and 40. give boxplots for activity status (i.e. regularly active / not regularly active) and intervention group respectively plotted against leisure time physical activity minus the extreme values.

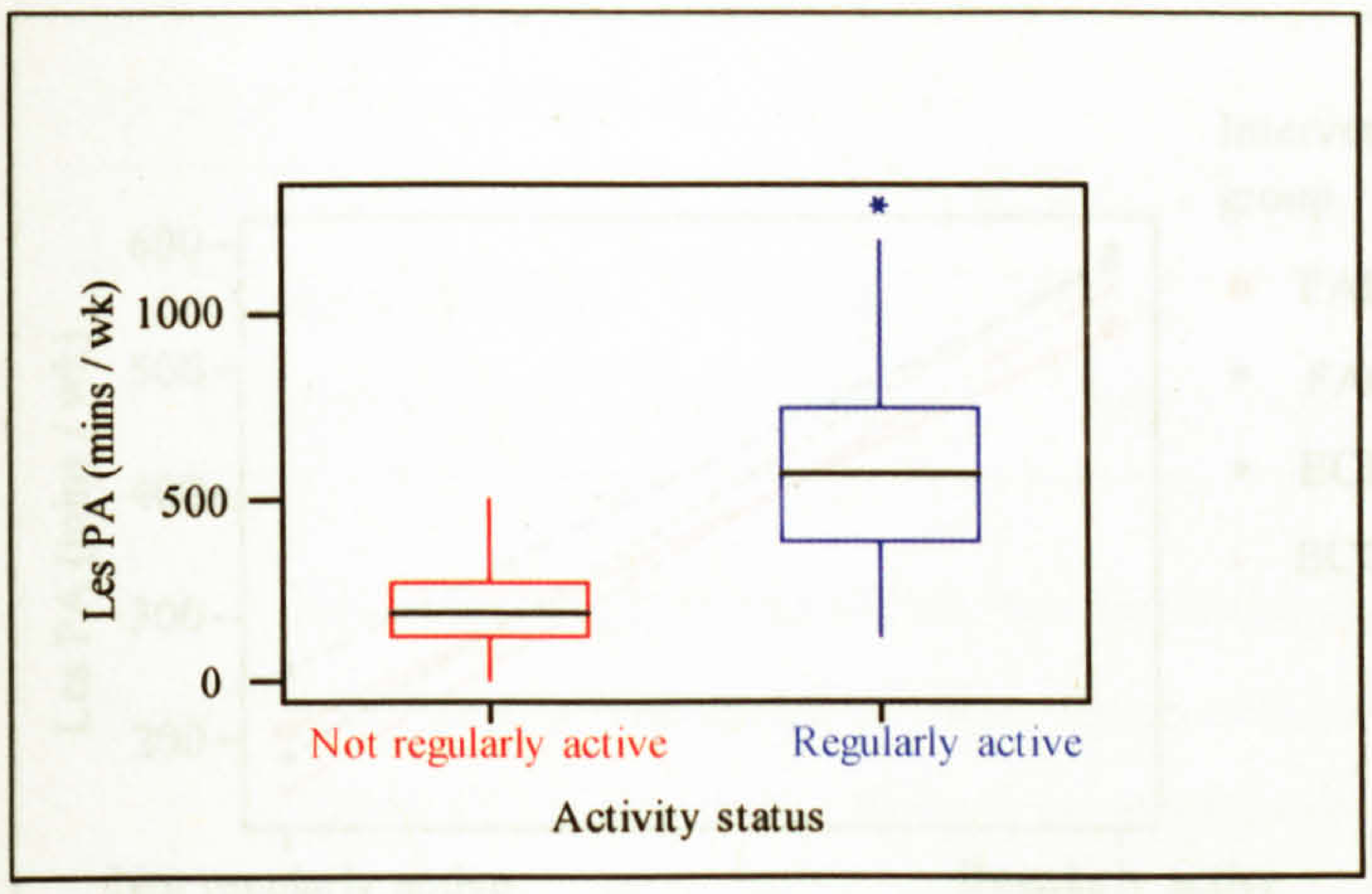


Figure 39. Baseline boxplot of activity status verses leisure time physical activity minus extreme values (mins/wk)

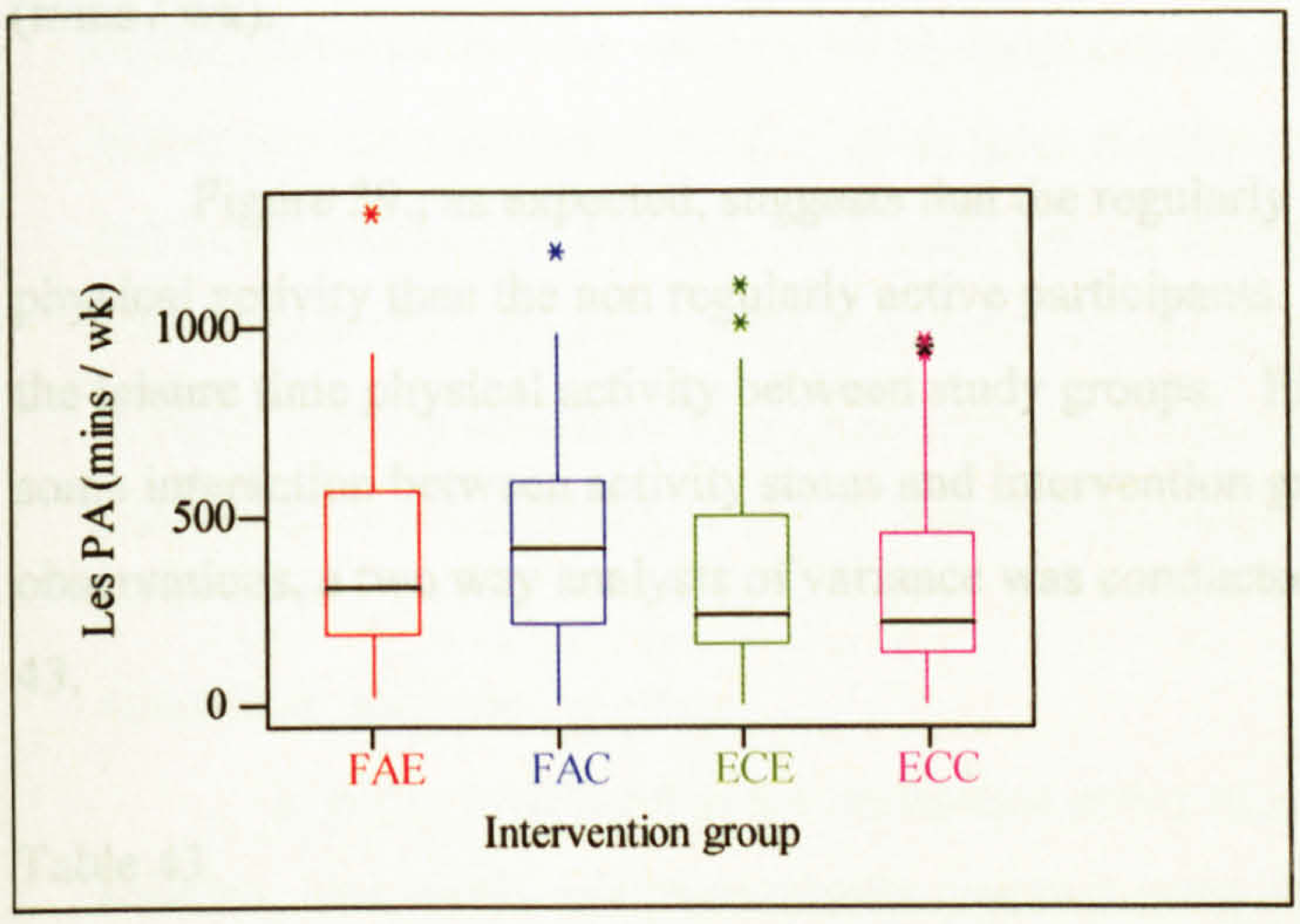


Figure 40. Baseline boxplot of intervention group verses leisure time physical activity minus extreme values (mins/wk)

Figures 39. and 40. show that removing the extreme values has improved the normality of the data although both plots still show some outliers. Taking the logarithms of the data had little effect on the number of outliers or the distribution of the data (appendix U).

Figures 39. and 40. represent main effect plots for activity status and intervention group respectively. Figure 41. plots the interaction between activity status and intervention group.

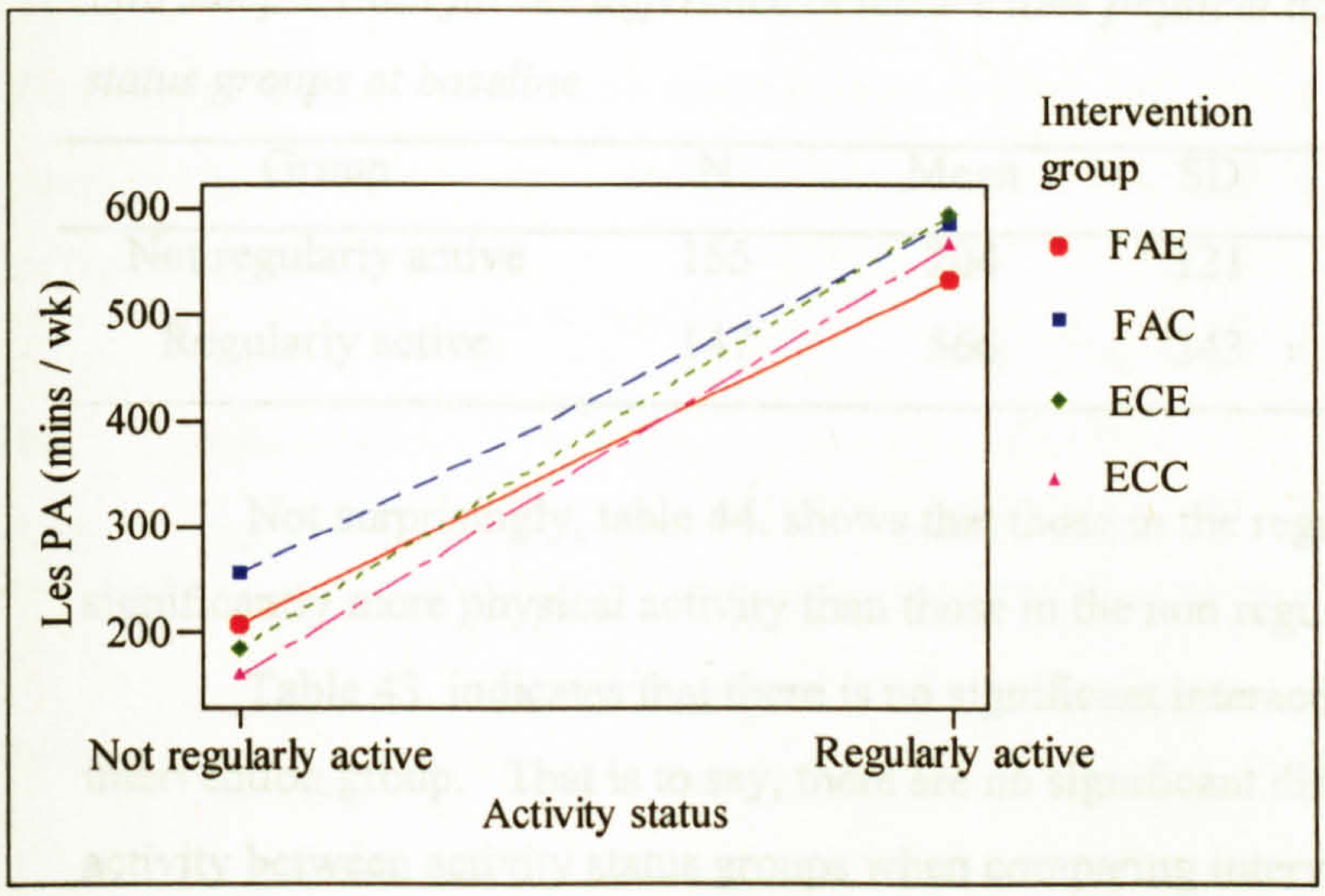


Figure 41. An interaction plot for intervention group and activity status for baseline leisure activity (mins / wk).

Figure 39., as expected, suggests that the regularly active participants are reporting more physical activity than the non regularly active participants. Figure 40. suggests no difference in the leisure time physical activity between study groups. Figure 41. suggests that there may be some interaction between activity status and intervention group. To formally check these observations, a two way analysis of variance was conducted, the results of which are given in table 43.

Table 43.

The results of a two way (intervention group and activity status) analysis of variance performed on baseline leisure time physical activity (mins / wk)

Source	DF	F	P
Intervention group	3	1.47	0.22
Activity status	1	266.34	< 0.05
Int group * Act status	3	1.04	0.37
Error	294	/	/
Total	301	/	/

Table 43. shows no significant difference between intervention groups but a significant main effect for activity status. Table 44. reports the results of a two sample t-test on the difference between non regularly active and regularly active participants.

Table 44.

Two sample t-test for the difference in leisure time physical activity (mins / wk) between activity status groups at baseline

Group	N	Mean	SD	T	P	CI
Not regularly active	155	204	121	-16.24	< 0.05	-406, -318
Regularly active	147	566	243			

Not surprisingly, table 44. shows that those in the regularly active group were reporting significantly more physical activity than those in the non regularly active group.

Table 43. indicates that there is no significant interaction between activity status and intervention group. That is to say, there are no significant differences in leisure time physical activity between activity status groups when comparing intervention groups.

Given that participants dropped out of the study at each test stage, the following analyses of the effects of the interventions on physical activity are split into three sections: an analysis of the immediate intervention effect (i.e. up to three months post test), an anlaysis of the effect of the re-test interventions (i.e. 3 months to 1 year) and an analysis of the overall long-term effect (i.e. a comparison of baseline to 1 year post test). In addition, given that adoption and maintenance of physical activity should be viewed as separate phases (Sallis and Hovell, 1990), it was decided to analyse those not regularly active at baseline separately from those regularly active at baseline.

Immediate intervention effect

In order to determine the immediate effect of each intervention, physical activity levels at baseline, four weeks and three months post-test need to be analysed. There are several questions of importance that need to be answered for both those not regularly active and also for those regularly active. First, is there any main effect of intervention group (i.e. FAE, FAC, ECE, ECC) or test stage (i.e. baseline, 4 weeks and three months post test)? Second, is there any significant interaction effect? In this case, the most appropriate analysis is a two way repeated measures analysis of variance with one within (test stage) factor and one between subject factor (intervention group) for each activity status group. Table 45. gives descriptive statistics for each activity status group for leisure time physical activity for each study group at test stages baseline, four weeks and three months for all participants still participating in the study at three months post test minus those extreme values removed at baseline as described earlier (p.166).

Table 45.

Descriptive statistics for leisure time physical activity (mins / wk) minus extreme values for each study group at baseline, four weeks and three months post test for participants remaining in study at three months.

Test Stage	Descriptive Statistics	Study Group and Activity Status							
		FAE		FAC		ECE		ECC	
		NRA	RA	NRA	RA	NRA	RA	NRA	RA
Base	N	24	37	34	37	38	19	27	20
	Mean	206.9	539.7	282.6	604.7	179.2	638.9	158.0	527.2
	Median	200.0	555.0	270.0	590.0	177.5	655.0	150.0	465.0
	SD	115.1	222.1	134.6	248.0	100.0	237.3	80.9	219.0
4 wk	N	24	37	34	37	38	19	27	20
	Mean	428.3	570.9	497.8	725.1	474.9	664.7	442.4	601.7
	Median	785.0	610.0	542.5	720.0	452.5	620.0	490.0	550.0
	SD	202.5	228.2	227.5	291.1	215.1	216.4	438.8	223.9
3 mth	N	24	37	34	37	38	19	27	20
	Mean	477.9	533.8	535.7	723.6	485.1	686.6	389.8	498.5
	Median	417.5	530.0	585.0	680.0	487.5	635.0	300.0	445.0
	SD	237.1	226.1	200.9	324.4	156.1	323.4	386.4	269.7

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Not regularly active at baseline

Figures 42. and 43. give boxplots for intervention group and test stage respectively against leisure time physical activity for those not regularly active at baseline.

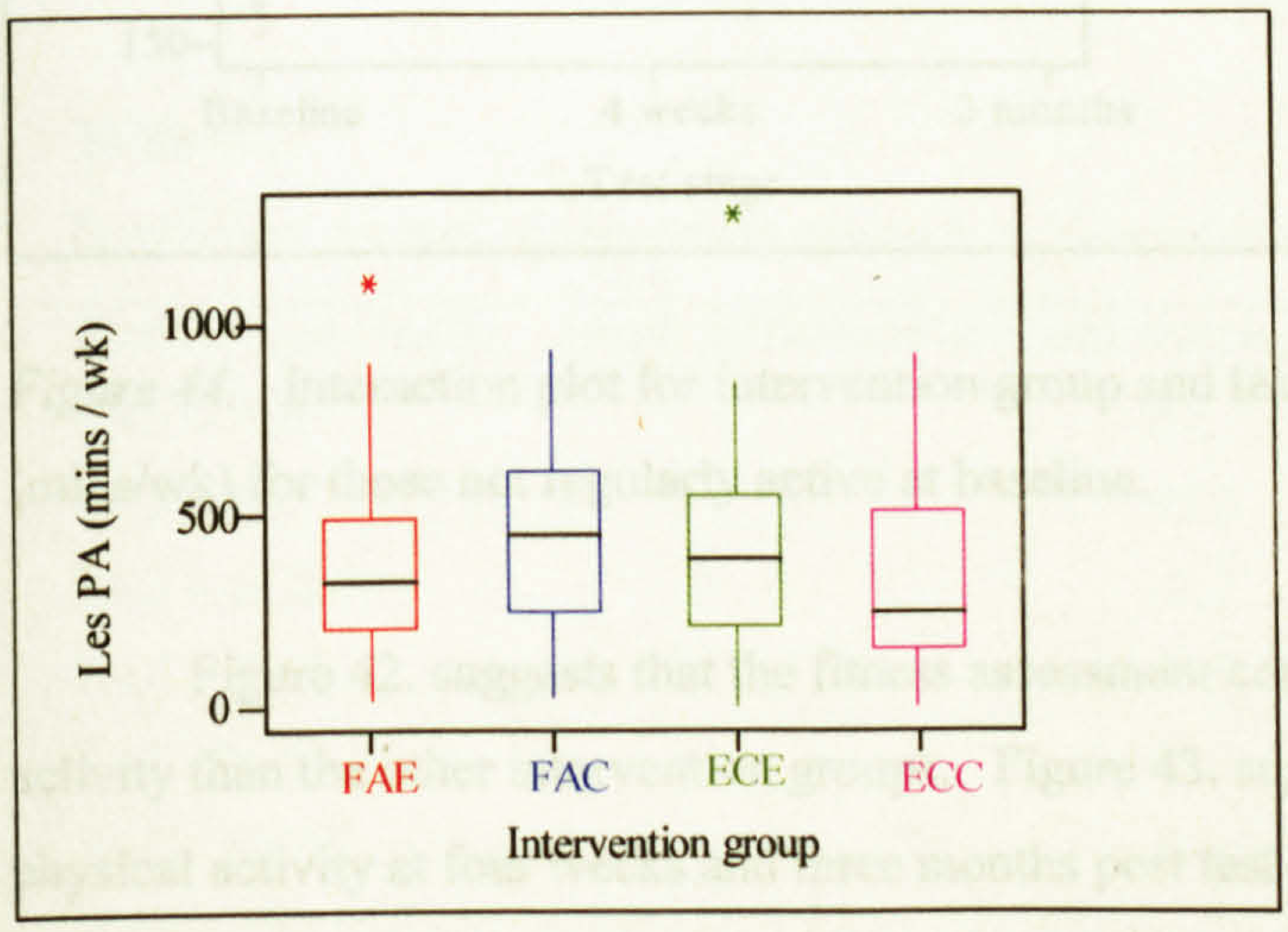


Figure 42. Boxplot of intervention group against leisure time physical activity for those not regularly active at baseline (mins / wk) over the first three test stages.

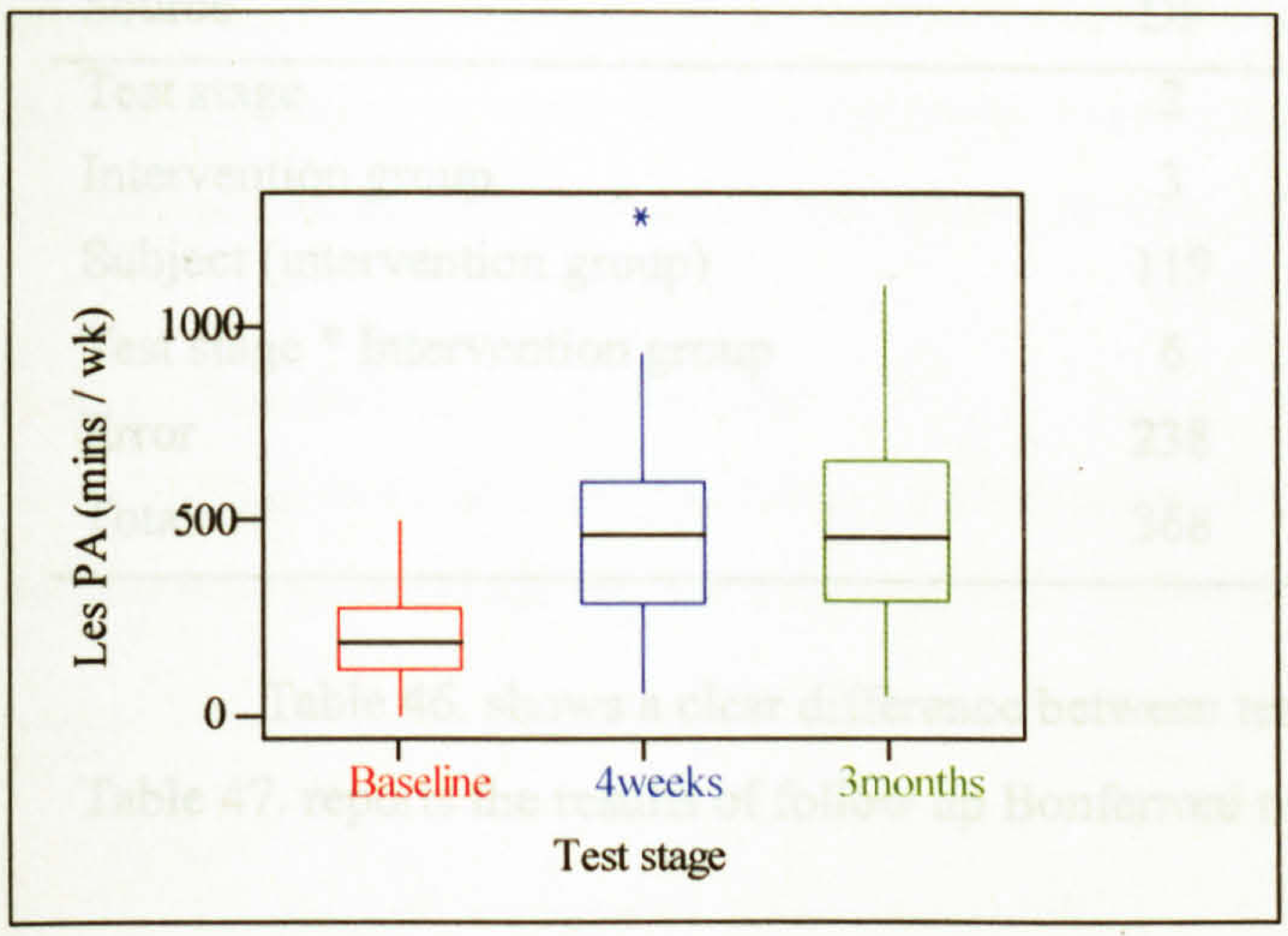


Figure 43. Boxplot of test stage against leisure time physical activity (mins/wk) for those not regularly active at baseline over the first three test stages.

Figures 42. and 43. show that there are few outliers and that the graphs are reasonably symmetrical. This indicates that the data is normally distributed. Figure 44. plots the interaction.

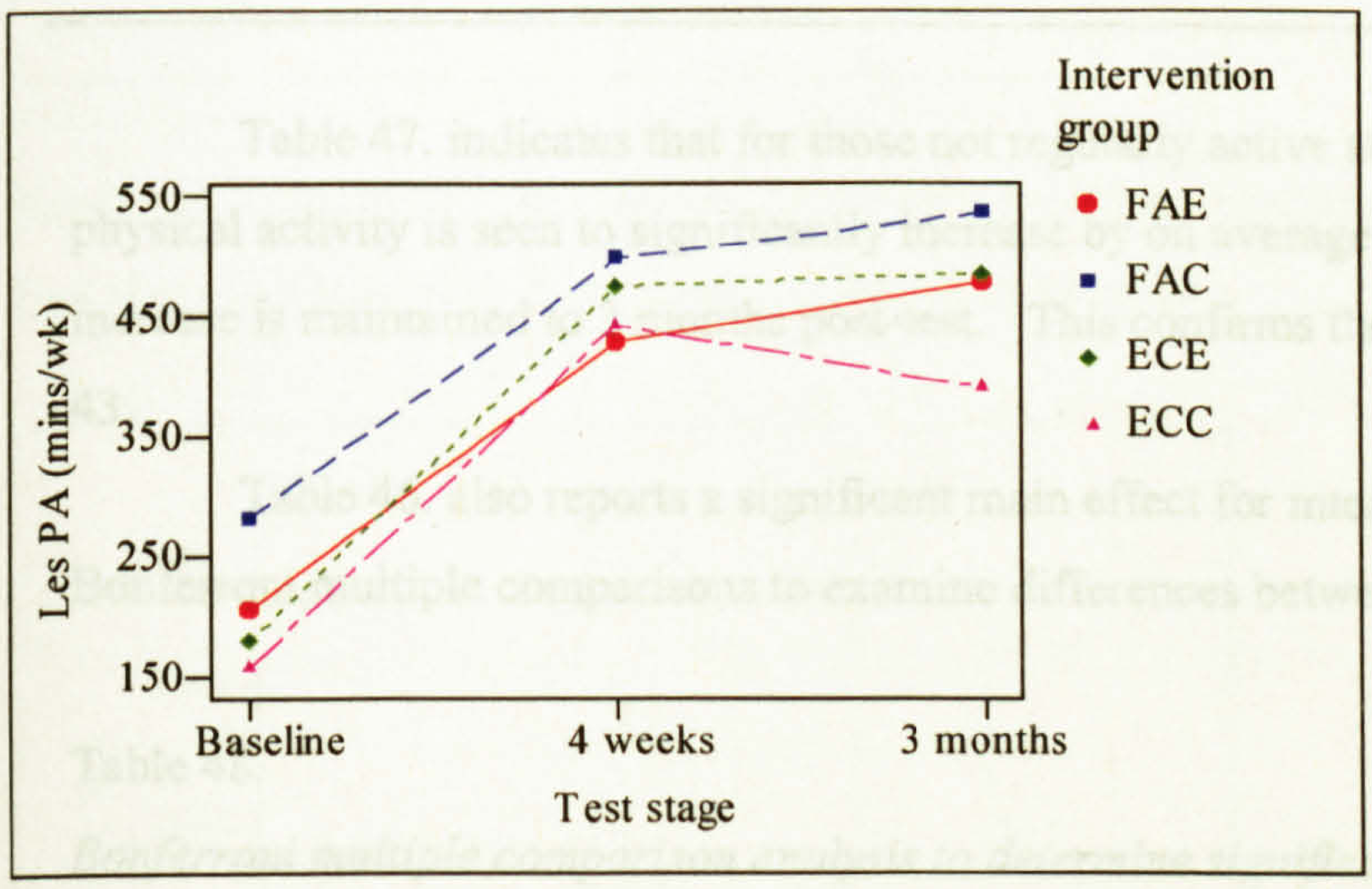


Figure 44. Interaction plot for intervention group and test stage for leisure time physical activity (mins/wk) for those not regularly active at baseline.

Figure 42. suggests that the fitness assessment control group are reporting more physical activity than the other intervention groups. Figure 43. suggests that the groups are reporting more physical activity at four weeks and three months post test compared to baseline. Figure 44. indicates little interaction between the groups over the test stages. To formally test these observations, a two way analysis of variance on those not regularly active at baseline for test stage by intervention group was conducted. Table 46. reports the results of this analysis.

Table 46.

Results of a two way analysis of variance on not regularly active participants by test stage

Source	DF	F	P
Test stage	2	126.21	< 0.05
Intervention group	3	3.1	< 0.05
Subject (intervention group)	119	2.81	< 0.05
Test stage * Intervention group	6	1.14	0.34
Error	238	/	/
Total	368	/	/

Table 46. shows a clear difference between test stages for those not regularly active. Table 47. reports the results of follow up Bonferroni multiple comparisons for repeated measures.

Table 47.

Follow up Bonferroni multiple comparisons for repeated measures for the not regularly active group for test stage differences

Test stage	Mean difference between test stages (mins/wk)	Interval estimate
Baseline - 4 weeks	-256.5	-303.21, -209.72
Baseline - 3 months	-268.3	-314.37, -222.14
4 weeks – 3months	-11.8	-54.42, 30.84

Table 47. indicates that for those not regularly active at baseline, their 4 weeks post-test physical activity is seen to significantly increase by on average 257 minutes. This significant increase is maintained to 3 months post-test. This confirms the subjective impression from figure 43.

Table 46. also reports a significant main effect for intervention group. Table 48. reports Bonferroni multiple comparisons to examine differences between intervention groups.

Table 48.

Bonferroni multiple comparison analysis to determine significant intervention group differences.

Intervention Group	Mean difference between intervention groups (mins/wk)	Interval estimate
FAE – FAC	*-67.7*	*-158.28, 22.91*
ECE – ECC	*49.6*	*-35.86, 135.21*
FAE – ECE	-8.7	-97.29, 79.91
FAE – ECC	40.9	-54.35, 136.31
FAC- ECE	59.0	-21.23, 139.21
FAC – ECC	108.6	21.07, 196.26

Note. The first two italicised rows of the table represent the comparison's *within* each randomised control trial, the remaining rows, the *between* trials comparisons

Table 48. shows that the fitness assessment control group are reporting significantly more physical activity, on average, than the exercise consultation control group over the three test stages. As the interaction between intervention group and test stage is not significant (table 46.), it can be concluded that this difference between control groups is consistent across test stages.

Regularly active at baseline

Figures 45. and 46. give boxplots for intervention group and test stage respectively for leisure time physical activity for those regularly active at baseline.

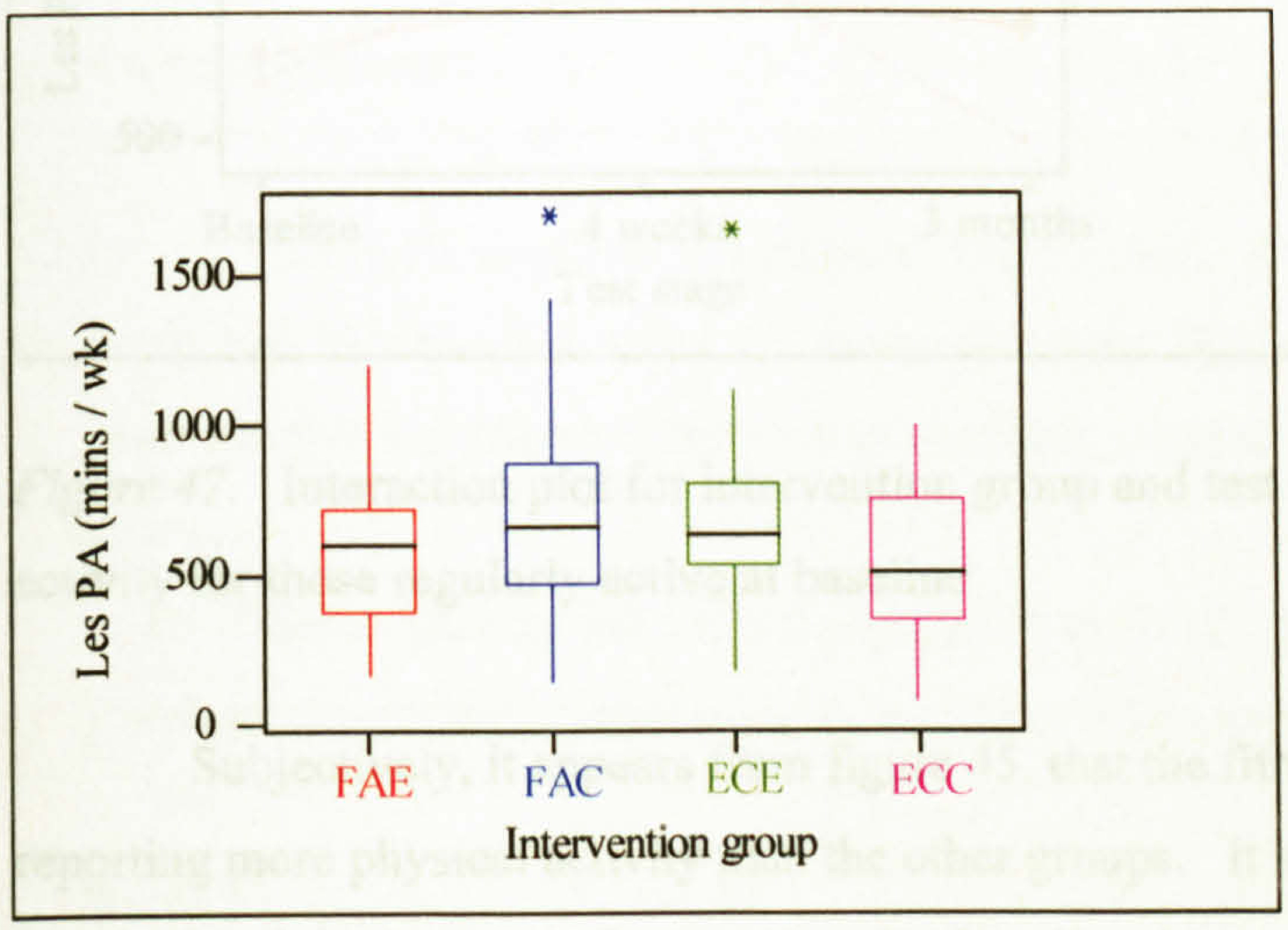


Figure 45. Boxplot of intervention group verses leisure time physical activity (mins / wk) for the first three test stages for those regularly active at baseline

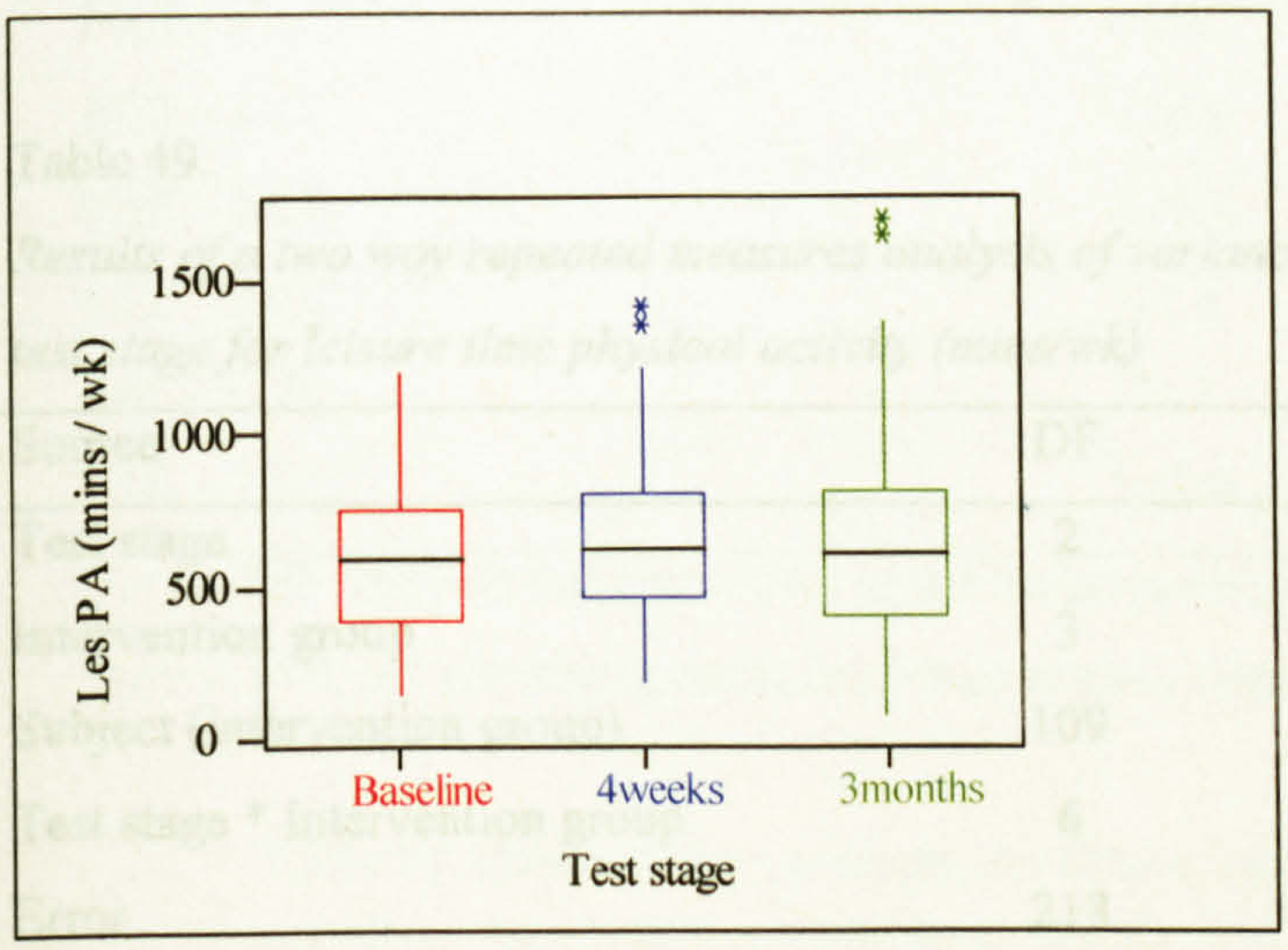


Figure 46. Boxplot of test stage verses leisure time physical activity (mins/wk) for the first three test stages for those regularly active at baseline

Figures 45. and 46. show outliers. However, taking logarithms of the data had little effect on the number of outliers or the distribution of the data (appendix U).

Figure 47. plots the interaction between the intervention group and test stage for the log of leisure time physical activity.

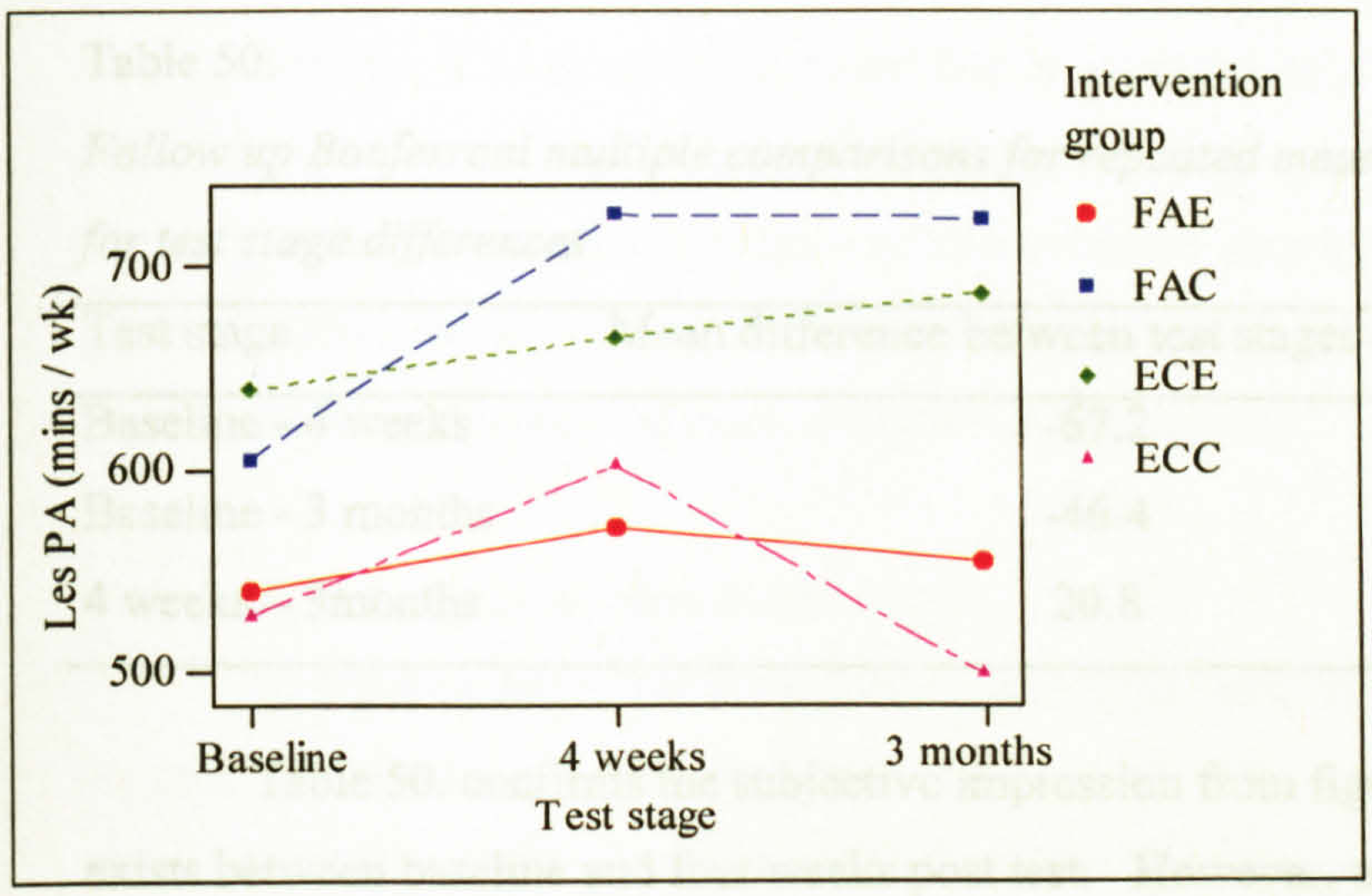


Figure 47. Interaction plot for intervention group and test stage for the log of leisure time physical activity for those regularly active at baseline

Subjectively, it appears from figure 45. that the fitness assessment control group are reporting more physical activity than the other groups. It also appears from figure 46. that physical activity increases four weeks after baseline, but returns to near baseline levels three months post test. Figure 47. indicates some interaction between the intervention groups over the three test stages. Table 49. reports the results of a two way repeated measures analysis of variance on those regularly active at baseline for test stage by intervention group.

Table 49.

Results of a two way repeated measures analysis of variance on regularly active participants by test stage for leisure time physical activity (mins/wk)

Source	DF	F	P
Test stage	2	3.3	< 0.05
Intervention group	3	3.41	< 0.05
Subject (intervention group)	109	4.35	< 0.05
Test stage * Intervention group	6	1.28	0.27
Error	218	/	/
Total	338	/	/

Table 49. once again confirms a significant difference between individual participants in the study.

Table 49. indicates a significant main effect for test stage. Table 50. reports the results of follow up Bonferroni multiple comparisons for repeated measures to examine differences between test stages for the regularly active group.

Table 50.

Follow up Bonferroni multiple comparisons for repeated measures for the regularly active group for test stage differences

Test stage	Mean difference between test stages (mins/wk)	Interval estimate
Baseline - 4 weeks	-67.2	-113.71, -20.63
Baseline - 3 months	-46.4	-110.19, 17.28
4 weeks – 3months	20.8	-39.42, 80.83

Table 50. confirms the subjective impression from figure 46. that a significant difference exists between baseline and four weeks post test. However, unlike those not regularly active at baseline, this significant difference is not maintained to three months, falling back to baseline levels.

Table 49. also indicates a significant main effect for intervention group. Table 51. gives Bonferroni multiple comparisons to examine differences between intervention groups.

Table 51.

Bonferroni multiple comparison analysis to determine significant intervention group differences for those regularly active.

Intervention Group	Mean difference between intervention groups (mins/wk)	Interval estimate
FAE – FAC	*-129.7*	*-221.09, -38.28*
ECE – ECC	*120.9*	*-5.02, 246.86*
FAE – ECE	-108.6	-219.56, 2.35
FAE – ECC	12.3	-96.79, 121.43
FAC- ECE	21.1	-89.87, 132.04
FAC – ECC	142.0	32.89, 251.12

Note. The first two italicised rows of the table represent the comparison's *within* each randomised control trial, the remaining rows, the *between* trials comparisons

Table 51. shows that on average, the fitness assessment control group are reporting significantly more physical activity than the fitness assessment experimental group and the exercise consultation control group over the three test stages. Again this confirms our observations from figure 45. As the interaction between intervention group and test stage is not significant (table 49.), it can be concluded that this difference between groups is consistent across test stages. It appears therefore that the fitness assessment control intervention had a greater effect on activity than the

actual fitness assessment. This is an interesting finding that will be reviewed further in the discussion.

In order to view "the whole picture", a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status) was conducted. This analysis indicated that as expected, those regularly active participants reported significantly more leisure time physical activity over the three test stages than those not regularly active. The analysis also confirmed that the activity status groups showed a different pattern of physical activity over the three test stages as reported in tables 47 and 50. The full results of this analysis of variance are given in appendix V.

Effectiveness of intervention re-test.

In order to determine the effectiveness of the intervention re-tests, comparison of the three months, six months and one year post test data needs to be conducted (as participants received an intervention re-test after completing the three month re-test questionnaires). The main questions of interest here are whether firstly there is any main effect for intervention group or test stage and secondly is there is any interaction effect? Table 52. gives descriptive statistics for leisure time physical activity for each study group at test stages three months, six months and one year post test for all participants still participating in the study at one year post test minus those data removed at baseline.

Table 52.

Descriptive statistics for leisure time physical activity (mins / wk) minus extreme values for each study group at three months, six months and one year post test for participants remaining in study at one year post test

Test Stage	Descriptive Statistics	FAE		FAC		ECE		ECC	
		NRA	RA	NRA	RA	NRA	RA	NRA	RA
3 mth	N	10	19	16	16	22	7	14	8
	Mean	511.5	652.6	509.7	679.4	461.6	577.0	423.9	610.0
	Median	467.5	695.0	467.5	670.0	470.0	635.0	360.0	657.0
	SD	307.3	197.0	197.8	316.4	146.9	309.0	224.8	322.0
6 mth	N	10	19	16	16	22	7	14	8
	Mean	354.0	629.5	497.0	570.0	443.6	667.0	308.6	534.0
	Median	262.5	690.0	458.0	530.0	477.5	540.0	242.5	452.0
	SD	184.5	205.8	423.0	249.8	211.9	557.0	179.5	298.0
1 yr	N	10	19	16	16	22	7	14	8
	Mean	281.0	629.2	316.6	574.1	314.1	501.0	248.2	385.0
	Median	225.0	710.0	302.5	600.0	267.5	630.0	207.5	400.0
	SD	100.4	164.5	159.2	314.7	160.1	322.0	157.8	283.0

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Not regularly active at baseline

Figures 48. and 49. give boxplots for intervention group and test stage respectively against leisure time physical activity for those not regularly at baseline.

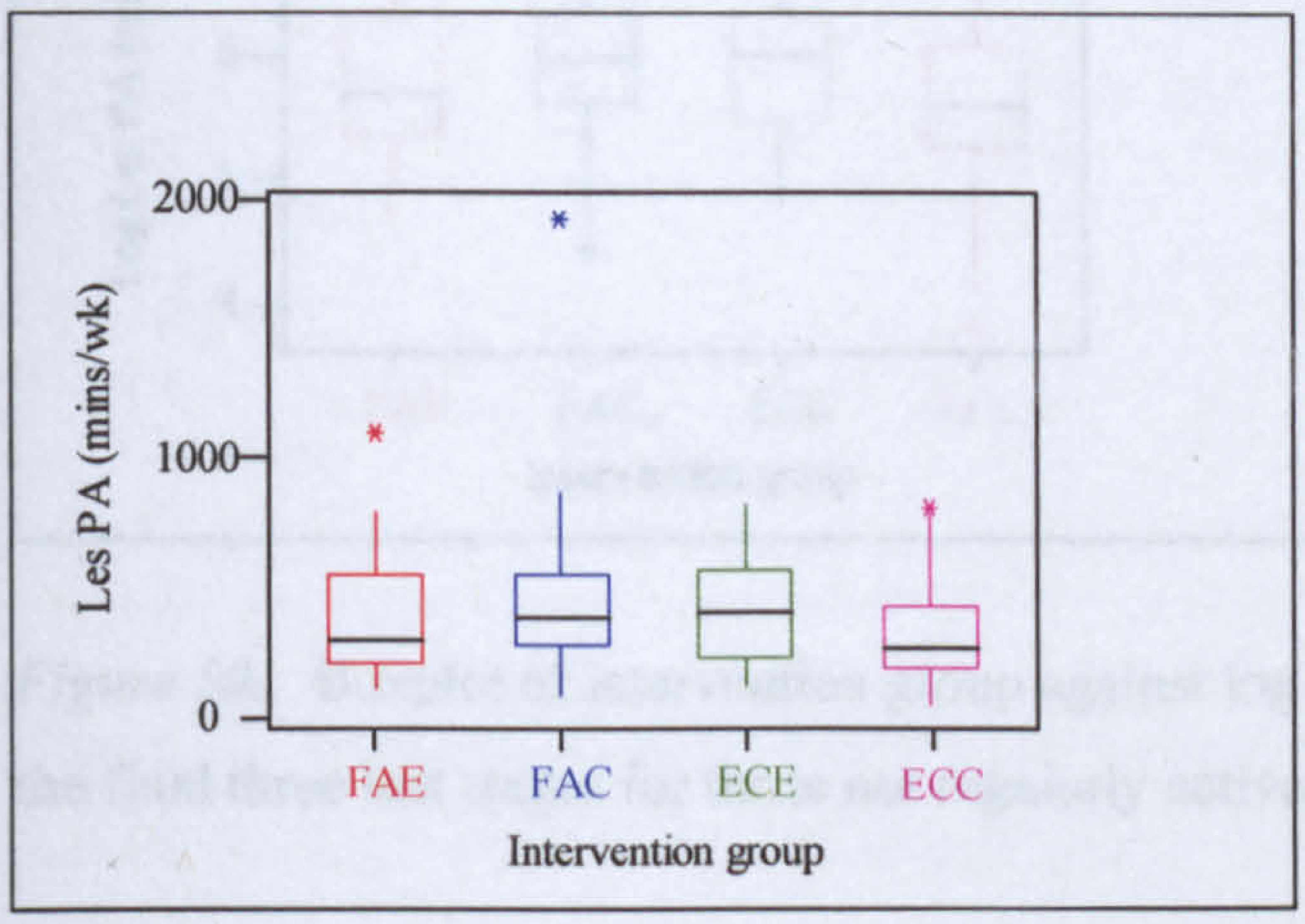


Figure 48. Boxplot of intervention group against leisure time physical activity (mins / wk) for the final three test stages for those not regularly active at baseline.

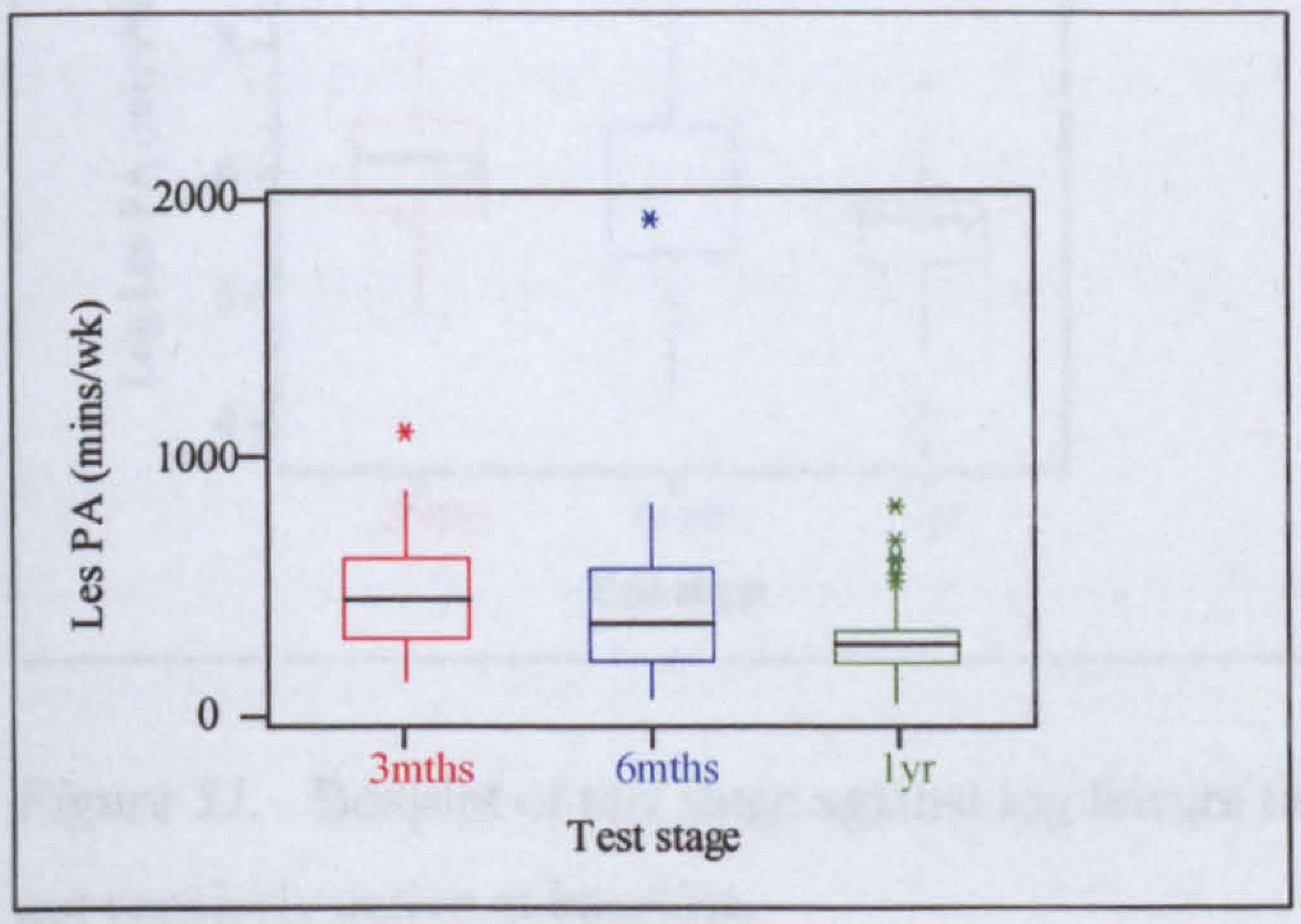


Figure 49. Boxplot of test stage against leisure time physical activity (mins/wk) for those not regularly active at baseline

Figures 50. and 51. give boxplots for intervention group and test stage respectively for log of leisure time physical activity.

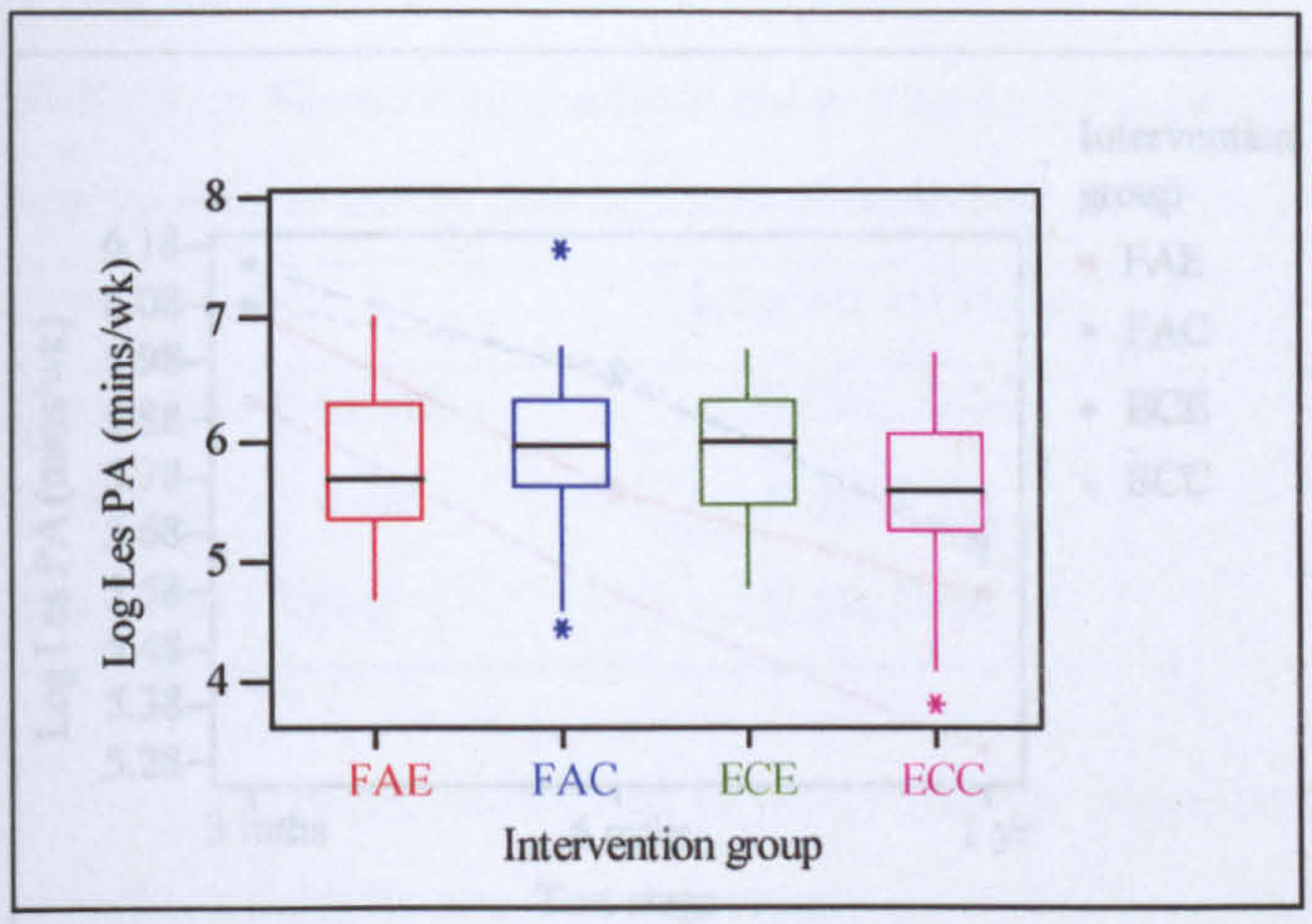


Figure 50. Boxplot of intervention group against log leisure time physical activity (mins / wk) for the final three test stages for those not regularly active at baseline.

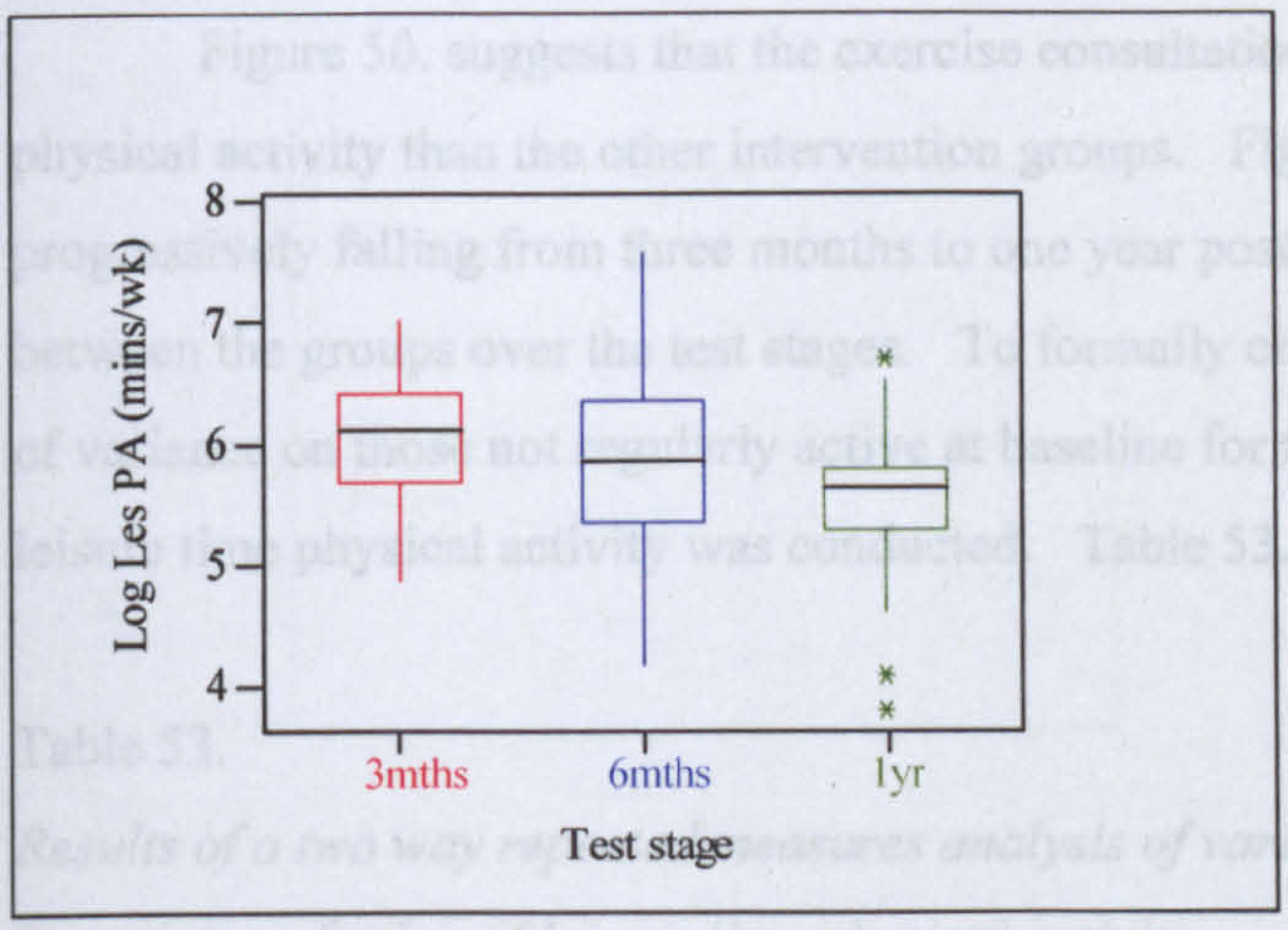


Figure 51. Boxplot of test stage against log leisure time physical activity (mins/wk) for those not regularly active at baseline.

Figures 50. and 51. show a normal relationship for intervention group and test stage.

Figure 52. plots the interaction for log of leisure time physical activity.

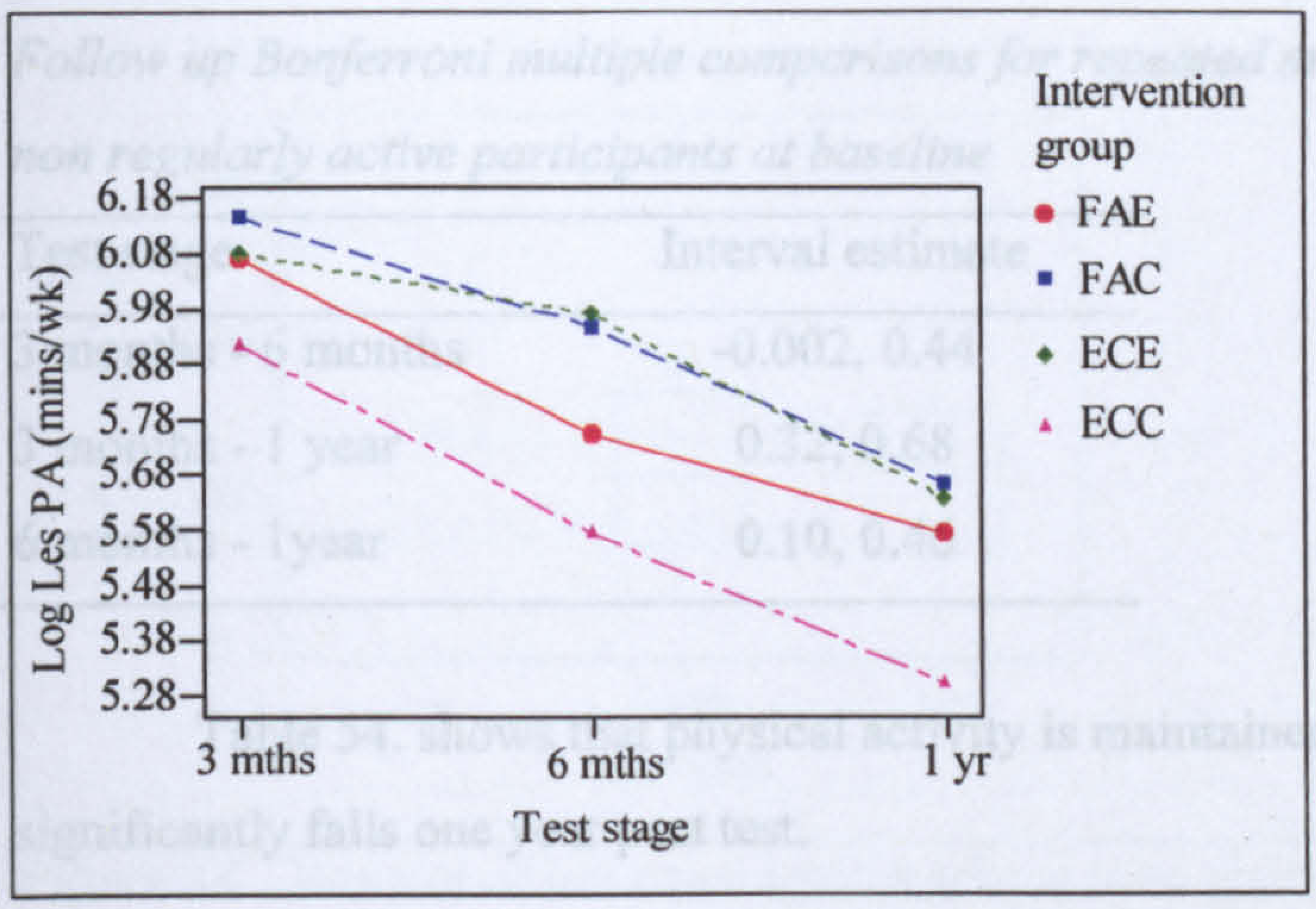


Figure 52. Interaction plot for intervention group and test stage for log of leisure time physical activity for those not regularly active at baseline.

Figure 50. suggests that the exercise consultation experimental group are reporting more physical activity than the other intervention groups. Figure 51. suggests that physical activity is progressively falling from three months to one year post test. Figure 52. indicates little interaction between the groups over the test stages. To formally check these observations, a two way analysis of variance on those not regularly active at baseline for test stage by intervention group for log of leisure time physical activity was conducted. Table 53. reports the results of this analysis.

Table 53.

Results of a two way repeated measures analysis of variance on non regularly active participants by test stage for log of leisure time physical activity

Source	DF	F	P
Test stage	2	18.53	< 0.05
Intervention group	3	1.99	0.13
Subject (intervention group)	58	2.48	< 0.05
Test stage * Intervention group	6	0.28	0.95
Error	116	/	/
Total	185	/	/

Table 53. reports a significant main effect for test stage, but not for intervention group. There is a significant subject nesting effect (as expected) but no significant interaction between test stage and intervention group.

Table 54. reports the results of Bonferroni multiple comparison for repeated measures to examine the main effect of test stage for not regularly active participants.

Table 54.

Follow up Bonferroni multiple comparisons for repeated measures for test stage differences for non regularly active participants at baseline

Test stage	Interval estimate
3 months - 6 months	-0.002, 0.44
3 months - 1 year	0.32, 0.68
6 months - 1year	0.10, 0.46

Table 54. shows that physical activity is maintained from three months to six months but significantly falls one year post test.

Regularly active at baseline

Figures 53. and 54. give boxplots for intervention group and test stage respectively.

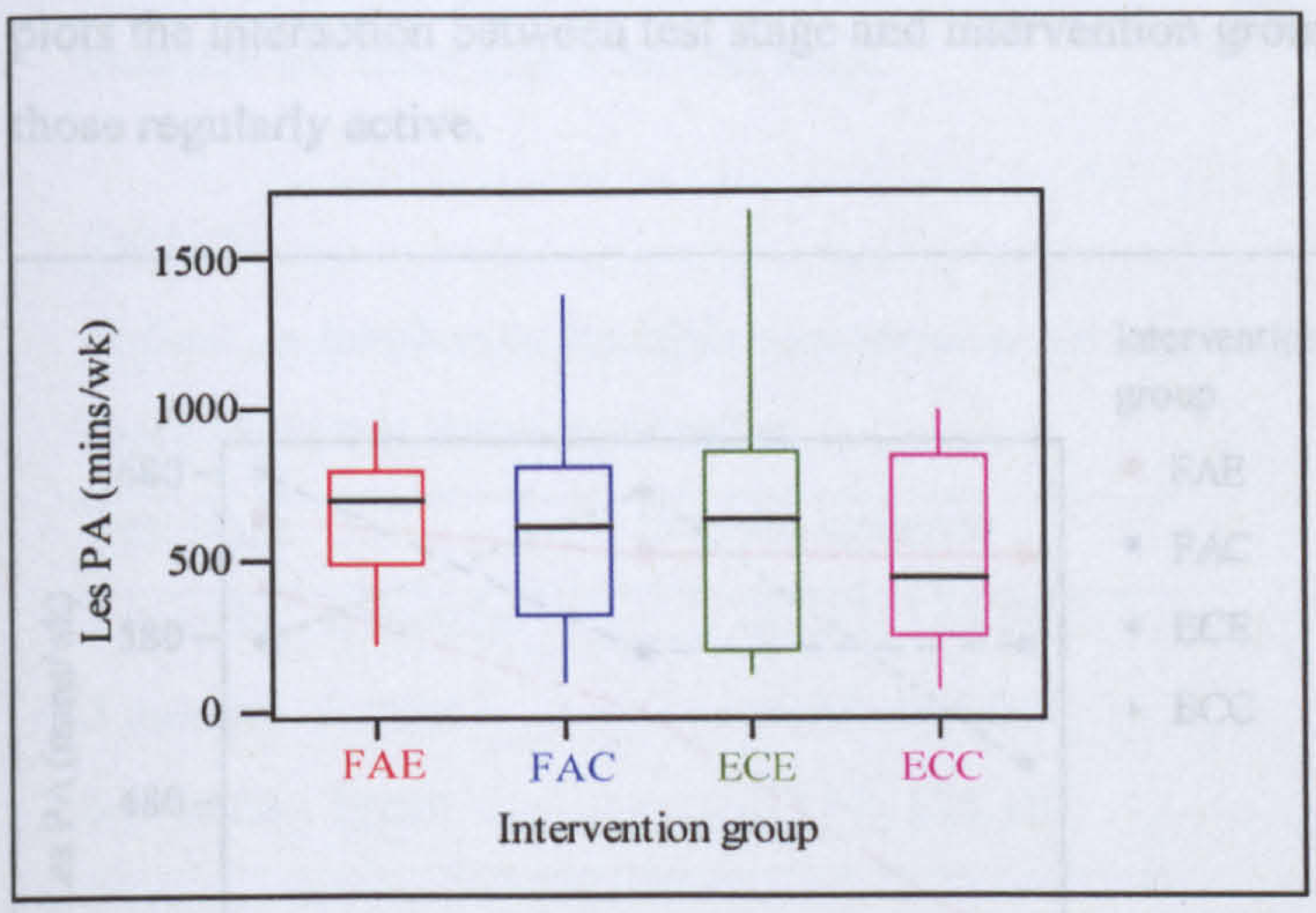


Figure 53. Boxplot of intervention group against leisure time physical activity (mins / wk) for the final three test stages for those regularly active at baseline.

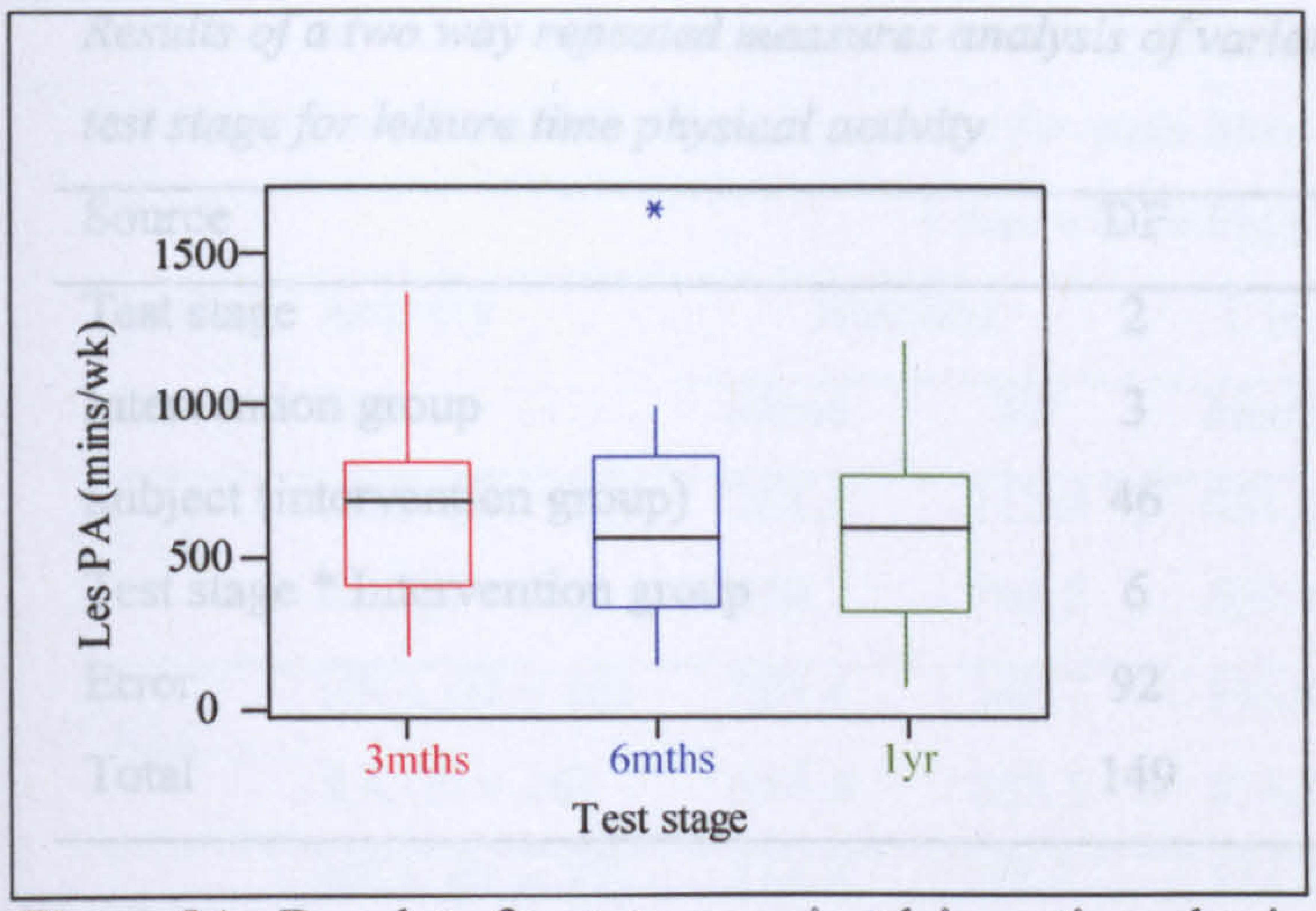


Figure 54. Boxplot of test stage against leisure time physical activity (mins/wk) for those regularly active at baseline.

Figures 53. and 54. show the data is normally distributed with few outliers. Figure 55. plots the interaction between test stage and intervention group for leisure time physical activity for those regularly active.

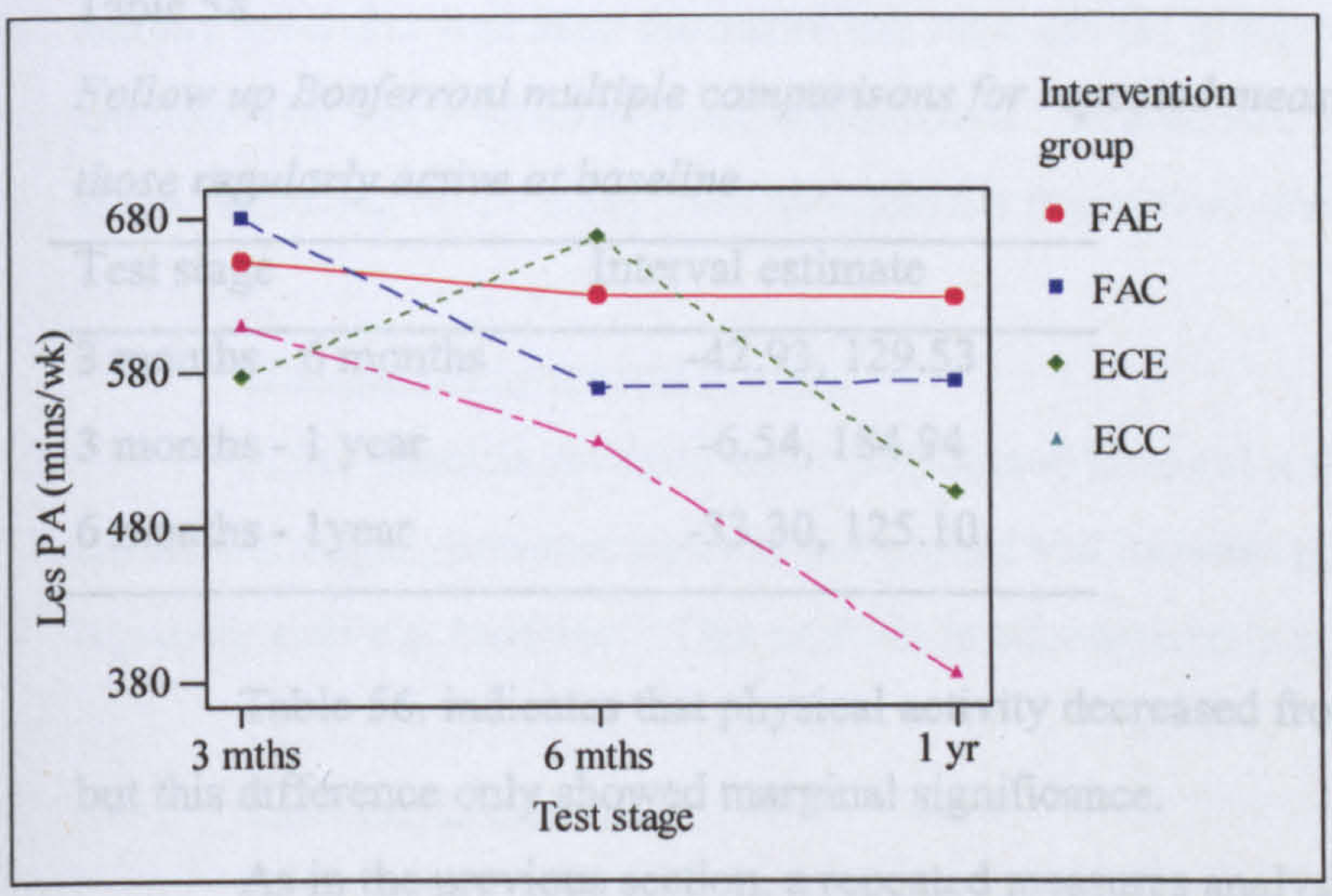


Figure 55. Interaction plot for intervention group and test stage for leisure time physical activity for those regularly active.

Figure 53. suggests that there is little difference between intervention groups. Figure 54. suggests that physical activity is relatively stable over the three test stages. Figure 55. indicates several significant interactions between the groups over the test stages. To formally test these observations, a two way analysis of variance on those regularly active at baseline for test stage by intervention group for leisure time physical activity was conducted. Table 55. reports the results of this analysis.

Table 55.

Results of a two way repeated measures analysis of variance on regularly active participants by test stage for leisure time physical activity

Source	DF	F	P
Test stage	2	4.22	< 0.05
Intervention group	3	0.54	0.66
Subject (intervention group)	46	5.73	< 0.05
Test stage * Intervention group	6	1.30	0.27
Error	92	/	/
Total	149	/	/

Table 55. reports a significant main effect for test stage, but not for intervention group. There is a significant subject nesting effect (as expected) but no significant interaction between test stage and intervention group.

Table 56. reports the results of Bonferroni multiple comparison for repeated measures to examine the main effect for test stage.

Table 58.

Follow up Bonferroni multiple comparisons for repeated measures for test stage differences for those regularly active at baseline

Test stage	Interval estimate
3 months - 6 months	-42.93, 129.53
3 months - 1 year	-6.54, 184.94
6 months - 1year	-33.30, 125.10

Table 56. indicates that physical activity decreased from three months to one year post test but this difference only showed marginal significance.

As in the previous section, a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status) was conducted. This analysis indicated that again as expected, those regularly active participants reported significantly more leisure time physical activity over the three test stages than those not regularly active. The full results of this analysis of variance are given in appendix V.

Baseline to one year post test analysis

In order to test for any significant change between activity status groups within their intervention groups from baseline to one year post test, eight one sample t-tests were conducted on the baseline to one year post test differences. Table 57. reports the results of these t-tests.

Table 57.

Eight one sample t - tests conducted to assess significant differences in leisure time physical activity (mins/wk) from baseline to 1 year post test for each intervention group

		Leisure time Physical Activity (Mins / wk)					
Study	Activity	Baseline		1 year post test		T - test result	
Group	Status	Mean	SD	Mean	SD	T	P
FAE	NRA (N = 10)	208.5	112.4	281.0	100.4	1.92	0.09
	RA (N = 19)	629.7	198.2	629.2	164.5	-0.02	0.99
FAC	NRA (N = 16)	253.4	148.7	316.6	159.2	1.05	0.31
	RA (N = 16)	654.4	282.5	574.1	314.7	-1.10	0.29
ECE	NRA (N = 22)	166.6	73.9	314.1	160.1	3.43	< 0.05
	RA (N = 7)	710.0	213.0	501.1	322.0	-1.3	0.24
ECC	NRA (N = 14)	168.9	77.9	248.2	157.8	1.86	0.09
	RA (N = 8)	558.1	256.0	385.0	283.0	-2.29	0.06

Note. NRA = not regularly active at baseline, RA = regularly active at baseline

Table 57. shows that the only group who have significantly increased their physical activity level one year after the initial test stage are the group who were not regularly active at baseline who received an exercise consultation. In addition, all those participants regularly active at the beginning of the study have successfully maintained this activity after one year.

Occupational physical activity

A full analysis revealed that occupational physical activity remained relatively constant across test stages, between intervention groups and between people who were regularly and not regularly active at baseline. This analysis is summarised in appendix W.

Total physical activity.

The previous section has indicated virtually no change in any of the groups occupational physical activity throughout the course of the study. As total physical activity is obtained by adding occupational and leisure time physical activity this would suggest that changes in total physical activity will simply mirror changes in leisure time physical activity. Figure 56. plots the means of total, leisure and occupational physical activity at each test stage for those participants remaining in the study at that test stage.

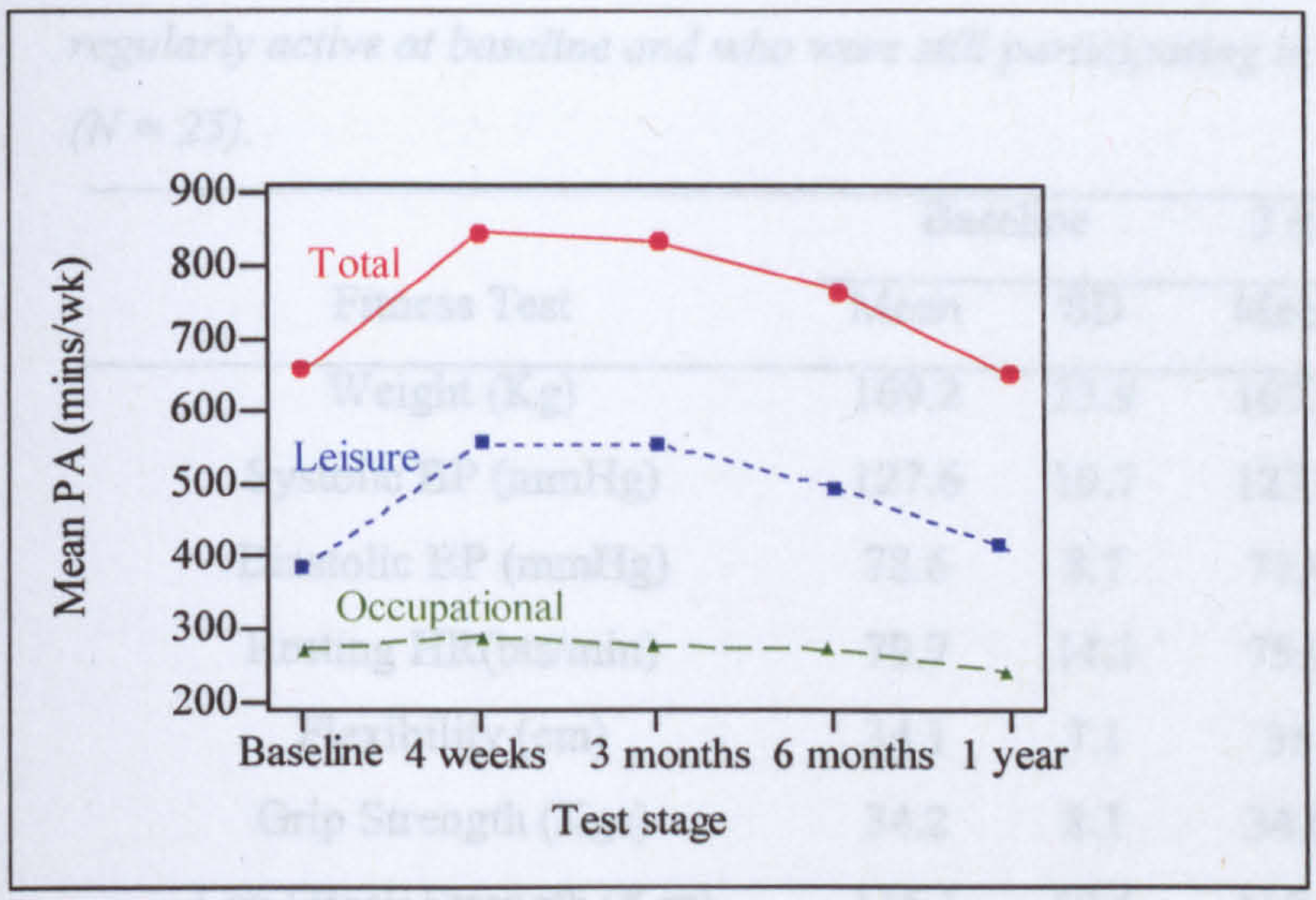


Figure 56. The means of total, leisure and occupational physical activity plotted against test stage for participants remaining in the study at that test stage

Figure 56. confirms the earlier observation that total physical activity shows an almost identical relationship to leisure time physical activity. This means that a complete analysis of total physical activity is not required.

Changes in Health Related Fitness

Only the fitness assessment experimental group received a full health related fitness assessment as part of their intervention. This was repeated at the three-month post test stage. This allows for a comparison to monitor changes in health related fitness. The following section explores any differences that may have occurred over the three months. Given that the previous section has shown that those receiving a fitness assessment who were not regularly active reported a different pattern of physical activity over the first three months of the study compared to those who were regularly active, it is possible that any changes in health related fitness may differ between the groups. For this reason, the two groups are analysed separately.

Not regularly active participants at baseline.

Table 58. gives the baseline and three month test stage fitness assessment descriptive statistics for the non regularly active participants at baseline who were still involved in the study at three month post test and reports a series of one sample t-tests designed to highlight significant differences.

Table 58.

The baseline and three month test stage fitness assessment descriptive statistics for participants not regularly active at baseline and who were still participating in the study at three months post test (N = 25).

Fitness Test	Baseline		3 mnth post test		t test analysis	
	Mean	SD	Mean	SD	t	p value
Weight (Kg)	169.2	33.9	167.8	33.9	-1.8	0.084
Systolic BP (mmHg)	127.6	10.7	127.5	9.9	-0.06	0.75
Diastolic BP (mmHg)	78.6	8.7	77.4	8.7	-1.25	0.22
Resting HR(bts/min)	79.7	14.3	75.9	8.8	-2.1	< 0.05
Flexibility (cm)	34.1	7.1	35	7.8	2.39	< 0.05
Grip Strength (Kgs)	34.2	8.1	34.6	8.4	1.52	0.14
Leg / Back Strength (Kgs)	115.1	37.6	118.9	37.8	3.25	< 0.05
Peak Flow Rate (l/min)	447.7	106.4	449.7	104.3	0.46	0.65
Cardio-respiratory fitness (mls/O2/kg/min)	35.4	9.4	36.6	8.95	2.82	< 0.05

Table 58. shows that all fitness components changed positively (i.e. blood pressure, heart rate and weight decreased, flexibility, strength and cardio-respiratory fitness increased) after three months. Follow up t-test analysis showed that resting heart rate, flexibility, leg and back strength and cardio-respiratory fitness changed significantly. These positive results suggest that the significantly increased total physical activity reported by this group at three months (as detailed in the previous section) has significantly improved four components of the group's health related fitness.

Regularly active participants at baseline.

Table 59. gives the baseline and three month test stage fitness assessment descriptive statistics for the regularly active participants at baseline who were still involved in the study at three month post test and reports a series of one sample t-tests designed to highlight significant differences.

Table 59.

The baseline and three month test stage fitness assessment descriptive statistics for participants regularly active at baseline and who were still participating in the study at three months post test (N = 38).

Fitness Test	Baseline		3 mnth post test		t test analysis	
	Mean	SD	Mean	SD	t	p value
Weight (Kg)	160.8	32.2	161	32	0.29	0.70
Systolic BP (mmHg)	135.8	10.7	132.8	10.8	-2.82	< 0.05
Diastolic BP (mmHg)	83.3	9.1	8	8.81	-2.99	< 0.05
Resting HR(bts/min)	78.9	7.61	77.5	7.85	-1.87	0.11
Flexibility (cm)	35.9	5.3	36.6	5.5	3.8	< 0.05
Grip Strength (Kgs)	33.9	10.9	34.3	10.9	2.31	< 0.05
Leg / Back Strength (Kgs)	121.2	44.9	121.8	44.2	0.6	0.51
Peak Flow Rate (l/min)	464.9	135.4	469.7	134.4	1.94	0.10
Cardio-respiratory fitness (mls/O2/kg/min	35.8	8.1	36.8	8.22	3.42	< 0.05

Again, it is interesting to note from table 59. that all fitness components other than weight showed a positive change with systolic and diastolic blood pressures, flexibility, grip strength and cardio-respiratory fitness all improving significantly. The previous section has shown that this group were not reporting significantly elevated physical activity levels three months post test but they did significantly increase their physical activity four weeks post test. It appears that their initial level of activity combined with an increase as measured at four weeks post test was sufficient to produce a positive effect on their health related fitness.

As was previously mentioned, the fitness assessment experimental group was the only group to receive a full health related fitness assessment and so this is the only group that can be analysed for changes in these components. However, the weight of the participants in the other three groups was measured at baseline and three months post test. Table 60. reports the baseline and three month test stage weight descriptive statistics for the non regularly active and the regularly active participants at baseline who were still involved in the study at three month post test for each remaining study group and reports a series of one sample t-tests designed to highlight significant differences.

Table 60.

The baseline and three month test stage weight descriptive statistics for participants non regularly active and regularly active at baseline and who were still participating in the study at three months post test for the ECE, FAC and ECC study groups

		Weight (Kg)					
		Baseline		3 mnth post test		t test analysis	
Study group	Activity level	Mean	SD	Mean	SD	T	p value
ECE	NRA (N=39)	154.9	35.6	153.9	34.9	-2.32	< 0.05
	RA (N=19)	147.6	27.8	140.8	27.5	-1.33	0.12
FAC	NRA (N=35)	162.1	28.4	160.8	28	-4.61	< 0.05
	RA (N=38)	166.6	34.2	163.9	31.6	-1.04	0.13
ECC	NRA (N=27)	170.7	44.4	169.3	44.8	-2.56	< 0.05
	RA (N=20)	158.9	39.2	156.2	31.7	-1.16	0.13

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Table 60. shows that all groups have shown a reduction in weight from baseline to three months post test. However, this was only significant for participants not regularly active at baseline in each study group. This could possibly be explained by the fact that the previous sections have shown that those not regularly active at baseline significantly increased and then sustained this increased physical activity to three months test. In contrast, although those regularly active at baseline significantly increased physical activity, this increase was not sustained through to three months test. Another possible explanation could be that those already active at baseline could be near their "target weight". However, those not regularly active at baseline are more likely to be overweight because they are by definition "not regularly active". In this case, it is more likely that these individuals would initially show greater weight losses compared to their active counterparts.

Summary of Results from Section Two

1. For those not regularly active at baseline, significantly more of the fitness assessment experimental group dropped out of the study at four weeks and over the course of the whole study compared to the exercise consultation experimental group. No differences were observed for those regularly active at baseline.
2. At baseline, those regularly active participants reported significantly more leisure time physical activity than those not regularly active.
3. Over the course of the whole study, those regularly active reported significantly more leisure time physical activity than those not regularly active.
4. Those not regularly active at baseline significantly increased leisure time physical activity after four weeks and maintained this to three months post test. The fitness assessment control

group reported significantly more activity, on average, over the three test stages compared to the exercise consultation control group. This difference was consistent across the test stages.

5. Those regularly active at baseline significantly increased activity after four weeks but did not sustain this to three months post test. The fitness assessment control group again reported significantly more activity than the exercise consultation control group and also the fitness assessment experimental group. Again, this difference was consistent over the test stages.
6. Those not regularly activity at baseline maintained their activity level through to six months post test but it significantly decreased from six months to one year post test. No significant differences in leisure time activity were observed between the study groups over the test stages and no differences in the pattern of activity over the test stages were observed.
7. Those regularly active at baseline sustained their three-month activity level through to six months post test, although it decreased slightly. One year post test activity again fell, but it was not significantly different from six months post test. It was marginally significantly different from three months post test. Again, no difference in leisure activity between intervention groups over the test stages and no difference in the pattern of activity was observed.
8. For those not regularly active at baseline, only those receiving an exercise consultation reported significantly elevated physical activity levels after one year. For those regularly active at baseline, all groups successfully maintained this activity level one-year post test.
9. Occupational activity remained virtually unchanged over the test stages and between study groups.
10. For those receiving a fitness assessment both the non-regularly active and regularly active participants improved in a range of health related fitness components from baseline to three months post test.
11. In the remaining study groups, all those not regularly active at baseline lost a significant amount of weight. Those regularly active also lost weight but this fall was not significant.

Section Three – Intervention Effects on the Stages of Exercise Behaviour Change

The following section reports the effects of each intervention on stage of exercise behaviour change. The specific objectives of the section are outlined at the start of this chapter.

Participants Classified as Not Regularly Active at Baseline

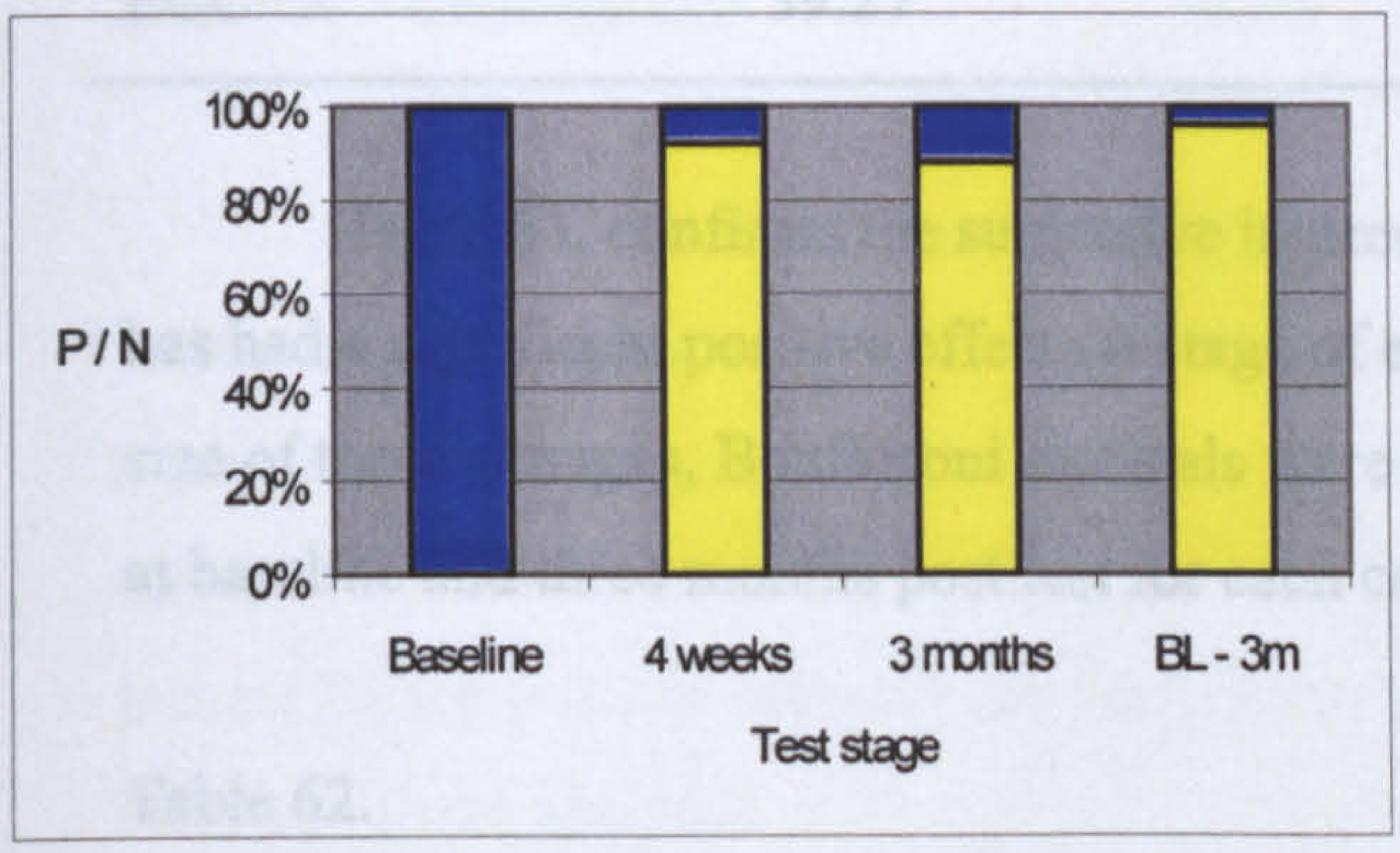
Immediate intervention effect.

Table 1 in appendix X reports the stage of exercise behaviour change at baseline, four weeks and three months post test of those participants not regularly active at baseline remaining in the study three months post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

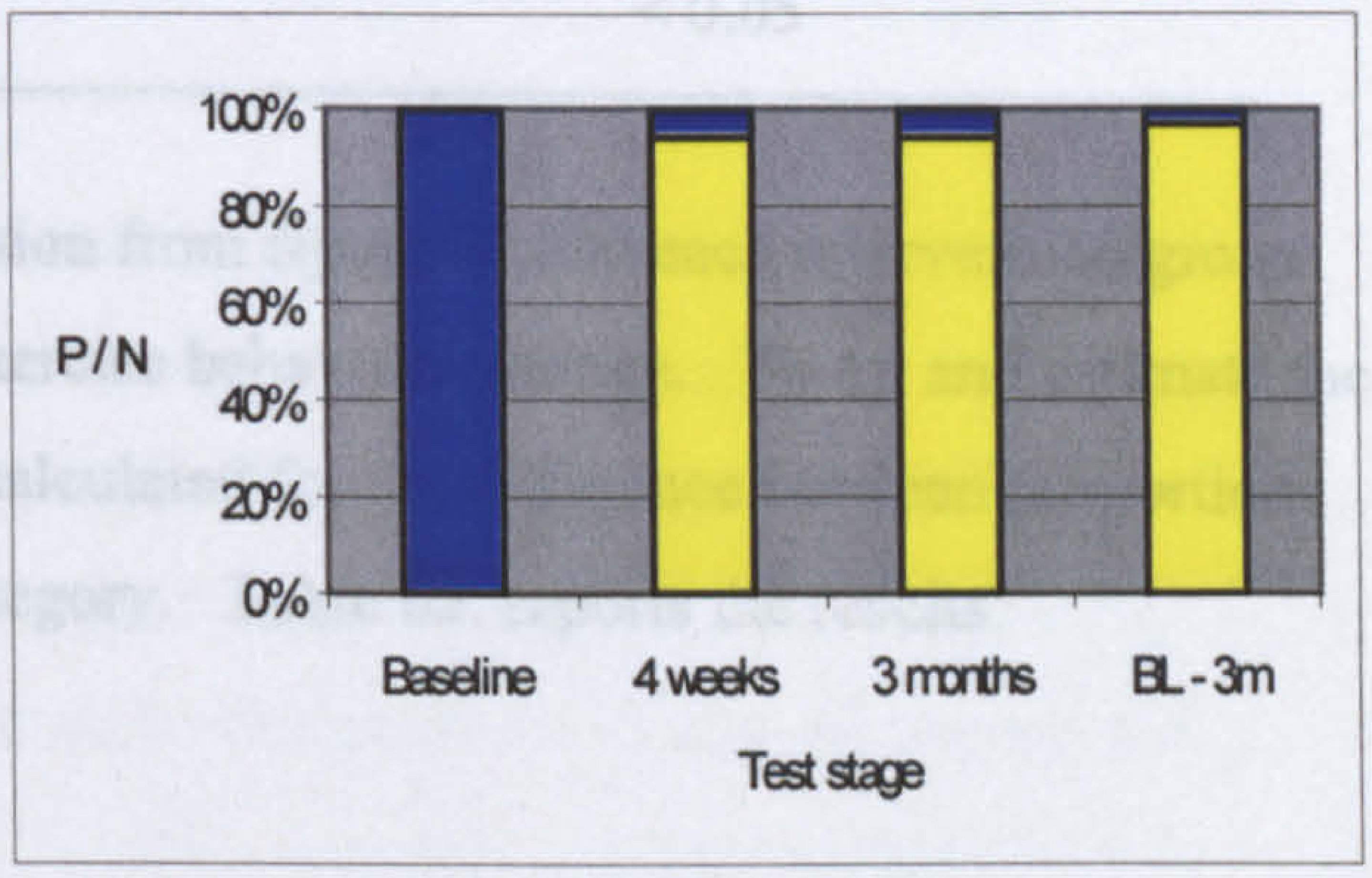
Figure 57.a - 57.d plot the percentage of participants in each category (positive or negative) for each test stage (an explanation of the positive and negative categories was given on page 138 in the data analysis section).

KEY

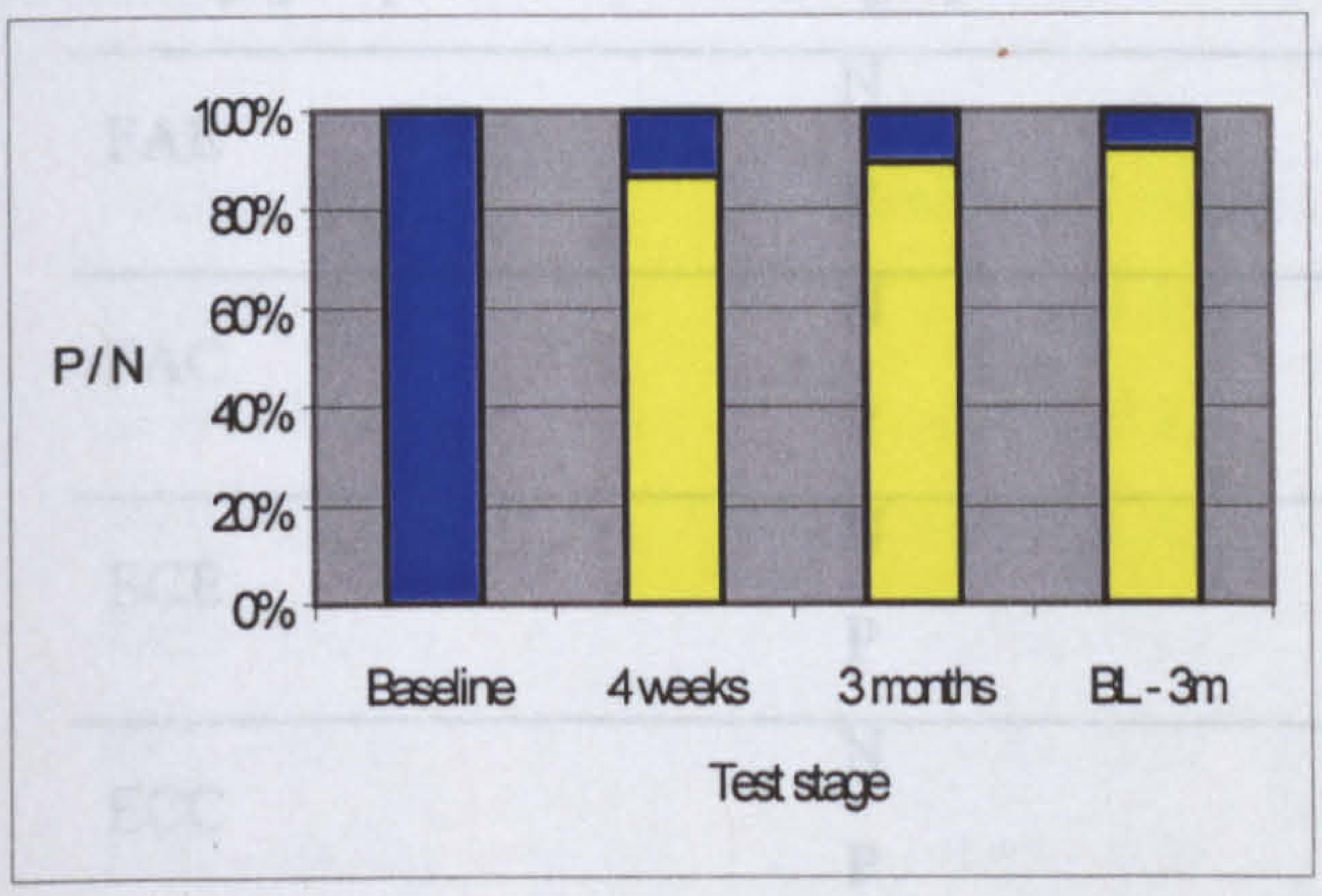
Positive category (P) Negative category (N)



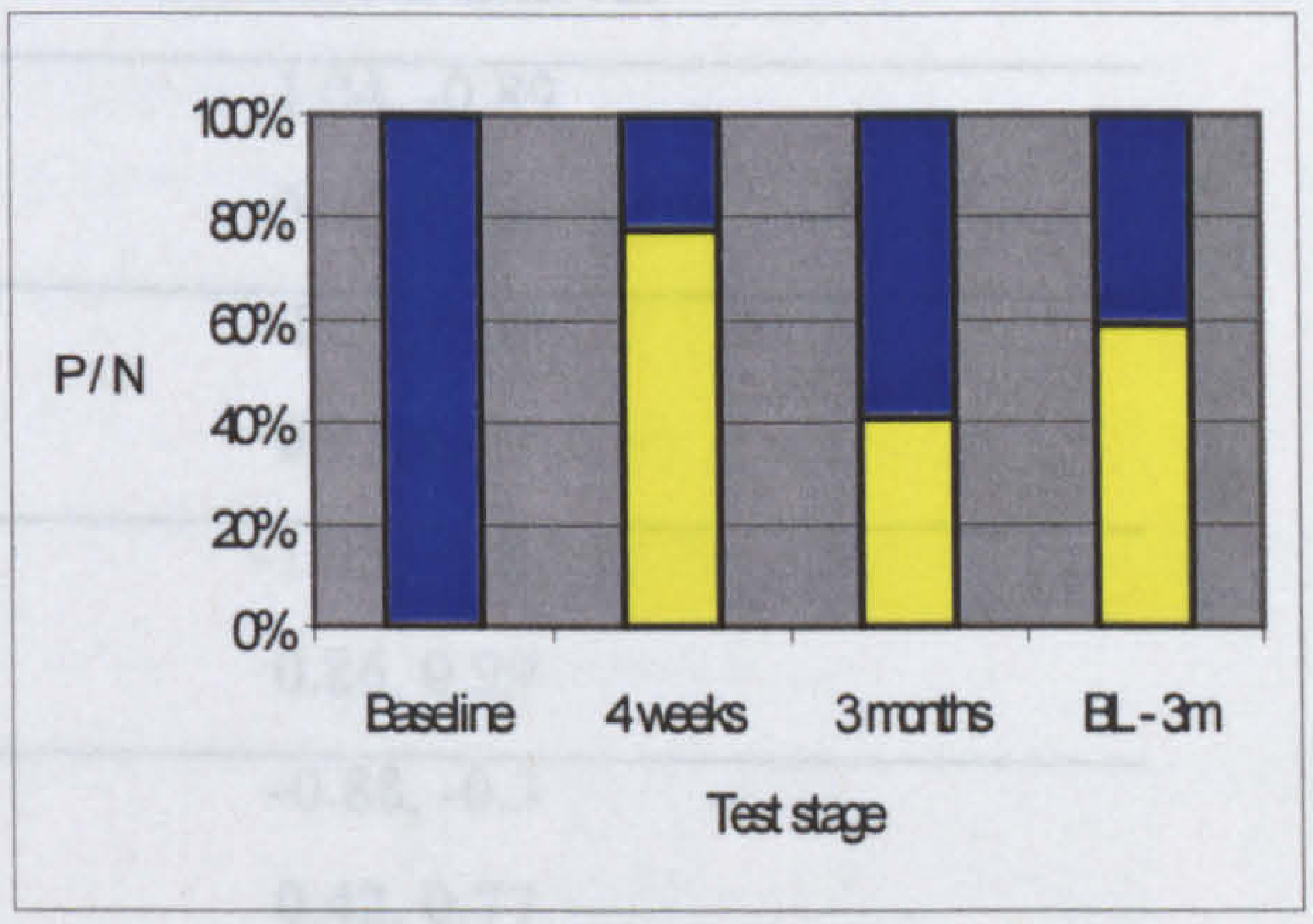
(a.) Fitness assessment experimental



(b.) Fitness assessment control



(c.) Exercise consultation experimental



(d.) Exercise consultation control

Figure 57. The percentage of those not regularly active at baseline in each category (positive or negative) at each test stage

Note. SOC = stage of exercise behaviour change, BL – 3m = baseline to 3 month comparison.

Figure 57. shows that each intervention has had a positive effect on those not regularly active at baseline. In order to test if this effect was significant at three months post test compared to baseline for each study group, four Wald tests of marginal homogeneity were conducted to

determine if the proportions in the positive and negative categories were the same at baseline and at three months. Table 61. reports the results of these tests.

Table 61.

Four Wald tests of marginal homogeneity to evaluate the difference in proportions in the positive and negative categories at three months post test compared to baseline for each study group

Study group	Test statistic	DF	P
FAE	600	1	< 0.05
FAC	1190	1	< 0.05
ECE	468	1	< 0.05
ECC	39.27	1	< 0.05

Table 61. confirms the subjective impression from figure 57 that each intervention group has had a significant positive effect on stage of exercise behaviour change. To try and estimate the size of these changes, Bonferroni intervals were calculated for the difference between proportions at baseline and three months post test for each category. Table 62. reports the results.

Table 62.

Four sets of Bonferroni intervals for the difference between proportions at baseline and three months post test for each category for each study group

Study group	Category	Bonferroni Interval
FAE	N	-1.04, -0.89
	P	0.96, 0.96
FAC	N	-1.03, 0.92
	P	0.97, 0.97
ECE	N	-1.03, -0.81
	P	0.86, 0.99
ECC	N	-0.88, -0.3
	P	0.42, 0.77

Table 62. suggests that for each study group the numbers in the negative category have significantly fallen compared to those in the positive category which have significantly increased. The table also suggests that the decreases in the negative category and the corresponding increases in the positive category are less for the exercise consultation control group compared to the other 3 study groups. For example, the population proportion in the positive category has increased from between 42% and 77% for the exercise consultation control group compared to the exercise consultation experimental group who have shown an increase which is likely to lie between 86% and 99%.

To test if any significant differences in the distribution of participants in the positive and negative categories were evident between study groups when comparing test stages, three chi square tests were conducted. Table 63. reports the results of these tests.

Table 63.

The results of three chi square tests conducted to examine differences between study groups when comparing test stages

Test stage	χ^2 statistic	DF	P
Baseline – four weeks	4.41	3	0.22
Four weeks – three months	33.99	3	< 0.05
Baseline – three months	24.79	3	< 0.05

Table 63. shows no significant difference between study groups when comparing four weeks to baseline, but a significant difference when comparing four weeks to three months post test and baseline to three months post test. To investigate where these significant differences lay, a series of Bonferroni confidence intervals were calculated to assess differences between study groups for the positive category for each of the test stage comparisons. Table 64. reports the results of these analyses.

Table 64.

Bonferroni intervals for study group differences for the positive category when comparing test stage

	Test stage	
Study group	4 weeks – 3 months	Baseline – 3 months
FAE – FAC	*-0.14, 0.26*	*-0.17, 0.14*
ECE – ECC	*-0.77, -0.21*	*-0.60, -0.57*
FAE – ECE	-0.20, 0.23	-0.19, 0.12
FAE – ECC	-0.78, -0.17	-0.64, -0.1
FAC – ECE	-0.21, 0.12	-0.18, 0.09
FAC – ECC	-0.81, -0.27	-0.64, -0.12

Note. The first two italicised rows of the table represent the comparison's *within* each randomised control trial, the remaining rows, the *between* trials comparisons

Table 64. shows that the exercise consultation control group differ significantly from the other three study groups for the proportion in the positive category when comparing four weeks to three months post test and baseline to three months post test. This confirms the earlier observation from table 62. and the subjective impression from figure 57. that the exercise consultation experimental group and both fitness assessment groups show larger improvements in stage of exercise behaviour change at three months compared to the exercise consultation control group.

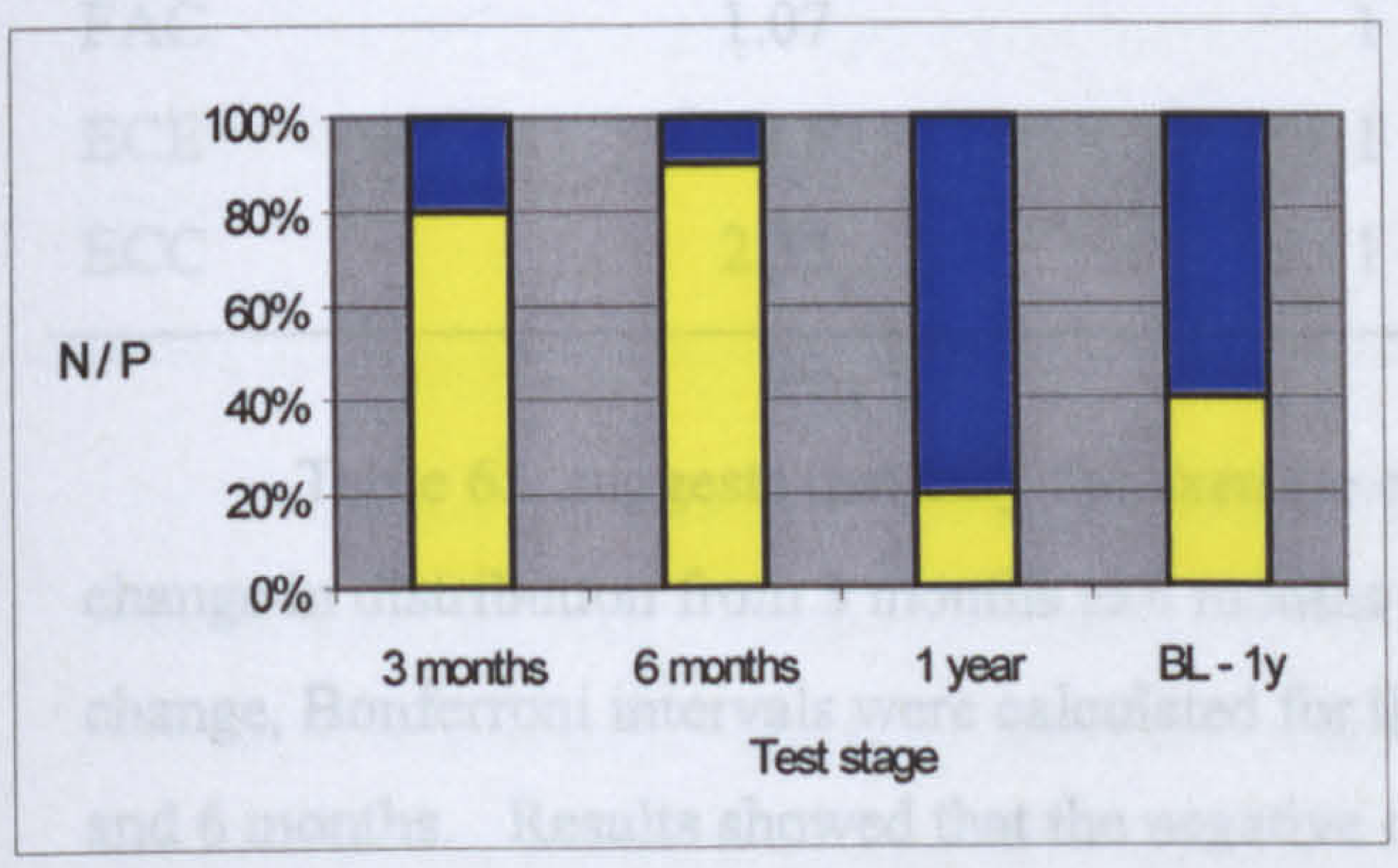
Intervention re-test and long term effect.

Table 2 in appendix X reports the stage of exercise behaviour change at three months, six months and one year post test of those participants not regularly active at baseline remaining in the study at one year post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

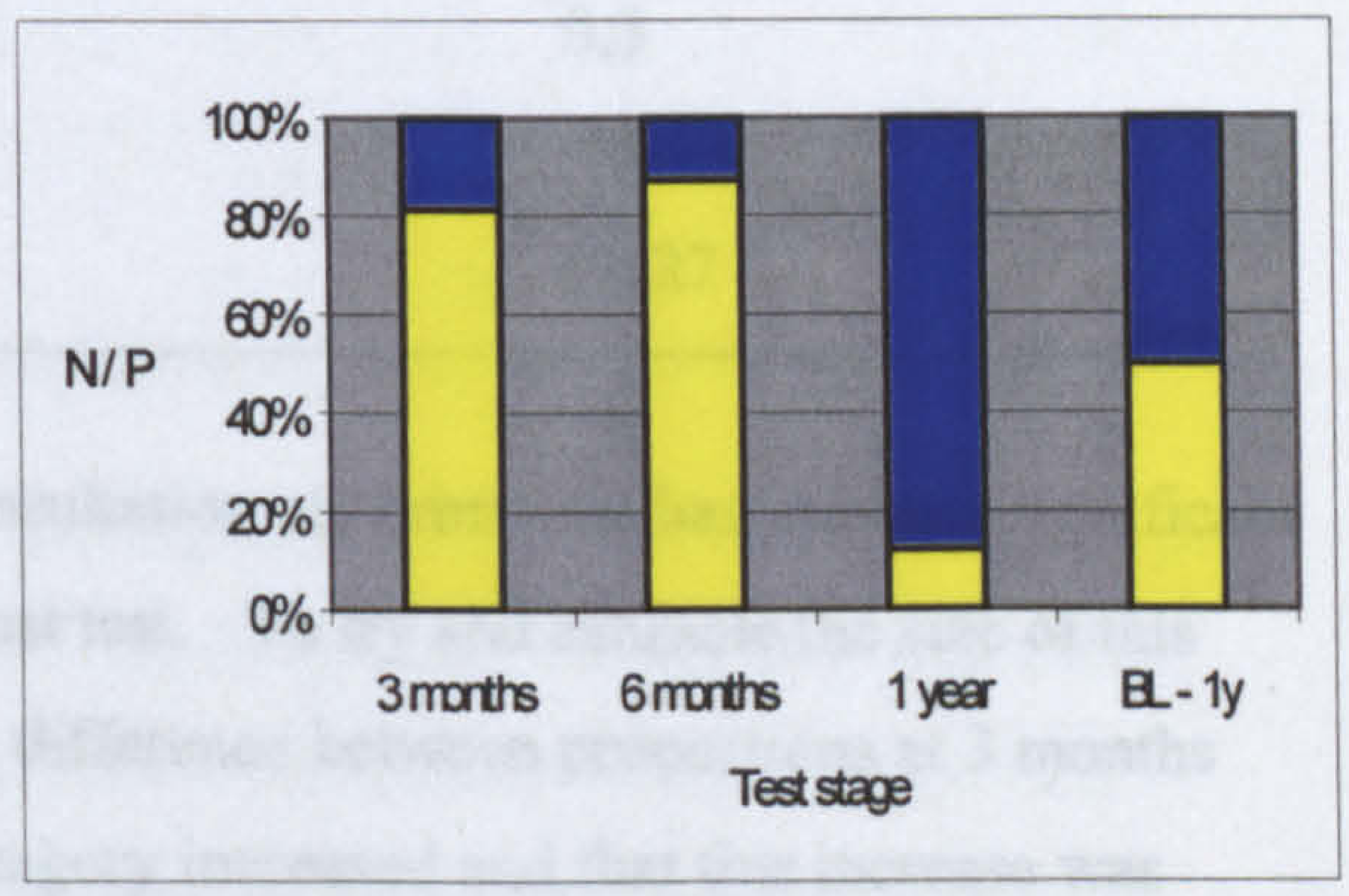
Figure 58.a - 58.d plot the percentage of participants in each category (positive or negative) for each test stage.

KEY

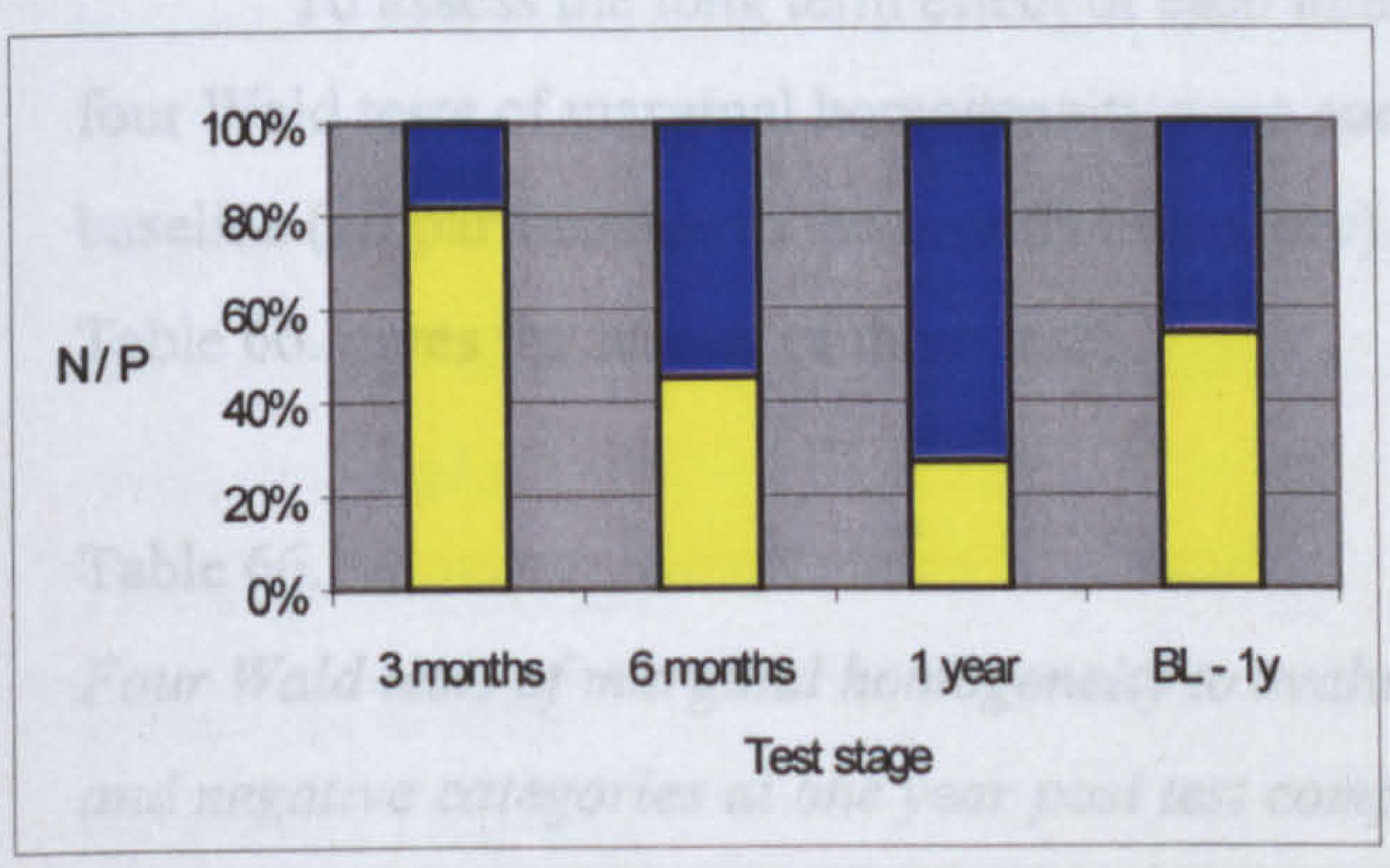
Positive category (P) Negative category (N)



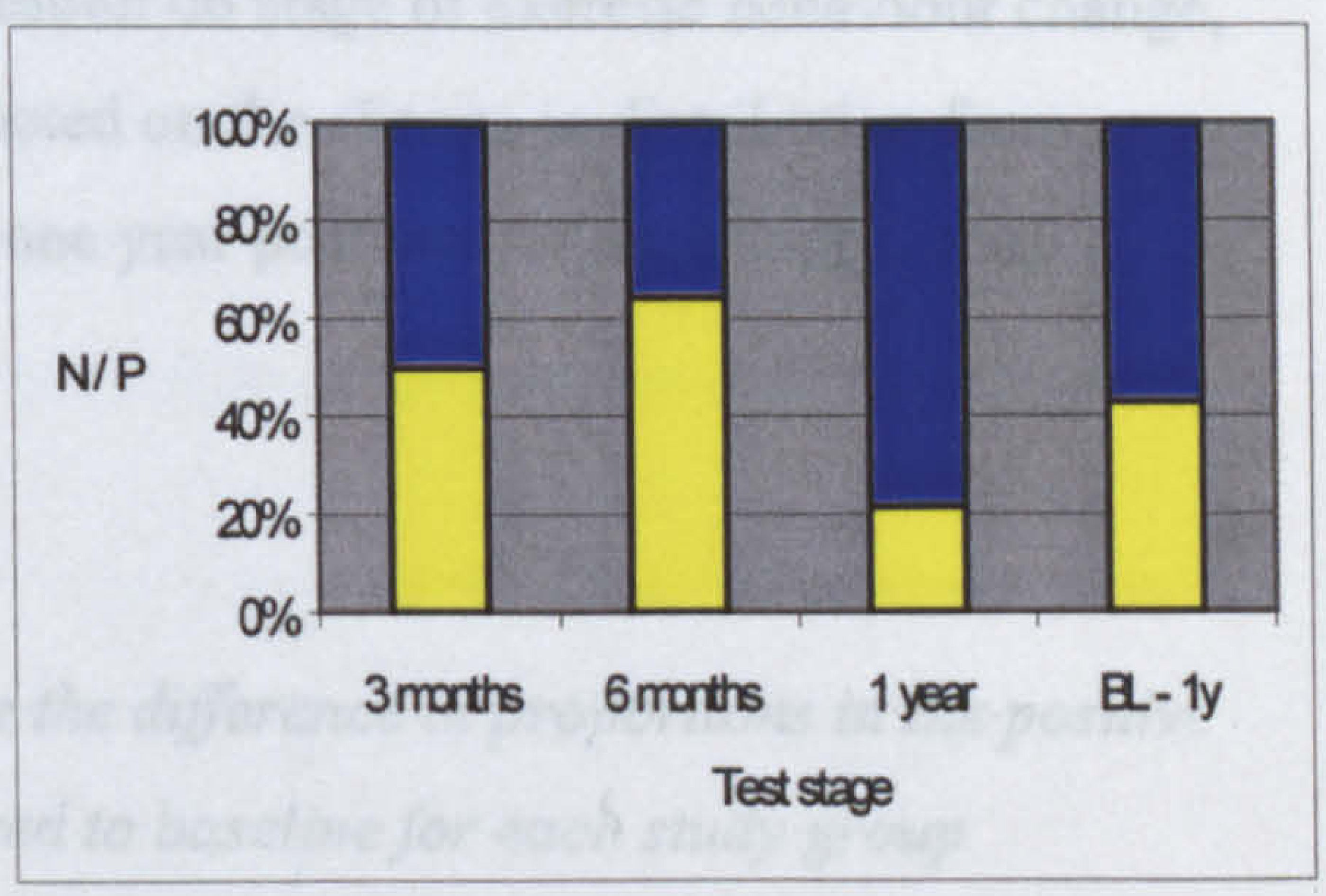
(a.) Fitness assessment experimental



(b.) Fitness assessment control



(c.) Exercise consultation experimental



(d.) Exercise consultation control

Figure 58. The percentage of those not regularly active at baseline in each category (positive or negative) at each test stage

Note. SOC = stage of exercise behaviour change, BL – 1y = baseline to 1 year comparison.

Figure 58. shows the effect of each intervention re-test at six months and one year. The figure shows that at six months post test, only the exercise consultation experimental group appear to have a smaller percentage in the positive category compared to three months post test. In order to test if there was any significant change in the proportions of participants in the positive and negative categories at six months post test compared to three months post test for each study group, four Wald tests of marginal homogeneity were conducted. Table 65. reports the results of these tests.

Table 65.

Four Wald tests of marginal homogeneity to evaluate the difference in proportions in the positive and negative categories at six months post test compared to three months post test for each study group

Study group	Test statistic	DF	P
FAE	1.11	1	0.29
FAC	1.07	1	0.3
ECE	12.57	1	< 0.05
ECC	2.33	1	0.127

Table 65. suggests that only the exercise consultation experimental has shown a significant change in distribution from 3 months to 6 months post test. To try and estimate the size of this change, Bonferroni intervals were calculated for the difference between proportions at 3 months and 6 months. Results showed that the negative category increased and that this increase was likely to be between 11% and 62% (CI's = 0.11, 0.62). In contrast, the positive category showed a significant decrease and this decrease was likely to be between 3% and 70% (CI's = -0.7, -0.03).

To assess the long term effect of each intervention on stage of exercise behaviour change, four Wald tests of marginal homogeneity were conducted on the change in distribution from baseline (all participants in the negative category) to one year post test for each study group. Table 66. gives the results of these tests.

Table 66.

Four Wald tests of marginal homogeneity to evaluate the difference in proportions in the positive and negative categories at one year post test compared to baseline for each study group

Study group	Test statistic	DF	P
FAE	6.76	1	< 0.05
FAC	16.0	1	< 0.05
ECE	26.4	1	< 0.05
ECC	10.5	1	< 0.05

Table 66. shows that each intervention has had a positive effect on stage of exercise behaviour change at one year post test. To estimate the size of these changes, Bonferroni intervals were calculated for the changes in distribution from baseline to one year post test. Table 67. gives the results of these tests.

Table 67.

Four sets of Bonferroni intervals for the difference between proportions at baseline and one year post test for each category for each study group

Study group	Category	Bonferroni Interval
FAE	N	-0.91, 0.11
	P	0.12, 0.68
FAC	N	-0.90, -0.10
	P	0.27, 0.73
ECE	N	-0.88, -0.21
	P	0.35, 0.74
ECC	N	-0.87, 0.01
	P	0.19, 0.67

Table 67. shows that each study group has had a significant effect on the positive category with the exercise consultation experimental group showing the greatest change (anywhere from 35% to 74% increase). The table also shows that the fitness assessment control and exercise consultation experimental groups have also had a significant effect on the negative categories.

To test if any significant differences in the distribution of participants in the positive and negative categories were evident between study groups when comparing test stages, three chi square tests were conducted. Table 68. reports the results of these tests.

Table 68.

The results of three chi square tests conducted to examine differences between study groups when comparing test stages

Test stage comparison	χ^2 statistic	DF	P
Three - six months	10.2	3	< 0.05
Six months - one year	1.23	3	0.75
Baseline – one year	0.80	3	0.85

Table 68. shows that no significant differences exist between study groups when comparing six months to one year post test and baseline to one year post test but differences do exist when comparing three months post test to six months post test. To identify which study

groups differed, a series of Bonferroni confidence intervals were calculated to assess differences between study groups for the positive category. Table 69. reports the results of these analyses.

Table 69.

Bonferroni intervals for the difference between study groups for the positive category when comparing test stage

	Test stage
Study group	3 months - 6 months
FAE – FAC	*-0.36, 0.31*
ECE – ECC	*-0.25, 0.63*
FAE – ECE	-0.82, -0.07
FAE – ECC	-0.68, 0.16
FAC – ECE	-0.78, -0.07
FAC – ECC	-0.63, 0.17

Note. The first two italicised rows of the table represent the comparison's *within* each randomised control trial, the remaining rows, the *between* trials comparisons

Table 69. shows that the proportion of participants in the positive category is significantly less for the exercise consultation experimental group when compared to both the fitness assessment groups. This confirms the subjective impression from figure 58.

Participants Classified as Regularly Active at Baseline

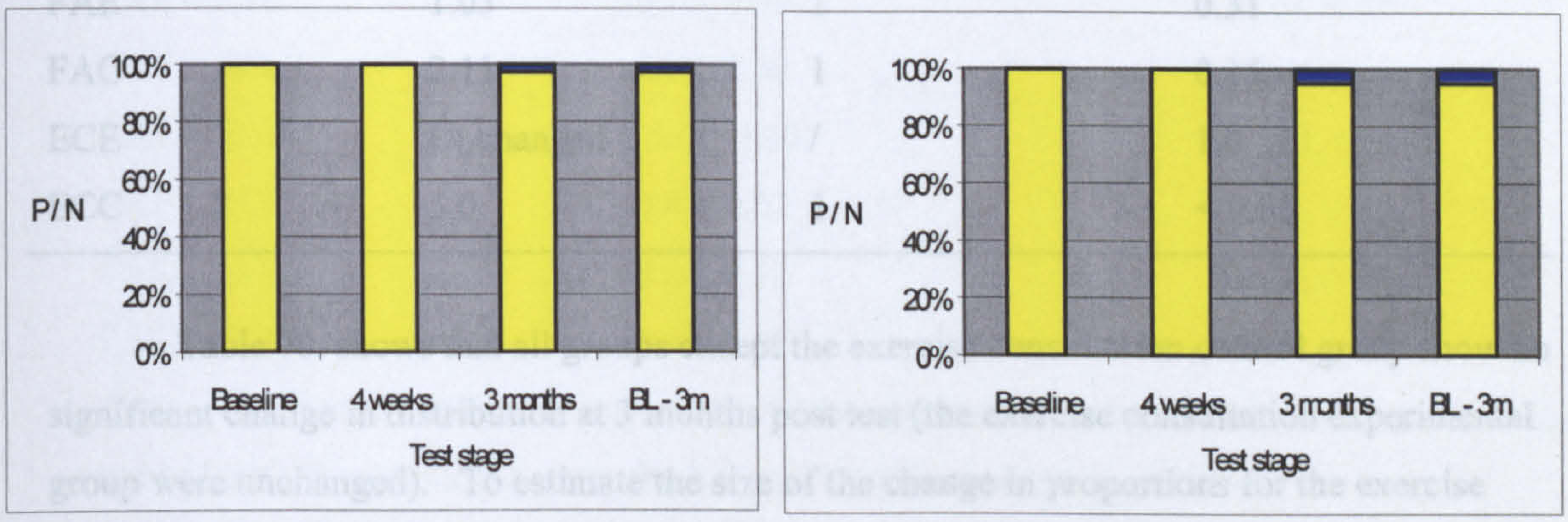
Immediate intervention effect.

Table 3 in appendix X reports the stage of exercise behaviour change at baseline, four weeks and three months post test of those participants regularly active at baseline remaining in the study three months post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

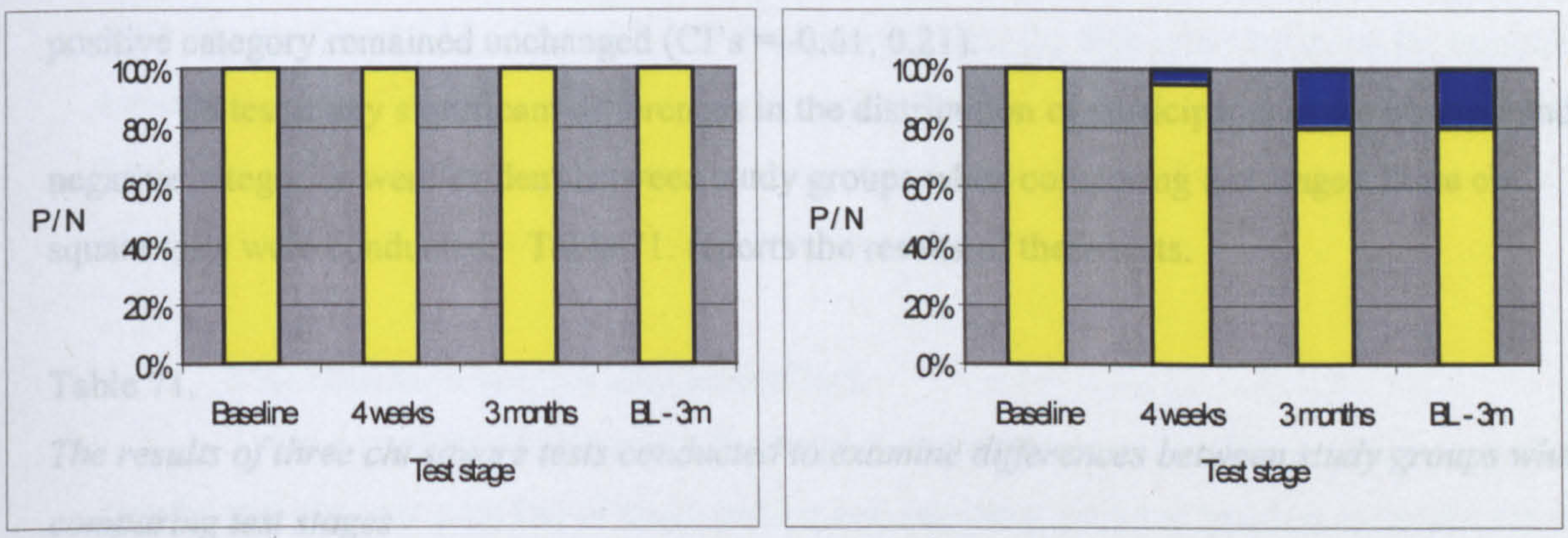
Figure 59.a - 59.d plot the percentage of participants in each category (positive or negative) for each test stage.

KEY

Positive category (P) Negative category (N)



(a.) Fitness assessment experimental (b.) Fitness assessment control



(c.) Exercise consultation experimental (d.) Exercise consultation control

Figure 59. The percentage of those regularly active at baseline in each category (positive or negative) at each test stage

Note. SOC = stage of exercise behaviour change, BL – 3m = baseline to 3 month comparison.

Figure 59. shows that for those regularly active at baseline, each intervention has maintained participants in the positive category up to three months. In order to test if this effect was significant (i.e. no significant change) at three months post test compared to baseline for each study group, four Wald tests of marginal homogeneity were conducted to determine if the proportions in the positive and negative categories were the same at baseline and at three months. Table 70. reports the results of these tests.

Table 70.

Four Wald tests of marginal homogeneity to evaluate the difference in proportions in the positive and negative categories at three months post test compared to baseline for each study group

Study group	Test statistic	DF	P
FAE	1.03	1	0.31
FAC	2.11	1	0.15
ECE	Unchanged	/	1.0
ECC	5.0	1	< 0.05

Table 70. shows that all groups except the exercise consultation control group show no significant change in distribution at 3 months post test (the exercise consultation experimental group were unchanged). To estimate the size of the change in proportions for the exercise consultation control group, Bonferroni intervals were calculated for the difference between proportions at baseline and 3 months post test for each category. Results show that the negative category significantly increased from between 3% to 37% (CI's = 0.03, 0.37). However, the positive category remained unchanged (CI's = -0.61, 0.21).

To test if any significant differences in the distribution of participants in the positive and negative categories were evident between study groups when comparing test stages, three chi square tests were conducted. Table 71. reports the results of these tests.

Table 71.

The results of three chi square tests conducted to examine differences between study groups when comparing test stages

Test stage	χ^2 statistic	DF	P
Baseline – four weeks	4.79	3	/
Four weeks – three months	8.84	3	< 0.05
Baseline – three months	8.84	3	< 0.05

The chi square test for differences between study groups when comparing baseline to four weeks post test shown in table 71. is probably invalid as four cells had expected counts less than 1.0 (three of the study groups had no participants in the negative category at four weeks post test). However, it is clear from figure 59. that the difference between groups was negligible at four weeks post test. To investigate which study groups showed significant differences in the positive category at four weeks to three months post test and baseline to three months post test, a series of Bonferroni confidence intervals were calculated. Table 72. reports the results of these analyses.

Table 72.

Bonferroni intervals for the difference between study groups for the positive category when comparing test stages

	Test stage	
Study group	4 weeks – 3 months	Baseline – 3 months
FAE – FAC	*-0.14, 0.09*	*-0.14, 0.09*
ECE – ECC	*-0.44, 0.04*	*-0.44, 0.04*
FAE – ECE	-0.042, 0.09	-0.042, 0.09
FAE – ECC	-0.42, 0.07	-0.42, 0.07
FAC – ECE	-0.04, 0.15	-0.04, 0.15
FAC – ECC	-0.40, 0.12	-0.40, 0.12

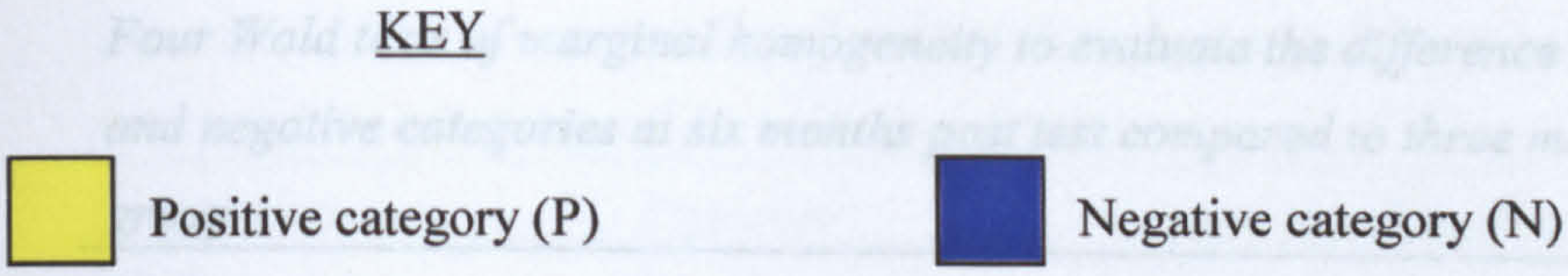
Note. The first two italicised rows of the table represent the comparison's *within* each randomised control trial, the remaining rows, the *between* trials comparisons

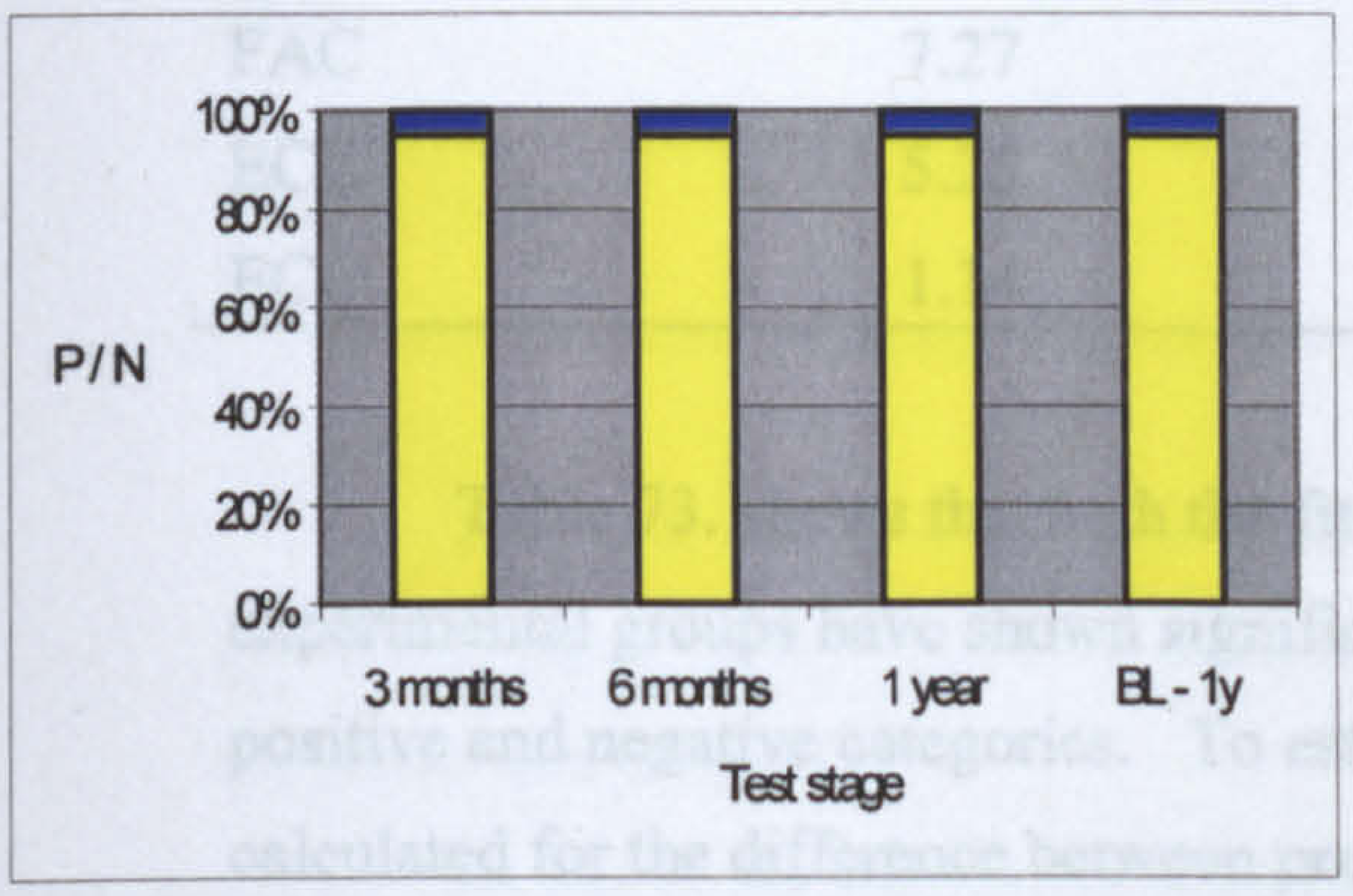
Table 72. shows that the changes in distribution when comparing baseline to three months post were identical to those when comparing four weeks to three months post test (as shown in table 71. and figure 59.). For each test stage comparison, the difference between the exercise consultation experimental group and the remaining three groups approached significance, reflecting the fact that the exercise consultation experimental group maintained all of its participants in the positive category at four weeks and three months post test.

Intervention re-test and long term effect.

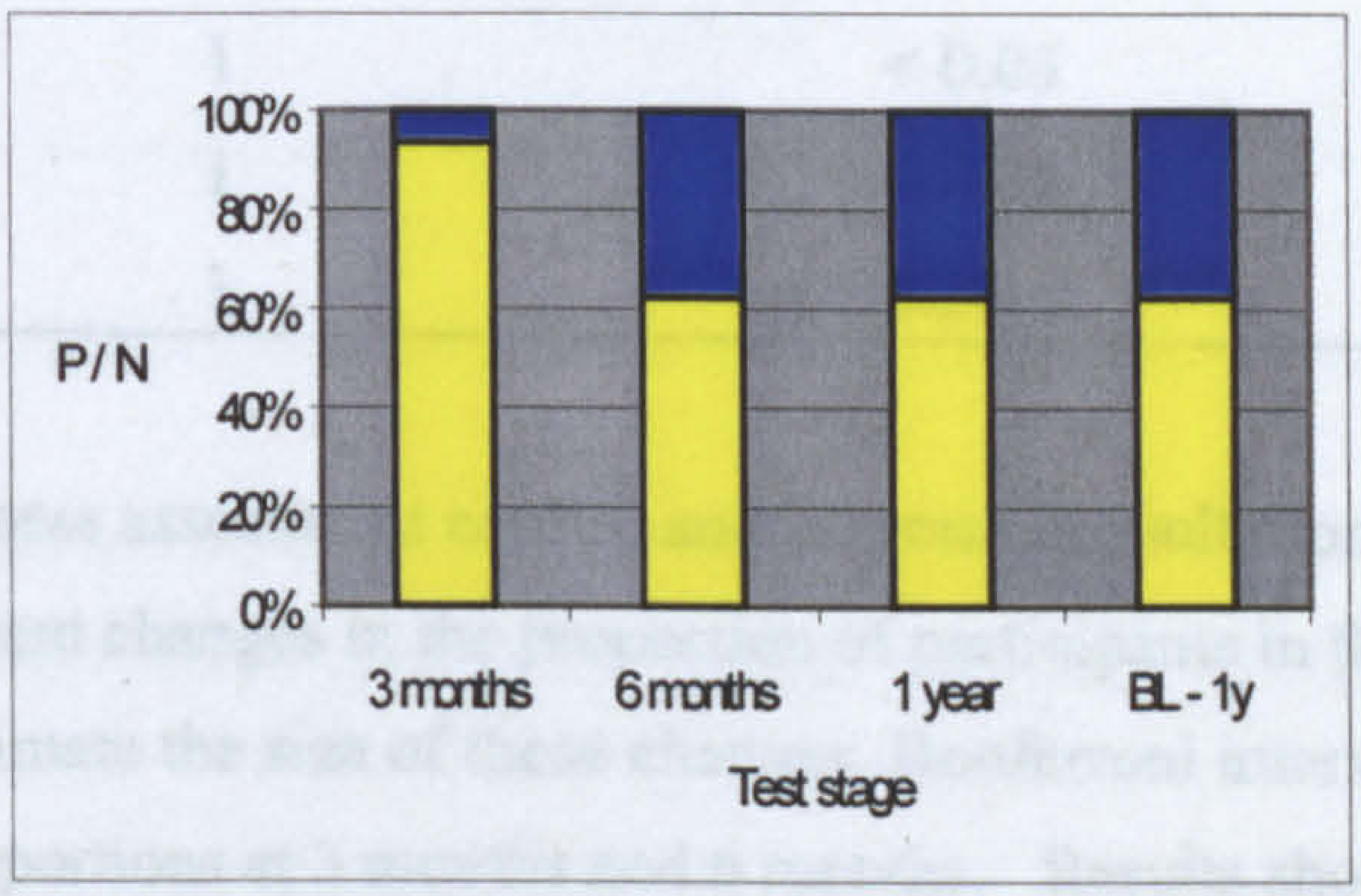
Table 4 in appendix X reports the stage of exercise behaviour change at three months, six months and one year post test of those participants regularly active at baseline remaining in the study at one year post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

Figure 60.a - 60.d plot the percentage of participants in each category (positive or negative) for each test stage.

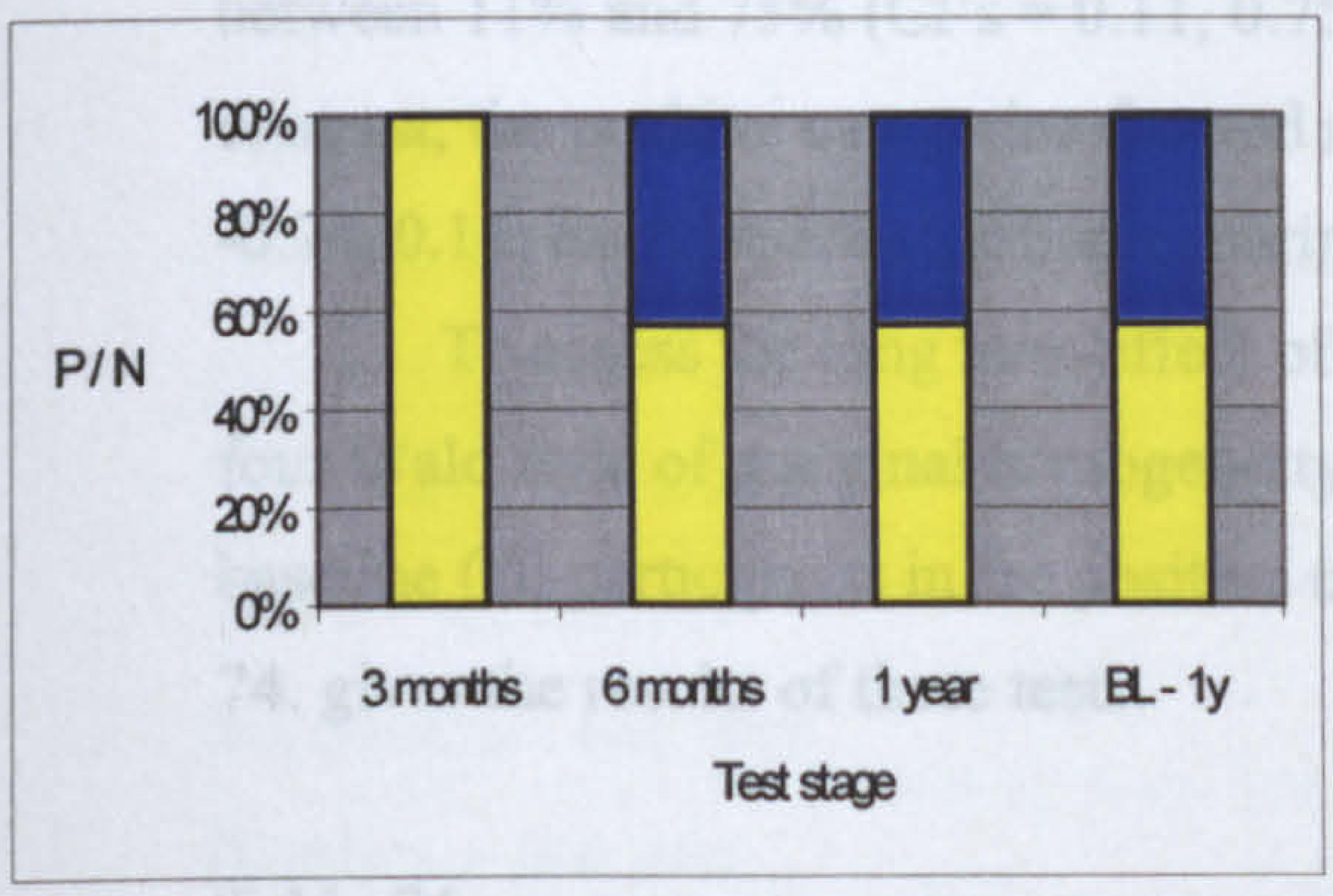




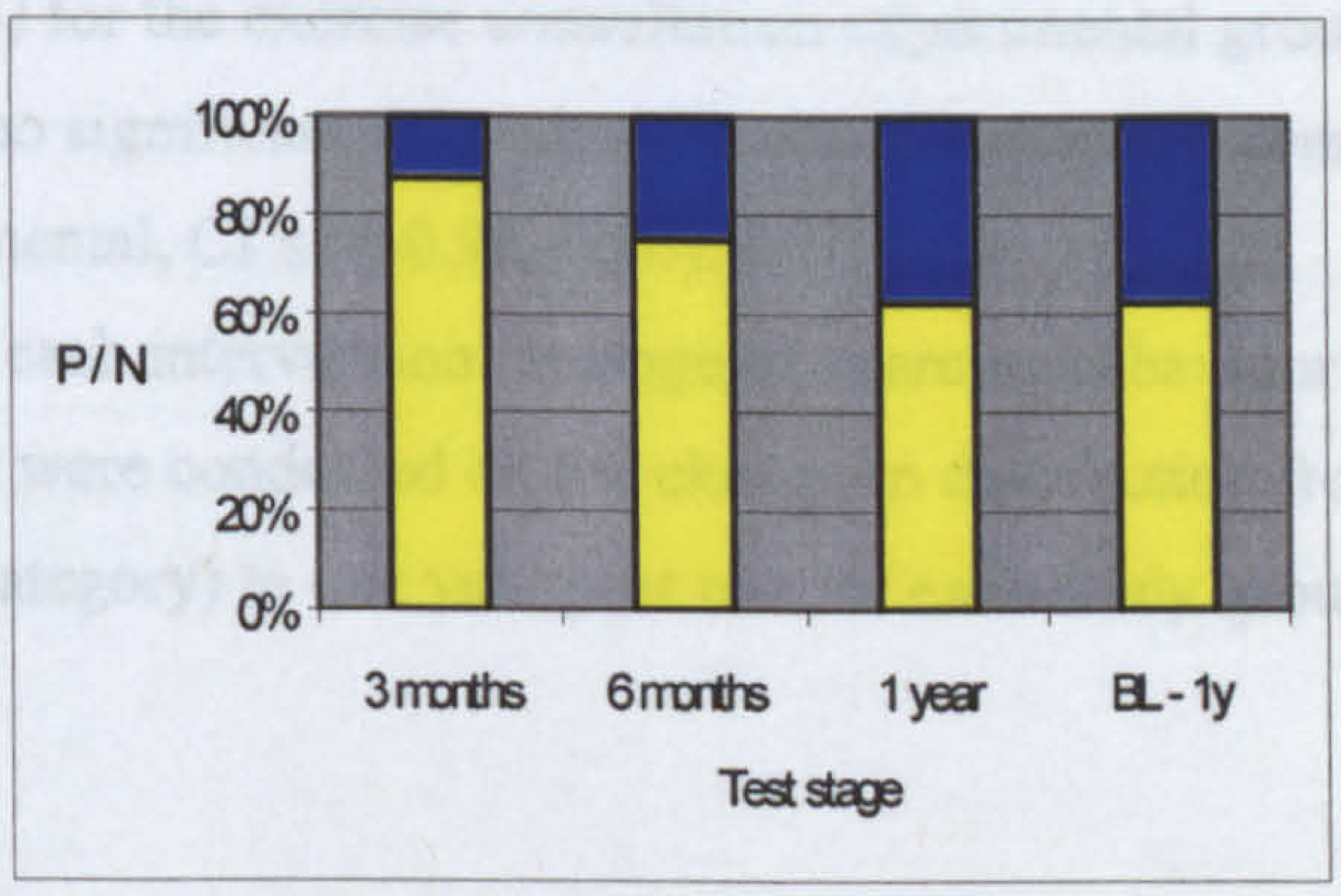
(a.) Fitness assessment experimental



(b.) Fitness assessment control



(c.) Exercise consultation experimental



(d.) Exercise consultation control

Figure 60. The percentage of those regularly active at baseline in each category (positive or negative) at each test stage

Note. SOC = stage of exercise behaviour change, BL – 1y = baseline to 1 year comparison

Figure 60. shows the effect of each intervention re-test at six months and one year. The figure shows that at six months post test, only the fitness assessment experimental group appear to have successfully maintained participants in the positive category. In order to test if there was any significant change in the proportions of participants in the positive and negative categories at six months post test compared to three months post test for each study group, four Wald tests of marginal homogeneity were conducted. Table 73. reports the results of these tests.

Table 73.

Four Wald tests of marginal homogeneity to evaluate the difference in proportions in the positive and negative categories at six months post test compared to three months post test for each study group

Study group	Test statistic	DF	P
FAE	Unchanged	/	1
FAC	7.27	1	< 0.05
ECE	5.25	1	< 0.05
ECC	1.14	1	0.29

Table 73. shows that both the fitness assessment control and exercise consultation experimental groups have shown significant changes in the proportion of participants in the positive and negative categories. To estimate the size of these changes, Bonferroni intervals were calculated for the difference between proportions at 3 months and 6 months. Results showed that the negative categories for each study group significantly increased and that these increases were likely to be between 7% and 56% (CI's = 0.07, 0.56) for the fitness assessment control group and between 11% and 75% (CI's = 0.11, 0.75) for the exercise consultation experimental group. In contrast, the positive categories showed no significant decreases (Fitness assessment control, CI's = -0.74, 0.11; exercise consultation experimental, CI's = -0.99, 0.14).

To assess the long term effect of each intervention on stage of exercise behaviour change, four Wald tests of marginal homogeneity were conducted on the change in distribution from baseline (all participants in the positive category) to one year post test for each study group. Table 74. gives the results of these tests.

Table 74.

Four Wald tests of marginal homogeneity to evaluate the difference in proportions in the positive and negative categories at one year post test compared to baseline for each study group

Study group	Test statistic	DF	P
FAE	1.05	1	0.31
FAC	9.6	1	< 0.05
ECE	5.25	1	< 0.05
ECC	4.8	1	< 0.05

Table 74. shows that all study groups except the fitness assessment experimental group have significantly changed in their distribution. To estimate the size of the changes in the remaining three study groups, Bonferroni intervals were calculated for the changes in distribution from baseline to one year post test. Table 75. gives the results of these tests.

Table 75.

Four sets of Bonferroni intervals for the difference between proportions at baseline and one year post test for each category for each study group

Study group	Category	Bonferroni Interval
FAC	N	0.15, 0.6
	P	-0.80, 0.05
ECE	N	0.11, 0.75
	P	-0.99, 0.14
ECC	N	0.08, 0.68
	P	-0.94, 0.19

Table 75. shows that the proportion of participants in the negative category for each study group has significantly increased compared to the numbers in the positive category which have remained unchanged.

To test if any significant differences in the distribution of participants in the positive and negative categories were evident between study groups when comparing test stages, three chi square tests were conducted. Table 76. reports the results of these tests.

Table 76.

The results of three chi square tests conducted to examine differences between study groups when comparing test stages

Test stage comparison	χ^2 statistic	DF	P
Three – six months	7.02	3	0.07
Six months - one year	7.36	3	0.06
Baseline – one year	7.36	3	0.06

Table 76. suggests there is evidence of a difference between study groups when comparing test stages. To compare study groups, Bonferroni confidence intervals were calculated to assess differences for the positive category. Table 77. reports the results of these analyses.

Table 77.

Bonferroni intervals for the difference between study groups for the positive category when comparing test stage

	Test stage comparison		
Study group	3 months – 6 months	6 months – 1 year	Baseline – 1 year
FAE – FAC	*-0.67, 0.02*	*-0.67, 0.02*	*-0.67, 0.02*
ECE – ECC	*-0.46, 0.82*	*-0.62, 0.72*	*-0.62, 0.72*
FAE – ECE	-0.89, 0.13	-0.89, 0.13	-0.89, 0.13
FAE – ECC	-0.62, 0.22	-0.80, 0.15	-0.80, 0.15
FAC – ECE	-0.64, 0.53	-0.64, 0.53	-0.64, 0.53
FAC – ECC	-0.39, 0.64	-0.55, 0.55	-0.55, 0.55

Note. The first two italicised rows of the table represent the comparison's *within* each randomised control trial, the remaining rows, the *between* trials comparisons

Table 77. shows that for each test stage comparison, the only study groups which appeared to differ were the fitness assessment experimental and control groups. It appears that the experimental group have a significantly greater proportion of participants in the positive category at each test stage compared to the control group.

Summary of Results from Section Three

1. For those participants not regularly active at baseline, each study group showed a significant positive change in their stage of exercise behaviour change in the first three months of the study. The improvements were less pronounced in the exercise consultation control group. From three months to six months only the exercise consultation experimental group showed a significant decrease in those in the positive category. However, analysing the long-term effect (i.e. baseline to one year post test), although all study groups showed a significant positive effect, the exercise consultation experimental group had the largest positive effect on stage of exercise behaviour change.
2. For those participants regularly active at baseline, only the exercise consultation control group reported a significant change in the distribution of participants in the positive and negative categories over the first three months (i.e. a significant increase in those in the negative category). The exercise consultation experimental group was the most successful at maintaining participants in the positive category over the first three months of the study. However from three months to six months, both the exercise consultation experimental and fitness assessment control groups showed significant increases in the negative category. Overall (i.e. baseline to 1 year), the fitness assessment experimental group was the most successful at maintaining a positive stage of exercise behaviour change.

Section Four – Intervention effects on Processes of Exercise Behaviour Change

The following section examines the processes of exercise behaviour. The specific objectives of the section were detailed at the start of the chapter.

The Effects of Each Intervention on Processes of Exercise Behaviour Change

As discussed at the beginning of the "intervention effects on processes of exercise behaviour change" section in chapter four (p.118), it is possible that the interventions may have a different effect on the processes of exercise behaviour change given their nature, although this was not found in chapter four. The effects of the interventions on the processes of exercise behaviour change in the current study are likely to be strongest immediately after the interventions. In order to compare interventions therefore analyses were conducted on the differences in the processes of exercise behaviour change from baseline (immediately before interventions) to four weeks post test (soon after interventions). If no differences are found between interventions at this stage (as in the pilot study), it is very unlikely that differences will occur throughout the course of the rest of the study. In addition, given the finding in an earlier section that use of the processes of exercise behaviour change differs between stages of exercise behaviour change, analyses was conducted for each stage of exercise behaviour change.

Contemplation.

In order to compare like with like, analyses was conducted for all those baseline contemplators who progressed at least one stage of exercise behaviour change at four weeks post test in each intervention group. In addition, before any comparison of changes in processes of exercise behaviour change is conducted, it is important to establish if any differences between intervention groups for each process of exercise behaviour change existed at baseline (i.e. before any interventions). Table 1 in appendix Y gives the median score for each process of exercise behaviour change for each intervention group at baseline for contemplators who progressed at least one stage of exercise behaviour change at four weeks post test. The table also gives the results of ten Kruskal Wallis tests, which indicated no significant differences between intervention groups for each process of exercise behaviour change at baseline.

Table 78. gives the medians of the difference between baseline to four weeks post test for each process of exercise behaviour change for each intervention group. The table also gives the results of ten Kruskal Wallis tests, conducted to identify significant differences between intervention groups for the differences between baseline and four weeks post test for each process of exercise behaviour change.

Table 78.

The medians of the difference between baseline to four weeks post test for each process of exercise behaviour change for each intervention group

	Intervention Group				Kruskal Wallis test	
	FAE	FAC	ECE	ECC	Test	
Processes	N = 13	N = 20	N = 16	N = 11	Statistic	P
Experiential						
Consciousness Raising	-1.0	-4.0	-7.0	-5.0	4.57	0.21
Dramatic Relief	0.0	-2.0	-4.5	-5.0	1.77	0.62
Enviromental Reevaluation	-1.0	-4.5	-5.0	0.0	2.75	0.43
Self Reevaluation	-2.0	-4.5	-4.5	-1.0	1.40	0.71
Social Liberation	-2.0	-0.5	-1.0	-1.0	4.68	0.20
Behavioural						
Counter-Conditioning	-6.0	-3.5	-6.5	-6.0	1.32	0.73
Helping Relationships	-3.0	-2.5	-6.5	-5.0	4.73	0.19
Reinforcement Management	-6.0	-3.5	-2.0	-6.0	2.64	0.45
Self Liberation	-6.0	-5.0	-6.5	-4.0	2.47	0.48
Stimulus Control	-2.0	-2.5	-7.0	-5.0	1.74	0.63

Note. As the 4 week scores were subtracted from the baseline scores, negative signs indicate an increase at four weeks.

Table 78. shows that there is no significant difference between any of the intervention groups for the difference between baseline and four weeks post test processes of exercise behaviour change. It is interesting to note however that the majority of process scores have increased four weeks post test and for all but two of the processes (social liberation and reinforcement management) the greatest increases were observed in the group who received an exercise consultation.

Preparation.

As with baseline contemplators, in order to compare like with like, analyses was conducted for all those baseline preparers who progressed at least one stage of exercise behaviour change at four weeks post test in each intervention group. Again, as with baseline contemplators, it is important to establish if any differences between intervention groups for each process of exercise behaviour change existed at baseline (i.e. before any interventions). Table 2 in appendix Y gives the median score for each process of exercise behaviour change for each intervention group at baseline for preparers who progressed at least one stage of exercise behaviour change at four weeks post test. The table also gives the results of ten Kruskal Wallis tests, conducted to identify significant differences between intervention groups for each process of exercise behaviour change at baseline. The results showed that there was a significant difference between study groups at baseline for helping relationships, reinforcement management and stimulus control. To compare the effect of intervention groups on processes of exercise behaviour change, these three processes were not used for analysis.

Table 79. gives the medians of the difference between baseline to four weeks post test for each process of exercise behaviour change (minus the three exclusions) for each intervention group. The table also gives the results of seven Kruskal Wallis tests, conducted to identify significant differences between intervention groups for the differences between baseline and four weeks post test for each process of exercise behaviour change.

Table 79.

The medians of the difference between baseline to four weeks post test for each process of exercise behaviour change (minus exclusions) for each intervention group.

	Intervention Group				Kruskal Wallis test	
	FAE	FAC	ECE	ECC	Test	
Processes	N = 14	N = 15	N = 19	N = 11	Statistic	P
Experiential						
Consciousness Raising	-5.5	-3.0	-4.0	-5.0	3.01	0.39
Dramatic Relief	-5.0	0.0	-3.0	-4.0	6.97	0.07
Enviromental Reevaluation	-4.5	-1.0	-3.0	-4.0	2.9	0.41
Self Reevaluation	-5.5	-2.0	-2.0	-3.0	3.17	0.37
Social Liberation	-3.0	-1.0	0.0	-2.0	7.08	0.07
Behavioural						
Counter-Conditioning	-2.5	-2.0	-4.0	-3.0	0.54	0.91
Self Liberation	-5.0	-2.0	-4.0	-4.0	2.79	0.42

Note. As the 4 week scores were subtracted from the baseline scores, negative signs indicate an increase at four weeks.

As with baseline contemplators, table 79. shows that there is no significant difference between any of the preparers in the intervention groups for the difference between baseline and four weeks post test processes of exercise behaviour change.

Action.

Only one participant who was classified as an actioner at baseline progressed into maintenance at four weeks post test. Similarly, only one baseline actioner regressed into preparation. The remaining baseline actioners remained as actioners at four weeks post test (table 3 in appendix X). Given this, it is extremely unlikely that any differences in the processes of exercise behaviour change use will exist between study groups when no major change in stage of exercise behaviour has occurred. This is especially true given the fact that no difference between study groups was evident even when a shift in the stage of exercise behaviour change was evident (i.e. as for baseline contemplators and preparers reported above).

Maintenance.

Table 3 in appendix X shows that no baseline maintainers regressed in their stage of exercise behaviour change at four weeks post test. For the reasons given in the previous paragraph it is again extremely unlikely that significant differences in the processes of change use will be evident from baseline to four weeks post test when comparing intervention groups.

As mentioned at the start of this section, the effect of the interventions on the processes of exercise behaviour change is likely to be strongest immediately following the interventions. As no differences were found between the interventions at this point it is very unlikely that differences occurred throughout the course of the study. Given this, to identify key processes of exercise behaviour change associated with shifts in stage of exercise behaviour change, the data from all of the intervention groups can be pooled. For example, all contemplators progressing into preparation can be used for analysis, irrespective of intervention group.

Identification of Dominant Processes of Exercise Behaviour Change when progress is made through the Stages of Exercise Behaviour Change

When a person progresses in their stage of exercise behaviour change, there are four possibilities; contemplation to either preparation or action (it is impossible for a contemplator to progress directly into maintenance - they will progress through action first), preparation to action (again, it is impossible for a preparer to progress directly into maintenance) and action into maintenance. The following section reports the analyses conducted to identify dominant processes of exercise behaviour change for participants in each stage of progression. Analyses were conducted for all participants who progressed between successive test stages i.e. baseline to four weeks, six months to one year post test. Progress between two test stages that were not successive (i.e. 4 weeks to 6 months post test) were not used in the analysis. Additionally, participants who progressed, regressed and progressed again were only included once in the analysis.

Contemplation to preparation.

In total, 11 progressions were made from contemplation to preparation. In contrast, 10 contemplators remained in that stage of exercise behaviour change at a successive test stage. The first part of the overall analysis is to conduct a linear discriminant analysis to identify if the model can discriminate between those who progressed (i.e. contemplation to preparation) and those who didn't (i.e. contemplation to contemplation) using the processes of exercise behaviour change. To gain a subjective impression, figures 61. and 62. give boxplots for the median experiential and behavioural processes of exercise behaviour change respectively plotted against those participants who did and did not improve their stage of exercise behaviour change.

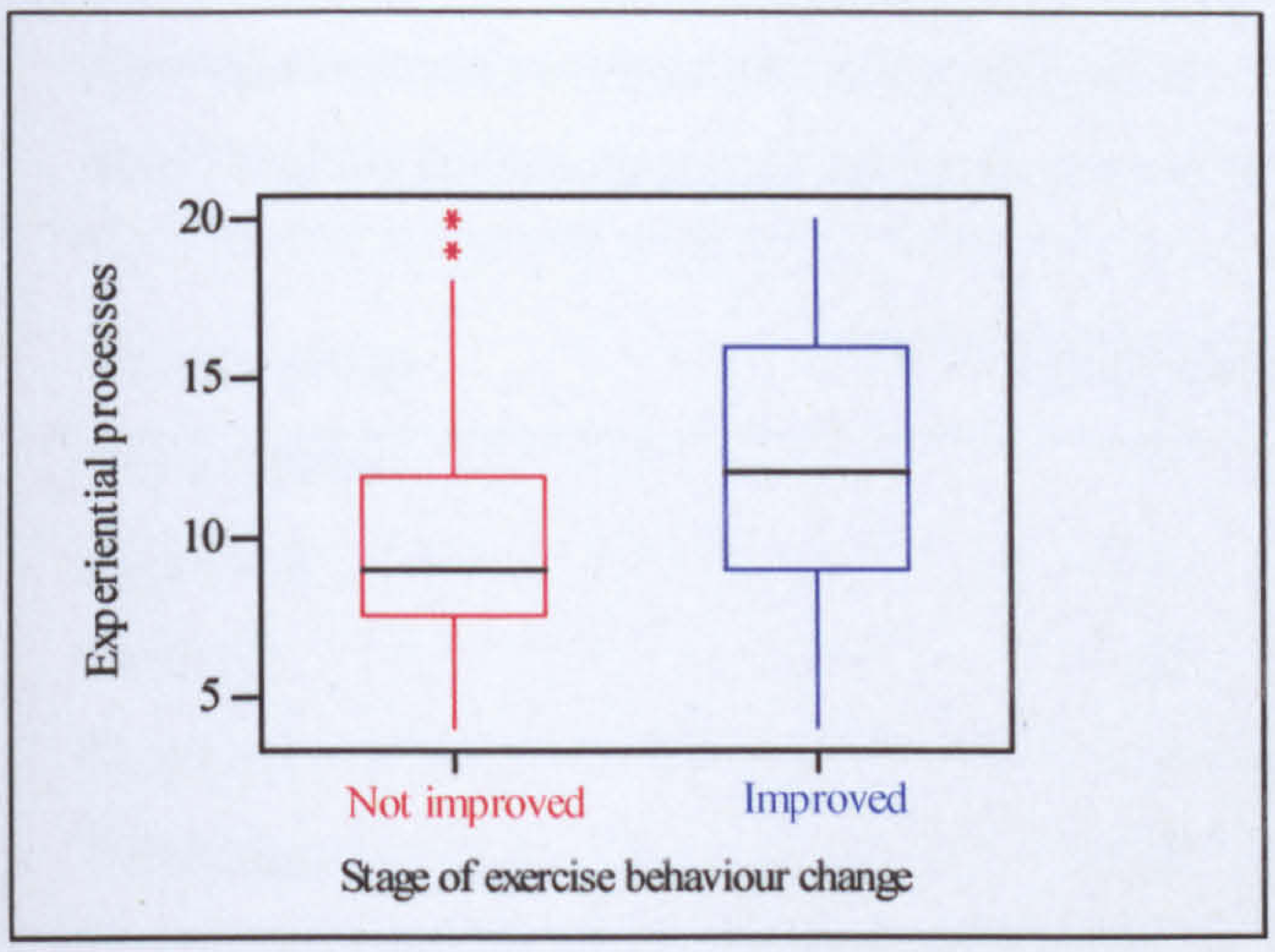


Figure 61. Experiential processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

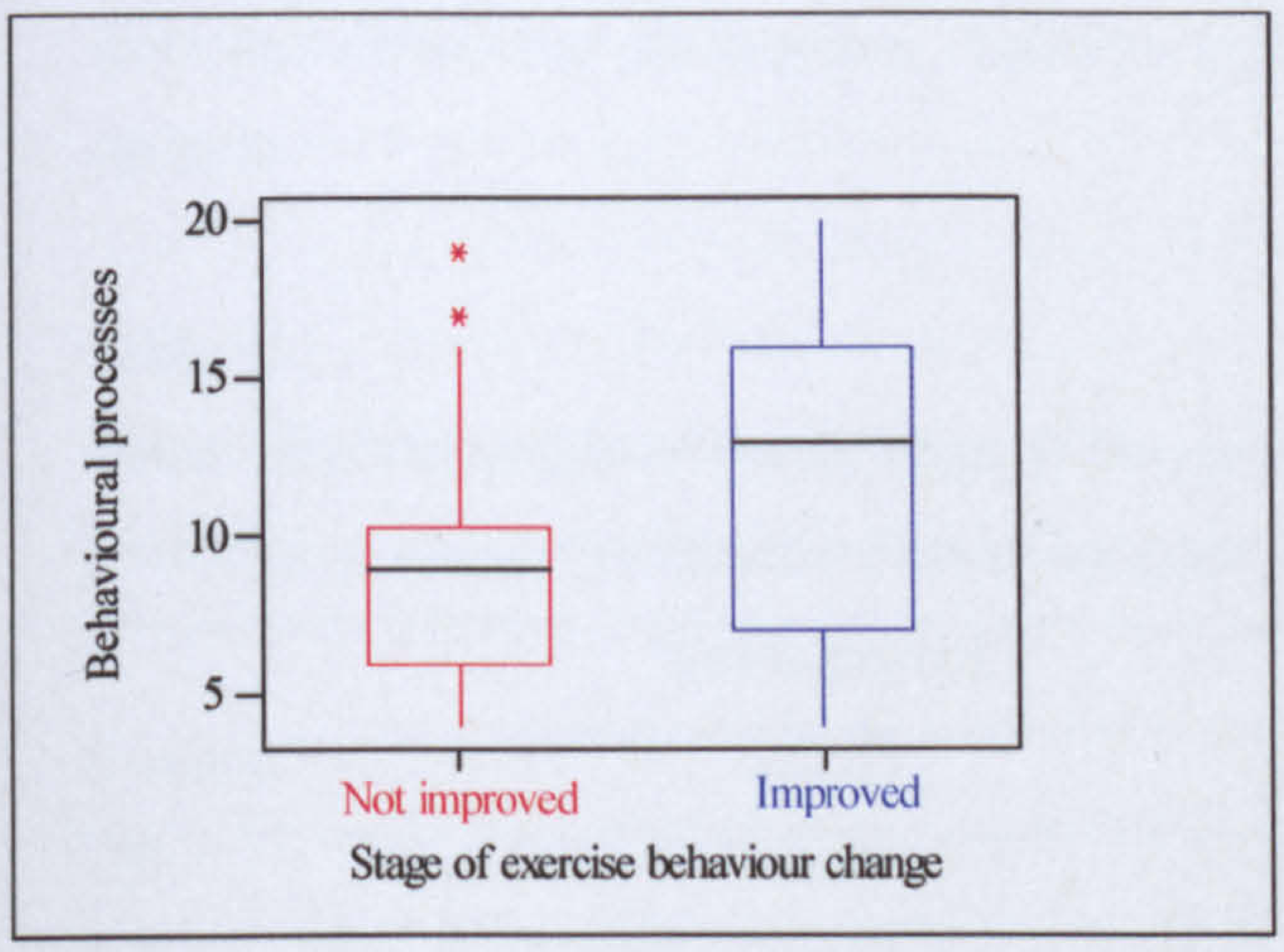


Figure 62. Behavioural processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

It appears from figures 61. and 62. that both experiential and behavioural processes of exercise behaviour are good discriminators. To test how well all ten processes of exercise behaviour change can identify those who improved and those who didn't, a linear discriminant analysis, using cross validation was conducted. Table 80. reports the misclassification matrix for this analysis.

Table 80.

The misclassification matrix of a linear discriminant analysis using cross validation where the dependent variable is those who progressed from contemplation to preparation and those who didn't and the independent variable is the processes of exercise behaviour change

	True group	
Put into group	Not improved	Improved
Not improved	7	4
Improved	3	7
Total N	10	11
N correct	7	7
Percentage	70	64
N = 21, N correct = 14, percentage correct = 67		

Table 80. shows that the discriminant analysis correctly identified 67% of participants. Further, it shows that 70% of those not improving were classified correctly compared to 64% of those participants that did improve. Table 81. gives the linear discriminant functions for the analysis.

Table 81.

Linear discriminant functions for stage of change non-improvers and improvers based on processes of change for the discriminant analysis

	Not improved	Improved
Constant	-34.83	-49.7
CR	2.86	1.79
DR	-0.92	-1.09
ER	-2.35	-2.19
SR	1.89	2.14
SO	-1.16	-0.44
CC	-0.56	0.11
HR	0.05	0.16
RM	2.09	1.66
SL	5.52	6.28
SC	-3.23	-3.02

Table 81. suggests that the behavioural processes of self liberation and stimulus control are the most important contributors to the performance of the classifier. However, as the spread of values for all the processes is not particularly large, this suggests that all processes (with the possible exception of helping relationships) are important when predicting stage of exercise

behaviour change. It is possible from table 81. to predict future stage of exercise behaviour change progress from the processes of exercise behaviour change using the following formula;

For the group not improving,

Linear discriminant function (LDF) 1 = -34.83 + 2.86 * CR – 0.92 * DR etc

For the group improving,

(LDF) 2 = -49.7 + 1.79 * CR – 1.09 * DR etc

A prediction could be made by substituting the new participants processes of exercise behaviour change scores into LDF 1 and LDF 2. The participant would be predicted as an improver if the LDF 2 score exceeded the LDF 1 score and vice versa. If the scores of both the LDF calculations were close however, it would be sensible to exercise caution in making a prediction; further investigation would be recommended.

The next stage in the overall analysis is to perform a binary logistic regression using the improved / not improved indicators as the binary response and the processes of exercise behaviour change as the explanatory variable. This will indicate if any of the processes of exercise behaviour change are useful predictors in progressing from contemplation to preparation. Ideally, individual processes of exercise behaviour change would be used in the analysis. However, given the relatively small numbers in each group, it was decided to group the processes into experiential and behavioural processes of exercise behaviour change. Table 82. reports the logistic regression results.

Table 82.

Logistic regression table for experiential and behavioural processes of exercise behaviour change

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI	
						Lower	Upper
Constant	-1.79	0.63	-2.85	0.004	/	/	/
Experiential	0.06	0.05	1.17	0.24	1.07	0.96	1.18
Behavioural	0.11	0.05	2.11	0.035	1.12	1.01	1.25

Log – likelihood = - 66.70

Test that all slopes are zero: G = 11.93, DF = 2, P = 0.003

Hosmer-Lemeshow goodness of fit: χ^2 = 11.37; df = 8, p = 0.18

Table 82. indicates that the model is a good fit of the data as the p value for the test that the slopes are zero has a value less than 0.05 and the p value for the goodness of fit test is greater than 0.05. The table also shows that the p value for the constant (intercept) is less than 0.05 so it can be concluded that the true intercept is likely to be non zero. In addition, table 82. shows that the p

value for the experiential processes is greater than 0.05, suggesting these processes of exercise behaviour change are not useful predictors of progress into preparation from contemplation. In contrast, the p value for the behavioural processes is less than 0.05, suggesting that behavioural processes are useful predictors of progress, having accounted for the experiential processes.

The next step is to re-fit the logistic regression model without the experiential variable. Table 83. reports the logistic regression table.

Table 83.

Logistic regression table for experiential processes of exercise behaviour change

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-1.40	0.52	-2.69	0.007	/	/	/
Behavioural	0.15	0.05	3.09	0.002	1.16	1.05	1.27
Log – likelihood = --67.39							
Test that all slopes are zero: G = 10.54, DF = 1, P = 0.001							

Table 83. indicates that the model is a good fit of the data as the p value for the test that the slopes are zero has a value less than 0.05. The table also shows that the p value for the constant (intercept) is less than 0.05 so it can be concluded that the true intercept is likely to be non zero. The odds ratio for the behavioural processes is greater than 1 (1.16) suggesting that an increase in the behavioural processes of exercise behaviour change by 1 unit is likely to increase the odds of progression from contemplation into preparation by 16% (95% CI: 5% - 27%).

Contemplation to action.

In total, 52 progressions were made from contemplation to action. As before, 10 contemplators remained in that stage of exercise behaviour change at a successive test stage. Again, the first part of the overall analysis is to conduct a linear discriminant analysis to identify if the model can discriminate between those who progressed (i.e. contemplation to action) and those who didn't (i.e. contemplation to contemplation) using the processes of exercise behaviour change. To gain a subjective impression, figures 63. and 64. give boxplots for the median experiential and behavioural processes of exercise behaviour change respectively plotted against those participants who did and did not improve their stage of exercise behaviour change.

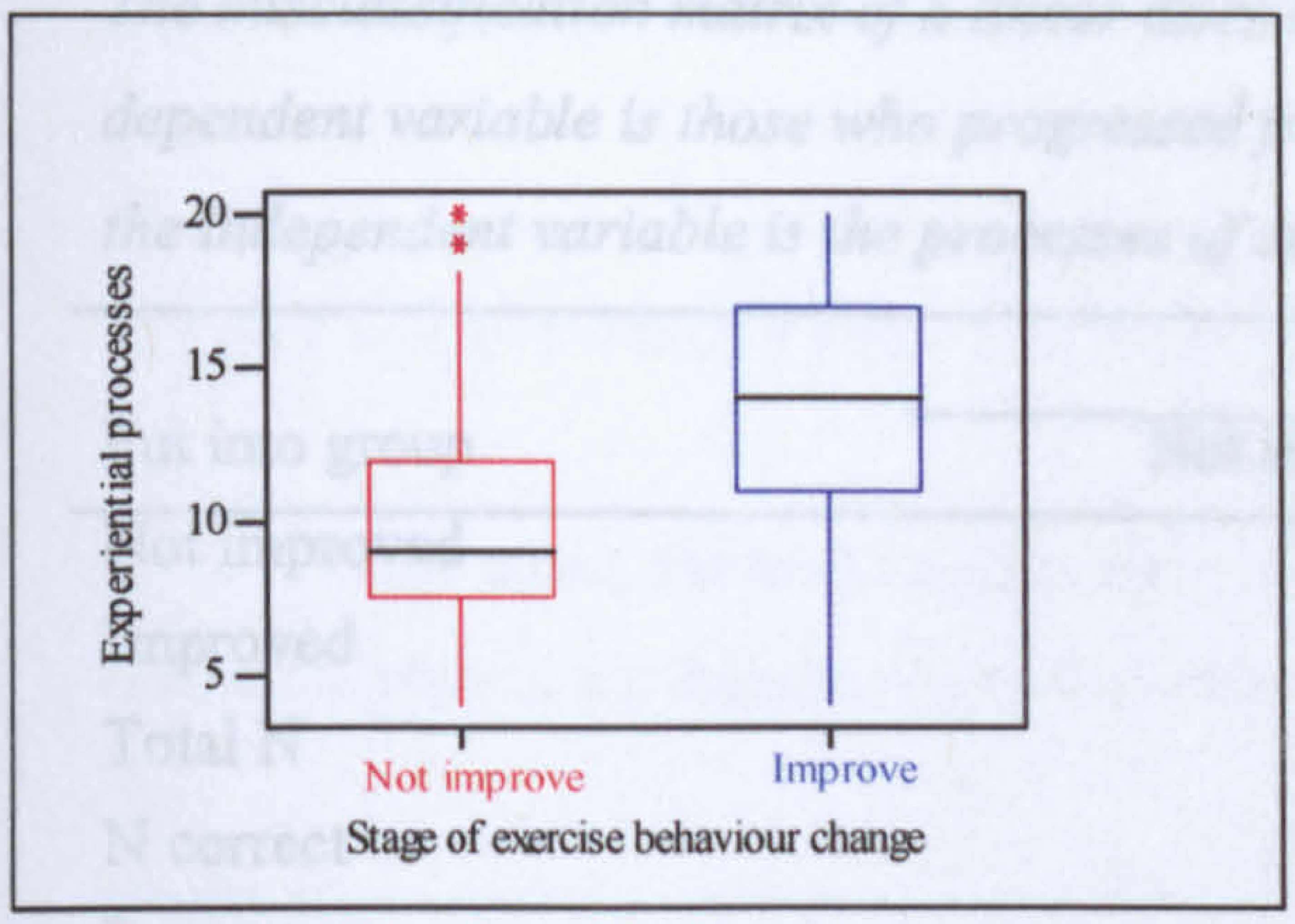


Figure 63. Experiential processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

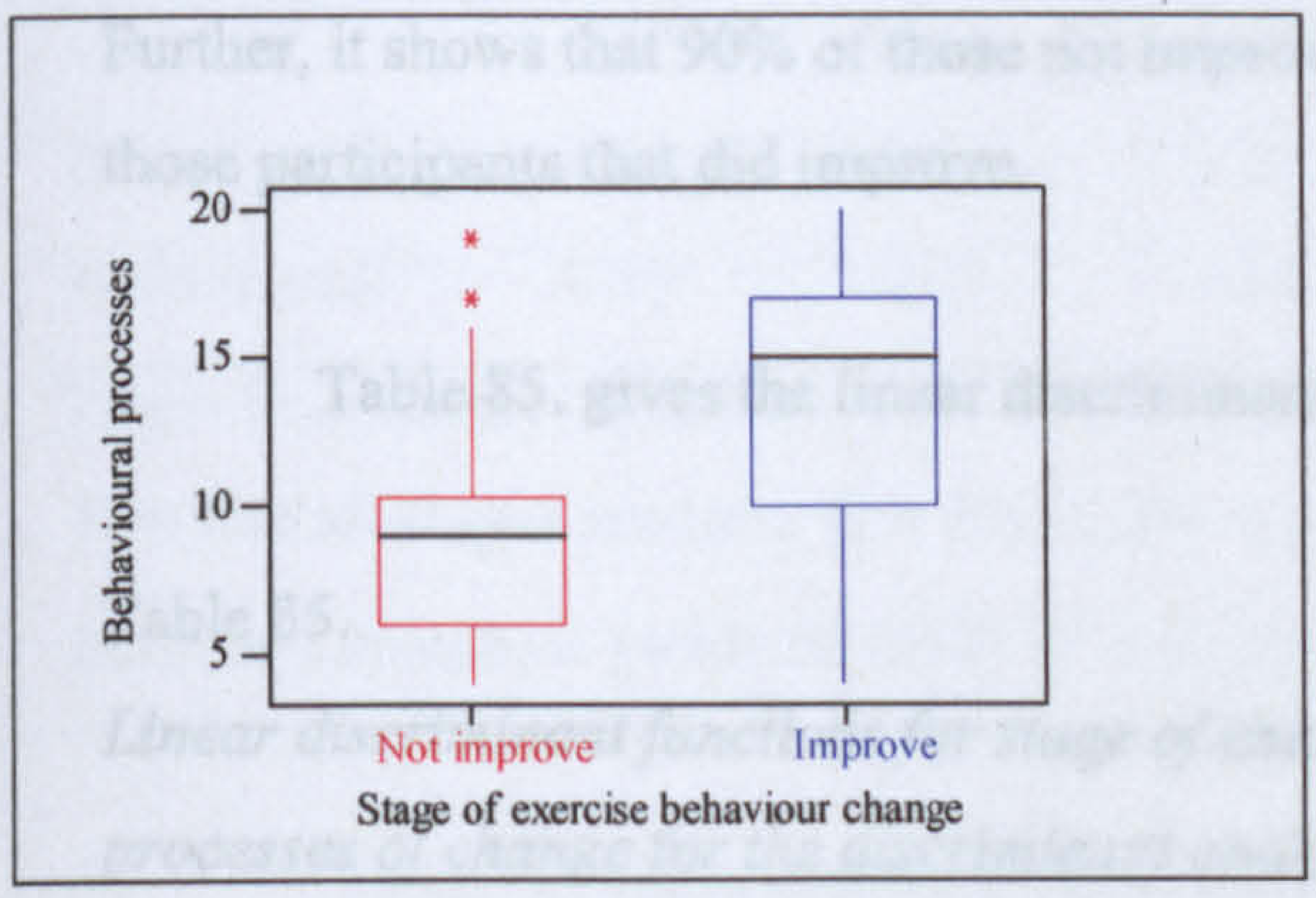


Figure 64. Behavioural processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

It appears from figures 63. and 64. that both experiential and behavioural processes of exercise behaviour are good discriminators. To test how well all ten processes of exercise behaviour change can identify those who improved and those who didn't, a linear discriminant analysis using cross validation was conducted. Table 84. reports the misclassification matrix for this analysis.

Table 84.

The misclassification matrix of a linear discriminant analysis using cross validation where the dependent variable is those who progressed from contemplation to action and those who didn't and the independent variable is the processes of exercise behaviour change

	True group	
Put into group	Not improved	Improved
Not improved	1	41
Improved	9	11
Total N	10	52
N correct	9	41
Percentage	90	79
N = 62, N correct = 50, percentage correct = 81		

Table 84. shows that the discriminant analysis correctly identified 81% of participants. Further, it shows that 90% of those not improving were classified correctly compared to 79% of those participants that did improve.

Table 85. gives the linear discriminant functions for the analysis.

Table 85.

Linear discriminant functions for stage of change non-improvers and improvers based on processes of change for the discriminant analysis

	Not improved	Improved
Constant	-12.51	-18.76
CR	0.01	0.03
DR	0.21	-0.04
ER	0.07	0.39
SR	0.65	0.81
SO	0.29	0.31
CC	0.60	0.69
HR	0.37	0.44
RM	0.22	0.08
SL	0.39	0.38
SC	-0.75	-0.44

Table 85. suggests that there are no individual processes of exercise behaviour change that are particularly dominant when progression is made from contemplation to action. Again, it is possible from table 85. to predict progress from contemplation to action given the processes of exercise behaviour change scores:

For the group not improving,

Linear discriminant function (LDF) 1 = -12.51 + 0.01 * CR + 0.21 * DR etc

For the group improving,

(LDF) 2 = -18.76 + 0.03 * CR – 0.04 * DR etc

Once again, the next stage in the overall analysis is to perform a binary logistic regression. Table 86. reports the logistic regression table.

Table 86.

Logistic regression table for experiential and behavioural processes of exercise behaviour change

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-1.71	0.54	-3.18	0.001	/	/	/
Experiential	0.11	0.04	2.55	0.01	1.11	1.03	1.21
Behavioural	0.19	0.04	4.34	0.000	1.21	1.11	1.31

Log – likelihood = -113.14

Test that all slopes are zero: G = 47.64, DF = 2, P = 0.00

Hosmer-Lemeshow goodness of fit: χ^2 = 8.67; df = 8, p = 0.37

Table 86. again shows that the p value for the constant (intercept) is less than 0.05 so it can be concluded that the true intercept is likely to be non zero. The model also appears to fit the data well as the p value for the test of all slopes are zero is less than 0.05 and the goodness of fit test has a p value greater than 0.05. Table 86. also shows that both experiential and behavioural processes have a p value less than 0.05 suggesting each is a statistically significant predictor of progression from contemplation to action in addition to the other. Hence both variables can be retained in the model. The odds ratio for the experiential processes of exercise behaviour change suggest that an increase of 1 unit is likely to increase the odds of progression from contemplation into action by 11% (95% CI: 3% - 21%) (keeping the behavioural scores constant). Similarly, an increase of 1 unit in the behavioural scores is likely to increase the odds of progression from contemplation into action by 21% (95% CI: 11% - 31%) (keeping the experiential scores constant).

<u>Preparation to action.</u>

In total, 73 progressions were made from preparation to action. In contrast, 65 preparers remained in that stage of exercise behaviour change at a successive test stage. Again, the first part of the overall analysis is to conduct a linear discriminant analysis. Figures 65. and 66. give boxplots for the median experiential and behavioural processes of exercise behaviour change respectively plotted against those participants who did and did not improve their stage of exercise behaviour change.

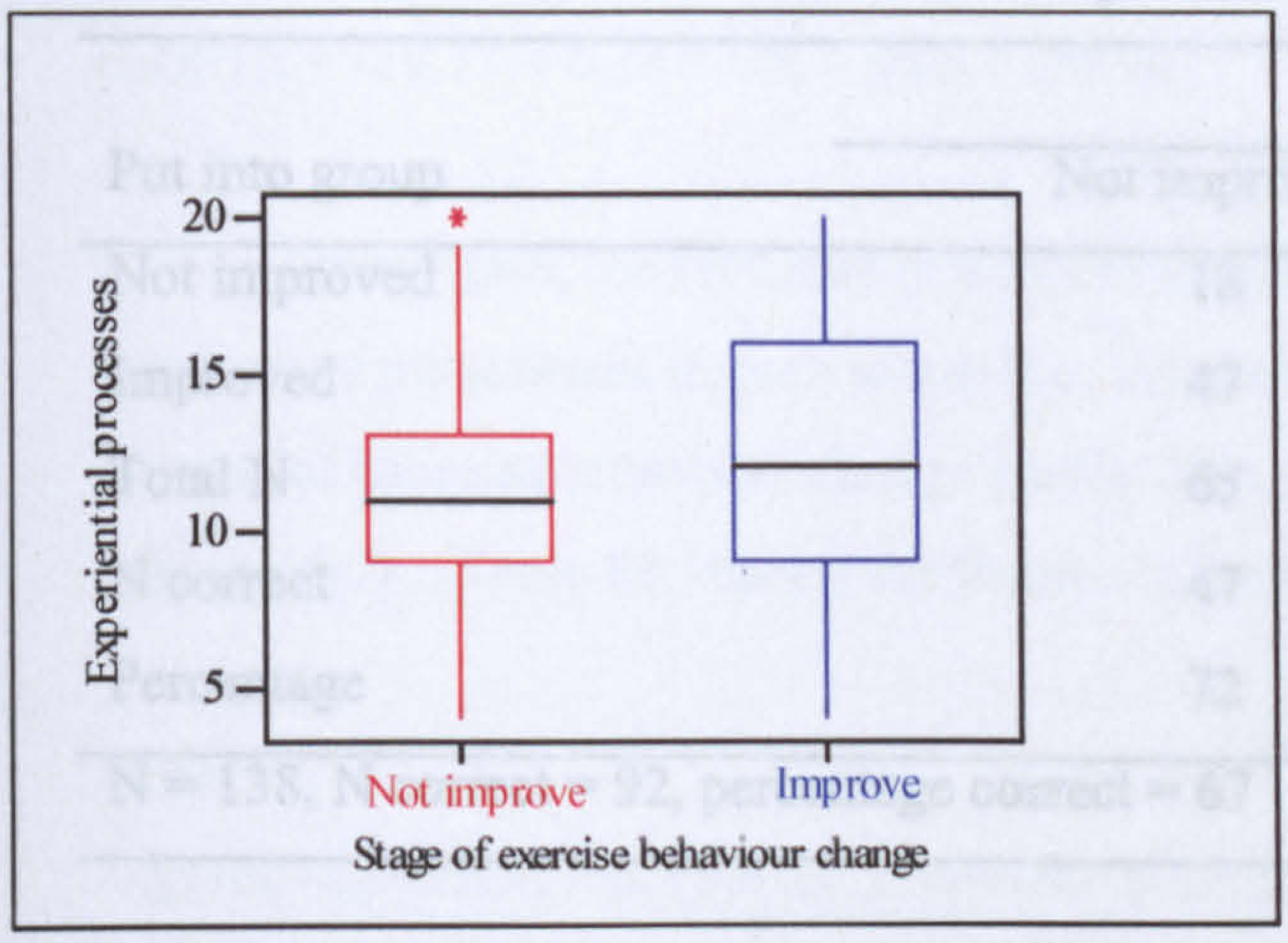


Figure 65. Experiential processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

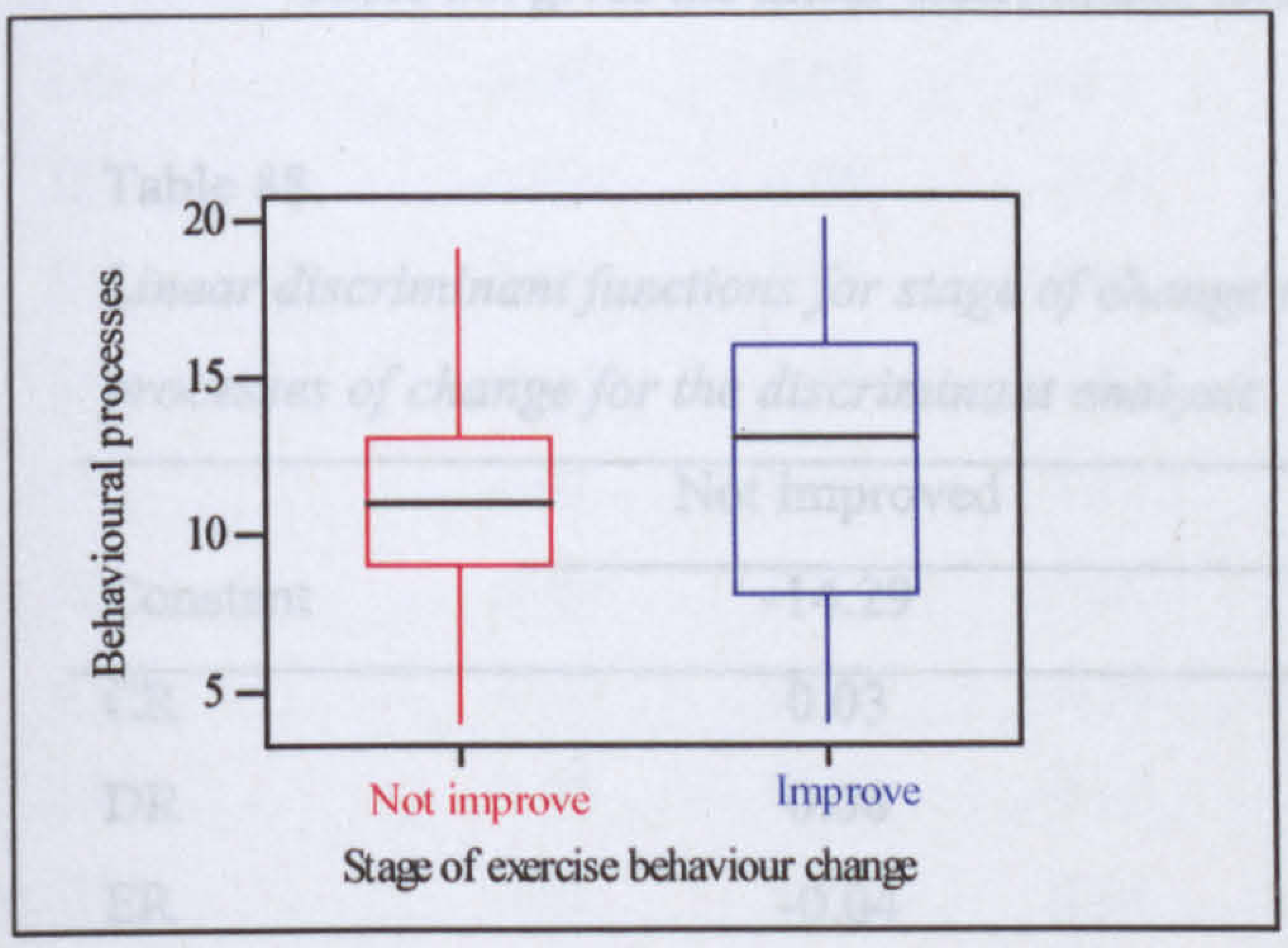


Figure 66. Behavioural processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

It appears from figures 65. and 66. that neither the experiential or behavioural processes of exercise behaviour are good discriminators. To test how well all ten processes of exercise behaviour change can identify those who improved and those who didn't, a linear discriminant analysis using cross validation was conducted. Table 87. reports the misclassification matrix for this analysis.

Table 87.

The misclassification matrix of a linear discriminant analysis using cross validation where the dependent variable is those who progressed from preparation to action and those who didn't and the independent variable is the processes of exercise behaviour change

	True group	
Put into group	Not improved	Improved
Not improved	18	45
Improved	47	28
Total N	65	73
N correct	47	45
Percentage	72	62
N = 138, N correct = 92, percentage correct = 67		

Table 87. shows that the discriminant analysis correctly identified 67% of participants. Further, it shows that 72% of those not improving were classified correctly compared to 62% of those participants that did improve.

Table 88. gives the linear discriminant functions for the analysis.

Table 88.

Linear discriminant functions for stage of change non-improvers and improvers based on processes of change for the discriminant analysis

	Not improved	Improved
Constant	-14.29	-19.13
CR	0.03	0.14
DR	0.08	0.09
ER	-0.04	-0.07
SR	0.31	0.35
SO	0.84	0.73
CC	0.44	0.45
HR	-0.19	-0.25
RM	-0.11	0.17
SL	0.96	1.37
SC	0.17	0.19

Table 88. suggests that there are no individual processes of exercise behaviour change that are particularly dominant when progression is made from contemplation to action, although self liberation appears to be the most important. Again, it is possible from table 88. to predict progress from preparation to action given the processes of exercise behaviour change scores:

For the group not improving,

Linear discriminant function (LDF) 1 = -14.29 + 0.03 * CR + 0.08 * DR etc

For the group improving,

(LDF) 2 = -19.13 + 0.14 * CR – 0.09 * DR etc

Once again, the next step is to perform a binary logistic regression. In this case, the numbers of participants in each group (i.e. improved and not improved) allows for analysis of each process of exercise behaviour change (rather than grouping them into experiential and behavioural). Table 89. reports the logistic regression table for these participants.

Table 89.

Logistic regression table for the processes of exercise behaviour change

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI	
						Lower	Upper
Constant	-5.16	1.28	-4.03	0.000	/	/	/
CR	0.14	0.08	1.85	0.06	1.15	0.99	1.34
DR	-0.007	0.08	-0.1	0.92	0.99	0.86	1.14
ER	-0.002	0.08	-0.02	0.98	1.0	0.85	1.17
SR	0.05	0.08	0.63	0.53	1.05	0.90	1.22
SO	-0.16	0.08	-1.96	0.05	0.86	0.73	1.00
CC	0.01	0.07	0.18	0.86	1.01	0.88	1.17
HR	-0.09	0.07	-1.37	0.17	0.91	0.79	1.04
RM	-0.08	0.09	-0.88	0.38	0.92	0.76	1.11
SL	0.46	0.11	4.17	0.000	1.58	1.28	1.97
SC	0.05	0.08	0.64	0.52	1.05	0.90	1.22

Table 89. again indicates that the true intercept is likely to be non zero. Table 89 also indicates that the processes of social liberation and self liberation are useful predictors of progress. The next step is to re-fit the logistic regression model using just these two processes of exercise behaviour change. Table 90. reports the logistic regression table for these two processes.

Table 90.

Logistic regression table for social liberation and self liberation

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-4.32	1.11	-3.88	0.000	/	/	/
SO	-0.13	0.07	-1.98	0.048	0.88	0.77	1.00
SL	0.44	0.09	5.16	0.000	1.56	1.32	1.85

Log – likelihood = -74.27

Test that all slopes are zero: G = 42.31, DF = 2, P = 0.00

Hosmer-Lemeshow goodness of fit: $\chi^2 = 8.61$; df = 8, p = 0.38

Table 90. again shows that the true intercept is likely to be non zero and that the model explains the data well. The table also shows that both social liberation and self liberation are significant predictors of progression from preparation into action. For social liberation, a decrease in the score by 1 unit is likely to increase the chances of progression by 12% (95% CI: 0% - 23%). In contrast, an increase in the self liberation score by one unit is likely to increase the chances of progression from preparation into action by 56% (95% CI: 32% - 85%).

Action to maintenance.

In total, 56 progressions were made from action to maintenance. In contrast, 194 actioners remained in that stage of exercise behaviour change at a successive test stage. Again, the first part of the overall analysis is to conduct a linear discriminant analysis. Figures 67. and 68. give boxplots for the median experiential and behavioural processes of exercise behaviour change respectively plotted against those participants who did and did not improve their stage of exercise behaviour change.

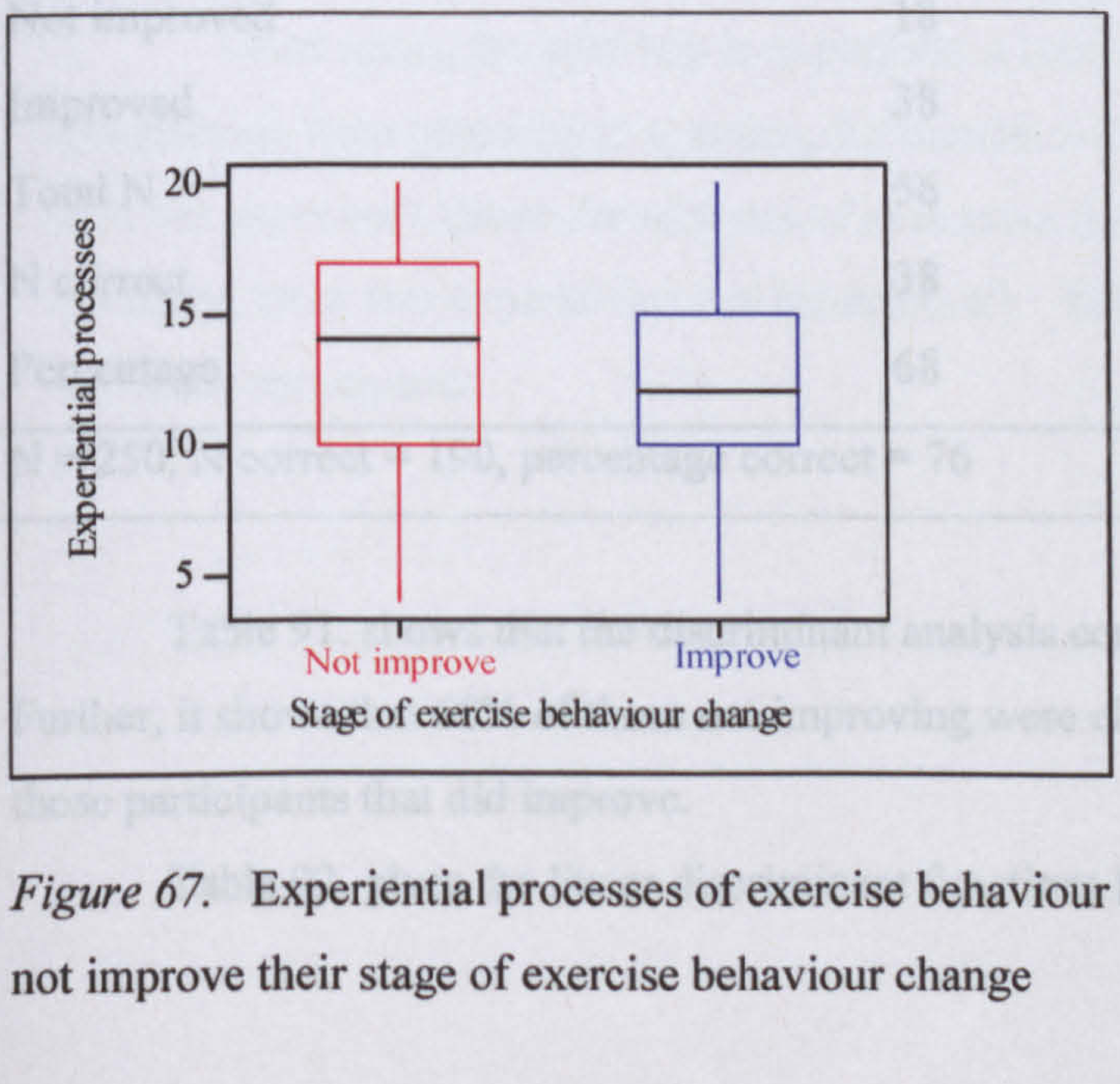


Figure 67. Experiential processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

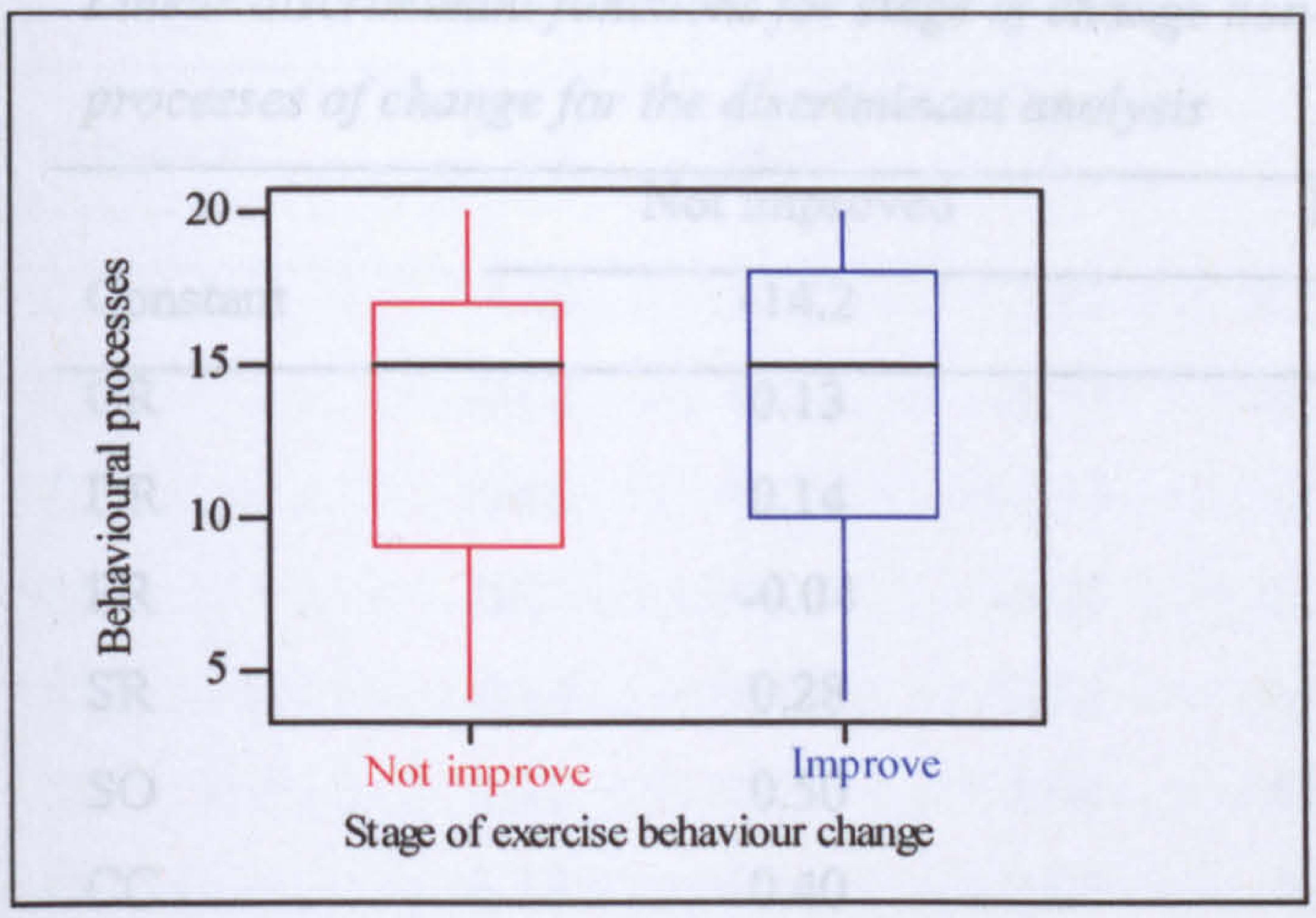


Figure 68. Behavioural processes of exercise behaviour change for those participants who did and did not improve their stage of exercise behaviour change

Figures 67. and 68. show a fair degree of overlap suggesting that neither the experiential or behavioural processes of exercise behaviour are good discriminators. To test how well all ten processes of exercise behaviour change can identify those who improved and those who didn't, a linear discriminant analysis using cross validation was conducted. Table 91. reports the misclassification matrix for this analysis.

Table 91.

The misclassification matrix of a linear discriminant analysis using cross validation where the dependent variable is those who progressed from action to maintenance and those who didn't and the independent variable is the processes of exercise behaviour change

	True group	
Put into group	Not improved	Improved
Not improved	18	152
Improved	38	42
Total N	56	194
N correct	38	152
Percentage	68	78

N = 250, N correct = 190, percentage correct = 76

Table 91. shows that the discriminant analysis correctly identified 76% of participants. Further, it shows that 68% of those not improving were classified correctly compared to 78% of those participants that did improve.

Table 92. gives the linear discriminant functions for the analysis.

Table 92.

Linear discriminant functions for stage of change non-improvers and improvers based on processes of change for the discriminant analysis

	Not improved	Improved
Constant	-14.2	-16.38
CR	0.13	0.12
DR	0.14	0.08
ER	-0.04	-0.38
SR	0.28	0.11
SO	0.50	0.62
CC	0.40	0.53
HR	-0.04	0.09
RM	-0.09	-0.05
SL	0.89	1.16
SC	-0.17	-0.14

Again, with the possible exception of self liberation, table 92. suggests that there are no individual processes of exercise behaviour change that are particularly dominant when progression is made from action to maintenance. As before, it is possible from table 92. to predict progress from action to maintenance given the processes of exercise behaviour change scores.

For the group not improving,

Linear discriminant function (LDF) 1 = -14.2 + 0.13 * CR + 0.14 * DR etc

For the group improving,

(LDF) 2 = -16.38 + 0.12 * CR – 0.08 * DR etc

Once again, the next step is to perform a binary logistic regression. As in the case of progression from preparation to action, the numbers of participants in each group (i.e. improved and not improved) allows for analysis of each process of exercise behaviour change (rather than grouping them into experiential and behavioural). Table 93. reports the logistic regression table for these participants.

Table 93.

Logistic regression table for the processes of exercise behaviour change

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI	
						Lower	Upper
Constant	-4.09	1.18	-3.47	0.001	/	/	/
CR	-0.03	0.06	-0.57	0.57	0.97	0.86	1.09
DR	-0.06	0.05	-1.23	0.22	0.94	0.85	1.04
ER	-0.31	0.07	-4.35	0.000	0.73	0.63	0.84
SR	-0.16	0.06	-2.61	0.009	0.85	0.76	0.96
SO	0.12	0.06	2.06	0.04	1.13	1.01	1.28
CC	0.13	0.06	2.05	0.04	1.14	1.01	1.30
HR	0.11	0.05	2.19	0.03	1.12	1.01	1.24
RM	0.01	0.05	0.26	0.79	1.01	0.91	1.13
SL	0.32	0.08	3.68	0.000	1.37	1.16	1.62
SC	0.03	0.05	0.48	0.63	1.03	0.92	1.14

Table 93. again indicates that the true intercept is likely to be non zero. Table 93 also indicates that six of the processes of exercise behaviour change (ER, SR, SO, CC, HR and SL) are useful predictors of progress. The next step is to re-fit the logistic regression model using these six processes of exercise behaviour change. Table 94. reports the logistic regression table for these processes.

Table 94.

Logistic regression table for significant process predictors

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI	
						Lower	Upper
Constant	-4.14	1.15	-3.6	0.000	/	/	/
ER	-0.33	0.07	-4.84	0.000	0.72	0.63	0.82
SR	-0.18	0.06	-3.09	0.002	0.84	0.75	0.94
SO	0.13	0.06	2.17	0.03	1.14	1.01	1.28
CC	0.13	0.06	2.22	0.03	1.14	1.02	1.28
HR	0.10	0.05	2.20	0.03	1.11	1.01	1.22
SL	0.30	0.05	3.78	0.000	1.36	1.16	1.60

Log – likelihood = -99.07

Test that all slopes are zero: G = 67.82, DF = 6, P = 0.000

Hosmer-Lemeshow goodness of fit: $\chi^2 = 7.54$; df = 8, p = 0.48

Table 94. again shows that the true intercept is likely to be non-zero and that the model explains the data well. The table also shows that all six processes of exercise behaviour change are significant predictors of progression from action into maintenance. For environmental reevaluation and self reevaluation, table 94. indicates that a decrease in their score by one unit is likely to increase the chances of progression from action into maintenance (for ER, increased odds by 28%, 95% CI: 18% - 37%; for SR by 16%, 95% CI: 6% - 25%). This finding is consistent with the cross-sectional finding in section 1 (p.156). It suggests that use of the experiential processes (both ER and SR are experiential) peak in the action stage and significantly fall into maintenance.

In contrast, an increase of one unit in the processes of social liberation, counter-conditioning, helping relationships and self liberation is likely to increase the chances of progression from action into maintenance (by 14% for SO, [95% CI: 1% - 28%]; 14% for CC, [95% CI: 2% - 28%], 11 % for HR, [95% CI: 1% - 22%] and 36% for SL, [95% CI: 16% - 60%]).

<u>Changes in the Processes of Exercise Behaviour Change Corresponding to Regression from the Maintenance Stage of Exercise Behaviour Change.</u>

The previous analyses have identified prominent processes of exercise behaviour change when progression is made through the stages of exercise behaviour change. Having progressed to the maintenance stage of exercise behaviour change it is obviously an aim to keep people in this stage. The following analyses attempt to identify if a reduction in any of the processes of exercise behaviour change is associated with regression from the maintenance stage of change.

In total, 263 maintainers continued in this stage of exercise behaviour change at a successive test stage. In contrast, 10 maintainers regressed at least 1 stage of exercise behaviour change. Again, the first part of the overall analysis is to conduct a linear discriminant analysis. Figures 69. and 70. give boxplots for the median experiential and behavioural processes of exercise behaviour change respectively plotted against those participants who did and did not regress in their stage of exercise behaviour change.

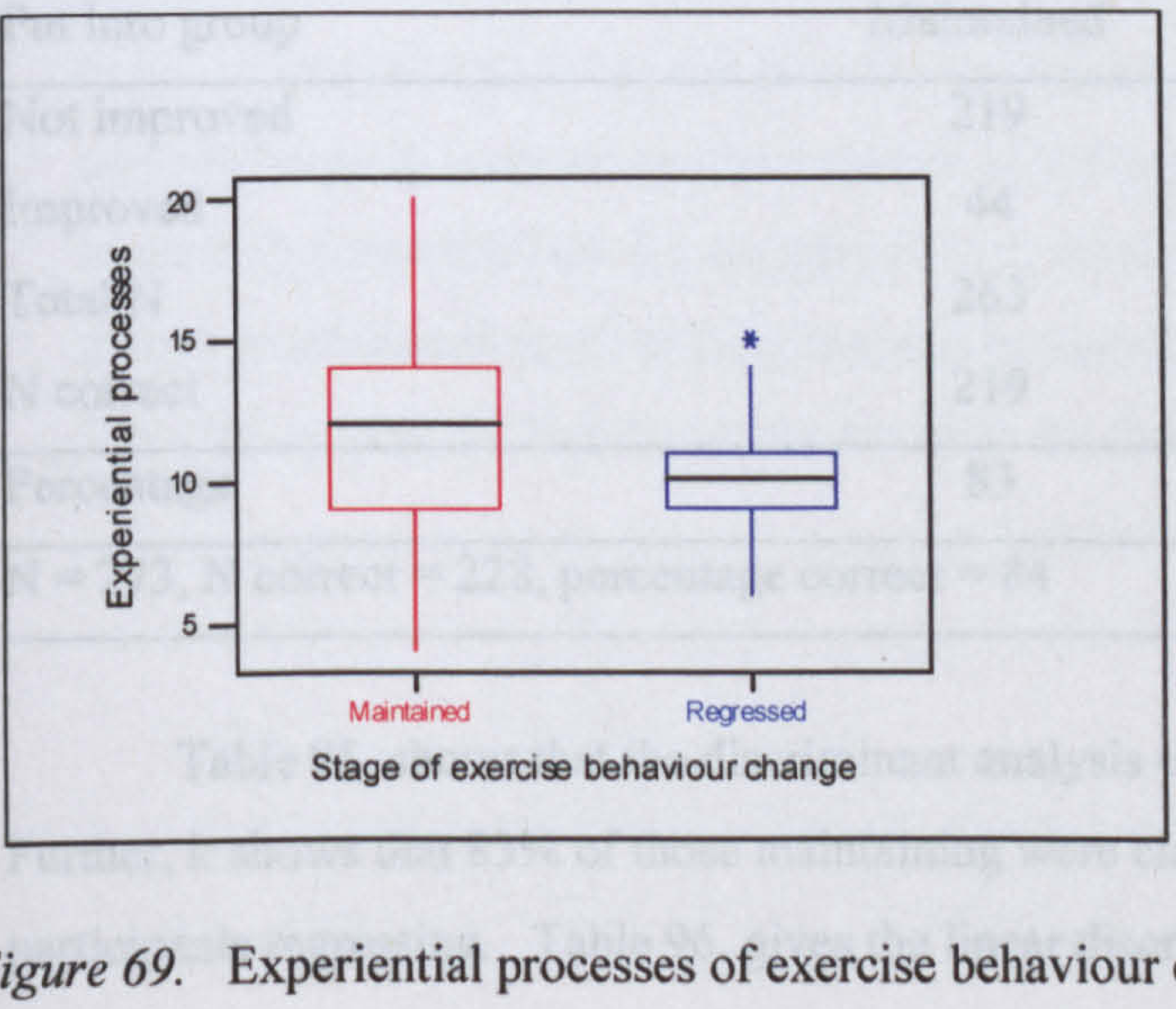


Figure 69. Experiential processes of exercise behaviour change for those participants who did and did not regress in their stage of exercise behaviour change

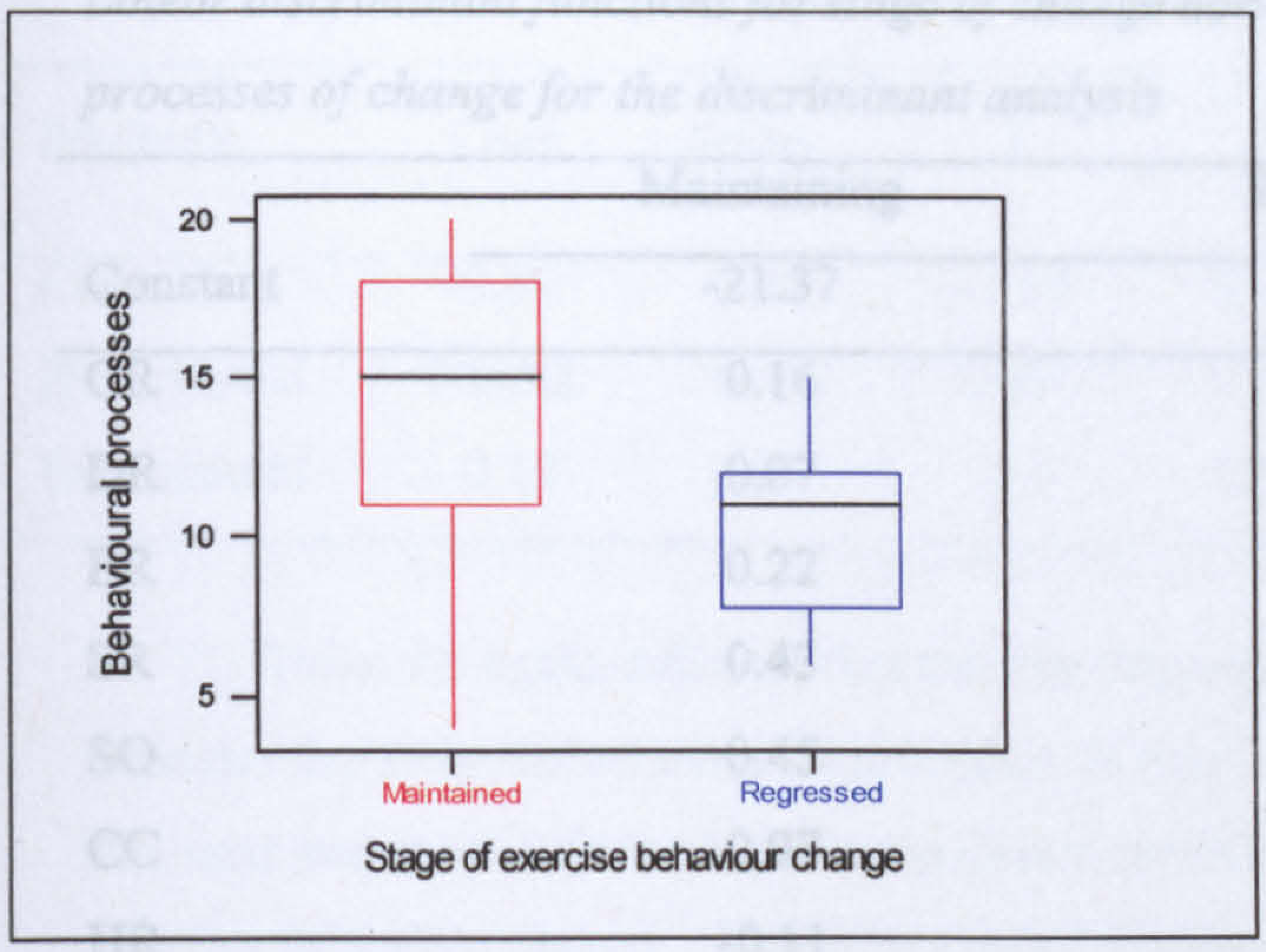


Figure 70. Behavioural processes of exercise behaviour change for those participants who did and did not regress in their stage of exercise behaviour change

Figures 69. and 70. show that both the experiential or behavioural processes of exercise behaviour appear to be good discriminators. This appears especially true for the behavioural processes of exercise behaviour change. To test how well all ten processes of exercise behaviour change can identify those who maintained and those who regressed, a linear discriminant analysis using cross validation was conducted. Table 95. reports the misclassification matrix for this analysis.

Table 95.

The misclassification matrix of a linear discriminant analysis using cross validation where the dependent variable is those who maintained and those who regressed and the independent variable is the processes of exercise behaviour change

	True group	
Put into group	Maintained	Regressed
Not improved	219	1
Improved	44	9
Total N	263	10
N correct	219	9
Percentage	83	90
N = 273, N correct = 228, percentage correct = 84		

Table 95. shows that the discriminant analysis correctly identified 84% of participants. Further, it shows that 83% of those maintaining were classified correctly compared to 90% of those participants regressing. Table 96. gives the linear discriminant functions for the analysis.

Table 96.

Linear discriminant functions for stage of change non-improvers and improvers based on processes of change for the discriminant analysis

	Maintaining	Regressing
Constant	-21.37	-12.88
CR	0.16	0.16
DR	0.07	0.17
ER	0.22	0.41
SR	0.43	0.28
SO	0.45	0.53
CC	0.97	0.55
HR	-0.11	-0.21
RM	0.07	-0.06
SL	0.83	-0.6
SC	-0.08	-0.04

Table 96. suggests that there are no individual processes of exercise behaviour change that are particularly dominant when regression occurs at maintenance. The processes of counter conditioning and self liberation appear important for maintenance. As before, it is possible from table 96. to predict regression from maintenance given the processes of exercise behaviour change scores:

For the group maintaining,

Linear discriminant function (LDF) 1 = -21.37 + 0.16 * CR + 0.07 * DR etc

For the group regressing,

(LDF) 2 = -12.88 + 0.16 * CR – 0.17 * DR etc

The next step is to perform a binary logistic regression. As in the case of progression from contemplation to preparation, the numbers of participants in each group (i.e. improved and not improved) does not allow for analysis of each process of exercise behaviour change. Analysis was therefore conducted on all experiential and behavioural processes of exercise behaviour change. Table 97. reports the logistic regression table for these participants.

Table 97.

Logistic regression table for the processes of exercise behaviour change

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-0.89	0.45	-1.97	0.05	/	/	/
Experiential	0.0002	0.04	0.000	1.0	1.0	0.92	1.08
Behavioural	-0.19	0.04	-5.4	0.000	0.82	0.77	0.88

Table 97. again indicates that the true intercept is likely to be non zero. Table 97. also indicates that only the behavioural processes of exercise behaviour change are good discriminators. The next step is to re-fit the logistic regression model using just the behavioural processes of exercise behaviour change. Table 98. reports the logistic regression table.

Table 98.

Logistic regression table for social liberation and self liberation

Predictor	Coef	StDev	Z	P	Odds Ratio	95% CI Lower	95% CI Upper
Constant	-0.89	0.36	-2.48	0.01	/	/	/
Behavioural	-0.19	0.03	-6.13	0.00	0.82	0.77	0.88

Log – likelihood = -99.07

Test that all slopes are zero: G = 67.82, DF = 6, P = 0.000

Hosmer-Lemeshow goodness of fit: $\chi^2 = 71.82$; df = 6, $p < 0.05$

Table 98. again shows that the true intercept is likely to be non-zero and that the behavioural processes of exercise behaviour change appear to be a significant predictor of regression from maintenance. The odds ratio suggests that a decrease in the behavioural processes by 1 unit is likely to increase the odds of regression from maintenance by 18% (95% CI: 12% - 23%). However, this finding has to be viewed with caution as the goodness of fit p value is less than 0.05, indicating the model is not a good fit of the data.

<u>Summary of Results from Section Four</u>

1. There were no significant differences between intervention groups for the use of the processes of exercise behaviour change.
2. When progression was made from each of the stages of exercise behaviour change, the processes of exercise behaviour change could accurately distinguish between those who progressed and those who did not.
3. For progression from contemplation to preparation, increasing the use of the behavioural processes gave the best odds of progression.

4. For progression from contemplation to action, increasing the use of both experiential and behavioural processes increased the odds of progression.
5. For progression from preparation to action, increasing the use of self liberation gave the best odds of progression.
6. For progression from action to maintenance, increasing the use of counterconditioning, social liberation, helping relationships and self liberation significantly increased the odds of progression.
7. A reduction in the behavioural processes of exercise behaviour change significantly increased the odds of regression from the maintenance stage of exercise behaviour change although this finding has to be viewed with caution.

Discussion

Introduction

Before the results are discussed, it is important to mention the issue of participant self-selection. As was discussed in the "delimitations" section of chapter 1 (p.11), participants were given the opportunity to volunteer for their preferred intervention, and then randomly assigned into either an experimental or control group. This produced two randomised control trials (one for each intervention). Although this did allow for a comparison of the kinds of people attracted to either intervention, this "self selection" issue may have threatened the external validity of the study as any differences observed between groups throughout the course of the study may have been caused by group differences and not the interventions. For this reason, caution has been employed when directly comparing intervention groups (i.e. fitness assessment against exercise consultation). Although comparisons have been made between intervention groups in the study (to provide an overall "picture"), where possible, discussion points and conclusions are drawn mainly from a comparison of each experimental group with it's respective control group (i.e. comparisons *within* each randomised control trial, corresponding to the first two italicised rows of tables 38, 48, 51, 64, 69, 72, 77).

The following discussion is split into four sections, corresponding to the four results sections. A summary of each result section has been given on pages 162 (section 1), 191 (section 2), 206 (section 3) and 229 (section 4).

Section One - Pre-intervention Analysis

All Participants Applying for the Study.

Of the 3000 application forms issued a total of 370 were returned, giving a response rate of 12.3%. At first glance this appears to be low but it has to be remembered that this was a study conducted with a free-living population. The initial application form was mailed to prospective volunteers and as such would have had to compete with normal "junk mail" for their attention. It is difficult to find similar studies with which to compare the present study but the evaluation of the Health Education Board for Scotland's National mass media campaign on active living showed that between 0.1 - 1 % of the population called the help-line, this after repeated advertisements on national television (Cavill, 1999).

The study as a whole attracted significantly more (nearly double) females compared to males. This suggests that males need to be actively targeted in similar health promotion programmes. This result is also encouraging however, given that as described in chapter two, Scottish females were found to be the least active population in Great Britain (excluding Wales which could not be compared given the lack of relevant Welsh national surveys) and in general, a larger proportion of females are known to suffer mental health problems (Meltzer et al., 1994). This suggests that females, and Scottish females in particular, should be targeted with physical activity interventions.

As with the pilot project, fitness assessments attracted significantly more volunteers than exercise consultations, confirming the observations highlighted in chapter two that fitness assessments are of particular benefit in attracting participants to health promotion programmes (Health Education Authority, 1992). In addition, fitness assessments also attracted significantly more males than females (exercise consultations attracted equal numbers), suggesting that they be a successful intervention for targeting males.

The ages of the males and females applying for a fitness assessment was not significantly different, this also being the case for the exercise consultations. However, fitness assessments attracted significantly younger males and females compared to the exercise consultations. Fitness assessments also attracted significantly more regularly active participants compared to exercise consultations which attracted significantly more non-regularly active participants, possibly explained by the fact that physical activity levels are seen to decrease with age (Scottish Health Survey, 1997). Another possible explanation is that non regularly active people may perceive themselves as less fit and consequently feel less "threatened" by an intervention involving no physical activity as opposed to one involving a fitness "test". As exercise consultations are predominately aimed at helping sedentary people become active (Loughlan and Mutrie, 1995a), the fact that they seem to attract them as well is of added benefit. The fact that fitness assessments attracted significantly more people who were regularly active may explain the finding discussed earlier that fitness assessments also attracted significantly more males. Wyse et al (1995) have shown that males are more likely to be in a "higher" stage of exercise behaviour change compared to females. Further analysis indicated no difference in the weight of volunteers for either intervention but those applying for a fitness assessment were significantly taller. Given loss of height is associated with aging (Bjorntorp and Eden, 1996), this may have been due to the fact that those in fitness assessment group were significantly younger.

Randomisation of Participants into Study Groups.

After applying for their chosen intervention, participants were randomly assigned into either an experimental or control group. The methodology for this is given in full in the procedures section of chapter 5 (p.132) but involved the main researcher selecting two application forms from a particular pile (fitness assessment or exercise consultation) and tossing a coin. Depending on the result of this coin toss, participants were assigned into either an experimental or control group. It could be argued that this method could have been biased as the researcher delivering the interventions also randomly assigned the groups. A second person, independent from the study, randomly assigning the participants would have negated this potential source of bias. It has to be noted however that prior to their interventions, the main researcher had no contact with any study participants and fully abided by the results of the coin toss.

At the beginning of the study, there were no significant differences in sex, age, height, weight and stage of exercise behaviour change when comparing the experimental groups to their corresponding control groups, suggesting that the randomisation process had been successful. The four study groups were then invited to attend their allocated intervention. Sixteen percent of those applying for the study failed to keep their initial intervention appointment. There was no difference in the proportion of those attending and those not attending their intervention when males and females were compared and when intervention choice was compared. A similar finding was observed for the proportions of those attending and not attending their interventions when control groups were compared to experimental groups. Clearly, the fact that people had been allocated to a control intervention did not have an undue effect on participation. The ages of those not attending and attending interventions were not significantly different for the exercise consultation interventions but those not attending the fitness assessment interventions were significantly younger than those who did. Thus for the exercise consultation interventions, sex, age, intervention choice and study group are not related to early study drop-out. For the fitness assessment interventions, sex, intervention choice and study group are not related to early study drop-out but age appears to be. The reason for this is unclear. It is possible that parents "volunteered" their children for the study (family applications were common). If this was the case it could possibly explain why those not attending their intervention were younger, as somebody who had been "volunteered" may be less likely to attend than someone who had applied in person. This may have been more evident for the fitness assessment interventions as already established, they initially attracted a larger number of young people.

Study Expectations

Despite the efforts of the researcher to ensure study expectations were equal across study groups, both control groups reported lower scores for their intention to become more active and their belief that they actually would become more active. These results are similar to other comparable studies (e.g. Loughlan and Mutrie, 1997). However, it appears that baseline intentions are of little importance, given that both control groups showed similar profiles of physical activity (at least in the in the short time) compared to the experimental groups. Again, this is similar to the Loughlan and Mutrie study.

Stage of Change Profile

At baseline, 26% of participants were contemplators, 26% preparers (i.e. 52% not regularly active), 20% were actioners and 28% were maintainers (i.e. 48% regularly active). This is similar to studies using different populations. As discussed in chapter two, Mutrie et al. (1997) reported 41% to 52% in contemplation and preparation and 32% to 48% in action and maintenance from various British populations such as NHS staff, students and diabetic patients. Thus the methods used in the current study seem to have attracted a normal stage of exercise behaviour change population.

Pre-intervention Relationships between Physical Activity, Stages and Processes of Exercise Behaviour Change

With regards to the pre-intervention relationship between physical activity and stage of exercise behaviour change, analysis indicated the "expected" relationship for total and leisure time physical activity, again demonstrating the concurrent validity of SPAQ for leisure time physical activity. As discussed in the previous two chapters, there remains a question mark over the questionnaire's ability to accurately record occupational physical activity, and again no change was observed between stages of exercise behaviour change. As before, it is unclear whether participants were unable to increase occupational physical activity because of work commitments or whether no change was due to limitations in either SPAQ or the stage of exercise behaviour change questionnaire.

An interesting finding is that contemplators were reporting around 450 minutes of physical activity per week. Even ignoring occupational physical activity, they were still reporting around 250 minutes per week. These findings are consistent with comparable research. Loughlan and Mutrie (1997) found that contemplators reported around 230 minutes per week of leisure time physical activity at baseline. Given that SPAQ only records moderate intensity activity or above, this would suggest that even the most inactive participants were meeting the current active living recommendations. It is possible however that some people in the contemplation and preparation stages of exercise behaviour change either miss-classified themselves according to stage or over estimated their physical activity. Indeed, figure 37. in chapter 5, when box plotting leisure time physical activity for those not regularly active participants, showed several outliers from the main group, with participants reporting in excess of 500 minutes of leisure time physical activity per week. Again, this highlights the difficulty in accurately measuring physical activity with a subjective tool.

The pre-intervention relationship between the stages and processes of exercise behaviour change will be discussed in section four.

Section Two - Intervention Effects on Study Drop-outs and Physical Activity

Study Drop-out

Study drop out rate analysis showed that there was no difference between the proportions of regularly active and non regularly active participants dropping out of the study at any test stage. In total, 201 (64%) of the original 312 participants remained in the study at six months post test. At 1 year post test, the number remaining had almost halved to 113 (36% of original number). The drop out rates in the present study compare with similar studies. As reviewed in chapter two, Loughlan and Mutrie (1997) compared the effectiveness of fitness assessments and exercise consultations using NHS staff. At the end of their 6 month study, 63% of original participants remained.

This drop out rate of over 60% after one year appears to be relatively high given that Sallis et al. (1986) showed approximately half of those people undertaking an exercise programme will drop out after 1 year. However, it could not be determined if those people not returning questionnaires (i.e. "drop outs") in the present study actually stopped exercising. It may have been the case that they joined the study to gain help and advice in beginning an exercise programme. They may have started to exercise regularly on their own and felt that they no longer needed the study to continue. Similarly, those exercising regularly at the start of the study and dropping out may have continued to exercise regularly. However, given that those participants returning questionnaires were offered free exercise vouchers, it seems reasonable to assume that if they continued to be regularly active, they would have returned the questionnaires.

After approximately one week, participants not returning questionnaires were written to with a reminder letter (plus a copy of the questionnaires), emphasising the importance of their continued involvement in the study, irrespective if they were exercising or not. This improved the initial response rate. To further improve response rate, it may have been beneficial to develop a method of delivering the questionnaires by telephone. This method could then have been used if no initial response was obtained.

For those not regularly active at baseline, analysis showed that at four weeks post test, significantly more participants receiving a fitness assessment dropped out of the study compared to those receiving an exercise consultation. A similar result was observed at one year post test. Thus for those participants initially not regularly active, compared to fitness assessments, exercise consultations were more successful at keeping participants involved in the study in both the short and long term. It is possible that the fitness assessment may have been an unpleasant experience for some of the participants. There were no drop out rate differences between groups at any test stage for those regularly active at baseline.

Baseline Leisure Time Physical Activity

At baseline, regularly active participants were reporting significantly more leisure time physical activity than non regularly participants, as expected. There was no significant difference in activity between intervention groups and, more importantly, no interaction between intervention group and activity status. This again confirms participants had been successfully randomised into experimental and control groups and also shows that despite the fact participants volunteered for either intervention (raising questions over the external validity of the study, as mentioned at the start of the discussion), this self-selection did not produce any pre-intervention group differences in physical activity.

Immediate Intervention Effect on Leisure Time Physical Activity

With respect to the immediate intervention effect analysis, again as expected, those regularly active at baseline reported significantly more leisure time physical activity than those not regularly active at baseline over the first three months of the study. The two activity status groups also showed a different pattern of physical activity use over the three test stages. For those not regularly active at baseline, leisure time physical activity significantly increased to four weeks post-test and was maintained to three months post. This is comparable to similar research. As discussed in chapter two, Loughlan and Mutrie (1997) analysed the effect of fitness assessments and exercise consultations on leisure time physical activity and found that following the interventions, activity significantly increased and was maintained to three months post test. Harlend et al. (1999) reported similar results for 523 middle aged sedentary participants. Physical activity (including occupational activity) was seen to significantly increase in the short term (3 months) following a combination of motivational interviewing and the provision of exercise vouchers.

For those regularly active at baseline, physical activity significantly increased four weeks post-test but fell again to baseline levels three months post-test. This however is still a positive result as these participants still remained regularly physically active three months post-test. It is difficult to relate this finding to comparable research because, as discussed in chapter two, there have been no studies to the authors knowledge that have investigated the effects of a fitness assessment or exercise consultation on physical activity for those already regularly active.

For both activity status groups, the fitness assessment control group reported significantly more physical activity over the three months than the exercise consultation control group. For those regularly active, the fitness assessment control group also reported significantly more activity over the test stages than the fitness assessment experimental group. At first glance, it would appear that the fitness assessment control intervention has had a different effect on physical activity compared to the other interventions. However, importantly, there was no significant interaction between test stage and intervention group for either activity status. That is to say, the difference between the fitness assessment control group and the other groups was consistent over the three test stages, including baseline. The pattern of activity over the test stages was similar between all study groups. At baseline, the fitness assessment control group had higher levels of activity compared to the other three groups. All interventions then had a similar effect on activity so that the difference between groups was similar at four weeks and three months post-test as it was at baseline.

The fact that the fitness assessment control group appear to be reporting higher levels of baseline activity than the other groups would seem to contradict the baseline analysis conducted at the beginning of the "intervention effects on physical activity" section in chapter five and the "baseline analysis" section in this discussion, which indicated no significant differences between intervention groups at baseline. However, the baseline analysis was conducted with all participants attending their intervention. The intervention effect analysis was conducted for only those participants returning three-month questionnaires. As tables 36. and 39. in chapter five indicate, between 5% (exercise consultation experimental group - not regularly active) and 42% (fitness assessment control group - not regularly active) of initial participants dropped out of the study at 3 months post-test. Thus these drop-outs appear to have caused a discrepancy in baseline activity levels for both those regularly and non regularly active. Although this finding is interesting and highlights the importance of retaining study participants, as discussed earlier, the main conclusion that can be drawn from the immediate intervention effect analysis is that all interventions had a comparable short-term effect on leisure time physical activity for both those regularly and non regularly active.

With regard to those not regularly active, this finding is again similar to that reported by Loughlan and Mutrie (1997). They found little difference in the activity pattern of not regularly active participants over the first three months of their study when comparing the effects of a fitness assessment, an exercise consultation and a control intervention (physical activity information only). It is interesting to note that although both the Loughlan and Mutrie study and the present study used similar protocols for the exercise consultation and control interventions, Loughlan and Mutrie did not use a computer based fitness assessment. Given the similar results reported by both studies it would suggest that using a computer with tailored software is no more beneficial than delivering a non-computer led assessment. Until a direct comparison between the two methods is evaluated however, caution has to be exercised when drawing this conclusion.

<u>Effectiveness of Intervention Re-tests on Leisure Time Physical Activity</u>

With respect to the analysis of the effects of the re-test interventions, there was no difference in the physical activity pattern between intervention groups for either those not regularly active or those regularly active at baseline. Collectively, for those not regularly active at baseline, their physical activity levels were maintained from three months to six months. At first glance, this suggests that the intervention re-tests were effective in maintaining leisure time physical activity up to six months. However, it is possible that activity would have been maintained without the re-test interventions. Indeed, in the Loughlan and Mutrie (1997) study, no re-test interventions were offered, but leisure time physical activity, although decreasing from three months to six months, did not decrease significantly (i.e. was maintained).

After six months post test, physical activity was seen to decline to one year post test. This is similar to the work of Harland et al., (1999) (reported earlier). Although physical activity was not measured at six months post-test, the increase seen at three months post-test was not sustained in the long-term (1 year).

Like those not regularly active at baseline, for those regularly active at baseline, leisure time physical activity decreased from three months to one year post test, although this decrease only showed marginal significance. The crucial period for long term maintenance of physical activity therefore appears to be six months (and onwards) after the adoption of regular physical activity. This may be the most appropriate time to offer a re-test intervention and ongoing support.

Baseline to One Year Comparison of Leisure Time Physical Activity

As discussed in the previous paragraph, for those not regularly active at baseline, leisure time physical activity fell from six months to one year post test. For all but the group receiving an exercise consultation, analysis showed that activity levels returned to baseline levels. This suggests that although no intervention group differences were detectable over the intermediate test stages, exercise consultations had the greatest long-term positive impact with those not initially regularly active.

For those regularly active at baseline, activity initially increased to four weeks post but then showed a gradual decline to one year post test. However, analysis showed that all study groups were reporting similar levels of activity one-year post compared to baseline, suggesting successful maintenance of activity over the study. It is unclear why (or indeed if) the interventions helped those already active maintain activity compared to those who had recently become regularly active. Possibly those initially regularly active felt more comfortable with their activity. They may have developed a "habit" of doing regular physical activity. It is also possible that the interventions had no effect on physical activity for those people who were regularly active but did for those people not regularly active at baseline. This would explain why for those people originally not regularly active, activity dramatically increased in the medium term. For those initially regularly active, it may have been the case that without the interventions, activity would have been successfully maintained anyway.

Occupational physical activity

The analysis of occupational physical activity showed virtually no differences between activity status groups, intervention groups or between test stages. This is consistent with previous findings of the study.

Changes in health related fitness

For those not regularly active at baseline receiving a fitness assessment, positive changes in a range of health related physical fitness components were evident. Thus it appears that their increased physical activity up to three months had a beneficial effect on health related fitness. The changes in health related fitness observed were similar to comparable research. For example, Project *Active* (Dunn et al., 1997) (as reviewed in chapter two) showed that for 235 initially sedentary participants, 6 months after receiving either a lifestyle intervention or a traditional fitness intervention, 78% and 85% respectively of the groups had increased baseline activity levels so that at post test they were either meeting or exceeding the current "active living" physical activity guidelines (Pate et al. 1995). These increases in activity were associated with significant decreases in systolic and diastolic blood pressures and body weight and significant increases in cardiorespiratory fitness. In the present study, cardiorespiratory fitness significantly increased at re-test and the reduction in weight showed marginal significance. Diastolic and systolic blood pressures were also reduced although not significantly. The changes in weight and blood pressure may have reached significance if participants were re-tested at 6 months post test (as in the Dunn et al. Study), given they were still regularly active at this point.

It is also interesting to note that for those regularly active at baseline, an improvement in health related fitness was also observed. This group showed an initial increase in activity which fell to baseline levels three months post test. It appears that their continued participation in activity (coupled with the increase at four weeks) was enough to enhance their health related fitness.

Although the full range of health related fitness components were not measured in the remaining study groups, those not regularly active at baseline showed a significant weight loss at three months post test in each intervention group. For those regularly active at baseline, weight loss was observed, but the changes were not significant for each intervention group. Given all intervention groups reported similar physical activity profiles over the three month period for each activity status, it is reasonable to assume that changes in all health related fitness components would also be comparable for each activity status.

Section Three - Intervention Effects on Stage of Exercise Behaviour Change

Not Regularly Active at Baseline

For those not regularly active at baseline, each intervention had a significant positive effect on stage of exercise behaviour change. This is perhaps to be expected given these participants significantly increased their physical activity from baseline to three months post test. Compared to its control group, the exercise consultation experimental group showed a far greater increase in those in the positive category up to three months. Thus it appears that giving an exercise consultation is more successful at initially progressing participants through the stages of exercise behaviour change compared to giving physical activity information only. There was little difference between the fitness assessment groups.

Analysis of the intervention re-test showed that only the exercise consultation experimental group showed a significant decline in those in the positive category (and corresponding increase in those in the negative category) from three to six months post test. The remaining groups showed no significant difference (indicating successful maintenance of positive stage of exercise behaviour change). The reason why the exercise consultation experimental group should show a decline is unclear. This effect was not maintained to one year post test however, with analysis showing that when baseline was compared to one year post test, all interventions had had a significant stage of exercise behaviour change effect. Further analysis showed that those receiving an exercise consultation reported the largest positive long-term effect. This corroborates the finding discussed earlier that for those not regularly active at baseline, only those receiving an exercise consultation reported significantly higher baseline activity levels at one year post-test.

These long-term comparisons are based on an analysis of only those participants remaining in the study at 1 year post test. If the number of those participants in the positive category at 1 year post test in each group is divided by the total number of participants not regularly active at baseline for each intervention group, the real long term effect (including the effects of drop outs) of the interventions can be compared. Referring to table 36. and table 2 (appendix X), 9% of the baseline non regularly active partcicpants receiving a fitness assessment were in a positive stage of exercise behaviour change at 1 year post test (4 / 43 x 100). Similar analysis showed that both control groups had 18% in the positive category (FAC, 8 / 45 x 100; ECC, 6 / 34 x 100) and the exercise consultation group had 29% in the positive category (12 / 34 x 100). Thus compared to the fitness assessment, the control groups were twice as successful in changing stage of exercise behaviour change in the long term and the exercise consultation was almost 3 times as successful. Again it has to be remembered however that the stage of exercise behaviour change of those participants not returning questionnaires could not be determined. It is seems reasonable to assume nevertheless that those people not increasing their physical activity (and consequently not progressing in their stage of exercise behaviour change) would deem this as failure, possibly preventing questionnaire returns.

Another interesting finding was that in general, the immediate intervention effect was to move contemplators straight into the action stage of exercise behaviour change, bypassing preparation. It is possible that contemplators changing behaviour by themselves, without the aid of an intervention, progress through the preparation stage of exercise behaviour change (the TTM was developed from "self-changers"). However, this study suggests that physical activity interventions (including giving physical activity information only) may help contemplators to progress immediately into action. Having successfully progressed the majority of both baseline contemplators and preparers into action (at four weeks and three months post test) however, the majority regressed back in the long term (at 1 year post test). These results concur with the physical activity analysis which showed a large increase in activity at four weeks and three months but this fell back to baseline levels one year post test.

Regularly Active at Baseline

With respect to those regularly active at baseline, as these participants were already in a "positive" stage of exercise behaviour change, a non significant change in the ratio of participants in the positive to negative category would indicate a successful intervention effect. The fitness assessment experimental group appeared to show the most successful maintenance of stage of exercise behaviour change across all the study test stages remaining virtually unchanged in the numbers in the positive categories (all other intervention groups showed significant increases in the negative categories at various test stages). In addition, conducting a similar analysis to that reported for those participants not regularly active at baseline (referring to tables 39. and 4 in appendix X), 37% (19 / 51 x 100) of the fitness assessment experimental group regularly active at baseline were in the positive category one year post test. This compares to 21% for the fitness assessment control group (10 / 48 x 100), 20% for the exercise consultation experimental group (5 / 25 x 100) and 16% for the exercise consultation control group (4 / 25 x 100). Thus for those regularly active, it appears that fitness assessments offer the best chance of long-term stage of exercise behaviour change maintenance.

Section Four - Intervention Effects on Processes of Exercise Behaviour Change

Baseline Cross-sectional Analysis

A baseline analysis of the relationship between the stages and processes of exercise behaviour change confirmed the work of Marcus et al. (1992b). The study showed that there was no difference in the use of the experiential processes between contemplators and preparers but preparers were using the behavioural processes more. In addition, actioners were using both experiential and behavioural processes more than contemplators and preparers. Compared to actioners, maintainers use of the experiential processes was significantly less, but unchanged for use of the behavioural processes. Finally, it appeared that in general, use of the experiential processes appeared important in the early stages of exercise behaviour change. However, in the latter stages, behavioural processes were dominant. These near identical findings to those of Marcus et al. Suggest that their process of exercise behaviour change questionnaire is applicable to a British population. Further, it suggests that encouraging those in the early stages of exercise behaviour change to switch from use of the experiential processes to use of the behavioural processes may facilitate progress into the latter stages. However, as discussed in chapter two, this is a cross-sectional analysis and as such, these conclusions should be confirmed by the longitudinal analysis.

Longitudinal Analysis

The longitudinal analysis conducted allows for clearer conclusions to be drawn. Initial analysis showed that there was no significant difference in the change of process use between intervention groups when progress was made through the stages of exercise behaviour change. This is perhaps surprising given that as mentioned in chapter four, each intervention contains elements that relate to specific processes. This finding, however, allowed for specific longitudinal analyses to identify key processes corresponding to shifts in stages of exercise behaviour change based on study data for all intervention groups combined (i.e. if significant intervention group differences had been found, separate longitudinal analyses would need to have been conducted for each intervention group).

For contemplators, analysis revealed that the processes of exercise behaviour change could distinguish between those who progressed into preparation and those who remained in contemplation. Further analysis showed that the behavioural processes were better predictors of progression than the experiential processes with self liberation and stimulus control appearing particularly dominant. Thus interventions focussing on increasing use of behavioural processes may enhance progression from contemplation to preparation. More specifically, interventions targeting the behavioural processes of self liberation and stimulus control may be most successful. This would involve enhancing the person's belief that they could exercise more and removing or controlling the stimulus that can cause inactivity, such as the provision of physical activity literature or the removal of labour saving devices such as escalators.

As has already been highlighted, the majority of contemplators progressed immediately into action. From a public health point of view, this is more desirable than passing through preparation first (however, it is as yet unknown whether contemplators passing through preparation to action are more likely to progress to maintenance than contemplators bypassing preparation – given the small numbers progressing into preparation and then into action and maintenance, the present study cannot explore this possibility). Analysis showed that collectively, the processes could accurately distinguish between those contemplators progressing into action and those remaining in contemplation. No individual processes appeared to be dominant with both behavioural and experiential processes significant predictors of progress. However, the behavioural processes had a larger odds ratio, suggesting that increases in these processes would give the greatest odds of progression.

Once again, the processes were successful at determining those preparers progressing into action and those remaining in preparation. As with progression from contemplation to preparation, increased use of self liberation was particularly important. Interestingly, a decrease in the use of social liberation also appeared to be a significant predictor of progression although the odds ratio for self liberation was much higher, suggesting that an increase in the use of this process would stand a better chance of progressing preparers into action.

For those actioners progressing into maintenance the processes could again distinguish between progressors and maintainers. It was found that increasing the use of helping relationships, social liberation, counterconditioning and self liberation increased the odds of progression, with the latter three of particular importance.

The final analysis of this section examined relapse from maintenance. A decrease in the behavioural processes of exercise behaviour change was found to be a significant predictor of regression. Thus it appears that focussing on the behavioural processes of exercise behaviour change may help keep people in the maintenance stage of exercise behaviour change.

Thus for progress through the stages of exercise behaviour change, the process of self liberation appears to be particularly important at each stage of progression. The process of stimulus control also appears to be important when progressing from contemplation to preparation. For progression into action, use of both sets of processes appears equally important. Progression into maintenance is particularly associated with increased use of the experiential process of social liberation and of the behavioural processes of helping relationships and self liberation. A decreased use of the behavioural process was found to be a significant predictor of relapse from maintenance.

The longitudinal study identified key processes people used when changing their stage of exercise behaviour change. However, it could be argued that the results of these analyses should not be used to design future interventions targeting these processes as any changes in process use in the current study may have been "biased" by the interventions. In other words, participants may have used the particular processes because of the interventions, and not because they perceived these processes as the most beneficial at that stage. If no interventions were given, participants may have progressed through the stages using different processes. If this was the case, targeting the processes identified in this study may not be the most efficient use of resources.

However, the results of the present study would suggest that the interventions do not "interfere" with participants process use. First, despite the interventions being different, there was no difference in the process use after participants received the interventions. Second, different processes were found to be used at different stages of exercise behaviour change. If the interventions had affected participants process of change use then it would be expected that the same processes would have been used at each stage of exercise behaviour change. Third, the results are consistent with comparable research examining "self change". As discussed in chapter two, Marcus et al. (1996) analysed process use in people progressing and regressing in their stage of exercise behaviour change over a six month period. They did not analyse each stage separately, but grouped all progressors together and all regressors together, and analysed any differences in process use at post test. For the progressors, significant increases were observed in all processes other than social liberation but changes were greater in the behavioural processes. The process showing the greatest change was self liberation. This is consistent with the current study where self liberation was identified as a dominant process in each stage of progression. In addition, for the relapsers in the Marcus study, use of all five behavioural processes significantly decreased from baseline to follow up, with only one of the experiential processes significantly decreasing. Again, this is consistent with the current study which demonstrated a reduction in the use of the behavioural processes alone significantly increased the odds of relapse.

Thus it appears that the interventions do not directly affect process use. Rather, it is possible they encourage and motivate the participant to become more regularly active. The participant then selects the processes of exercise behaviour change required for progression, as in self progression. If this in fact is the case, the results of the present study can be used to design future interventions, specifically targeting dominant processes.

In general, this study has shown that fitness assessments are not particularly suited to promoting physical activity with those not regularly active. They attracted significantly more people who were regularly active, are relatively expensive to administer (upwards of £3000 for the necessary equipment), require specialised equipment, are not suitable for people with certain medical conditions, showed poor study adherence and produced no unique physical activity changes. Those using fitness assessments to promote physical activity in the sedentary should therefore re-assess their current service provision.

In contrast, exercise consultations are relatively cheap to administer, require no specialised equipment, can be "delivered" in a variety of environments (e.g. GP surgeries, community centres, in people homes), attracted significantly more non regularly active participants, can be used with all sections of society and appear to offer the best chance of study adherence and long term behaviour change for the sedentary population. It is therefore recommended that these interventions be used to promote activity in the sedentary population. However, one of the most interesting study findings was that offering information about physical activity can have a comparable short term positive effect when compared to structured physical activity interventions. This finding is consistent with comparable research (Loughlan and Mutrie, 1997). Thus offering relevant physical activity information to contemplators and preparers may be a cost effective alternative in situations where an exercise consultation is impractical. Indeed, as described in chapter two, Blamey, Mutrie, and Aitchison (1996) showed that a simple physical activity poster could significantly increase stair use with the general public. For long term maintenance however, it appears that the provision of an exercise consultation is important, possibly six months after the provision of the physical activity literature.

Mass media campaigns could promote physical activity information and places where the general public gather, such as waiting rooms, community centres, public houses, shops could provide relevant physical activity information, possibly in the form of booklets (as used in the present study). Mass media physical activity campaigns using new forms of communication technology have to be careful however not to exclude socially disadvantaged populations (Marcus et al., 1998). This study has found that approximately 50% of the initial participants were either contemplators or preparers. The study has also shown that 18% of those contemplators and preparers receiving information only were categorised in a positive stage of exercise behaviour change after one year. If the whole of the Scottish population (approximately 5 million) were given access to relevant physical activity information, based on the present study, approximately 450,000 people would be classified in a positive stage of exercise behaviour change after one year. It has to be remembered however that the information group in the present study also had access to a researcher who could answer questions and provide additional information and were offered free exercise vouchers. Whether a similar "information effect" would be present without the contact with the researcher and the exercise vouchers needs to be explored.

This study has also highlighted that for those sedentary people ready to change their behaviour, getting them active is relatively straight forward. What appears more difficult is keeping them active. It is possible that offering an intervention to those in the action stage of exercise behaviour change, based on the processes of exercise behaviour change identified as important for progression into maintenance, would be effective. This intervention should focus on the processes of counterconditioning, social liberation, helping relationships and self liberation. This would involve instilling into the participant that physical activity can help to alleviate conditions such as stress and tiredness, and should be viewed as a time that can be used to relax and recover from the days worries. It would also involve increasing the awareness of the person to the availability of physical activity opportunities in society, such as active living or the availability of local sports clubs / leisure centres. The intervention should also contain a section that focuses on the need for support for the participant. This may come in the form of a friend or family member or maybe someone connected with the intervention / project. This person should encourage the person to be active and be there for them should they experience any problems. Finally, the intervention should contain a section that enhances the participant's commitment to exercise. Making them understand that only they are responsible for their health and well being and instilling in them that they can continue to exercise if they want to are important components. The initial exercise consultation (conducted to progress contemplators and preparers into action) could be adapted to target these processes.

The present research identified that a reduction in the behavioural processes of exercise behaviour change was a significant predictor of regression from maintenance, although this finding has to be viewed with caution. If further studies confirm this finding, this suggests that if and when a person progresses from action into maintenance, ongoing behavioural skills training could be offered to prevent relapse. It is also possible that offering some form of fitness assessment at this stage may also help maintenance. This study has shown that for those initially regularly active, the fitness assessment experimental group reported the greatest long term positive effect on stage of exercise behaviour change and showed the best study adherence. In addition, they also attracted significantly more participants who were regularly active.

As described in chapter one, free exercise vouchers were offered to remove the "lack of money" barrier, allowing the results to be applied to the general population and allowing for a realistic comparison of interventions. It could be argued that the supply of free exercise vouchers caused the initial increases in activity and not the actual interventions. Whilst this may have been the case, this would not explain the differences observed between interventions, as all participants received exercise vouchers. In addition, lack of money is not the only barrier to exercise. The Allied Dunbar National Fitness Survey (1992) reported a wide variety of barriers to exercise such as availability (e.g. lack of facilities, no social support), physical (e.g. too old / unhealthy / fat), emotional (e.g. too shy or "not the sporty type"), motivational (e.g. no energy, lack of enjoyment, need to "rest") and time (e.g. lack of time due to work or children). The provision of exercise vouchers would not have helped participants to overcome these additional barriers. Further evidence that the provision of vouchers did not cause the rises in activity observed comes from comparing the results to comparable research. As already outlined, Loughlan and Mutrie (1997) compared the effects of a fitness assessment, exercise consultation and the provision of information on physical activity levels. They reported results similar to that found in the present study with no offer of free exercise vouchers.

The results of the present study are of value to all organisations (such as other local authorities and health boards) who have a remit to promote physical activity. As discussed in chapter one, it is possible to generalise the results of the study to the general population, given that the cost barrier to exercise was removed. Further, the results are of particular relevance to populations who suffer from high levels of social and economic deprivation. The results have shown that with a similar population, when the cost barrier to exercise is removed, the study as a whole had a significant positive impact on physical activity intentions and behaviour. Other organisations should therefore examine ways of initially making exercise opportunities more affordable for those economically disadvantaged communities. Combined with appropriate interventions, this would attract these populations into exercise. Once this had been achieved, mechanisms could be put in place to facilitate long term adherence.

Finally, as previously mentioned, the three studies reported in this thesis have underlined the difficulty in accurately measuring physical activity. The development of a practical measurement tool that can be used with large numbers is of prime importance.
This is highlighted by the fact that in the previous two years, over sixteen different groups / organisations / projects (listed in Appendix Z) have expressed an interest in and requested copies of SPAQ.

Study Limitations

As well as the de-limitations identified before the study and described in chapter one, several limitations were also identified as the study progressed. First, there was a question mark over the ability of SPAQ to record occupational physical activity. This meant that only changes in leisure time physical activity could be viewed with confidence. Second, the stage of exercise behaviour change questionnaire did not specifically mention occupational physical activity in it's description of regular physical activity. Thus participants may only have been classified according to their leisure time activity, although this observation needs to be confirmed or refuted by future research. Finally, it was impossible to tell if participants not returning questionnaires had become more or less active or progressed / regressed in their stage of exercise behaviour change. This reduced the ability of the study to identify long term differences between groups or between test stages.

Chapter 6

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Measurement of Dependent Variables

Physical Activity Measurement

One of the overall aims of the study was to produce a reliable, valid, self-assessing, seven day occupational and leisure time physical activity recall questionnaire that was British culture bound and relatively quick and easy to complete. Chapter three described the development of SPAQ, a self-assessing seven day recall measure of occupational and leisure time physical activity. SPAQ was shown to be quick and easy to complete, and a reliable and valid measure of leisure time physical activity. The reliability and validity were reduced however for occupational physical activity, due mainly to occupational walking. It has to be noted nevertheless that comparing all components of SPAQ to similar questionnaires, SPAQ still showed comparable, if not superior reliability and validity (albeit using a technique of association not agreement).

Although SPAQ proved to be a reliable and valid measure of leisure time physical activity, and several interesting group differences were observed in the study, overall, the analyses highlighted the difficulty in measuring physical activity and more specifically, measuring changes in physical activity. Undoubtedly, one of the main problems is the potential range even in supposedly similar groups / populations. This was highlighted by the wide standard deviations often observed for specific groups. Whether this is just reflecting the diversity of physical activity behaviour, is a fault in the measuring device or is a combination of the two is difficult to ascertain. Again, the identification of a practical, cost effective "gold standard" measure of physical activity is of vital importance.

Stage of Exercise Behaviour Change Measurement

Loughlan and Mutrie's (1995b) adapted stage of exercise behaviour change questionnaire was used to record stage of exercise behaviour change. At baseline, similar proportions of participants in each stage were recorded compared to other British studies. Further, the questionnaire was able to successfully record changes in stage of exercise behaviour change as the study progressed. These findings suggest that the questionnaire is of great use in physical activity research.

The fact that occupational activity did not differ between stages of exercise behaviour change may have been caused by the stage of exercise behaviour change questionnaire itself. The questionnaire does not refer directly to occupational physical activity in it's description of regular physical activity. Thus participants may have ignored occupational physical activity when completing it. However, as previously discussed, the failure of occupational physical activity to change could also have been caused by problems with SPAQ or it may be a true reflection of occupational physical activity, with participants unable to increase activity through constraints of employment. Clearly, more research with occupational physical activity is required.

Processes of Exercise Behaviour Change Measurement

Marcus et al's (1992b) questionnaire was used to record the ten processes of exercise behaviour change. Analysis showed similar results to that of Marcus et al. suggesting the questionnaire is applicable to a British population.

Participant Characteristics and Study Drop Out

Studies using a similar population and similar procedures to the main investigation presented in this thesis should expect to attract around 10% of the population. Further, they should also expect to attract nearly twice as many females as males, suggesting that males need to be actively targeted in similar health promotion programmes. In addition, this study has shown that after 6 months approximately half of the participants failed to return questionnaires. After a further 6 months, this number halved again. This would suggest that ongoing support is necessary to maintain study participants, although it is unclear whether those not returning questionnaires stopped exercising. In addition, sex, age, intervention choice and study group were not significant factors in early study drop out.

Interventions

Fitness Assessments

Fitness assessments attracted significantly more participants than exercise consultations and significantly more males than females, suggesting that they could be used to target males in physical activity promotion programmes. However, they also attracted significantly more regularly active participants, suggesting they may not be particularly suited to promoting physical activity in the sedentary. This conclusion is strengthened by the fact that for those originally not regularly active, although fitness assessments did initially increase physical activity (producing significant positive changes in a range of health related fitness components) they did not produce any unique physical activity changes and activity levels fell to baseline levels one year post test. Further, compared to exercise consultations, significantly more of those not regularly active receiving a fitness assessment immediately dropped out of the study and this trend was continued up to one year post test. Further analysis revealed that in real terms, the fitness assessment had an overall positive effect on the stage of exercise behaviour change of 9% of those originally not regularly active recieving a fitness assessment. This compared to 18% of the control groups and 29% for the group receiving an exercise consultation.

As already outlined, fitness assessments attracted significantly more people who were regularly active suggesting that these interventions may be more applicable for people who are already active. Although fitness assessments produced no unique physical activity changes with these participants, there were no differences in drop out rates between the intervention groups (unlike those originally not regularly active). Further, regularly active participants receiving a fitness assessment showed the most successful long term maintenance of stage of exercise behaviour change across the interventions, and in contrast to those not regularly active at baseline, the fitness assessment experimental group showed the highest percentage (37%) of original participants in the "positive" stage of exercise behaviour category at one year post test. Thus it appears fitness assessments may be of more use to people who are regularly active.

Exercise Consultations

The study suggests that compared to fitness assessments, exercise consultations are more suited to people who are not regularly active. First, exercise consultations attracted significantly more people not regularly active. Second, significantly more non regularly active participants remained in the study in both the short and long term. Third, the only group of participants to report significantly higher levels of physical activity one year post test were those not regularly active at baseline receiving an exercise consultation. Finally, for those non regularly active participants remaining in the study one year post test, those receiving an exercise consultation reported the largest positive effect on stage of exercise behaviour change. Similarly, taking drop outs into account, as already mentioned, the exercise consultation had the best long term effect, with 29% of original participants classified in a positive stage of exercise behaviour change.

Information Control Groups

Analysis showed that volunteers were successfully randomised into experimental and control groups, based on their intervention choice. There were no differences between intervention groups for short term drop outs suggesting that non participation was not due to participants failing to receive their choice of intervention. Despite the fact that both control groups showed lower intentions to become more active and the belief that they actually would become more active, both control groups showed a similar pattern of physical activity over the test stages as the experimental groups. In addition, similar effects on stage of exercise behaviour change were also shown for both regularly and non regularly active participants. This suggests that targeting sedentary people who are ready to change their behaviour with relevant physical activity information may be a cost effective alternative to offering specific activity interventions.

Physical Activity, Stage and Processes of Exercise Behaviour Change

The pattern of physical activity over the test stages was similar for all intervention groups. For those regularly active at baseline, physical activity initially increased at four weeks but then fell to baseline levels three months post test and was maintained to six months post test. At one year post test, participants were reporting similar levels of activity compared to baseline, suggesting successful maintenance of activity. As expected, given the stability of physical activity over the test stages, the stages of exercise behaviour change also remained relatively constant.

For those not regularly active at baseline, physical activity was seen to significantly increase with this increase being maintained to six months post test. However, activity levels then fell to baseline levels one year post test, with the exception of the exercise consultation experimental group. The stage of exercise behaviour change mirrored the activity pattern with the majority of baseline contemplators and preparers initially progressing into action. Stage of exercise behaviour change was reasonably well maintained to six months post test but at one year post test, the majority of participants had regressed to baseline stages of exercise behaviour change. Various processes of exercise behaviour change were identified as being important when progress was made through the stages of exercise behaviour change.

These results suggest that for those sedentary people ready to change their behaviour, getting them regularly active is relatively easy. What appears difficult is keeping them active. Although there is some evidence the re-test interventions helped to maintain activity, it appears that people who have recently become regularly active (i.e. actioners) need ongoing support. Initially, an exercise consultation should be conducted (or physical activity information offered if it is not practical to offer an exercise consultation). When the person has progressed into action they should then receive an intervention designed to target the processes identified as being important for progression into maintenance (counterconditioning, social liberation, helping relationships and self liberation). The exercise consultation could be adapted to incorporate these processes into a relapse prevention intervention.

For those in the maintenance stage of exercise behaviour change, ongoing behavioural skills training is advised. Fitness assessments may also prove useful at this stage.

Transtheoretical Model of Behaviour Change

The TTM has proven to be of great value in this research. It was used to partially validate the physical activity questionnaire and has facilitated the classification of participants into various stages of physical activity intention or behaviour, allowing the effect of the interventions on physical activity to be assessed for those who were not and those who were regularly active. It has also provided a further means of evaluating the effectiveness of the interventions (by analysisng changes in stage of exercise behaviour change). Finally, it has provided vital information on the techniques and strategies people use when they change their physical activity behaviour. This allows for the development of specific interventions designed to facilitate and maintain physical activity behaviour change.

Delimitations and Limitations

Four main delimitations were identified at the beginning of this research. First, the participants were self selected, possibly reducing the external validity of the study. However, all participants were successfully randomly assigned to experimental and control groups and analysis showed that there were no pre-intervention differences between study groups for physical activity. This suggests that the physical activity differences observed throughout the course of the study were not due to baseline differences.

Second, as all participants came from a "tight knit" community it is possible that interventions were discussed and compared. Although there is no way of controlling against this in a free living society, all interventions were conducted in the same building by the same researcher and control participants were offered a "limited" intervention.

Third, as the study was conducted with a population suffering a high level of social and economic deprivation, it could be argued that the results can only be generalised to similar populations. However, the removal of the financial barrier to exercise (i.e. providing free exercise vouchers) and the similarity of the findings to comparable studies using no vouchers (Loughlan and Mutrie, 1997) suggests that the results can be generalised to the general population. In addition, the study is of particular value to organisations promoting physical activity with socially and economically deprived communities. This research has shown that the methodology used is successful in attracting a socially and economically deprived population to physical activity interventions. Further, the interventions used in the study had a positive effect on this population's physical activity intention and behaviour. The afore mentioned organisations should therefore combine similar interventions with exercise opportunities that are affordable for similar populations. This would attract these populations into exercise.

Finally, the use of a questionnaire to measure physical activity was presented as a possible de-limitation. Question marks existed over the questionnaire's ability to record occupational physical activity but it was shown to be a reliable and valid measure of leisure time activity.

Three further study limitations came to light during the study. First, as highlighted throughout this thesis, and mentioned in the previous paragraph, only leisure time physical activity could be analysed with confidence. This meant that any changes in occupational and hence total physical activity could not be properly analysed. Second, the stage of exercise behaviour change questionnaire did not specifically mention occupational physical activity in it's description of regular physical activity. Thus participants may only have been classified according to their leisure time activity, although this observation needs to be confirmed or refuted by future research.

Finally, the ability of the study to determine any long term difference between test stage or intervention group was reduced due to the number of participants failing to return questionnaires at subsequent test stages.

Recommendations for Research and Practice

Based on the results presented within this thesis, the following recommendations are offered:

Future Research

a) Research is required to determine if the giving of relevant physical activity information is as successful outwith the control conditions of this study.
b) The identification of a practical "gold standard" physical activity measure is of critical importance to physical activity research.
c) Further work with SPAQ needs to be conducted so that it shows comparable levels of validity and reliability for occupational physical activity as it does for leisure time physical activity. SPAQ has already been adapted in an attempt to improve it's measurement of occupational physical activity. "SPAQ 2" has been tested for reliability and validity and results are encouraging, although the study has yet to be formerly published. The timescale for adaptations and testing for SPAQ 2 meant that it could not be used in the present study. It is recommended that SPAQ 2 be validated against a "gold standard" physical activity measure.
d) Loughlan and Mutrie's (1995b) stage of exercise behaviour change questionnaire needs to be adapted to emphasise occupational physical activity in the description of regular physical activity.
e) Further longitudinal analysis is required to confirm that the interventions used in the present study had no effect on the processes of exercise behaviour change. Further longitudinal studies are also required to identify dominant processes in "self changers".
f) Research should be conducted to design interventions aimed at keeping people regularly active. Targeting the dominant processes identified in this study could act as a starting point for this research. Further, the roles of fitness assessments in the maintenance of activity should also be further examined.
g) Comparable studies should be conducted to determine if the interventions have similar effects on different populations.

Practice

a) The practice of offering fitness assessments to those who are not regularly active should be reviewed. They may be of more use for those already active.

b) The use of exercise consultations for promoting physical activity with the sedentary should be encouraged.

c) In cases where it is impractical to offer exercise consultations, relevant physical activity information should be offered. Further, if the nation is to become more active, this kind of information should be freely available to the general population.

d) Ongoing support is vital for long term maintenance. Interventions should be devised and targeted for those participants in the action and maintenance stages of exercise behaviour change.

e) Organisations responsible for the promotion of physical activity with socially and economically deprived communities should combine appropriate interventions with affordable exercise opportunities.

Reference List

Albanes, D., Blair, A. & Taylor, P.R. (1989). Physical activity and risk of cancer in the NHANES I population. American Journal of Public Health, 79, 744–750.

American College of Sports Medicine. (1978). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness in healthy adults. Medicine and Science in Sports and Exercise, 10, vii-x.

American College of Sports Medicine. (1990). The recommended quantity and quality of exercise for developing and maintaining cardiovascular and muscular fitness in healthy adults. Medicine and Science in Sports and Exercise, 2, 265-274.

American College of Sports Medicine & American Diabetes Association. (1997). Joint Position Statement. Diabetes mellitus and exercise. Medicine and Science in Sports and Exercise, 29(2), 1-6.

American College of Sports Medicine. (1998a). The recommended quantity and quality of exercise for developing and maintaining cardiorespiratory and muscular fitness, and flexibility in healthy adults. Medicine and Science in Sports and Exercise, 30(6), 975-991.

American College of Sports Medicine. (1998b). Exercise and physical activity for older adults. Medicine and Science in Sports and Exercise, 30(6), 992-1008.

Anderson, R.E., Wadden, T.A., Bartlett, S.J., Zemel, B., Verde, T.J. & Franckowiak, S.C. (1999). Effects of lifestyle activity verses structured aerobic exercise in obese women. Journal of the American Medical Association, 281, 335-340.

Armstrong, C.A., Sallis, J.F., Hovell, M.F. & Hofstetter, C.R. (1993). Stages of change, self-efficacy, and the adoption of vigorous exercise: A prospective analysis. Journal of Sport and Exercise Psychology, 15, 390-402.

Arroll, B. & Beaglehole, R. (1992). Does physical activity lower blood pressure? A critical review of the clinical trials. Journal of Clinical Epidemiology, 45, 439–447.

Ashton, J. & Seymor, H. (1992). The New Public Health. Milton Keynes: Open University Press.

Ashworth, P. (1997). Breakthrough or bandwagon? Are interventions tailored to stage of change more effective than non-staged interventions. Health Education Journal, 56, 166-174.

Astrand, P.O. & Rhyming, I. (1954). A nomogram for calculation of aerobic capacity from pulse rate during submaximal work. Journal of Applied Physiology, 7, 218-21.

Astrand, P.O. & Rodahl, K. (1977). Textbook of work physiology. New York: McGraw Hill.

Ayrshire & Arran Health Board. (1996). Health and ill-health in Ayrshire and Arran. The 1996 report of the director of public health. Ayr: Ayrshire and Arran Health Board.

Ayrshire & Arran Health Board. (1998a). Health and ill-health in Ayrshire and Arran. The 1998 report of the director of public health. Ayr: Ayrshire and Arran Health Board.

Ayrshire & Arran Health Board. (1998b). Adult health and lifestyle survey 1998. Ayr: Ayrshire and Arran Health Board.

Ballor, D.L. & Keesey, R.E. (1991). A meta-analysis of the factors affecting exercise-induced changes in body mass, fat mass, and fat-free mass in males and females. International Journal of Obesity, 15, 717–726.

Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. Psychological Review, 84, 191-215.

Bandura, A. (1982). Self-efficacy mechanism in human agency. American Psychologist, 87, 122-147.

Bandura, A. (1997). Editorial: The anatomy of stages of change. American Journal of Health Promotion, 12(1), 8-10.

Baranowski. T. (1988). Validity and reliability of self-report measures of physical activity: an information processing perspective. Research Quarterly for Exercise and Sport, 59(4), 314-327.

Baranowski, T., Smith, M., Thomson, W.O., Baranowski, J., Herbert, D. & DeMoor, C. (1999). Intraindividual variability and reliability in a 7-day exercise record. Medicine and Science in Sports and Exercise, 31(11), 1619-1622.

Baric, L. (1991). Health promotion and health education. (2nd ed). Altrincham: Barns Publications.

Becker, M.H. & Maiman, L.A. (1975) Sociobehavioural determinants of compliance with health care and medical care recommendations. Medical Care, 13, 10-24.

Berger, B.G. & McInman, A. (1993). Exercise and the quality of life. In R.N. Singer, M. Murphey, & L.K Tennant (Eds.), Handbook of Research on Sport Psychology. (pp. 729-760). New-York: McMillan.

Bernstein, L., Henderson, B.E., Hanisch, R., Sullivan-Halley, J. & Ross, R.K. (1994). Physical exercise and reduced risk of breast cancer in young women. Journal of the National Cancer Institute, 86, 1403–1408.

Biddle, S.J.H. (1995). Exercise and psychological health. Research Quarterly in Exercise and Sports, 66(4), 292-297.

Biddle, S.J.H., Fox, K.R. & Edmunds, L. (1994) Practice-based primary care interventions to increase physical activity: Research report. London: Health Education Authority.

Biddle, S.J.H. & Mutrie, N. (1991). Psychology of physical activity and exercise. A health related perspective. London: Springer Verlag.

Billings, J., Zeitel, L., Lukomnik, J., Carey, T., Blank, A. & Newman, L. (1993). Impact of socioeconomic status on hospital use in New York City. Health Aff (Millwood),12, 162-173.

Bjorntorp, P. & Eden, S. (1996). Hormonal influence on human body composition. In A.F. Roche, S.B. Heymsfield, & T.G. Lohman (Eds.), Human body composition. (pp. 329-353). Champaign, IL: Human Kinetics.

Blair, S.N. (1984). How to assess exercise habits and physical fitness. In J. Matarazzo, S. Weiss, & N. Miller (Eds.), Behavioural health: A handbook of health enhancement and disease prevention. (pp. 424-447). New York: Wiley.

Blair, S.N. (1992). How much physical activity is good for health? Annual Review of Public Health, 13, 99-126.

Blair, S.N. (1994). Physical activity, fitness and coronary heart disease. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. (pp. 579-590). Champaign, IL: Human Kinetics.

Blair, SN. (1997). Effects of physical activity on cardiovascular disease mortality independent of risk factors. In A.S Leon (Ed.), Physical activity and cardivascular health: A national consensus. (pp. 127-136). Champaign IL: Human Kinetics

Blair, S.N., Dowda, M., Pate, R.R., Kronenfeld, J., Howe, H.G. Jr., Parker, G., Blair, A. & Fridinger, F. (1991). Reliability of long-term recall of participation in physical activity by middle age men and women. American Journal of Epidemiology, 133, 266-275.

Blair, S.N., Haskell, W.L., Ho, P., Paffenbarger, R.S. Jnr., Vranizan, K.M., Farquhar, J.W. & Wood, P.D. (1985). Assessment of habitual physical activity by seven day recall in a community survey and controlled experiments. American Journal of Epidemiology, 122, 794-804.

Blair, S.N., Kamprt, J.B., Kohl III, H.W., Barlow, C.E., Macera, C.A., Paffenbarger Jr, R.S. & Gibbons, L.W. (1996). Influences of cardiorespiratory fitness and other precursers on cardiovascular disease and all-cause mortality in men and women. Journal of the American Medical Association, 276(3), 205-210.

Blair, S.N., Kohl, III H.W. & Barlow, C.E. (1993). Physical activity, physical fitness, and all-cause mortality in women: do women need to be active? Journal of the American College of Nutrition, 12, 368–371.

Blair, S.N., Kol III., N.H.W., Paffenbarger, R.S. Jr., Clark D.G., Cooper, K.H. & Gibbons, L.W. (1989). Physical fitness and all-cause mortality: a prospective study of healthy men and women. Journal of the American Medical Association, 262, 2395-2401.

Blamey, A.A.M., Mutrie, N. & Aitchison, T. (1996). Promoting active living: A step in the right direction. Journal of the Institute of Health Education, 34, 5-9.

Bland, J.M. & Altman, D.G. (1986). Statistical methods for assessing agreement between two methods of clinical measurement. The Lancet, 1, 307-310.

Blomquist, M., Freyschuss, U., WimaL.G. & Strandric, B. (1986). Physical activity in self-treatment in cystic fibrosis. Archives of disease in childhood, 61, 362-367.

Booth, M.L., Owen, N., Bauman, A.E. & Gore, C.J. (1996). Retest reliability of recall measures of leisure-time physical activity in Australian adults. International Journal of Epidemiology, 25(1), 153-159.

Bouchard, C. & Stevens, T. (1994). Physical activity, fitness and health: The model and key concepts in physical activity, fitness and health. A concensus statement. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Bratteby, L.E., Sandhagen,B., Fan, H. & Samuelson, G. (1997). A 7-day activity diary for assessment of daily energy expenditure validated by the doubly labelled water method in adolescents. European Journal of Clinical Nutrition, 51, 585-591.

Brenner, M. (1996). Weights and Measures. Health Club Management, March 1996. Fitness Industry Association, 25-26.

Breslow, L. (1994). A health promotion primer for the 1990s. In N. Black, D. Boswell, A. Gray, S. Murphy & J. Popay (Eds.), Health and disease: A reader, revised edition. Milton Keynes: Open University Press.

Broskoski, M.B., Pivarnik, J.M. & Morrow, Jnr, J.R. (1991). Caltrac validity for estimating caloric expenditure in children. Medicine and Science in Sports and Exercise, 23, 60-65.

Bruce, R.A., DeRoven, T.A. & Hossack, K.F. (1980). Pilot study examining the motivational effects of maximal exercise testing to modify risk factors and health habits. Cardiology, 11, 111-119.

Bundgaard, A. (1985). Exercise in the asthmatic. Sports Medicine, 2, 254-266.

Bunton, R. (1991). Theories of behavioural change and their use in health promotion: Some neglected areas. Health Education Research Theory and Practice, 6(2), 153-162.

Bunton, R., Baldwin, S. and Flynn, D. The 'stages of change model' and its use in health promotion: A critical review. (un pub). University of Teeside: Centre for Social and Policy Research.

Burn, G.E., Naylor, P. & Page. (1999). Assessment of stages of change for exercise within a worksite lifestyle screening programme. American Journal of Health Promotion, 13(3), 143-145.

Byers, T. (1995). Body weight and mortality. The New England Journal of Medicine, 333, 723-744.

Calfas, K.J., Long, B.J., Sallis, J.F., Wooten, W.J., Pratt, M. & Patrick, K. (1996). A controlled trial of physician counselling to promote the adoption of physical activity. Preventive Medicine, 25, 225-233.

Caltrac Motion Sensor. (1993). Hemokinetics Inc, 5930 Seminole Centre Court, Madison, WI 53711, USA.

Camacho, T.C., Roberts, R.E., Lazarus, N.B., Kaplan G.A. & Cohen, R.D. (1991). Physical activity and depression: Evidence from the Atlanta County Study. American Journal of Epidemiology, 134, 220-231.

Canadian Public Health Association. (1977). Canadian Fitness Survey. Toronto: Canadian Ministry of Sport.

Canadian Public Health Association. (1979). Standardised test of fitness: Norms and percentile scores. Toronto: Canadian Ministry of State.

Cardinal, B.J. (1993). Validation of a stages of exercise adoption scale. Research Quarterly for Exercise and Sport, 67, 50-51.

Cardinal, B.J. (1997a). Predicting exercise behaviour using components of the transtheoretical model of behaviour change. Journal of Sport Behaviour, 20(3), 272-283.

Cardinal, B.J. (1997b). Construct validity of stages of change for exercise behaviour. American Journal of Health promotion, 12(1), 68-74.

Casperson, C.J., Powell, K.E. & Christenson, G.M. (1985). Physical activity, exercise, and physical fitness: Definitions and distinctions for health related research. Public Health Reports, 100, 126-131.

Castairs, V. & Morris, R. (1981). Deprivation and health in Scotland. Aberdeen: Aberdeen University Press.

Cavill, N. (1999). National campaigns to promote physical activity: Can they make a difference? International Journal of Obesity, 49-51.

Centres for Disease Control and Prevention. (1995). Healthy eating and physical activity: Focus group research with contemplators and preparers. Atlanta: Nutrition and Physical Activity Communications Team, National centre for Chronic Disease Prevention and Health Promotion, Centres for Disease Control and Prevention.

Centres for Disease Control and Prevention & American College of Sports Medicine. (1993). Recommendations to fight America's epidemic of physical inactivity. Press release, Atlanta:

Chamove, A. (1988). Exercise effects in psychiatric populations: A review. In Sport, health, psychology and exercise symposium proceedings. (pp. 8-48). London: Health Education Authority and The Sports Council.

Clarke, P. & Eves, F. (1997). Applying the transtheoretical model to the study of exercise on prescription. Journal of Health Psychology, 2(2), 195-207.

Colhoun, H. & Prescott-Clarke, P. (1996). Health survey for England 1994. London: Her Majesties Stationary Office.

Corbin, C.B., Dowell, L.J., Lindsay, R. & Tolson, H. (1978). Concepts in physical education. Dubuque, IA, US: Brown.

Cox, B. (1993). The Health and lifestyle survey: seven years on. Aldershot, Dartmouth: Health Promotion Research Trust.

Craft, L.L & Landers, D.M. (1998). The effect of exercise on clinical depression and depression resulting from mental illness: A meta-analysis. Journal of Sport and Exercise Psychology, 20, 339-357.

Crocker, P.R.E. & Grozelle, C. (1991). Reducing induced state anxiety: effects of acute aerobic exercise and autogenic relaxation. Journal of Sports Medicine and Physical Fitness, 31, 277-282.

Cummings, S.R., Kelsey, J.L., Nevitt, M.C. & O'Dowd, K.J. (1985). Epidemiology of osteoporosis and osteoporotic fractures. Epidemiological Reviews, 7, 178–208.

Dahlgren, G. & Whitehead, M. (1995). The main determinants of health. In M. Benzeval, K. Judge, & M. Whitehead (Eds.), Inequalities in health. Kings Fund.

Dannenberg, A.L. & Wilson, P.W.E. (1989). Framingham leisure time physical activity questionnaire. In T.M. Drury (Eds.), Assessing physical fitness & physical activity in population-based surveys. (pp.649-652). Washington, DC: US. Government printing office.

Davies, P.S.W. (1992). Developments in the assessment of physical activity. In N.G. Norgan (Eds.), Physical activity and health. Cambridge: Cambridge University Press.

Delany J.P., Schoellor, D.A., Hoyt, R.W., Askew, E.W. & Sharp, M.A. (1989). Field use of D2 18O to measure energy expenditure of soldiers at different energy intakes. Journal of Applied Physiology, 67, 1922-1929.

Department of Health. (1992). The Health of the nation: A strategy for health in England. London: Her Majesties Stationary Office.

Department of Health. (1995). Policy appraisal and health. A guide From the department of health. London: Her Majesties Stationary Office.

Desharnais, R., Godin, G. & Jobin, J. (1987). Motivational characteristics of evalu*life and the Canadian home fitness test. Canadian Journal of Public Health, 78, 161-164.

DiClemente, C.C., Prochaska, J.O. & Gilbertini, M. (1985). Self-efficacy, and the stages of change of smoking. Cognitive Therapy and Research, 9, 1, 181-200.

DiClemente, C.C., Prochaska, J.O., Velicer, W.F., Fairhurst, S., Rossi, J.S. & Velasquez, M. (1991). The process of smoking cessation: An analysis of precontemplation, contemplation and preparation stages of change. Journal of Consulting and Clinical Psychology, 9, 295-304.

Dirkin, G. (1994). Technological supports for sustaining exercise. In R.K. Dishman (Eds.), Advances in exercise adherence. (pp. 237-274). Champ IL: Human Kinetics.

Dishman, R.K. & Buckworth, J. (1996). Increasing physical activity: a quantitative synthesis. Medicine and Science in Sports and Exercise, 28(6), 706-719.

Downie, R.S., Fyfe, C. & Tannahill, A. (1990). Health promotion: Models and values. Oxford: Oxford University Press.

Downie, R.S., Tannahill, C. & Tannahill, A. (1996). Health promotion: Models and values (2nd ed). Oxford: Oxford University Press.

Dunn, A.L., Marcus, B.H., Kampert, J.B., Garcia, M.E., Kohl III, H.W. & Blair, S.N. (1999). Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness. Journal of the American Medical Association, 281, 327-334.

Durstine, J.L. & Haskell W.L. (1994). Effects of exercise training on plasma lipids and lipoproteins. Exercise and Sport Sciences Reviews, 22, 477–521.

Dustman, R.E., Emmerson, R. & Shearer, D. (1994). Physical activity, age, and cognitive-neuropsychological function. Journal of Aging Physical Activity, 2, 143-181.

Ebrahim, S. & Smith, G.D. (1997). Systematic review of randomised controlled trials of multiple risk factor interventions for preventing coronary heart disease. British Medical Journal, 314, 1666-1674.

Ebrahim, S. & Smith, G.D. (1998). Lowering blood pressure: a systematic review of sustained effects of non-pharmocological interventions. Journal of Public Health Medicine, 20, 4, 441-448.

Edwards, W. (1961) Behavioural decision theory. Annual Review of Psychology, 12, 473-498.

Epstein L.H. & Wing R.R. (1980). Aerobic exercise and weight. Addictive Behaviors, 5, 371–388.

Ettinger, W.H. Jnr. & Afable, R.F. (1994). Physical disability from knee osteoarthritis: the role of exercise as an intervention. Medicine and Science in Sports and Exercise, 26, 1435–1440.

Eurofit. (1983). Testing physical fitness. Strasbourg: Council of Europe.

Ewart, C.K. (1989). Psychological effects of resistive weight training: implications for cardiac patients. Medicine and Science in Sports and Exercise, 21, 683-688.

Fagard, R.H. (1994). Physical fitness and blood pressure. Journal of Hypertension (Suppl.5), 11, 547-552.

Farnham, M. & Mutrie, N. (1998). An evaluation of exercise consultation in a community setting. International Journal of Health Education, 36, 1, 4-8.

Faulkner, G & Sparkes, A. (1999). Exercise as therapy for Schizophrenia: An ethnographic study. Journal of Sport and Exercise Psychology, 21, 52-69.

Fishbein, M. & Ajzen, I. (1975). Belief,Aattitude, Intention and Behaviour. Don Mills, New York: Addison-Wesley.

Fitech. (1990a). Fitech body management: Computerised fitness testing systems, Fitech Ltd, Chester, England.

Fitech. (1990b). Fitness matters for schools, Fitech Ltd, Chester, England.

Fitech. (1993). Fitech price guide, Fitech Ltd, Chester, England.

Fitech. (1996). Fitech reference manual. Fitech Ltd, Chester, England.

Folsum, A.R., Casperson, C.J., Taylor, H.L., Jacobs, D.R., Jnr., Luepker, R.V., Gomez-Marin, O., Gillum, R.F. & Blackburn, H. (1985). Leisure-time physical activity and its relationship to coronary risk factors in a population-based sample. The Minnesota Heart Survey. American Journal of Epidemiology, 121, 570-579.

Fox, K.R. (1997). Preface. In K.R. Fox. (Ed.), The physical self: From motivation to well-being. Champaign, IL: Human Kinetics.

Fox, K.R. & Biddle, S.J.H. (1988). The use of fitness tests. Educational and psychological considerations. Journal of Physical Education, Recreation and Dance, 59, 47-53.

Fries, J.F. & Spitz, P.W. (1990). The hierarchy of patient outcomes. In B. Spilker (Ed.), Quality of Life Assessments in Clinical Trials. (pp. 25-35). New York: Raven Press.

Fryer, D. & Payne, R.L. (1986). Being unemployed: A review of the psychological experiences of unemployment. International Review of Industrial and Organisational Psychology, 9, 235-277.

Fulcher, K. (1994). Fitness assessment. Sportcare Journal, 1, 3, 38-39.

Gaskin, K. & Vincent, J. (1996). Co-operating for health. Loughborough: Centre for research in social policy, Loughborough University.

Giacca, A. et al. (1994). Physical activity, fitness and type I diabetes. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Gledhill, N. (1990). Discussion. Assessment of fitness. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Godin, G. (1994). Social-Cognitive Models. In R.K. Dishman (Ed.), Advances in exercise adherence, (pp. 113-136). Champ, IL: Human Kinetics.

Godin, G., Desharnais, R., Jobin, J. & Cook, J. (1987). The impact of physical fitness and health-age appraisal upon exercise intentions and behaviour. Journal of Behavioural Medicine, 10, 241-250.

Godin, G., Jobin, J. & Bouillon, J. (1986). Assessment of leisure time exercise behaviour by self report: A concurrent validity study. Canadian Journal of Public Health, 77, 359-362.

Godin, G. & Shephard, R.J. (1985). A simple method to assess exercise behaviour in the community. Canadian Journal of Applied Sports sciences, 10, 141-146.

Gordon, D.J., Witztum, J.L., Hunninghake, D., Gates, S. & Glueck, C.J. (1983). Habitual physical activity and high-density lipoprotein cholesterol in men with primary hypercholesterolemia. Circulation, 67, 512-520.

Greater Glasgow Health Board. (1998). Exercise referral project protocol. Glasgow: Greater Glasgow Health Board.

Green, R.. & Raeburn, N. (1990). Contemporary developments in health promotion. In N. Bracht (Eds.), Definition and Challenges in Health Promotion at Community Level. London: Sage Publications.

Gretebeck, R.J. & Montoye, H.J. (1992). Variability of some objective measures of physical activity. Medicine and Science in Sport and Exercise, 24(10), 1167-1172.

Gruber, J.J. (1986). Physical activity and self-esteem development in children: a meta analysis. In G.A. Stull, & H.M. Eckert (Eds.), Effects of physical activity on children. Champ, IL: Human Kinetics and American Acadamy of Physical Education.

Harland, J., White, M., Drinkwater, C., Chinn, D., Farr, L. & Howel, D. (1999). The Newcastle exercise project: A randomised controlled trial of methods to promote physical activity in primary care. British Medical Journal, 319, 828-832.

Harris, S.S., Casperson, C.J., DeFriese, G.H. & Estes, E.H. (1989). Physical activity counseling for healthy adults as a primary preventive intervention in the clinical setting. The Journal of the American Medical Association, 261, 3590-3598.

Haskell, W.L. (1994). Health consequences of physical activity: understanding and challenges regarding dose-response. Medicine and Science in Sports and Exercise, 26, 649-660.

Haskell, W.L., Yee, M.C., Evans, A. & Irby, P.J. (1993). Simultaneous measurement of heart rate and body motion to quantitative physical activity. Medicine and Science in Sport and exercise, 25, 109-115.

Health Education Authority. (1992). Fitness testing for health promotion. London: Health Education Authority.

Health Education Authority. (1995). Promoting physical activity - Guidance for commissioners, purchasers and providers. London: Health Education Authority.

Health Education Authority. (1996a). Active for life campaign. London: Health Education Authority.

Health Education Authority. (1996b). Promoting physical activity in primary health care: Guidance for the primary health care team. London: Health Education Authority.

Health Education Authority & The Sports Council. (1992). The Allied Dunbar national fitness survey: A report on activity patterns and fitness levels. Anonymous. London: The Sports Council.

Health Education Board for Scotland. (1994). Hassle free exercise campaign. Edinburgh: Health Education Board for Scotland.

Health Education Board for Scotland. (1998). Mental health promotion: A strategic statement. Edinburgh: Health Education Board for Scotland.

Health Promotion Authority for Wales. (1989). Exercise for health. Cardiff: Health Promotion Authority for Wales.

Hellman, E.A., Williams, M.A. & Thalken, L. (1996). Modifications of the 7-day activity interview for use among older adults. The Journal of Applied Gerontology, 15(1), 116-132.

Hill, A.B. (1984). The environment and disease: association or causation? Proceedings of the Royal Society of Medicine, 2, 328–332.

Hillsdon, M. & Thorogood, M. (1996). A systematic review of physical activity promotion strategies. British Journal of Sports Medicine, 30, 84-89.

Hillsdon, M., Thorogood, M., Anstiss, T. & Morris J. (1995). Randomised controlled trials of physical activity promotion in free living populations: A review. Journal of Epidemiology and Communtiy Health, 49, 448-453.

Hoinville, E. (1995). Analysis of combined data from ADNFS and HEANSAH (unpublished). In Health Education Authority. Health Update 5. London: The Health Education Authority.

Hussey, R. (1984). Evaluation of the international garden festival health fair. Liverpool: Mersey Regional Health Authority.

Inequalities in Health. The Black Report. (1982). Penguin, ISBN 0-14-022-4203.

Jacobs, D.R., Jr., Ainsworth, B.E., Hartman, T.J. & Leon, A.S. (1993). A simultaneous evaluation of ten commonly used physical activity questionnaires. Medicine and Science in Sport and exercise, 25, 81-91.

Jaglal, S.B., Kreiger, N.& Darlington, G. (1993). Past and recent physical activity and risk of hip fracture. American Journal of Epidemiology, 138, 107–118.

Janis, I.L. & Mann, L. (1977). Decision making: A psychological analysis of conflict, choice, and commitment. New York: Free Press.

Jette, M. (1976). The Canadian home fitness test as a predictor of aerobic capacity. Canadian Medical Association, 114, 680-682.

Jones, J.G. & Cale, A. (1989). Changes in mood and cognitive functioning during long distance running - an exploratory investigation. Physical Education Review, 12, 78-83.

Kelley, G. & McClellan, P. (1994). Anti-hypertensive effects of aerobic exercise: a brief meta-analytic review of randomized controlled trials. American Journal of Hypertension, 7, 115–119.

King, A.C., Blair, S.N., Bild, D.E., Dishman, R.K., Dubbert, P.M., Marcus, B.H., Oldridge, N.B., Paffenbarger, R.S., Jnr., Powell, K.E. & Yeager, K.K. (1992).. Determinants of physical activity and interventions in adults. Medicine and Science in Sport and Exercise, 24, 6, S221-S236.

Kohl III, H.W. & McKenzie, J. (1994). Physical Activity Fitness and Stroke. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Krall, L.P. & Beaser, R.S. (1989). Joslin diabetes manual, (12th ed). Philadelphia: Lea and Febiger.

Kriska, A.M., Blair, S.N. & Pereira, M.A. (1994). The potential role of physical activity in the prevention of non-insulin-dependent diabetes mellitus: The epidemiological evidence. Exercise and Sport Science Review, 22, 121-143.

Krølner, B., Toft, B.,Nielsen S. & Tøndevold, E. Physical exercise as prophylaxis against involutional vertebral bone loss: a controlled trial. Clinical Science, 64, 541–546.

Kujala, U.M., Kettunen, J., Paananen, H., Aalto, T., Battié, M.C., Impivaara, O., Videman, T. & Sarna, S. (1995). Knee osteoarthritis in former runners, soccer players, weight lifters, and shooters. Arthritis and Rheumatism, 38, 539–546.

Labonte, R. (1995). Health promotion and empowerment: Practice frameworks. Toronto: Centre for Health Promotion, University of Toronto.

Lamb, K.L. & Brodie, D.A. (1990). The assessment of physical activity by leisure time physical activity questionnaire. Sports Medicine, 10(3), 159-180.

Lamb, K.L. & Brodie, D.A. (1991). Leisure time physical activity as an estimate of physical fitness - a validity study. Journal of Clinical Epidemiology, 44(1), 41-52.

Landers, D. & Petruzello, S. (1994). Physical activity, fitness and anxiety. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Laporte, R.E., Montoye, H.J &, Casperson, C.J. (1985). Assessment of physical activity in epidemiologic research: problems and prospects. Public Health Reports, 100, 131-146.

Laitakari, J. (1998). On the practical applicability of stage models to health promotion and health education. American Journal of Health Behaviour, 22(1), 28-38.

Lee, I.M. (1994). Physical activity, fitness and cancer. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Lee, I.M. & Paffenbarger, R.S., Jnr. (1996). Do physical activity and physical fitness avert premature mortality. Exercise and Sport Science Reviews, 24, 135-171.

Lertzman, M.M. & Cherniack, R.M. (1976). Rehabilitation of patients with chronic obstructive pulmonary disease. American Review of Respiratory Disease, 114, 1145-1165.

Long, B., Calfas, K., Wooten, W., Sharpe, D., Patrick, K. & Sallis, J. (1992). Project PACE physician manual: Physician-based assessment and counselling. Atlanta: Centres for Disease Control and Prevention.

Long, B.C. & Haney, C. (1986). Enhancing physical activity in sedentary women: information, locus of control and attitudes. Journal of Sports Psychology, 8, 8-24.

Loughlan, C. (1995). Increasing health related physical activity in previously sedentary adults : A comparison of fitness testing and exercise consultation. Unpublished doctoral. dissertation, University of Glasgow, Glasgow.

Loughlan, C. & Mutrie, N. (1995a). Conducting an exercise consultation: Guidelines for health professionals. Journal of the Institute of Health Education, 33(3), 78-82.

Loughlan, C. & Mutrie, N. (1995b). Recruitment of sedentary NHS staff for a workplace exercise programme using an adapted "stages of change" exercise questionnaire. Journal of Sports Sciences, 13, 63-64.

Loughlan, C. & Mutrie, N. (1996). Appraisal of validation criteria for a 7 day leisure time physical activity questionnaire. Journal of Sports Sciences, 14, 37-38.

Loughlan, C. & Mutrie, N. (1997). An evaluation of the effectiveness of three interventions in promoting physical activity in a sedentary population. Health Education Journal, 56, 154-165.

MacAuley, E. (1994). Physical activity and psychosocial outcomes. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. (pp. 851-867). Champaign, IL: Human Kinetics.

MacDonald, G. & O'Hara, K. (1996). Ten elements of mental health, its promotion and demotion. Paper given at Options for Life. The 6th Annual European Conference on the Promotion of Mental Health.

Machin, D. & Campbell, M.J. (1987). Statistical tables for the design of clinical trials. Oxford: Blackwell Scientific.

Macintyre, S. (1994). Socio economic variations in Scotland's health – A review. Health Bulletin, 52(1), 456-471.

Maliszewski, A.F., Freedson, P.S., Ebbeling, C.J., Crusse-Meyer, J. & Kastango, K.B. (1991). Validity of the Caltrac accelerometer in estimating energy expenditure and activity in children and adults. Pediatric Exercise Science, 3, 141-151.

Manson, J.E., Nathan, D.M., Krolewski, A.S., Stampfer, M.J., Willet, W.C. & Hennekens, C.H. (1992). A prospective study of exercise and incidence of diabetes among US male physcicians. Journal of the American Medical Association, 268, 63-67.

Manson, J.E., Rimm, E.B., Stampfer, M.J., Colditz, G.A., Willett, W.C. & Krolewski, A.S. (1991). Physical activity and incidence of non-insulin dependent diabetes mellitus in women. Lancet, 338, 774-778.

Marcus, B.H., Banspach, S.W., Lefebvre, R.C., Rossi, J.S., Carleton, R.A. & Abrams, D.B. (1992a). Using the stage of change model to increase the adoption of physical activity among community participants. American Journal of Health Promotion, 6, 424-429.

Marcus, B.H., Emmons, K.M., Simkin-Silverman, L.R. (1998). Evaluation of motivationally tailored verses standard self-help physical activity interventions at the workplace. American Journal of Health Promotion, 12, 246-253.

Marcus, B.H., Goldstein, M.G., Jette, A., Simkin-Silverman, L., Pinto, B.M., Milan, F., Washburn, R., Smith, K., Rakowski, W. & Dube, C.E. (1997). Training physicians to conduct physical activity counselling. Preventive Medicine, 26, 382-388.

Marcus, B.H., King, T.K., Clark, M.M., Pinto, B.M. & Bock, B.C. (1996). Theories and techniques for promoting physical activity behaviours. Sports Medicine, 22(5), 321-331.

Marcus, B.H. & Owen, N. (1992). Motivational readiness, self-efficacy and decision-making for exercise. Journal of Applied Social Psychology, 22, 3-16.

Marcus, B.H., Owen, N., Forsyth, L.H., Cavill, N.A. & Fridinger, F. (1998). Physical activity interventions using mass media, print media, and information technology. American Journal of Preventive Medicine, 15(4), 362-378).

Marcus, B.H., Rossi, J.S., Selby, V.C., Niaura, R.S. & Abrams, D.B. (1992b). The stages and processes of exercise adoption and maintenance in a worksite sample. Health Psychology, 11, 386-395.

Marcus, B.H., Selby, V.C., Niaura, R.S. & Rossi, J.S. (1992c). Self-efficacy and the stages of exercise behaviour change. Research Quartery for Exercise and Sport, 63, 60-66.

Marcus, B.H. & Simkin, L.R. (1993). The stages of exercise behaviour. The Journal of Sports Medicine and Physical Fitness, 33(1), 83-88.

Marcus, B.H. & Simkin, L.R. (1994). The transtheoretical model: applications to exercise behaviour. Medicine and Science in Sport and Exercise, 26, 1400-1404.

Marcus, B.H., Simkin, L.R., Rossi, J.S. & Pinto, B.M. (1996). Longitudinal shifts in employees stages and processes of exercise behaviour change. The Science of Health Promotion, 10(3), 195-200.

Marsh, H.W., Richards, G.E., Johnson, S., Roche, L. & Tremayne, P. (1994). Physical self-description questionnaire: Psychometric properties and multitrait-multimethod analysis of relations to existing instruments. Journal of Sport and Exercise Pstchology, 16, 270-305.

McFarlane, C. (1996). The retest reliability, and criterion validity of a seven day recall questionnaire, as a measure of physical activity status, using a Caltrac. Unpublished Msc dissertation, University of Glasgow, Glasgow.

McLoone, P. (1996). Suicide and deprivation in Scotland. British Medical Journal, 312, 543-534.

Mechelen, W.V. (1997). A physically active lifestyle - public health's bets buy? British Journal of Sports Medicine, 31, 264-265.

Melanson, E.L. & Freedson, P.S. (1995). Validity of the computer science and applications, Inc (CSA) activity monitor. Medicine and Science in Sports and Exercise, 27(6), 934-940.

Meltzer, H., Gill, B., Petticrew, M. & Hinds, K. (1994). The prevalence of psychiatric morbidity among adults living in private households. London: Office of Population Censuses and Surveys.

Miller, W.R. (1978). Behavioural treatment of problem drinkers: A comparative outcome study of three controlled drinking tharapies. Journal of Consulting and Clinical Psychology, 46, 74-86.

Miller, W.R. (1983). Motivational interviewing with problem drinkers. Behavioural Psychotherapy, 11, 147-172.

Miller, W.R. (1996). Motivational Interviewing: Research, Practice and Puzzles. Addictive Behaviours, 21(6), 835-842.

Miller, W.R. & Rollnick, S. (1991). What motivates people to change? Motivational interviewing: preparing people to change addictive behaviour. New York: Guilford.

Miller, W.R. & Taylor, C.A. (1980). Relative effectiveness of bibliotherapy, individual and group self-control training in the treatment of problem drinkers. Addictive Behaviours, 5, 13-24.

Mittendorf, R., Longnecker, M.P., Newcomb, P.A., Dietz, A.T., Greenberg, E.R., Bogdan, G.F., Clapp, R.W. & Willett, W.C. (1995). Strenuous physical activity in young adulthood and risk of breast cancer (United States). Cancer Causes and Control, 6, 347–353.

Montoye, H.J., Kemper, H.C.G., Saris, W.H.M. & Washburn, R.A. (1996). Measuring physical activity and energy expenditure. Champ, IL: Human Kinetics

Montoye, H.J. (1975). Physical activity and health: An epidemiologic study of an entire community. Englewood Cliffs, NJ: Prentice-Hall.

Morris, J. (1994). Exercise in the prevention of coronary heart disease: today's best buy in public health. Medicine and Science in Sport and Exercise, 26(7), 807-814.

Morris, J.N., Everitt, M.G., Pollard, R., Chave, S.P.W. & Semmence, A.M. (1980). Vigorous exercise in leisure time; protection against coronary heart disease. Lancet, 2, 1207-1210.

Moses, J. Steptoe, A, Mathews, A. & Edwards, S. (1989). The effects of exercise training on mental well-being in the normal population: a controlled trial. Journal of Psychosomatic Research, 33(1), 47-61.

Mutrie, N. (in press). The relationship between physical activity and clinically defined depression. In S. Biddle, K. Fox & S. Boucher (Eds.), Exercise in the Promotion of Mental Health and Well-Being. London: Routledge.

Mutrie, N. (1997). The theraputic effects of exercise on the self. In K. Fox (Ed), The physical self: From motivation to well-being. (pp.287-314). Champaign, IL: Human Kinetics.

Mutrie, N & Biddle, S.J. (1995). The effects of exercise on mental health in non-clinical populations. In S.Biddle (Ed.), European perspectives on exercise and sport psychology. (chapter 3). Champaign: Human Kinetics.

Mutrie, N. & Caddell, C. (1994). Stages of exercise behaviour change in corporate employees. Journal of Sports Sciences, 12(2), 202-3.

Mutrie, N. & Thin, A. (1992). An assessment of the effects of exercise on cognitive functioning. Journal of Sports Sciences, 10, 617-618.

Mutrie N, Loughlan C, Campbell M., Marsden, E. & Carron, T. (1997). The transtheoretical model applied to four Scottish populations. Journal of Sports Sciences, 15, 100.

Naylor, P.J., McKenna, J., Barnes, K. & Christopher, M. (1995). Decision balance and self-reported physical activity levels: validating the stages of change for exercise in British University students. Journal of Sports Sciences, 13, 68-69.

Nicholl, J.P. Coleman, P & Blazier, J.E. (1994). Health and healthcare costs and benefits of exercise. Pharmaco Economics, 5, 109-122.

Nicholls, B. (1999). The RAF is using motivational counselling and wellness to encourage personnel to exercise. Catherine Larner reports. Health Club Management, February, 20-22.

Northern Ireland Health & Activity Survey. (1993). Belfast: Her Majesties Stationary Office.

Ossip-Klein, D.J., Doyne, E.J., Bowman, E.D., Osborn, K.M., McDougall-Wilson, I.B. & Neimeyer, R.A. (1989). Effects of running and weight lifting on self-concept in clinically depressed women. Journal of Consulting and Clinical Psychology, 57, 158-161.

Paffenbarger R.S., Jnr., Blair, S.N., Lee, I.M. & Hyde, R.T. (1993b). Measurement of physical activity to assess health effects in free-living populations. Medicine and Science in Sport and Exercise, 25, 60-70.

Paffenbarger R.S., Jnr., Hyde, R.T. & Wing A.L. (1987). Physical activity and incidence of cancer in diverse populations: a preliminary report. American Journal of Clinical Nutrition, 45, 312–317.

Paffenbarger, R.S., Jnr., Hyde, R.T., Wing A.L. & Hsieh, C. (1986). Physical activity, all cause mortality, and longevity of college alumni. New England Journal of Medicine, 314, 605-613.

Paffenbarger, R.S., Jnr., Hyde, R.T., Wing, A.L., Lee, I.M., Jung, D.L. & Kampert, J.B. (1993a). The association of changes in physical activity level and other lifestyle characteristics with mortality among men. New England Journal of Medicine, 328, 538-545.

Paffenbarger, R.S., Jnr, Jung, D.L., Leung, R.W. & Hyde, R.T. (1991). Physical activity and hypertension: an epidemiological view. Annals of Medicine, 23, 319–327.

Paffenbarger, R.S., Jnr., Lee, I.M. & Leung, R. (1994). Physical activity and personal characteristics associated with depression and suicide in American college men. Acta Psychiatrica Scandinavica Supplementum, 377, 16–22.

Paffenbarger, R.S., Jnr., Patrick, K., Pollock, M., Rippe, J.M., Sallis, J. & Wilmore, J.H. (1995). Physical activity and public health: A recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. Journal of the American Medical Association, 273, 402-407.

Pate, R.R., Pratt, M., Blair, S.N., Haskell, W.L., Macera, C.A., Bouchard, C., Buchner, D., Ettinger, W., Heath, G., King, A.C., Kriska, A., Leon, A.S., Marcus, B.H., Morris, J., Paffenbarger Jr, R.S., Patrick, K., Pollock, M., Rippe, J.M., Sallis, J. & Wilmore J.H. (1995). A recommendation from the Centres for Disease Control and prevention and the American College of Sports Medicine. Journal of the American Medical Association, 273(5), 402-407.

Patrick, K., Sallis, J.F., Long. B., Calfas, K.J., Wooten, W., Heath & G, Pratt, M. (1994). A new tool for encouraging physical activity. The Physician and Sports Medicine, 22(11), 11-15.

Pender, N.J., Sallis, J.F., Long, B.J. & Calfas, K.J. (1994). Health care provider counselling to promote physical activity. In R.K. Dishman (Ed.), Advances in exercise adherence. (pp. 213-236). Champaign, IL: Human Kinetics.

Peterson, T.R. & Aldana, S.G. (1998). Improving behaviour: An application of the stages of change model in a worksite setting. American Journal of Health Promotion, 13(4), 229-232.

Petruzello, S.J., Landers, D.M. & Salazar, W. (1993). Exercise and anxiety reduction: Examination of temperature change as an explanation for affective change. Journal of Sports and Exercise Psychology, 13, 63-75.

Pols, M.A., Peters, P.H.M., Ocke, M.C., Bas Bueno-De-Mesquita, H., Slimani, N., Kemper, H.C.G. & Collette, H.J.A. (1997). Relative validity and repeatability of a new questionnaire on physical activity. Preventive Medicine, 26, 37-43.

Powell, K.E. & Blair, S.N. (1994). The public health burdens of sedentary living habits: Theoretical but realistic estimates. Medicine and Science in Sports and Exercise, 26, 851-856.

Powell, K.E., Thompson, P.D., Casperson, C.J. & Kendrick, J.S. (1987). Physical activity and the incidence of coronary heart disease. Annual Review of Public Health, 8, 253-287.

Prochaska, J.O. (1979). Systems of psychotherapy: A transtheoretical analysis. Homewood, IL: Dorsey Press

Prochaska J.O. (1989). What causes people to change from unhealthy to health enhancing behaviour? In C.C. Cummings & J.D. Floyd (Eds.), Human behaviour and cancer risk reduction: Overview and report of a conference on unmet research needs. (pp. 30-34). Atlanta, GA: American Cancer Society:

Prochaska, J.O. & DiClemente, C.C. (1982). Self change and therapy change of smoking behaviour. A comparison of processes of change in cessation and maintenance. Addictive Behaviour, 7, 133-142.

Prochaska, J.O. & DiClemente, C.C. (1983). Stages and processes of self-change of smoking: toward an integrative model of change. Journal of Consulting and Clinical Psychology, 51, 390-395.

Prochaska, J.O., DiClemente, C.C. & Norcross, J.C. (1992). In search of how people change: Applications to addictive behaviours. The American Psychologist, 47, 1102-1114

Prochaska, J.O. & Marcus, B.H. (1994). The Transtheoretical Model: Applications to exercise. In R.K. Dishman (Ed.), Advances in exercise adherence. (pp. 161-180). Champaign, IL: Human Kinetics.

Prochaska, J.O. & Velicer, W.F. (1997a). Introduction: The transtheoretical model. American Journal of Health Promotion, 12, 1, 6-7.

Prochaska, J.O. & Velicer, W.F. (1997b). The transtheoretical model of health behaviour change. American Journal of Health Promotion, 12(1), 38-48.

Prochaska, J.O. & Velicer, W.F. (1997c). Response. Misinterpretations and misapplications of the transtheoretical model. American Journal of Health Promotion, 12(1), 11-12.

Prochaska, J.O., Velicer, W.F., Guadagnoli, E. & Rossi, J.S. (1991). Patterns of change: Dynamic typology applied to smoking cessation. Multivariate Behavioural Research, 26, 83-107.

Prochaska, J.O., Velicer, W.F., Rossi, J.S., Goldstein, M., Marcus, B.H., C'Connell, D., Rakowski, W., Fiore, C., Harlow, L., Redding, C., Rosenbloom, D. & Rossi, S. (1994). Stages of change and decisional balance for twelve problem behaviours. Health Psychology, 13, 47-51.

Recker, R.R., Davies, K.M., Hinders, S.M., Heaney, R.P., Stegman, M.R. & Kimmel, D.B. (1992). Bone gain in young adult women. Journal of the American Medical Association, 268, 2403–2408.

Reed, G.R., Velicer, W.F., Prochaska, J.O., Rossi, J.S. & Marcus, B.H. (1997). What makes a good staging algorithm: Examples from regular exercise. American Journal of Health Promotion, 12(1), 57-66.

Reid, E.L. & Morgan, R.W. (1979). Exercise prescription: a clinical trial. American Journal of Public Health, 69, 591-595.

Reiff, G.G., Montoye, H.J., Remington, R.D., Napier, J.A., Metzner, H.L. & Epstein, F.H. (1967). Assessment of physical activity by questionnaire and interview. Journal of Sports Medicine and Physical Fitness, 7, 135-142.

Rejeski, W.J., Brawley, L.R. & Shumaker, S.A. (1996). Physical activity and health related quality of life. Exercise and Sport Science Reviews, 24, 71-108.

Rejeski, R.E. & Thompson, A. (1993). Historical and conceptual roots of exercise psychology. In P. Seraganian (Ed.), The influence of physical exercise on psychological processes, (pp. 3-35). New York: Wiley.

Roche, A.F., Guo, S.S., Chumlea, W.C., Tyleshevski, F. & Siervogel, R.M. (1996). The prediction of body mass index values at 35 years. American Journal of Human Biology, 8(1), 154.

Rogers, R.W. (1975). A protection motivation theory of fear appeals and attitude change. Journal of Psychology, 91, 93-114.

Rollnick, S. & Miller, W.R. (1995). What is motivational interviewing? Behavioural and Cognitive Psychology, 23, 325-334.

Roviaro, S., Holmes, D.S. & Holmsten, R.D. (1984). Influence of a cardiac rehabilitation programme on the cardiovascular, psychological, and social functioning of cardiac patients. Journal of Behavioural Medicine, 7, 61-81.

Safrit, M.J. (1995). Complete guide to youth fitness testing. Washington, DC: Human Kinetics.

Sallis, J.F., Haskell, W.L., Fortmann, S.P., Vranizan, K.M., Taylor, C.B. & Solomon, D.S. (1986). Predictors of adoption and maintenance of physical activity in a community sample. Preventive Medicine, 15, 331-341.

Sallis, J.F. & Hovell, M.F. (1990). Determinants of exercise behaviour. Exercise and Sports Science Reviews, 18, 307-330.

Sallis, J.F., Hovell, M.F. & Hoftstetter, C.R. (1992). Explanation of vigorous activity during two years using social learning variables. Social Science and Medicine, 34, 25-32.

Sallis, J.F., Hovell, M.F., Hofstetter, C.R., Faucher, P., Elder, J.P., Blanchard, J., Casperson, C.J., Powell, K.E. & Christenson, G.M. (1989). A multivariate study of determinants of vigorous exercise in a community sample. Preventive Medicine, 18, 20-34.

Samuuelson, M. (1997). Commentary. Changing unhealthy lifestyle: Who's ready who's not? An argument in support of the stages of change component of the transtheoretical model. American Journal of Health Promotion, 12(1), 13-14.

Sandvic, L., Erikssen, J., Thaulow, C., Erikssen, G., Mundal, R. & Rodahl, K. (1993). Physical fitness as a predictor of mortality among healthy, middle aged Norwegian men. New England Journal of Medicine, 328, 533-537.

Saunders, B., Wilkinson, C. & Philips, M. (1995). The impact of a brief motivational intervention with opiate users attending a methadone programme. Addiction, 90(3), 415-24.

Schwartz, R.S. (1997). Physical activity, insulin resistance and diabetes. In A.S. Leon (Ed.), Physical activity and cardivascular health: A national consensus. (pp. 105-111). Champaign, IL: Human Kinetics.

Scottish Forum for Public Health Medicine. (1994). Mental health overview and programme. Scottish needs assessment programme. Glasgow.

Scottish Forum for Public Health Medicine. (1996). Scottish needs assessment programme. Physical activity report. Glasgow: University of Glasgow.

Scottish Health Survey. (1997). The Scottish health survey, 1995. Edinburgh: Her Majesties Stationary Office.

Scottish Homes. (1996). Scottish house condition survey. Scottish Homes.

Scott-Samual, A. (1998). Putting health on the regeneration agenda. (pp. 4-6). London: Health Education Authority.

Shapiro, S., Weinblatt, E., Frank, C.W., Sagar, R.V. & Densen, P.M. (1963). The H.I.P. study of incidence and diagnosis of coronary heart disease: Methodology. Journal of Chronic Disease, 16, 1281-1292.

Sheehan, D.J. (1973). Vigorous exercise in leisure-time and the incidence of coronary heart disease. Lancet, 1, 333– 339.

Shephard, R.J. (1997). What is the optimal type of physical activity to enhance health ? British Journal of Sports Medicine, 31, 277-284.

Siri, W.E. (1961). Body composition from fluid space and density. In J. Brozec, & A. Hanschel (Eds.), Techniques for Measuring Body Composition. Washington: National Academic Science.

Smith, R.A. (1989). Fitness testing in a private sector health club: a case study. The British Journal of Physical Education, Summer, 20, 72-73.

Smith, R.A. (1989). Fitness testing. How and why? Fitness Supplement, The Leisure Manager, August, 3-4.

Smith, R.A. & Biddle, S.J.H. (1999). Attitudes and exercise adherence: Test of the theories of reasoned action and planned behaviour. Journal of Sports Sciences, 17, 269-281.

Smith, W.C.S., Crombie, I.K., Tunstall Pedoe, H., Groden, B.M. & McHardy, J. (1989). Ayrshire and Arran coronary prevention programme – Baseline risk factor survey. Health Bulletin, 47, 5 (September), 227-233.

Sonstroem, R.J. (1988). Psychological models. In, R.K. Dishman (Ed.), Exercise adherence. (pp. 125-154). Champaign, IL: Human Kinetics.

Stephens, T. (1988). Physical activity and mental health in the United States and Canada: Evidence from four population surveys. Preventive Medicine, 17, 35–47.

Stephens, T. & Craig, C.L. (1990). The Well-being of Canadians: High-lights of the 1988 Campbell's Survey. Ottawa: Canadian Fitness and Lifestyle Research Institute.

Sykes, K. (1986). A simple home fitness test and exercise guidelines. Chester: Fitech Ltd.

Sykes, K. (1989). Measurement and evaluation of community physical fitness - concept and controversy. Health Education Journal, 48(4), 190-197.

Taylor, H.L. (1983). Physical activity: is it still a risk factor? Preventive Medicine, 12, 20-24.

Taylor, W.C., Baranowski, T.B. & Rohm Young, D. (1998). Physical activity interventions in low-income, ethnic minority, and populations with disability. American Journal of Preventive Medicine, 15(4), 334-343.

The James Report. (1993). The Scottish diet. Edinburgh: Her Majesties Stationary Office.

The Royal College of Physicians. (1991). Medical aspects of exercise: benefits and risks. London: The Royal College of Physicians.

The Scottish Office. (1991). Health education in Scotland: A national policy statement. Edinburgh: The Scottish Office Home and Health Department.

The Scottish Office. (1992). Scotland's health: A challenge to us all. A policy statement. Edinburgh: Her Majesties Stationary Office.

The Scottish Office. (1996). Annual report of the registrar general for Scotland. Edinburgh: The Stationary Office.

The Scottish Office. (1998). Working together for a healthier Scotland. A consultation document. Edinburgh: The Stationary Office.

Thomas, J.R., Landers, D.M., Salazar, W. & Etnier, J. (1994). Exercise and cognitive function. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Thompson, P. & Fahrenbach. (1994). Risks of exercising : Cardiovascular including sudden cardiac death. In C. Bouchard, R.J. Shephard & T. Stephens (Eds.), Physical activity fitness and health: International proceedings and concensus statement. Champaign, IL: Human Kinetics.

Tinetti, M.E., Baker, D.I., McAvay, G., Claus, E.B., Garrett, P., Gottschalk, M., Koch, M.L., Trainor, K. & Horwitz, R.I. (1994). A multifactorial intervention to reduce the risk of falling among elderly people living in the community. New England Journal of Medicine, 331, 821–827.

Tregoning, D., Gent, N. & Stephenson, D. (1990). A comparison of the response of manual and non-manual workers to fitness testing. Health Education Journal, 49(1), 30-31.

Triandis, H.C. (1977). Interpersonal behaviour. Monterey, CA: Brooks/Cole.

Tryon, W. (1985). Human activity: A review of quantitative findings. In W. Tryon (Ed.), Behavioural assessment in behavioural medicine. (pp. 257-300). New York: Springer.

Turner, A. (1991). Fitness testing & behavioural outcomes. Mid-Downs Health Authority: Health Education Unit.

Tudor, K. (1996). Mental health promotion: Paradigms and practice. London: Routledge.

U.S. Department of Health & Human Services. (1990). Healthy people 2000 - National health promotion and disease prevention objectives. Washington, DC: U.S. Government Printing Office.

U.S. Department of Health & Human Services., Public Health Service., Centres for Disease Control & Prevention., National Centre for Chronic Disease Prevention. & Health Promotion, Division of Nutrition & Physical Activity. (1999). Promoting physical activity: A guide for community action. Champaign, IL: Human Kinetics.

U.S. Department for Health & Human Services. (1996). Physical activity and health: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centres for Disease Control and Prevention, National Centre for Chronic Disease Prevention and Health Promotion.

Veale, D.M.W. (1987). Exercise dependence. British Journal of Addiction, 82, 735-740.

Veale, D.M.W. & Le Ferve, K. (1988). A survey of exercise dependence. In Sport, health, psychology and exercise symposium proceedings. (pp. 112-115). London: Sports Council and Health Education Authority.

Velicer, W.F., DiClemente, C.C., Prochaska, J.O. & Brandenburg, N. (1985). A decisional balance measure for assessing and predicting smoking status. Journal of Personality and Social Psychology, 48, 1279-1289.

Velicer, W.F., DiClemente, C.C., Rossi, J.S. & Prochaska, J.O. (1990). Relapse situations and self-efficacy: An integrative model. Addictive Behaviours, 15, 271-83.

Vuori, I. (1998). Does physical activity enhance health? Patient Education and Counseling, 33, 95-103.

Wankel, L.M. et al., (1994). The use of exercise adherence counselling to facilitate regular physical activity involvement. In Proceedings of commonwealth games conference scientific congress. Vancouver.

Wankel, L.M., Yardley, J.K. & Graham, J. (1985). The effects of motivational interventions upon the exercise adherence of high and low self-motivated adults. Canadian Journal of Applied Sport Sciences, 10, 147-155.

Wareham, N.J. & Rennie, K.L. (1998). The assessment of physical activity in individuals and populations. Why try to be more precise about how physical activity is assessed? International Journal of Obesity, 22(suppl 2), S30-38.

Washburn, R.A. & Montoye, H.J. (1986). The assessment of physical activity by questionnaire. American Journal of Epidemiology, 123(4), 563-576.

Wenger, N.K. & Furberg, C.D. (1990). Cardiovascular disorders. In B. Spilker (Ed.), Quality of life assessments in clinical trials. (pp. 335-345). New York: Raven Press

Whaley, M.H. & Blair, S.N. (1995). Epidemiology of physical activity, physical fitness, and coronary heart disease. American College of Sports Medicine Certified News, 5, 1-7.

Whitehead, M. (1997). Editorial. How useful is the stages of change model? Health Education Journal, 56, 111-112.

Williams, E., Klesges, R.C., Hanson, C.L. & Eck, L.H. (1989). A prospective study of the reliability and convergent validity of three physical activity measures in a field research trial. Journal of Clinical Epidemiology, 42, 1161-70.

Wimbush, E., MacGregor, A. & Fraser, E. (1998). Impacts of a national mass media campaign on walking in Scotland. Health Promotion International, 13, 1, 45-53.

Winett, R.A. (1990). Developing more effective health-behaviour programs: Analysing the epidemiological and biological bases for activity and exercise programmes. Applied Preventive Psychology, 7, 209-224.

Woods, C.B., Mutrie, N. & Scott, M. (1999). More students, more active, more often: Exercise behaviour change in a student population. Journal of Sports Sciences Abstracts, 17(1), 70.

Woods C.B., Mutrie, N. & Scott, M. (2000). From inactivity to activity: A study of exercise behaviour change in 16-24 year olds. Journal of Sports Sciences Abstracts, 18(1), 61-62.

World Health Organisation. (1958). The first ten years. The health organisation. Geneva: World Health Organisation.

World Health Organisation. (1991). World health statistics annual. In Health update 1, Health Education Authority, 1993. London: Health Education Authority.

World Health Organisation. (2000). World health statistics. World Health Organisation Web Site (www.who.org.)

Wyse, J.P., Mercer, T.H., Ashford, B., Buxton, K.E. & Gleeson, N.P. (1995). Evidence for the validity and utility of the stages of exercise behaviour change scale in young adults. Health Education Research, Theory and Practice, 10, 365-77.

Appendixes

Chapter 3

A. Loughlan and Mutrie (1995) Seven Day Leisure Time Physical Activity Recall Questionnaire
B. First Draft SPAQ
C. Initial SPAQ Piloting Studies
D. Second Draft SPAQ
E. Third Draft SPAQ
F. Original *Ricclees* Application Form

Chapter 4

G. Fitech Formal Consent Form
H. Exercise Consultation Reference Sheet
I. Full Information Booklet
J. Exercise Consultation Goal Record Sheet
K. The Pre - intervention Relationships Between the Stages of Exercise Behaviour Change, the Processes of Exercise Behaviour Change and Physical Activity in Pilot Study.
L. Occupational Physical Activity Analysis in Pilot Study
M. Intervention Effects on Processes of Exercise Behaviour Change in Pilot Study

Chapter 5

N. SPAQ Professionally Produced
O. POCQ Professionally Produced
P. Expectation Questionnaire
Q. Amended *Ricclees* Application Forms
R. Fitness Assessment Goal Record Sheet
S. *Ricclees* Information Booklet
T. Main study pre-intervention descriptive statistics
U. Main Study Leisure Time Physical Activity Graphs
V. Main Study Analyses of Variance for Immediate Intervention and Re-test Intervention Effect
W. Main Study Occupational Physical Activity Analysis
X. Main Study Stage of Exercise Behaviour Change Tables
Y. Main Study Processes of Exercise Behaviour Change Tables and Analyses
Z. List of Groups and Organisations who have expressed an interest in SPAQ

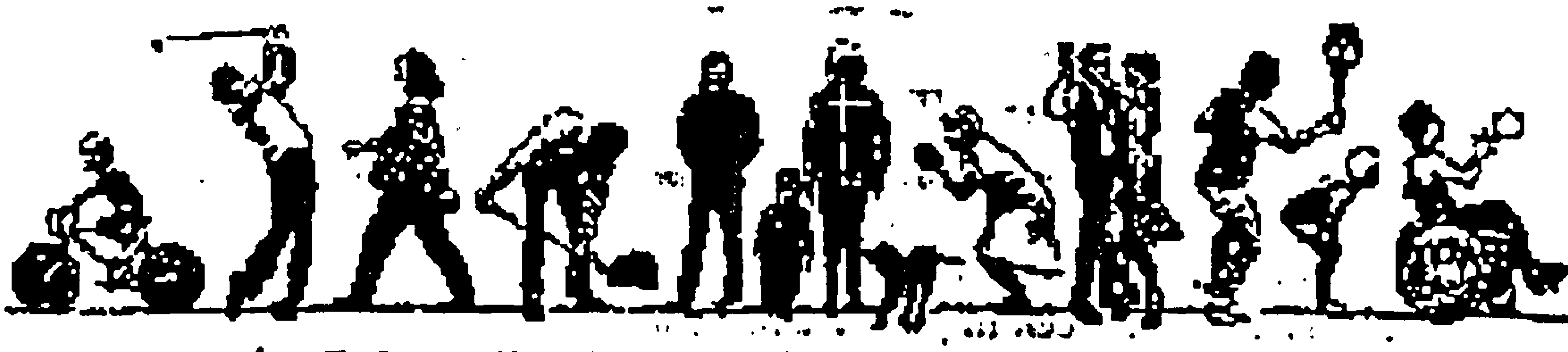
Appendix A

Loughlan and Mutrie (1996) Seven Day Leisure Time Physical Activity Recall Questionnaire

PAGE

NUMBERING

AS ORIGINAL



BE ACTIVE IN AYRSHIRE

Exercise Project
run by
Glasgow University

7 Day recall of physical activity

Please complete the enclosed 7 Day recall questionnaire
- remember to mark in the preferred size for your free T-shirt

Thank you

Christopher Loughlan
Researcher
University of Glasgow

7 Day Recall
Leisure Time Physical Activity

The 7day recall is a relatively simple and quick method of measuring the amount of physical activity you've done over the last week in your leisure time.

example,
Name: *Sheila Smith*

Day	morning	afternoon	evening
Sunday	*walked to shops 20 mins* *walked dog 20 mins* 40 mins	*went to swimming pool* 20 mins	

Recalling your activity

To help you remember your activites over the previous week, think of what you did on each day at each time block e.g. in the above, ask yourself what did I do on Sunday morning, then the afternoon, then finally in the evening.

Accuracy

In the example above, Shiēla recalled accurately that she swam for about 20 mins though she was actually in the pool for 45 minutes.

Put down the actual amount you were physically active.

Duration

To help you recall think of the time in blocks of 10 minutes. Put down all your physical activity which lasted for 10 or more minutes.

Activity

The chart on the opposite page gives you some guidance as to what activities you should include in the recall

Totals

You may have been active on two different occasions in any one session

Add the total minutes of physical activity for each morning, afternoon and evening timeblock and place in the ☐ provided.

Complimentary T-shirt

T Shirt size? S ☐ M ☐ L ☐ tick box

p.s. make sure that your name is at the top of the returned questionnaire on p.4

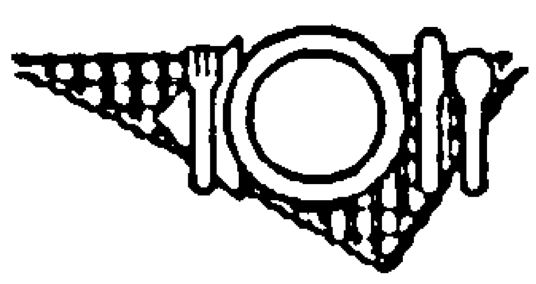
7 Day Recall LEISURE TIME PHYSICAL ACTIVITY

WHICH ACTIVITIES? - This chart is designed to help you fill out the 7 day recall

X

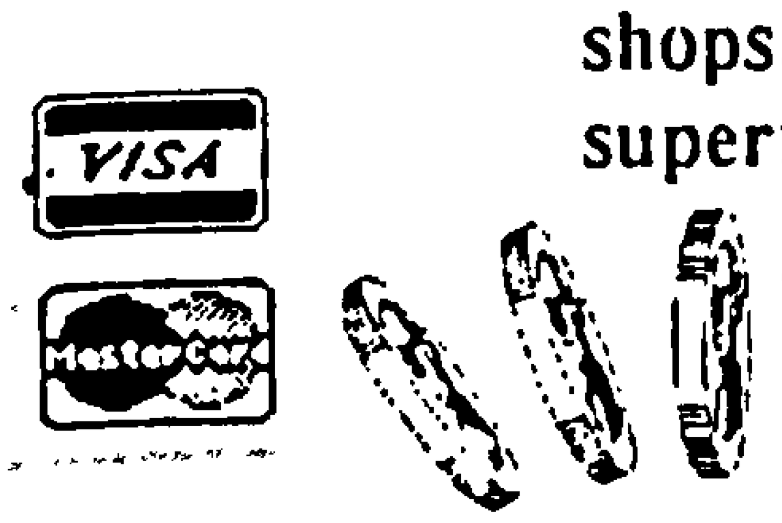
DO NOT INCLUDE LIGHT ACTIVITIES

- <u>Kitchen</u> e.g. baking, washing dishes, preparing food.

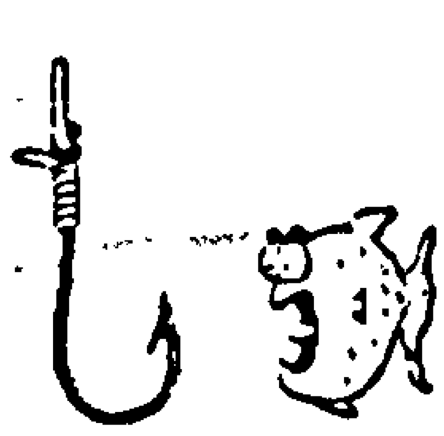


- <u>Household</u> e.g. embroidery, sewing/mending, dusting/polishing, hoovering, waxing/polishing car, knitting, painting.

- <u>Shopping</u> e.g. in and around shops, supermarket



- <u>Sport/leisure</u>. e.g. snooker, billiards, darts, fishing, playing a musical instrument.



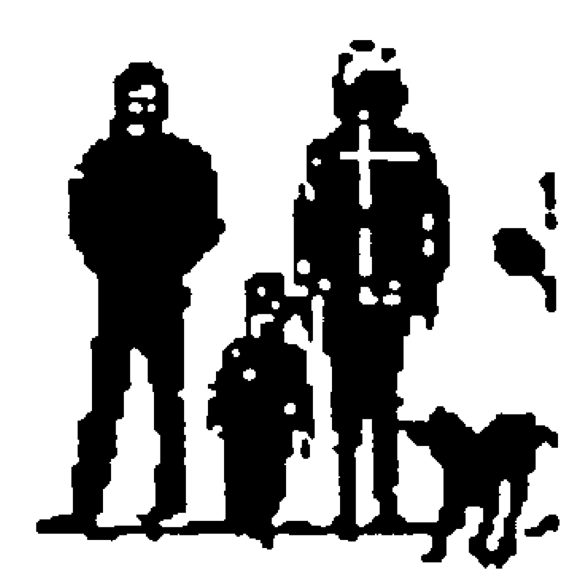
✓

INCLUDE MODERATE TO HARD ACTIVITIES

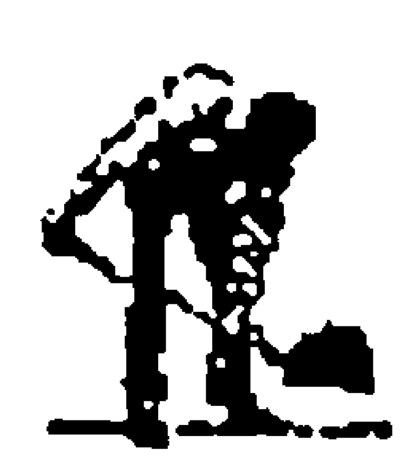
- <u>Exercise</u> e.g. exercise classes, exercise at home dancing

- <u>Household</u> e.g. DIY - sawing, sanding, papering, scraping, scrubbing floors

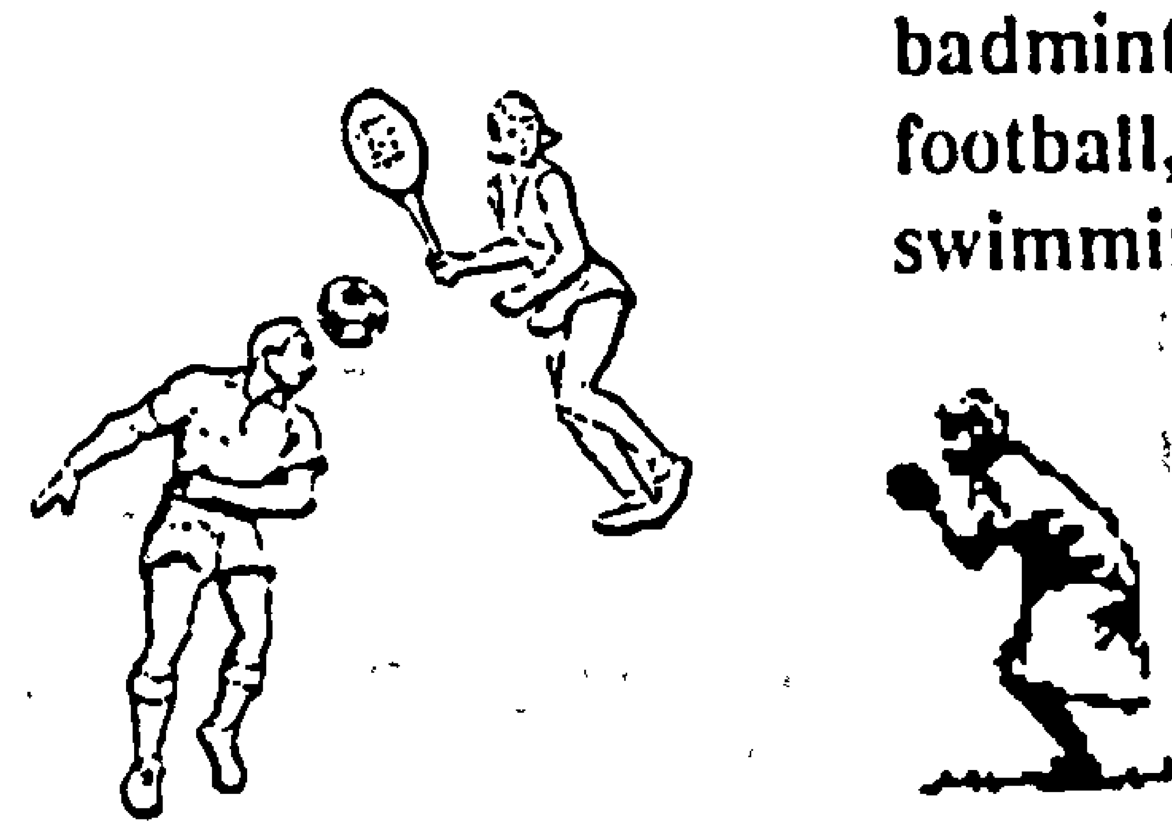
- <u>Walking</u> e.g. walking to shops, walking your dog, walking to work.



- <u>Outdoor Activities</u> e.g. gardening. washing car,



- <u>Sport</u> e.g. netball, badminton, football, golf, swimming.



7 day recall Leisure Time Physical Activity

NAME Dept/Ward

day	morning	afternoon	evening
1 Monday			
2 Tuesday			
3 Wed'sday			
4 Thursday			
5 Friday			
6 Saturday			
7 Sunday			

Lastly !
Is the above level of physical activity representative of a normal week Y/N? (delete)
If no. what are vou likelv to do?............hours............mins

Appendix B

First Draft SPAQ

PHYSICAL ACTIVITY QUESTIONNAIRE

DEVELOPED BY KILMARNOCK AND LOUDOUN DISTRICT COUNCIL AND THE UNIVERSITY OF GLASGOW

The following questionnaire is a simple way of measuring the amount of physical activity you have done over the last week. The questionnaire is strictly confidential so try and answer all questions as honestly as you can. Obviously, the overall accuracy depends on the accuracy of individual answers. The questionnaire is not a test so there is no pass / fail.

May I take this opportunity to thank you for taking the time to fill out the questionnaire.

Matthew Lowther
Exercise and Health Advisor.
Kilmarnock and Loudoun District Council.

NAME:

TELEPHONE NUMBER: Ext

AGE IN YEARS :

TODAYS DATE:

(1.) ARE YOU CURRENTLY EMPLOYED? Yes / No (*please circle*)

(2.) Have you changed your employment or the kind of work you do in the last month?
Yes / No (*please circle*)

If YES , has this resulted in an increase in the amount of physical activity you do?
Yes / No (*please circle*).

If yes how?

On the following page you will find a sheet which lists your physical activity for the **previous** week.

(3.) How to fill out the Physical Activity Questionnaire

Starting with the first activity listed think back over the previous week as to to how long you have spent doing that activity. If you haven't done any of the activity listed then simply put a cross in the first box and move onto the next activity. If you have participated in the activity in the previous week put a tick in the first box. Then write in the total number of minutes spent doing the activity for each day. Add all the days up to give you a total time spent doing that activity in the previous week. Simply repeat for the next activity.

ACTIVITY	X ✓	MON
1. Active housework (e.g. hoovering . dusting etc).		
2. Walking out of doors.		
3. Manual work (e.g. digging . sawing . building . carrying loads . D.I.Y. etc).		
4. Dancing.		
5. Aerobics / gymnastics / exercises.		
6. Golf / bowls.		
7. Cycling for pleasure or to work.		
8. Competitive sports or training (e.g. squash . football . cycling . swimming etc).		
9. Athletics / running / jogging.		
10. Stairwalking		
11. Hillwalking / climbing.		
Other physical activity (please write in) 12		
13		

(4.) Was last week typical of the amount of physical activity you usually do? *(Tick one box only)*

- YES ☐
- NO - I usually do more ☐
- NO - I usually do less ☐

Ho
Ho

curacy

ease try and be as accurate as possible. For example you may have spent an ur at the swimming pool but actually only swam for 20 minutes. Additionally, be refull not to count the same activity twice. For example, if you have spent time in e last week hillwalking be carefull not to include this in the "walking out of doors" ction as well. Finally, breaking the days into morning, afternoon and evening cks may help you to remember what you were doing on specific days.

TUES	WED	THUR	FRI	SAT	SUN	TOTAL

Grand total :

ore do you normally do? __________ Hours __________ Minutes

s do you normally do? __________ Hours __________ Minutes

(5.) REGULAR PHYSICAL ACTIVITY RELATES TO :

Exercise e.g.,weight training , aerobics etc-for 2 - 3 times per week ; hillwalking at least once per week
or
Sport e.g.,golf , hockey , football etc - for 2- 3 times per week
or
General activity e.g., walking , gardening etc accumulating at least 30 minutes / 4-5 times per week

BOX 1.
Please read through all categories and tick ONE box for the category which best describes how physically active you have been over the last six months.

tick one box

- [ ] I am not regularly physically active and do not intend to be so in the next 6 months.
- [ ] I am not regularly physically active but am thinking about starting to do so in the next 6 months.
- [ ] I do some physical activity but not enough to meet the description at the top of the page.
- [ ] I am regularly physically active but only began in the last 6 months.
- [ ] I am regularly physically active and have been so for longer than 6 months.

(6.) Overall , how easy / difficult was the physical activity questionnaire to fill in? *(please circle one)*

Very difficcult **Difficult** **Moderately easy** **Easy** **Very easy**

Please make any comments as to any aspects of the questionnaire you found confusing or any ways the questionnaire could be improved or made easier , e.g. are there any other activities you feel should be included or are there any questions you didn't understand etc.

____
____
____
____
____
____
____
____

Appendix C

Initial SPAQ Piloting Studies

PILOT STUDY A

Introduction

The aim of this study was to produce a draft SPAQ that could be piloted and by the use of participant feedback developed to produce a second draft SPAQ.

Methodology

Subjects

A total of 43 people completed the first draft of the questionnaire. Twenty-three participants (all women, mean age = 38, SD = 8.3 years) were drawn from a local women's group and the remaining 20 participants (mean age = 33, SD = 7.1 years) were drawn from a local unemployed group. Ten (50%) of the unemployed respondents were male, 10 (50%) were female.

Instruments

SPAQ / Stage of Exercise Behaviour Change Questionnaire

The starting point for the creation of the SPAQ was to select a similar instrument which could be developed to meet the specific aim of the study and as discussed in chapter three, the seven day recall questionnaire used in a similar exercise study (Loughlan and Mutrie, 1996) was chosen for this purpose.

The initial draft was printed onto both sides of an A3 sheet of paper folded in the middle to produce four A4 size separate pages. The first page was concerned with personal details, the middle two with the activity recall section and the back page with the stage of exercise behaviour change section. An additional section for participant feedback was also included at the end of the questionnaire. An example of the first draft is given in appendix B.

Procedures

A total of 100 draft SPAQ's were distributed to the organisers of a local women's group (N=50) and a local unemployed group (N=50). Each group organiser was asked to distribute the questionnaire throughout their own group. Instructions were given that participation in the study was voluntary and that if volunteers wished to participate they should complete all sections of the questionnaire. Questionnaires were collected the following week and scored. For further feedback fifteen participants were selected for follow up telephone calls by randomly selecting 15 questionnaires from all those completed. Ten participants from the women's group and 5 from the unemployed group were contacted after the study by telephone and asked the following questions:

(a.) How long did SPAQ take to complete?

(b.) Did you read all the instructions given throughout the questionnaire? If not, why?

(c.) Were you sure which activities were to be included in the recall section?

In addition, follow up participants were verbally administered the stage of exercise behaviour change questionnaire and any difference between their answer and their response on the questionnaire recorded. They were also invited to explain why this differed. Finally, any responses which the researcher classed as "unrealistic" were questioned. For example, two people reported over three hours stair-walking.

Results

A total of 43 (43%) questionnaires were returned, 23 (46%) from the women's group, 20 (40%) from the unemployed group. Table 1 gives basic descriptive statistics for total physical activity (mins / wk) for each stage of exercise behaviour change.

Table 1.

Descriptive statistics for total physical activity (mins / wk) for each stage of exercise behaviour change

Stage of Change	N	%	Total Physical Activity (mean; mins / wk)	SD
Pre-contemplation	4	9	1160	1015.7
Contemplation	6	14	699	482.2
Preparation	8	19	978	623.9
Action	5	12	525	894.2
Maintenance	20	46	1075	896.4

Figure 1 graphically displays the relationship between stage of exercise behaviour change and total physical activity.

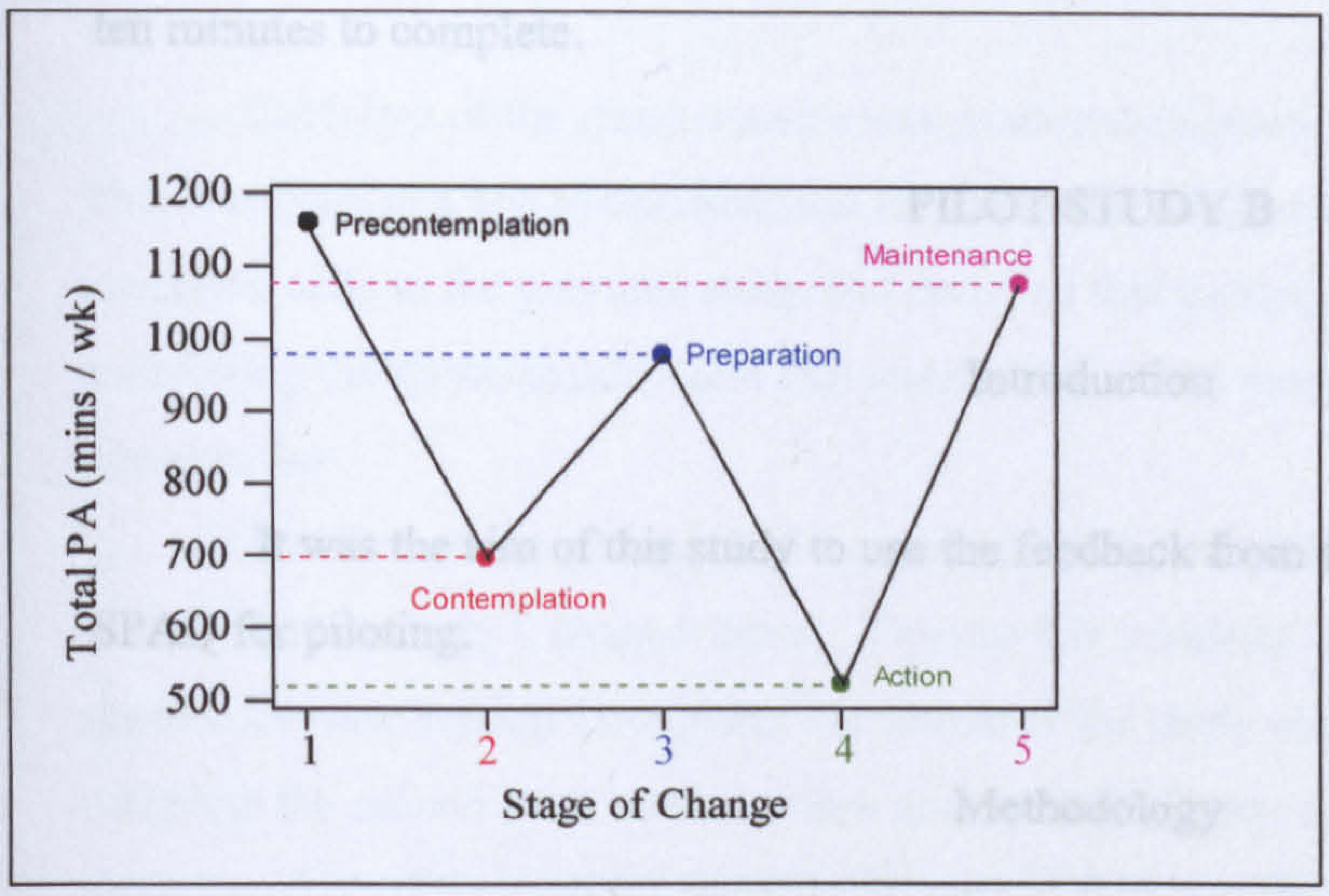


Figure 1. The relationship between stage of exercise behaviour change and total physical activity (mins / wk)

Figure 1 does not display the expected relationship between physical activity and stage of exercise behaviour change described in chapter two. Clearly, there is a problem with either the activity recall section or the stage of exercise behaviour change section of the draft questionnaire when, for example, precomtemplators are reporting the highest amounts of physical activity and actioners the least.

Initial analysis of the feedback section of the draft showed that 72% of the participants found SPAQ either easy or very easy to complete. The assumption that the questionnaire was difficult to complete could not be used to explain the spurious results found. Possible explanations only came to light after analysis of the follow up telephone conversations where the following points were made:

(a.) It appeared that there was too much writing at the top of the activity recall section and people were not reading it. As this part of the questionnaire explains how to complete the activity recall section it is not surprising that unexpected results were found.

(b.) Participants were unsure what activities to include in the recall section and what not to. It appeared that a better explanation of the activities to include was required.

(c.) Some participants were grossly over-estimating the amount of stair walking they had done. It appeared that they were including normal walking in the stair walking section.

(d.) With regard to the stage of exercise behaviour change questionnaire participants reported not reading the physical activity section at the top of the page. It appeared their eyes were immediately drawn to the follow up questions as this section had a box drawn around it, the physical activity description did not.

(e.) It appeared that participant's stage of exercise behaviour change were being "biased" by the previous activity recall section. It was considered that moving this section to the front page of the questionnaire would eliminate this problem.

Finally, feedback from the telephone conversations showed that SPAQ took approximately ten minutes to complete.

PILOT STUDY B

Introduction

It was the aim of this study to use the feedback from study A to produce a second draft SPAQ for piloting.

Methodology

Subjects

A total of 41 people participated in study 2. Twenty-five participants (mean age = 38, SD = 12.2 years) were drawn from a group of the general public who had volunteered for an exercise project and 16 participants (mean age = 32, SD = 11.1 years) were drawn from East Ayrshire Council employees. Six (24%) of the general public group were male, 19 (76%) were female. Four (25%) of the East Ayrshire Council employees were male, 12 (75%) were female.

Instruments

SPAQ / Stage of Exercise Behaviour Change Questionnaire

After analysing the feedback from study A the following changes were made to the draft SPAQ :

(a.) The amount of writing at the top of the activity recall section was reduced.

(b.) Clearer descriptions of what and what not should be included in the activity sections were given.

(c.) The activity sections were organised into similar groups with the stair-walking section being included in the walking sections.

(d.) The stage of exercise behaviour change section was moved to the front page of the questionnaire. A box was placed round the physical activity description in order to highlight it.

An example of the second draft SPAQ is given in appendix D.

Procedures

Draft two of the questionnaire was produced (appendix D) and piloted with two groups. This was done in a one to one situation so that immediate feedback was available. The follow up telephone calls in the previous study had revealed that participants had made mistakes when completing the questionnaires and that questioning of the participants could highlight where these mistakes lay.

The first group consisted of the general public who had volunteered for an exercise project as described in study I, chapter three. Twenty-five residents of Shortlees and Riccarton had applied for membership throughout the course of the study and these people were invited to complete the second draft questionnaire prior to their fitness assessment. The second group was made up of 16 of the author's work colleagues at East Ayrshire Council who were verbally invited to participate in the study.

The purpose of the study was explained to all volunteers and it was made clear that they were in no way obligated to participate. They were also assured of confidentiality. Participants were then invited to complete draft two of SPAQ and no other verbal instructions were given. Upon completion, questionnaires were scored and participants encouraged to explain their responses to each of the questions. Any of these verbal responses which differed from the questionnaire response (after clarification by the researcher of exactly what was to be recorded) were noted and the participant was encouraged to explain the reason for the difference.

Results

All 41 (100%) of the participants agreed to complete a questionnaire. Table 2 gives descriptive statistics for total physical activity (mins / wk) for each stage of exercise behaviour change.

Table 2.

Descriptive statistics for total physical activity (mins / wk) for each stage of exercise behaviour change

Stage of Change	N	%	Total Physical Activity (mean; mins / wk)	SD
Pre-contemplation	5	12	494	188.8
Contemplation	10	24.5	679	324
Preparation	7	17	660	225.2
Action	10	24.5	1026	763.9
Maintenance	9	22	1045	736.7

Figure 2 graphically displays the relationship between stage of exercise behaviour change and physical activity.

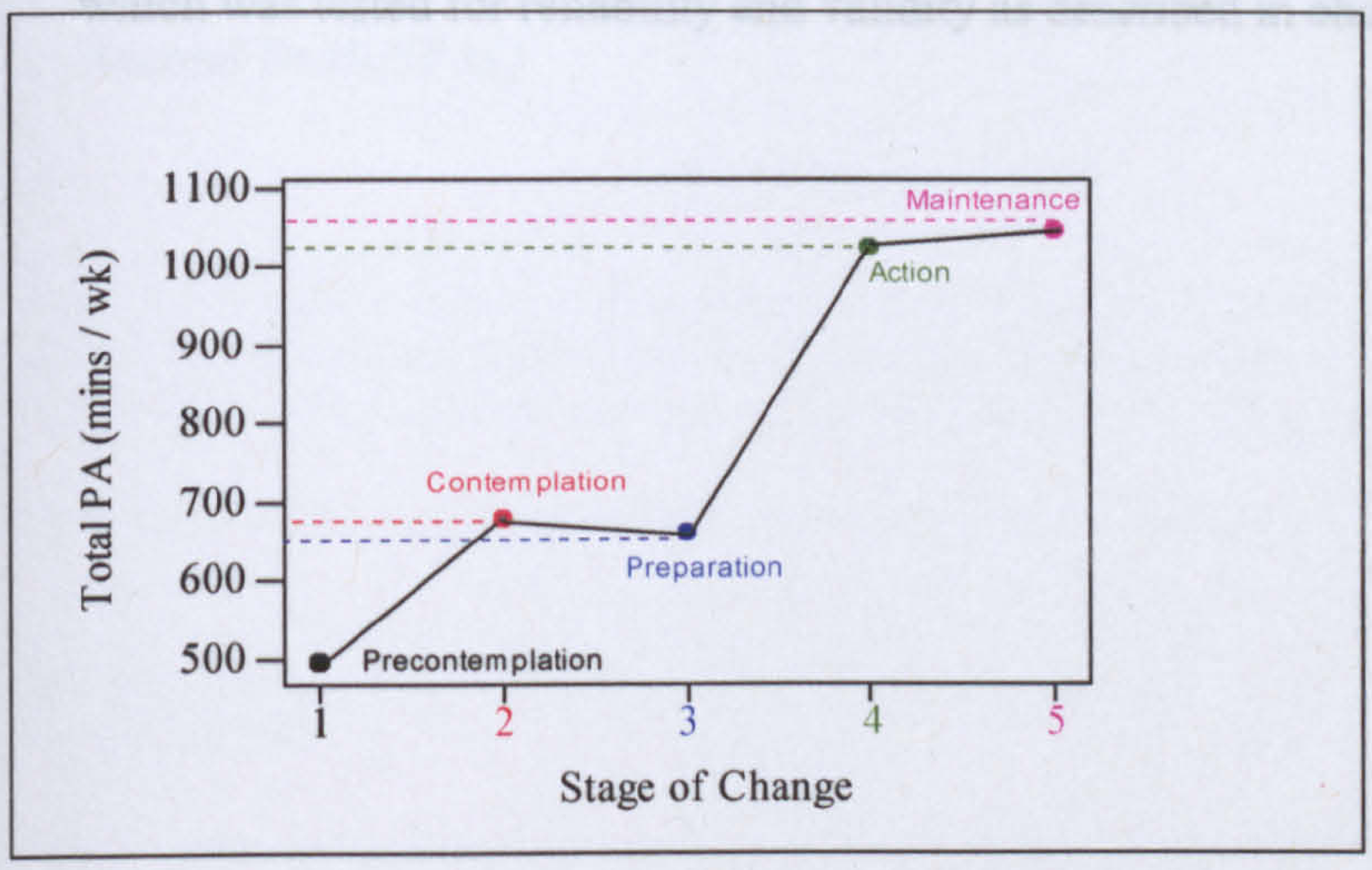


Figure 2. The relationship between stage of exercise behaviour change and total physical activity (mins / wk)

Figure 2 shows that this version of SPAQ displays a much better relationship between stage of exercise behaviour change and reported weekly physical activity than that of figure 1 in study A.

After participants had completed the questionnaire, it was found from the follow up questions that some of them were either under or over estimating physical activity in the walking and manual labour sections. When questioned about this it appeared that they were confusing occupational and leisure time physical activity in these two categories. When plotting stage of exercise behaviour change against physical activity with these two sections removed it can be seen from figure 3 that the expected relationship between physical activity and stage of change is evident.

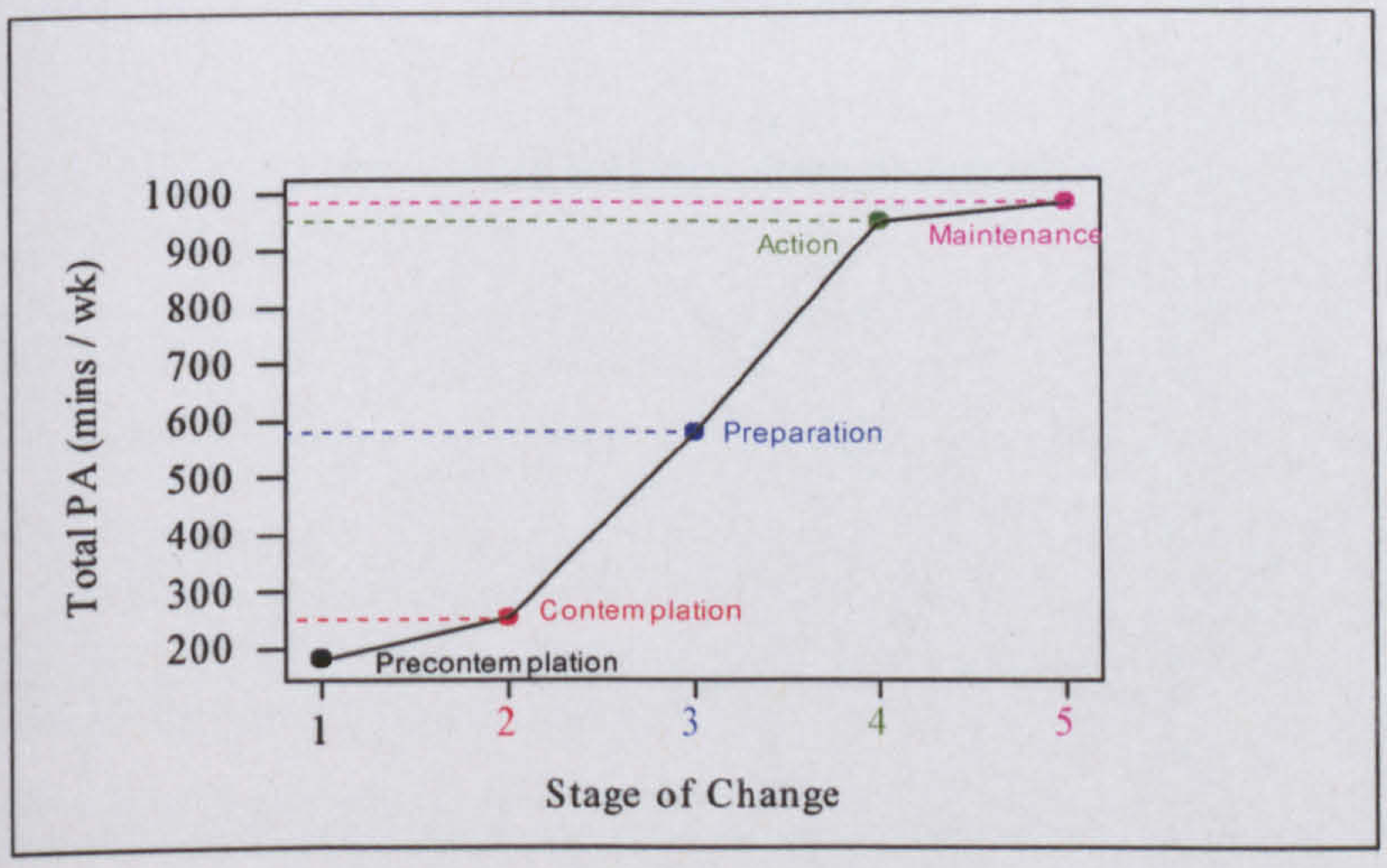


Figure 3. The relationship between stage of exercise behaviour change and total physical activity (mins / wk) minus the walking and manual labour sections.

It is clear from figures 2 and 3 that an alteration to the manual labour and walking sections of draft two was required. This was achieved by splitting each of the sections into a "work" component and an "outwith" work component. This resulted in a third draft SPAQ (appendix E) which was tested for reliability and validity as described in chapter three.

Appendix D

Second Draft SPAQ

East Ayrshire Council
Community Services

PHYSICAL ACTIVITY QUESTIONNAIRE

UNIVERSITY of GLASGOW

DEVELOPED BY EAST AYRSHIRE COUNCIL AND THE UNIVERSITY OF GLASGOW

The following questionnaire is a simple way of measuring the amount of physical activity you have done over the last week. The questionnaire is strictly confidential so try and answer all questions as honestly as you can. Obviously, the overall accuracy depends on the accuracy of individual answers. The questionnaire is not a test so there is no pass / fail.

May I take this opportunity to thank you for taking the time to fill out the questionnaire.

Matthew Lowther,
Exercise and Health Adviser, East Ayrshire Council.
Researcher, University of Glasgow.

REGULAR PHYSICAL ACTIVITY RELATES TO :

Exercise e.g.,weight training, aerobics etc-for 2 - 3 times per week ; hillwalking at least once per week

or

Sport e.g.,golf, hockey, football, netball etc - for 2- 3 times per week

or

General activity e.g., walking, gardening etc accumulating at least 30 minutes / 4-5 times per week

1.) Do you consider yourself to be regularly physically active now?

YES ☐ NO ☐ *(please tick one box)*

If YES go to question (2.), if No, were you regularly physically active,

3 months ago YES ☐ NO ☐ *(please tick one box)*

6 months ago YES ☐ NO ☐ *(please tick one box)*

Now go to question (2.)

2.) Please read through all categories listed below and tick **ONE** box for the category which best describes how physically active you have been over the last six months.

I am not regularly physically active and do not intend to be so in the next 6 months.	
I am not regularly physically active but am thinking about starting to do so in the next 6 months.	
I do some physical activity but not enough to meet the description of regular physical activity given above.	
I am regularly physically active but only began in the last 6 months.	
I am regularly physically active and have been so for longer than 6 months.	

(please tick one box)

On the following page you will find a sheet which lists your physical activity for the previous week.

The following questions relate to your physical activity over the previous week. Please try and think carefully and be as accurate as possible with your answers. For example you may have spent 4 hours at the disco but actually only spent half

(3.) In the past week how many minutes did you spend each day :

a.	**Walking?** e.g. walking to the shops , walking your dog , walking to work , hillwalking , walking up or down stairs , walking while at work etc.
	Example *Example* *Example*
b.	**Doing active housework?** Do include e.g. hoovering , scrubbing floors , bed making , hanging out washing etc Do not include e.g sewing , dusting , washing dishes , preparing food etc.
c.	**Doing manual work?** Do include e.g. gardening , decorating , washing car , lifting , climbing ladders etc Do not include e.g. shopping etc (unless actually walking or carrying shopping)
d.	**Dancing?** e.g disco , line , country etc
e.	**Cycling for pleasure or to work?**
f.	**Participating in a sport , leisure activity or training?** Do include e.g. exercise classes , football , swimming , golf , jogging , athletics etc Do not include e.g. darts , snooker / pool , fishing , playing a musical instrument etc
g.	**Other Physical Activity <u>if not already covered</u> (please write in)?** e.g. playing games with children , stacking shelves at work etc.

(4.) Was last week typical of the amount of physical activity you usually do? *(Tick one box only)*

YES	
NO - I usually do more	
NO - I usually do less	

that time dancing. Additionally, be carefull not to count the same activity twice. For example, if you have spent time in the last week hillwalking be carefull only to include this in either the walking or the leisure section and not both.

ON	TUES	WED	THUR	FRI	SAT	SUN	TOTAL
	10 mins,	10 mins	/	30 mins	15 mins	70 mins	165 mins

...uch more do you normally do? ________ Hours ________ Minutes

...uch less do you normally do? ________ Hours ________ Minutes

On the following page there is a section which records your personal details.

PERSONAL DETAILS

NAME:

TELEPHONE NUMBER: Ext

AGE IN YEARS :

TODAYS DATE:

(1.) Are you currently employed?

Yes / No *(please circle)*

(2.) Have you changed your employment or the kind of work you do in the last month?

Yes / No *(please circle)*

If YES , has this resulted in an increase in the amount of physical activity you do?

Yes / No *(please circle)*

If yes how?

END OF QUESTIONNAIRE ; THANKYOU

FOR OFFICE USE (please do not complete)

Exercise hours per week ;

Stage of Change ;

Appendix E

Third Draft SPAQ

PHYSICAL ACTIVITY QUESTIONNAIRE

East Ayrshire COUNCIL
Community Services

DEVELOPED BY EAST AYRSHIRE COUNCIL AND THE UNIVERSITY OF GLASGOW

UNIVERSITY of GLASGOW

The following questionnaire is a simple way of measuring the amount of physical activity you have done over the last week. The questionnaire is strictly confidential so try and answer all questions as honestly as you can. Obviously, the overall accuracy depends on the accuracy of individual answers. The questionnaire is not a test so there is no pass / fail.

May I take this opportunity to thank you for taking the time to fill out the questionnaire.

Matthew Lowther,
Exercise and Health Adviser, East Ayrshire Council.
Researcher, University of Glasgow.

REGULAR PHYSICAL ACTIVITY RELATES TO :

Exercise e.g.,weight training, aerobics etc-for 2 - 3 times per week ; hillwalking at least once per week

or

Sport e.g.,golf, hockey, football, netball etc - for 2- 3 times per week

or

General activity e.g., walking, gardening etc accumulating at least 30 minutes / 4-5 times per week

1.) Do you consider yourself to be regularly physically active now?

YES ☐ NO ☐ *(please tick one box)*

If YES go to question (2.), if No, were you regularly physically active,

3 months ago YES ☐ NO ☐ *(please tick one box)*

6 months ago YES ☐ NO ☐ *(please tick one box)*

Now go to question (2.)

2.) Please read through all categories listed below and tick **ONE** box for the category which best describes how physically active you have been over the last six months.

I am not regularly physically active and do not intend to be so in the next 6 months.	
I am not regularly physically active but am thinking about starting to do so in the next 6 months.	
I do some physical activity but not enough to meet the description of regular physical activity given above.	
I am regularly physically active but only began in the last 6 months.	
I am regularly physically active and have been so for longer than 6 months.	

(please tick one box)

On the following page you will find a sheet which lists your physical activity for the previous week.

- The following questions relate to your physical activity over the previous week. Please try and think carefully and be as accurate as possible with your answers. For example you may have spent 4 hours at the disco but actually only spent half

(3.) In the past week how many minutes did you spend each day :

a. **Walking at work?**
e.g. walking up or down stairs, walking to and from your desk, "doing the rounds" etc

Example *Example* *Examp*

b. **Walking outwith work?**
e.g. walking to the shops, walking your dog, walking to work, hillwalking, walking for pleasure, walking up or down stairs etc.

Example *Example* *Examp*

c. **Manual Labour at work?**
Do include e.g. lifting, stacking shelves, climbing ladders, building work etc.
Do not include e.g. sitting at desk, answering telephone, driving, checkout operatio

d. **Manual Labour outwith work?**
Do include e.g. cutting grass, decorating, washing car, D.I.Y., digging etc
Do not include e.g. weeding, planting, pruning etc.

e. **Doing active housework?**
Do include e.g hoovering, scrubbing floors, bed making, hanging out washing e
Do not include e.g. sewing, dusting, washing dishes, preparing food etc.

f. **Dancing?**
e.g disco, line, country etc

g. **Cycling for pleasure or to work?**

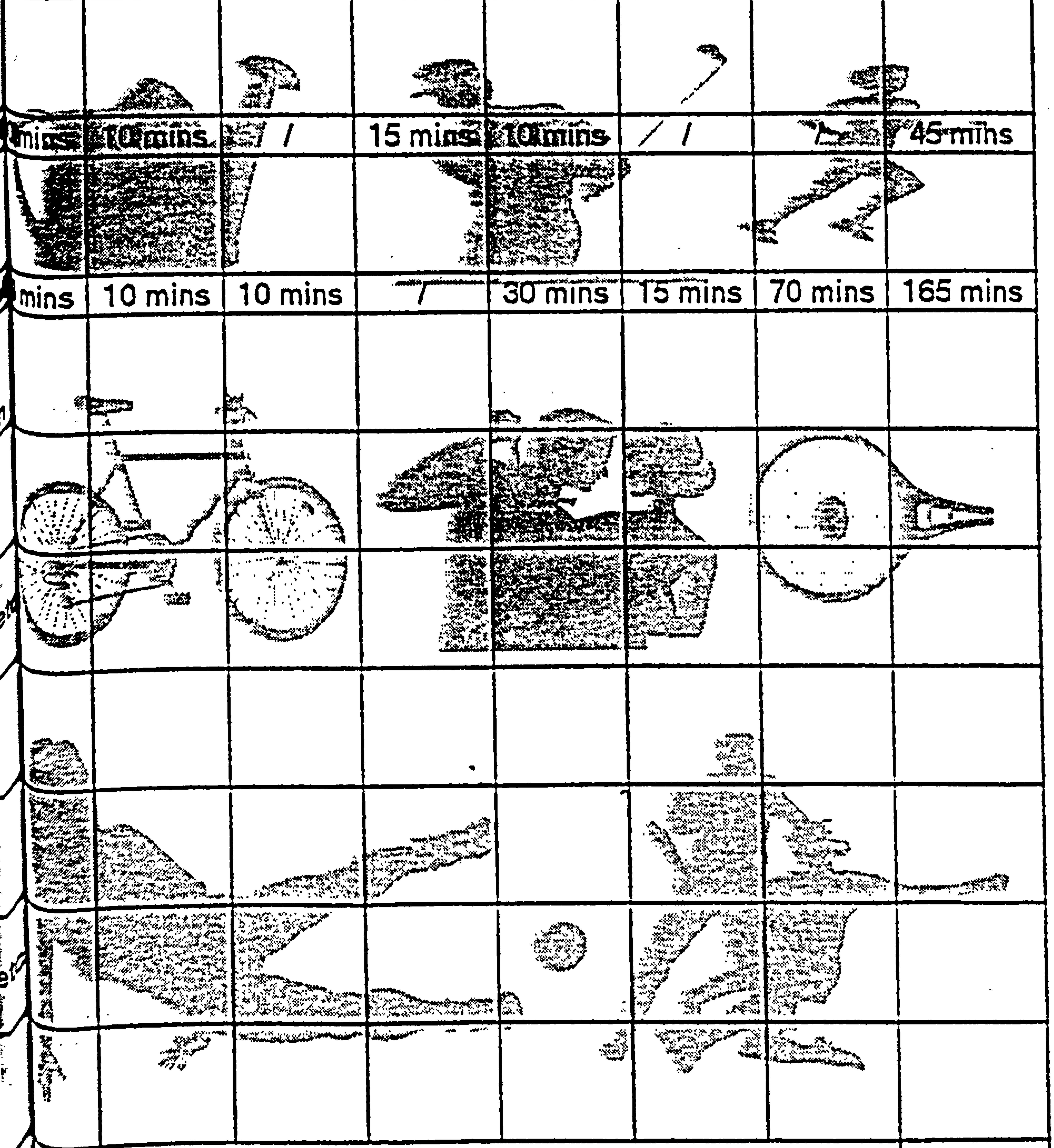
h. **Participating in a sport, leisure activity or training?**
Do include e.g. exercise classes, football, swimming, golf, jogging, athletics et
Do not include e.g. darts, snooker / pool, fishing, playing a musical instrument etc.

i. **Other Physical Activity if not already covered (please write in)**

(4.) Was last week typical of the amount of physical activity you usually do?

YES	☐	*(Tick one box onl*
NO - I usually do more	☐	Normally how m
NO - I usually do less	☐	Normally how m

that time dancing. Additionally, be carefull not to count the same activity twice. For example, if you have spent time in the last week hillwalking be carefull only to include this in either the walking or the leisure section and not both.



ON	TUES	WED	THUR	FRI	SAT	SUN	TOTAL
mins	10 mins	/	15 mins	10 mins	/		45 mins
mins	10 mins	10 mins	/	30 mins	15 mins	70 mins	165 mins

_______________ Of which activity? _______________

_______________ Of which activity? _______________

he following page there is a section which records your personal details.

PERSONAL DETAILS

NAME:

TELEPHONE NUMBER: Ext

AGE IN YEARS :

TODAYS DATE:

1.) Are you currently employed?

Yes / No *(please circle)*

2.) Have you changed your employment or the kind of work you do in the last month?

Yes / No *(please circle)*

If YES , has this resulted in an increase in the amount of physical activity you do?

Yes / No *(please circle)*

If yes how?

END OF QUESTIONNAIRE ; THANKYOU

FOR OFFICE USE (please do not complete)

Exercise hours per week ;

Stage of Change ;

Appendix F

Original *Ricclees* Application Form

Name ....
Address ....
....
....
Postcode ....
Date of Birth ....
Tel. No. (Home) ....(Work) ....
T-Shirt size (S, M, L) ....

I, the undersigned, have read and fully understand the Club's terms and conditions and will abide by them. I understand that failure to do so may lead to my dismissal from the Club.

Signature ....

Date ....

Please return this form by hand to:-
The Barn Community House, Riccarton,
Shortlees Community House or
Leisure Services Department
or post to:-

HEALTHY LIFESTYLE PROJECT
LEISURE SERVICE
CIVIC CENTRE
KILMARNOCK KA1 1BY
Telephone: (01563) 78431

KILMARNOCK and LOUDOUN district council

Leisure Services

Please tear along dotted line

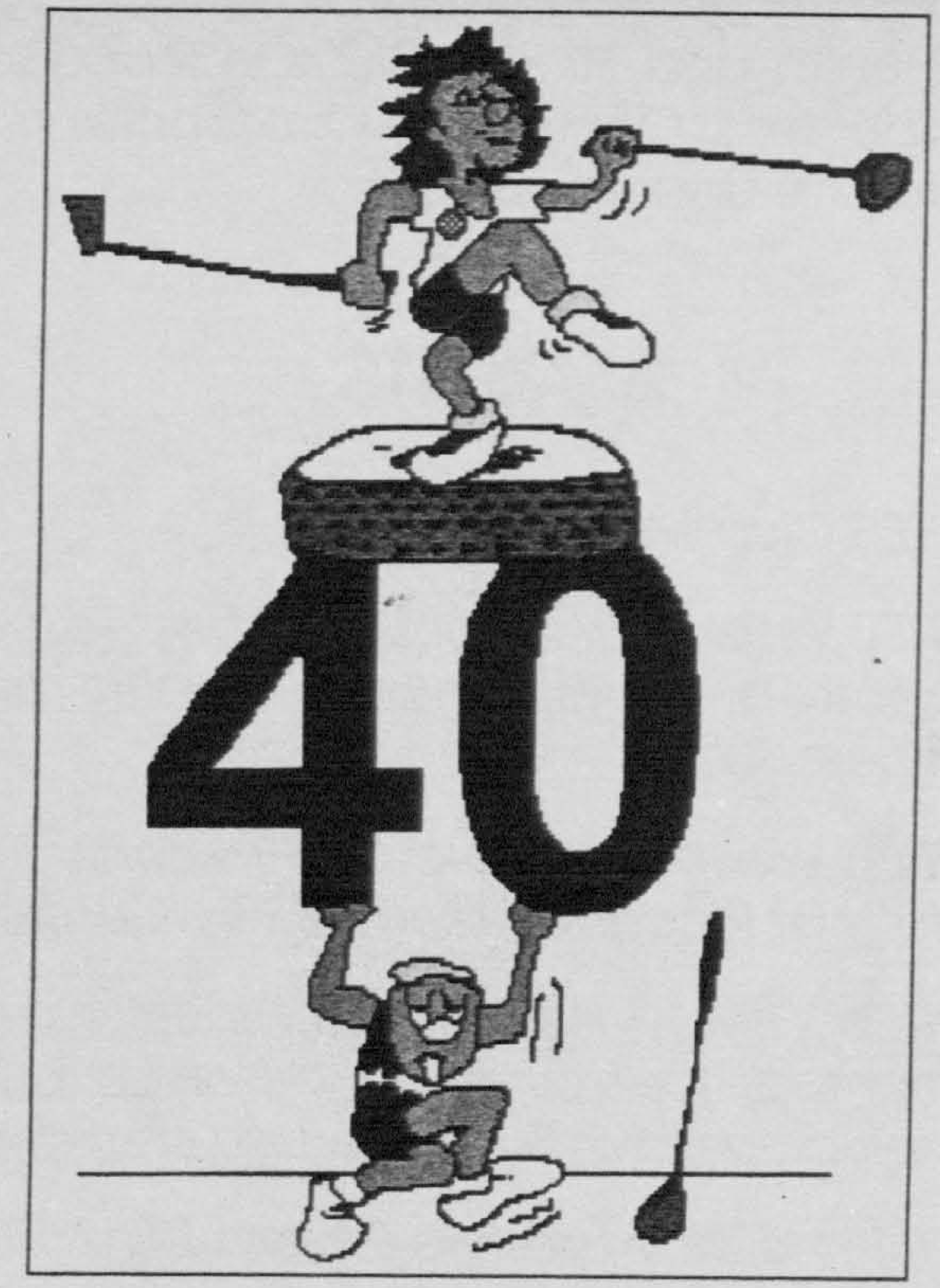
TERMS AND CONDITIONS

1. **Membership Cards** are issued in a specific name and are not transferable.
2. Only residents of Shortlees or Riccarton may apply to join either of the Clubs. Proof of residency will be requested before cards are issued.
3. Possession of a **Membership Card** does not entitle the holder priority over other customers.
4. While in the Galleon Centre the holder is subject to all its rules and regulations.
5. **Membership Cards** must be displayed every time a particular service is requested.
6. **Membership Cards** are valid only until the date shown on the card.
7. ***The Healthy Lifestyle Project*** reserves the right to confiscate **Membership Cards** and/or refuse further applications if the holder does not comply with the conditions of use.
8. ***The Healthy Lifestyle Project*** reserves the right to vary conditions of use and facilities available without prior notice.
9. The **Membership Card** only entitles access to the Galleon Centre's Health and Fitness Suite and no other area.
10. Any false information given will disqualify the application.
11. If you move from either Shortlees or Riccarton, membership will no longer be valid and **Membership Cards** must be submitted to the Leisure Service Department.

KILMARNOCK and LOUDOUN district council

Leisure Services

SOLVE THE CATCHPHRASE



ANSWER OVERLEAF

The Healthy Lifestyle Project

AIMING FOR BETTER HEALTH

KILMARNOCK and LOUDOUN district council
Leisure Services

ANSWER: **OVER 40 AND UNDER 40 HEALTH AND FITNESS CLUBS**

The Healthy Lifestyle Project is now initiating two Health and Fitness Clubs in Riccarton and Shortlees. One for the Over Forties and one for the Under Forties.

BENEFITS

- *FREE Club Membership*
- *FREE Weekly work-outs at the Galleon Centre's fabulous new Health and Fitness Suite*
- *FREE Weekly aerobic and flexibility sessions at Riccarton Community Centre*
- *FREE 'Fitech' Health and Fitness assessment as well as a full dietary analysis including advice on exercise and diet.*
- *FREE Healthy Lifestyle Project T-Shirt*
- *FREE entry into Club competitions*
- *Access to regular 'Getaway' Trips organised for Club Members*
- *Opportunity for interested Members to gain recognised Health and Fitness qualifications*
- *FREE access to the Healthy Lifestyle Projects accompanying health and fitness library*
- *Subject to demand FREE crèche facilities*

HOW DO I JOIN?

Membership of either of the Clubs is only available to residents of **Shortlees** or **Riccarton.**

If you would like to join, simply fill in the application form overleaf.

You can then hand it into the Leisure Service Department in John Finnie Street, Shortlees Community House or the Barn Community House, Riccarton. Alternatively you can post your applications to the address at the bottom of the Application Form.

Upon completion you will be issued with a MEMBERSHIP CARD, which involves coming into the Leisure Service Department at John Finnie Street to have your photograph taken for your card. Your membership card will then be posted out to you within a couple of days along with your free HEALTHY LIFESTYLE PROJECT T-SHIRT.

THEN WHAT DO I DO?

Once you have received your membership card you may visit the Galleon Centre's Health and Fitness Club whenever you wish. Simply present your card at the reception and away you go. A date will also be arranged with you for your free Health and Fitness Fitech assessment as well as being informed of your club night for the aerobics and flexibility sessions.

As a member you will also receive regular leaflets detailing current club competitions, forthcoming trips and listings of all the Health, Fitness and Dietary Literature available to you free from the HEALTHY LIFESTYLE PROJECT library.

HOW LONG DOES MEMBERSHIP LAST?

Memberships will be valid for 1 full year. When your membership expires you will only need to call in at the Leisure Service Department with proof that you are still eligible and another card will be issued. If you move from Shortlees or Riccarton you will be required to surrender your card as your membership will no longer be valid.

LOST CARDS

If your card becomes lost, a replacement can be ordered. Because your picture is stored on computer you only have to telephone to order a replacement.

Appendix G

Fitech Formal Consent Form

PERSONAL DETAILS

REF. No. ....

TODAY'S DATE ....

FORENAMES ....

SURNAME ....

SEX ....

WEIGHT ....

HEIGHT ....

DATE OF BIRTH ....

ADDRESS ....

....

....

....

....

TEL. NO. ....

CONFIGURABLE CODES

....

....

....

....

LIFESTYLE EVALUATION

SMOKER YES / NO

NO. PER DAY ....

UNITS OF ALCOHOL CONSUMED

PER WEEK ....

ACTIVITY POINTS

WORK ....

LEISURE ....

TEST RESULTS

BODY FAT

TRICEPS .... mm

BICEPS .... mm

SUBSCAPULARIS .... mm

SUPRAILIAC .... mm

TOTAL ....

BLOOD PRESSURE

SYSTOLIC .... mm Hg

DIASTOLIC .... mm Hg

RESTING H.R. .... bts/min

FLEXIBILITY .... cms

BODY STRENGTH

GRIP .... kgs

LEG & BACK .... kgs

LUNG EFFICIENCY

FVC ....

FEV[1] ....

PEFR ....

STAMINA

WORK LOAD .... Kps

6.0 MIN H.R. .... bts/min

AER. CAP .... mls O_2/Kg/min

PERCEIVED EXERTION ....

CHOLESTEROL

TOTAL CHOLESTEROL ....

TRIGLYCERIDES ....

HDL ....

LDL ....

Fitech

FORMAL CONSENT FORM & RECORD CARD

Name ....

Appointment Time ....

Please complete and return to:

A tracksuit or sportswear is the most ideal clothing for the purpose of this test. However, if this is not possible please come in loose fitting clothing, i.e.

Gentlemen -	may remove their jacket and tie.
Ladies -	full skirt and cotton blouse.

NB. Ladies should avoid wearing an underwired bra as this may cause an interference with the testing equipment. Also, no leotards or high heels please.

BEFORE TAKING THE TEST

- Avoid EATING, SMOKING or DRINKING tea, coffee or alcohol for at least 2 hours before the test.
- Do not take the test if you have had a cold or are recovering from a bout of illness.
- Do not exercise prior to the test.

IMPORTANT NOTICE

Please inform the tester if you are currently taking any medication, since certain types (e.g. Beta Blockers) will affect the heart rate and blood pressure results.

To be completed by the tester:

INJURY/MEDICAL NOTES

Date	Nature of Injury / Medical Condition	Treatment

General Notes

FORMAL CONSENT FORM

THE FITNESS TESTS will take around 20 minutes to complete and include measurement of your HEIGHT and WEIGHT, BODY FAT PERCENTAGE, BLOOD PRESSURE, STRENGTH, SUPPLENESS, LUNG EFFICIENCY and STAMINA. Stamina or AEROBIC FITNESS is determined by measuring your heart rate during a 6 minute bout of submaximal exercise on a stationary cycle. From this your AEROBIC CAPACITY score may be predicted along with a FITNESS RATING for your age and sex.

Before participating in these Fitness Tests, please answer the following 5 questions regarding your health.

		YES	NO
1.	Have you EVER suffered from a heart condition or high blood pressure?	......	......
2.	Do you have chest trouble, like asthma or bronchitis?	......	......
3.	Are you troubled with joint pains, severe back pains or arthritis?	......	......
4.	Are you recovering from an illness or operation?	......	......
5.	Are there any other aspects of your health that may be adversely affected by exercise? e.g. Pregnancy, Epilepsy.	......	......

If the answer to any of these questions is YES, please consult your Doctor before starting any vigorous exercise or taking this Fitness Test. Please ask him/her to give you a signed note saying you are fit to take the test and bring it with you at your appointment time.

WARNING

There is always a very small risk that taking any form of exercise may reveal an unknown health defect or weakness which leads to injury, illness or even fatality. That is true of the Fitech Test. Any person who:-

1. has any reason to believe that they may suffer from any such defect or weakness OR
2. has habitually taken no form of exercise OR
3. has any known medical complaint which may be adversely affected by exercise

should seek medical advice before participating in the Fitech Test and subsequent recommended exercise programmes.

Signed .... Date ....

Appendix H

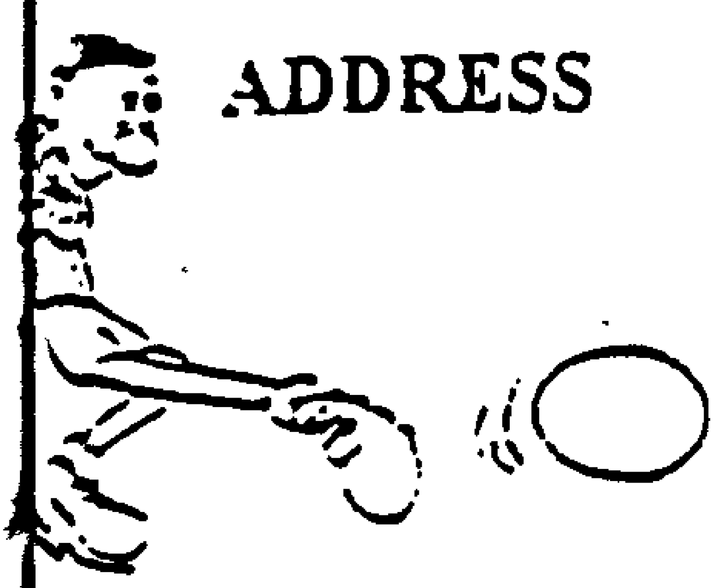
Exercise Consultation Reference Sheet

EXERCISE CONSULTATION REFERENCE SHEET

NAME

DOB

ADDRESS



Exercise History/Previous interests and participation in sport and exercise.
Think about any physical activity (exercise and sport) you do or have done?

Prompts could be regular walking, DIY, gardening, leisure time activities etc.

BALANCE

Think of the possible gains and losses about becoming more physically active

GAINS	*LOSSES*

BARRIERS

Think of the barriers you have about becoming more active

Prompt Time, Money, Illness/Injury, Facilitys, Weather

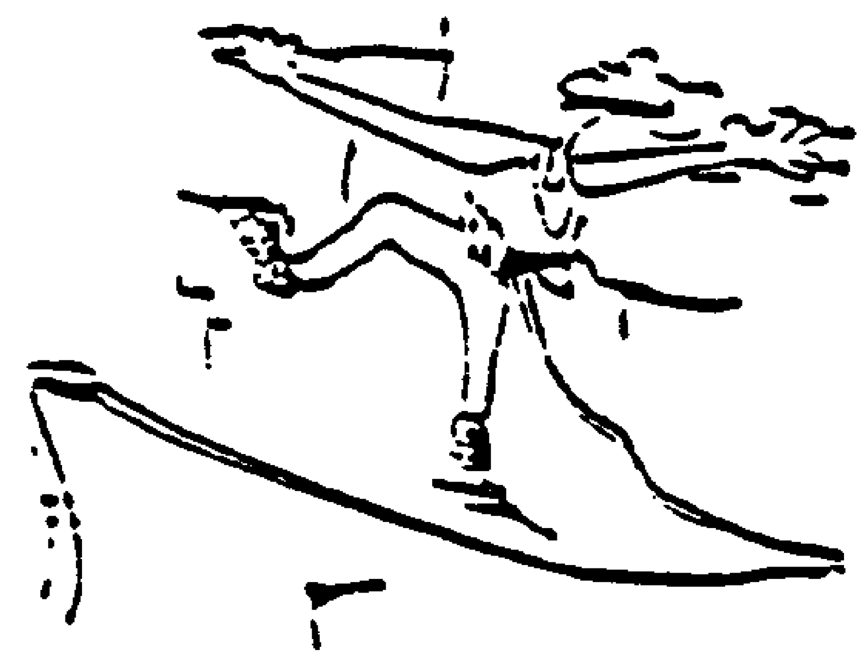
SUPPORT

Do you have any friends,family, or work colleagues who are at the same stage?

GOALS

What are your main goals for taking up exercise/being more active

Now 3 Months 1 Year



Prompt

Feel Better

Meet people

Health

Lose/gain weight

Achievement

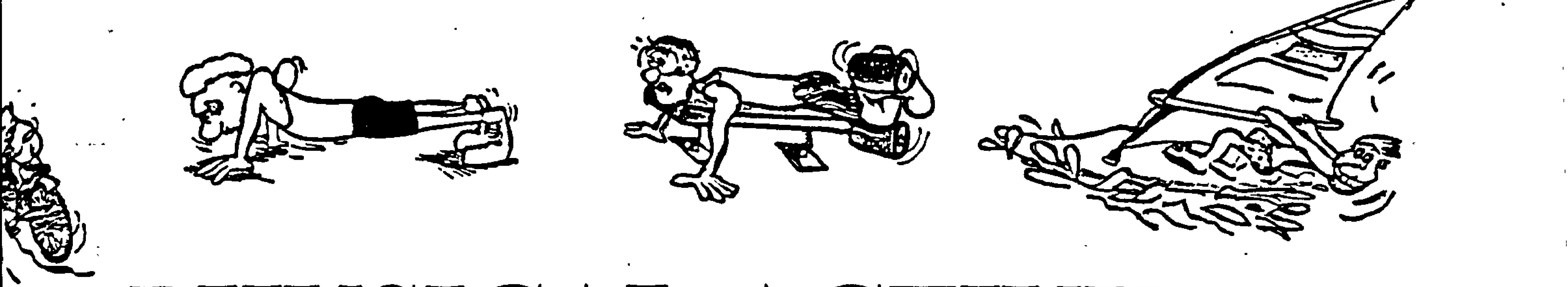
Challenge

Excitement

HT WT

Appendix I

Full Information Booklet



PHYSICAL ACTIVITY QUESTIONNAIRE

r Participant,

y I take this opportunity to thankyou for taking the time to fill out this questionnaire which should take no longer than 20 utes. It is important I get as many subjects as possible so I really do appreciate your participation.

questionnaire is a simple way of measuring the amount of physical activity you have done over the last week as well as cating what experiences you may draw upon when exercising or are thinking about exercising. You have both my rance and the managements that any results obtained will be used as part of a Master of Science Degree and will be strictly fidential. Only myself will have access to individual results and only general trends will eventually be published so please nd answer all questions as honestly as you can. Obviously, the overall accuracy depends on the accuracy of individual wers. The questionnaire is not a test so there is no pass / fail.

will also be given the chance to participate in either a fitness assessment or exercise consultation. A fitness assessment lves measuring height, weight, % body fat, blood pressure, flexibility, strength, lung efficiency and stamina. The lts are then analysed using state of the art software to produce an immediate, comprehensive guide to your overall health ed fitness. Particular areas which may need improvement can be highlighted allowing you and your adviser to discuss any s in which these areas can be improved. You will also receive a "cardiac risk assessment" which graphically displays on puter hypothetical benefits associated with lifestyle changes. At the end of the assessment you will receive a prehensive report allowing you to analyse your performance and any subsequent recommendations in your own time. The rt is also useful if you are thinking about increasing the amount of physical activity you do as it acts as a baseline in which easure any improvements.

ntrast, an exercise consultation is the "supportive" way to introduce exercise into your life. It involves a one to one ussion with an exercise specialist about such areas as current activity levels, advantages and disadvantages of becoming active, barriers to exercise and setting an exercise programme suitable for your lifestyle. The main aim of the sultation is to motivate you to make the necessary changes in your lifestyle to accommodate regular physical activity. At nd of the consultation you are given a goal card which details short term, intermediate and long term goals aimed at iding you with a progressive method of increasing and then maintaining your physical activity levels.

intervention should take no longer than 30 minutes and will be arranged at a time most suitable to yourself (i.e. in work or in your leisure time) and will take place at the police station.

r approximately 3 months you will receive another questionnaire similar to this and then again after a further 3 months. At time you will also be invited for a second intervention to evaluate any improvements.

again thankyou for your participation and I look forward to meeting you personally should you volunteer.

Lowther,
cise and Health Adviser, East Ayrshire Council; Researcher, University of Glasgow.

t Ayrshire
COUNCIL
unity Services

DEVELOPED BY EAST AYRSHIRE COUNCIL AND THE UNIVERSITY OF GLASGOW

UNIVERSITY
of
GLASGOW

SECTION 1

NAME:____________________________________

TEL Ext:____________________________________

AGE IN YEARS:______________________________

TODAYS DATE:______________________________

DEPARTMENT:______________________________

(1.) Have you changed your employment or the kind of work you do in the last month?

YES ☐ NO ☐ *(please tick one box)*

If NO , go to question 2.

If YES , has this resulted in an increase in the amount of physical activity you do?

YES ☐ NO ☐ *(please tick one box)*.

If YES how?

(2.) Would you like to receive either a fitness assessment or exercise consultation?

YES ☐ NO ☐ *(please tick one box)*

If NO , please go to Section 2 on the next page

If YES which intervention would you prefer?

FITNESS ASSESSMENT ☐ EXERCISE CONSULTATION ☐ *(please tick one box)*

Please note that due to the nature of the study you may be randomly assigned into a group who will have to wait approximately 3 months for their chosen intervention.

Please indicate any dates you are on holiday in the next month so an appointment time can be arranged.

1.
2.
3.

You will be notified of an appointment shortly. If this is unacceptable you will have the opportunity to rearrange it. Now please continue the questionnaire with Section 2 on the next page.

SECTION 2

REGULAR PHYSICAL ACTIVITY RELATES TO :	
ercise	e.g.,weight training , aerobics etc-for 2 - 3 times per week ; hillwalking at least once per week
or	
ort	e.g.,golf , hockey , football , netball etc - for 2- 3 times per week
or	
neral activity	e.g., walking , gardening etc accumulating at least 30 minutes / 4-5 times per week

) Do you consider yourself to be regularly physically active now?

YES ☐ NO ☐ *(please tick one box)*

'YES go to question (2.) , if NO , were you regularly physically active,

nonths ago? YES ☐ NO ☐ *(please tick one box)*

nonths ago? YES ☐ NO ☐ *(please tick one box)*

n go to question (2.)

) Please read through all categories listed below and tick **ONE** box for the category ich best describes how physically active you have been over the last six months.

(please tick one box)

I am not regularly physically active and do not intend to be so in the next 6 months.	
I am not regularly physically active but am thinking about starting to do so in the next 6 months.	
I do some physical activity but not enough to meet the description of regular physical activity given above.	
I am regularly physically active but only began in the last 6 months.	
I am regularly physically active and have been so for longer than 6 months.	

the following page you will find a sheet which lists your physical activity for the vious week.

The following questions relate to your physical activity over the previous week. Please try and think carefully and be as accurate as possible with your answers. For example you may have spent 4 hours at the disco but actually only spent half

(3.) In the past week how many minutes did you spend each day ;

i. **Walking at work?**
e.g. walking up or down stairs, walking to and from your desk, "doing the rounds"

Example *Example* *Ex*

ii. **Walking outwith work?**
e.g. walking to the shops, walking your dog, walking to work, hillwalking, walking for pleasure, walking up or down stairs etc.

Example *Example* *Ex*

iii. **Manual Labour at work?**
Do include e.g. lifting, stacking shelves, climbing ladders, building work etc
Do not include e.g. sitting at desk, answering telephone, driving, checkout oper

iv. **Manual Labour outwith work?**
Do include e.g. cutting grass, decorating, washing car, D.I.Y., digging etc
Do not include e.g. weeding, planting, pruning etc.

v. **Doing active housework?**
Do include e.g hoovering, scrubbing floors, bed making, hanging out washing
Do not include e.g. sewing, dusting, washing dishes, preparing food etc.

vi. **Dancing?**
e.g disco, line, country etc

vii. **Cycling for pleasure or to work?**

viii. **Participating in a sport, leisure activity or training?**
Do include e.g. exercise classes, football, swimming, golf, jogging, athletics
Do not include e.g. darts, snooker / pool, fishing, playing a musical instrument etc

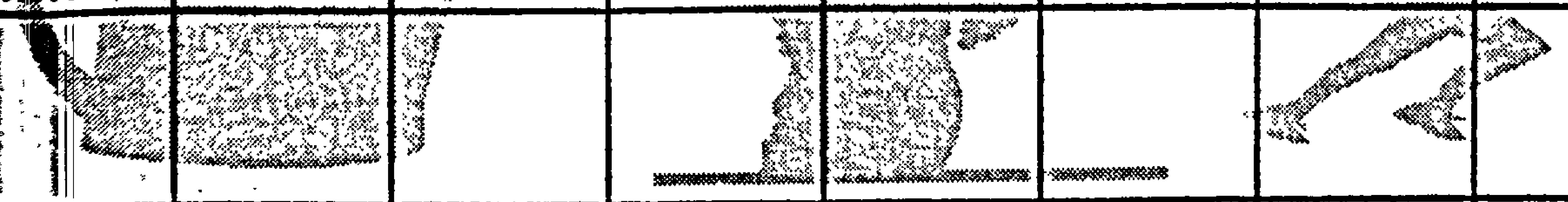
ix. **Other Physical Activity if not already covered (please write in)**

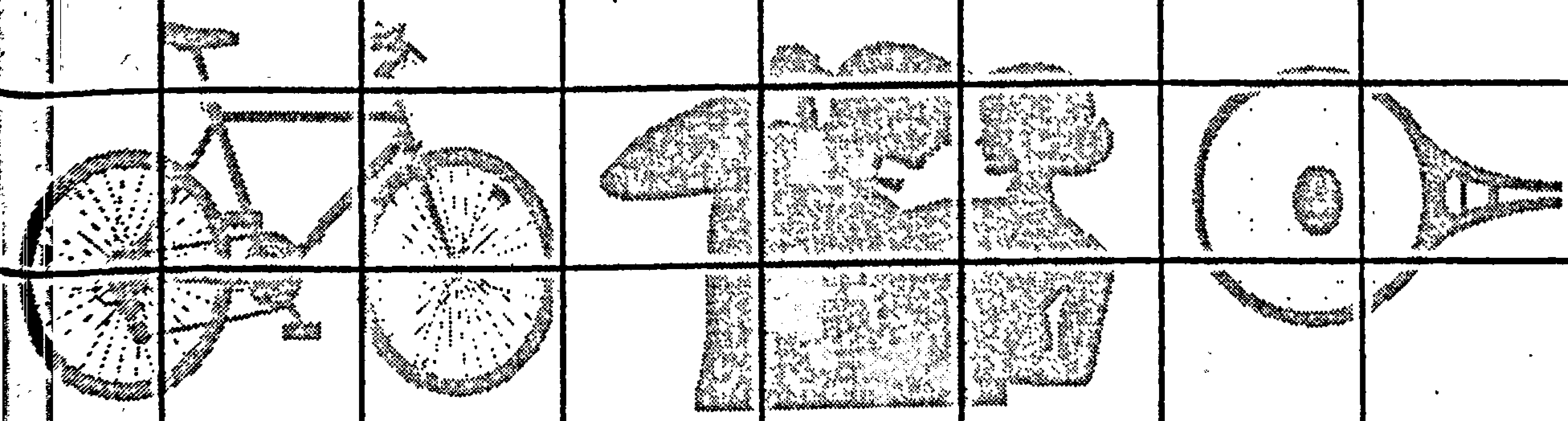
(4.) Was last week typical of the amount of physical activity you usually do? *(please tick one box)*

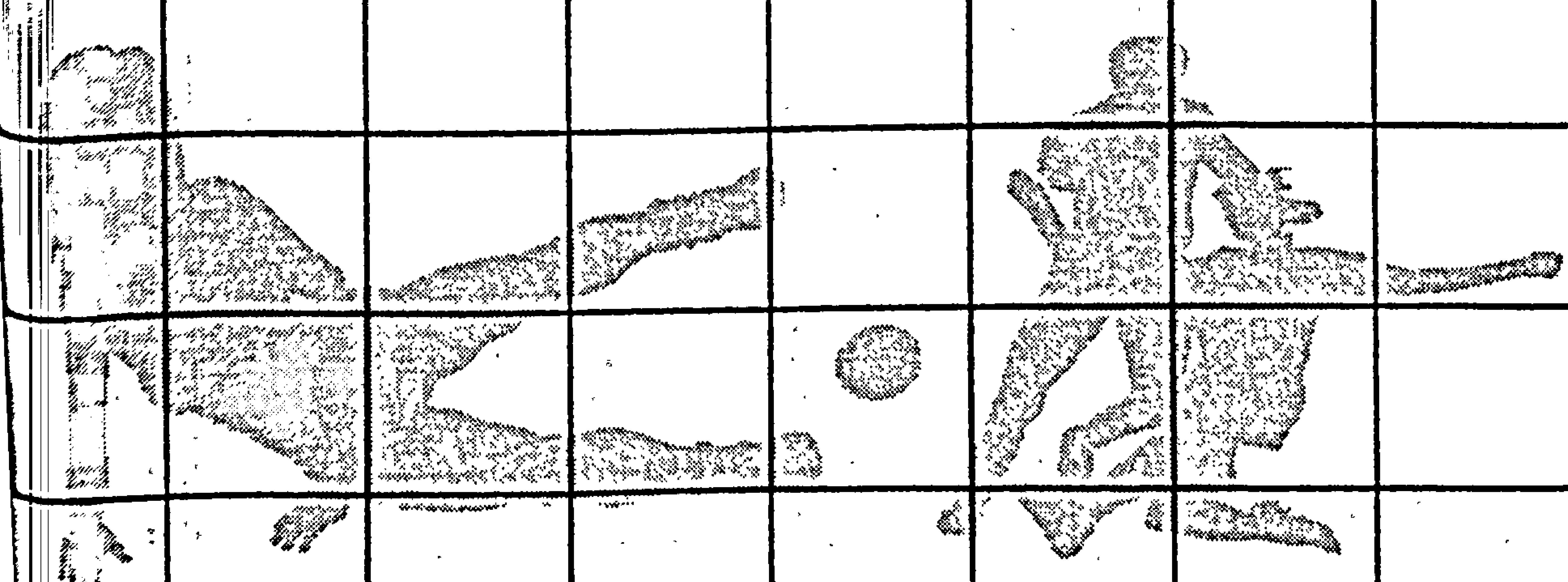
YES	☐	
NO - I usually do more	☐	Normally how
NO - I usually do less	☐	Normally how

On the following page Section 3 details the extent to which you draw upon some ex

that time dancing. Additionally, be carefull not to count the same activity twice. For example, if you have spent time in the last week hillwalking be carefull only to include this in either the walking or the leisure section and not both.







MON	TUES	WED	THUR	FRI	SAT	SUN	TOTAL
0 mins	10 mins	/	15 mins	10 mins	/	/	45 mins
0 mins	10 mins	10 mins	/	30 mins	15 mins	70 mins	165 mins

e? ____________ Of which activity? ____________

? ____________ Of which activity? ____________

riences.

SECTION 3

The following experiences can affect the exercise habits of some people. Think of any similar experiences you may be currently having or have had during the last month. Then rate how frequently the event occurs. Please circle the number that best describes your answer for each experience. How frequently does this occur?

	Never		Occasionally		Repeatedly	For Office use only
1. Instead of remaining inactive I engage in some physical activity	1	2	3	4	5	g
2. I tell myself I am able to keep exercising if I want to.	1	2	3	4	5	b
3. I put things around my home to remind me of exercising.	1	2	3	4	5	f
4. I tell myself that if I try hard enough I can keep exercising.	1	2	3	4	5	b
5. I recall information people have personally given me on the benefits of exercise.	1	2	3	4	5	a
6. I make commitments to exercise.	1	2	3	4	5	b
7. I reward myself when I exercise	1	2	3	4	5	j
8. I think about information from articles and advertisements on how to make exercise a regular part of my life.	1	2	3	4	5	a
9. I keep things around my place of work that remind me to exercise.	1	2	3	4	5	f
10. I find society changing in ways that make it easier for the exerciser.	1	2	3	4	5	h
11. Warnings about health hazards of inactivity affect me emotionally.	1	2	3	4	5	c
12. Dramatic portrayals of the evils of inactivity affect me emotionally.	1	2	3	4	5	c
13. I react emotionally to warnings about an inactive lifestyle.	1	2	3	4	5	c
14. I worry that inactivity can be harmful to my body.	1	2	3	4	5	c
15. I am considering the idea that regular exercise would make me a healthier, happier person to be around.	1	2	3	4	5	i
16. Ihave someone on whom I can depend when I am having problems with exercising.	1	2	3	4	5	e
17. I read articles about exercise in an attempt to learn more about it.	1	2	3	4	5	a
18. I try to set realistic exercise goals for myself rather than setting myself up for failure by expecting too much.	1	2	3	4	5	j
19. I have a healthy friend that encourages me to exercise when I don't feel up to it.	1	2	3	4	5	e
20. When I exercise, I tell myself that I am being good to myself by taking care of my body.	1	2	3	4	5	j
21. Exercise is my special time to relax and recover from the days worries, not a task to get out of the way.	1	2	3	4	5	g
22. I am aware of more and more people encouraging me to exercise these days.	1	2	3	4	5	h
23. I do something nice for myself for making efforts to exercise more.	1	2	3	4	5	j
24. I have someone who points out my rationalizations for not exercising.	1	2	3	4	5	e
25. I have someone who provides feedback about my exercising.	1	2	3	4	5	e
26. I remove things that contribute to my inactivity.	1	2	3	4	5	f
27. I am the only one responsible for my health, and only I can decide whether or not I will exercise.	1	2	3	4	5	b
28. I look for information related to exercise.	1	2	3	4	5	a
29. I avoid spending long periods of time in enviroments that promote inactivity.	1	2	3	4	5	f
30. I feel I would be a better role model for others if I exercised regularly.	1	2	3	4	5	d

	Never	Occasionally		Repeatedly		For office use only
31. I think about the type of person I will be if I keep exercising.	1	2	3	4	5	i
32. I notice that more businesses are encouraging their employees to exercise by offering fitness courses and time off to exercise.	1	2	3	4	5	h
33. I wonder how my inactivity affects those people who are close to me.	1	2	3	4	5	d
34. I realise that I might be able to influence others to be healthier if I would exercise mor	1	2	3	4	5	d
35. I get frustrated with myself when I don`t exercise.	1	2	3	4	5	i
36. I am aware that many health clubs now provide free creches to their members.	1	2	3	4	5	h
37. Some of my close friends might exercise more if I would.	1	2	3	4	5	d
38. I consider the fact that I would feel more confident in myself if I exercised regularly.	1	2	3	4	5	i
39. When I feel tired I make myself exercise anyway because I know I will feel better afterward.	1	2	3	4	5	g
40. When I`m feeling tense , I find exercise a great way to relieve my worries.	1	2	3	4	5	g

END OF QUESTIONNAIRE - WELL DONE!

PLEASE RETURN TO KENNY MORRISON AT OFFICER SAFETY TRAINING , KILMARNOCK

FOR OFFICE USE ONLY (Please do not complete)

REF No:

DATE:

DEPARTMENT:

STAGE OF CHANGE:

PREFERRED INTERVENTION:

WORK TIME PHYSICAL ACTIVITY: +/- TOTAL:
(i.e. i. + iii. + v.)

LEISURE TIME PHYSICAL ACTIVITY: +/- TOTAL:
(i.e. ii. + iv. + vi. + vii. + viii. + ix.)

TOTAL PHYSICAL ACTIVITY FOR NORMAL WEEK:

a: Consciousness Raising	5 + 8 + 17 + 28 / 4	________CR
b: Self Liberation	2 + 4 + 6 + 27 / 4	________SL
c: Dramatic Relief	11 + 12 + 13 + 14 / 4	________DR
d: Enviromental Reevaluation	30 + 33 + 34 + 37 / 4	________ER
e: Helping Relationships	16 + 19 + 24 + 25 / 4	________HR
f: Stimulus Control	3 + 9 + 26 + 29 / 4	________SC
g: Counter Conditioning	1 + 21 + 39 + 40 / 4	________CC
h: Social Liberation	10 + 22 + 32 + 36 /4	________SO
i: Self Reevaluation	15 + 31 + 35 + 38 / 4	________SR
j: Reinforcement Management	7 + 18 + 20 + 23 / 4	________RM

GROUP:

ASSESSMENT ARRANGED FOR:

Appendix J

Exercise Consultation Goal Record Sheet

PERSONAL GOAL RECORD SHEET

Below is a list of activity "goals" you set yourself at your recent appointment. Remember you don't need to become an "exercise junkie" to make significant improvements. Even the smallest of changes like walking for an extra 15 minutes each day can produce significant results.

1. LONG TERM GOALS

(i.e. What would you hope to have achieved after 3 months before your final re-assessment?)

a.) ______________________________

b.) ______________________________

c.) ______________________________

SHORT TERM GOALS

(i.e. What differences do you think you can make immediately?)

a.) ______________________________

b.) ______________________________

c.) ______________________________

INTERMEDIATE GOALS

(i.e. What would you hope to have achieved after approximately 6 weeks?)

a.) ______________________________

b.) ______________________________

c.) ______________________________

When you reach a particular goal try and reward yourself. Remember to regularly check your goal record sheet to remind yourself of what you are ultimately trying to achieve. Finally , it is only yourself who can make these small changes and at the end of the day it will be you who will benefit most from the advantages of being fitter.

GO FOR IT - WHAT HAVE YOU GOT TO LOSE?

Appendix K

The Pilot Study Pre-intervention Relationships Between the Stages of Exercise Behaviour Change, the Processes of Exercise Behaviour Change and Physical Activity

Stage of Exercise Behaviour Change and Physical Activity

Table 1 reports the descriptive statistics for stage of exercise behaviour change and physical activity for all respondents attending their initial appointment.

Table 1.

Descriptive statistics for stage of exercise behaviour change and physical activity (mins / wk) for all respondents attending initial appointments

		Physical Activity (mins / wk)								
		Occupational			Leisure time			Total		
SOC	N	Me	Md	SD	Me	Md	SD	Me	Md	SD
2	8	179	130	130	208	158	133	387	338	230
3	14	329	295	261	519	523	170	848	885	334
4	15	390	340	365	813	640	501	1203	940	631
5	38	328	293	278	854	790	358	1182	1130	534

Note. Me = Mean, Md = median, SD = standard deviation, SOC = stage of exercise behaviour change, 2 = contemplators, 3 = preparers, 4 = actioners, 5 = maintainers.

Figures 1, 2 and 3 show boxplots of occupational, leisure time and total physical activity respectively for each stage of exercise behaviour change.

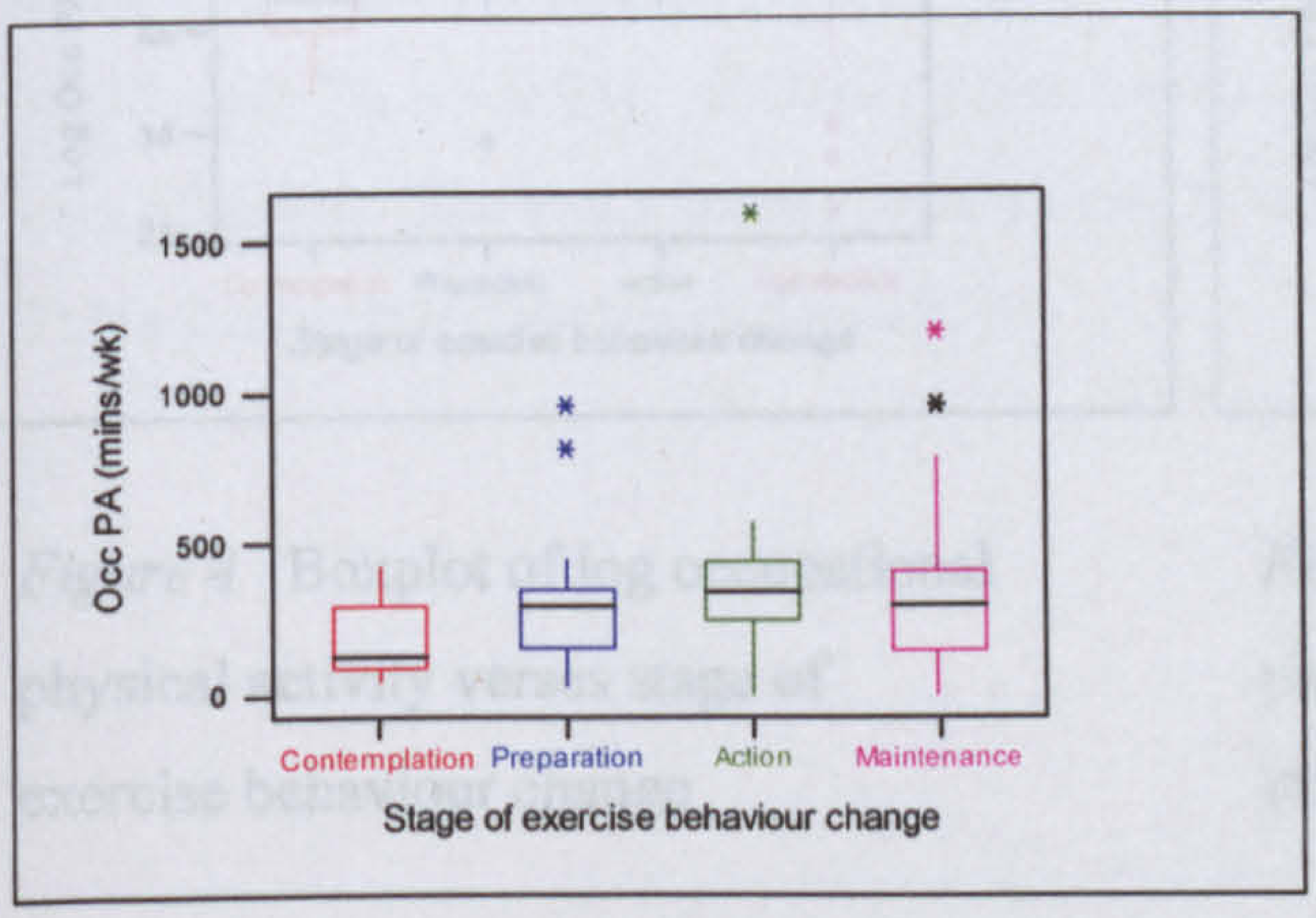


Figure 1 Boxplot of occupational physical activity verses stage of exercise behaviour change

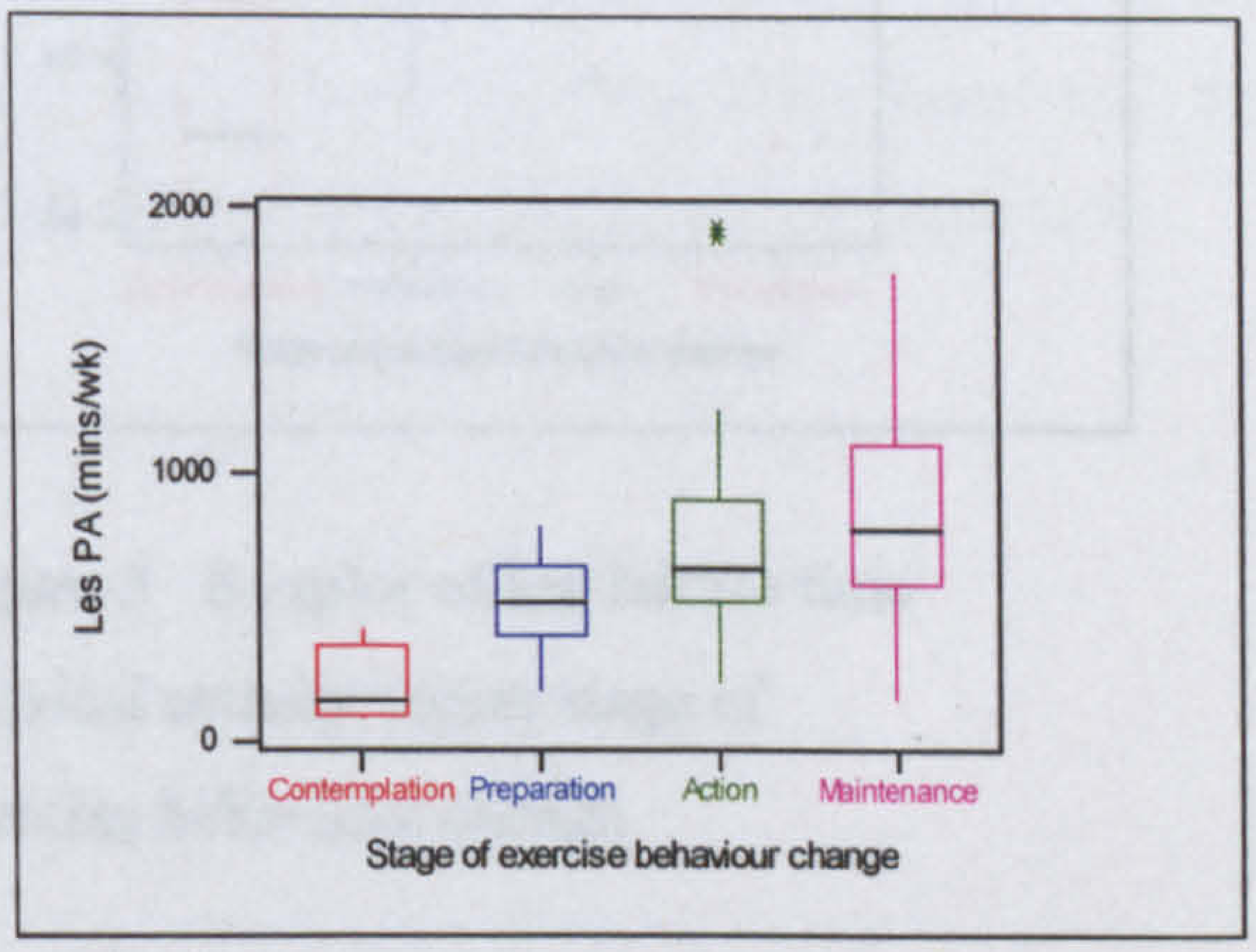


Figure 2 Boxplot of leisure time physical activity verses stage of exercise behaviour change

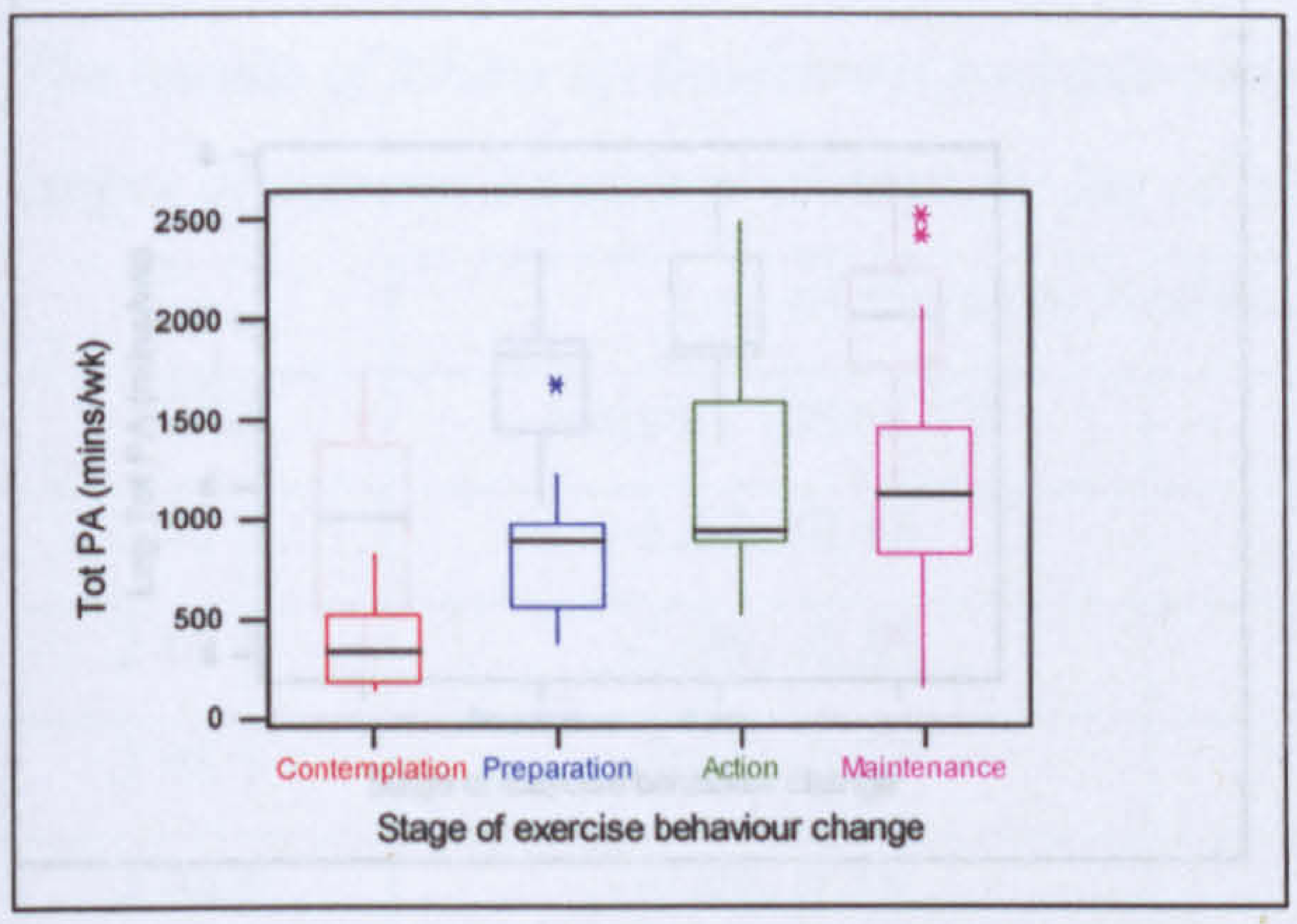


Figure 3 Boxplot of total physical activity verses stage of exercise behaviour change

Figures 1, 2 and 3 show clear outliers within each physical activity category. It is possible that transforming the data by taking the logarithms may enhance the data's normality by reducing the number of outliers. Figures 4, 5 and 6 give boxplots for the log of occupational, leisure time and total physical activity respectively for each stage of exercise behaviour change.

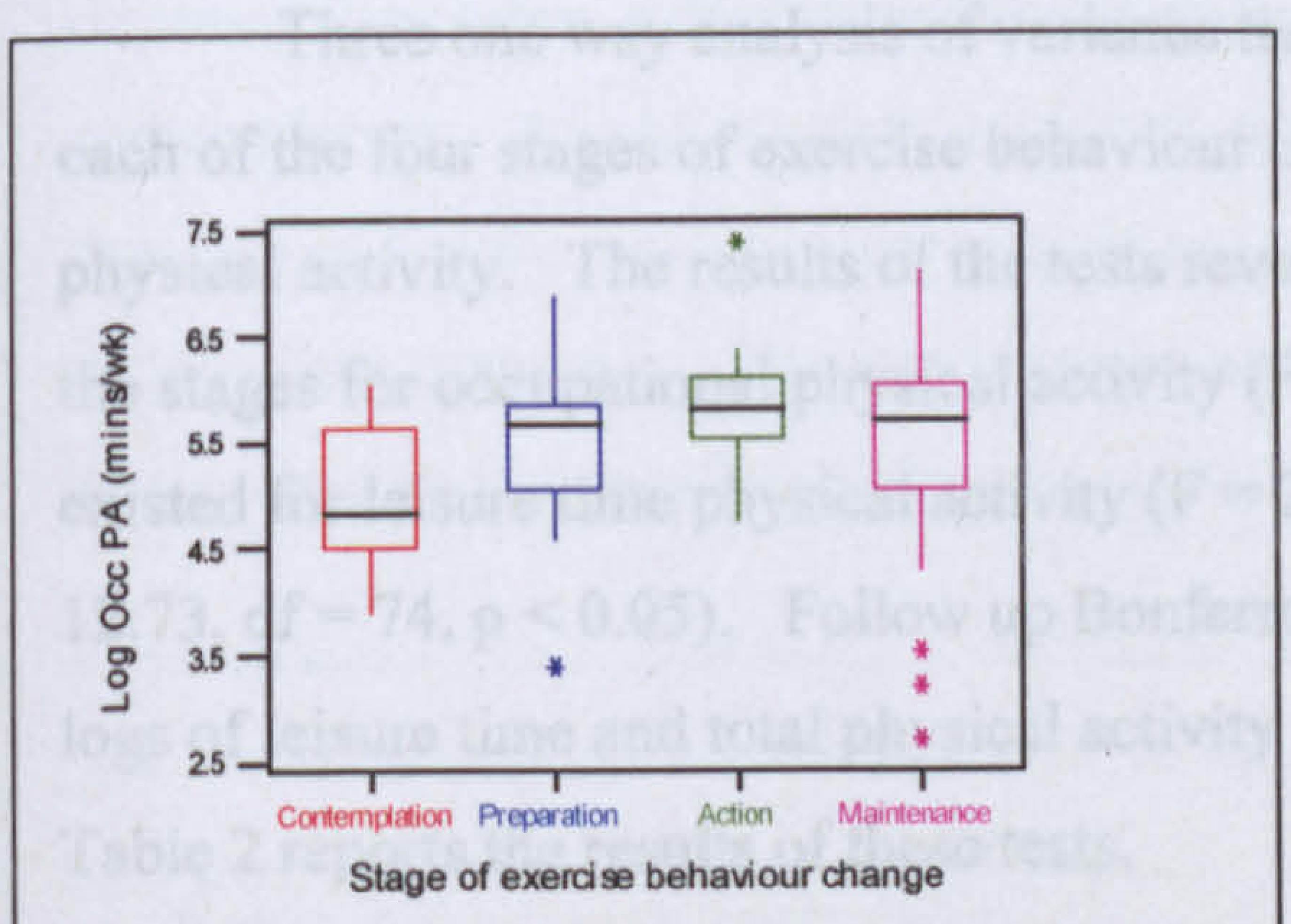


Figure 4 Boxplot of log occupational physical activity verses stage of exercise behaviour change

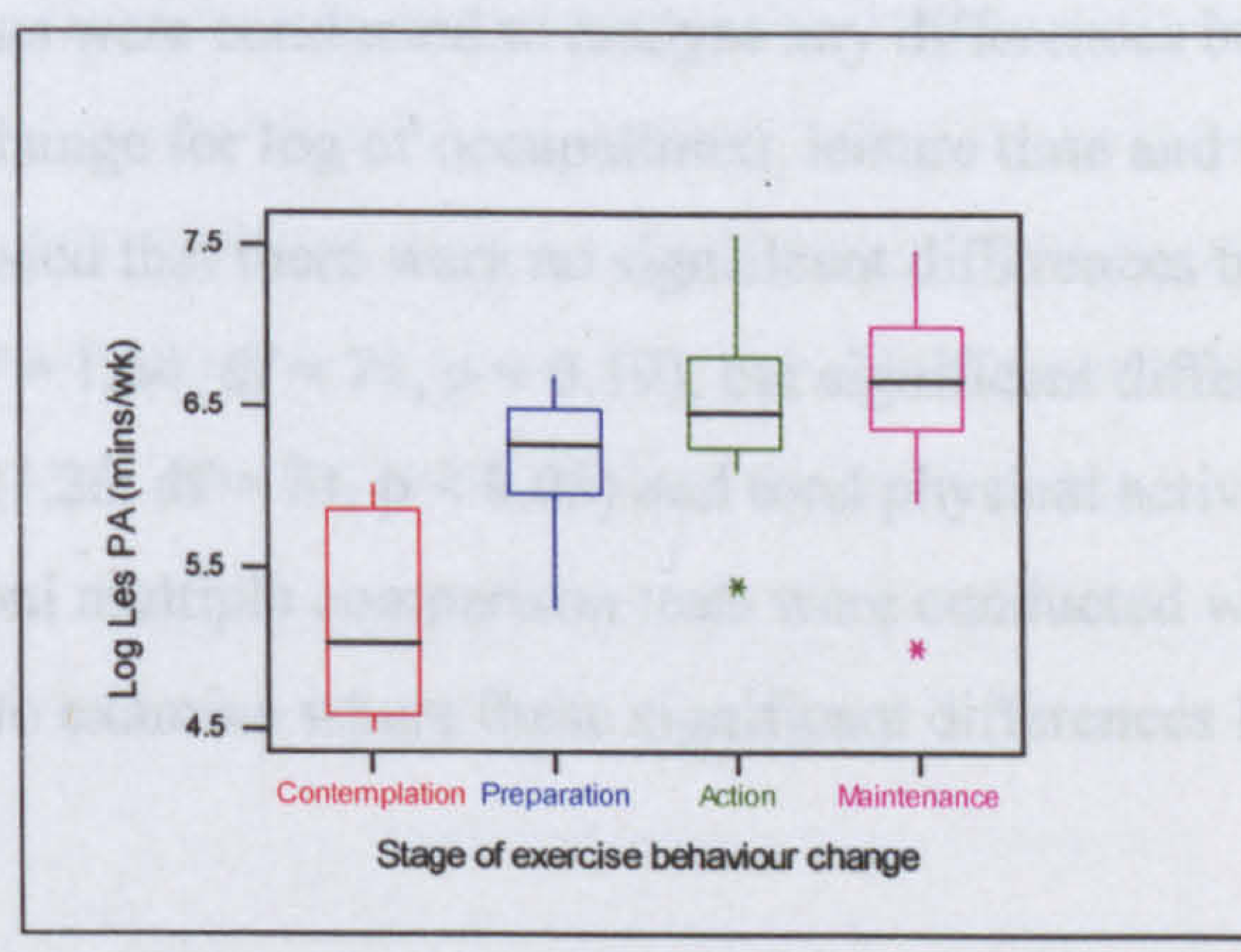


Figure 5 Boxplot of log leisure time physical activity verses stage of exercise behaviour change

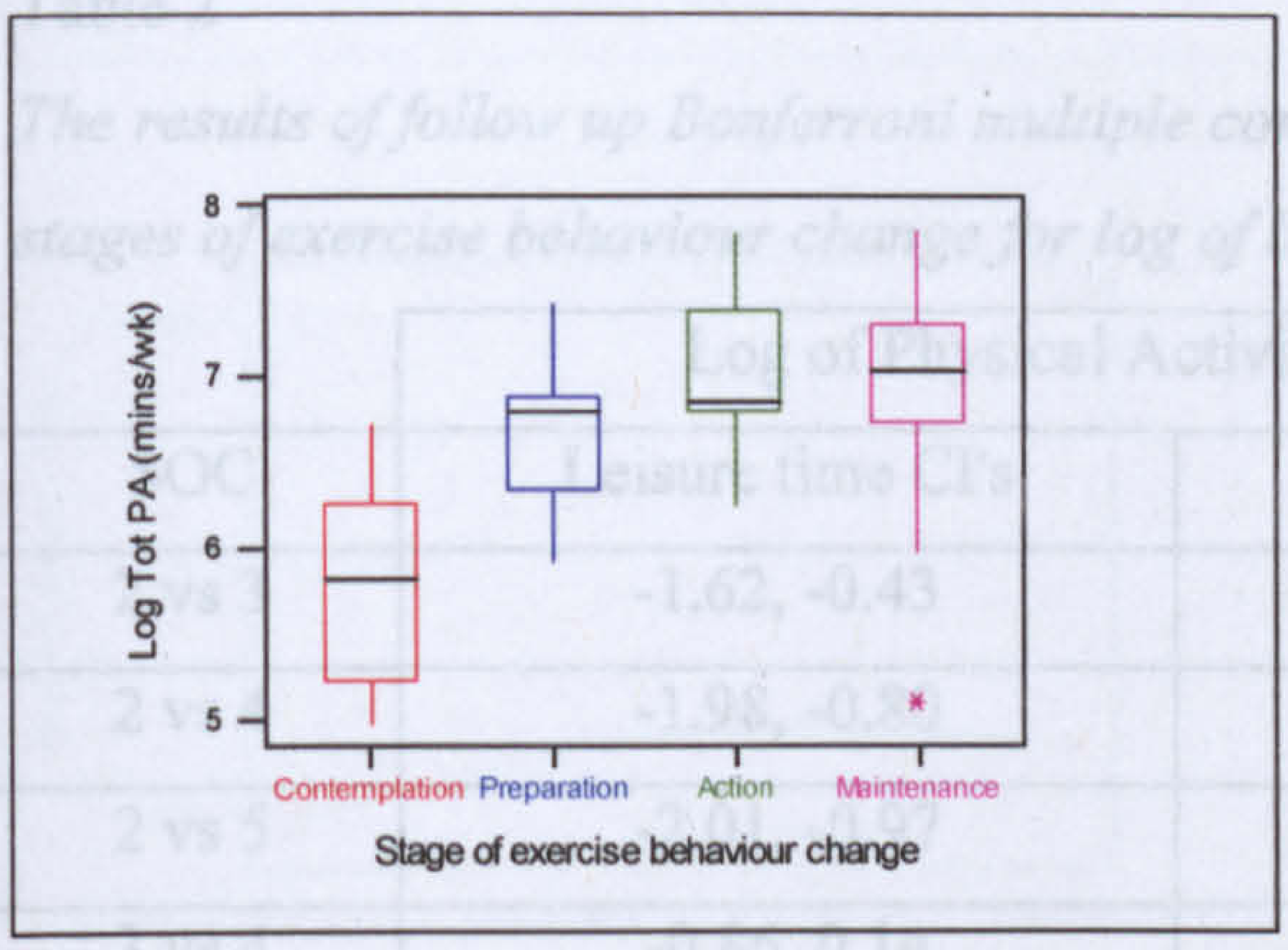


Figure 6 Boxplot of total physical activity verses stage of exercise behaviour change

Figures 4, 5 and 6 show that taking the logarithms has reduced the number of outliers and enhanced the normality of the data. Three Bartlet's test for the homogeneity of variance confirmed no significant differences for the log of each set of data (occupational physical activity, test statistic = 3.15, $p = 0.37$; leisure physical activity, test statistic = 2.73, $p = 0.44$; total physical activity, test statistic = 2.05, $p = 0.56$).

Three one way analysis of variance tests were conducted to analyse any differences between each of the four stages of exercise behaviour change for log of occupational, leisure time and total physical activity. The results of the tests revealed that there were no significant differences between the stages for occupational physical activity ($F = 1.64$, $df = 71$, $p = 0.19$), but significant differences existed for leisure time physical activity ($F = 21.26$, $df = 74$, $p < 0.05$) and total physical activity ($F = 12.73$, $df = 74$, $p < 0.05$). Follow up Bonferroni multiple comparison tests were conducted with the logs of leisure time and total physical activity to examine where these significant differences lay. Table 2 reports the results of these tests.

Table 2

The results of follow up Bonferroni multiple comparison tests to identify significant differences between stages of exercise behaviour change for log of leisure time and total physical activity

	Log of Physical Activity (mins / wk)	
SOC	Leisure time CI's	Total CI's
2 vs 3	-1.62, -0.43	-1.48, -0.27
2 vs 4	-1.98, -0.80	-1.78, -0.58
2 vs 5	-2.01, -0.97	-1.69, -0.63
3 vs 4	-0.86, 0.14	-0.82, 0.20
3 vs 5	-0.88, -0.043	-0.72, 0.14
4 vs 5	-0.51, 0.31	-0.40, 0.44

Note. SOC = stage of exercise behaviour change, 2 = contemplators, 3 = preparers, 4 = actioners, 5 = maintainers, CI = confidence interval, $p < 0.05$

Table 2 shows that there is no significant difference between actioners and maintainers or between actioners and preparers in terms of the total amount of physical activity reported. However, preparers, actioners and maintainers report significantly more total physical activity than contemplators. An almost identical relationship exists between the stages of exercise behaviour change and leisure time physical activity other than maintainers are reporting significantly more activity than preparers. The relationships between stage of exercise behaviour change and total, leisure time and occupational physical activity are given in figures 7, 8 and 9 respectively.

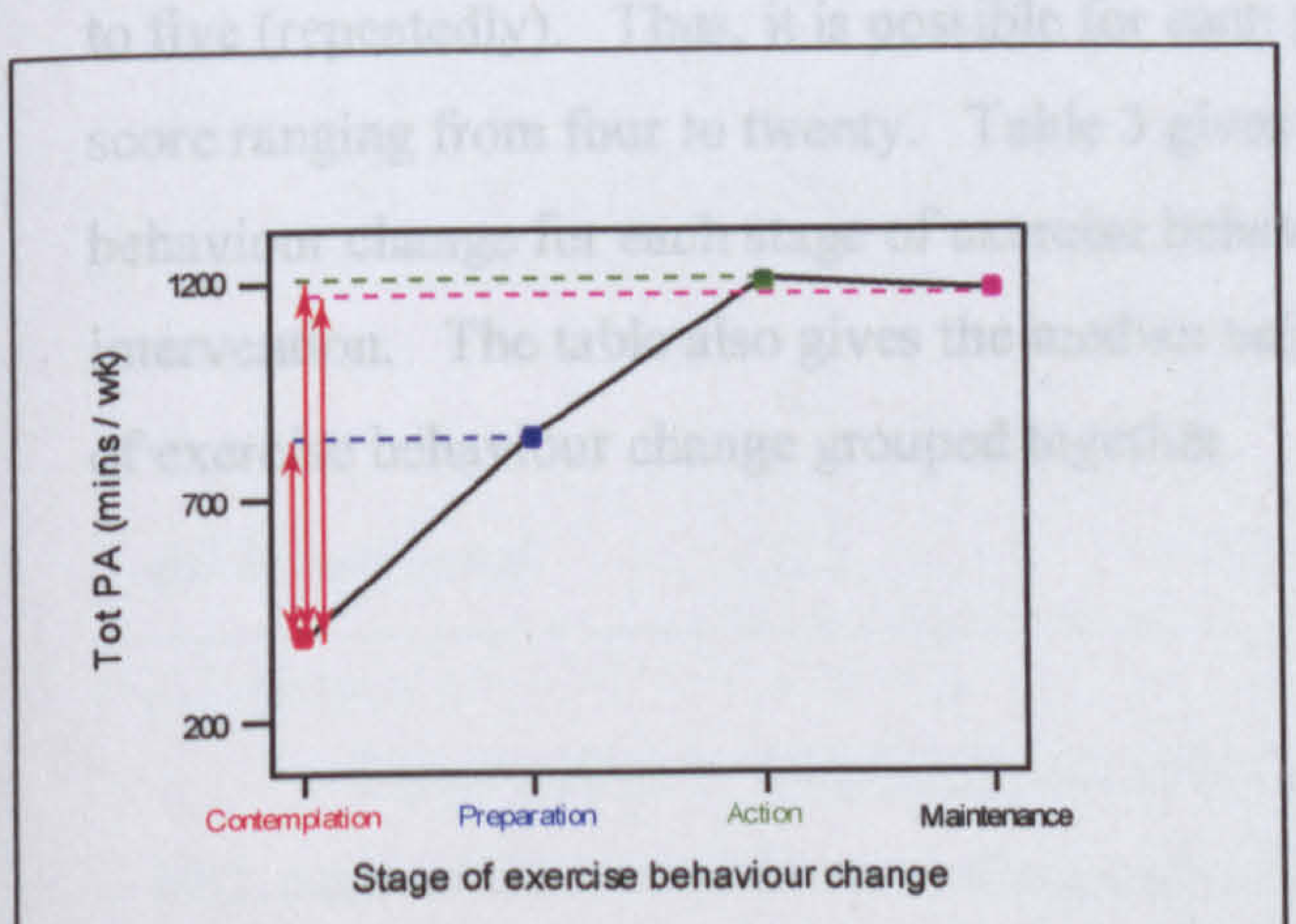


Figure 7 The relationship between stage of exercise behaviour change and total physical activity (arrows indicate significant inter-stage differences $p < 0.05$)

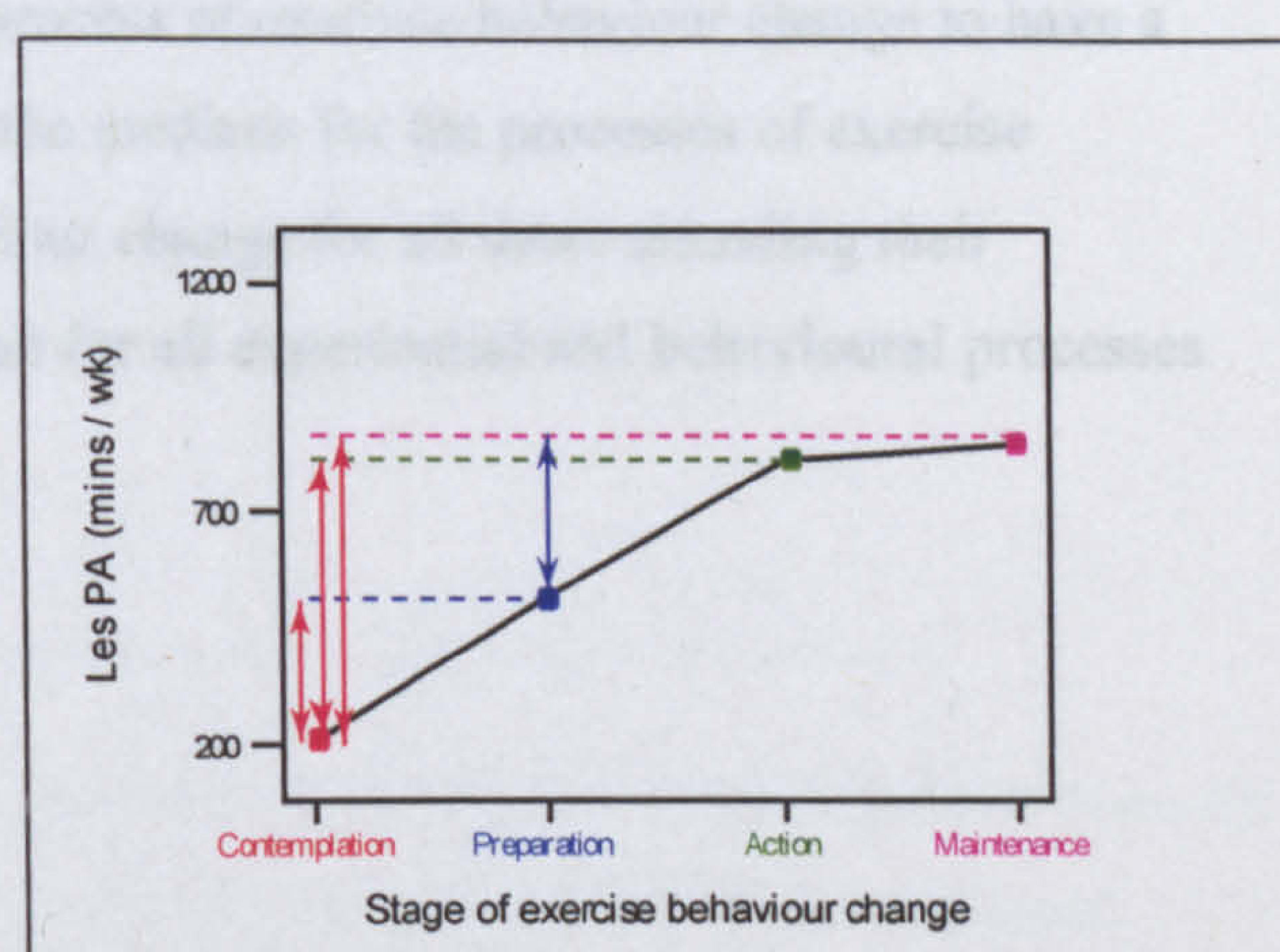


Figure 8 The relationship between stage of exercise behaviour change and leisure physical activity (arrows indicate significant inter-stage differences $p < 0.05$)

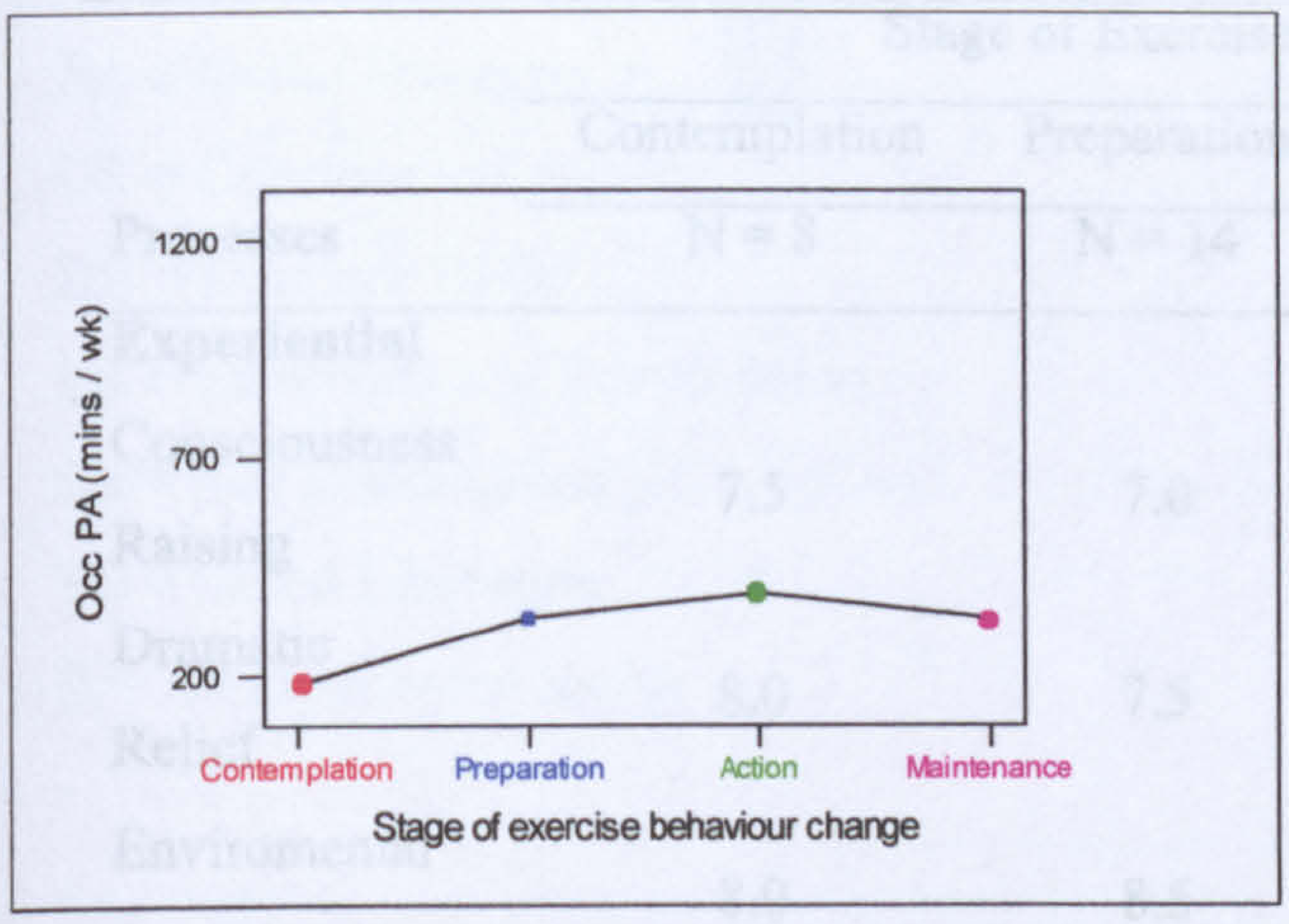


Figure 9. The relationship between stage of exercise behaviour change and occupational physical activity

Figures 7, 8 and 9 show that as in the previous study, changes in total physical activity are almost exclusively due to changes in leisure time physical activity.

Processes of Exercise Behaviour Change and the Stages of Exercise Behaviour Change

The processes of exercise behaviour change questionnaire requires participants to answer four questions for each process of exercise behaviour change. The participant is asked to rate on a Likert scale the frequency with which a particular event occurs. The scale ranges from one (never) to five (repeatedly). Thus, it is possible for each process of exercise behaviour change to have a score ranging from four to twenty. Table 3 gives the medians for the processes of exercise behaviour change for each stage of exercise behaviour change for all those attending their intervention. The table also gives the median value for all experiential and behavioural processes of exercise behaviour change grouped together.

Table 3.

Medians of processes of exercise behaviour change for each stage of exercise behaviour change.

	Stage of Exercise Behaviour Change			
	Contemplation	Preparation	Action	Maintenance
Processes	N = 8	N = 14	N = 15	N = 38
Experiential				
Consciousness Raising	7.5	7.0	7.0	9.0
Dramatic Relief	8.0	7.5	10.0	8.5
Enviromental Reevaluation	8.0	8.5	11.0	8.0
Self Reevaluation	11.0	10.5	13.0	13.0
Social Liberation	7.5	9.0	7.0	9.0
All experiential	8.0	9.0	10.0	10.0
Behavioural				
Counter-Conditioning	6.5	8.0	13.0	16.0
Helping Relationships	4.5	5.0	8.0	8.0
Reinforcement Management	7.0	5.0	8.0	11.0
Self Liberation	8.5	11.0	15.0	14.0
Stimulus Control	6.5	6.0	6.0	7.0
All behavioural	6.5	6.0	9.0	11.0

Figures 10 (a.) - 10 (d.) plot the median processes of exercise behaviour change scores for each stage of exercise behaviour change as well as the median scores of all experiential and behavioural processes of exercise behaviour change for each stage of exercise behaviour change.

KEY

Experiential Processes =

CR = Conciousness Raising

DR = Dramatic Relief

ER = Environmental Reevaluation

SR = Self Reevaluation

SO = Social Liberation

E = All experiential scores

Behavioural Processes =

CC = Counter Conditioning

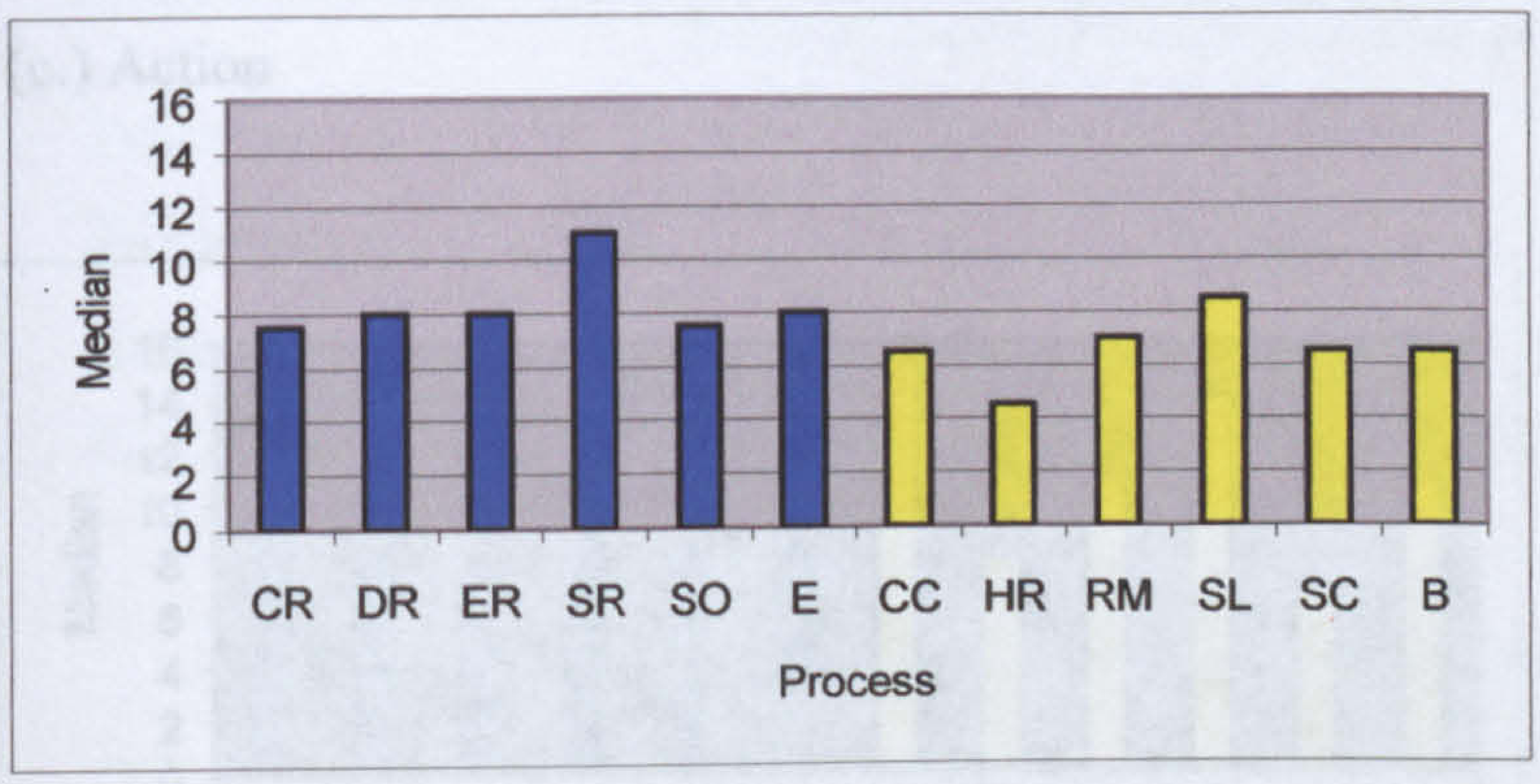
HR = Helping Relationships

RM = Reinforcement Management

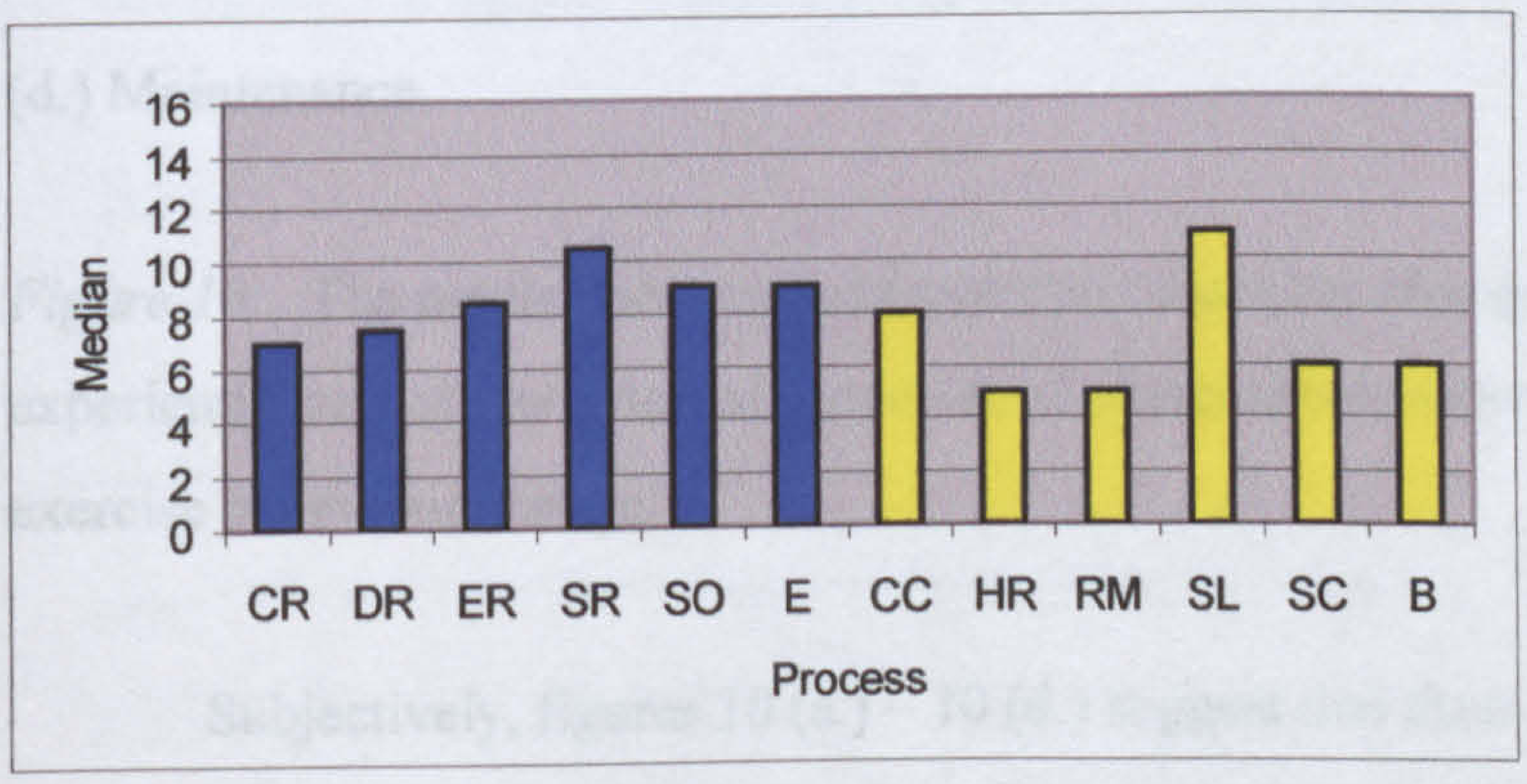
SL = Self Liberation

SC = Stimulus Control

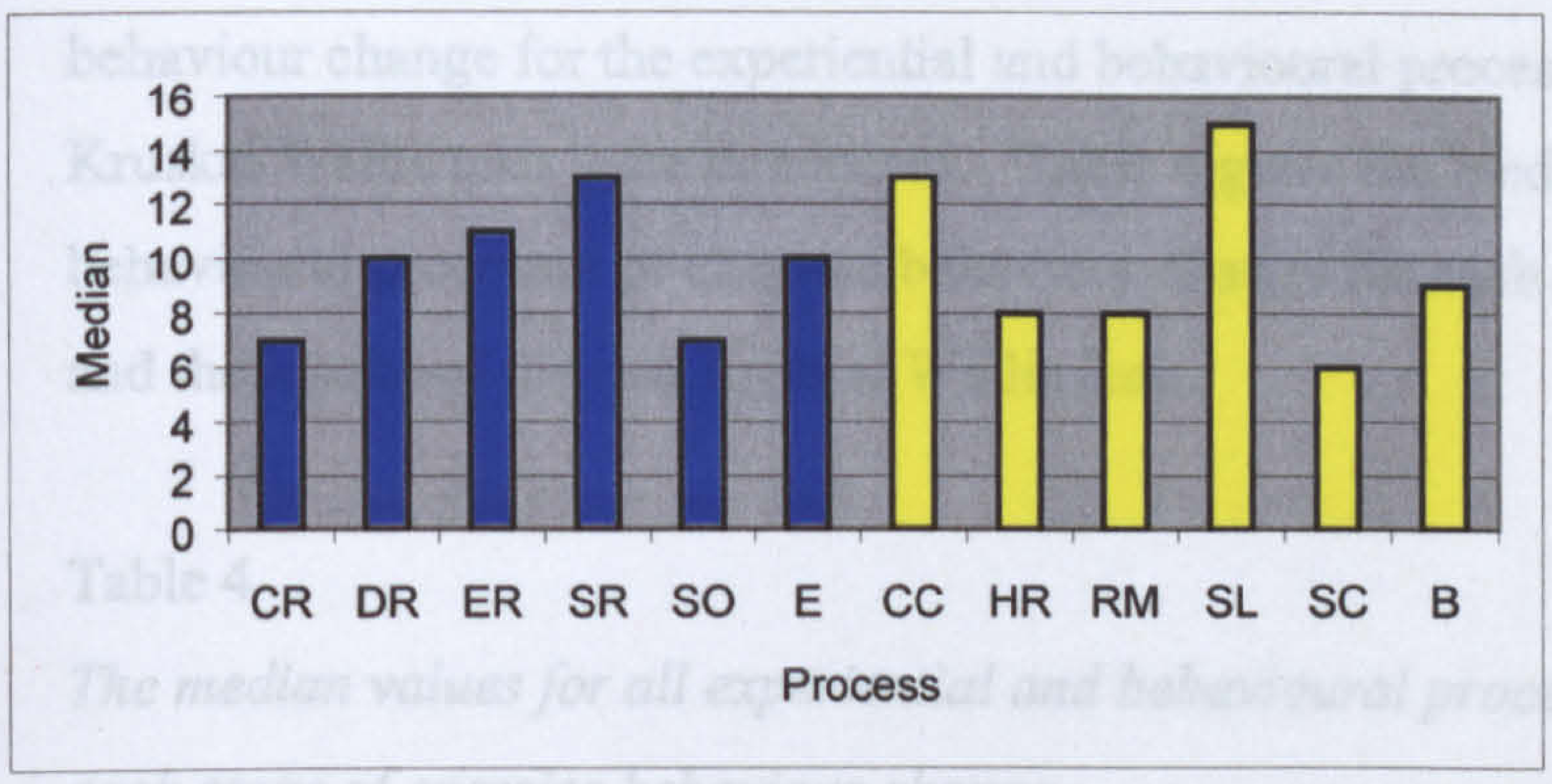
B = All behavioural scores



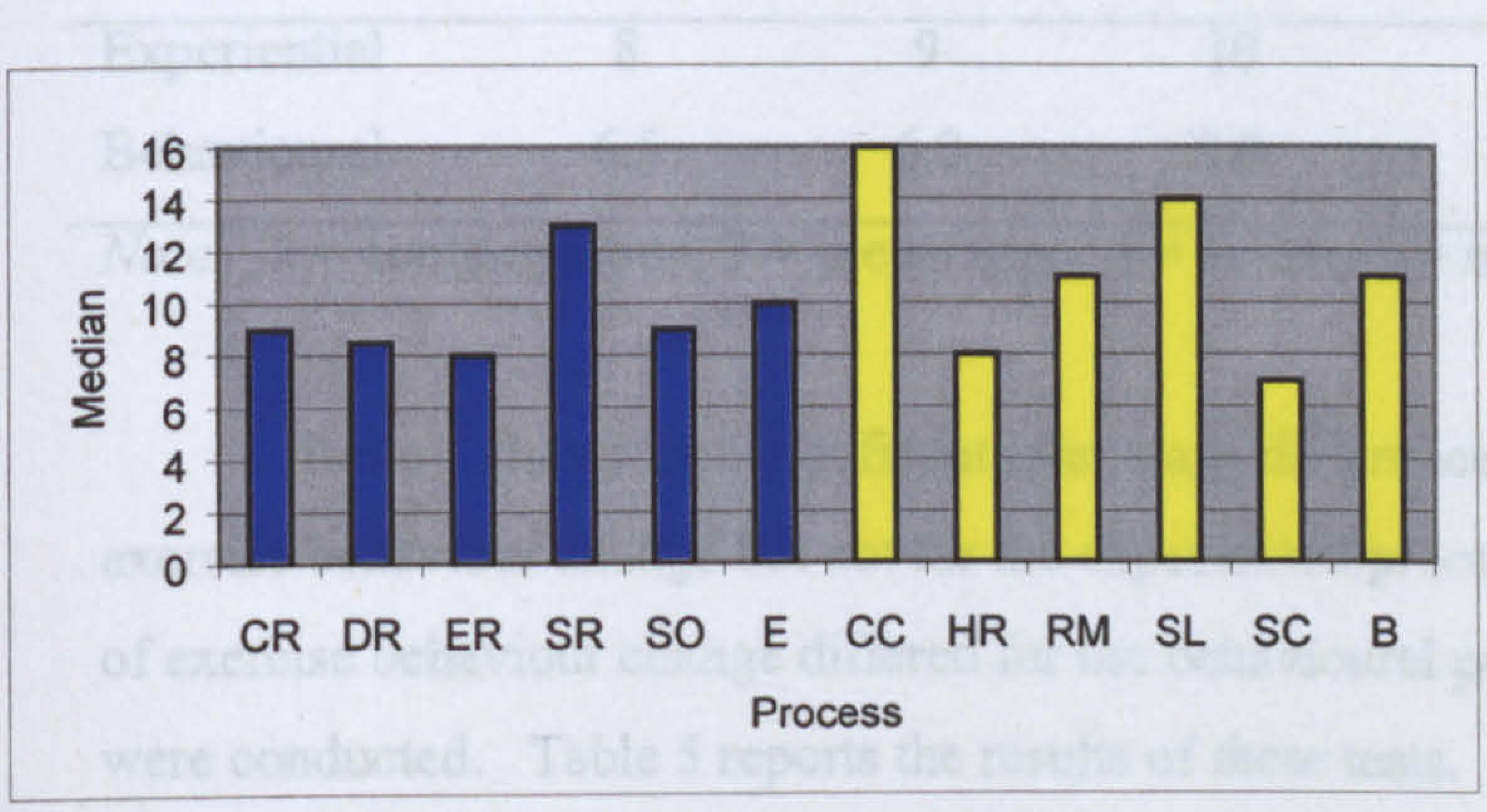
(a.) Contemplation



(b.) Preparation



(c.) Action



(d.) Maintenance

Figure 10. The median processes of exercise behaviour change scores and the median of all experiential and all behavioural processes of exercise behaviour change scores for each stage of exercise behaviour change

Subjectively, figures 10 (a.) – 10 (d.) suggest that there are differences in the trends of the experiential processes compared to that of the behavioural processes. It appears that preparers use the experiential processes more than contemplators. The reverse seems to be the case for the behavioural processes. With regard to the actioners and maintainers, use of the experiential processes appear similar but maintainers appear to use the behavioural processes more than the actioners. It also appears that the experiential processes are more dominant in the earlier stages of exercise behaviour change whereas use of either set of processes is similar in the latter stages of exercise behaviour change. Finally, it appears that use of both experiential processes and behavioural processes is more pronounced in the later stages of exercise behaviour change compared to the earlier stages.

To formerly test the subjective impressions from figure 10, two sets of analyses were conducted. Firstly, to assess if there was any significant differences between stages of exercise behaviour change for the experiential and behavioural processes of exercise behaviour change, two Kruskal Wallis tests were conducted. Table 4 gives the median values for all experiential and behavioural processes of exercise behaviour change for each stage of exercise behaviour change and the results of the two Kruskal Wallis tests.

Table 4

The median values for all experiential and behavioural processes of exercise behaviour change for each stage of exercise behaviour change.

	Stage of exercise behaviour change				*Kruskal*	
Processes	2	3	4	5	Wallis	P
Experiential	8	9	10	10	5.53	0.14
Behavioural	6.5	6.0	9.0	11.0	35.57	< 0.05

Note. 2 = contemplation, 3 = preparation, 4 = action, 5 = maintenance.

Table 4 shows that significant inter stage differences exist for the behavioural processes of exercise behaviour change but not for the experiential processes. In order to identify which stages of exercise behaviour change differed for the behavioural processes, a series of Mann Whitney tests were conducted. Table 5 reports the results of these tests. (Note that a modified p value at the 96.5% level is used to assess significance to take account of multiple comparisons).

Table 5.

A series of Mann Whitney tests conducted to identify significant inter-stage differences for the behavioural processes of exercise behaviour change.

	Behavioural processes	
SOC	W	P
2 v 3	2144.5	0.64
2 v 4	1851.0	< 0.035
2 v 5	3009.0	< 0.035
3 v 4	4389.5	< 0.035
3 v 5	6462.0	< 0.035
4 v 5	9093.0	0.12

Note. SOC = stage of exercise behaviour change, 2 = contemplation, 3 = preparation, 4 = action, 5 = maintenance

Table 5 shows that there is no significant difference in the contemplators and preparers use of the behavioural processes of exercise behaviour change. This is also the case for the actioners and maintainers. However, both actioners and maintainers report significantly greater use of the behavioural processes of exercise behaviour change than both the contemplators and preparers.

In order to assess if there was any significant difference between experiential processes and behavioural processes for each stage of exercise behaviour change, four Wilcoxon matched pairs tests were conducted. Table 6 reports the results of these analyses.

Table 6.

Four Wilcoxon matched pairs tests, conducted to identify significant differences between sets of processes of exercise behaviour change for each stage of exercise behaviour change

	Processes of exercise behaviour change		Test	
SOC	Experiential	Behavioural	Statistic	P
Contemplation	8.0	6.5	409.0	< 0.05
Preparation	9.0	6.0	1393.5	< 0.05
Action	10	9.0	1132.5	0.87
Maintenance	10	11.0	6349.0	0.06

Table 6 indicates that in the early stages of exercise behaviour change, the experiential processes are dominant. However, in the latter stages of exercise behaviour change, there is no significant difference in the use of experiential and behavioural processes of exercise behaviour change.

Appendix L

Pilot Study Occupational Physical Activity Analysis

Occupational Physical Activity

Table 1. gives the descriptive statistics for occupational physical activity for each intervention group at test (for those participants returning re-test questionnaire) and six month re-test.

Table 1.

Descriptive statistics for occupational physical activity (mins / wk) for each intervention group at test (for those participants returning re-test questionnaire) and six month re-test.

Physical Activity	Fitness Assessment (mins/wk)			Exercise Consultation (mins/wk)		
Time Period	N	Mean	SD	N	Mean	SD
Test	26	302.1	355.5	8	340.0	235.5
Re-test	26	287.5	264.9	8	298.1	242.4

Table 2. gives the result of a two way repeated measures analysis of variance with one within (test stage) factor and one between subject factors (intervention group) for occupational physical activity.

Table 2.

The results of a two way (intervention group and test stage) analysis of variance performed on occupational physical activity (mins / wk)

Source	DF	F	P
Intervention group	1	0.04	0.84
Test stage	1	1.05	0.31
Subject (intervention group)	32	18.28	< 0.05
Intervention group * Test stage	1	0.25	0.63
Error	32	/	/
Total	67	/	/

Table 2. shows no significant main effect for either intervention group or test stage. There is no significant interaction between test stage and study group but there is a significant difference between individual participants, as expected.

Appendix M

Intervention Effects on Processes of Exercise Behaviour Change in Pilot Study

In order to compare interventions, analyses were conducted on the differences in the processes of exercise behaviour change from test to re-test. In addition, as discussed in chapter two, use of the processes of exercise behaviour change differs between stages of exercise behaviour change (Marcus et al, 1992a). Ideally therefore, analyses should be conducted on each stage of exercise behaviour change. However, only two baseline contemplators in each intervention group returned re-test questionnaires. Analysis was therefore conducted on those not regularly active at baseline (i.e. contemplators and preparers) and those regularly active at baseline (i.e. actioners and maintainers).

Contemplation and Preparation

In order to compare like with like, analyses was conducted for all those baseline contemplators and preparers who progressed at least one stage of exercise behaviour change at re-test in each intervention group. In addition, before any comparison of changes in processes of exercise behaviour change is conducted, it is important to establish if any differences between intervention groups for each process of exercise behaviour change existed at baseline (i.e. before any interventions). Table 1 gives the median score for each process of exercise behaviour change for each intervention group at baseline for contemplators and preparers who progressed at least one stage of exercise behaviour change at re-test. The table also gives the results of ten Mann Whitney tests, conducted to identify significant differences between intervention groups for each process of exercise behaviour change at baseline.

Table 1.

The median score for each process of exercise behaviour change for each intervention group at baseline for contemplators and preparers who progressed at least one stage of exercise behaviour change at re-test.

	Intervention Group		Mann Whitney test	
	FA	EC	Test	
Processes	N = 4	N = 3	Statistic	P
Experiential				
Consciousness Raising	7.0	7.0	15.0	0.86
Dramatic Relief	8.5	12.0	15.0	0.86
Enviromental Reevaluation	8.0	11.0	14.0	0.60
Self Reevaluation	11.5	13.0	15.0	0.86
Social Liberation	6.0	9.0	12.0	0.22
Behavioural				
Counter-Conditioning	9.0	7.0	16.0	1.0
Helping Relationships	5.5	4.0	15.0	0.86
Reinforcement Management	8.0	5.0	16.0	1.0
Self Liberation	12.0	12.0	16.0	1.0
Stimulus Control	6.5	6.0	16.0	1.0

Table 1 shows that for baseline contemplators and preparers who progressed at least one stage of exercise behaviour change at re-test, there are no significant differences between study groups for any of the processes of exercise behaviour change.

Table 2 gives the medians of the difference between test to re-test for each process of exercise behaviour change for each intervention group. The table also gives the results of ten Mann Whitney tests, conducted to identify significant differences between intervention groups for the differences between test to re-test for each process of exercise behaviour change.

Table 2.

The medians of the difference between test to re-test for each process of exercise behaviour change for each intervention group.

	Intervention Group		Mann Whitney test	
Processes	FA (N=4)	EC (N=3)	Test Statistic	P
Experiential				
Consciousness Raising	0.5	1.0	16.0	1.0
Dramatic Relief	1.0	0.5	16.0	1.0
Enviromental Reevaluation	0.5	0.0	16.5	1.0
Self Reevaluation	0.5	-1.0	19.5	0.29
Social Liberation	0.0	0.0	17.5	0.72
Behavioural				
Counter-Conditioning	0.0	-1.0	17.5	0.72
Helping Relationships	0.0	0.5	18.0	0.60
Reinforcement Management	0.0	-1.0	19.0	0.38
Self Liberation	3.0	1.0	20.0	0.22
Stimulus Control	-1.0	0.0	13.5	0.48

Table 2 shows that there is no significant difference between intervention groups for the difference between test and re-test processes of exercise behaviour change. This conclusion has to be viewed with caution however, given the small numbers in each intervention group.

Action and Maintenance

Of all baseline actioners and maintainers, only one participant shifted in their stage of exercise behaviour change at re-test (an actioner progressed to maintenance). Given this, it is extremely unlikely that any differences in the processes of exercise behaviour change use will exist between study groups when no major change in stage of exercise behaviour has occurred. This is especially true given the fact that no difference between study groups was evident even when a shift in the stage of exercise behaviour change was evident (i.e. as for baseline contemplators and preparers reported above).

Appendix N

SPAQ Professionally Produced

SCOTTISH PHYSICAL ACTIVITY QUESTIONNAIRE

The following questionnaire is a simple way of measuring the amount of physical activity you have done over the last week. The questionnaire is strictly confidential so try and answer all questions as honestly as you can. Obviously, the overall accuracy depends on the accuracy of individual answers. It is not a test so there is no pass or fail.

REGULAR PHYSICAL ACTIVITY RELATES TO:

Exercise e.g. weight training, aerobics, etc. for 2 - 3 times per week; hillwalking for at least 2 hours/once per week

or

Sport e.g. golf, hockey, football, netball, etc. for 2 - 3 times per week

or

General Activity e.g. walking, gardening, etc. accumulating to at least 30 minutes/4 - 5 times per week

(1)

Do you consider yourself to be regularly physically active now? YES ☐ NO ☐ *(please tick one box)*

If YES go to question (2). If NO, were you regularly physically active,

3 months ago? YES ☐ NO ☐ *(please tick one box)*

6 months ago? YES ☐ NO ☐ *(please tick one box)*

Now go to question (2)

(2)

Please read through all categories listed below and tick ONE box for the category which best describes how physically active you have been over the last six months.

(please tick one box)

i) I am not regularly physically active and do not intend to be so in the next six months. ☐

ii) I am not regularly physically active but am thinking about starting to do so in the next six months. ☐

iii) I do some physical activity but not enough to meet the description of regular physical activity given above. ☐

iv) I am regularly physically active but only began in the last 6 months. ☐

v) I am regularly physically active and have been so for longer than 6 months. ☐

On the following page you will find a sheet which lists your physical activity for the previous week.

The following questions relate to your physical activi[ty] be as accurate as possible with your answers. For e[x]... only spent half that time dancing. Additionally, be ca[reful]... have spent time in the last week hillwalking be ca[reful]... section and not both.

(3) **In the past week how many minutes did you spend each day:**

i	**Walking at work?** e.g. walking up or down stairs, walking to and from your desk, "doing the rounds", etc.
	Example Example Example Example Example Example Example Example Example Example Exam[ple]
ii	**Walking outwith work?** e.g. walking to the shops, walking your dog, walking to work, hillwalking, walking for pleasure, walking up or do[wn]...
	Example Example Example Example Example Example Example Example Example Example Exam[ple]
iii	**Manual Labour at work?** *Do include* e.g. lifting, stacking shelves, climbing ladders, building work, etc. *Do not include* e.g. sitting at desk, answering telephone, driving, check-out operation, etc.
iv	**Manual Labour outwith work?** *Do include* e.g. cutting grass, decorating, washing car, D.I.Y., digging, etc. *Do not include* e.g. weeding, planting, pruning, etc.
v	**Doing active housework?** *Do include* e.g. hoovering, scrubbing floors, bed making, hanging out washing, etc. *Do not include* e.g. sewing, dusting, washing dishes, preparing food, etc.
vi	**Dancing?** e.g. disco, line, country, etc.
vii	**Cycling for pleasure or to work?**
viii	**Participating in a sport, leisure activity or training?** *Do include* e.g. exercise classes, football, swimming, golf, jogging, athletics, etc. *Do not include* e.g. darts, snooker/pool, fishing, playing a musical instrument, etc.
ix	**Other Physical Activity if not already covered?** ***(please write in)***

(4)

Was last week typical of the amount of physical activity you usually do?	YES	☐	*(please tick one box)*	
	NO - I usually do more	☐		Normally how ...
	NO - I usually do less	☐		Normally how ...

revious week. Please try and think carefully and may have spent 4 hours at the disco but actually ount the same activity twice. For example, if you include this in either the walking or the leisure

MON	TUES	WED	THUR	FRI	SAT	SUN	TOTAL
10 mins	10 mins	/	15 mins	10 mins	/	/	45 mins
30 mins	10 mins	10 mins	/	30 mins	15 mins	70 mins	165 mins
						TOTAL	

Of which activity?

Of which activity?

PERSONAL DETAILS

NAME:	
TELEPHONE NUMBER:	
AGE IN YEARS:	
TODAYS DATE:	

(1) Are you currently employed? YES ☐ NO ☐ *(please tick one box)*

(2) If NO, end of Questionnaire. If YES, have you changed your employment or the kind of work you do in the last month? YES ☐ NO ☐ *(please tick one box)*

(3) If NO, end of Questionnaire. If YES, has this resulted in an increase in the amount of physical activity you do? YES ☐ NO ☐ *(please tick one box)*

If NO, end of Questionnaire. If YES, how and by how much?

END OF QUESTIONNAIRE – THANK YOU

This questionnaire was developed by Glasgow University, Forth Valley Health Board and East Ayrshire Council.

Any correspondence should be addressed to: **Dr. Nanette Mutrie,**
University of Glasgow, Division of Neuroscience and Biomedical Systems and Departments of Medicine
64 Oakfield Avenue, Glasgow G12 8LT, Scotland.

FOR OFFICE USE *(please do not complete)*

Total Physical Activity in minutes per week:	
Work based Physical Activity in minutes per week:	
Leisure based Physical Activity in minutes per week:	
Stage of Change:	

Appendix O

Processes of Exercise Behaviour Change Questionnaire Professionally Produced

East Ayrshire COUNCIL Community Services

PROCESS OF CHANGE QUESTIONNAIRE

East Ayrshire COUNCIL Community Services

The following experiences can affect the exercise habits of some people. Think of any similar experiences you may be currently having or have had during the last month. Then rate how frequently the event occurs. Please circle the number that best describes your answer for each experience. How frequently does this occur?

	Never		Occasionally		Repeatedly	For Office use only
1. Instead of remaining inactive I engage in some physical activity	1	2	3	4	5	g
2. I tell myself I am able to keep exercising if I want to	1	2	3	4	5	b
3. I put things around my home to remind me of exercising	1	2	3	4	5	f
4. I tell myself that if I try hard enough I can keep exercising	1	2	3	4	5	b
5. I recall information people have personally given to me on the benefits of exercise	1	2	3	4	5	a
6. I make commitments to exercise	1	2	3	4	5	b
7. I reward myself when I exercise	1	2	3	4	5	j
8. I think about information from articles and advertisements on how to make exercise a regular part of my life	1	2	3	4	5	a
9. I keep things around my place of work that remind me to exercise	1	2	3	4	5	f
10. I find society changing in ways that make it easier for the exerciser	1	2	3	4	5	h
11. Warnings about health hazards of inactivity affect me emotionally	1	2	3	4	5	c
12. Dramatic portrayals of the evils of inactivity affect me emotionally	1	2	3	4	5	c
13. I react emotionally to warnings about an inactive lifestyle	1	2	3	4	5	c
14. I worry that inactivity can be harmful to my body	1	2	3	4	5	c
15. I am considering the idea that regular exercise would make me a healthier, happier person to be around	1	2	3	4	5	i
16. I have someone on whom I can depend when I am having problems with exercising	1	2	3	4	5	e
17. I read articles about exercise in an attempt to learn more about it	1	2	3	4	5	a
18. I try to set realistic exercise goals for myself rather than setting myself up for failure by expecting too much	1	2	3	4	5	j
19. I have a healthy friend that encourages me to exercise when I don't feel up to it	1	2	3	4	5	e
20. When I exercise, I tell myself that I am being good to myself by taking care of my body	1	2	3	4	5	j

		Never	Occasionally		Repeatedly		For Office use only
21.	Exercise is my special time to relax and recover from the days worries, not a task to get out of the way	1	2	3	4	5	g
22.	I am aware of more and more people encouraging me to exercise these days	1	2	3	4	5	h
23.	I do something nice for myself for making efforts to exercise more	1	2	3	4	5	j
24.	I have someone who points out my rationalizations for not exercising	1	2	3	4	5	e
25.	I have someone who provides feedback about my exercising	1	2	3	4	5	f
26.	I remove things that contribute to my inactivity	1	2	3	4	5	b
27.	I am the only one responsible for my health, and only I can decide whether or not I will exercise	1	2	3	4	5	a
28.	I look for information related to exercise	1	2	3	4	5	f
29.	I avoid spending long periods of time in environments that promote inactivity	1	2	3	4	5	d
30.	I feel I would be a better role model for others if I exercised regularly	1	2	3	4	5	d
31.	I think about the type of person I will be if I keep exercising	1	2	3	4	5	i
32.	I notice that more businesses are encouraging their employees to exercise by offering fitness courses and time off to exercise	1	2	3	4	5	h
33.	I wonder how my inactivity affects those people who are close to me	1	2	3	4	5	d
34.	I realise that I might be able to influence others to be healthier if I would exercise	1	2	3	4	5	d
35.	I get frustrated with myself when I don't exercise	1	2	3	4	5	i
36.	I am aware that many health clubs now provide free creches to their members	1	2	3	4	5	h
37.	Some of my close friends might exercise more if I would	1	2	3	4	5	d
38.	I consider the fact that I wold feel more confident in myself if I exercised regularly	1	2	3	4	5	i
39.	When I feel tired I make myself exericse anyway because I know I will feel better afterward	1	2	3	4	5	g
40.	When I'm feeling tense, I find exercise a great way to relieve my worries	1	2	3	4	5	g

NAME	
DATE	

FOR OFFICE USE ONLY			
a. CR		f. SC	
b. SL		g. CC	
c. DR		h. SO	
d. ER		i. SR	
e. HR		j. RM	

END OF QUESTIONNAIRE – THANK YOU

Appendix P

Expectation Questionnaire

Fitness assessment group

Do you think a fitness assessment will alter your:

	not at all	not really	unchanged	a little	greatly	
a.) intention to be more active	☐	☐	☐	☐	☐	*tick one box*
a.) actual physical activity	☐	☐	☐	☐	☐	*tick one box*

Information group

Do you think information on physical activity will alter your:

	not at all	not really	unchanged	a little	greatly	
a.) intention to be more active	☐	☐	☐	☐	☐	*tick one box*
a.) actual physical activity	☐	☐	☐	☐	☐	*tick one box*

Exercise consultation group

Do you think an exercise consultation will alter your:

	not at all	not really	unchanged	a little	greatly	
a.) intention to be more active	☐	☐	☐	☐	☐	*tick one box*
a.) actual physical activity	☐	☐	☐	☐	☐	*tick one box*

Appendix Q

Amended *Ricclees* Application Forms

Name..

Address..

....

....Postcode.......................

Date of Birth...

Tel: (Home)..............................(Work)...........................

Please tick only the boxes which apply

I apply for a Ricclees Membership Card but do not fall into one of the categories listed below ☐

I apply for a Ricclees Membership Card and do fall into one of the categories below ☐

I am eligible as:

Reg. Unemployed	☐	Widow	☐
Senior Citizen (60 yrs +)	☐	YTS/ET Trainee	☐
Reg. Disabled	☐	Income Support	☐
Invalidity Benefit	☐	Family Credit	☐
Reduced Earnings	☐	Housing Benefit	☐
Full time Student	☐		

At the initial meeting I would prefer:

A Fitness Assessment ☐

An Exercise Consultation ☐

OFFICE USE ONLY	
Date Rcd	
Status Conf	
Int date	
Act 1	
Act 2	

Please return this form to
Ricclees Health and Fitness Club
Community Services Department
John Finnie Street
Kilmarnock KA1 1BY
Telephone: (01563) 578433

East Ayrshire Council Community Services

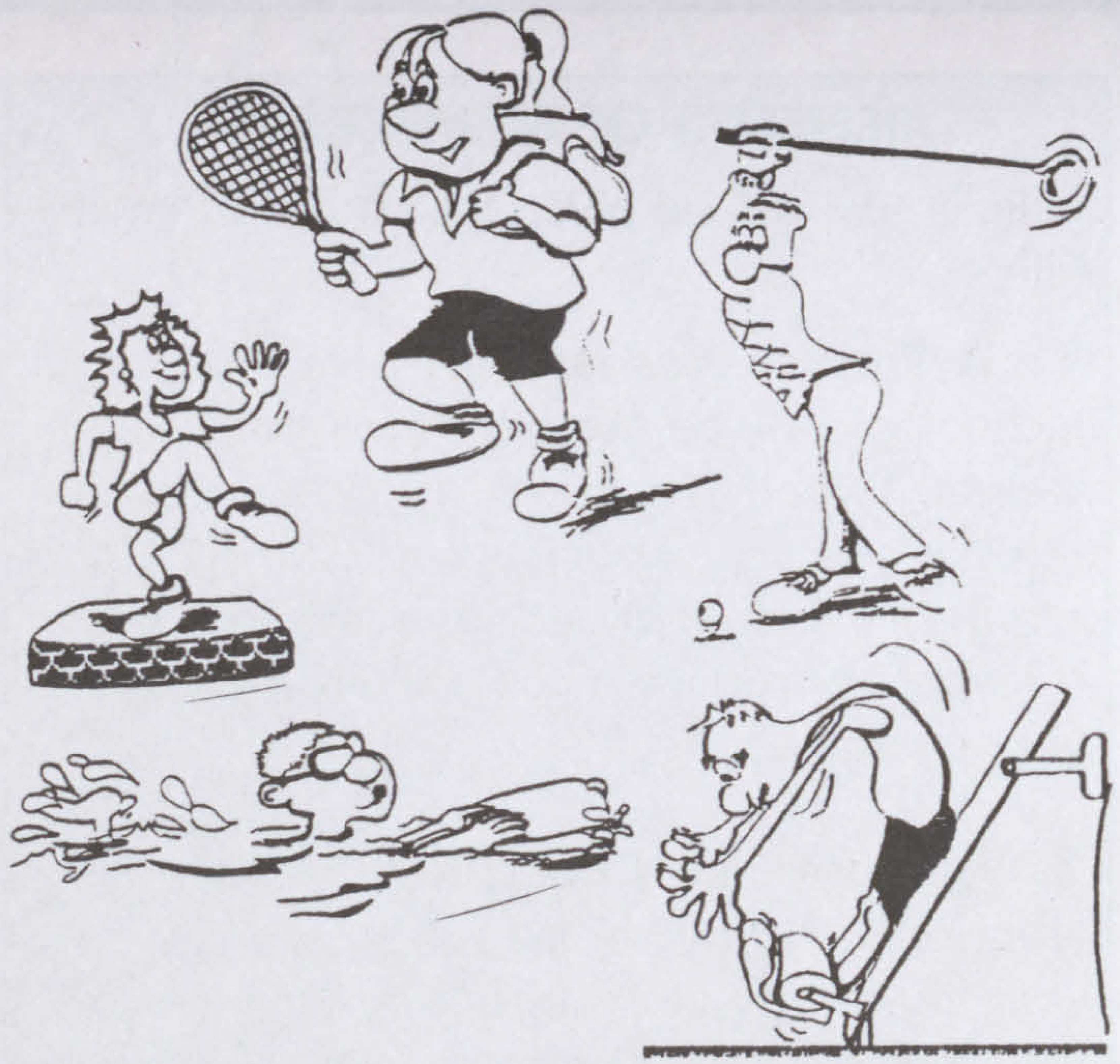
Please note you must return this form by hand together with the correct documentation if you are applying under one of the above categories

PLEASE TEAR ALONG DOTTED LINE

1. Membership Cards/Vouchers are issued in a specific name and are not transferable.
2. Only residents of Shortlees or Riccarton may apply for membership.
3. Possession of a Membership Card/Voucher does not entitle priority over other customers.
4. While in any facility the holder of the Membership Card/Voucher is subject to all its rules and regulations.
5. Vouchers are only valid if presented with a valid Membership Card in the name of the person stated on the Voucher.
6. Membership Cards/Vouchers which are changed or marked in any way will not be valid.
7. The Voucher only entitles access to the activity stated on the Voucher.
8. Vouchers can only be used once.
9. Staff at the appropriate facility can refuse entry at any time.
10. Membership Cards/Vouchers are only valid for the dates shown.
11. The Healthy Lifestyle Project reserves the right to confiscate Membership Cards/Vouchers and/or refuse further applications if the holder does not comply with the conditions of use.
12. The Healthy Lifestyle Project reserves the right to vary conditions of use and activities offered without prior notice.
13. Any false information given will disqualify the application.

East Ayrshire Council Community Services

RICCLEES HEALTH AND FITNESS CLUB



APPLICATION FORM

Ricclees Health and Fitness Club offers a wide range of health and fitness services for residents of Shortlees and Riccarton including swimming sessions, badminton, workouts at the Galleon Centre's fitness suite and golf, as well as fitness assessments and exercise consultations.

THE HEALTHY LIFESTYLE PROJECT

AIMING FOR BETTER HEALTH

East Ayrshire Council Community Services

WHO IS ELIGIBLE FOR MEMBERSHIP?

All residents of Shortlees and Riccarton are eligible for membership of *Ricclees.* Please note that proof of residency will be required.

BENEFITS OF MEMBERSHIP

Initially you will be given the choice of having either:

1. *A Fitness Assessment.* Here the latest technology will be used to assess your height, weight, % body fat, blood pressure, strength, flexibility, lung capacity and stamina. The results are then analysed using state of the art software to produce a comprehensive guide to your overall fitness.

2. *An Exercise Consultation.* This is the "supportive" way to introduce exercise into your life. It involves a one to one consultation with an exercise specialist in an effort to motivate you to make the necessary changes in your lifestyle.

If you decide to join the club you will be required to complete two questionnaires after which you will be offered a 3 month supply of vouchers which entitle you to free entry into one of the following:

1. The Galleon Centre Swimming Pool (up to a maximum of 2 visits per week).
2. Golf at Caprington Golf Course (maximum 1 round per week - no weekends).
3. Badminton at Shortlees Community Education Centre (maximum of 3 sessions per week - minimum 2 people).

If you fall into one of the following categories you will also have the option of receiving vouchers for the Galleon Centre's fitness room (up to a maximum of 2 visits per week).

Category	Documentation Required
Registered Unemployed	UB40
Senior Citizen (60 yrs +)	Any proof of age, e.g. birth certificate, driver's licence, etc.
Registered Disabled	D.L.A. Payment Book or notice of award/Bus Pass
Reduced Earnings Allowance	Allowance book or notice of award
Full time Student	Matriculation card or letter from school or college
Widow	Pension book or notice of award
YTS/ET Trainee	Letter from Employer
Income Support	Allowance book or DSS form B3
Family Credit	Payment book
Housing Benefit	Letter from housing officer

Please note you are entitled to receive vouchers for any activity over any 3 month period. At the end of the 3 months you will be invited back for another assessment and given the opportunity to select another 3 months supply of vouchers. In addition to this members are also entitled to 2 weekly aerobic sessions in Riccarton Community Centre as well as access to the Healthy Lifestyle Project's diet class and extensive health and fitness library. You will also be placed on the mailing list for any future initiatives.

HOW DO I JOIN?

You must be a resident of Shortlees or Riccarton to apply for membership. If you would like to join simply fill out the attached application form and return it to the address at the bottom of the form. Please note that if you are applying for use of the Galleon Centre gym under one of the stated categories you will need to present the application form by hand together with the required documentation.

HOW LONG DOES MEMBERSHIP LAST?

Your membership card will be valid for approximately 6 months. Each block of vouchers will be valid for 3 months. If you move outwith Shortlees or Riccarton both your membership card and vouchers will no longer be valid.

LOST CARDS/VOUCHERS

If your **card** becomes lost, a replacement can be ordered. Simply telephone the number at the bottom of the application form. Lost **vouchers** cannot be replaced however so be sure to keep these in a safe place. Vouchers will only be honoured when presented with a valid membership card.

Appendix R

Fitness Assessment Goal Record Sheet

PERSONAL GOAL RECORD SHEET

Below is a list of activity "goals" you set yourself at your recent appointment. Remember you don't need to become an "exercise junkie" to make significant improvements. Even the smallest of changes like walking for an extra 15 minutes each day can produce significant results.

1. LONG TERM GOALS

(i.e. What would you hope to have achieved after 3 months before your final re-assessment?)

a.) ____________________

b.) ____________________

c.) ____________________

SHORT TERM GOALS

(i.e. What differences do you think you can make immediately?)

a.) ____________________

b.) ____________________

c.) ____________________

INTERMEDIATE GOALS

(i.e. What would you hope to have achieved after approximately 6 weeks?)

a.) ____________________

b.) ____________________

c.) ____________________

When you reach a particular goal try and reward yourself. Remember to regularly check your goal record sheet to remind yourself of what you are ultimately trying to achieve. Finally, it is only yourself who can make these small changes and at the end of the day it will be you who will benefit most from the advantages of being fitter.

GO FOR IT - WHAT HAVE YOU GOT TO LOSE?

Appendix S

***Ricclees* Information Booklet**

Diet Class
The project operates a diet class on Monday afternoons in Riccarton Community Centre before the aerobics class at around 1.15pm. Here you are weighed each week and keep your own record on your personal record sheet. Initially you are given a computerised dietary analysis and from the results of this and other measurements (i.e. height / weight etc) your target weight and recommended calorific intake can be calculated. Again this service is free to members of *Ricclees*.
(NO DIET CLASS UNTIL AFTER CHRISTMAS)

Healthy and Fitness Library
The Healthy Lifestyle Project operates a health and fitness library. Members of *Ricclees* are free to choose 1 book to loan over a 1 month period. Additionally you may choose as many leaflets as you want. Leaflets do not have to be returned. The following is a listing of current books / leaflets available.

BOOKS	LEAFLETS
: Careers in sport.	Advice for those recovering from a heart attack
: Children and sport ; Fitness injuries and diet.	Beating heart disease
: Circuit training for all sports.	Daily Record good health guide
: Fitness for sport.	Enjoy fruit and veg.
: Food for sport.	Healthier eating
: Health and fitness instructor's handbook.	30 Healthier recipes
: Health and fitness centre's - A practical guide.	Help and advice on strokes
: Manual of Nutrition	Hypertension. What is it?
Ropics ; The next jump forward in fitness.	Stopping smoking
Running ; Fitness and injuries - A self help guide.	Stopping smoking made easier
. Swimming for fitness.	Taking more exercise
: Towards a healthier Scotland - A lifestyle handbook.	Thats the limit - A guide to sensible drinking
: Warm up and preparation for athletes of all sports.	

Future Initiatives
As a member of *Ricclees* you will be placed on the mailing list for any future initiatives. For example the Healthy Lifestyle Project is in the process of setting up a safe joggers network for residents of Shortlees and Riccarton.

The project is always on the look out for new ideas so if there is anything you would like to see introduced please contact me.

YOUR INFORMATION GUIDE TO *RICCLEES* HEALTH AND FITNESS CLUB

The following is a guide to the services offered by *Ricclees* health and fitness club. It is designed to be as informative as possible but should you require any additional information please contact myself (Matthew Lowther - Healthy Lifestyle Officer) on Kilmarnock 578433.

As you are aware *Ricclees* offers a range of physical activity vouchers. Please refer to the following for information regarding the use of each activity voucher.

RICCLEES GUIDE-LINES FOR SWIMMING VOUCHERS

Each swimming voucher entitles you to one free entry into any **public session** at the **Galleon Centre Swimming pool**. You may use the pool through *Ricclees* up to a maximum of twice per week. Simply present a swimming voucher for that week at the reception along with your *Ricclees* membership card. The times of the public swimming sessions are given below.

MONDAY :	7am-9am (adults only) / 9am-7.40pm
TUESDAY :	9am-7.45pm
WEDNESDAY :	7am-9am (adults only) / 9am-7.45pm / 8pm-9.45 (adults only)
THURSDAY :	9am-5.45pm / 8pm-9.45pm
FRIDAY :	7am-9am (adults only) / 9am-6.45pm / 7pm-8.45pm (fun swim / aqua disco) / 9pm-9.45pm (adults only)
SATURDAY :	9am-10.45am / 11am-12.45pm (fun swim) /1pm-9.45pm
SUNDAY :	9am-7.25pm

Please note that it may be necessary to restrict entry for swimming to one session per week if excessive numbers enrol.

HEALTHY LIFESTYLE PROJECT

AIMING FOR BETTER HEALTH

East Ayrshire COUNCIL

RICCLEES GUIDE-LINES FOR GYM VOUCHERS

Each Gym voucher entitles you to one free entry into the **Galleon Centres fitness suite** up to a maximum of two visits per week. You may use the gym through *Ricclees* up to a maximum of twice per week. Simply present a Gym voucher for that week at the reception along with your *Ricclees* membership card. The opening times of the gym are given below.

MONDAY : 7.00am
TUESDAY : 9.00am
WEDNESDAY : 7.00am
THURSDAY : 9.00am
FRIDAY : 7.00am
SATURDAY : 8.00am
SUNDAY : 9.00am

Please note that last admission on any day is 10.00pm.

Before using your voucher you need to go through an induction programme for the gym which comprises guidance on the correct and safe use of the equipment. Those [illegible] complete the course - which lasts approximately 30 minutes - are issued with an [illegible] user card allowing them access to Excells. You will have to make an [illegible] for the initial induction. The best way to do this is by phoning the Galleon on Kilmarnock 524014. When you go along for the induction simply present one of the Gym vouchers at the reception. After the induction you are free to use the gym at your leisure. Excells staff are always on hand to help you build your own customised exercise programme.

Please note that it may be necessary to restrict entry to the gym to one session per week if excessive numbers enrol.

CRECHE FACILITIES AT THE GALLEON CENTRE

The Galleon Centre offers extensive creche facilities. The times of the creches are given below ;

MONDAY / FRIDAY : 9.00am - 4.00pm
TUESDAY / WEDNESDAY / FRIDAY : 9.00am - 5.00pm

Each session lasts for one and a half hours and costs £1.20 which your *Ricclees* membership does not cover. The age range of the creche is 6 weeks to 6 years.

RICCLEES GUIDE-LINES FOR BADMINTON VOUCHERS

Each badminton voucher entitles you to one free entry into **Shortlees Community Education Centre** for one session of badminton. You may use the centre through *Ricclees* up to a maximum of three times per week. The centre has been booked for *Ricclees* members on the following days ;

TUESDAY : 1 Court between 4.00pm and 6.00pm
WEDNESDAY / THURSDAY : 1 Court between 1.00pm and 3.00pm

To book a court on any of these days you must fill out the appropriate booking sheet at the centre. Courts are available in blocks of half an hour. When booking please try and not book the whole session as other people may be waiting for a game. When you are due to play you must present a badminton voucher for that week along with your *Ricclees* membership card.

You will be able to borrow rackets / shuttlecocks at the centre which will be free of charge to *Ricclees* members.

There is a badminton club which operates out of the centre on a Thursday night. Anyone interested will be welcome to attend. For more information please contact me.

RICCLEES GUIDE-LINES FOR GOLF VOUCHERS

Each golfing voucher entitles you to one free round of golf at **Caprington Golf Course** (9 or 18 holes). You may use the golf course through *Ricclees* once per week. Simply present a golfing voucher for that week at the starters office along with your *Ricclees* membership card at your appropriate tee-off time. Please note that the voucher is not valid at the weekend. You must pre-book a tee-off time for the 18 hole course which can either be done in person at the starters office or by phoning Kilmarnock 521915. The course is open from approximately 8.00am to 10.00pm but times may vary according to the weather / time of year etc.

ADDITIONAL SERVICES OFFERED BY *RICCLEES*

Aerobics

The project offers two aerobic classes which are both based in **Riccarton Community Centre**. Classes are free to *Ricclees* members and take place on a Wednesday evening between 7.30pm - 8.30pm and a Monday afternoon between 1.30pm - 2.30pm. (NO MONDAY CLASS UNTIL AFTER CHRISTMAS)

Appendix T

Main Study Pre-Intervention Descriptive Statistics

Table 1 gives the descriptive statistics for the 312 people who attended their intervention in the main study.

Table 1.

Descriptive statistics for those people attending their intervention

				Age (years)				
Group	Sex	N	%	Mean	Median	SD	Min	Max
FAE	Male	37	39	33.3	32	11.5	17	65
	Female	57	61	35.5	35	13.8	16	72
All FAE	/	*94*	*100*	*34.7*	*33*	*12.9*	*16*	*72*
FAC	Male	41	44	36	33	14.9	17	67
	Female	52	56	39	35.5	16.8	16	67
All FAC	/	*93*	*100*	*37.7*	*35*	*16*	*16*	*67*
All FA	/	**187**	**60**	**36.2**	**34**	**14.6**	**16**	**72**
ECE	Male	21	32	45.5	42	18.2	18	74
	Female	45	68	46.7	41	17.7	16	80
All ECE	/	*66*	*100*	*46.3*	*41.5*	*17.7*	*16*	*80*
ECC	Male	12	20	54.2	59	21	18	77
	Female	47	80	51.9	47	15.9	24	77
All ECC	/	*59*	*100*	*52.3*	*52*	*16.9*	*18*	*77*
All EC	/	**125**	**40**	**49.2**	**47**	**17.5**	**16**	**80**

Note. FAE = fitness assessment experimental, FAC = fitness assessment control, ECE = exercise consultation experimental, ECC = exercise consultation control

Table 2 gives the descriptive statistics for the 58 people who did not attend their intervention in the main study.

Table 2.

Descriptive statistics for those people not attending their intervention

Group	Sex	N	%	Age (years) Mean	Median	SD	Min	Max
FAE	Male	8	44	26.5	24.5	9.2	17	39
	Female	10	56	29.5	28.5	7.2	21	42
All FAE	*/*	*18*	*100*	*28.2*	*27.5*	*8.1*	*17*	*42*
FAC	Male	8	40	32.9	22.5	19.3	17	65
	Female	12	60	34.1	32.0	11.5	20	65
All FAC	*/*	*20*	*100*	*33.6*	*30.5*	*14.6*	*17*	*65*
All FA	**/**	**38**	**100**	**31.1**	**29.5**	**12.1**	**17**	**65**
ECE	Male	3	43	34.3	28.0	11.9	27	48
	Female	4	57	32.3	29.5	13.4	20	50
All ECE	*/*	*7*	*100*	*33.1*	*28.0*	*11.8*	*20*	*50*
ECC	Male	5	38	55.4	69.0	21.6	30	75
	Female	8	62	51.3	52.0	19.2	17	75
All ECC	*/*	*13*	*100*	*52.9*	*52.0*	*19.4*	*17*	*75*
All EC	**/**	**20**	**100**	**45.9**	**48.5**	**19.3**	**17**	**75**

Note. FAE = fitness assessment experimental, FAC = fitness assessment control, ECE = exercise consultation experimental, ECC = exercise consultation control

Appendix U

Main Study Leisure Time Physical Activity Graphs

Figures 1 and 2 give boxplots for activity status and intervention group respectively plotted against the log of leisure time physical activity minus the extreme values reported at the start of section two in chapter 5.

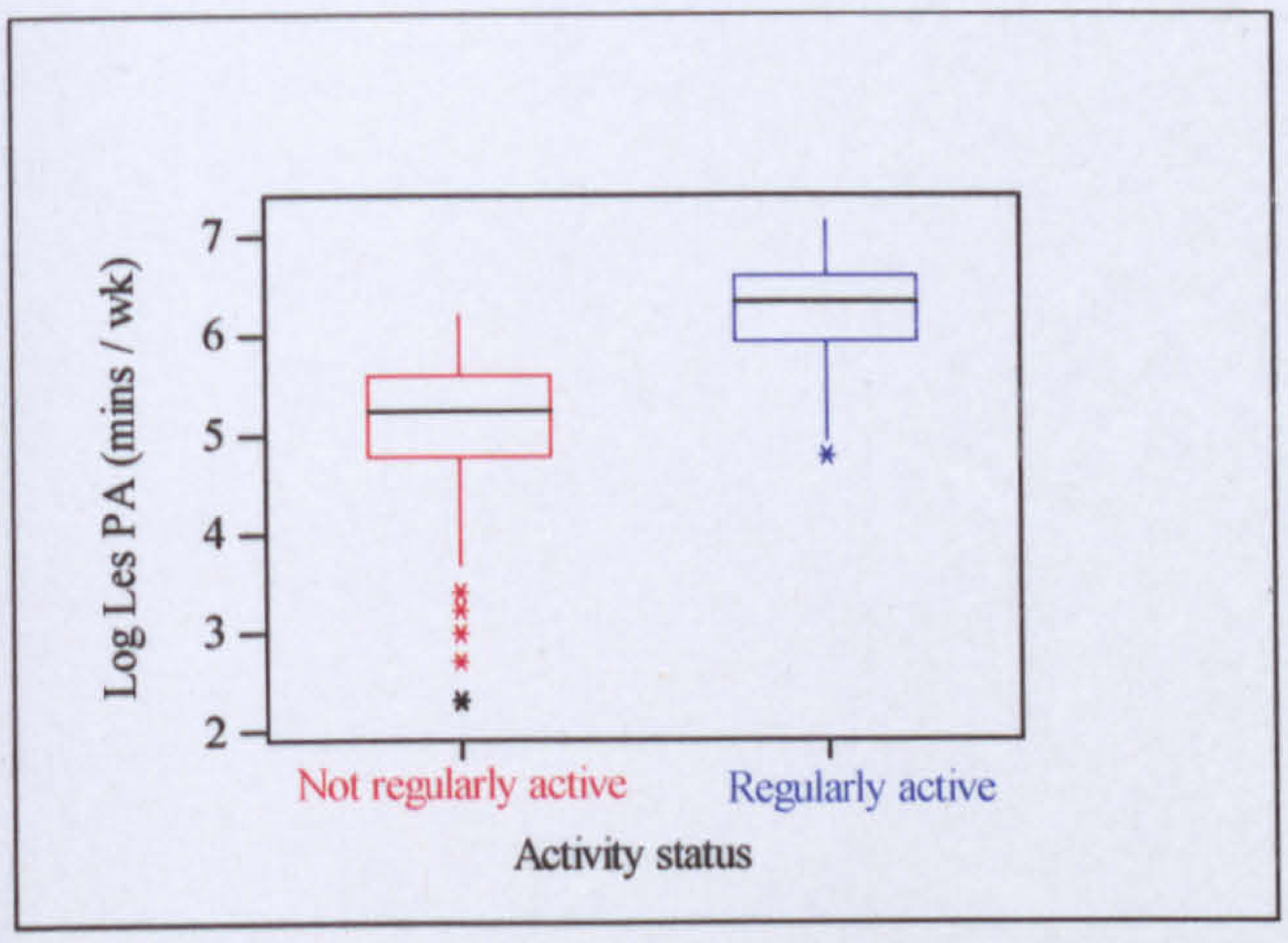


Figure 1 Boxplot of activity status against log of leisure time physical activity (mins / wk)

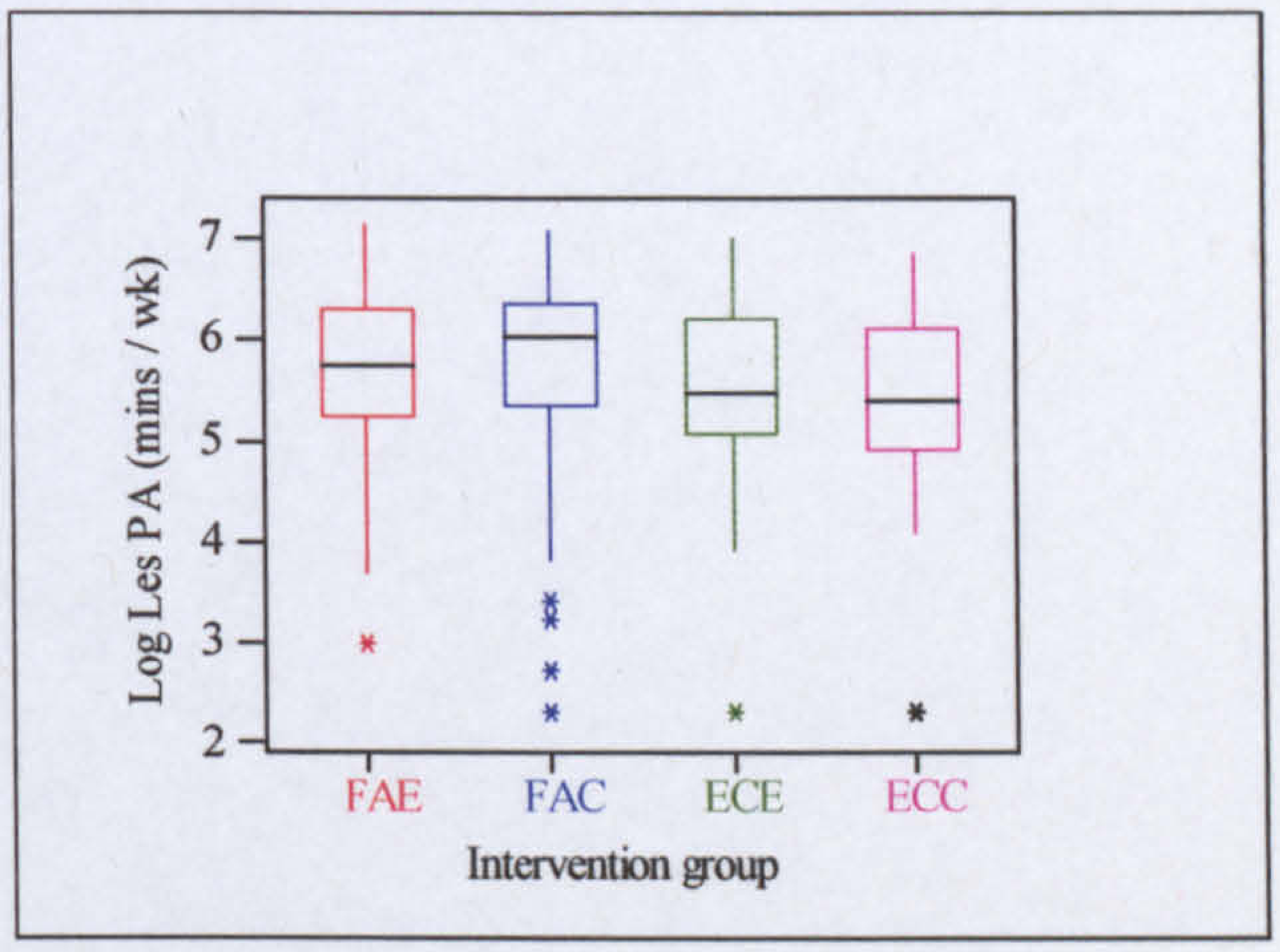


Figure 2 Boxplot of intervention group against log of leisure time physical activity (mins/wk)

Figures 3 and 4 give boxplots for intervention group and test stage respectively plotted against the log of leisure time physical activity for those regularly active.

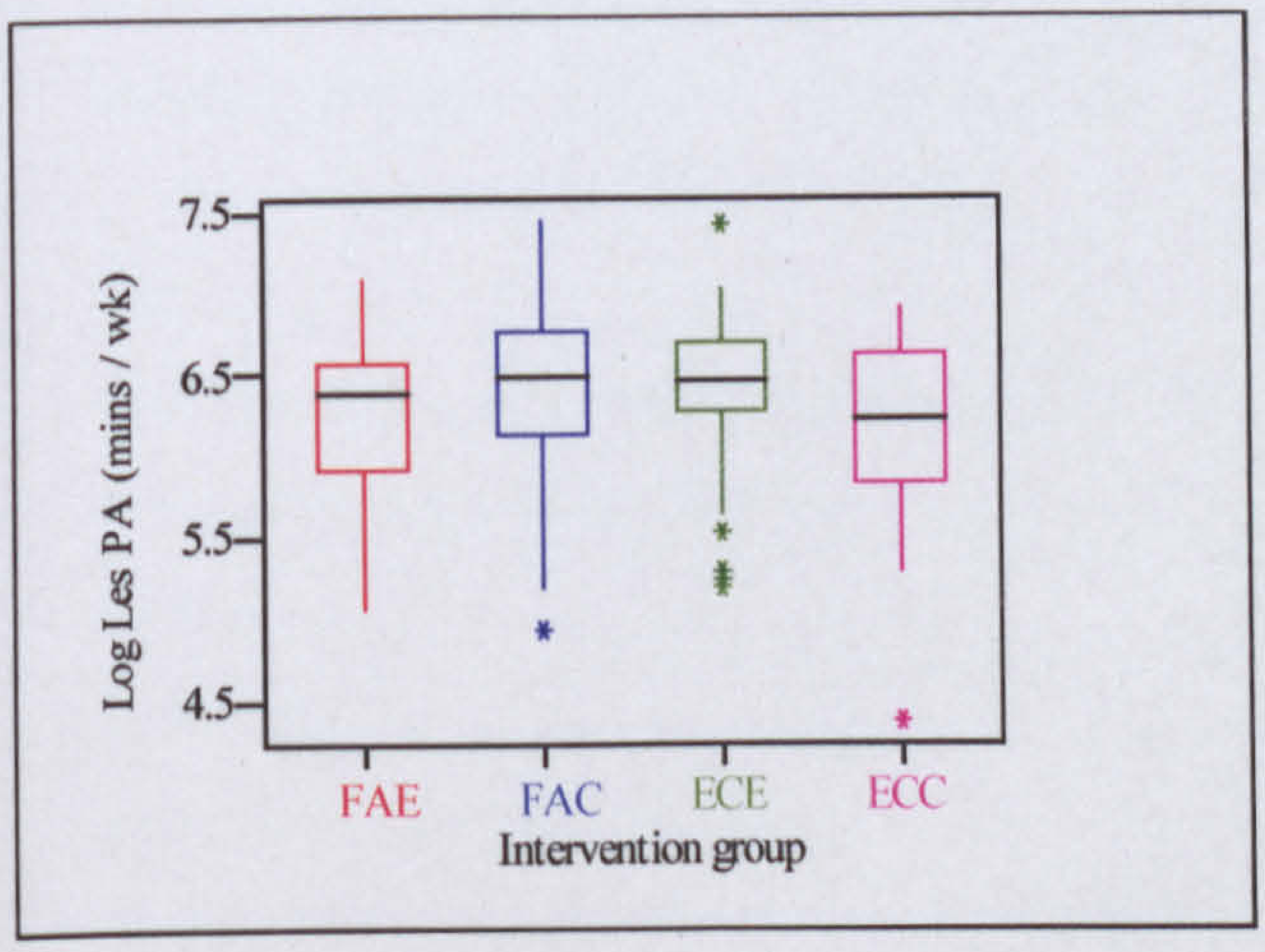


Figure 3 Boxplot of intervention group against log leisure time physical activity (mins/wk)

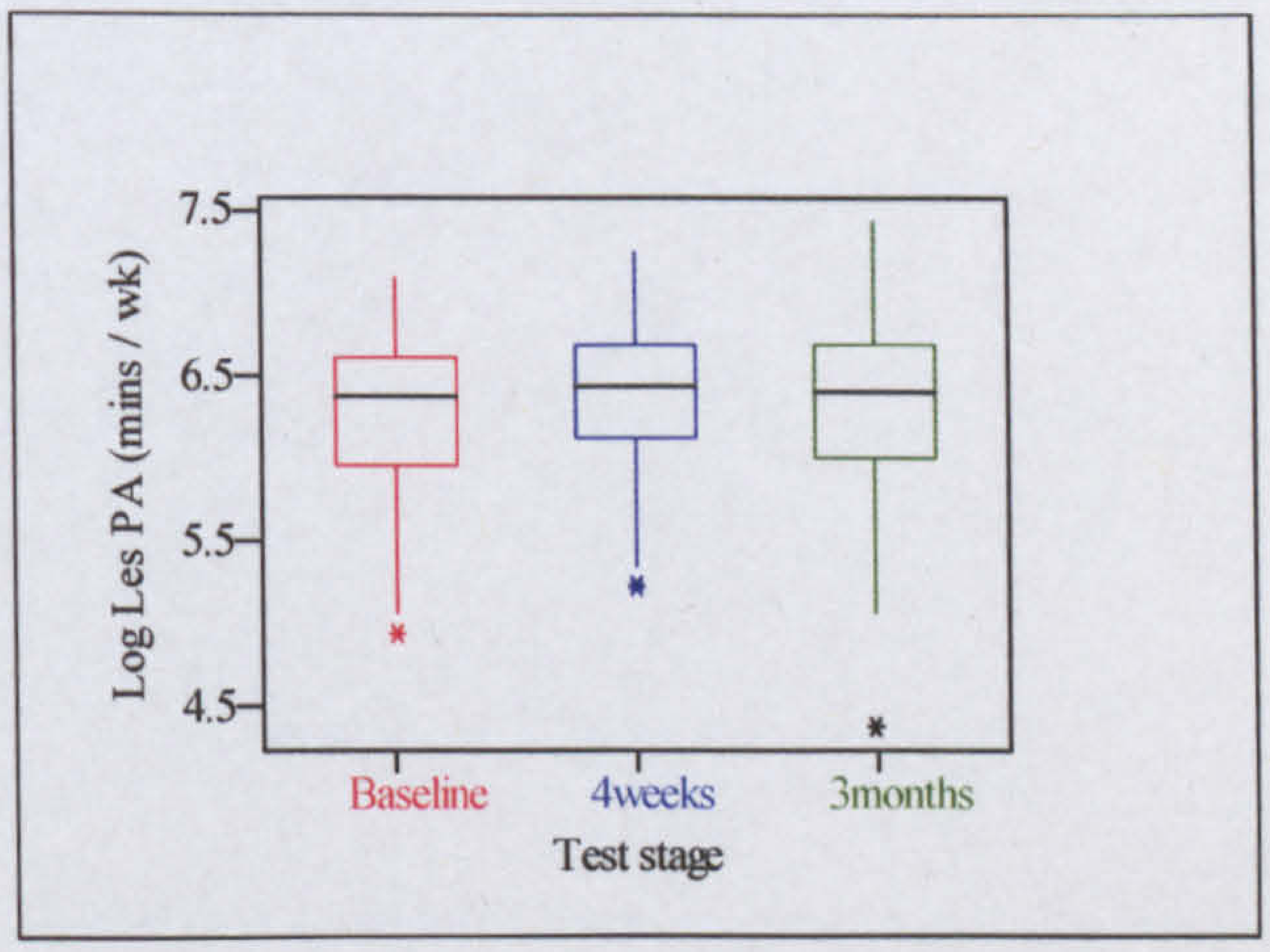


Figure 4 Boxplot of test stage against log leisure time physical activity (mins /wk)

Appendix V

Main Study Analyses of Variance for Immediate Intervention and Re-test Intervention Effect

Immediate Intervention Effect

Figure 1 gives the interaction plot for activity status, intervention group and test stage.

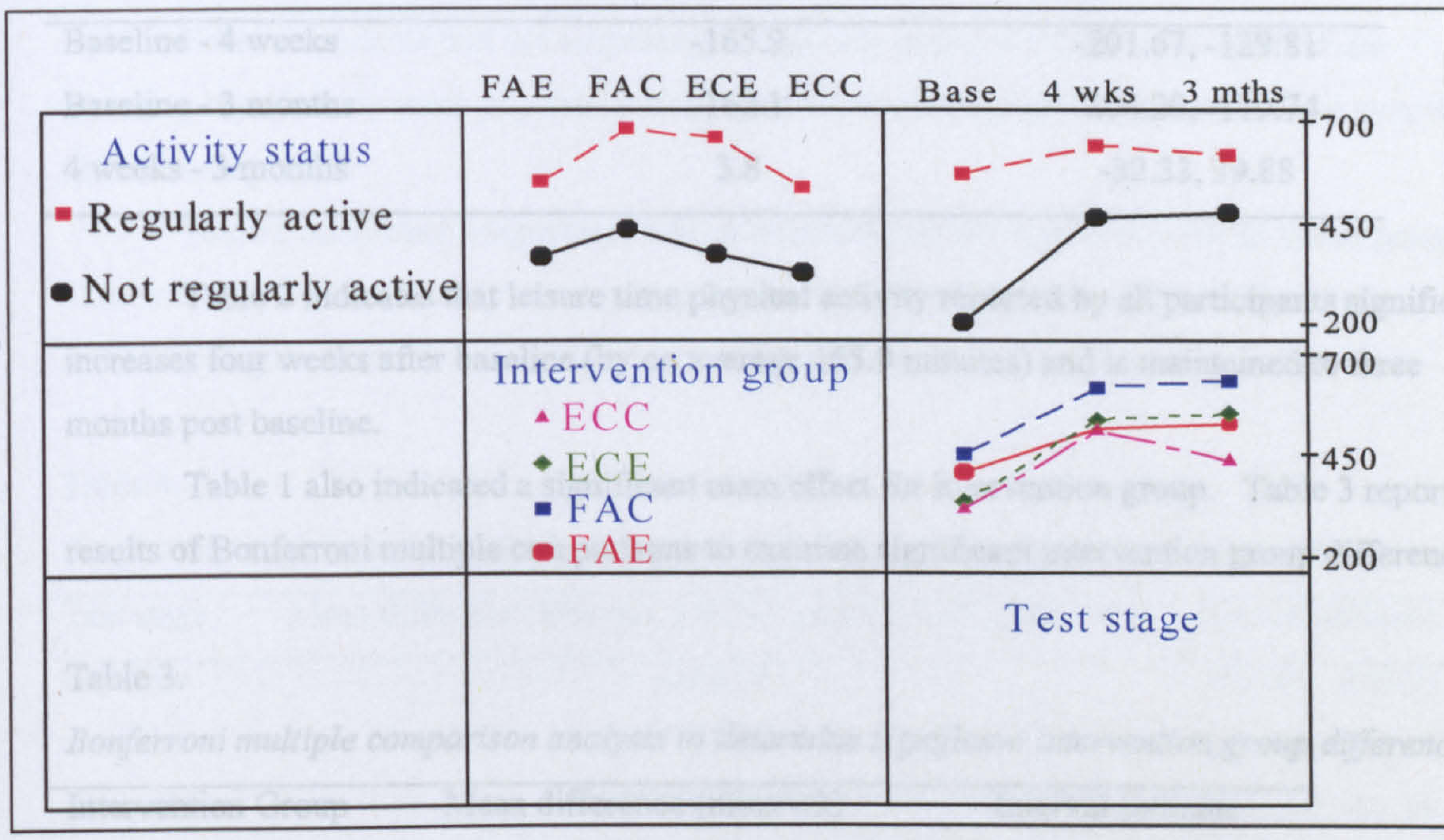


Figure 1 Interaction plot for activity status, intervention group and test stage

Table 1 reports the results of a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status).

Table 1.

The results of a one within (test stage) factor and two between subject factors (intervention group and activity status) analysis of variance performed on leisure time physical activity (mins / wk)

Source	DF	F	P
Test stage	1.93	67.9	< 0.05
Intervention group	3	5.82	< 0.05
Activity status	1	92.06	< 0.05
Subject (intervention group * act status)	228	3.69	< 0.05
Test stage * intervention group	5.79	1.39	0.22
Test stage * activity status	1.93	31.55	< 0.05
Intervention group * activity status	3	0.79	0.50
Test stage * intervention group * activity status	5.79	1.01	0.42
Error	440.6		
Total	691.0		

Table 2 reports the results of Bonferroni multiple comparisons for repeated measures for the test stage main effect.

Table 2.

Bonferroni multiple comparison for repeated measures analysis for test stage

Test stage	Mean difference (mins/wk)	Interval estimate
Baseline - 4 weeks	-165.9	-201.67, -129.81
Baseline - 3 months	-162.1	-204.20, -119.74
4 weeks - 3 months	3.8	-32.33, 39.88

Table 2 indicates that leisure time physical activity reported by all participants significantly increases four weeks after baseline (by on average 165.9 minutes) and is maintained to three months post baseline.

Table 1 also indicated a significant main effect for intervention group. Table 3 reports the results of Bonferroni multiple comparisons to examine significant intervention group differences.

Table 3.

Bonferroni multiple comparison analysis to determine significant intervention group differences.

Intervention Group	Mean difference (mins/wk)	Interval estimate
FAE – FAC	-84.3	-154.86, -13.72
FAE – ECE	8.1	-66.31, 82.62
FAE – ECC	62.0	-16.47, 140.44
FAC- ECE	92.4	20.56, 164.34
FAC – ECC	146.3	70.26, 222.29
ECE – ECC	53.9	-25.82, 133.47

Table 3 indicates that the fitness assessment control group are reporting significantly more physical activity over the three test stages compared to those participants in the other three groups. The interaction plot for intervention group and test stage (figure 1) shows that the fitness assessment control group are reporting consistently higher levels of physical activity across the three test stages. However, there was no significant interaction between intervention group and test stage which suggests that the pattern of physical activity over the three test stages was similar between groups. That is to say, no intervention was any more successful in increasing physical activity levels from baseline.

Table 4 reports the results of a two sample t-test for the difference between the activity status groups.

Table 4.

Results of a two sample t-test for the difference between the activity status groups

Group	N	Mean	SD	T	P	CI
Not regularly active	123	386	224	-12.45	< 0.05	-266, -194
Regularly active	113	613	263			

Table 4 confirms that not surprisingly, regularly active participants at baseline are reporting significantly more physical activity than those not regularly active at baseline over the three test stages.

Table 1 confirmed a significant interaction between test stage and activity status group. That is to say, the two activity status groups showed a different pattern of physical activity over the three test stages. Table 5 reports Bonferroni multiple comparisons for the interaction.

Table 5.

Bonferroni confidence intervals for the interaction between test stage and activity status group

Test stage	Mean difference between activity status groups (mins/wk)	Interval estimate
Baseline	-366.79	-424.65, -308.93
4 weeks	-177.66	-251.53, -103.78
3 months	-145.16	-225.14, -65.18

Table 5 shows that there remains a significant difference between those participants regularly active at baseline and those not regularly active across the three test stages. However, this difference is decreasing as the study progresses. The interaction plot for activity status and test stage shown in figure 1 clearly demonstrates this.

Table 6 reports the results of two one way repeated measures analysis of variance tests, conducted to examine differences between test stages for each activity status group

Table 6.

The results of two one way repeated measures analysis of variance tests, conducted to examine differences between test stages for each activity status group

Activity status	DF	F	P
Not regularly active	2	132.6	< 0.05
Regularly active	2	4.26	< 0.05

Table 6 shows that there are significant differences between test stages for each activity status group. Table 7 and 8 report the results of follow up Bonferroni multiple comparisons for repeated measures for those not regularly active and those regularly active respectively.

Table 7.

Follow up Bonferroni multiple comparisons for repeated measures for the not regularly active group for test stage differences

Test stage	Mean difference between test stages (mins/wk)	Interval estimate
Baseline - 4 weeks	-256.5	-303.21, -209.72
Baseline - 3 months	-268.3	-314.37, -222.14
4 weeks - 3months	-11.8	-54.42, 30.84

Table 8.

Follow up Bonferroni multiple comparisons for repeated measures for the regularly active group for test stage differences

Test stage	Mean difference between test stages (mins/wk)	Interval estimate
Baseline - 4 weeks	-67.2	-113.71, -20.63
Baseline - 3 months	-46.4	-110.19, 17.28
4 weeks – 3months	20.8	-39.42, 80.83

Tables 7 and 8 confirm the analyses reported in chapter 5.

Effectiveness of Intervention Re-test

Figure 2 plots the interaction between activity status, intervention group and test stage for the log of leisure time physical activity.

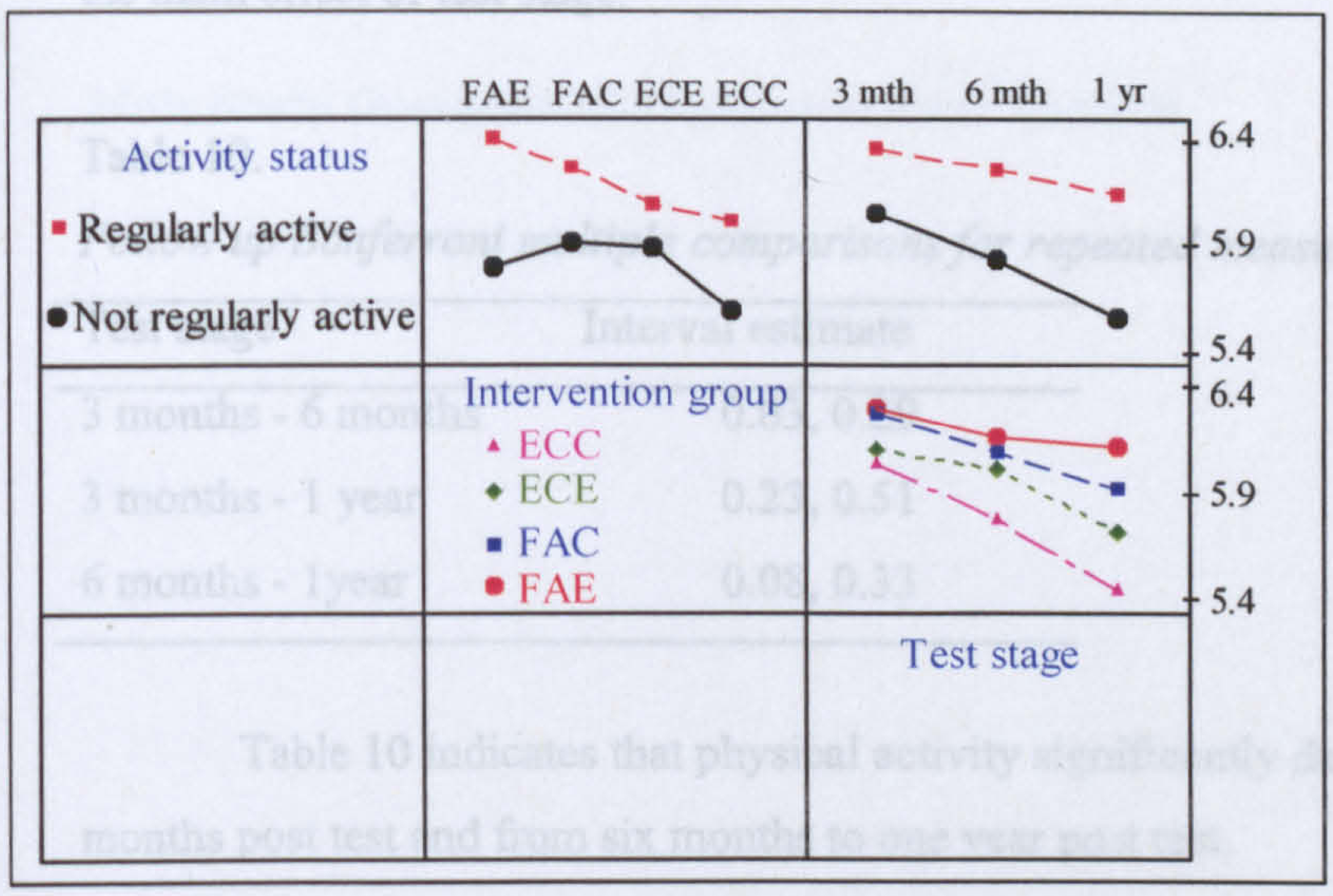


Figure 2. Interaction plot for activity status, intervention group and test stage for the log of leisure time physical activity

Table 9 reports the results of a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status).

Table 9.

The results of a one within (test stage) factor and two between subject factors (intervention group and activity status) analysis of variance performed on the log of leisure time physical activity (mins / wk)

Source	DF	F	P
Test stage	2	22.1	< 0.05
Intervention group	3	2.17	0.1
Activity status	1	19.6	< 0.05
Subject (intervention group * act status)	102	3.59	< 0.05
Test stage * intervention group	6	0.91	0.49
Test stage * activity status	2	2.16	0.12
Intervention group * activity status	3	0.83	0.48
Test stage * intervention group * activity status	6	0.46	0.84
Error	208		
Total	335		

Table 9 indicates a significant subject nesting effect for intervention group and activity status. Again, this tells us that there is a significant variation between participants. Table 9 also indicates clear main effects for test stage and activity status but not for intervention group. There are no significant interactions between test stage, intervention group and activity status.

Table 10 reports the results of Bonferroni multiple comparisons for repeated measures to examine the main effect of test stage.

Table 10.

Follow up Bonferroni multiple comparisons for repeated measures for test stage differences

Test stage	Interval estimate
3 months - 6 months	0.03, 0.29
3 months - 1 year	0.23, 0.51
6 months - 1year	0.08, 0.33

Table 10 indicates that physical activity significantly decreases from three months to six months post test and from six months to one year post test.

Table 9 also indicates a significant main effect for activity status. Table 11 reports the results of a two sample t-test for the difference between activity status groups over the two test stages.

Table 11.

Results of a two sample t-test for the difference between the activity status groups

Group	N	Mean	SD	T	P
Not regularly active	186	5.82	0.58	-6.97	< 0.05
Regularly active	150	6.26	0.58		

Table 11 indicates that those regularly active at baseline continue to report significantly more physical activity than those not regularly active at baseline.

Appendix W

Main Study Occupational Physical Activity Analysis

Occupational Physical Activity

Baseline Analysis

Table 1 gives basic descriptive statistics for occupational physical activity for each test study group at baseline.

Table 1.

Descriptive statistics for occupational physical activity (mins / wk) for each study group at baseline

Study Group	Activity Status	Baseline Total PA (mins/wk) N	Mean	Median	SD
FAE	NRA	43	210.1	200.0	139.9
	RA	51	313.3	210.0	349.3
FAC	NRA	45	336.3	290.0	263.9
	RA	48	374.8	200.0	458.6
ECE	NRA	41	255.7	200.0	183.2
	RA	25	316.0	150.0	389.6
ECC	NRA	34	287.1	160.0	281.1
	RA	25	358.4	300.0	258.3

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Table 1 reports the initial occupational physical activity levels at baseline of participants regularly active and not regularly active for each intervention. At baseline, as with leisure time physical activity, there are three main questions to be answered. First, are those regularly active participants reporting significantly more activity than those non regularly active participants (as would be expected), second, are there any significant differences in physical activity participation between intervention groups, and finally, is there any significant interaction between intervention group and activity status at baseline? A two way analysis of variance will be used to answer these questions. The first step is to plot the data. Figures 1 and 2 show boxplots for activity status (i.e. regularly active / not regularly active) and intervention group respectively plotted against occupational physical activity.

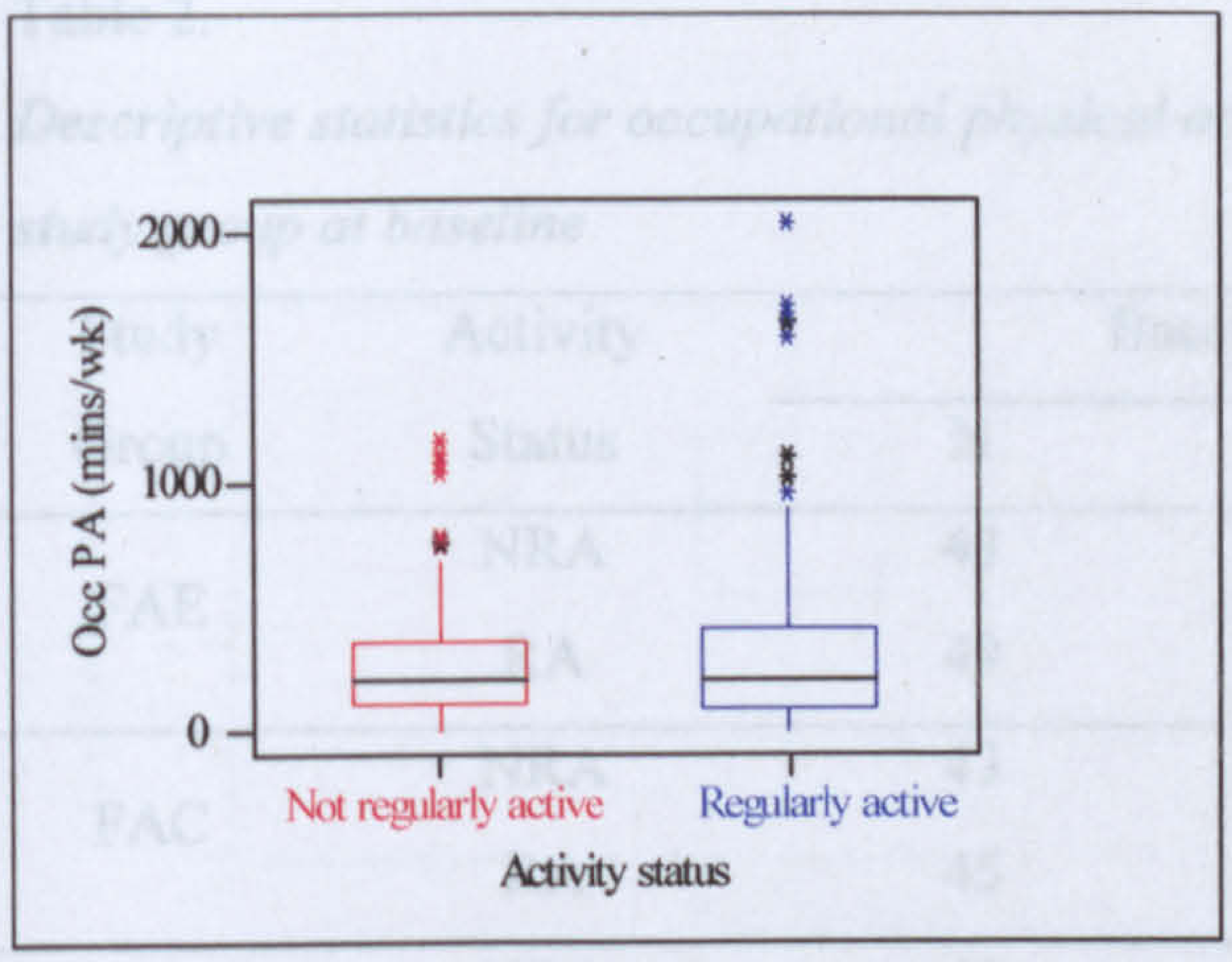


Figure 1 Boxplot of activity status against occupational physical activity (mins / wk)

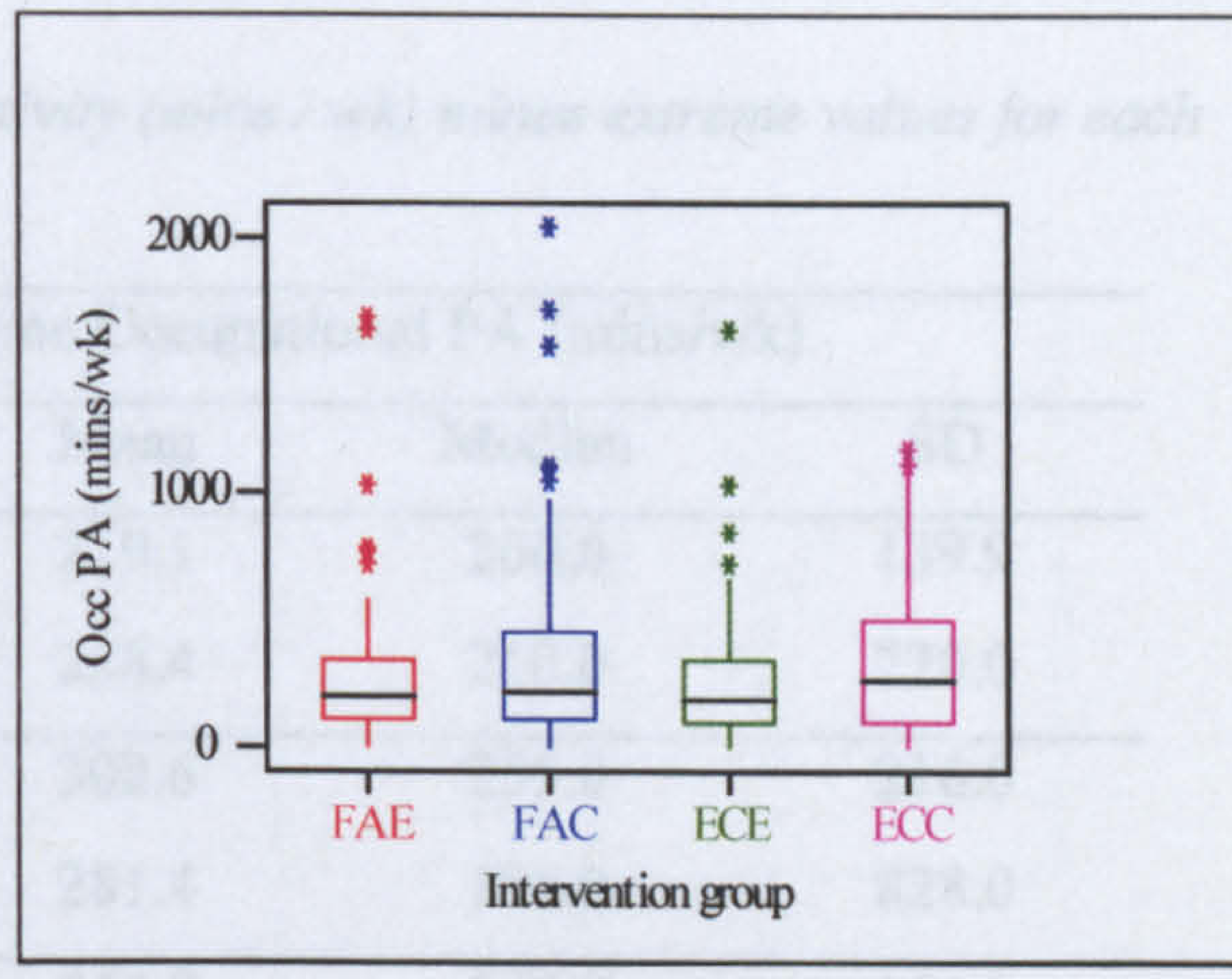


Figure 2 Boxplot of intervention group against occupational physical activity (mins/wk)

As with leisure time physical activity, figures 1 and 2 show that the data appears to be positively skewed with eight regularly active participants reporting in excess of 1500 minutes of occupational physical activity per week and 4 non regularly active participants reporting in excess of 1000 minutes per week.

It is clear from figures 1 and 2 that removing the extreme sets of data would enhance the normality of the data. In addition, as with leisure time physical activity, following these participants throughout the course of the study, they again continue to report higher amounts of physical activity than their counterparts. This suggests that if these sets of data are removed, the effect on the overall pattern of physical activity throughout the study will be minimal as these participants consistently report higher amounts of physical activity.

Table 2 reports descriptive statistics for occupational physical activity for each study group at each test stage, minus the extreme values.

Table 2.

Descriptive statistics for occupational physical activity (mins / wk) minus extreme values for each study group at baseline

Study Group	Activity Status	Baseline Occupational PA (mins/wk)			
		N	Mean	Median	SD
FAE	NRA	43	210.1	200.0	139.9
	RA	49	258.4	210.0	220.0
FAC	NRA	43	302.6	255.0	216.0
	RA	45	281.4	195.0	828.0
ECE	NRA	41	255.7	200.0	183.2
	RA	23	228.0	150.0	236.4
ECC	NRA	32	233.7	155.0	184.9
	RA	24	327.5	300.0	211.4

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Figures 3 and 4 give boxplots for activity status (i.e. regularly active / not regularly active) and intervention group respectively plotted against occupational physical activity minus the extreme values.

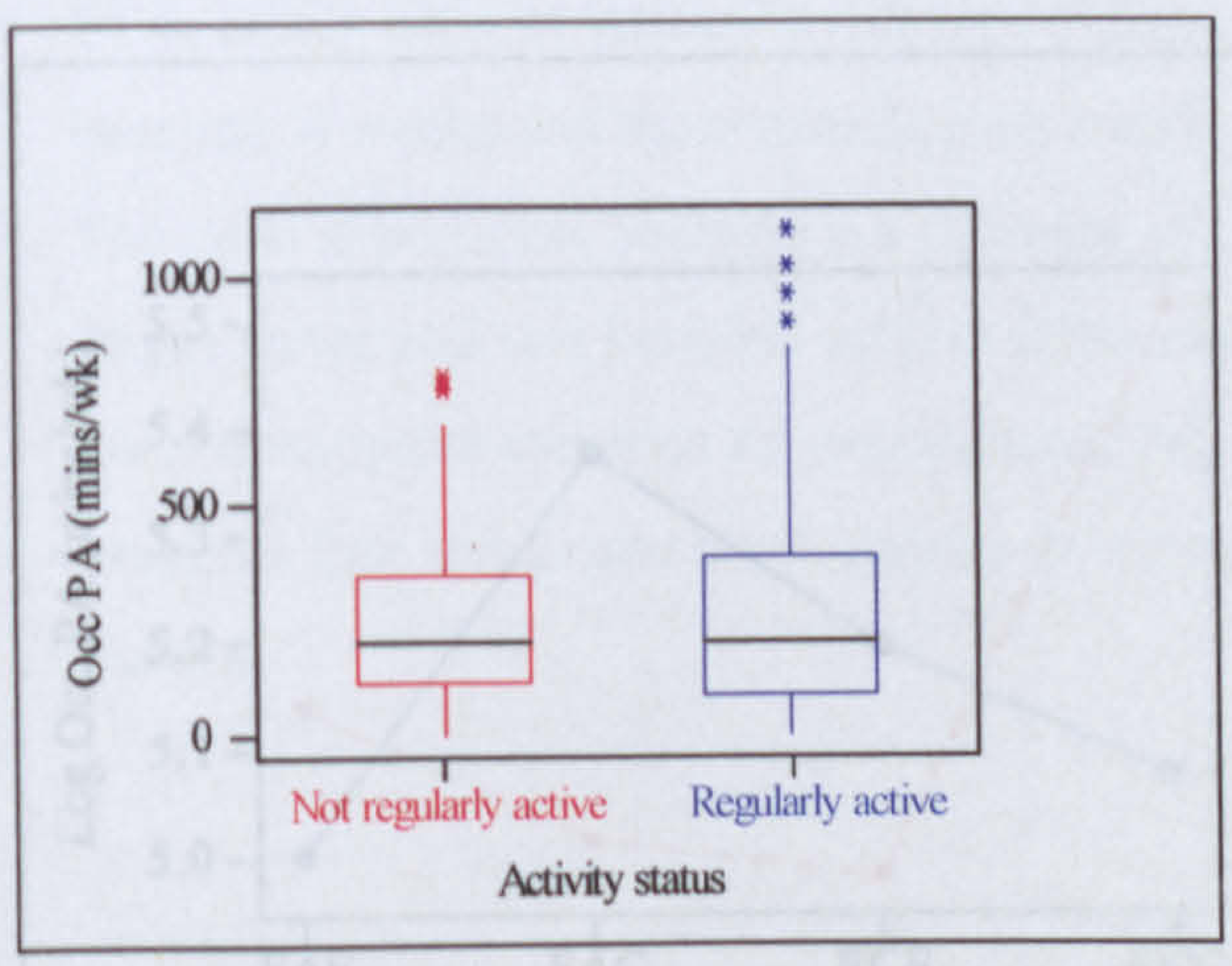


Figure 3 Boxplot of activity status against occupational physical activity (mins / wk)

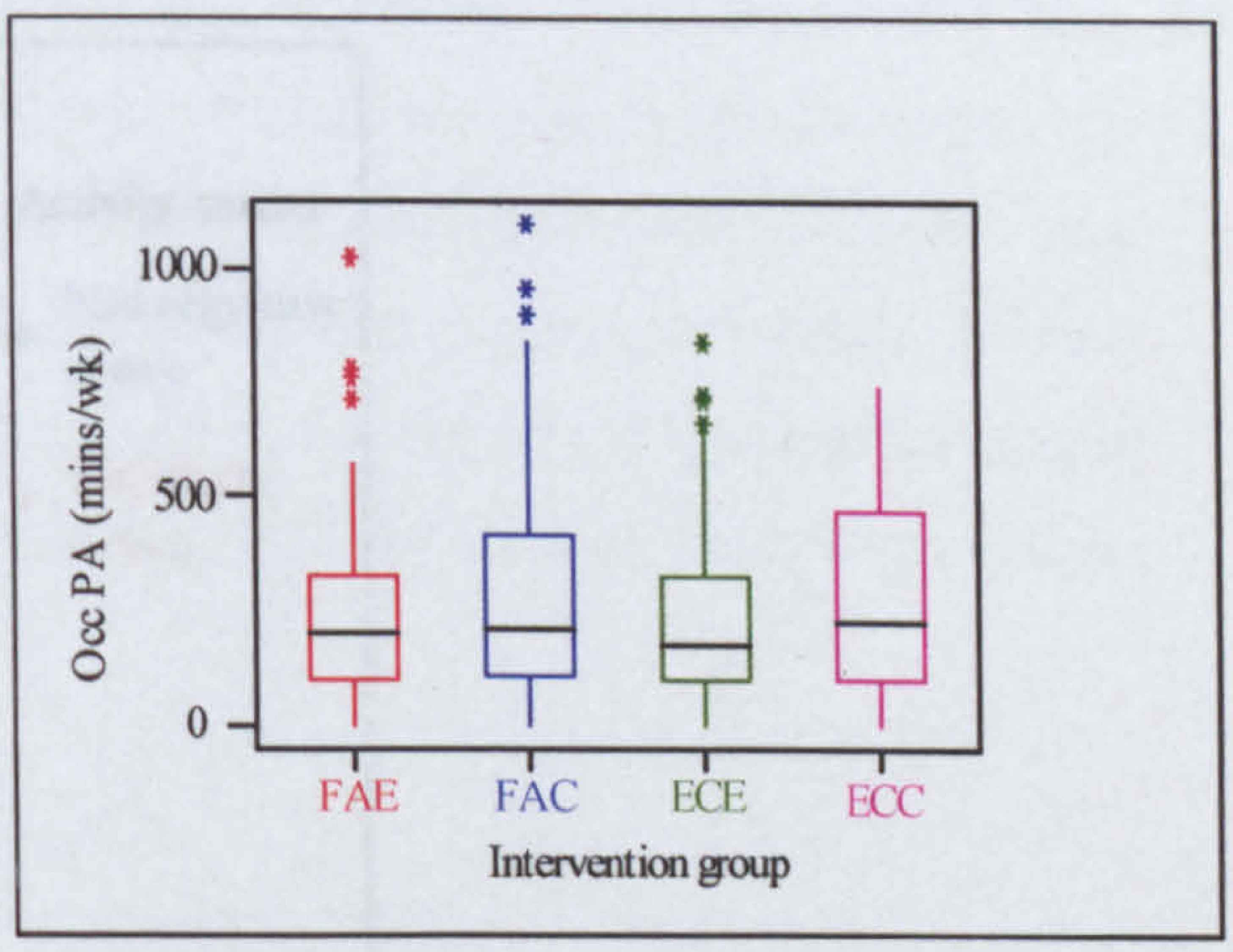


Figure 4 Boxplot of intervention group against occupational physical activity (mins/wk)

It is clear from figures 3 and 4 that the number of outliers has been reduced. However, the data still displays several outliers. It is possible that taking logarithms will further reduce the number of outliers. Figures 5 and 6 give boxplots for activity status and intervention group respectively plotted against log of occupational physical activity.

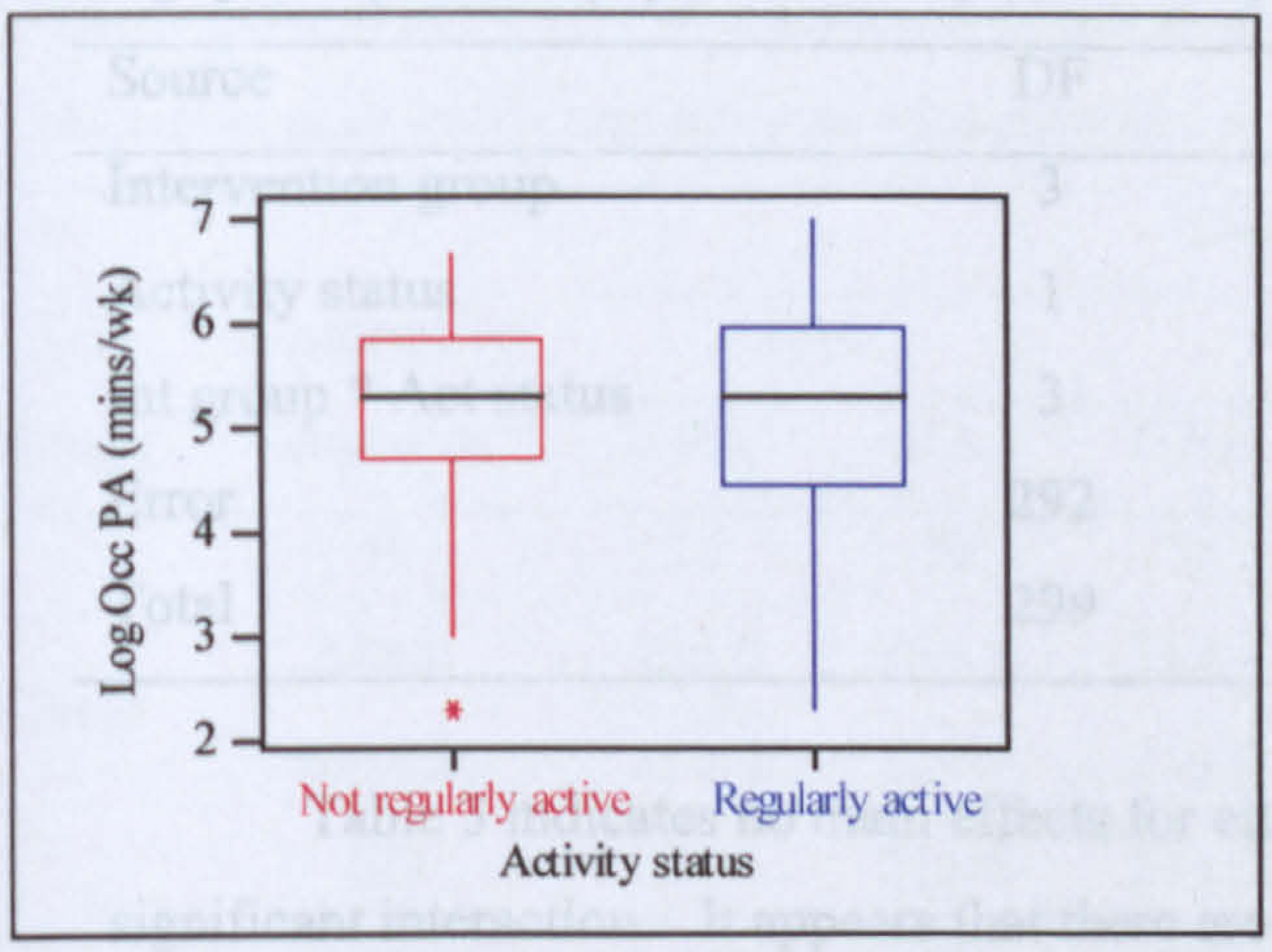


Figure 5 Boxplot of activity status against log occupational physical activity (mins / wk)

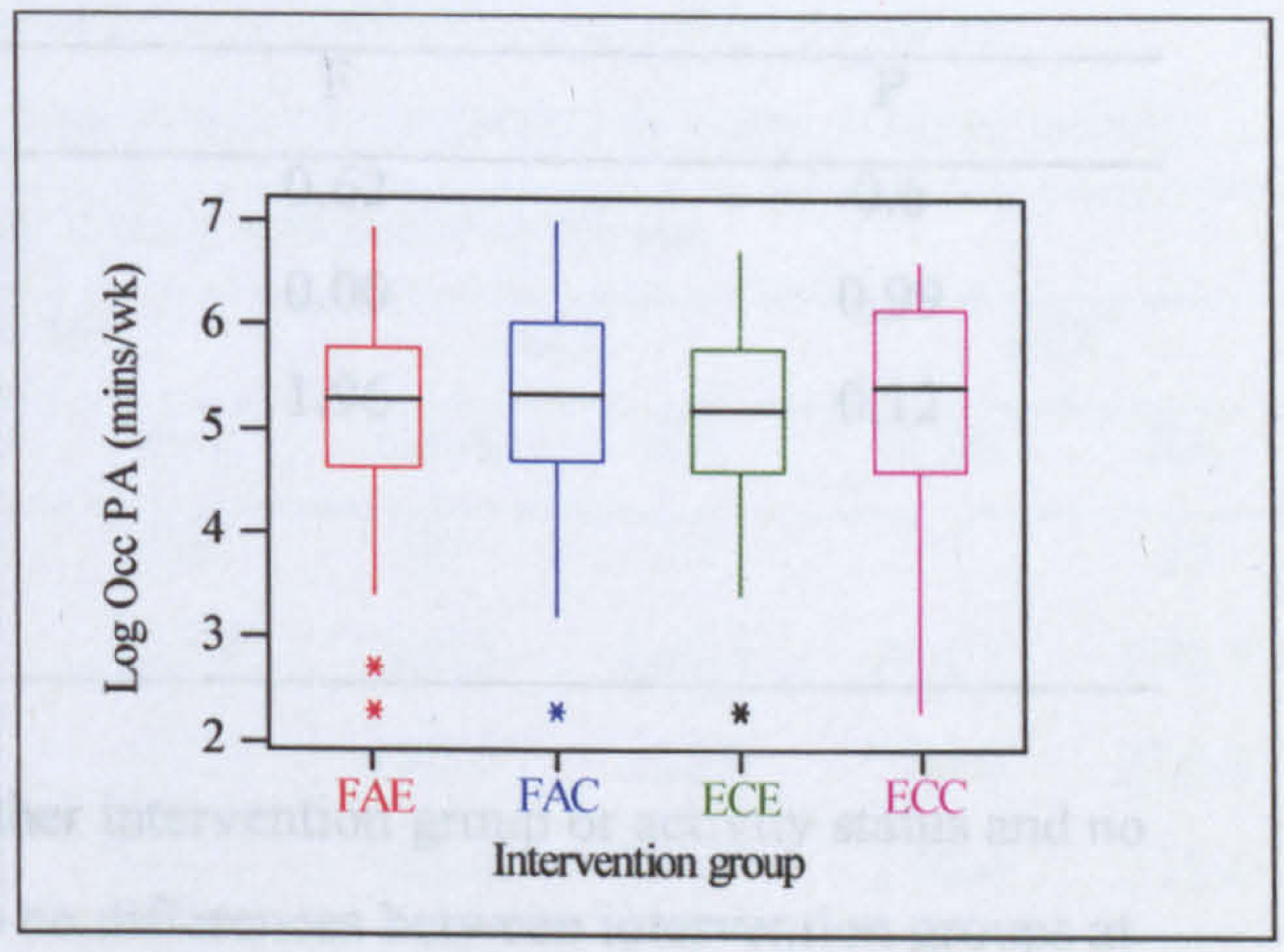


Figure 6 Boxplot of intervention group against log occupational physical activity (mins/wk)

Figures 5 and 6 show that taking logarithms has further reduced the number of outliers and enhanced the normality of the data.

Figures 5 and 6 portray main effect plots for activity status and intervention group respectively. Figure 7 plots the interaction between activity status and intervention group.

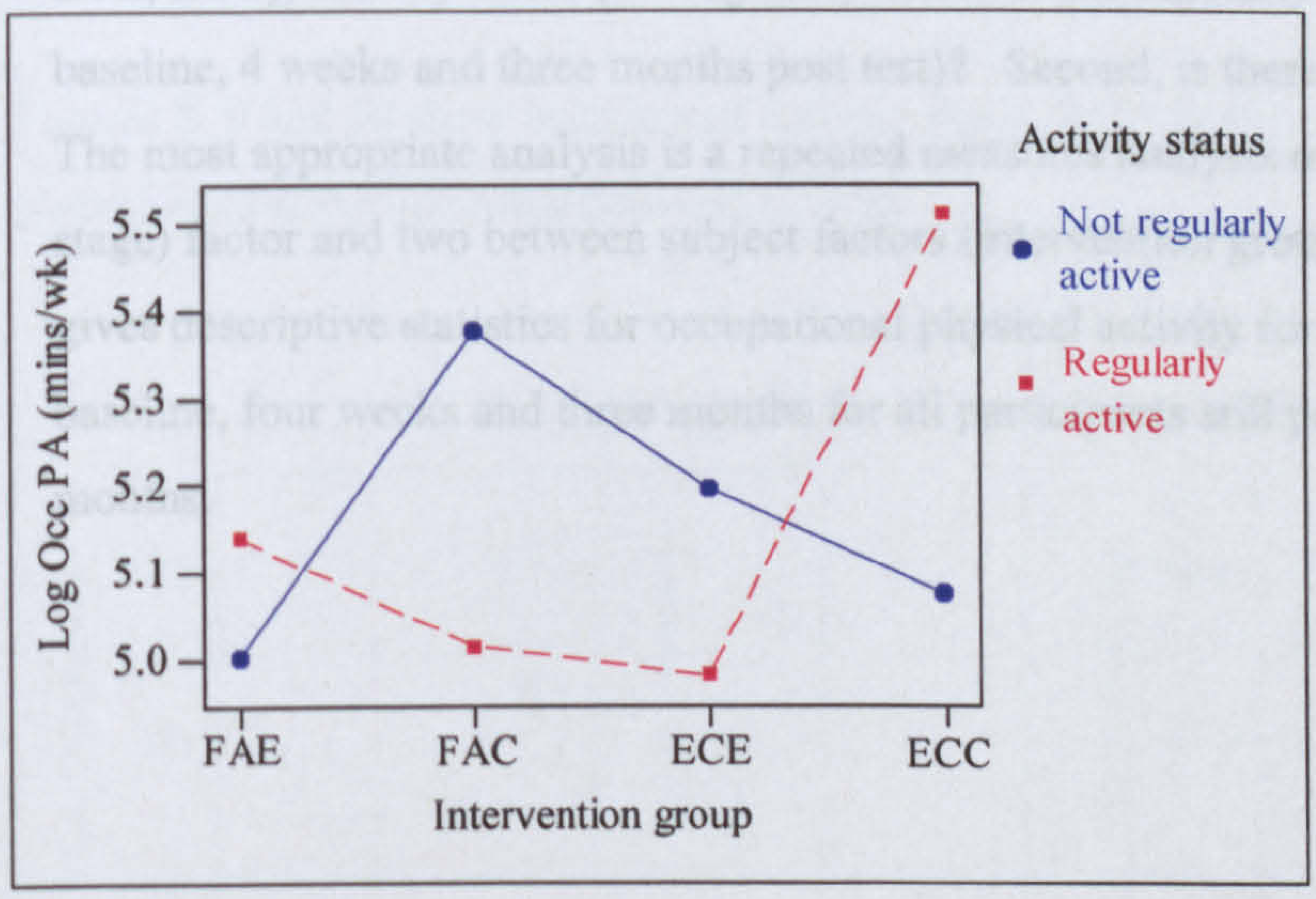


Figure 7 Interaction plot for activity status and intervention group

Figure 5 suggests that there is little difference in occupational physical activity between activity status groups. Figure 6 also suggests little difference between intervention groups. Figure 7 does however suggest some interaction. To formally check these observations, a two way (intervention group and activity status) analysis of variance was conducted, the results of which are given in table 3.

Table 3.

The results of a two way (intervention group and activity status) analysis of variance performed on log of occupational physical activity (mins / wk)

Source	DF	F	P
Intervention group	3	0.62	0.6
Activity status	1	0.00	0.99
Int group * Act status	3	1.96	0.12
Error	292		
Total	299		

Table 3 indicates no main effects for either intervention group or activity status and no significant interaction. It appears that there are no differences between intervention groups at baseline (as expected) but surprisingly, the regularly active group are not reporting significantly more physical activity than the non regularly active group.

Immediate Intervention Effect

In order to determine the immediate effect of each intervention, physical activity levels at baseline, four weeks and three months post test need to be analysed. Here, there are several questions of importance. First, is there any main effect of intervention group (i.e. FAE, FAC, ECE, ECC), activity status (i.e. regularly active or not regularly active at baseline) or test stage (i.e. baseline, 4 weeks and three months post test)? Second, is there any significant interaction effect? The most appropriate analysis is a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status). Table 4 gives descriptive statistics for occupational physical activity for each study group at test stages baseline, four weeks and three months for all participants still participating in the study at three months.

Table 4.

Descriptive statistics for occupational physical activity (mins / wk) for each study group at baseline, four weeks and three months post test for participants remaining in study at three months.

Test Stage	Descriptive Statistics	FAE NRA	FAE RA	FAC NRA	FAC RA	ECE NRA	ECE RA	ECC NRA	ECC RA
Base	N	25	38	33	36	39	17	27	19
	Mean	225.0	253.3	313.8	217.6	266.5	255.3	216.1	290.8
	Median	210.0	210.0	255.0	165.0	280.0	150.0	150.0	250.0
	SD	151.4	215.2	231.3	214.7	181.0	266.2	174.4	215.4
4 wk	N	25	38	33	36	39	17	27	19
	Mean	274.8	299.1	318.2	243.3	270.8	204.4	266.7	386.6
	Median	295.0	297.5	280.0	192.5	230.0	140.0	210.0	300.0
	SD	172.2	240.7	190.8	217.9	188.1	161.8	242.7	310.9
3 mth	N	25	38	33	36	39	17	27	19
	Mean	253.0	273.4	302.7	236.2	293.7	232.4	294.6	307.1
	Median	210.0	265.0	255.0	170.0	255.0	210.0	245.0	250.0
	SD	204.5	221.0	199.8	212.0	197.6	201.5	287.9	297.7

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Figures 8, 9 and 10 show boxplots of activity status, intervention group and test stage respectively plotted against occupational physical activity.

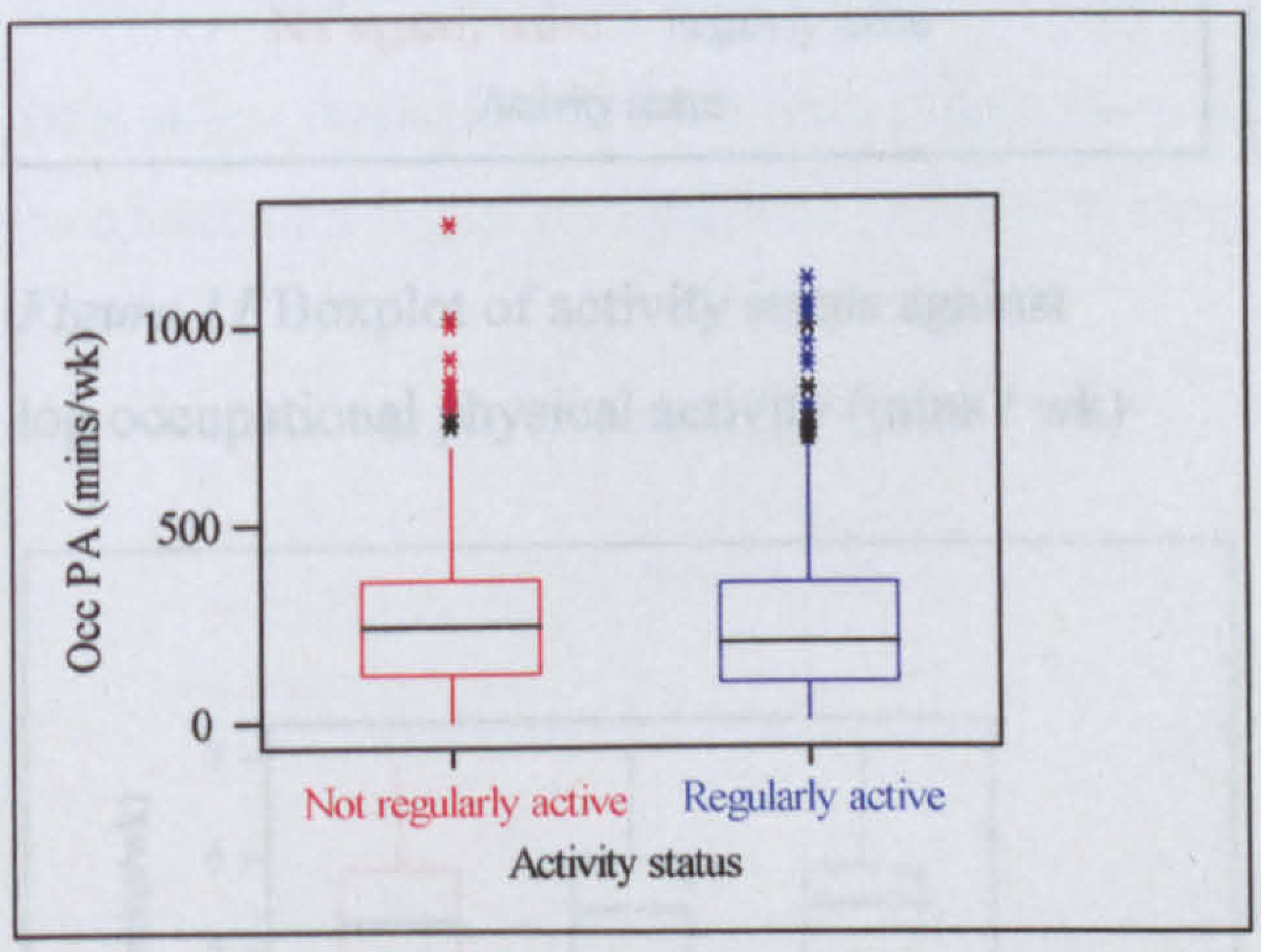


Figure 8 Boxplot of activity status against occ upational physical activity (mins / wk)

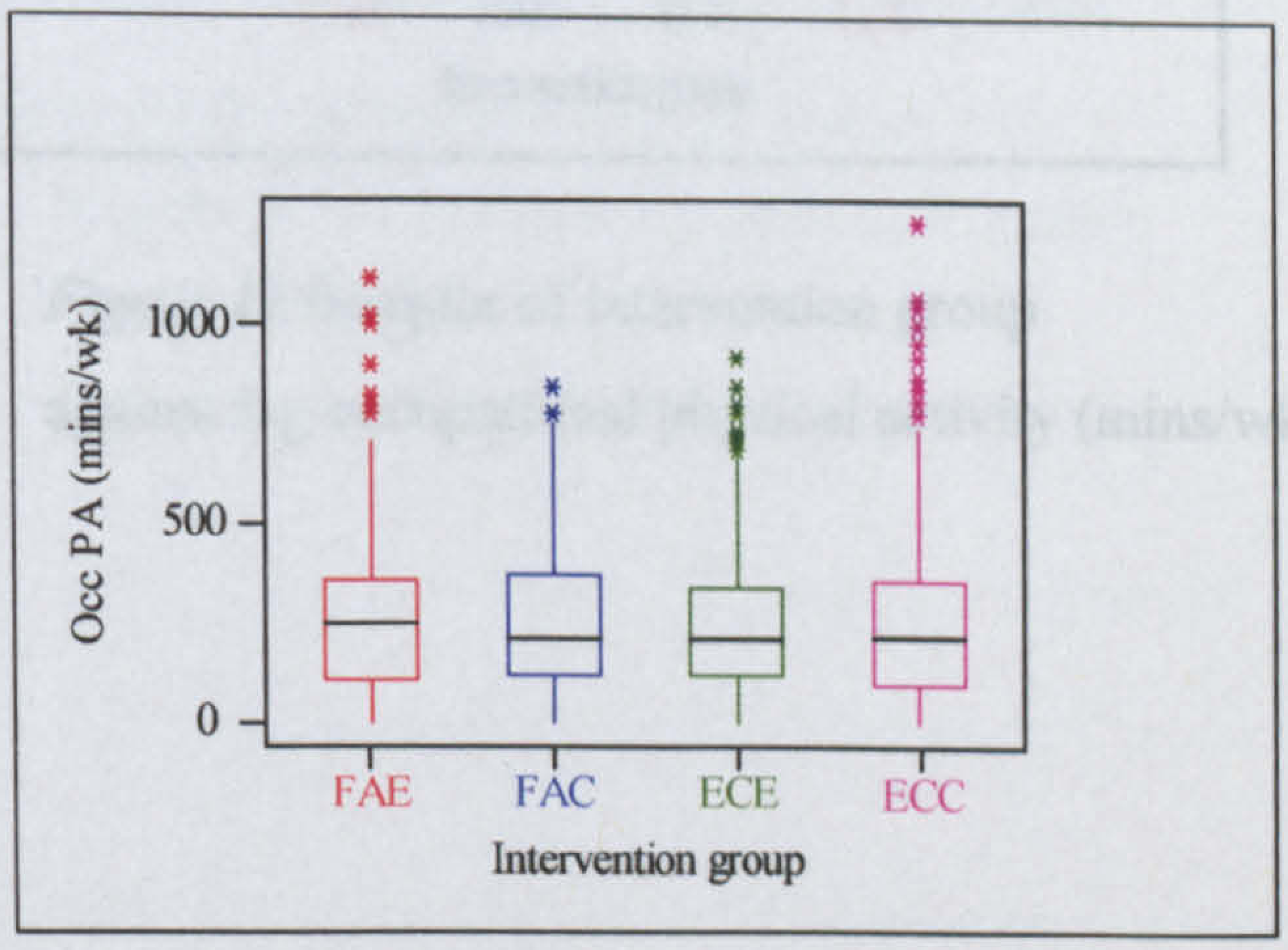


Figure 9 Boxplot of intervention group against occupational physical activity (mins/wk)

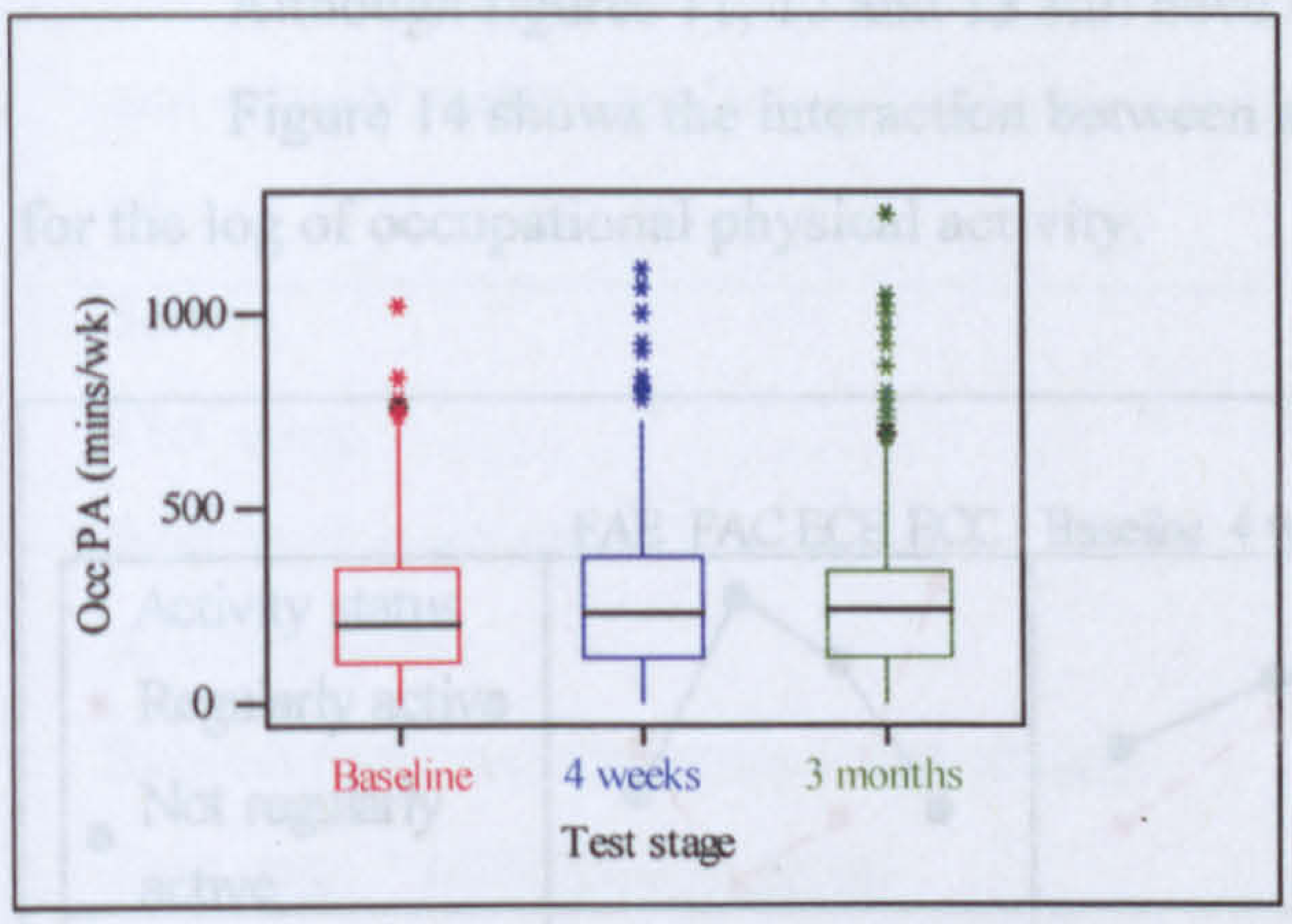


Figure 10 Boxplot of test stage against occupational physical activity (mins/wk)

Figures 8, 9 and 10 show clear outliers. Figures 11, 12 and 13 show boxplots of intervention group, activity status and test stage respectively plotted against the log of occupational physical activity.

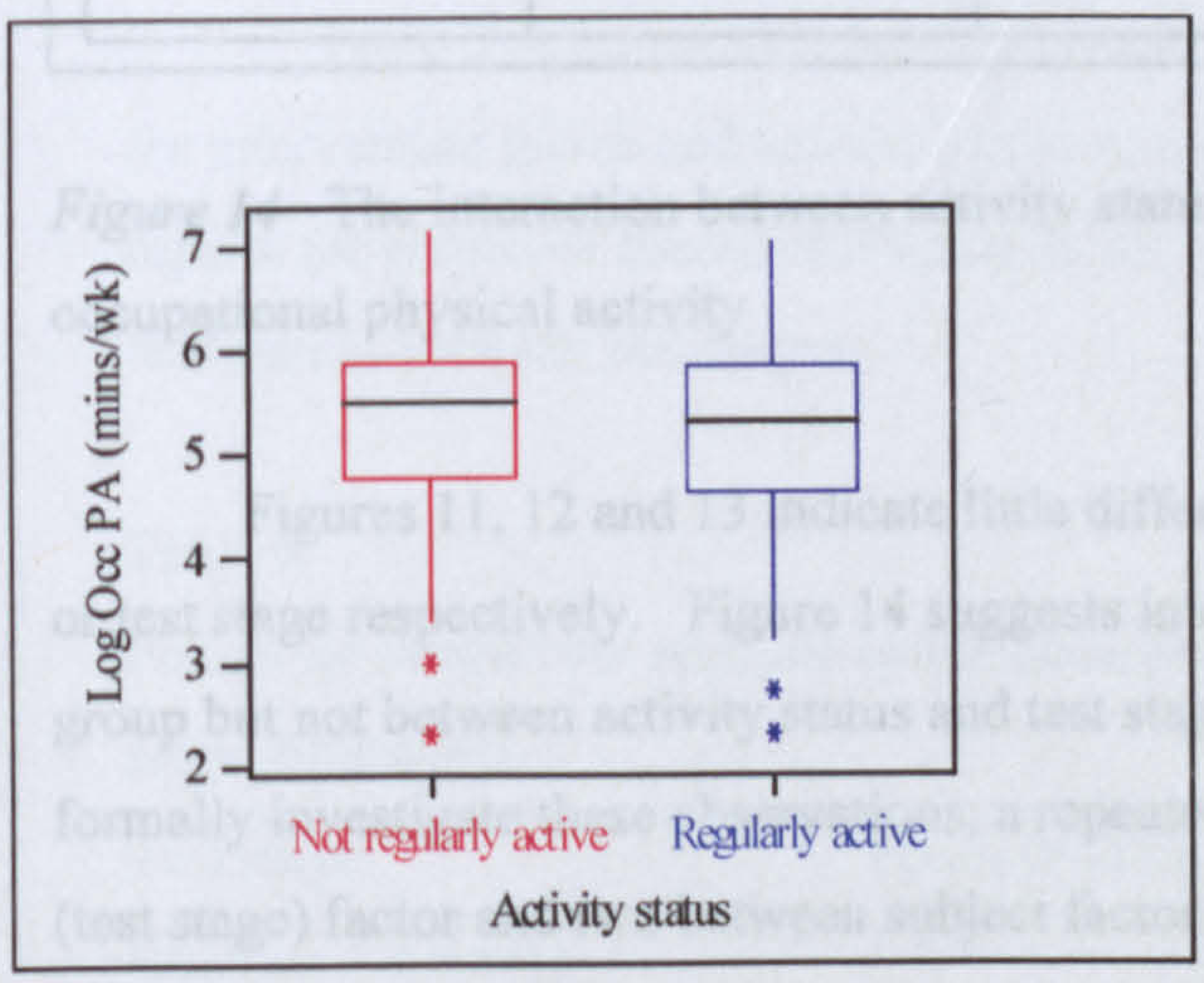


Figure 11 Boxplot of activity status against log occupational physical activity (mins / wk)

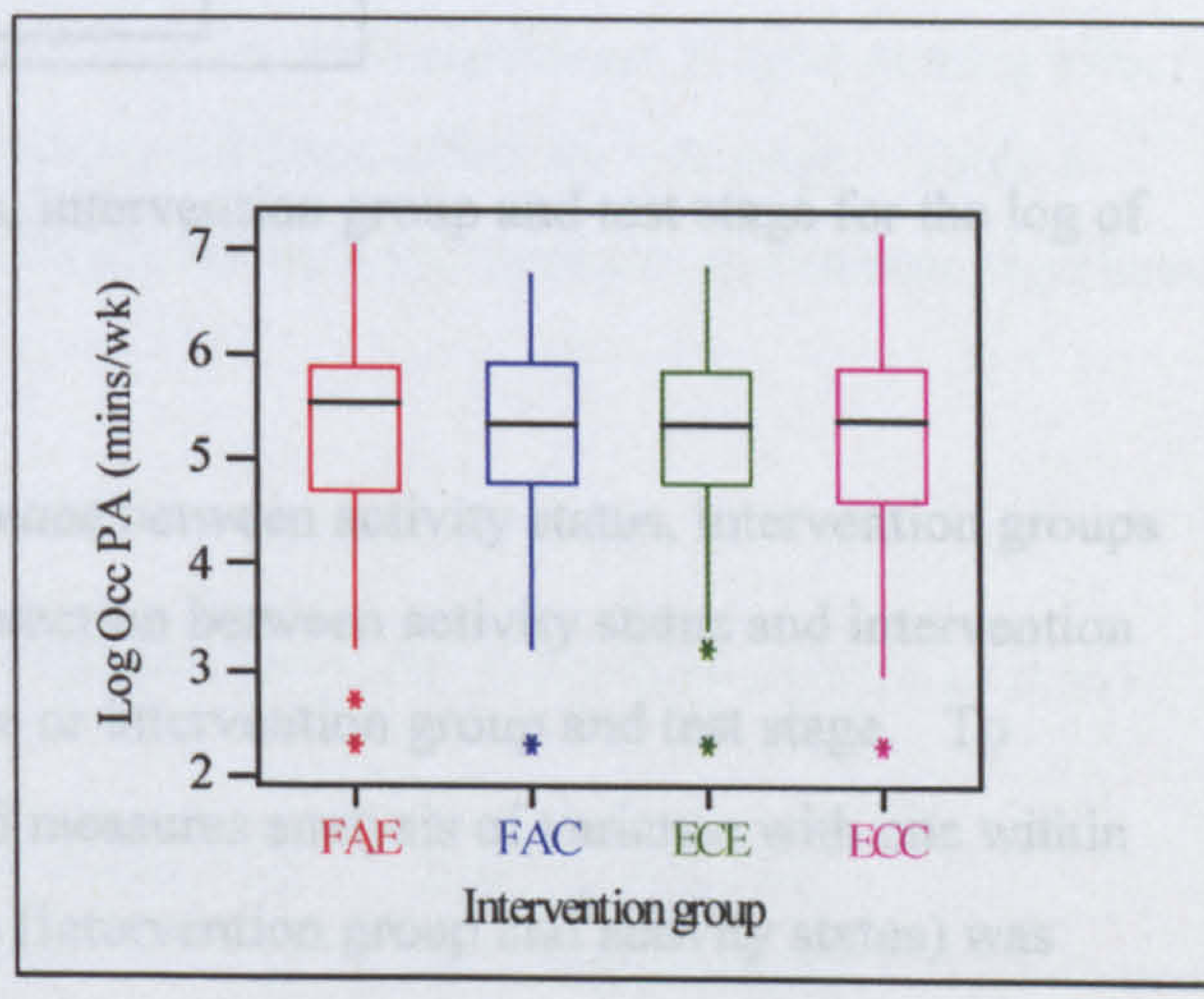


Figure 12 Boxplot of intervention group against log occupational physical activity (mins/wk)

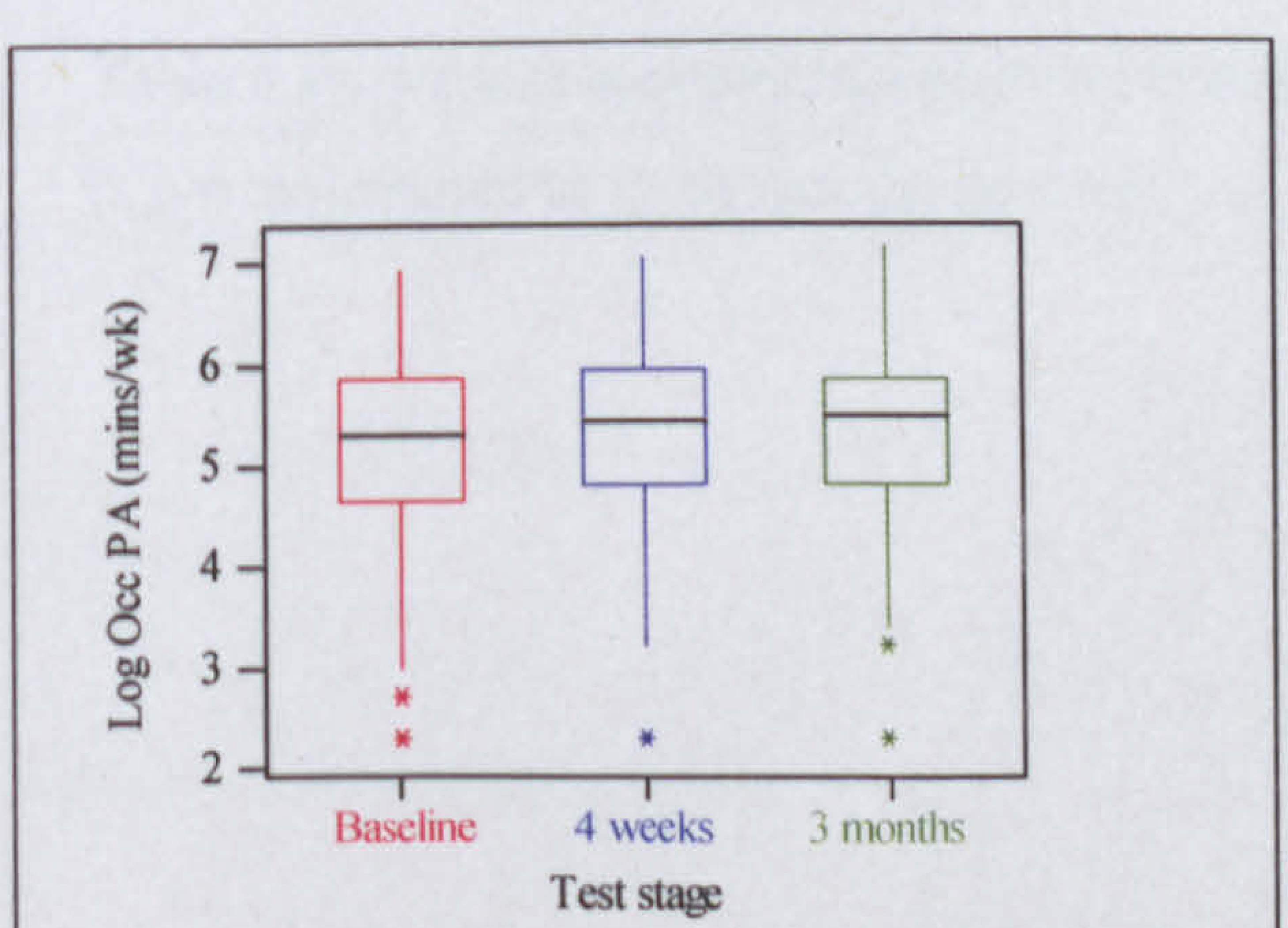


Figure 13 Boxplot of test stage against log occupational physical activity (mins/wk)

Although figures 11, 12 and 13 still have outliers, their numbers have been greatly reduced. Figure 14 shows the interaction between activity status, intervention group and test stage for the log of occupational physical activity.

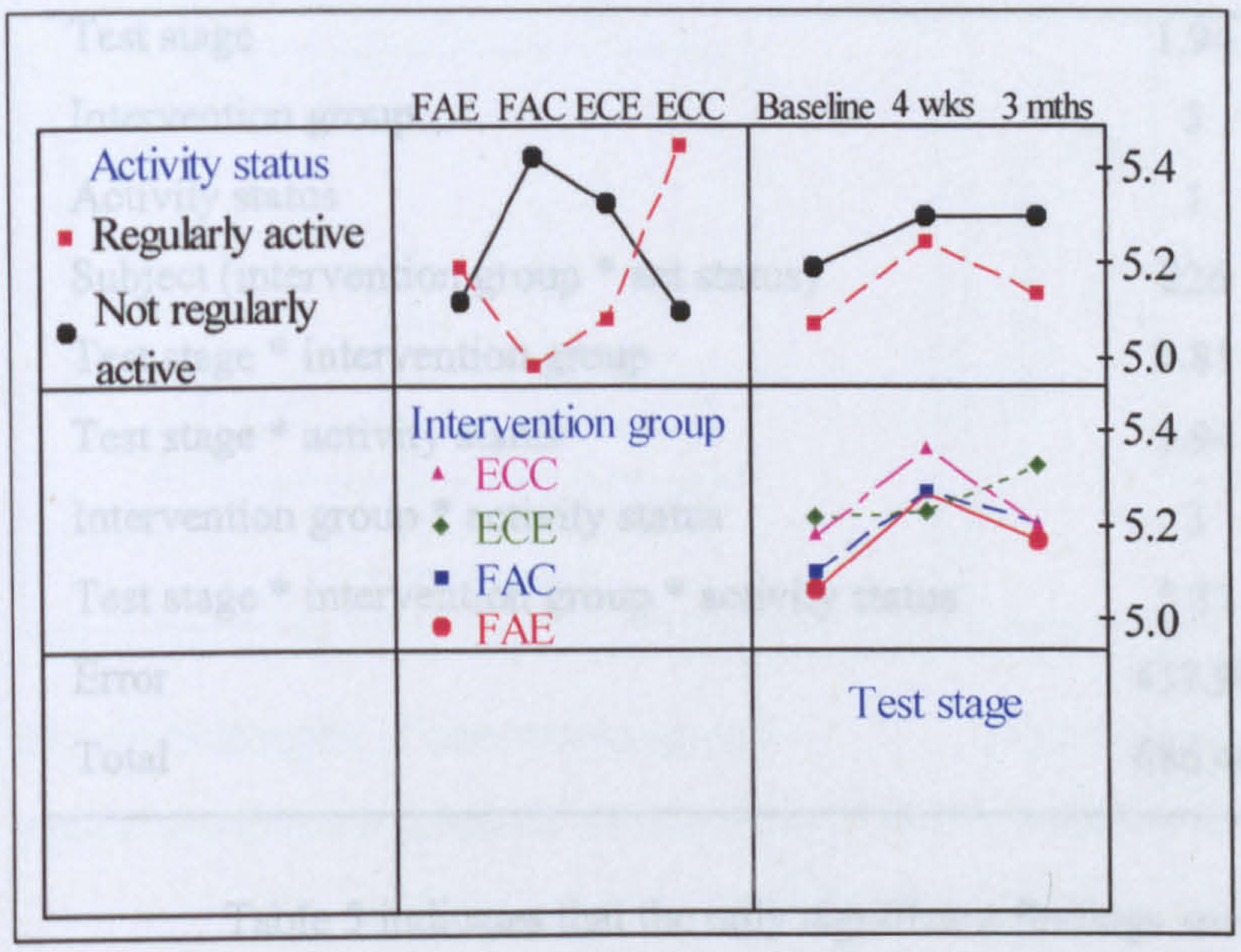


Figure 14 The interaction between activity status, intervention group and test stage for the log of occupational physical activity

Figures 11, 12 and 13 indicate little difference between activity status, intervention groups or test stage respectively. Figure 14 suggests interaction between activity status and intervention group but not between activity status and test stage or intervention group and test stage. To formally investigate these observations, a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status) was conducted for log of occupational physical activity. Results of this analysis are presented in table 5.

Table 5.

The results of a one within (test stage) factor and two between subject factors (intervention group and activity status) analysis of variance performed on log of occupational physical activity (mins / wk)

Source	DF	F	P
Test stage	1.94	4.46	< 0.05
Intervention group	3	0.04	0.99
Activity status	1	0.72	0.40
Subject (intervention group * act status)	226	9.65	< 0.05
Test stage * intervention group	5.81	0.68	0.67
Test stage * activity status	1.94	0.73	0.48
Intervention group * activity status	3	1.77	0.16
Test stage * intervention group * activity status	5.81	0.95	0.46
Error	437.96		
Total	686.46		

Table 5 indicates that the only significant findings are a significant subject nesting effect for intervention group and activity status as expected and main effect for test stage. Table 6 reports the results of Bonferroni multiple comparison for repeated measures to examine significant differences between test stages.

Table 6.

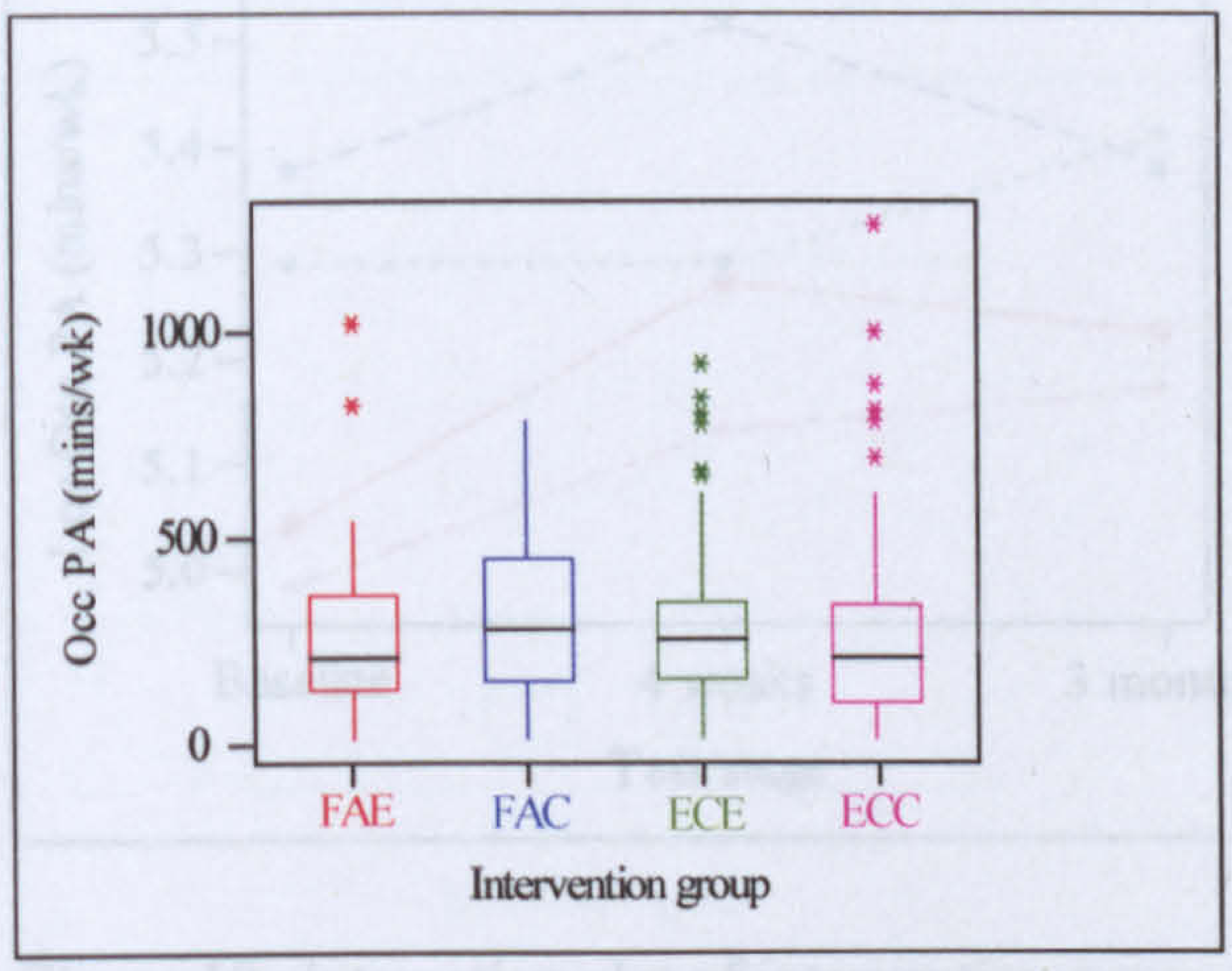
Follow up Bonferroni multiple comparison for repeated measures to examine significant inter-stage differences

Test stage	Mean difference (mins/wk)	Interval estimate
Baseline – 4 weeks	-0.15	-0.27, -0.03
Baseline – 3 months	-0.1	-0.23, 0.03
4 weeks – 3 months	0.05	-0.06, 0.16

Table 6 shows that occupational physical activity significantly increases to four weeks post test but is not maintained to three months post test.

Not Regularly Active at Baseline

Figures 15 and 16 give boxplots for intervention group and test stage respectively.



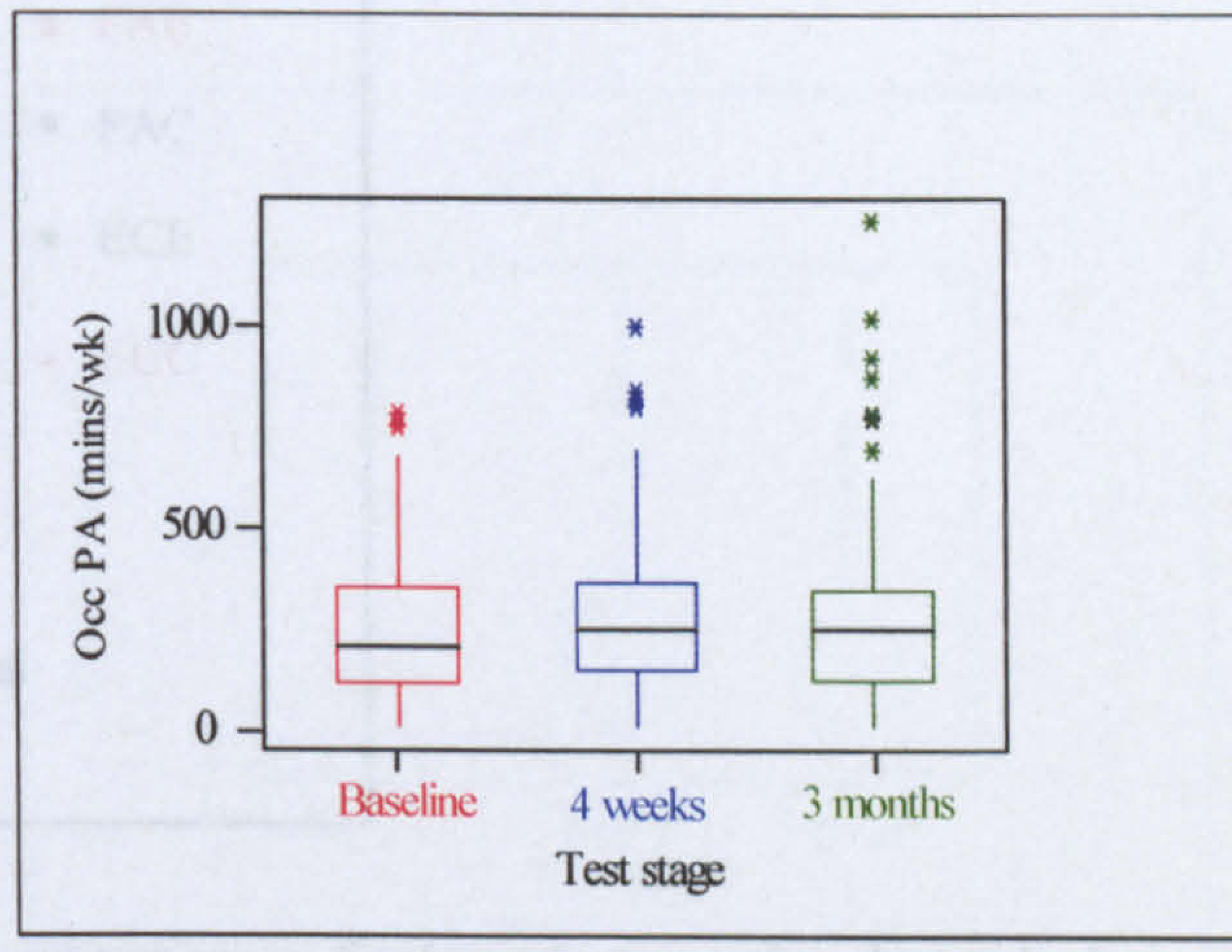
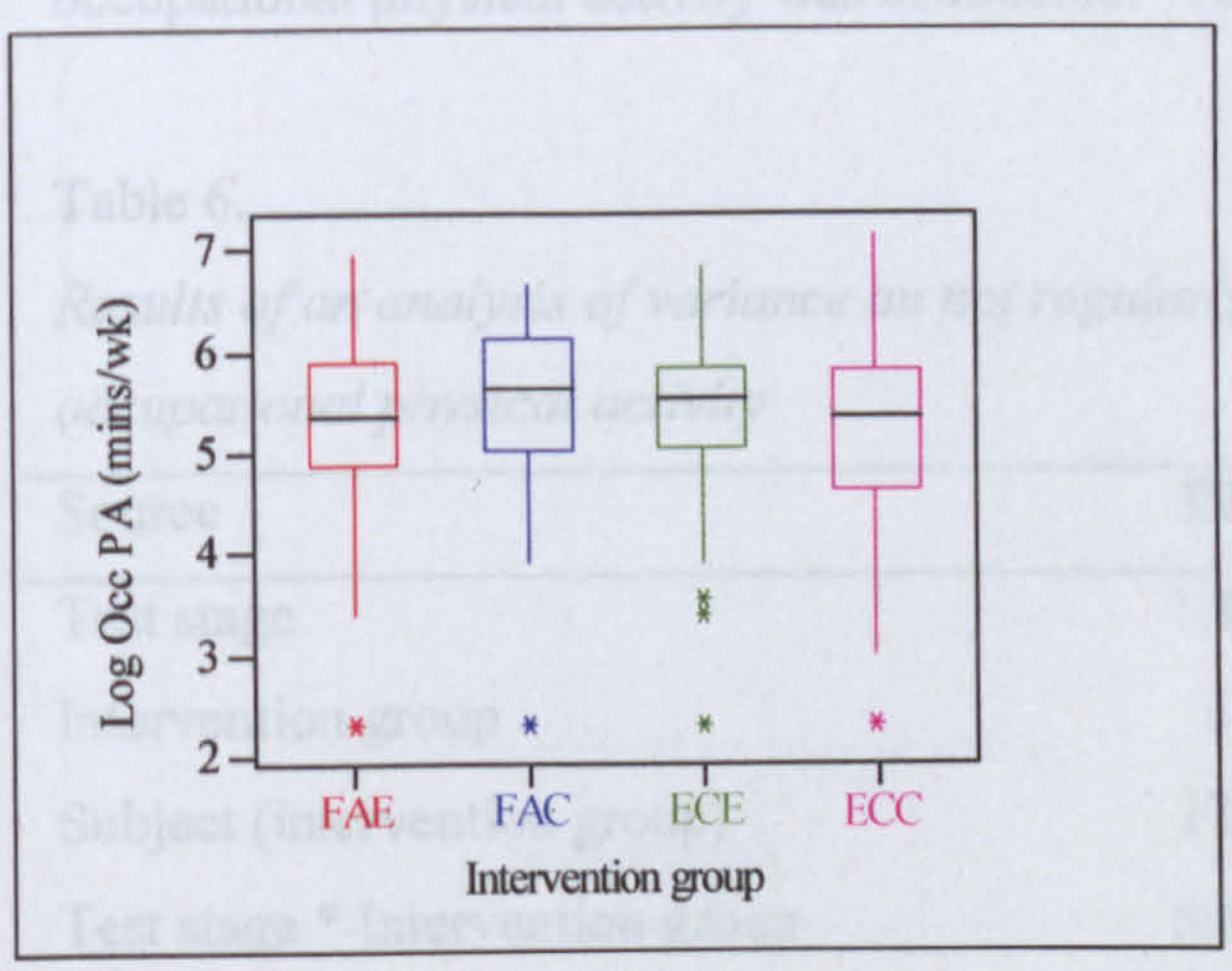


Figure 15 Boxplot of intervention group against occupational physical activity (mins / wk)

Figure 16 Boxplot of test stage against occupational physical activity (mins/wk)

Figures 15 and 16 again show many outliers. Figures 17 and 18 give boxplots of intervention group and test stage plotted against the log of occupational physical activity respectively.



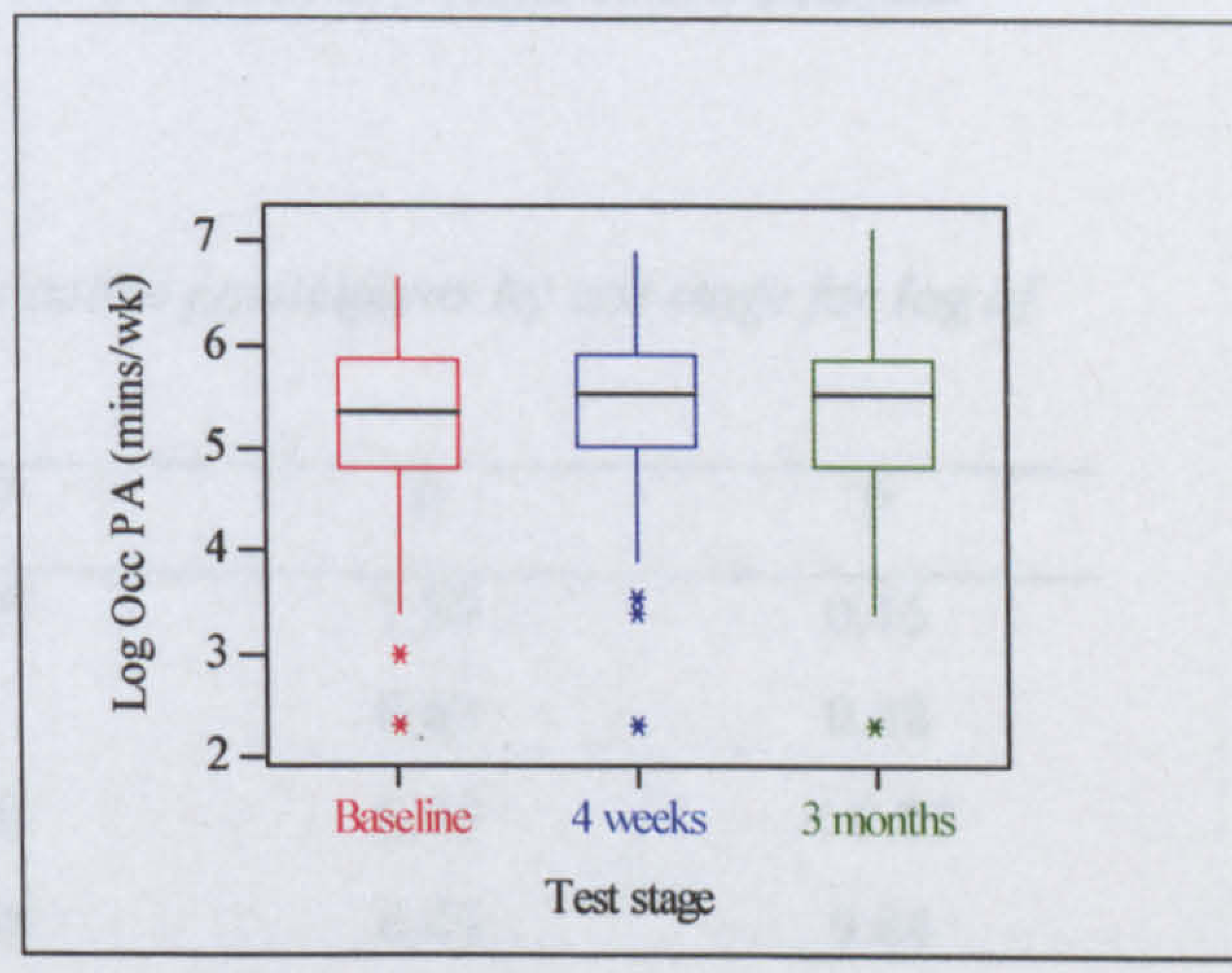


Figure 17 Boxplot of intervention group verses log occupational physical activity (mins/wk)

Figure 18 Boxplot of test stage verses log occupational physical activity (mins/wk)

Again, taking the logarithms reduces the number of outliers and enhances the normality of the data.

Figure 19 plots the interaction between intervention group and test stage for the log of occupational physical activity.

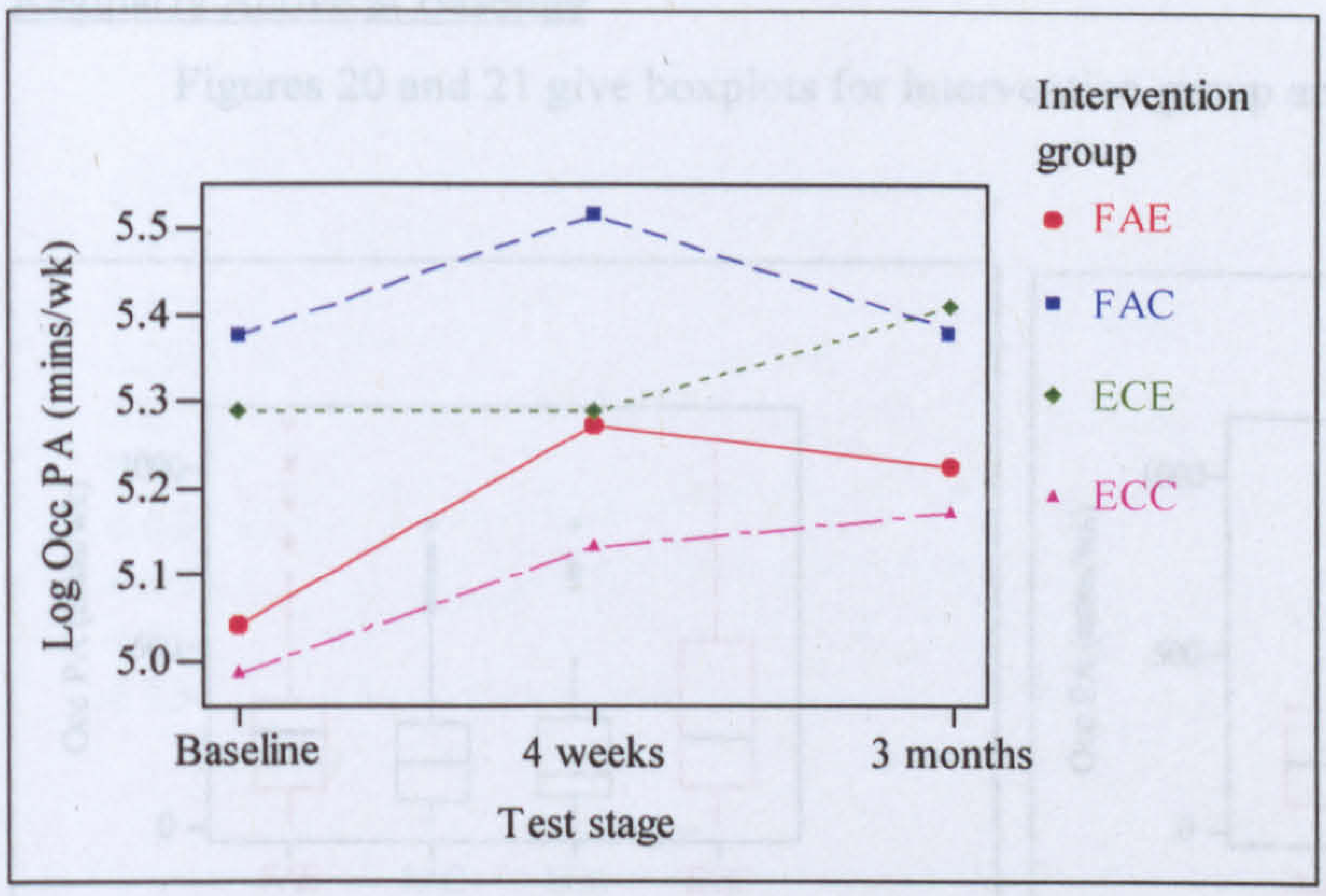


Figure 19 Interaction plot of intervention group and test stage for log of occupational physical activity.

Figures 17 and 18 suggest little difference between intervention groups or test stages and figure 19 shows little interaction. To formally check these observations, a two way analysis of variance on those not regularly active at baseline for test stage by intervention group for log of occupational physical activity was conducted. Table 6 reports the results of this analysis.

Table 6.

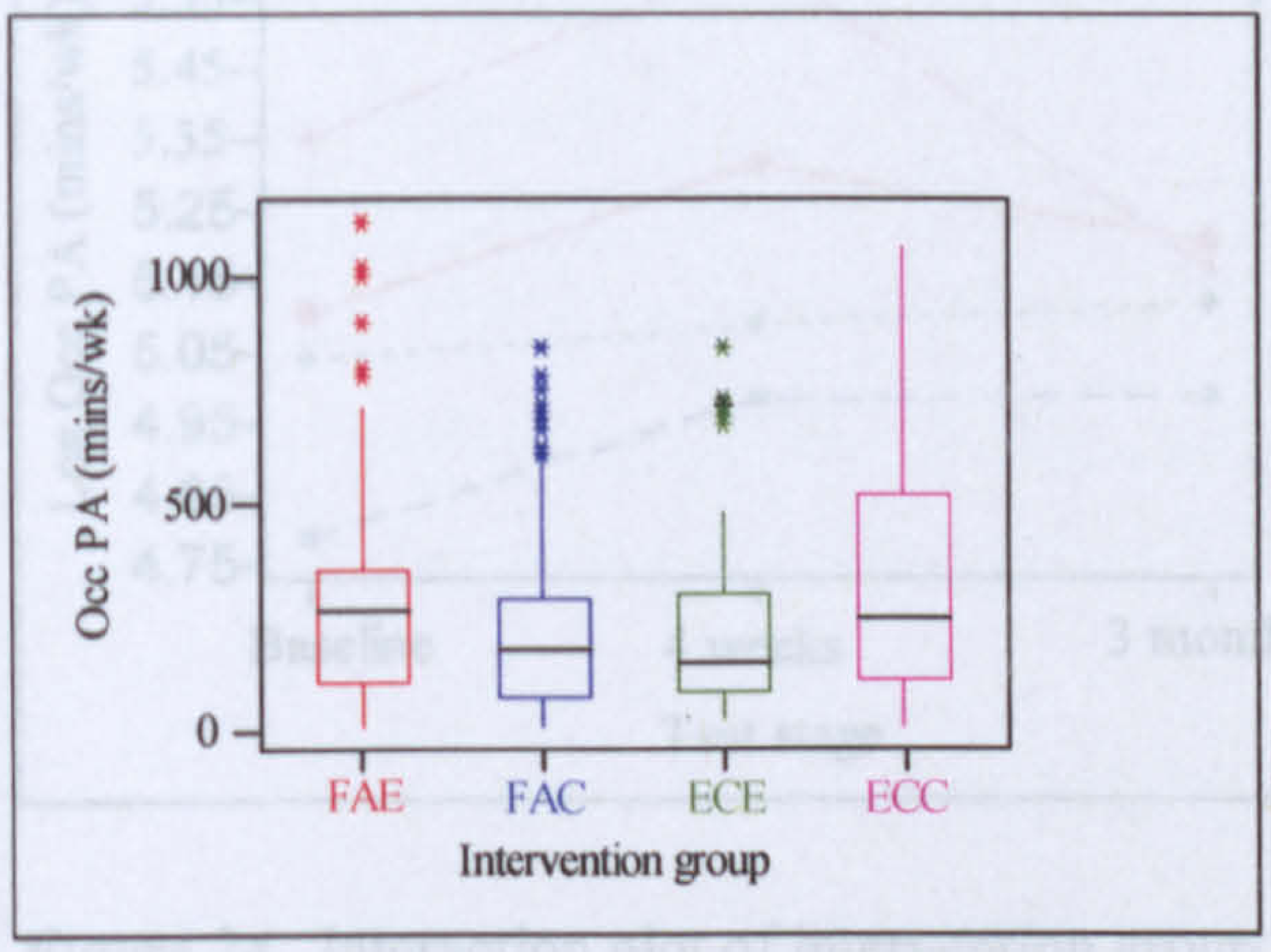
Results of an analysis of variance on not regularly active participants by test stage for log of occupational physical activity

Source	DF	F	P
Test stage	1.89	1.89	0.15
Intervention group	3	0.82	0.48
Subject (intervention group)	120	6.75	< 0.05
Test stage * Intervention group	5.68	0.45	0.84
Error	227.29		
Total	357.86		

Table 6 reports a significant subject nesting effect as expected. This is the only significant result.

Regularly Active at Baseline

Figures 20 and 21 give boxplots for intervention group and test stage respectively.



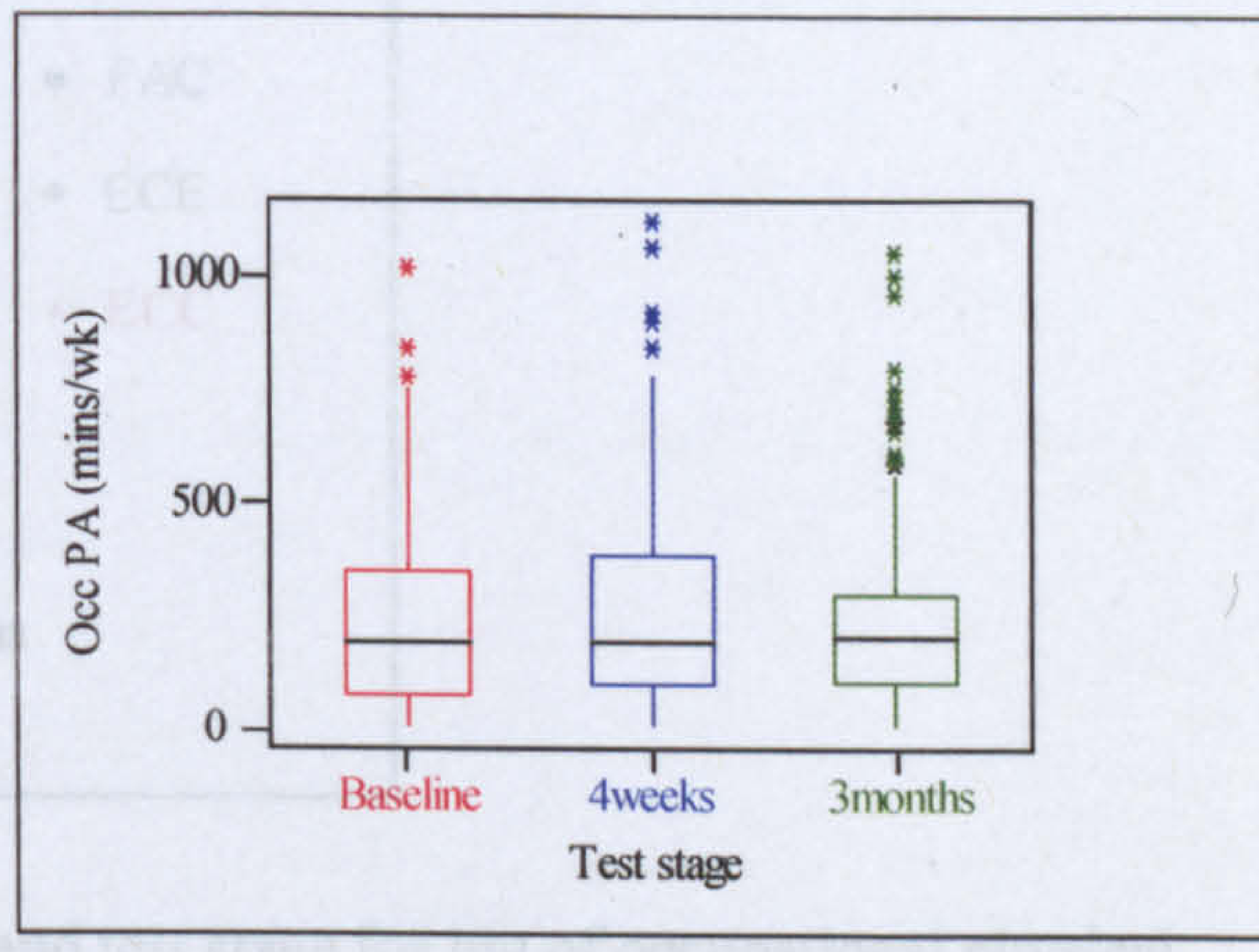
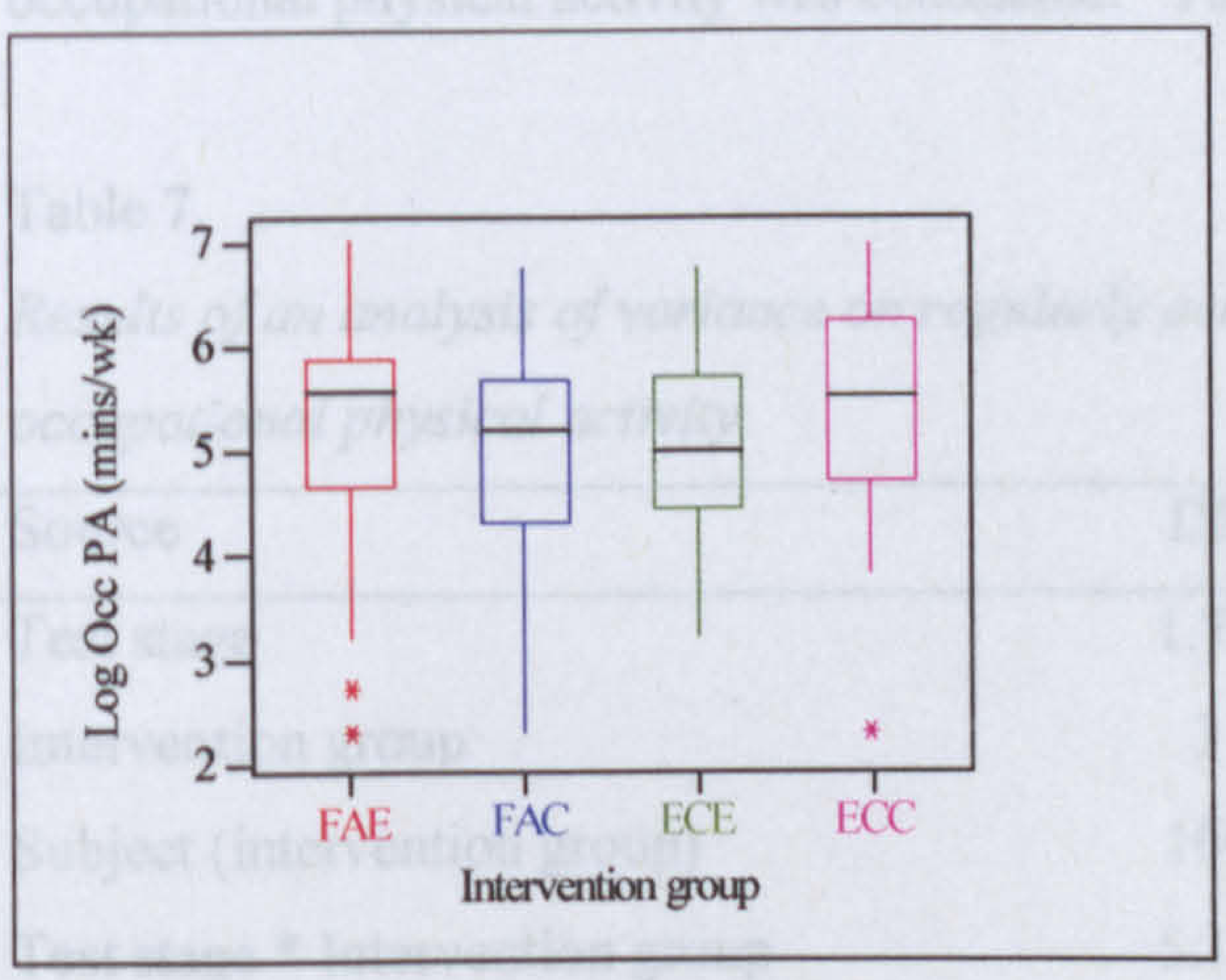


Figure 20 Boxplot of intervention group against occupational physical activity (mins / wk)

Figure 21 Boxplot of test stage against occupational physical activity (mins/wk)

Figures 20 and 21 again show many outliers. Figures 22 and 23 give boxplots of intervention group and test stage plotted against the log of occupational physical activity respectively.



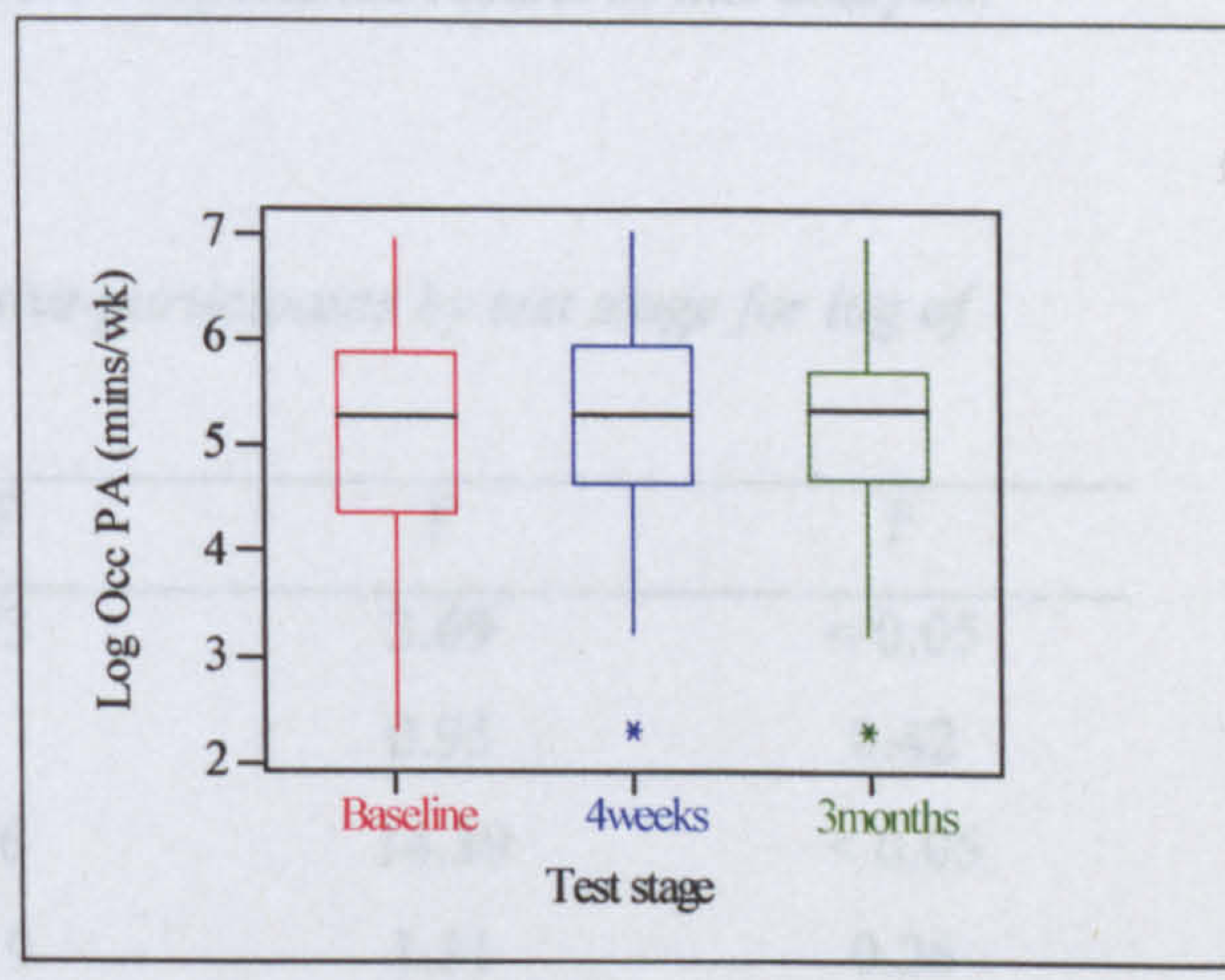


Figure 22 Boxplot of intervention group against log occupational physical activity (mins/wk)

Figure 23 Boxplot of test stage against log occupational physical activity (mins/wk)

Again, figures 22 and 23 show taking the logarithms reduces the number of outliers and enhances the normality of the data.

Figure 24 plots the interaction between intervention group and test stage for the log of occupational physical activity.

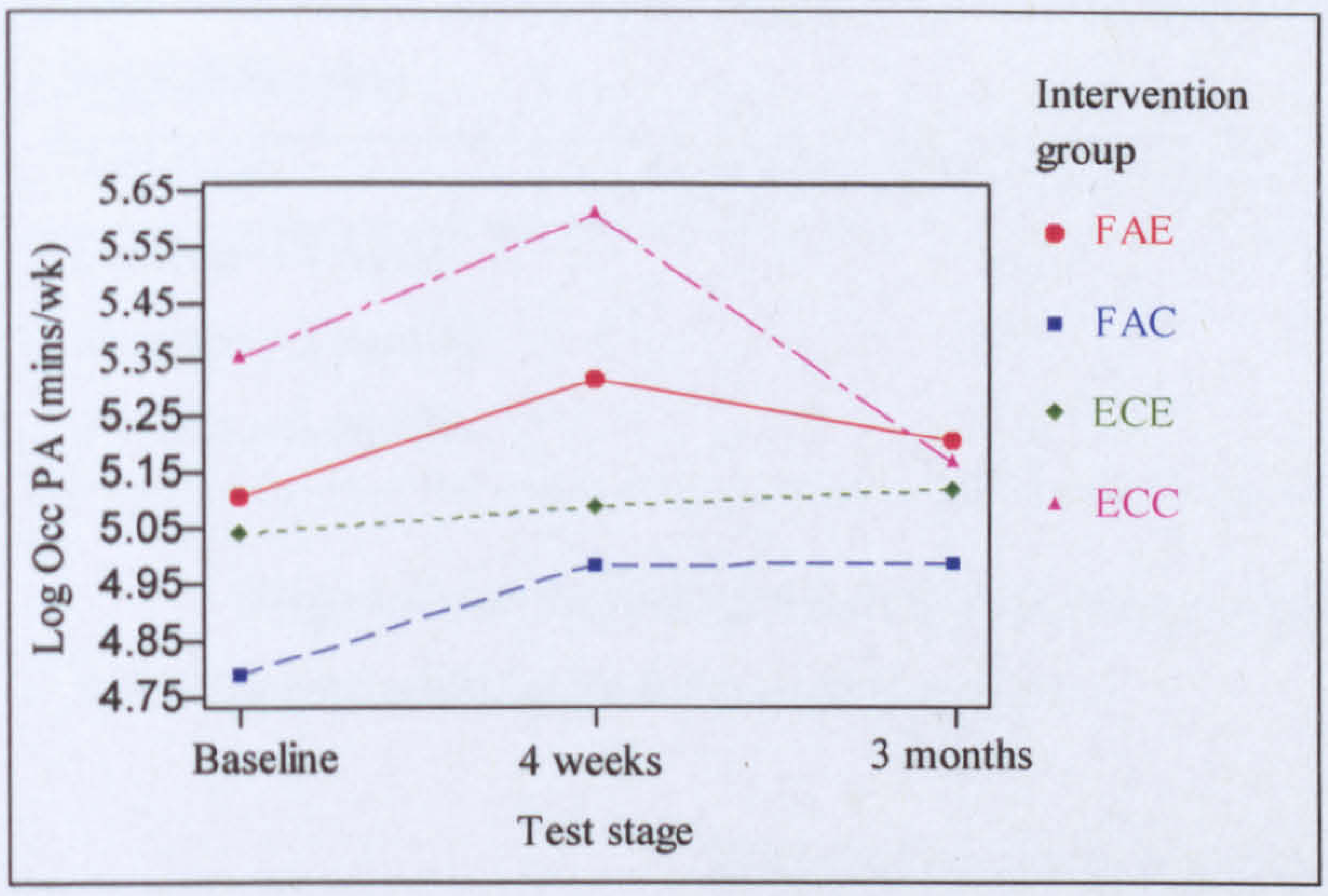


Figure 24 Interaction plot of intervention group and test stage for log of occupational physical activity.

Figures 22 and 23 suggest little difference between intervention groups or test stages and figure 24 shows little interaction. To formally check these observations, a two way analysis of variance on those not regularly active at baseline for test stage by intervention group for log of occupational physical activity was conducted. Table 7 reports the results of this analysis.

Table 7.

Results of an analysis of variance on regularly active participants by test stage for log of occupational physical activity

Source	DF	F	P
Test stage	1.73	3.69	< 0.05
Intervention group	3	0.95	0.42
Subject (intervention group)	106	14.39	< 0.05
Test stage * Intervention group	5.19	1.31	0.26
Error	183.54		
Total	299.46		

Table 7 reports a significant subject nesting effect as expected, and a significant main effect for test stage. Table 8 reports the results of Bonferroni multiple comparison for repeated measures to examine significant differences between test stages.

Table 8.

Follow up Bonferroni multiple comparison for repeated measures to examine significant inter-stage differences

Test stage	Mean difference (mins/wk)	Interval estimate
Baseline – 4 weeks	-0.19	-0.32, -0.06
Baseline – 3 months	-0.08	-0.26, 0.1
4 weeks – 3 months	0.11	-0.04, 0.25

Table 8 shows that occupational physical activity significantly increases to four weeks post test but is not maintained to three months post test.

Effectiveness of Intervention Re-test

In order to determine the effect the intervention re-tests, physical activity levels at three months, six months and one year post test need to be analysed. Here again, there are several questions of importance. First, is there any main effect of intervention group, activity status or test stage? Second, is there any significant interaction effect? Again, the most appropriate analysis is a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status). Table 9 gives descriptive statistics for occupational physical activity for each study group at test stages three months, six months and one year post test for all participants still participating in the study at one year post test.

Table 9.

Descriptive statistics for occupational physical activity (mins / wk) for each study group at 3 months, 6 months and 1 year post test for participants remaining in study at 1 year post test.

Test Stage	Descriptive Statistics	FAE NRA	FAE RA	FAC NRA	FAC RA	ECE NRA	ECE RA	ECC NRA	ECC RA
3 mth	N	10	20	16	16	22	5	14	8
	Mean	223.5	290.7	247.5	171.3	325.5	261.0	304.6	503.0
	Median	180.0	297.5	212.5	150.0	317.5	250.0	260.0	425.0
	SD	162.2	224.8	196.0	147.4	238.2	52.7	348.7	366.0
6 mth	N	10	20	16	16	22	5	14	8
	Mean	255.0	296.3	262.2	189.7	285.7	274.0	173.6	374.4
	Median	205.0	270.0	237.5	180.0	210.0	305.0	165.0	315.0
	SD	177.5	219.6	180.2	155.1	181.4	157.7	120.4	273.8
1 yr	N	10	20	16	16	22	5	14	8
	Mean	238.5	271.3	240.0	205.9	248.6	262.0	193.9	312.0
	Median	220.0	250.0	195.0	187.5	210.0	220.0	220.0	228.0
	SD	127.2	192.1	152.2	168.6	159.2	145.3	123.2	293.0

Note. NRA = not regularly active at baseline, RA = regularly active at baseline.

Figures 25, 26 and 27 show boxplots of intervention group, activity status and test stage respectively plotted against occupational physical activity.

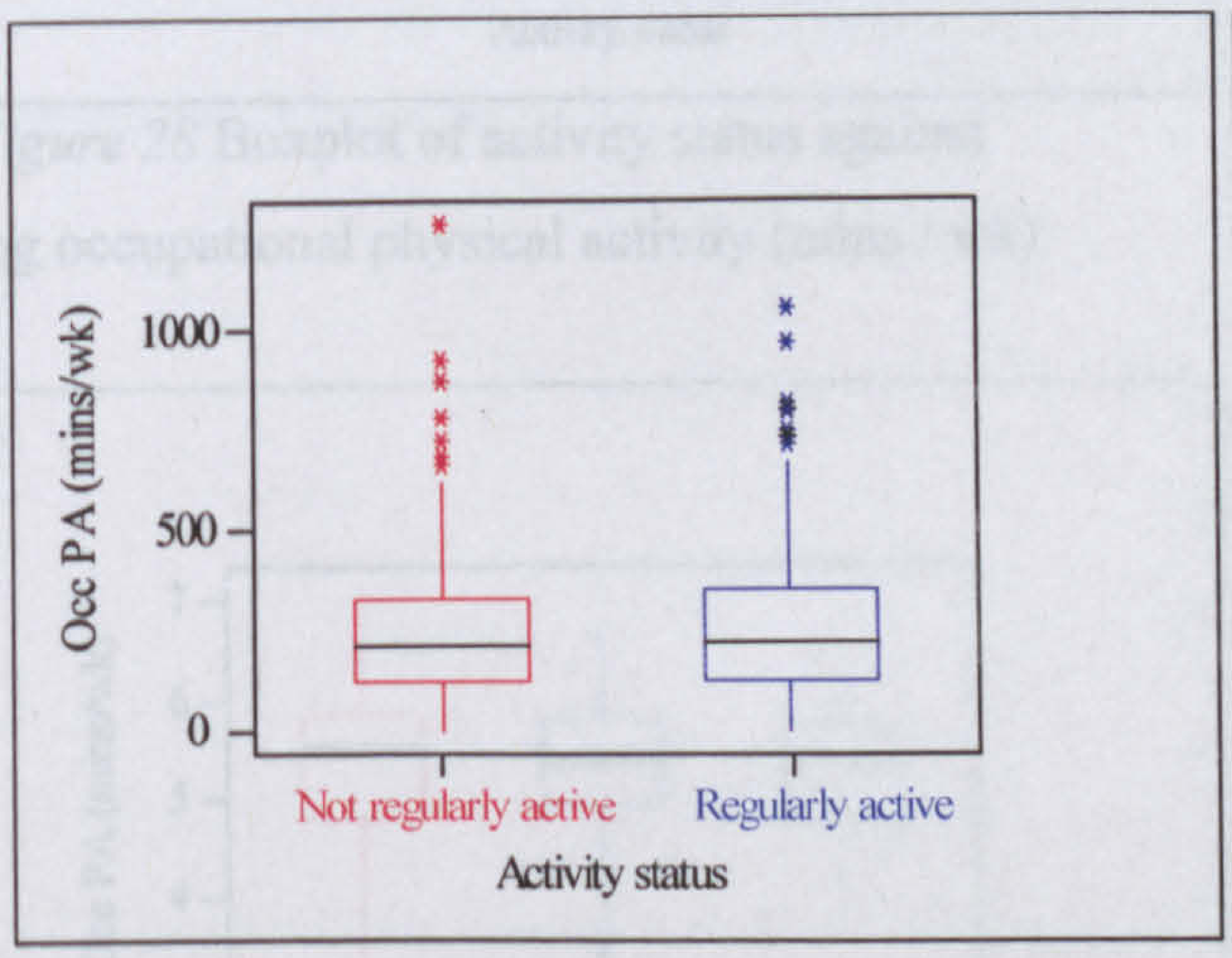


Figure 25 Boxplot of activity status against occupational physical activity (mins / wk)

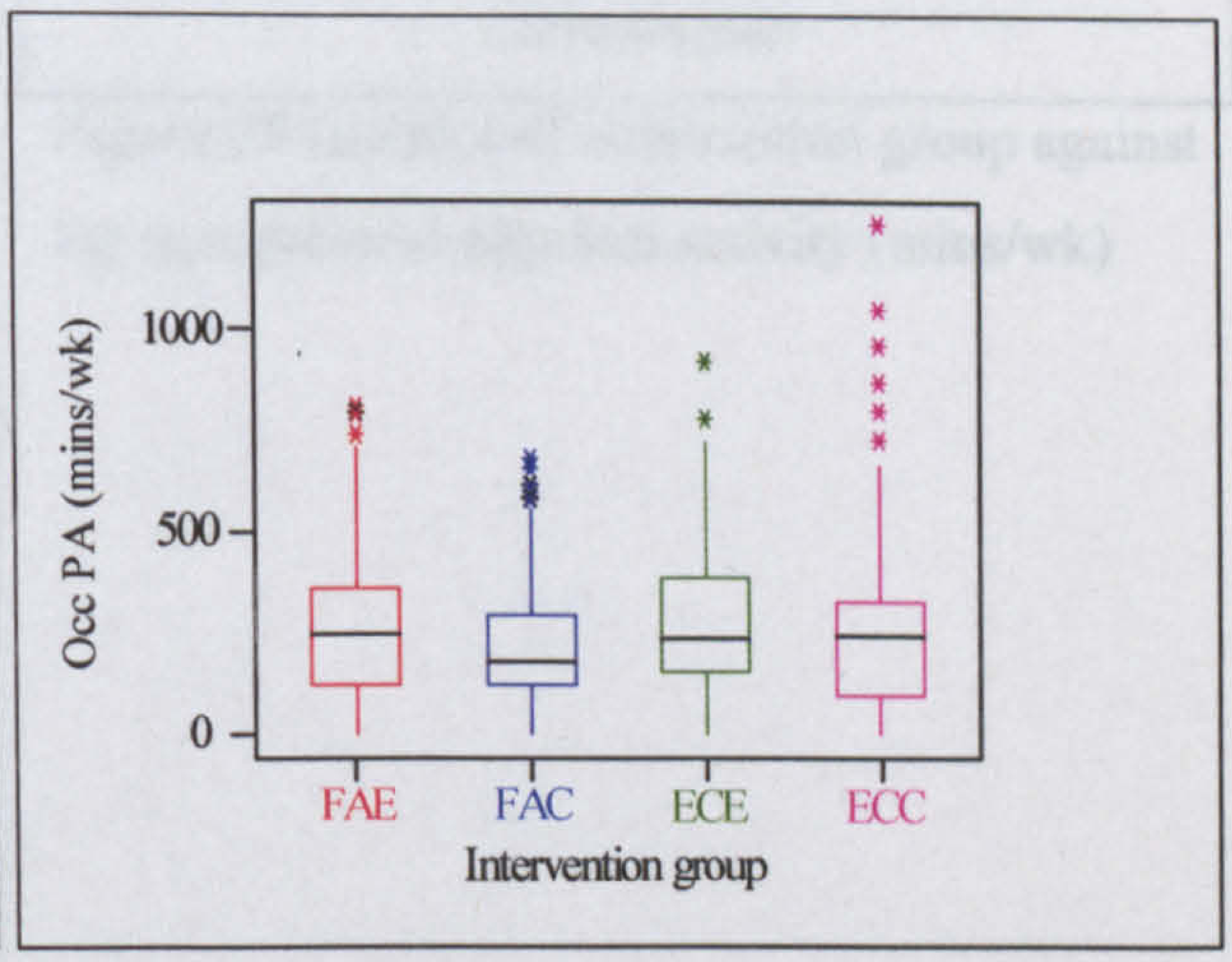


Figure 26 Boxplot of intervention group against occupational physical activity (mins/wk)

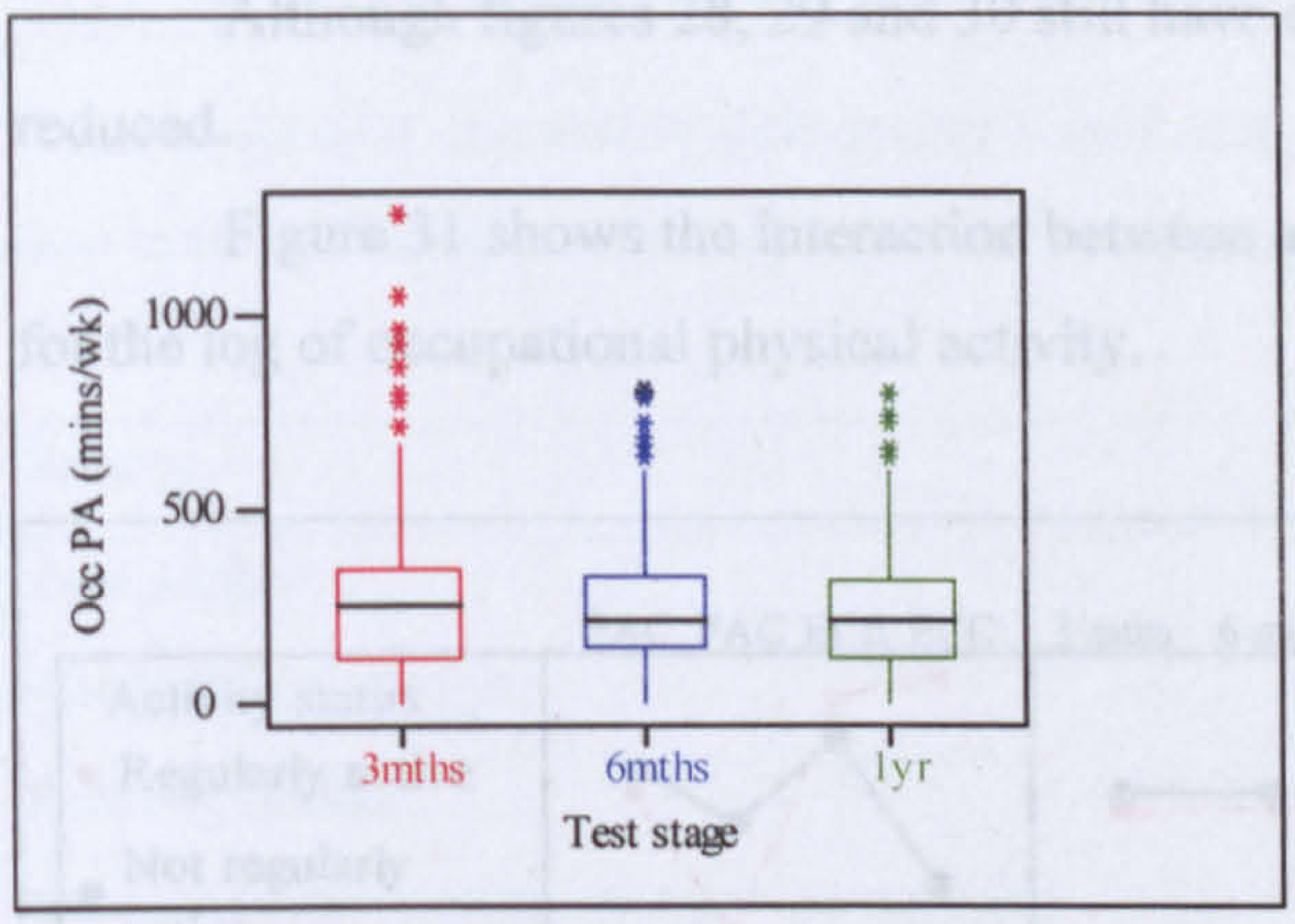


Figure 27 Boxplot of test stage against occupational physical activity (mins/wk)

Again, figures 25, 26 and 27 show clear outliers, positively skewing the data. Figures 28, 29 and 30 show boxplots of intervention group, activity status and test stage respectively plotted against the log of occupational physical activity.

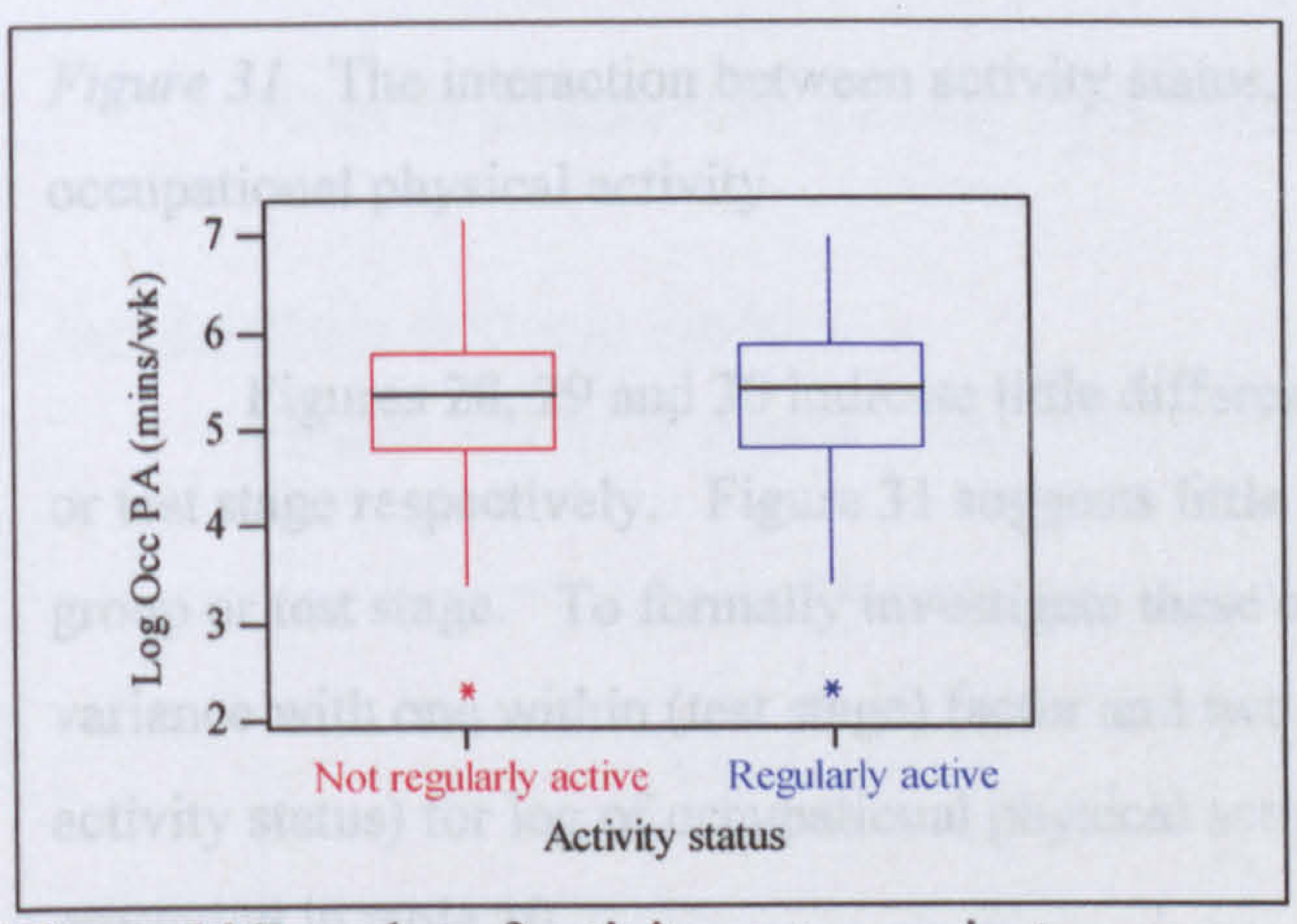


Figure 28 Boxplot of activity status against log occupational physical activity (mins / wk)

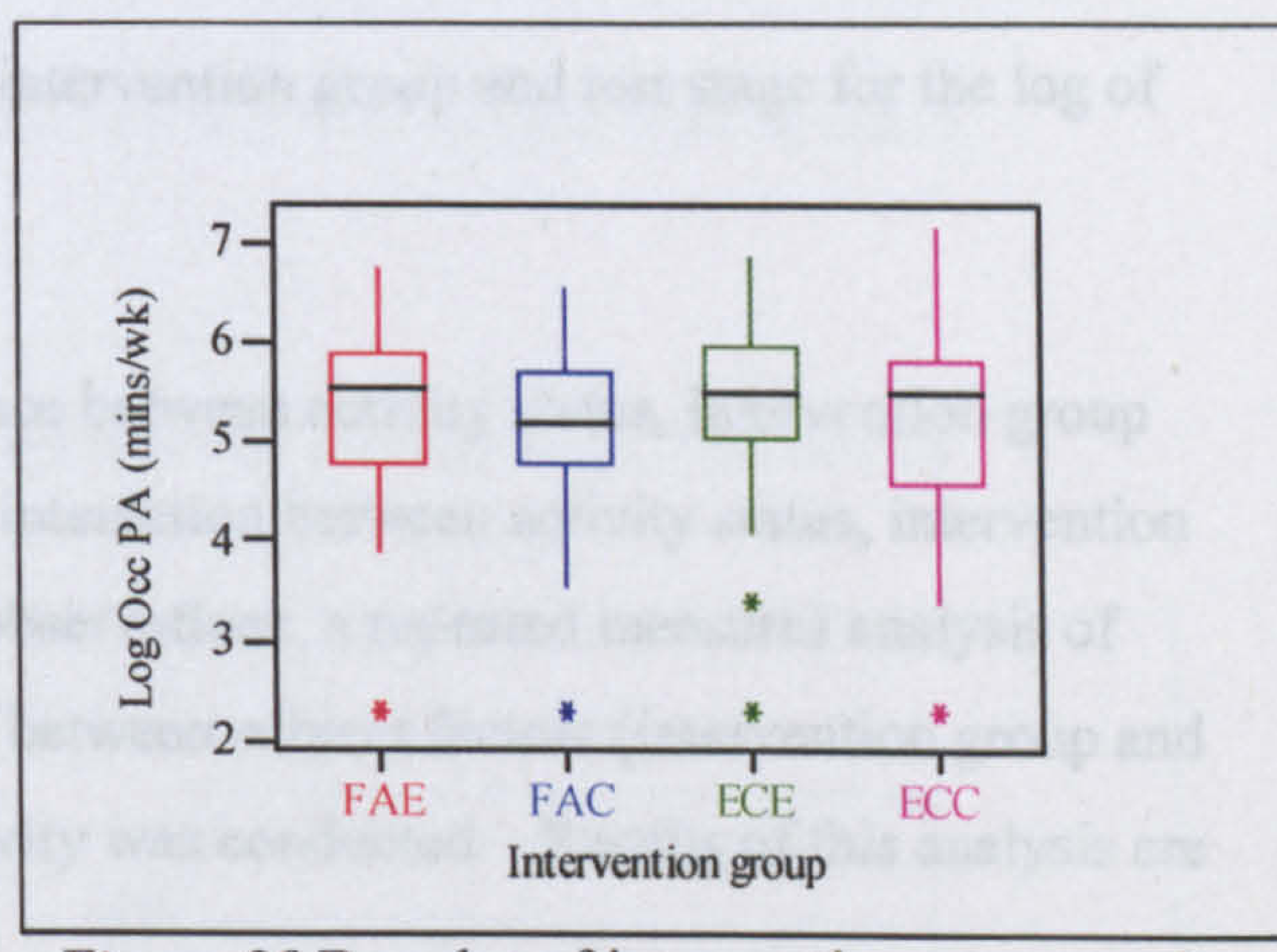


Figure 29 Boxplot of intervention group against log occupational physical activity (mins/wk)

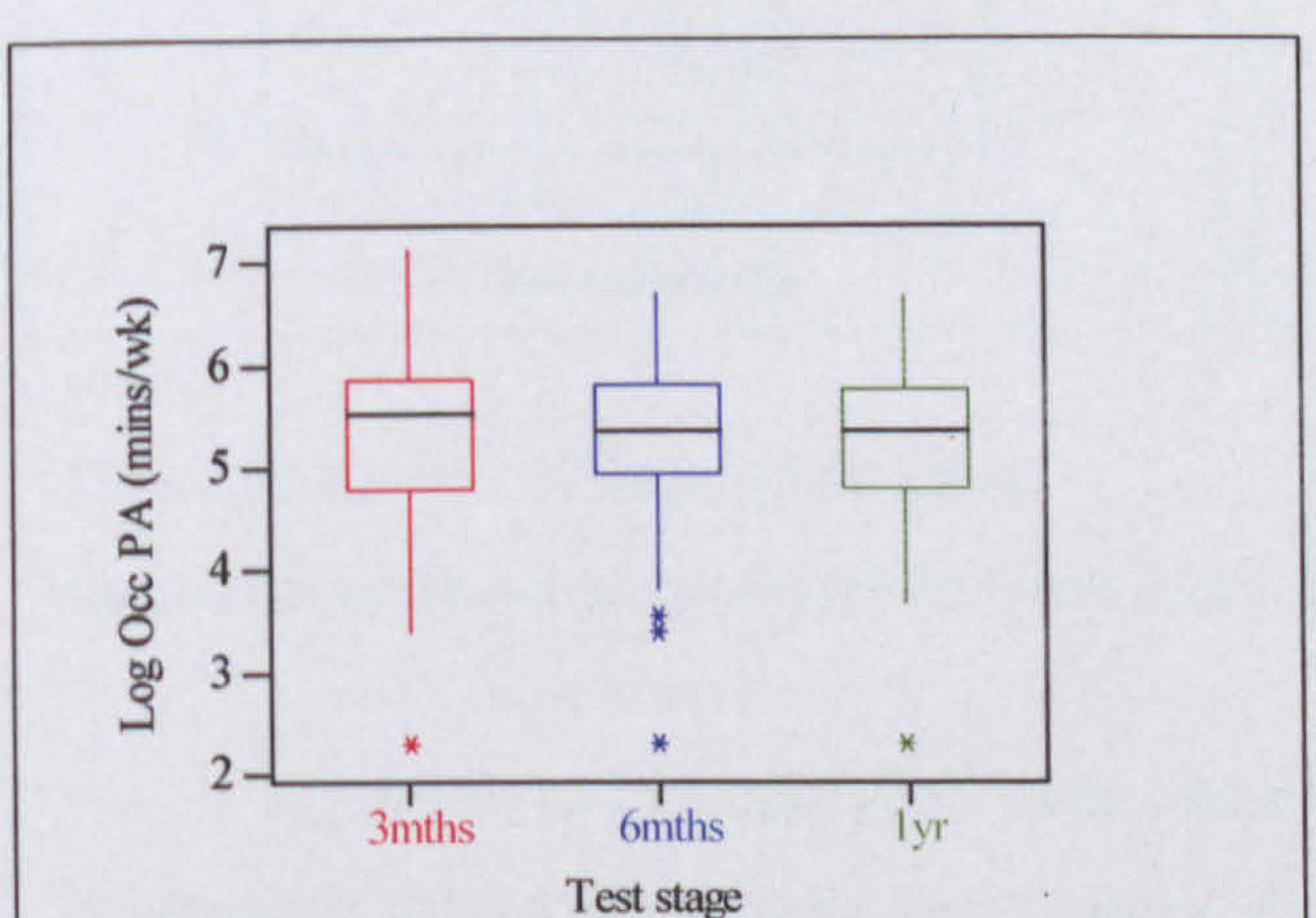


Figure 30 Boxplot of test stage against log occupational physical activity (mins/wk)

Although figures 28, 29 and 30 still have outliers, there numbers have been greatly reduced.

Figure 31 shows the interaction between activity status, intervention group and test stage for the log of occupational physical activity.

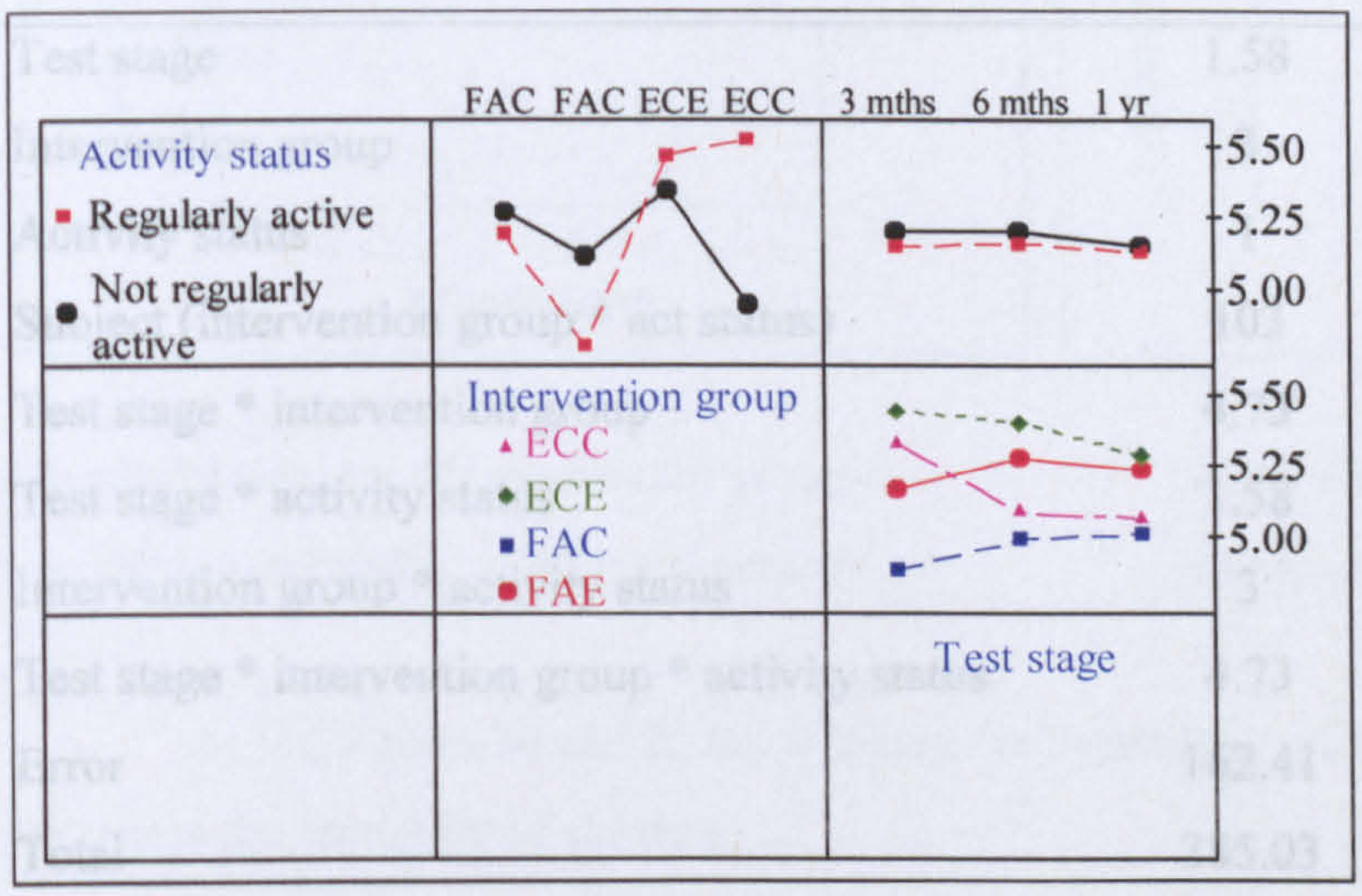


Figure 31 The interaction between activity status, intervention group and test stage for the log of occupational physical activity

Figures 28, 29 and 30 indicate little difference between activity status, intervention group or test stage respectively. Figure 31 suggests little interaction between activity status, intervention group or test stage. To formally investigate these observations, a repeated measures analysis of variance with one within (test stage) factor and two between subject factors (intervention group and activity status) for log of occupational physical activity was conducted. Results of this analysis are presented in table 10.

Table 10.

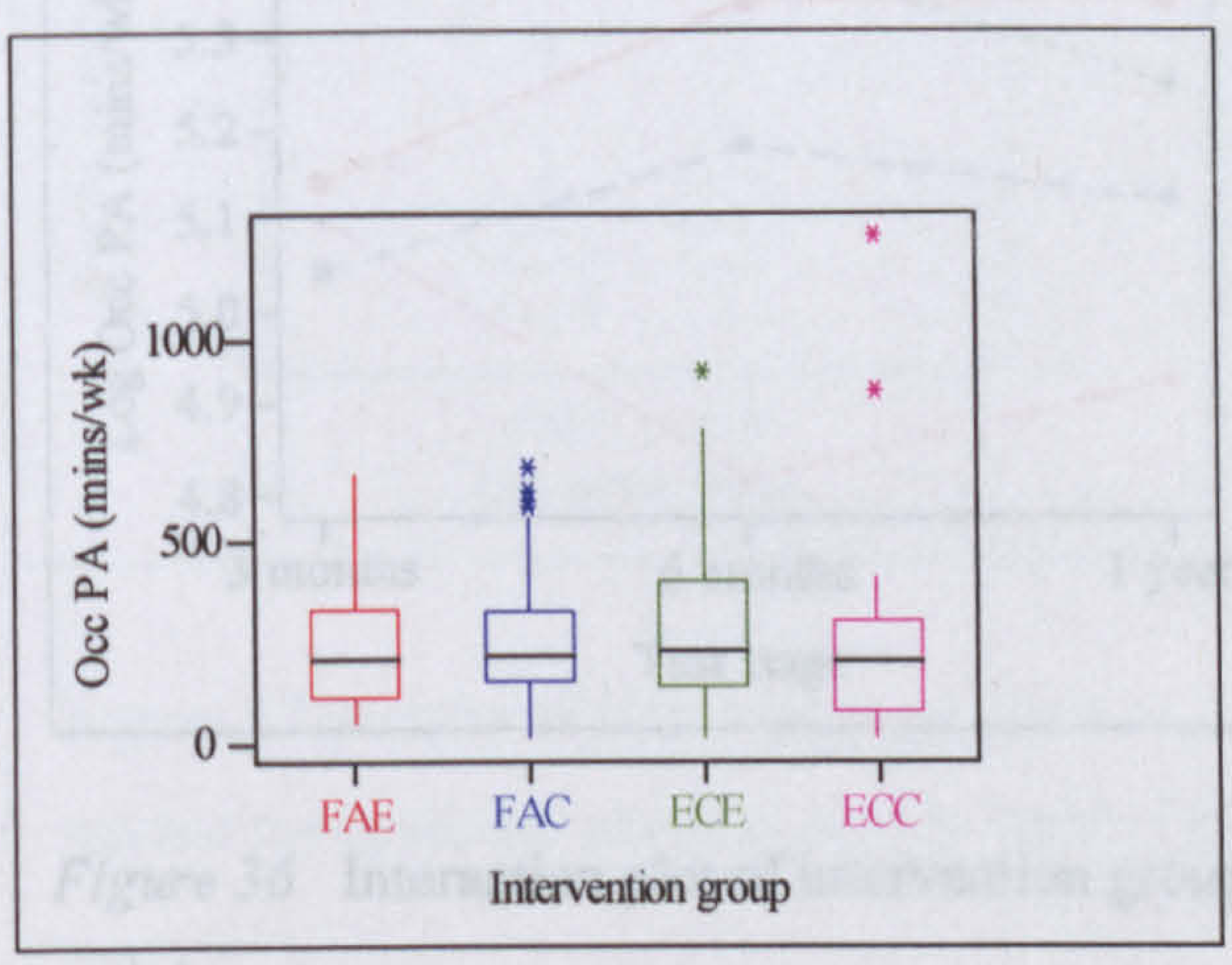
The results of a one within (test stage) factor and two between subject factors (intervention group and activity status) analysis of variance performed on log of occupational physical activity (mins / wk)

Source	DF	F	P
Test stage	1.58	0.36	0.65
Intervention group	3	0.84	0.48
Activity status	1	0.17	0.69
Subject (intervention group * act status)	103	19.41	< 0.05
Test stage * intervention group	4.73	1.63	0.16
Test stage * activity status	1.58	0.16	0.80
Intervention group * activity status	3	0.79	0.50
Test stage * intervention group * activity status	4.73	0.62	0.68
Error	162.41		
Total	285.03		

Table 10 indicates that the only significant finding is for the subject nesting effect.

Not Regularly Active at Baseline

Figures 32 and 33 give boxplots for intervention group and test stage respectively.



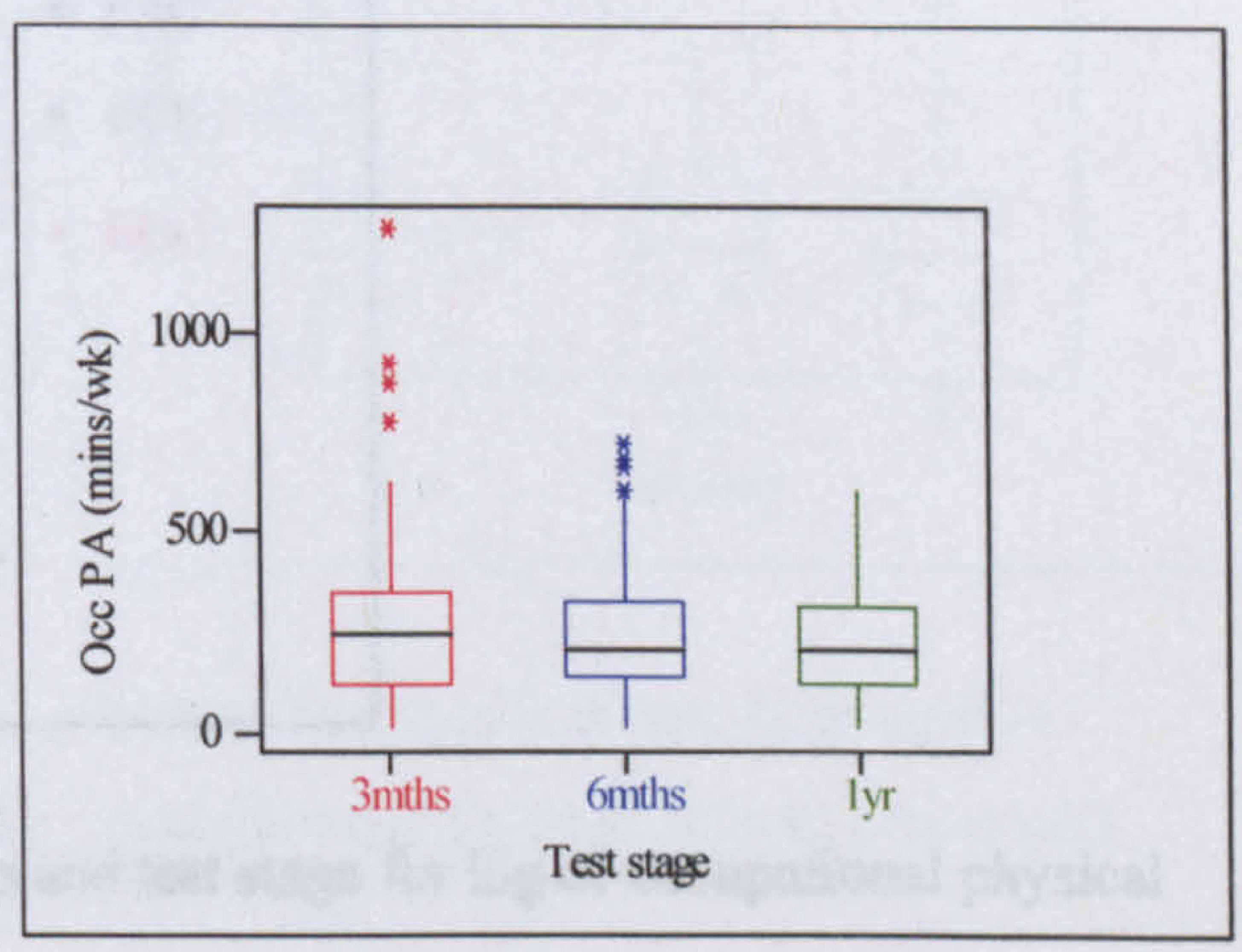


Figure 32 Boxplot of intervention group against occupational physical activity (mins / wk)

Figure 33 Boxplot of test stage against occupational physical activity (mins/wk)

Figures 32 and 33 again show many outliers. Figures 34 and 35 give boxplots of intervention group and test stage plotted against the log of occupational physical activity respectively.

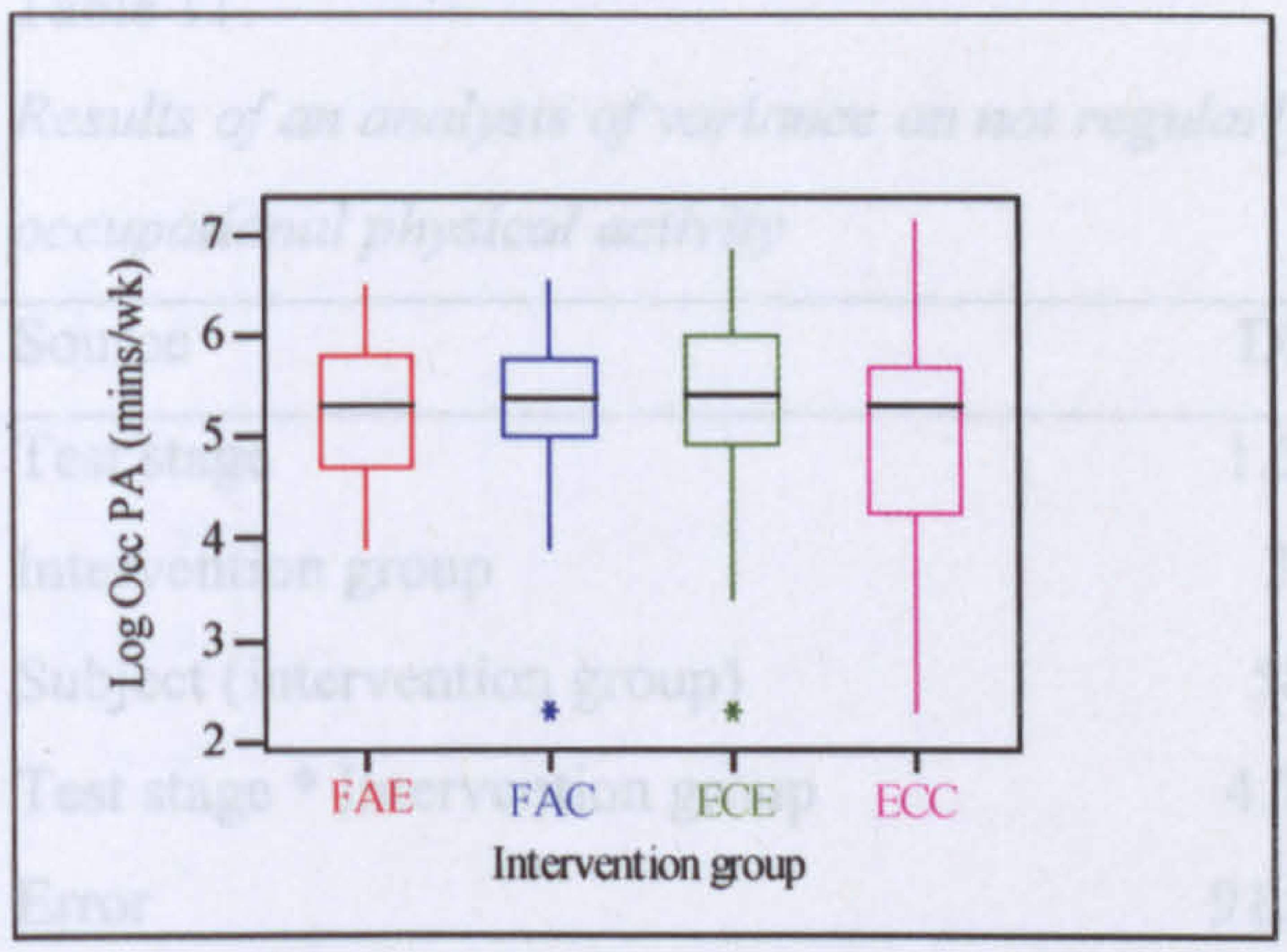


Figure 34 Boxplot of intervention group against log occupational physical activity

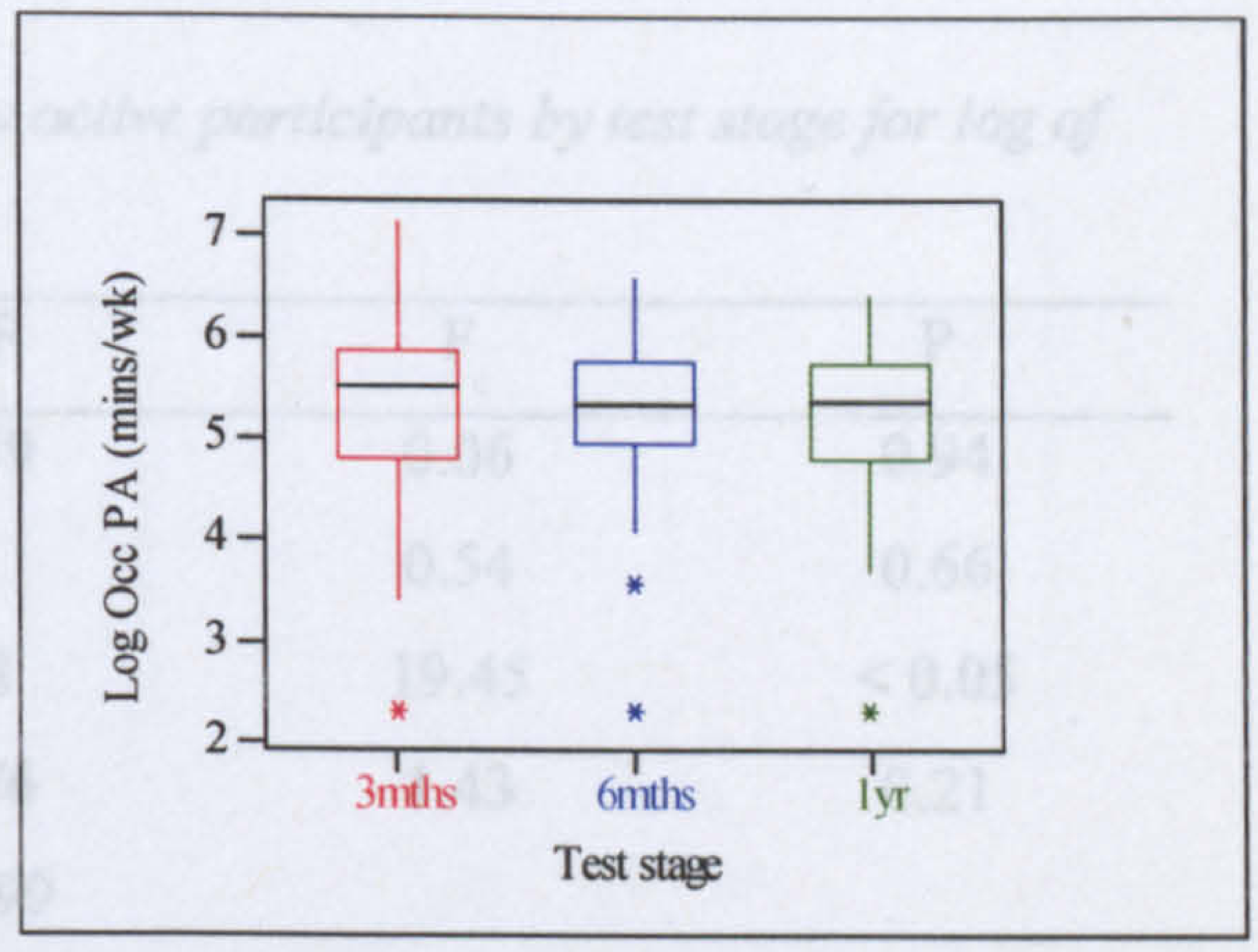


Figure 35 Boxplot of test stage against log occupational physical activity (mins/wk)

Again, figures 34 and 35 show taking the logarithms reduces the number of outliers and enhances the normality of the data.

Figure 36 plots the interaction between intervention group and test stage for the log of occupational physical activity.

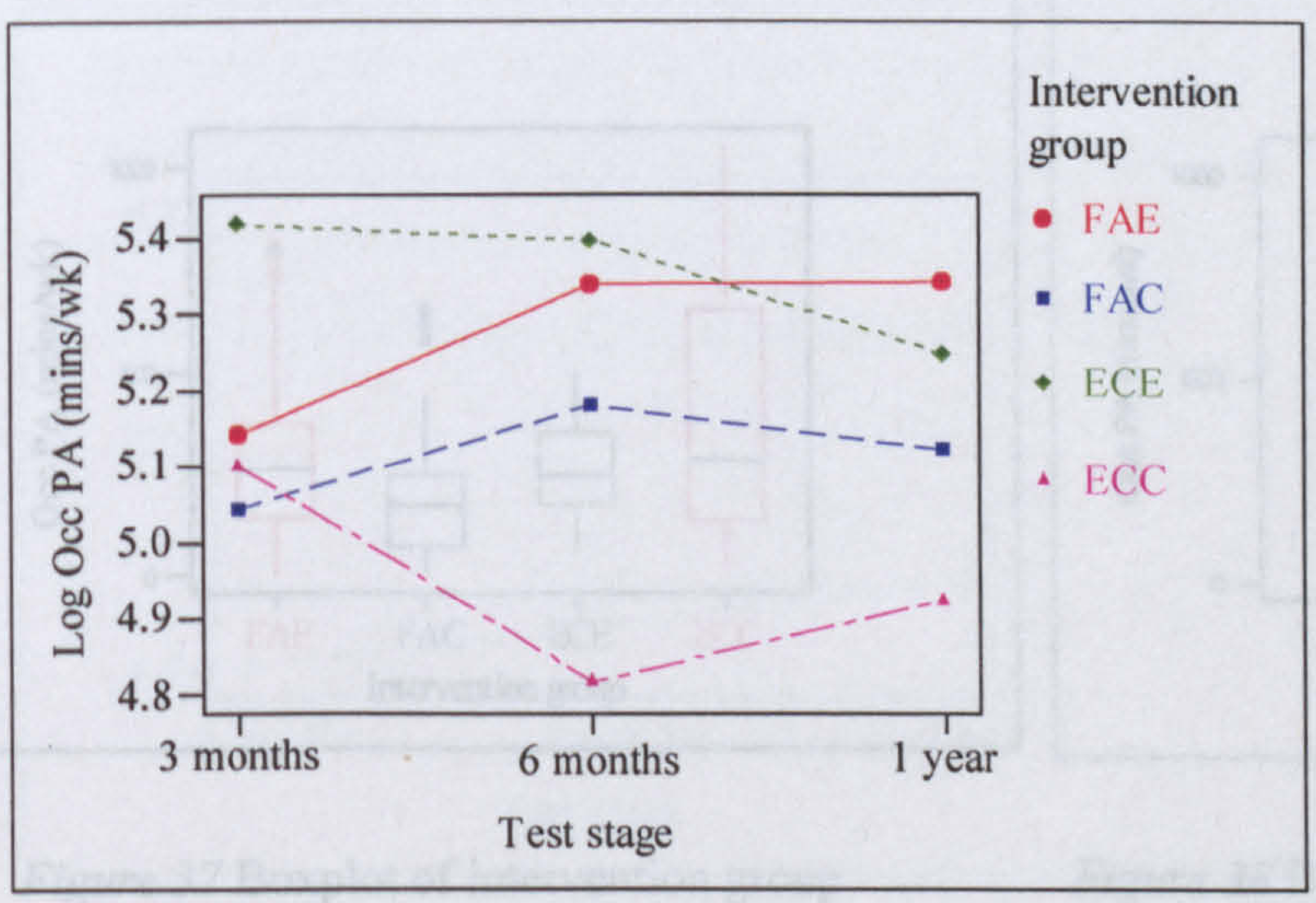


Figure 36 Interaction plot of intervention group and test stage for log of occupational physical activity.

Figures 34 and 35 suggest little difference between intervention groups or test stages and figure 36 shows marginal interaction. To formally check these observations, a two way analysis of variance on those not regularly active at baseline for test stage by intervention group was conducted. Table 11 reports the results of this analysis.

Table 11.

Results of an analysis of variance on not regularly active participants by test stage for log of occupational physical activity

Source	DF	F	P
Test stage	1.59	0.06	0.94
Intervention group	3	0.54	0.66
Subject (intervention group)	58	19.45	< 0.05
Test stage * Intervention group	4.76	1.43	0.21
Error	91.99		
Total	159.34		

Table 11 reports a significant subject nesting effect as expected. Again, this is the only significant result.

Regularly Active at Baseline

Figures 37 and 38 give boxplots for intervention group and test stage respectively.

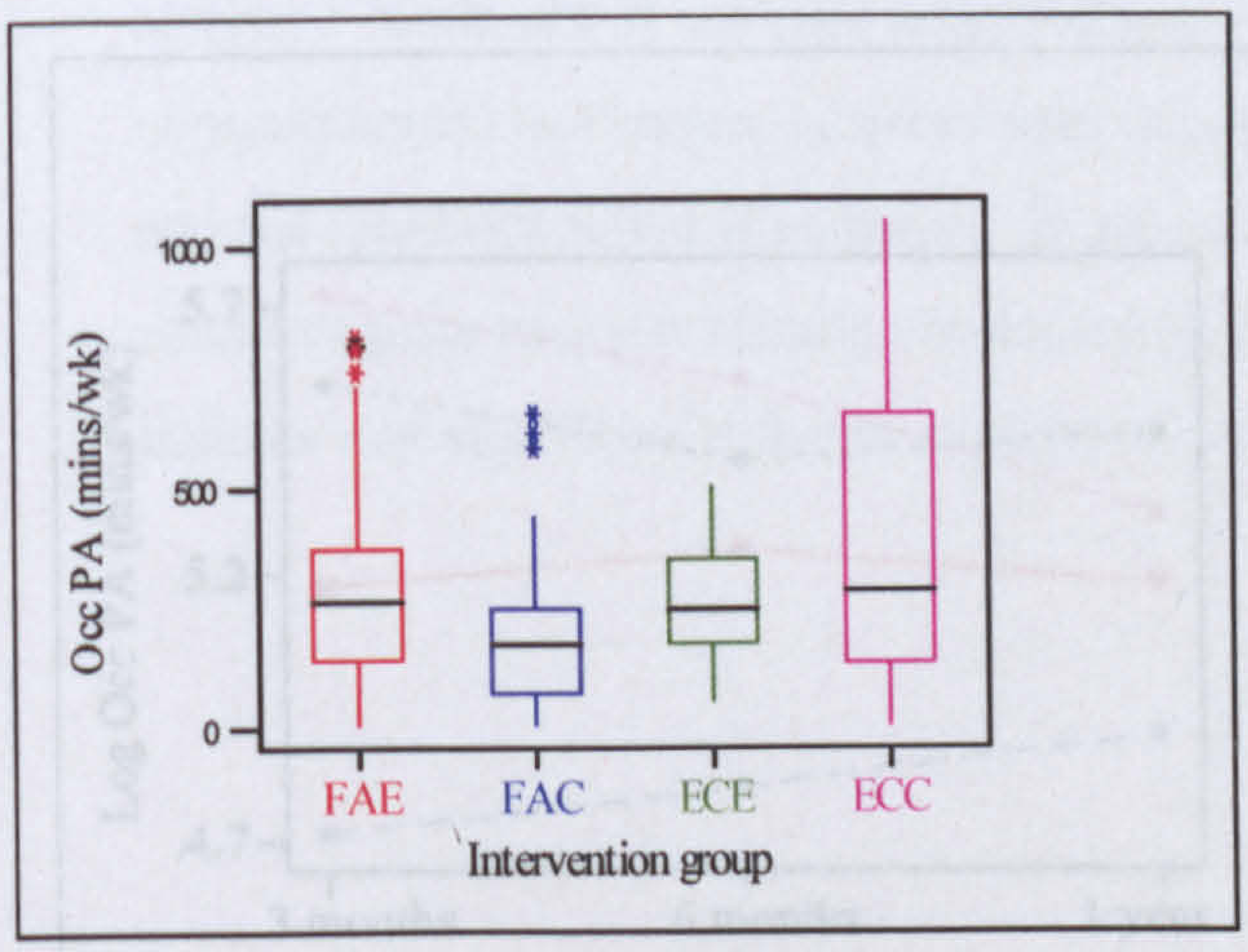


Figure 37 Boxplot of intervention group against occupational physical activity (mins / wk)

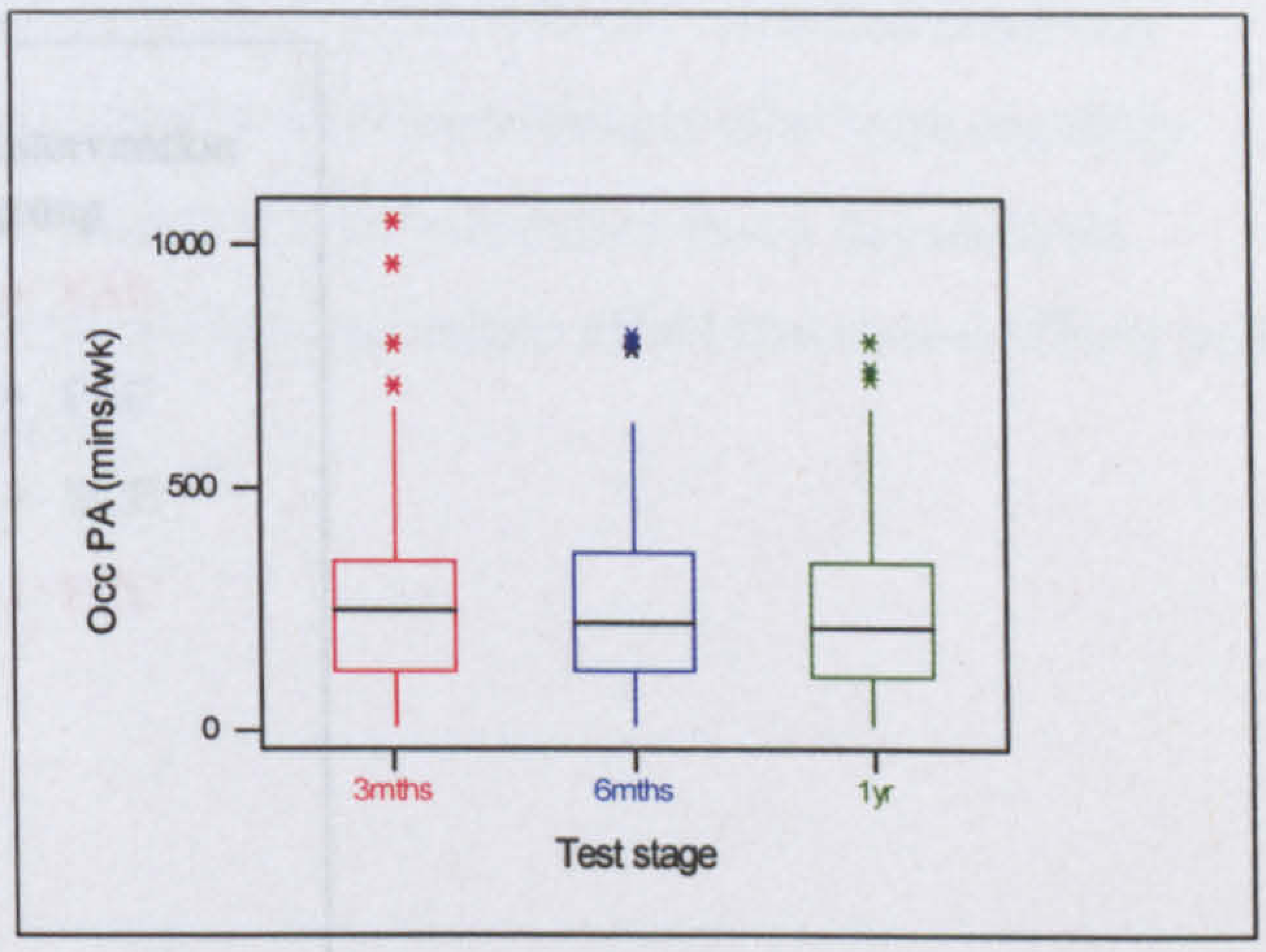
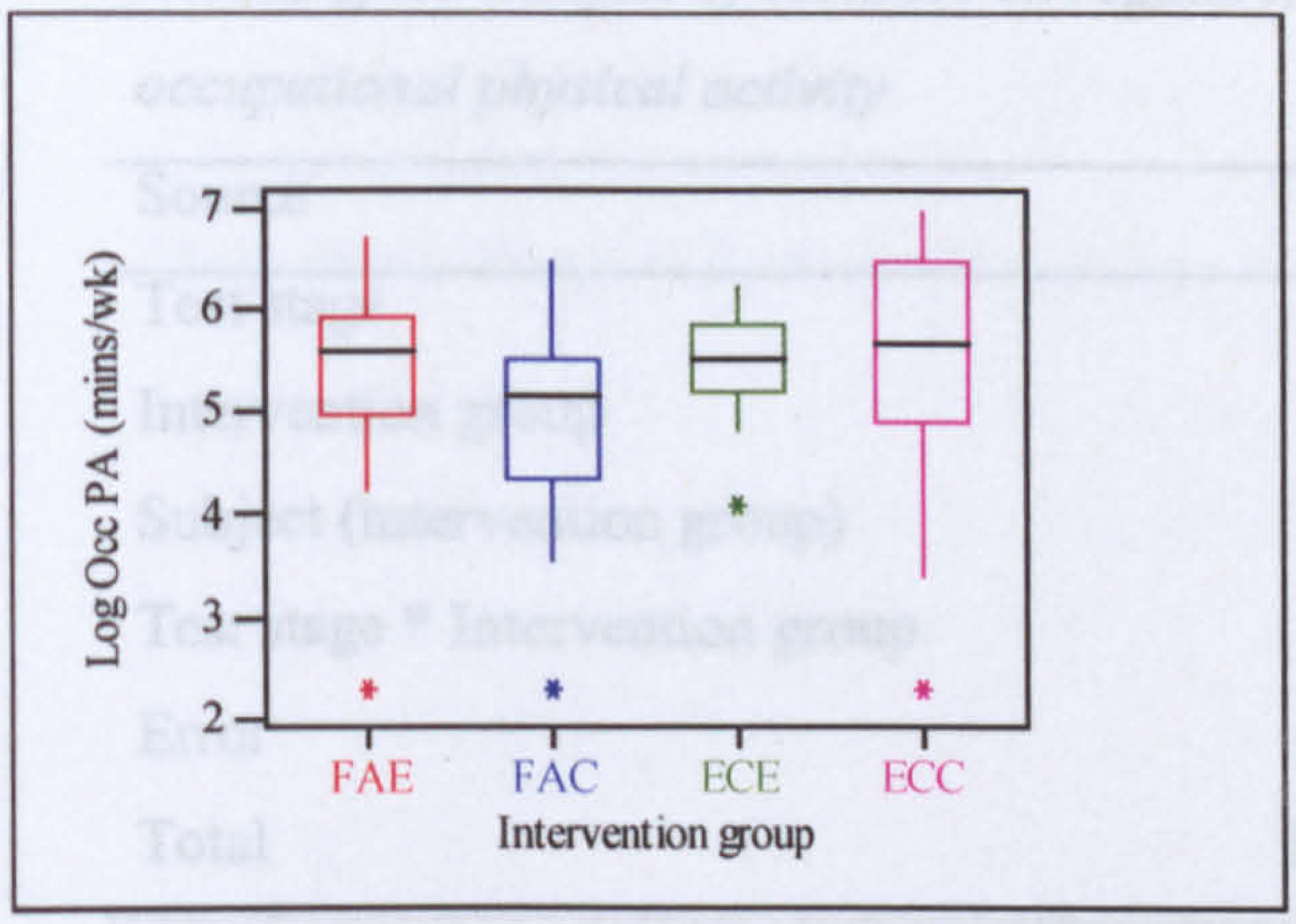


Figure 38 Boxplot of test stage against occupational physical activity (mins/wk)

Figures 37 and 38 again show outliers. Figures 39 and 40 give boxplots of intervention group and test stage plotted against the log of occupational physical activity respectively.



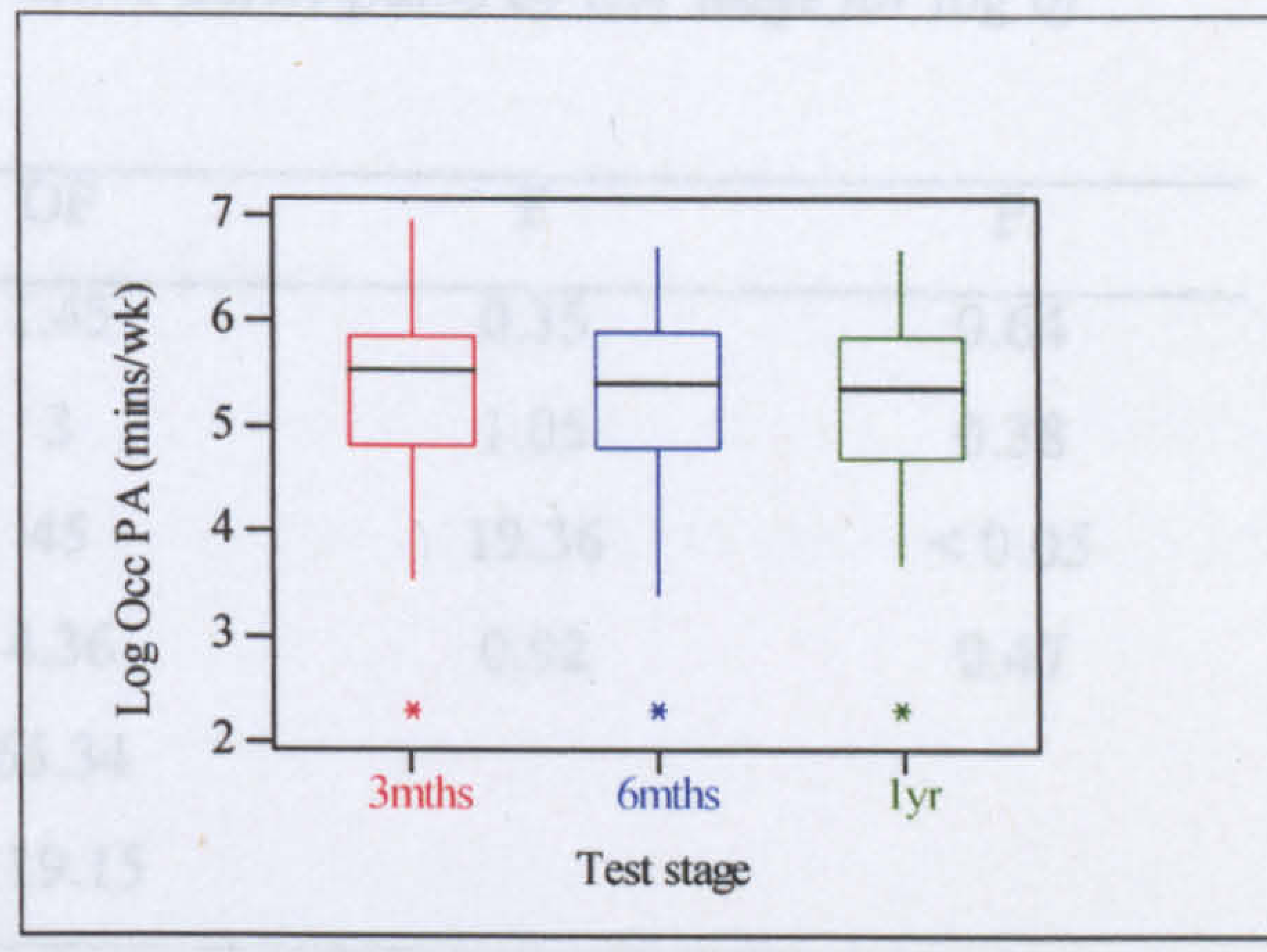


Figure 39 Boxplot of intervention group against log occupational physical activity (mins/wk)

Figure 40 Boxplot of test stage against log occupational physical activity (mins/wk)

Again, figures 39 and 40 show taking the logarithms enhances the normality of the data.

Figure 41 plots the interaction between intervention group and test stage for the log of occupational physical activity.

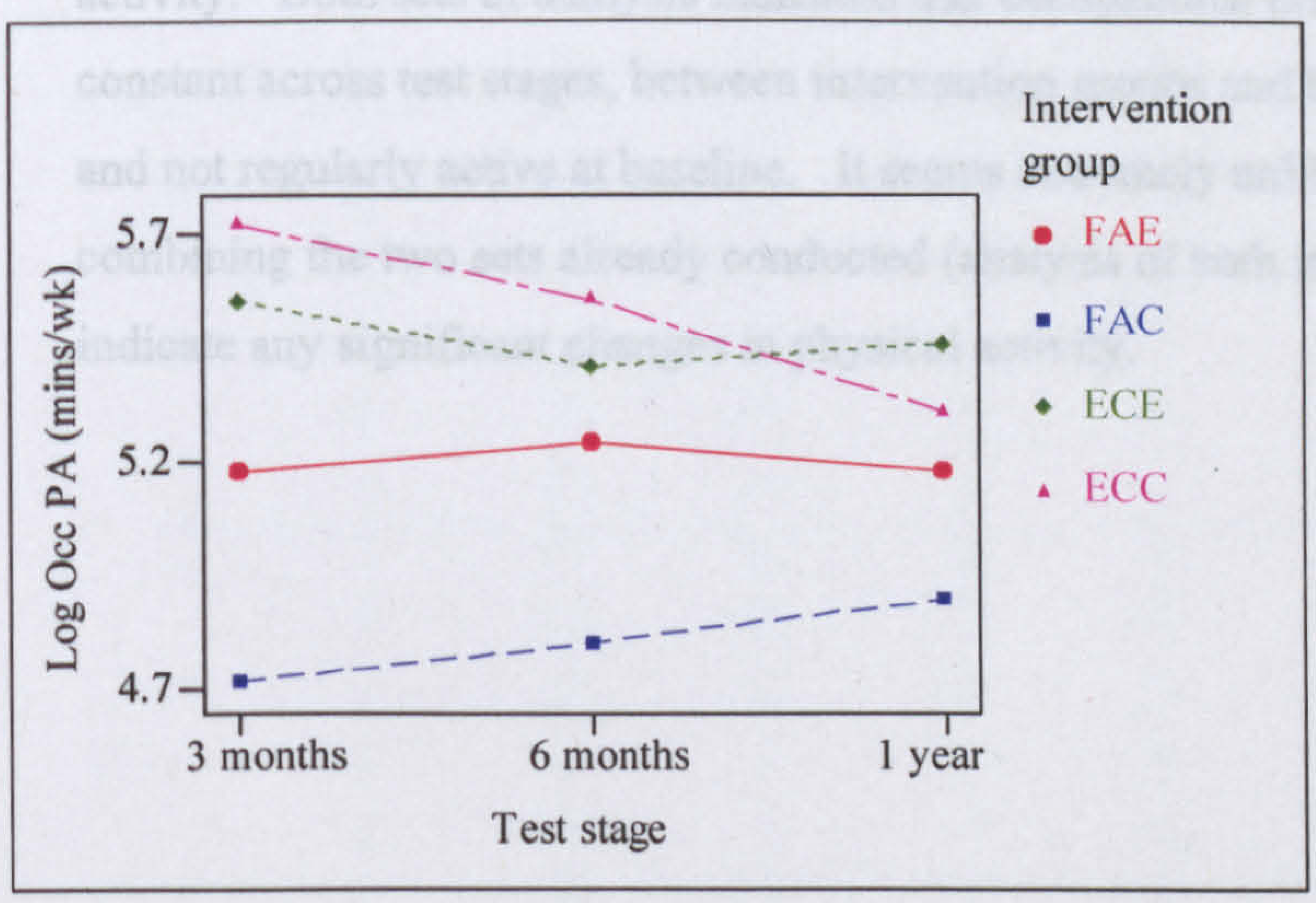


Figure 41 Interaction plot of intervention group and test stage for log of occupational physical activity.

Figures 39 and 40 suggest little difference between intervention groups or test stages and figure 41 shows little interaction. To formally check these observations, a two way analysis of variance on those not regularly active at baseline for test stage by intervention group for log of occupational physical activity was conducted. Table 12 reports the results of this analysis.

Table 12.

Results of an analysis of variance on regularly active participants by test stage for log of occupational physical activity

Source	DF	F	P
Test stage	1.45	0.35	0.64
Intervention group	3	1.05	0.38
Subject (intervention group)	45	19.36	< 0.05
Test stage * Intervention group	4.36	0.92	0.47
Error	65.34		
Total	119.15		

Again, as with those not regularly active at baseline, table 12 reports a significant subject nesting effect as expected, this being the only significant result.

Long Term Intervention Effects

The previous two sets of analysis have examined the immediate effect of each intervention on occupational physical activity and the effect of the re-test intervention on occupational physical activity. Both sets of analysis indicated that occupational physical activity remained relatively constant across test stages, between intervention groups and between people who were regularly and not regularly active at baseline. It seems extremely unlikely therefore that a full analysis combining the two sets already conducted (analysis of both immediate effect and re-test effect) will indicate any significant changes in physical activity.

Appendix X

Main Study Stage of Exercise Behaviour Change Tables

Participants Classified as Not regularly Active at Baseline

Immediate Intervention Effect

Table 1 reports the stage of exercise behaviour change at baseline, four weeks and three months post test of those participants not regularly active at baseline remaining in the study three months post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

Table 1.

The stage of exercise behaviour change at baseline, four weeks and three months post test of those not regularly active at baseline remaining in the study at three months post test for each study group

		Test stage							
Study		Baseline		4 weeks		3 months		Baseline-3 mths	
Group	SOC	N	%	N	%	N	%	N	%
	2	12	48	0	0	0	0	0	0
	3	13	52	4	16	3	12	3	12
	4	0	0	21	0	22	88	22	88
FAE	5	0	0	0	86	0	0	0	0
	P	0	0	23	92	22	88	24	96
	N	25	100	2	8	3	12	1	4
	2	20	57	1	3	0	0	0	0
	3	15	43	3	9	3	9	3	9
	4	0	0	31	88	31	88	31	88
FAC	5	0	0	0	0	1	3	1	3
	P	0	0	33	94	33	94	34	97
	N	35	100	2	6	2	6	1	3
	2	17	44	1	3	0	0	0	0
	3	22	56	5	13	5	13	5	13
	4	0	0	33	84	34	87	34	87
ECE	5	0	0	0	0	0	0	0	0
	P	0	0	34	87	35	90	36	92
	N	39	100	5	13	4	10	3	8
	2	13	48	3	11	3	11	3	11
	3	14	52	6	22	14	52	14	52
	4	0	0	18	67	10	37	10	37
ECC	5	0	0	0	0	0	0	0	0
	P	0	0	21	78	11	41	16	59
	N	27	100	6	22	16	59	11	41

Note. SOC = stage of exercise behaviour change, 2 = contemplation, 3 = preparation, 4 = action, 5 maintenance, P = positive category, N = negative category.

Intervention Re-test and Long Term Effect

Table 2 reports the stage of exercise behaviour change at three months, six months and one year post test of those participants not regularly active at baseline remaining in the study at one year post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

Table 2.

The stage of exercise behaviour change at three months, six months and one year post test of those not regularly active at baseline remaining in the study at one year post test for each study group.

		Test stage							
Study		3 months		6 months		1 year		Base - 1 year	
Group	SOC	N	%	N	%	N	%	N	%
FAE	2	0	0	0	0	3	30	3	30
	3	2	20	1	10	5	50	5	50
	4	8	80	7	70	0	0	0	0
	5	0	0	2	20	2	20	2	20
	P	8	80	9	90	2	20	4	40
	N	2	20	1	10	8	80	6	60
FAC	2	0	0	0	0	3	19	3	19
	3	3	19	2	12	11	69	11	69
	4	12	75	7	44	0	0	0	0
	5	1	6	7	44	2	12	2	12
	P	13	81	14	88	2	12	8	50
	N	3	19	2	12	14	88	8	50
ECE	2	0	0	1	5	1	5	1	5
	3	4	18	11	50	15	68	15	68
	4	18	82	1	5	0	0	0	0
	5	0	0	9	40	6	27	6	27
	P	18	82	10	45	6	27	12	55
	N	4	18	12	55	16	72	10	45
ECC	2	1	7	1	7	5	36	5	36
	3	6	43	4	29	6	43	6	43
	4	7	50	7	50	0	0	0	0
	5	0	0	2	14	3	21	3	21
	P	7	50	9	64	3	21	6	43
	N	7	50	5	36	11	79	8	57

Note. SOC = stage of exercise behaviour change, 2 = contemplation, 3 = preparation, 4 = action, 5 maintenance, P = positive category, N = negative category.

Participants Classified as Regularly Active at Baseline

Immediate Intervention Effect

Table 3 reports the stage of exercise behaviour change at baseline, four weeks and three months post test of those participants regularly active at baseline remaining in the study three months post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

Table 3.

The stage of exercise behaviour change at baseline, four weeks and three months post test of those regularly active at baseline remaining in the study at three months post test for each study group

		Test stage							
Study		Baseline		4 weeks		3 months		Baseline-3 mths	
Group	SOC	N	%	N	%	N	%	N	%
FAE	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	1	3	1	3
	4	14	37	14	37	9	24	9	24
	5	24	63	24	63	28	73	28	73
	P	38	100	38	100	37	97	37	97
	N	0	0	0	0	1	3	1	3
FAC	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	2	5	2	5
	4	18	47	17	45	9	24	9	24
	5	20	53	21	55	27	71	27	71
	P	38	100	38	100	36	95	36	95
	N	0	0	0	0	2	5	2	5
ECE	2	0	0	0	0	0	0	0	0
	3	0	0	0	0	0	0	0	0
	4	8	42	7	37	5	26	5	26
	5	11	58	12	63	14	74	14	74
	P	19	100	19	100	19	100	19	100
	N	0	0	0	0	0	0	0	0
ECC	2	0	0	0	0	0	0	0	0
	3	0	0	1	5	4	20	4	20
	4	7	35	6	30	3	15	3	15
	5	13	65	13	65	13	65	13	65
	P	20	100	19	95	16	80	16	80
	N	0	0	1	5	4	20	4	20

Note. SOC = stage of exercise behaviour change, 2 = contemplation, 3 = preparation, 4 = action, 5 maintenance, P = positive category, N = negative category.

Table 4 reports the stage of exercise behaviour change at three months, six months and one year post test of those participants regularly active at baseline remaining in the study at one year post test for each study group. The table also presents the number of participants in either the "positive" or "negative" categories.

Table 4.

The stage of exercise behaviour change at three months, six months and one year post test of those participants regularly active at baseline remaining in the study at one year post test for each study group.

		Test stage							
Study		3 months		6 months		1 year		Base - 1 year	
Group	SOC	N	%	N	%	N	%	N	%
	2	0	0	0	0	0	0	0	0
	3	1	5	1	5	1	5	1	5
	4	5	25	0	0	0	0	0	0
FAE	5	14	70	19	95	19	95	19	95
	P	19	95	19	95	19	95	19	95
	N	1	5	1	5	1	5	1	5
	2	0	0	0	0	1	6	1	6
	3	1	6	6	37	5	31	5	31
	4	5	31	0	0	0	0	0	0
FAC	5	10	63	10	63	10	63	10	63
	P	15	94	10	63	10	63	10	63
	N	1	6	6	37	6	37	6	37
	2	0	0	0	0	0	0	0	0
	3	0	0	3	43	3	43	3	43
	4	2	29	0	0	0	0	0	0
ECE	5	5	71	4	57	4	57	4	57
	P	7	100	4	57	4	57	4	57
	N	0	0	3	43	3	43	3	43
	2	0	0	0	0	0	0	0	0
	3	1	12.5	2	25	3	37.5	3	37.5
	4	2	25	0	0	0	0	0	0
ECC	5	5	62.5	6	75	5	62.5	5	62.5
	P	7	87.5	6	75	5	62.5	5	62.5
	N	1	12.5	2	25	3	37.5	3	37.5

Note. SOC = stage of exercise behaviour change, 2 = contemplation, 3 = preparation, 4 = action, 5 maintenance, P = positive category, N = negative category.

Appendix Y

Main Study Processes of Exercise Behaviour Change Tables and Analyses

Table 1 gives the median score for each process of exercise behaviour change for each intervention group at baseline for contemplators who progressed at least one stage of exercise behaviour change at four weeks post test. The table also gives the results of ten Kruskal Wallis tests, conducted to identify significant differences between intervention groups for each process of exercise behaviour change at baseline.

Table 1.

The median score for each process of exercise behaviour change for each intervention group at baseline for contemplators who progressed at least one stage of exercise behaviour change at four weeks post test.

	Intervention Group				Kruskal Wallis test	
	FAE	FAC	ECE	ECC	Test	
Processes	N = 13	N = 20	N = 16	N = 11	Statistic	P
Experiential						
Consciousness Raising	9.0	9.0	7.5	8.0	2.27	0.52
Dramatic Relief	9.0	8.5	10.5	8.0	2.03	0.57
Enviromental Reevaluation	11.0	10.0	11.0	9.0	3.26	0.35
Self Reevaluation	12.0	11.0	12.5	12.0	3.15	0.37
Social Liberation	10.0	9.0	9.0	10.0	0.28	0.96
Behavioural						
Counter-Conditioning	8.0	8.0	7.5	7.0	2.95	0.40
Helping Relationships	9.0	8.0	8.0	8.0	1.52	0.68
Reinforcement Management	8.0	8.0	7.5	7.0	1.86	0.60
Self Liberation	10.0	9.0	10.0	10.0	0.90	0.83
Stimulus Control	6.0	8.0	8.5	7.0	4.02	0.26

Table 1 shows that there are no significant differences between study groups for any of the processes of exercise behaviour change.

Table 2 gives the median score for each process of exercise behaviour change for each intervention group at baseline for preparers who progressed at least one stage of exercise behaviour change at four weeks post test. The table also gives the results of ten Kruskal Wallis tests, conducted to identify significant differences between intervention groups for each process of exercise behaviour change at baseline.

Table 2.

The median score for each process of exercise behaviour change for each intervention group at baseline for preparers who progressed at least one stage of exercise behaviour change at four weeks post test.

	Intervention Group				Kruskal Wallis test	
	FAE	FAC	ECE	ECC	Test	
Processes	N = 14	N = 15	N = 19	N = 11	Statistic	P
Experiential						
Consciousness Raising	9.0	8.0	10.0	8.0	1.88	0.60
Dramatic Relief	9.0	7.0	11.0	8.0	4.6	0.20
Enviromental Reevaluation	9.5	9.0	10.0	10.0	0.18	0.98
Self Reevaluation	12.0	11.0	11.0	12.0	1.29	0.73
Social Liberation	8.0	8.0	9.0	12.0	3.1	0.38
Behavioural						
Counter-Conditioning	11.0	7.0	11.0	8.0	7.1	0.07
Helping Relationships	9.0	6.0	9.0	13.0	10.42	< 0.05
Reinforcement Management	9.0	7.0	11.0	9.0	10.07	< 0.05
Self Liberation	11.0	10.0	10.0	12.0	5.53	0.14
Stimulus Control	7.5	6.0	8.0	5.0	8.62	< 0.05

Table 2 shows that there is a significant difference between study groups at baseline for helping relationships, reinforcement management and stimulus control.

Appendix Z

List of Groups and Organisations who have Expressed an Interest in SPAQ

1. Chester University College
2. Sport Scotland
3. Glasgow University
4. Greater Glasgow Health Board
5. University of Edinburgh
6. Physiotherapy Department, Seven Oaks Hospital
7. Cardiac Rehabilitation Department, Western General Hospital, Edinburgh
8. Grampion Heart Campaign
9. Western Isles Health Promotion Department
10. Borders Health Promotion Department
11. Department of Clinical Research, Crichton Royal Hospital, Dumfries
12. Department of Physiotherapy, Queen Margaret College, Edinburgh
13. Western Infirmary, Glasgow
14. Health Education Authority
15. Ayrshire and Arran Health Board
16. Centre for Health Promotion, Institute for Scientific Information, Philadelphia, USA