AN ANTHROPOLOGICAL STUDY ON 8799 ADULTS

IN THE UNITED KINGDOM

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by

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CONTENTS

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SUMMARY

The overall aim of this Thesis was to establish social factors affecting body composition in both males and females.

In order to achieve this the method adopted was to study a group of 6495 males and 2304 females aged 16-64 years, selected as described in Chapter 2, from both the British Armed Forces and the civilian population. The measurements taken from each individual were height, weight and four skinfolds. Using the equations of Durnin and Womersley (1974) and Siri (1956) the skinfolds were converted into a value for percent bodyfat (% fat) and fat free mass (FFM) was calculated by subtracting fat mass from body weight.

The two populations, Forces and civilians, were divided into age groups and the mean results for height, weight, FFM and % fat were established for both males and females. (However, in the female Forces sample only age groups 17-29 years were used due to the low values for 'n' found in the older age groups). All subjects completed a detailed questionnaire (see Appendix B). The following comparisons were made from the available anthropometric and social information.

* Forces and Civilian Populations

The main difference found between the male samples was for mean FFM values. The Forces sample were found to have a bigger 'build' than that of the civilian population.

The female Forces were found to be taller and heavier than the female civilians. The female Forces were on average slightly fatter but the difference in weight was due mainly to the differences in height between the two populations.

* Previous British Anthropometric Studies

The height and weight results of the civilian population were compared to previous studies. The studies involved were those of Kemsley (1943) and Montegriffo (1968). It was of interest

to note the general trends in height and weight over the past 40 years. The secular increase in height was found to be approximately 2cm/decade and weight gain with age decreasing.

* Individual Services within the Forces

The mean results within age groups were compared amongst all three services. In the male sample, all three services were very similar. However, the Army tended to have bigger 'builds' and the Navy were slightly 'fatter' than the Army or Airforce. For females, again all three services were very similar. However, the WRNS were also slightly 'fatter' than the Army or Airforce.

* Officers and Non-Commissioned Officers (NCO's)

The above groups were derived from the Forces sample and a comparison of mean results made. The Officers were found to be taller than the other ranks within similar age groups. However, when compared in similar height groups the NCO's were found to have higher mean values for FFM and % bodyfat than the Officers sample. Analysis of the female sample was limited due to low numbers. However, there was a tendency for the Officers to be slightly taller than the other ranks.

* Smoking Habits and Body Composition

Twice as many of the Forces male sample compared to the civilian male sample smoked (45% & 20% respectively). For both Forces and civilian male samples, smokers were found to be 'less fat' than 'non-smokers', on average by 1%. Ex-smokers who had given up within the past 5 years had the highest mean values for % bodyfat. 'Heavy' smokers were not found to be more obese than 'light' smokers. In the female samples again almost twice as many Forces females smoked (46%) compared to the civilian females (26%). Like the male samples both female samples found smokers to be 'less fat' than the non-smokers, again the magnitude of the difference being on average 1% bodyfat.

* Exercise Habits and Body Composition

In the Forces male sample 62% of subjects exercised ≥ 2/week compared to only 44% of the civilian male sample. For both the Forces and civilian male samples those who exercised more had higher mean values for FFM and lower mean values for % bodyfat (on average 1.5%) than the less active subjects.

In the Forces female sample 41% of subjects exercised ≥ 2/week compared to only 32% of the civilian female sample. Similar to the male findings, the general trend was that those subjects who took more exercise had less fat (on average 1%) and overall had higher mean values for FFM than the less active group. However, the differences found between the two female activity groups in mean FFM values were not as pronounced as the differences between the two male groups.

* Occupation and Body Composition

The findings of this study showed that both occupation and exercise can affect anthropometric variables. The Forces male sample showed that those subjects who had active jobs and who exercised had higher mean values for FFM (on average 2kg) and lower mean values for % bodyfat (on average 1.6%).

For the male and female civilian samples those subjects with sedentary jobs who exercised more were found to have less bodyfat (on average 1%). However, the differences in mean FFM values were not as significant.

CHAPTER 1

INTRODUCTION

Traditionally physical anthropologists have been interested in the skeleton. Osteometry covered a large part of the globus anthropologicus. Skeletal remains were plentiful and anthropologists were busy and intrigued. In so far as measurements were involved, rather than qualitative descriptions and classifications of the colour of the skin, shape of the nose, or texture of the hair, anthropologists compared the living representatives of the races of mankind, again in terms of skeletal dimensions. The techniques of physical anthropology were designed to render as negligible as possible the individual differences in fat and muscle.

The initial work by anthropologists therefore produced data on the skeleton only. Man, the professed subject matter of anthropology's enquiry, was squeezed out. The portion of the human body between the skin and the bone was a 'no man's land' lying fallow. Since the skeleton comprises only about 20% of the FFM (Von Liebig, 1874; Forbes et al, 1956) then a vast area of anthropology was still to be explored.

The realisation was slow to dawn that soft tissues were the anthropologists domain and that body composition is, in fact, the very key to human physique.

Anthropometry itself, i.e. the measurement of the body's dimensions, developed from the arts and the search for an ideal God-like image, Man was created in God's image and since the dimensions and proportions of the 'ideal' man were considered close to God, the artist attempted to express them by creating ideal, life-like and thus God-like images.

From the anthropologists point of view, the measurement of body weight is of limited use, because of the numerous factors, varying between components which make up weight, such as muscle, fat and skeletal mass. Nevertheless, one man who put much value on weight was the Belgian Adolphe Quetelet, born in the 19th century. Quetelet greatly influences the study of human growth and configuration by developing and applying simple laws of mathematics and statistics

to his data. Once again, greatly influenced by art and beauty, Quetelet sought the 'homme moyen', average man, believing that this would also be the perfect man. As a result Quetelet developed an index W/H^2 which is still frequently used in studies related to body composition.

The only way to determine accurately body composition is to carry out chemical and anatomical analysis of human cadavers and these studies were first carried out by anthropologists in the 19th century (Bischoff, 1863; Volkmann, 1874). In this way, body weight was at last broken down into its components.

In order to study the composition of living individuals, indirect methods have had to be developed which could be validated against the results of direct analysis, and one of the fathers of modern anthropology must be the Czech, Matiegka. Matiegka (1921) developed a technique and a series of simple measurements which allowed a quantitative assessment of the major body components, such as the fat mass. It was this basic idea which has been the backbone of many subsequent studies, including the current one.

In subsequent years the studies of the composition of the human body contrived to receive impetus through a variety of developments (Mouton, 1923; Scammon, 1930; Macy, 1942; Pace and Rathburn, 1945). The strongest stimulus came from the work of AR Behnke (1942) who developed the idea of measuring an individual's specific gravity underwater and as a result, dividing the body composition into 'lean' and 'fat' components. The need for a fundamental rethinking of one of the pillars of physical anthropology of the living man, that of body build, clearly emerged.

METHODS FOR DETERMINING BODY FAT

Methodologically the field has continued to advance and the indirect techniques have become more complex. Since this study was based outside the laboratory, the field techniques are discussed more fully.

DIRECT - DISSECTION AND CADAVER ANALYSIS

The only way to determine accurately an individual's fat content is to carry out cadaver analysis, either chemical or anatomical.

These studies were first instigated by anthropologists in the 19th century (Bischoff, 1863; Volkmann, 1874) but the number of cadavers analysed has been limited, although at least 8 have been accurately analysed chemically and 22 anatomically. This method is obviously not suitable for the majority of studies, however, it has been used to help standardise other methods, since it provides fairly accurate estimates of whole body composition.

INDIRECT METHODS

In order to study living individuals, indirect methods for measuring body composition and fat content have been developed and validated where possible against cadaver analysis. In relatively small samples of people, where laboratory facilities are available, there are many effective methods for assessing 'fatness'. The most commonly used methods are: densitometry - which entails weighing the individual underwater and calculating his density using Archimedes Principle.

Measurement of total body potassium, total body water, extracellular fluid volume, photogrammetry and lipid solutes are other commonly used methods.

Less well standardised methods include X-radiography, ultrasonography or electrical conductance.

In large populations or field studies, however, these methods are not suitable because of the often bulky or expensive equipment required and the expertise necessary to take the measurements. The most popular methods therefore are described below.

(a) WEIGHT-HEIGHT RELATIONSHIPS

The relationship between height and weight is often taken as an indicator of obesity, or more exactly, of 'overweight' and examples are the 'Desirable Weight-for-Height' tables which have been produced

from the mortality data collected by American insurance companies prior to 1959. As a consequence of these tables, many studies use relative weight i.e. actual weight/desirable weight x 100 as an obesity index. (These tables have recently been revised, but are still based on the old data.) Other examples are the many weight-height indices which have been developed i.e. the Quetelet Index (W/H^2), the Ponderal Index (H/W 1/3) or W/H, which are often used to indicate obesity, because of their relative simplicity.

The main problem with these weight-height relationships indices and tables is that they cannot differentiate between weight due to muscle, bone or fat. An 'overweight' individual is often automatically assessed as 'overfat' as opposed to muscular or large boned. Despite this obvious limitation, the indices in particular are still misused, which often leads to a confusion between results from different studies.

(b) ANTHROPOSCOPY

This is the science of visual observation and of physical traits which are not easily quantified. Anthroposcopy is distinct from anthropometry since the latter involves quantitative measurement while the former does not. The distinction should also be noted between somatotyping and somatometry, the former being a branch of anthroposcopy, while the latter is a branch of anthropometry. Sheldon (1940) produced a scheme of 'body typing' or somatotyping which has probably been the most influential. He rated each individual on a scale from 1 to 7 in three components: (a) endomorphy: soft-roundness (b) mesomorphy: predominance of squareness and muscularity and (c) ectomorphy: predominance of linearity and fragility.

Although Sheldon was attempting to assess each individual's permanent characteristics, his classifications and in particular, the endomorphy ratings, are generally used to describe both permanent and changing factors.

In summary, anthroposcopy tends to involve subjective techniques which are difficult to standardise without introducing some physical measurements, for example, from photographs (Parnell, 1958).

Since simple physical measurements can be taken easily in most studies, the more quantitative science of anthropometry is preferable.

(c) ANTHROPOMETRY

The techniques of anthropometry allow a quantitative description of the body through physical measurement of its dimensions (if photographs are used the method is known as photogrametry).

In any anthropometric study there is an enormous choice of possible measurement sites, but it is important from the practical point of view to keep the number down to a minimum. A large number of measurements require a lot of time which may not be available in field work.

The actual choice of sites varies between studies. Initially there was little standardisation of either sites of methodology, but in 1969, the International Biological Program produced a handbook called 'Human Biology: A Guide to Field Methods' edited by Weiner and Lourie and updated in 1981 as 'Practical Human Biology'. This book presented both a set of anthropometric techniques which had been agreed by authorities in the field, and a recommended set of 21 basic sites plus 17 additional, optional sites. This recommended list included specific skeletal measurements, circumferences and also skinfold measurements.

Measuring skinfold has an advantage over simply measuring height, weight, circumferences and diameters, because it allows the assessment of 'fatness' in the individual as opposed to 'overweight'. For this reason, it was used within this study as the basic method for measuring each subject's fat content.

The concept of body composition, together with the availability of these new tools for the measurement of body compartments, stimulated in recent years a substantial amount of research. Physical anthropology was brought into livelier contact with the dynamic problems of nutrition, growth, ageing and of physical exercise.

ANTHROPOMETRIC SURVEYS

During the 19th century more attention began to focus on public health and medical surveys were established to examine its many aspects. Concern for child health and working conditions was growing so the first surveys were carried out mainly on factory children. This was partly an attempt to relate stature with age and thus pin-point stunting of growth, possibly due to working conditions and under-nutrition. Francis Gatton, in the late 19th century, initiated an anthropometric survey in schools in order to examine secular changes in height differences due to environment, and later, hereditary factors. Similar studies were carried out at about the same time in Europe and America by scientists such as Pagliani and Bowditch respectively, and the first skinfold measurements were taken at the bicep site of children by the German, Kotelman, at the turn of the century (Tanner, 1981).

These mixed, cross-sectional and longitudinal studies have been developed and continued into the 20th century, with much of the work still centering around children and adolescents. Many national surveys have been established, however, which record height, weight and sometimes other measurements from a cross-section of all groups e.g. the Office of Population Censuses and Surveys (OPCS) in Britain, which records height and weight. More local, large scale surveys have also been carried out e.g. Montegriffo (1968) on London and overseas populations and Kemsley (1950) on a wide range of industries within Britain.

The main limitation of these surveys is that they produced average values for height and weight from measurements obtained using inaccurate methods. Height, for example, in some of these studies was determined with the subject wearing shoes and in many cases weight was measured with him wearing indoor clothing. Because of this methodology estimated corrections for shoes and clothing had to be made which can obviously lead to a certain degree of error. However, by bearing this in mind and making allowances where necessary, a general comparison was made between these earlier results.

Unlike many of the early 19th century anthropometric studies, which were needed to pin-point the relationship between under-

nutrition and poor environment, present day surveys are more often required to detect over-nutrition and obesity.

SMOKING AND PHYSICAL ACTIVITY STUDIES

Smoking Habits

With the virtual elimination of infection and malnutrition as causes of disabling disease and premature death in Britain, tobacco smoking and obesity have emerged as major health hazards. In men, for example, the risk of dying from coronary disease in smokers, is twice that for non-smokers (Doll and Hill 1964; Kahn 1966) and to be 25% above average weight also more than doubles the risk (Society of Actuaries 1959). Yet these two major health hazards are themselves universely related: non-smokers weigh more than smokers and smokers who give up smoking put on weight (Khosla and Lowe 1971). Similarly, a report from the Royal College of Physicians (1971) stated that a comparison of the weights in surveys of working men have shown that "non-smokers tend to be slightly heavier and taller than smokers ... and smokers who stop often find they gain weight and the gain may be considerable". Data from Lincoln (1969) also found non-smokers tend to weight more than smokers (age, height and income being matched) and with no material differences in physical energy expenditure. He also found that among former cigarette smokers the percentage of those who are making an effort to keep their weight down is 53%, compared with 32% for current cigarette smokers and 27% for current heavy smokers. Lincoln's data for the behaviour of recent abstainers are based on rather small numbers, but the indication is that just after a few months of abstention, ex-smokers, on average, gained approximately 3.6kg.

Members of the general public are aware of this paradox for in a study of motivation in smoking, some men who had given up smoking reported that they began to smoke again because they were putting on weight (Fox 1966). Their fear of becoming overweight was apparently so great that they were prepared to escape from the hazards of obesity, at the cost of exposing themselves, once again, to the hazards of smoking. However, it has been found that the body weight of subjects who have given up smoking does

eventually approach the body weight of mean of the same age who have never smoked (Lincoln 1969; Khosla and Lowe 1971).

In view of this curious situation it is surprising that there is so little reliable information about the relation between body weight and smoking. Indeed, the trends of body weight by smoking habits reported in literature tend to be anecdotal rather than based on well controlled studies (Fox 1966).

Physical Activity

Many investigations suggest that reduced physical activity may be important in the pathogenesis of obesity. Mayer et al (1954) showed that caloric surplus of obese hyperglycaemic mice during the active phase of their obesity is due primarily to the fact that they are far less active than their non-obese litter mates. When the 'waltzing gene' is bred into this strain of mice, moreover, the resultant increased activity is suffucient to prevent the development of their usual massive obesity.

What is known of the physical avtivity of obese persons indicates that physical inactivity may play a part in human obesity. Several studies based on reports of physical activity agree that obese persons are less active than persons of normal weight. In 1940, Bruch reported that physical inactivity was characteristic of a majority of the obese children she studied i.e. 76% of the boys and 88% of the girls were physically inactive. This observation has since been confirmed by Rony (1940), Brontein et al (1942), Graham (1947), Tolstrup (1953) and Juel-Nielson (1953), along with others. Similar studies by Pckos (1953), Fry (1953) indicate that obese children do not have higher average energy intakes than do control children of the same height and age.

In a study by Johnson et al (1956) energy intake and activity were systematically compared in paired groups of obese and normal weight school girls. Their findings were that suburban high school girls were generally not very active, but nevertheless there was a marked difference between the groups in that the obese groups were much less active than the non-obese. Generally speaking, the time spend by the obese groups in sports or any

other sort of exercise was less than half that spent by the lean girls. Energy intakes were generally larger in the non-obese girls than in the obese, and it was concluded that inactivity was more important than over-eating in the development of obesity. It is interesting to note that when these school girls attended summer camp, they all, both obese and non-obese, almost without exception, lost weight under a programme of enforced strenuous activity, in spite of simultaneous increased food intake.

Stephanik et al (1959) in a summer camp study, found that obese boys had significantly smaller energy intakes both during the school year and at the summer camp than the non-obese controls. Similar observations have been made by Bullen et al (1964).

In contrast to the foregoing studies which utilized reports of activity, Larsen (1949) attempted to measure actual physical activity by means of a mechanical pedometer. He found that 12 obese men and women studied on a hospital ward walked shorter distances than 10 non-obese hospitalised men and women, but he gave no details of the study. A study that also used pedometers to measure physical activity was that of Dorris and Stunkard (1957). They compared the physical activity of 15 obese women with that of 15 non-obese women matched for age, occupation and socio-economic background. The results of the study were striking and unequivocal. The obese women were far less active than their non-obese control subjects. In 1960 Chirico and Stunkard again studied the physical activity of obese and normal subjects of similar occupation and social status. They were asked to wear a pedometer for recording the number of steps throughout the day. The non-obese subjects were about twice as active as the obese ones.

A study of 55 men aged between 17 and 59 years was carried out in 1970 by Wilmore et al. The programme lasted for 10 weeks; the activity was jogging for not more than 24 minutes per day and no more than 3 days per week. All subjects underwent a series of anthropometric measurements, including skinfolds, circumferences and hydrostatic determination of body density both at the beginning and at the end of the 10 week period. Small but significant alterations in body composition resulted from this moderate exercise

programme. The losses were not spectacular but substantial considering the low intensity and short duration of the exercise programme. This was strictly an exercise induced weight loss. Anyone who altered his dietary habits during the study period was excluded from the analysis. The average loss of one quarter of a pound of fat per week, which would amount to a 13 pound fat loss per year.

The work of a number of investigators in the past has demonstrated unequivocally that physical activity is an effective agent in either the control or alteration of body composition or both.

CHAPTER 2

METHODS

2.1 GENERAL ROUTINE OF THE FIELD WORK

Every location visited, whether Service or civilian, varied slightly from the others and therefore there was no totally fixed routine to the field work. In general, however, the pattern was mostly the same and is described below.

In order to start work first thing on Monday morning, the field workers usually travelled to each location on the preceding Sunday. They were accommodated in the Officers' Mess at each Service establishment, and in local guest houses or hotels when visiting civilian companies. If the location was within about 50 miles of Glasgow, however, the team travelled back and forth each day.

A room with a table, a couple of chairs and if possible a changing area were requested before the team carried out each visit. The rooms provided ranged from a map room at the back of a squadron's hanger or the ladies' powder room in the basement of a bank, to entire wards in a medical centre and on one occasion a lecture theatre. On discovering that it was sports day at one RAF base, the team even carried out the measurements in a marquee on the edge of the football pitch. Where possible, changing rooms were provided, but generally this was either not possible or not practicable, and subjects had to undress either behind screens which were provided by the establishment, or in one corner of the room. Most subjects were very co-operative, and these inconveniences were regarded as amusing rather than annoying.

The number of individuals measured each day varied from about 30 to on occasions 100, but a comfortable number was around 60 or a rate of 10-12 per hour. The field workers normally worked totally independently, carrying out their own measurements and doing their own recording, and therefore two subjects could be measured simultaneously. This was found to be the quickest method. Limiting factors to the number of people seen in one day included:

1. A lack of space at some locations to have two subjects undressed and waiting to be measured while the measurements were carried out on two others.

2. A request from some subjects to be measured entirely on their own, which was always complied with.

3. A mixture of males and females arriving to be measured at the same time. The two sexes were always measured separately, and in arranging visits it was always requested that they come at different times of the day, although this was not always practicable.

4. The lack of a timetable for the attendance of subjects. While many establishments timetabled volunteers to attend, others found this impracticable and instead the volunteers attended at their own convenience. This meant that the research team could spend long periods of time with no-one to measure, followed by exceedingly busy periods.

5. The size of the office/factory being visited. If the establishment consisted of small offices or units, then often only one or two people from each unit could be spared at a time to be measured. It was only when these people had returned to their work that someone else would be free to attend and therefore the attendance was not in a continuous flow.

At some locations when attendance was low, the research team went round the office or workshop publicising the project and persuading reluctant individuals to participate.

In general, it was thought that the initial response rate achieved at any establishment seemed to depend on the enthusiasm for the project held by the individual at that establishment who was publicising and organising the project. It was also often found that the response was proportionally higher at small establishments where people tended to know each other, and once some had volunteered others often followed.

The reasons behind the survey were explained to all the subjects either individually or in groups.

The hours worked at each location were arranged to suit the volunteers and tended to be 8.30 a.m. - 5.00 p.m. at Service establishments and 9.00 a.m. - 5.30 p.m. at civilian locations. These hours were not rigid, however, and at a few Service training bases the

the measurements were carried out at weekends and in the evenings, as they were the only times that the recruits or students were free.

The length of time spent at each location varied from one day to weeks, and was dependent entirely on the number of volunteers. Since the research team knew these numbers approximately before each visit, they arranged their timetable so that several locations would be visited on any one field trip if it was appropriate. Field trips normally lasted 2-3 weeks, but near the end of the project this was often reduced to one week because consecutive weeks did not suit the companies involved. Appendix A, Tables 1-4, list the establishments visited and the numbers of people seen at each.

2.2 SUBJECT SELECTION FROM THE 3 ARMED FORCES

2.2.1 Introduction

The aim in the selection of subjects was to see a broad selection of about 5,000 males from the UK Regular Forces (a sample of approximately 1.6%) and as many females as possible. The final figures were 5,429 males and 1,123 females.

The subjects were found with the help of the Director of Army Preventative Medicine, the Medical Directorate General (Naval), and Director of Aviation Medicine (RAF). These 3 individuals and their departments wrote to various military establishments in the UK, asking for their co-operation in the survey. Once this was established the research team were informed, and subsequently made their own contacts with each Medical Officer (MO). The exact locations of each camp visited were not considered important, since members of the forces tend to change camps approximately every 3 years and therefore do not usually come from the local area.

2.2.2. Subject Selection at Individual Establishments

Once the decision was made to visit an establishment, the method for selecting the subjects varied between camps. A couple of

months before each visit a letter was sent to the camp Medical or Administrative Officer explaining the reasons for the survey and the measurements to be taken. This letter either came directly from the field workers, or via a district HQ. Thereafter, the organising officers arranged the selection of suitable subjects.

At the first six Service bases visited, a random sample of males and females from all ranks, ages and jobs was requested. In Table 1 this is defined as method (e). As the project progressed, however, gaps were seen in the sample, and specifications used for subject selection, together with the approximate numbers of people seen using each method. An estimate of the number of subjects who were 'asked' to attend to be measured, and the number 'told to attend', is also included.

These specifications were seldom strictly adhered to, but volunteers who were outwith them were still always included in the sample. The numbers are only approximate, since a mixture of methods was generally used at each establishment.

Near the start of the survey, methods (e) and (a) were most commonly used. Classes under instruction were timetabled to be measured, since the organisers at that establishment considered them to be a convenient source of large numbers of people. As gaps appeared in the sample methods (b), (c), (f) and eventually (g) were used. Throughout the survey, volunteers and 'passers-by' were also included in the sample and accounted for selection method (d) and (h).

Few subjects were pure volunteers. Most were chosen and told varying amounts about the survey before the field workers arrived. The field workers then told each subject more about the survey as he or she was being measured. As is shown in Table 1, some establishments would ask the chosen people to attend, it was found that the higher ranking and subsequently the older subjects, had most choice about attending and often had to be persuaded to become subjects.

2.2.3. Influence of the Investigators on the Sample

How much the investigators effected the attendance rate was difficult

to determine. They did not choose the individual subjects but they often persuaded reluctant subjects to participate, and persuaded others to volunteer. Any person with very strong objections did not have to participate, but very few fell into this category.

2.2.4. Difference between those in the Sample and the Remainder of the Services

The ideal samples of 2% from the Navy and RAF and 1% from the Army were not always achieved in individual groups, but were achieved overall. In general, the officer ranks were not as well represented as the other ranks.

Although the numbers of females examined were low, they in fact represented a high proportion of the total numbers and overall ranged between about 5 and 10%. Once again, however, the officers and in particular, the more senior officers, were not as well represented as the other ranks. This is probably due to the fact that the more senior ranks seemed reluctant to be measured.

In both sexes, most major occupational groups were sampled and although it was believed that any gaps in the sample would have little effect because of the large numbers involved, this could not be quantified.

It was thought that in general those males who were 'overweight' did not manage to avoid being subjects, and in fact were sometimes sought out specifically by those organising the flow of people. When attendance was voluntary, however, it was not possible to assess whether those who did not attend were different from those who did.

The situation was slightly different with the female subjects as they always had a far greater amount of choice about attending and many, although told to attend, did not. The sample may therefore have missed seeing many females who classed themselves as 'overweight'.

2.3. SUBJECT SELECTION FROM THE CIVILIAN POPULATION

2.3.1. Introduction

The aims of the civilian subjects were:

(a) To compare the anthropometric and social data from groups of civilians to data from similar groups in the Forces.

(b) To validate any results calculated on the Service population on a different population.

(c) To combine the 2 populations and thus increase the overall numbers, if they proved to be compatible.

Table 1

Methods used for Selecting the Services Sample

Method of Selection	MALES			FEMALES		
	Asked to attend*	Told to attend	Total	Asked to attend*	Told to attend	Total
(a)	-	988	988	-	46	46
(b) (i)	-	377	377	-	-	-
(b) (ii)	580	553	1133	29	-	29
(c)	8	90	98	-	28	28
(b) & (c) simultaneously	55	264	319	-	-	-
(d)	13	77	90	199	-	199
(e)	589	1624	2213	30	28	58
(f)	-	-	-	151	593	744
(g)	64	65	129	-	-	-
(h)	82	-	82	19	-	19
	1391	4038	5429	428	695	1123

* Approximate numbers only

KEY

(a) Classes under instruction, timetables to be measured as 'convenient' subjects.

(b) (i) 16 year olds, selected to be measured on the basis of their age, because the sample was lacking in that group.

(b) (ii) Individuals over 25 years, selected to be measured on the basis of their age.

(c) Individuals selected on the basis of their trade, because the sample was lacking in that trade.

(d) Individuals from hospital staff and out-patients, when the survey was based at a hospital.

(e) Fairly random selection from all age, rank and occupational groups.

(f) Selected on the basis of sex only.

(g) Individuals selected because they were between 5ft and 5ft 3ins or 6ft and 6ft 3 ins

(h) Volunteers, i.e. staff, friends, wives etc

2.3.2. Companies Contacted

Large companies and organisations with bases in Glasgow or Edinburgh and often in other cities throughout the UK were contacted and their help was asked in providing male and female subjects from all age groups and jobs. About 70 companies/organisations were written to, and 11 agreed to help.

Scottish companies were chosen mainly because it was relatively easy to see large numbers of civilians in our home area and they could then be compared with Scots in the Forces. It was also thought, however, that their offices or branches throughout Britain could help to fill gaps in the geographical area sample, as shown in Tables 3 and 4. Those areas from which additional sampling was most needed were:

(a) London
(b) West Midlands
(c) Yorkshire and Humberside
(d) South-East England

This idea unfortunately proved to be impracticable in most cases because it would have necessitated covering long distances in order to see perhaps only 40 people in the small subsidiary branches. In order to sample from these areas, therefore, the Medical Officers of the Civil Service, DHSS and National Coal Board were contacted, and agreed to help with the survey.

2.3.3. Subject Selection at Individual Establishments

Once the decison was made to visit a company, a few posters advertising the project, together with a few hundred questionnaires, were sent to the contact person. It was then left to the company to publicise the project, recruit volunteers and organise their attendance when the research team arrived.

Specifications laid down by the research team, about the type of subjects they wished, were:

(a) Females of any age but with the emphasis on those under 35 years. The reason behind this specification was that

the overall sample was low in female numbers and especially those over 35 years. It was decided to concentrate on those under 35 years as it was believed that this group of the Services would be of more interest.

(b) Males under 55 years, but with the emphasis on those outwith the height range 165cm - 183cm. It was hoped that these civilians would fillup gaps in the height and age distributions of the overall male sample, if the Forces and civilian samples proved to be compatible.

(c) At some locations, particularly the Scottish ones, males under 35 years were requested, in order to make a comparison between them and a similarly matched Forces group.

As in the case of selecting individuals from the Services, these specifications were seldom strictly adhered to and those outside the limits were still included in the sample. The response from the civilians was completely voluntary.

2.3.4. Influence of the Investigators on the Sample

It was generally found that when there was a personal contact between one of the research team and a representative from the company being visited in order to settle various details before the visit, that company then tended to put more energy into recruiting volunteers. This was the case with the Banks, British Rail, D. Montgomery and Scottish Amicable in the Glasgow area, DHSS in London and the Civil Service in Worthing, West Sussex.

If the response rate was low when the research team arrived at a location, they increased the numbers by both personally canvassing for volunteers and asking volunteers to send along their friends. Individuals persuaded in this manner, however, did not constitute a large proportion of the civilian sample, probably only approximately 5-10%.

2.3.5. Differences between Volunteers and the Remainder

Although many volunteers were slim, many who were 'overweight' also volunteered. The main reason for volunteering appeared to

be:

1. A general interest in the survey
2. A few friends volunteered, and others followed on
3. A special interest in body composition and health, due to sporting interests or because the individual was weight-conscious

Many 'overweight' people fell into these categories, especially Category 3, and the research team gave each individual an estimated 'desirable' weight.

It was not possible to give a quantitative estimation of how volunteers differed from those who did not volunteer.

2.4. ETHNIC GROUP AND GEOGRAPHICAL AREA OF THE SUBJECTS INCLUDED IN THE FINAL ANALYSIS

Although all ethnic groups were measured, only data from white Caucasians were included in the statistical analysis. Ethnic group was determined from skin colour, surname, place of birth of parents. This methodology was adopted because there is some evidence that there are differences in body density, in the proportion of fat situated subcutaneously (Jones et al, 1977) and in fat distribution (Robson et al, 1971; Malina, 1966) between ethnic groups. It has been suggested, e.g. that Gurkhas may have higher bone densities than other Indian groups, that Indian populations when compared to Europeans may have about 15-20% more of their fat situated subcutaneously and that African, Asian and Caribbean children may have a greater proportion of their subcutaneous fat located on their trunk than on their limbs. There may also be differences in body proportions between ethnic groups, and since all these factors combined would influence any calculated percentage body fat values, it was considered to be more accurate if ethnic group variations were removed where possible.

2.5 GEOGRAPHICAL DISTRIBUTION OF THE FINAL SAMPLE

The geographical area for each subject was defined as follows:

"The county in which the individual spent the main part of his first ten years". If he moved between several sounties during the ten years, he was coded according to the country he lived in (e.g. England or Wales) or as just 'British' if he had lived in more than one country.

Countries were then grouped into regions, as defined by OPCS. Tables 2 and 3 give the percentage distribution of the total UK mainland population throughout these regions. These figures came from "OPCS 1979 Population Estimates, England and Wales", HMSO, and from the General Register Office for Scotland, figures as at June 1980. The total population was defined as "the population resident in England, Wales and Scotland, plus members of HM Forces serving outside England, Wales and Scotland, minus the Forces of other countries temporarily in England, Wales and Scotland". Some subjects also came from both Northern and Southern Ireland.

The table also shows the percentage distribution of both the Forces and civilian samples examined in this survey, but only those who were included in the statistical analysis. As mentioned in 2.4 some ethnic groups of small sample size were excluded from the analysis. Table 1 gives the Forces results only.

The geographical distribution of the total UK population, as shown in Tables 2 and 3, did not alter if the population were restricted to include only the age ranged examined in the present survey (i.e. 16 to 56 years for the Forces and 17 to 65 years for the civilians).

2.5.1 Male Samples

The forces sample showed a disproportionally large representation from Scotland and disproportionally small samples from London, the North-West, the West Midlands and the South-East. Most other regions were also slightly poorly represented. The civilian sample was also biased towards Scotland for reasons explained in Section 2.3, but an attempt was made to fill in some of the gaps in the total sample distribution and this therefore influenced which civilian companies were involved in the survey. The remainder of the civilian male sample therefore came mainly from Yorkshire

TABLE 2: GEOGRAPHICAL DISTRIBUTION OF THE UK POPULATION FORCES SAMPLE AND CIVILIAN SAMPLE EXPRESSED AS A %

MALES

POPULATION	EIRE	NORTHERN IRELAND	SCOTLAND	NORTH	YORKS & HUMBERSIDE	NORTH WEST	EAST MIDLANDS	WEST MIDLANDS	EAST ANGLIA	LONDON	SOUTH EAST	SOUTH WEST	WALES	OTHERS 1
TOTAL MAINLAND[2]														
UK POPULATION	-	-	9	7	9	12	7	10	3	13	19	8	5	-
FORCES SAMPLE	0.5	2	17	6	7	9.5	6	6	2	4.5	15	9	5	6.5
CIVILIAN SAMPLE	0.5	0.5	41	1.5	14.5	3	4	9	0.5	6.5	12	2	1.5	3.5
TOTAL SAMPLE	0.5	1.5	21	5.5	8	8.5	5.5	6.5	2	5	14.5	8	4.5	6

Male Forces Sample = 5,336 (subjects included in the statistical analysis only)

Male Civilian Sample = 1,054

Key: 1 'OTHERS' includes subjects from no single district but coded as English, Welsh or British

2 Total mainland UK population represents the population resident in Mainland UK plus members of HM Forces serving outside mainland UK, minus the Forces of other countries temporarily resident in the UK

Figures from OPCS population estimates for 1979 : Series PP1, No 4

TABLE 3: GEOGRAPHICAL DISTRIBUTION OF THE UK POPULATION FORCES SAMPLE AND CIVILIAN SAMPLE EXPRESSED AS A %

FEMALES

POPULATION	EIRE	NORTHERN IRELAND	SCOTLAND	NORTH	YORKS & HUMBERSIDE	NORTH WEST	EAST MIDLANDS	WEST MIDLANDS	EAST ANGLIA	LONDON	SOUTH EAST	SOUTH WEST	WALES	OTHERS [1]
TOTAL MAINLAND[2]														
UK POPULATION	-	-	9	6	9	12	7	10	3	13	18	8	5	-
FORCES SAMPLE	0.5	1	10	5	10	10	7	8	1.5	2.5	13.5	9.5	5	14
CIVILIAN SAMPLE	1	0.1	35	1.5	17	3.5	2	5	0.4	10,5	19	1	1	3
TOTAL SAMPLE	0.5	0.5	23	3	13.7	6.5	4.5	6.5	1	6.5	16.5	5	3	8.5

Female Forces Sample = 1,086 (subjects included in the statistical analysis only)

Female Civilian Sample = 1,170

Key: 1 'OTHERS' includes subjects from no single district, but coded as English, Welsh or British

2 Total Mainland UK population represents the population resident in Mainland UK plus members of HM Forces serving outside Mainland UK, minus the Forces of other countries temporarily resident in the UK

Figures from OPCS population estimates for 1979 : Series PP1, No 4

and Humberside, the West Midlands, London and the South-East.

The overall male sample was therefore over-representative of Scotland, 21% as opposed to 9% and under-representative of London, 5% as opposed to 13%. The South-East, West Midlands and North West were also obviously under-represented.

2.5.2. Female Samples

The main deficiencies in the Forces female sample, were the disproportionally small samples from London and the South East. The civilians were again over-sampled in Scotland, with the remainder of the sample coming mainly from Yorkshire and Humberside, the West Midlands, London and the South-East.

The overall female sample was over-representative of Scotland with 23% as opposed to 9%, and Yorkshire and Humberside with 13.7% as opposed to 9% in the general population. It was under-representative of most other regions, but in particular the North, the North-West and London.

These biases within the male and female samples were not considered to be of great importance since the geographical area analysis carried out showed only small differences in the anthropometric measurements between the regions (McKay FC, 1983).

2.6. ANTHROPOMETRY

2.6.1 Anthropometric Measurements

The anthropometric measurements taken are listed below. The four skinfolds were taken as described by Durnin and Rahaman (1967).

Measurements Taken

(a) Stature

(b) Weight

(c) Skinfolds: Biceps
Triceps
Supra-iliac
Sub-scapular

Four circumference measurements and four bone diameters were also recorded.

Stature

Each subject stood on the horizontal platform of the stadiometer with his heels together, stretching upwards to his fullest extent. His back was straight as possible against the vertical bar of the stadiometer and his Frankfort plane was checked to be horizontal. He was asked to 'take a deep breath' in order to make him stretch up, and the head-bar was then brought down on to his head. The subject's heels were always watched to make sure that he did not raise them. Readings were taken to the nearest mm.

Weight

Weighing was carried out with the subject clothed only in underwear or light sportswear. (For any other article of clothing worn, the weight was corrected by weighing the article and subtracting this from the initial weight obtained). Readings were taken to the nearest 0.1kg.

Skinfolds

The skinfolds were picked up between the thumb and forefinger and the caliper jaws applied to the skinfold site, approximately 1cm below the forefinger and thumb. The measurement was read two seconds after the full pressure of the caliper jaws was applied to the skinfold. Each reading was to the nearest 0.2mm.

Biceps

The skinfold was picked up in front of the relaxed arm, at the mid-point of the belly or the muscle. (This site was marked initially until the observers felt sufficiently competent at locating the exact site by eye alone).

Triceps

The skinfold was taken at the back of the relaxed arm, at the mid-point between the acromion process and the olecranon process. The measurement was taken at this mid-point, and directly in line with the two processes. (This site was marked on every subject).

Sub-scapular

The skinfold was picked up under the angle of the scapula, just below the tip of the inferior angle of the scapula, at an angle of about 45° to vertical, and with the fingers touching the bone.

Supra-iliac

This measurement was taken just above the iliac crest, on the mid-axillary line. (This site was initially marked, again until the observers felt competent at locating the exact site).

Each of these measurements was taken in triplicate and the mean, to the nearest mm, was recorded.

2.6.2 Reproducibility of Measurements

Various reproducibility studies were carried out in the following three areas:

1. Repeat measurements of various anthropometric measurements taken on 3 separate days on the same subject by one observer.

2. Reproducibility of measurements taken on the left and right hand sides of the body.

3. Reproducibility of the skinfold measurements between observers.

Skinfold Measurements

(i) The initial reproducibility study involved 1 observer, 8 male and 8 female subjects. The biceps, triceps, sub-scapular

and supra-iliac skinfolds were measured on all 16 subjects, on both sides of the body. On each of 2 subsequent days within the same week, these 8 skinfolds were repeated. The results showed in conclusion that:

(a) The most reproducible sites were the sub-scapular and triceps in males and females respectfully.

(b) The least reproducible sites were the supra-iliac and biceps, in males and females respectively.

(c) The skinfold measurements were equally reproducible on the right and left hand sides of the body.

(d) Repeat measurements taken by 1 observer on 1 side of the body, on 3 occasions, caused a mean variation in calculated fat content of about 1% fat in males and females. The maximum variation in any individual was about 2% for both sexes.

(ii) Comparisons were then made at each site between the 3 sets of measurements on each side of the body, analysing male and female subjects separately.

In both males and females there were no significant differences between the means on either side of the body, at the triceps and sub-scapular sites. With females there were also no significant differences at the supra-iliac site or in the total of the 4 skinfolds, although the males did show significant differences at the biceps site.

Although significant, these differences were usually small and at an individual level the maximum difference in 'Total Skinfolds' between the two sides was 8mm and 13mm in the females, represening differences in fat content of 2% and 3% respectively. These differences could be due to the experimental error in taking repeat measurements and possibly also to slight differences in actual fat distribution between the right and left hand sides of the body in some subjects.

It was concluded that because error variations were small, the skinfolds could be measured on either side of the body but care ought to be taken most especially in the supra-iliac site in males and biceps side in females.

(iii) Reproducibility of Skinfold Measurements between Observers

Through the survey the 2 observers checked each other's measurements by taking duplicate measurements. Initially, every 10th subject was duplicated but as the survey progressed and the precision became more constant, this was reduced to about every 50th subject.

Analysis of the differences between the measurements of the observers showed that the greatest range of differences was where 95% of the sample showed a difference between -5.4 to 6.2mm in the 'Total Skinfolds' as calculated by 2 observers. This corresponded to a maximum difference of less than 2% fat in 95% of subjects. Since the differences were not consistently in one direction, i.e. neither observer consistently produced higher results than the other, it was concluded that their measurement techniques were similar and their results were reproducible between each other.

2.7 EQUIPMENT

Throughout the survey the following equipment was used:

(a) Weighing machines: Salter Model 109 (floor model) and Brash Model 424 weighing machine. The Salter scales are spring scales with a carrying handle and transit lock and have a capacity of 150kg x 0.5kg. The Brash scales are portable pillar scales with moveable weights and a capacity of 160kg x 0.05kg. After every field trip, the scales used were checked with standard weights and recalibrated if necessary. Overall, the Salter scales were used more often since they proved more portable and the additional accuracy of the Brash scales was not required.

(b) Skinfold calipers: Holtain/Tanner-Whitehouse skinfold calipers were used. The pressure between the anvils of 10g $/mm^{-2}$ was checked using weights before each field trip. The weight calculated by multiplying the measured surface area in mm of the caliper jaw by 10, was hung by a thread to the caliper jaw. If the caliper pressure was correct, this weight held the jaws still at any opening distance. Errors of up to $\pm$ 2g $/mm^2$ were considered

tolerable.

The dial calibration was also checked using a set of standard, measured lengths and had to be accurate to + 0.1mm. If the calipers required repair they were sent back to Holtain Ltd. Range 0 to 48mm x 0.2mm. divisions.

2.8 QUESTIONNAIRE

Each subject was asked to fill out a questionnaire. The Forces questionnaire differed slightly from the civilian questionnaire in the 'Work Background' section. A copy of each is at Appendix B.

The questionnaire was divided into five sections:

(a) personal background
(b) work background
(c) smoking habits
(d) health factors
(e) exercise habits

As each individual was examined, the observer looked over the questionnaire checking that the question had been answered correctly, although occasionally some were left unanswered or incorrectly answered.

During the course of the survey the Forces questionnaire had four important changes made to it:

1. Question 3 was changed from 'Places of Residence over the 10 years previous to joining the Services' to 'Places of Residence over the first 15 years of your Life'. We wanted to know the county in which each subject had spent most of his childhood, and therefore the second version of the question was considered to be more accurate. Since most of the Forces personnel joined when still in their teens, however, their answers to the 2 versions of the question would in most cases be the same and therefore the 2 sets of answers were combined.

2. Question 24 changed from 'For how many months have you been carrying out this level of exercise?' to 'For how many months have you been carrying out this level of exercise/lack of exercise?' These two changes were made from male subject No. 854 and female subject No. 69.

3. Question 4 was added from Male subject No 857, Female subject No. 69.

4. Question 17 - the 5th answer box was changed from 'More than 20' to '21-25' cigarettes and an extra five possible answers were added. This change was made from Male subject No. 3174, Female subject No. 359.

The civilian questionnaire was unchanged throughout the survey.

2.9 ANALYSIS AND PROCESSING OF ANTHROPOMETRIC AND QUESTIONNAIRE DATA

2.9.1 General

The bulk of the analysis was carried out on an ICL 2976 computer belonging to Glasgow University. A Commodore Pet was used for statistical analysis involving less than about 100 subjects.

The information from each subject's completed questionnaire was coded and transferred on to a specially designed computer data sheet, as shown in Appendix C.

In order to keep the survey anonymous each subject was given a number which became Variable 1. The answers to the social information questions were coded and recorded as Variables 2 to 8 and 26 to 48 on sides 1 and 2 respectively of the data sheet. The anthropometric measurements from each subject were recorded on side 1 of the data sheet, as Variables 9 to 14 and 18 to 25. The sum of the four skinfolds was calculated by hand and entered as Variable 15. Using the equations of Durnin and Womersley (1974) a table was constructed which, by taking the $\log_{10}$ sum of the 4 skinfolds, gave a value for the percent of the body weight accounted for by fat (percent fat) for both males and females separately.

For each subject, both the addition of the skinfolds and calculation of percent fat from the table, were double checked by the observers. Fat-free mass (in kg), (FFM) which is (body weight-fat mass) was calculated by the computer. Percent fat and FFM became Variables 16 and 17 respectively.

Once all this information was on the computer sheet, it was punched on to computer cards, ready to be read into the 2976 computer. Where answers were missing or obviously incorrect a 'missing value' code was used and this answer was discounted from any analysis. A description of each of the 48 variables recorded is given in Appendix D.

The computer cards wre read into the computer, in batches of about 200 subjects at a time, and all the information on them was listed on one printout. This was then checked for blanks and incorrect subject numbering.

Using the programs P1D and P2D from the program package 'Biomedical Computer Programs' (BMPD), available on the ICL 2976, checks were then made for extreme values of any measured variable, and any obvious incorrect coding of the questionnaire.

The computer sheet from every 50th subject was also checked against the original questionnaire for incorrect coding and against the computer printout to 'spot check' that the information from the data sheets had been correctly punched on to the computer cards. Any errors found using any of these checks were corrected on the data file using the 2976 'ECCE' program which permits data manipulation.

Throughout the survey data analysis was carried out using both the BMDP package of programs and 'MINITAB', an interactive statistical package (Ryan, Joiner and Ryan, 1981). Minitab had the advantage that it was interactive while BMDP was not, but the disadvantage that it could not deal with all the data at once because of the very large volume of the data.

CHAPTER 3

RESULTS AND DISCUSSION

3.1 INTRODUCTION

This chapter is divided into 7 major sections as described below.

Section 3.2. is a general description and discussion of the anthropometric data from both the Forces and civilian samples.

Section 3.3 is a comparison of the civilian results with previous British civilian studies and a discussion of the general trends.

Section 3.4. is a comparison of the mean results between the 3 services - Army, Air Force and Navy samples.

Section 3.5. is a comparison in mean results between the Officers and Non-Commissioned Officers and Junior Ranks.

Section 3.6 is a discussion and comparison of the smoking habits of both the Forces and Civilian samples. It also discusses the effects of smoking on body composition.

Section 3.7 is a discussion and comparison of the exercise habits of both the Forces and Civilian Samples. It also discusses the effects of 'exercise on body composition'.

Section 3.8 is a discussion of the combined effects of both exercise and occupation on body composition for the Forces and civilian samples.

3.2 MEAN ANTHROPOMETRIC RESULTS : FORCES AND CIVILIANS

The mean values for height, weight, % fat and FFM were calculated within age groups for the Forces and civilian male and female samples. These results are presented in Tables 4 to 7 and are described below. A comparison between the Forces and civilian results is included.

Most groups and sub-groups had fairly large sample sizes but any with less than 10 subjects were not discussed in detail, since it was believed that this sample size was too small to draw any conclusions. Due to the low number of females over 35 years, only those between 17 and 34 years were described in detail.

3.2.1 Forces : Males (Table 4)

(a) Height

Mean height varied between 174.7cm and 176.5cm but there were no significant differences between the means of any two consecutive age groups over the age of 19 years. The 16 year olds, however, were significantly smaller than the 25-29 year olds at the 5% level of significance. These significant differences in height found between the younger age groups compared to the older age groups, were probably due to the fact that the younger age groups were still growing. As has been observed in many other cross-sectional studies (Montegriffo, 1968; Rosenbaum, 1954; Kemsley, 1952) there was a small, steady decrease in mean height with age after 29 years, except in the 45-49 age group. There have been many suggestions put forward to explain these observations. The ageing process involving stature is, presumably, the result of shrinkage or compression of the intervertebral discs, osteoporosis, increasing curvature of the spine (Milne and Lauder, 1974) and an inability to stand erect; these, however, operate mostly above the age of 60 years. Factors such as arthritic lipping to articular margins and appositional bone growth (Lasker, 1953) may contribute also to age changes in height.

Within this study the changes in mean height between 29 years and 49 years were almost insignificant, but the decrease within the 50-59 year group may have been influenced by the ageing process mentioned above. The secular changes in height which have occurred within the past 60 years may also have influenced the results.

(b) Weight

Mean weight increased by a total of 14.9kg throughout the age groups. Up until age group 30-34 years the increases between age groups were significant at the 0·1% level. Between the ages of 30 and 49 years mean weight continued to increase slightly despite some slight decrease in mean height between age groups. In this age range, however, the increases were no longer significant between any two consecutive age groups. Mean weight was seen to fall slightly to the oldest age group but again this was not a significant decrease. Since mean FFM was also seen to generally decrease from the 25-29 year age group onwards, the increase in weight from the same age group was due mainly to the increase seen in % body fat with age.

(c) % Fat

Mean % fat over all the age groups varied by approximately 14%. Up until age group 30-34 years, it increased significantly at the 0·1% level. Between the ages of 30 and 39 years it remained steady but increased significantly at the 99.9% level to 24.6% in the 40-44 year olds. The increase from the 40-44 year olds to the 45-49 year olds was not significant. It reached a maximum of 27.2% within the oldest age group and this 1.7% increase was significant at the 5% level.

(d) Fat-Free Mass

Mean FFM increased by 5.3kg from 56.5kg for the 16 year olds to 61.8kg for the 25-29 year olds. The increase between the first three youngest age groups was significant at the 0·1% level and probably influenced by the parallel height increases. The peak value in the 25-29 year group

was then followed by a decrease significant at the 0.1% level to 60.3kg for the 30-34 year olds.

Mean FFM remained steady in the 30's but fell significantly at the 99.9% level to 58.7kg for the 40-44 year olds. There were no significant differences between the age groups over 40 years. The mean FFM values for the 16 year olds and the 50-59 year olds were both significantly smaller at the 0.1% level than the mean FFM values of those aged between 20 and 39.

As with the changes in mean height, it is difficult to know whether these changes in FFM were of a cross-sectional or longitudinal nature.

3.2.2 Civilian : Males (Table 5)

(a) Height

Mean height throughout the age groups varied between the maximum value of 177.3cm to the minimum value of 174.3cm. There were no significant differences found between any of the age groups between 17 and 49 years. However, the mean height of the 50-64 year olds was significantly smaller than both the 20-24 year olds and the 25-29 year olds at the 0.1% level and significantly smaller than the 40-44 year olds at the 5% level of significance. The initial difference in mean height was again probably due to the fact that the youngest age group was still growing and the slight decrease from the age group 20-24 years was similar to the decrease found in the male Forces sample.

(b) Weight

Mean weight throughout the age groups increased by a total of 9.5kg. Over the first three age groups it increased significantly at the 5% and 1% levels from 65.9kg to 72.9kg and from age 25 and 49 years mean weight increased by another 3.5kg, but the increases between consecutive

age groups were not significant. It was then seen to fall slightly to the oldest age group but not significantly so. The initial increase seen was probably largely a reflection of the increase in mean height and therefore FFM. However, the further increases with age were not height related and most have reflected variations in body fat since both mean height and FFM were seen to decrease after the age of 29 years. Since mean % fat increased with age, the slight decrease in mean weight for the 50-64 year old males was due mainly to the significant decrease in mean FFM at this age.

(c) % Fat

Mean % body fat increased from 14.8% in the youngest age group to 26.8% in the oldest age group, a total increase of 12% for the male civilian sample. The increases found between age groups were significant at the 5% level and above, apart from the first two age groups and the 30-34 year olds and 35-39 year olds.

(d) Fat-Free Mass

Mean FFM increased by 4kg from the 17 year olds to the 29 year olds. This increase, which was found to be significant at the 5% level, was then followed by a significant decrease at the 1% level of approximately 1.5kg for the 30-34 year old age group. Mean FFM did not differ significantly until the oldest age group where it decreased again by 2kg to 55.1kg. As with the Forces data, these increases and decreases in mean FFM within age groups were influenced partly by changes seen in height with age.

3.2.3 Comparison of Male Forces and Male Civilian Results

The differences between the two samples in mean height ranged from 0cm to 1.4cm and were significant only in the 20-24 year old group. In this group the civilians were significantly taller than the Forces at the 5% level by an average 1.1cm. This peak in civilian mean height was, however, not significantly different

at the .5% level from the means in the civilian age groups on either side and therefore the difference was probably an unimportant artefact. Comparing mean weight there were significant differences at the 5% level and above between the two samples. Differences were found at all ages from 20 years upwards, ranging from 2.3kg to 4.4kg and the male Forces were consistently heavier than the civilians in all age groups. Differences in % fat varied from 0.1% to 1.2% between the two samples but were only significant at the 5% level in the 40-44 and 45-49 year old groups. The 20-24 year olds and the 30-34 year olds who had shown significant weight differences between the two samples at the 1% level did not show significantly different % fat values and mean fat mass varied by less than 1kg between the samples within these two age groups. The differences in FFM between the two sampled means varied between 1.6kg and 2.8kg and were significant in all age groups over 20 years at the 1% and 0·1% levels. The Forces had consistently higher mean FFM values than the civilians. Since it had been shown that these differences in FFM were not totally due to differences in height, they must have been due to differences in 'build' where 'build' reflects muscle and skeletal dimensions relative to height. Although the 17-19 year old Forces subjects also had a higher mean FFM than the civilians it was not significant at the .5% level. These fairly large differences in mean FFM, together with the slight differences in mean % fat were largely responsible for the significant differences found in mean weight between the male Forces and civilians.

3.2.4 Forces : Females (Table 6)

The average results from 1,085 females for height, weight, % fat and FFM in age groups are shown in Table 6.

(a) Height

Mean height varied between a maximum value of 164.1cm for the 20-29 year olds and a minimum value of 160.1cm for the 30-34 year olds. It increased significantly at the 5% level between the first two age groups, remained steady between the ages of 20-29 years and then decreased significantly to the 30-34 year old age group. This decrease in mean height made the 30-34 year olds significantly smaller at the 0.1% level than the three younger age groups, but the increase again in the older age groups suggest that the fall was due to a sampling error. The significant increase in height between the first two age groups was again as with the males, probably due to the fact that growth had not stopped.

(b) Weight

Mean weight did not rise steadily with age, as in the male sample, but varied between 58.7kg in the 30-34 year age group and 61.5kg in the 20-24 year age group. This difference mainly reflected the differences in height and FFM between the groups and was significant at the 5% level. Those females aged 35 years and over had an overall average weight of 65.3kg as opposed to 60.9kg in the 17-34 year age group. This suggests that in the female sample weight did tend to increase significantly with age and that the significantly smaller height, FFM and weight in the 30-34 year olds was probably an artefact of the sample.

(c) % Fat

Mean % body fat increased only slightly over the first four age groups from 28.0% to 29.7%. This increase in mean fat content was not completely smooth as is seen by

the slight decrease in the 25-29 year olds and 45-49 year olds. The latter decrease was probably artefact due to low numbers in the older age groups. The decrease in the 25-29 year olds, however, was significantly different at the 1% level from the 30-34 year olds and could possibly reflect the conscious efforts of these females to keep their fat content down. The average content of the 35-55year olds was 32.4% and of the 17-34 year olds was 28.0%. This rise in mean fat content with age was the main contributing factor to the increase in mean weight found between these two groups. These results suggest that while mean fat content in females does increase with age, it may be slightly delayed when compared to the rate of rise in the male sample because of the conscious efforts of these females to keep their weight down in keeping with present day social pressures.

(d) Fat-Free Mass

Mean FFM varied between 44.0kg in the 25-29 year olds and 41.1kg inthe 30-34 year olds. The three youngest age groups did not differ significantly amongst each other in their mean FFM values, but were significantly higher at the 1% level than the 30-34 year olds. This change is discussed further in a following section but as with the male results, it is difficult to determine whether this was a longitudinal or cross-sectional variation.

3.2.5 Civilian : Females (Table 7)

The average results from 1163 (16 year olds were excluded) civilian females for height, weight, % fat and FFM in age groups are shown in Table

(a) Height

Mean height throughout the age groups varied between the maximum value of 163.4cm and the minimum value of 160.7cm. There were no significant differences in mean height between the ages of 20 years and 49 years. However, mean height did increase significantly at the 5% level between the

17-19 year olds and the 20-24 year olds and also decreased significantly at the 5% level from the 45-49 year olds to the oldest age group, making the 50-64 year olds significantly smaller than all the other age groups, apart from the age group 35-39 years. As with the male results the difference between the first two age groups was probably due to an increase in growth and the decrease to the age related deterioration.

(b) Weight

Mean weight increased gradually throughout the age groups by a total of 7.5kg. The increase between consecutive age groups was found to be significant only between groups 17-19 years and 20-24 years. From theages of 17 to 34 years mean weight increased by approximately 2kg only compared to the 7kg increase for civilian males over this age range. Mean weight for the females then increased by approximately 5.5kg between the ages of 34 and 64 years. As with the males, the initial increase in mean weight with age was due mainly to the increase in mean height and latterly due to the increase in body fat with age. Compared to the male total weight gain of approximately 9kg this suggests that women have a tendency, especially between the ages of 17 and 34 years, to gain slightly less weight with age than men over a similar period. However, the reverse was seen in the age range 34-64 years in that civilian women gained more than the civilian men.

(c) % Fat

Mean % body fat increased from 25.2% for the 17-19 year olds to 35.7% for the oldest age group, a total increase of 10.5% for the female civilian sample. The increase in % fat was significant between decades and not within a decade. Again, there were seen to be an approximate increase of 3% body fat for each decade from the age of 20 years. The female civilians sampled between the ages of 17 and 34 years gained on average only 3.1% body fat, whereas the male civilians gained on average 5.8% over

the same age range. This again suggests that females in their earlier years are possibly more weight conscious than their male contempories and attempt to keep their weight down to the level of their early 20's.

(d) Fat-Free Mass

Mean FFM varied by approximately 3kg throughout the age groups and was seen to increase significantly at the 0.1% level, between the 17-19 year olds and the 20-24 year olds. Until age 49 years FFM remained fairly steady but then decreased significantly at the 1% level for the oldest age group. Again this rise and decrease found the mean FFM was probably partly a reflection of the variation in mean height with age.

3.2.6 Comparison of Female Forces and Female Civilian Results

The differences in mean height between the two samples were not significantly beyond the age of 30 years, probably because of the lower sample sizes beyond that age. The differences in mean height for the 17-29 year age groups ranged from 0.7cm to 1.7cm and were significant at the 5% level in the 25-29 year old group only. The female Forces means were greater than the civilian values, and the differences were of a slightly greater magnitude than those in the male results, despite their general lack of significance. The female Forces had larger average weights than the civilians at the 0.1% level, and the differences ranged from 4.2kg to 5.0kg. FFM could not account for all these differences and as was seen, they were due mainly to both FFM and fat mass variations between the two samples. The differences in mean % fat values were significant at the 0.1% level in the 17-19 year olds and 20-24 year olds. The Forces sample had the larger means and the differences ranged from 0.9% to 2.8% or about 1.7kg to 2.9kg and therefore accounted for about half the weight variation between the two samples.

For FFM, the Forces mean values were again greater than their civilian equivalents by values from 1.9kg to 2.3kg and were significantly different in all groups between 17-29 years at the 0.1% level.

The differences in mean height must have accounted for some or all of these FFM differences, especially in the 25-29 year group and therefore it was difficult to determine whether differences in 'build' existed between the two population samples.

MEAN RESULTS WITHIN AGE GROUPS FOR FORCES SAMPLE : MALES

TABLE 4

(Standard Deviation in Parenthesis)

n = 5331

AGE(Yrs)	n	HEIGHT (cm)	WEIGHT (kg)	FAT %	FFM (kg)
16	370	174.7 (6.5)	65.5 (7.8)	13.4 (3.1)	56.5 (5.8)
17-19	1,057	175.7 (6.8)	68.2 (9.0)	15.4 (4.0)	57.4 (6.1)
20-24	1,274	176.2 (6.9)	72.7 (10.0)	16.6 (4.6)	60.3 (6.4)
25-29	792	176.4 (7.2)	75.2 (11.3)	17.4 (4.6)	61.8 (7.3)
30-34	782	175.8 (6.4)	76.7 (10.5)	21.0 (3.8)	60.3 (6.5)
35-39	579	175.7 (6.6)	77.0 (10.6)	21.0 (3.7)	60.5 (6.8)
40-44	269	175.4 (6.7)	78.3 (11.1)	24.6 (4.6)	58.7 (6.4)
45-49	142	176.5 (6.3)	80.4 (10.1)	25.5 (4.4)	59.6 (6.0)
50-59	66	175.3 (7.2)	80.0 (12.7)	27.2 (5.3)	57.7 (6.6)

MEAN RESULTS WITHIN AGE GROUPS FOR CIVILIAN SAMPLE : MALES

TABLE 5

(Standard Deviation in Parenthesis)

n = 1053

AGE(Yrs)	n	HEIGHT (cm)	WEIGHT (kg)	FAT %	FFM)kg)
17-19	42	175.4 (6.6)	65.9 (10.4)	14.8 (3.2)	55.8 (6.8)
20-24	145	177.3 (6.1)	69.4 (8.7)	16.0 (3.9)	58.1 (5.8)
25-29	170	176.4 (6.6)	72.9 (10.6)	17.5 (4.2)	59.9 (6.9)
30-34	116	175.2 (6.1)	72.7 (10.3)	20.6 (3.8)	57.5 (6.7)
35-39	125	175.4 (7.5)	73.7 (10.4)	21.2 (3.8)	57.8 (6.6)
40-44	105	175.8 (5.9)	74.0 (12.1)	23.4 (4.7)	56.3 (7.0)
45-49	107	175.1 (6.7)	76.4 (10.6)	24.7 (4.3)	57.2 (6.1)
50-64	243	174.3 (7.0)	75.6 (9.5)	26.8 (4.7)	55.1 (5.5)

MEAN RESULTS WITHIN AGE GROUPS FOR FORCES SAMPLE : FEMALES

TABLE 6

(Standard Deviation in Parenthesis)

n = 1,086

AGE(Yrs)	n	HEIGHT (cm)	WEIGHT (kg)	FAT %	FFM)kg)
17-19	405	163.1 (6.1)	60.5 (8.1)	28.0 (4.0)	43.4 (4.5)
20-24	488	164.1 (6.9)	61.5 (8.8)	28.1 (4.6)	43.9 (4.7)
25-29	118	164.1 (6.9)	61.0 (9.7)	27.1 (5.2)	44.0 (5.1)
30-34	38	160.1 (5.1)	58.7 (7.5)	29.7 (3.6)	41.1 (4.0)
35-39	14	164.3 (6.3)	64.5 (8.3)	30.6 (3.8)	44.5 (4.2)
40-44	13	162.4 (6.2)	67.7 (14.1)	34.0 (5.9)	44.1 (6.5)
45-49	6	163.3 (11.8)	60.9 (7.1)	31.1 (3.4)	41.9 (4.5)
50-55	4	162.1 (3.9)	66.8 (8.6)	35.7 (3.8)	42.7 (3.2)

MEAN RESULTS WITHIN AGE GROUPS FOR CIVILIAN SAMPLE : FEMALES

TABLE 7

(Standard Deviation in Parenthesis)

n = 1163

AGE(Yrs)	n	HEIGHT (cm)	WEIGHT (kg)	FAT %	FFM)kg)
17-19	136	162.2 (5.6)	55.5 (7.1)	25.2 (3.9)	41.3 (3.9)
20-24	338	163.4 (5.9)	57.3 (7.6)	26.4 (4.4)	42.0 (4.0)
25-29	171	162.6 (5.8)	56.7 (7.4)	26.2 (4.0)	41.7 (4.5)
30-34	67	162.4 (6.6)	57.6 (8.9)	28.3 (4.0)	41.0 (5.8)
35-39	81	162.0 (6.9)	59.7 (10.3)	29.1 (3.7)	42.1 (5.8)
40-44	84	162.5 (6.9)	61.6 (10.0)	32.2 (4.0)	41.6 (5.8)
45-49	87	162.4 (6.1)	62.9 (9.6)	33.0 (3.8)	41.9 (4.9)
50-64	197	160.7 (6.3)	63.0 (10.0)	35.7 (4.0)	40.2 (4.9)

3.3 A COMPARISON OF CIVILIAN RESULTS WITH PREVIOUS BRITISH STUDIES

In this section the civilian male and female results (1982) for height and weight were compared with previous British anthropometric studies.

In order to determine which sample was more worthwhile to compare with previous studies both the Forces and civilian male and female samples were compared to a large scale height/weight study carried out by the Office of Population Censuses and Surveys in 1981.

Neither the civilian nor the OPCS (1981) results for both male and females were found to be consistently different from one another and therefore were in actual fact similar. There was a tendency for the Forces male and female sample to be on average slightly taller than both samples. In both male and female samples, within limited height and age groups, the Forces tended to be heavier than the civilians by on average about 3kg. The male OPCS (1981) had weights similar to but slightly lighter than the Forces sample, while the female OPCS (1981) results were about midway between the Forces and civilians.

Although a few of these differences could be accounted for by slight differences in the height distribution of the samples, most must have been due to differences in either the fat content or 'build' of the samples. Since the slight differences in height were not found to be related to geographical area it was therefore suggested that the Forces male personnel may represent a slightly different population than the OPCS (1981) sample. There were not sufficient numbers of female Forces over the age of 29 years to consider a comparison with previous studies.

It was therefore concluded that the civilian (1982) male and female sample's results were more representative of the present day heights and weights for the British population.

3.3.1 Studies Involved in Comparisons

There have been several anthropometric studies involving the British population which enabled the civilian results to be compared with the findings from two of these previous studies.

The studies of Kemsley (1943) and Montegriffo (1968) were chosen as these studies were able to be manipulated into similar age groups for easy comparison.

Kemsley produced data on the height and weight ofboth sexes from age 14, on the civil population from a wide range of industries in 1943. In total, 27,515 males and 33,562 females were measured. Each subject was measured wearing shoes and indoor clothing. Montegriffo studied a sample taken from the staff of the British Petroleum Company Limited serving in the London Office and overseas. Measurements were taken at the time of medical examination from the beginning of 1964 until the end of 1966. The total number studied was 7,385 males and 2,884 females and as far as possible only subjects of English, Scottish and Welsh parentage. In Montegriffo's study subjects were measured without shoes and in indoor clothing.

As mentioned before, the previous studies only measured height and weight and with subjects wearing indoor clothing. However, by making careful allowances as described, a general comparison was made.

3.3.2 Males

Tables 8 and 9 show a comparison of mean height and weight of the civilian male sample (1982) compared with the previous mean results of Kemsley and Montegriffo, aged between 16 and 59 years.

Height

From Table 8 it can be seen that mean height in the male civilian sample peaked at age 20-24 years followed by a general decrease in mean height by approximately 3cm over the older age groups. This decrease was similar to the previous findings of Kemsley and Montegriffo where the decline in mean height, between the

age groups 20-24 years and 50-59 years, was 3.4cm and 3.5cm respectively. Comparing mean height, within similar age groups, between the studies (Table 8) having made allowances for shoes, showed that the male civilians were, on average, 9.8cm taller for all the age groups than those of Kemsley and 3.2cm on average taller than the mean heights given by Montegriffo. Tanner (1981) showed a secular increase in mean height, i.e. the increase seen in mean height over generations, to be 1cm every decade. It could therefore be said that this secular increase is still in progress but that Tanner under-estimated it and that this comparison of past generations shows the secular increase in height to be nearer 2cm per decade.

Weight

Looking at the mean weight within age groups (Table 9) it can be seen that the findings of Kemsley differed from those of Montegriffo and civilians (1982). Mean weight in Kemsley's study increased up until age group 30-39 years only and was then followed by a slight decrease in mean weight for the last two age groups. This decrease was probably a reflection of the decrease in mean height with age. However, a different pattern for the trends in mean weight was seen for the two most recent studies. For both Montegriffo and the Civilian 1982 sample mean weight increased steadily throughout the age groups despite the parallel decrease in mean height after age group 20-24 years. Comparing the three studies within similar age groups across Table 9 , it can be seen that after having made allowances for clothing, the male civilian 1982 sample was, on average, 8.5kg heavier than the mean weights of Kemsley but this was partly a reflection of the differences in mean heights within similar age groups. However, the comparison of mean weight in similar age groups between the male civilian 1982 sample and that of Montegriffo's sample were surprising. It showed that the male civilians 1982 between the ages of 16 and 49 years were, on average, only 1kg heavier and that the oldest age group was actually lighter than the sample from 1968 despite the differences in mean height of approximately 3cm between the similar age groups. Analysis of weight gain with age for all three studies between the age groups of 20-24 years and 50-59 years showed that weight gain with age for

all three studies between the age groups of 20-24 years and 50-59 years showed that weight gain with age for Kemsley's study was only 1.6kg in total. However, in comparison to the total weight gain between similar age groups for Montegriffo's study of 9.4kg, this revealed an increase of 7.8kg for weight gain with age between 1943 and 1968, i.e. over 25 years. Fortunately, a similar rate of increase in weight gain with age was not found for the present day male civilian 1982 sample. Compared to Montegriffo's study there was in fact a slight decrease in weight gain of 0.9kg for the civilian sample between the age groups of 20-24 years and 50-59 years to a total of 6.9kg .

3.3.3 Females

Tables 10 and 11 show a comparison of mean height and weight of the civilian 1982 female sample compared with the previous mean results of Kemsley and Montegriffo, aged between 16-59 years.

Height

From Table 10 it can be seen that mean height in the female civilian 1982 sample was similar to the male civilian 1982 sample in that it also was seen to peak in the age group 20-24 years followed by a gradual decline in mean height of approximately 3cms in total over the older age groups. This was similar to the previous studies in that mean height for the females was seen to peak at the age group 20-24 years in both studies, followed by a total decrease of 3.5cm and 3cm with age for Montegriffo and Kemsley respectively. Comparing mean heights within similar age groups between the studies shows that, having made allowances for shoes the female civilians 1982 were on average 7.8cm taller than those of Kemsley and again on average 2.7cm taller than the mean heights of Montegriffo. As with the present day male results the continual or secular increase in height with time did appear to be in progress and at a similar pace for the females.

Weight

Mean weight (Table 11) in age groups for the three studies increased steadily despite the parallel decrease in mean height after age

group 20-24 years. This finding for Kemsley was not similar to his male sample where mean weight was seen to decrease slightly for the two oldest age groups. Comparing the three samples, within similar age groups between the studies, it can be seen that after having made allowances for clothing, the female civilians 1982 were on average 3kgm heavier than those of 1943 which again probably reflected the differences in mean height. The comparison of mean weight in age groups between Montegriffo and the civilians 1982 resembled the findings from the male comparison in that the present day females were again, on average, only approximately 1kg heavier than the female sample of 1968 despite the considerable differences in mean height between the two samples. Again, as with the male civilian 1982 sample despite the similar secular increase in mean height, there was not a comparable increase in mean weight for the civilians 1982. Looking at weight gain between the age groups 20-24 years and 50-59 years for all three studies showed similar findings. Total mean weight gain between these age groups for Kemsley was 5.9kg. Unlike the male comparison, an increase in mean weight gain between these age groups, over the period of 25 years between Kemsley's study and Montegriffo's study was not found. Mean weight gain between age groups 20-24 years and 50-59 years for both Montegriffo and the civilian 1982 female samples remained steady, being 6.2kg and 5.7kg respectively. It is also interesting to note that when analysing mean weight gain within the civilian 1982 sample, the pattern differs between the male and female samples. Between the age groups 20-24 years and 30-39 years mean weight gain for the female sample is only 1.4kg compared to the male sample where mean weight gain was 3.8kg between the similar age range.

It is difficult to state the reasons behind the findings for mean weight within age groups for the present day civilians. It could be argued that since the civilian 1982 sample was totally voluntary that the overweight or weight conscious subjects would not be included in the sample. Howeer, as mentioned previously, the researchers found that not to be the case since many overweight subjects volunteered out of curiosity as to what a 'personal ideal weight' would be. Although the civilian sample was not totally representative of Britain and was biased towards mainly Scotland, the Midlands and the South East areas, it was still

thought to be reflective of general trends. From the mean % body fat results within age groups (Tables 5 & 6) both present day males and females were, on average, above the proposed 'ideal' levels of fatness. From the analysis the jump seen in the mean weight gain with age between 1943 and the results of those of 1968 for males was very marked. A possible explanation for this marked increase in mean weight gain with age in Montegriffo's study could be a reflection of the times in 1943. Kemsley's measurements were recorded during food rationing, while in 1966 Britain was booming economically and mechanisation on the increase, resulting in an overfed, sedentary population. Therefore, Montegriffo's mean weights not only reflected the standard increase but also a correction factor for 'abnormally' low weights found in the prolonged food rationing period of the Second World War in 1939. Over the same 25 year period mean weight gain with age for the female sample was very similar in both the previous studies and did not increase with time. This suggests that women have over the past 40 years have been more weight conscious than men, particularly in their earlier years; this is probably due to social pressures. If mean weight gain with age for the male sample had continued at the same rate as it did between 1943 to 1968 then by 1982 we could have expected a mean weight gain between the age groups 20-24 years and 50-59 years of approximately 11kg for the present day males. However, this fortunately was not the case. Both present day male and female total mean weight gain with age were slightly less than the total mean weight gain with age found in Montegriffo's study in 1968.

This gain suggests the continual weight consciousness of females today but also that males too are becoming more aware of weight increase with advancing years. This optimistic trend found for weight gain with age may also be reflective of the public's increased awareness, via the media, of the ill effects of obesity and diet related illnesses. Although mean % body fat values for age are still too high, the increment for weight gain with age was found to have decreased compared to the findings in 1968. Hopefully the optimistic trend will continue and in years to come the increase in weight found with age will be comparable to that of the findings of 1943 when the incidences of obesity related diseases were considerably less than those of today.

Previous British Data in Comparison to Present Study

Mean Height in Age Groups: Males

Table 8

(Standard Error in Parenthesis)

HEIGHT (CM)

STUDIES	1943		1968		1982	
AGE GROUPS	n	* KEMSLEY	n	MONTEGRIFFO	n	CIVILIANS
16-19	5114	166.9 (0.1,0.2)x	1217	173.2 (0.2)	42	175.4 (1.0)
20-24	2363	170.0 (0.3)	1566	173.7 (0.2)	145	177.3 (0.5)
25-29	1962	169.4 (0.1)	1005	173.0 (0.2)	170	176.4 (0.5)
30-39	6553	169.2 (0.1)	1606	172.7 (0.1)	241	175.3 (0.4)
40-49	6085	167.5 (0.1)	730	171.7 (0.2)	212	175.4 (0.4)
50-59	3369	166.6 (0.1,0.2)x	161	170.2 (0.5)	202	174.5 (0.4)

* Plus shoes (allow 2.5cm)

x Two standard errors due to the combination of age groups for comparison

Previous British Data in Comparison to Present Study

Mean Weight in Age Groups: Males

Table 9

(Standard Error in Parenthesis)

WEIGHT (kg)

STUDIES	1943		1968		1982	
AGE GROUPS	n	*KEMSLEY	n	*MONTEGRIFFO	n	CIVILIANS
16–19	5114	59.1 (0.1,0.2) x	1217	67.3 (0.2)	42	65.9 (1.6)
20–24	2363	65.3 (0.2)	1566	70.1 (0.2)	145	69.4 (0.7)
25–29	1962	66.5 (0.2)	1005	73.4 (0.3)	170	72.9 (0.8)
30–39	6553	67.6 (0.1)	1606	74.6 (0.2)	241	73.2 (0.7)
40–49	6085	66.9 (0.1)	730	76.6 (0.3)	212	75.2 (0.8)
50–59	3369	66.9 (0.1,0.2) x	161	79.5 (0.3)	202	76.3 (0.6)
		1.6		9.4		6.9

* Weight includes indoor clothing (allow 2kg)

x Two standard errors due to the combination of age groups for comparison

Previous British Data in Comparison to Present Study

Mean Height in Age Groups: Females

Table 10

(Standard Error in Parenthesis)

HEIGHT (cm)

STUDIES	1943		1968		1982	
AGE GROUPS	n	*KEMSLEY	n	MONTEGRIFFO	n	CIVILIANS
16-19	6336	159.1 (0.1,0.2) x	984	160.3 (0.2)	136	162.2 (0.5)
20-24	6182	159.5 (0.2)	513	161.0 (0.2)	338	163.4 (0.3)
25-29	4241	159.0 (0.1)	367	160.5 (0.3)	171	162.6 (0.4)
30-39	7685	158.6 (0.1)	429	159.9 (0.3)	148	162.2 (0.4)
40-49	5544	157.6 (0.1)	306	158.7 (0.3)	173	162.4 (0.5)
50-55	2235	156.5 (0.2,0.3) x	203	156.5 (0.4)	178	160.6 (0.4) +

* Plus shoes (allow 4cm)

+ Age Range 50-59 yrs

x Two standard errors due to the combination of age groups for comparison

Previous British Data in Comparison to Present Study

Mean Weight in Age Groups: Females

Table 11

(Standard Error in Parenthesis)

WEIGHT (Kg)

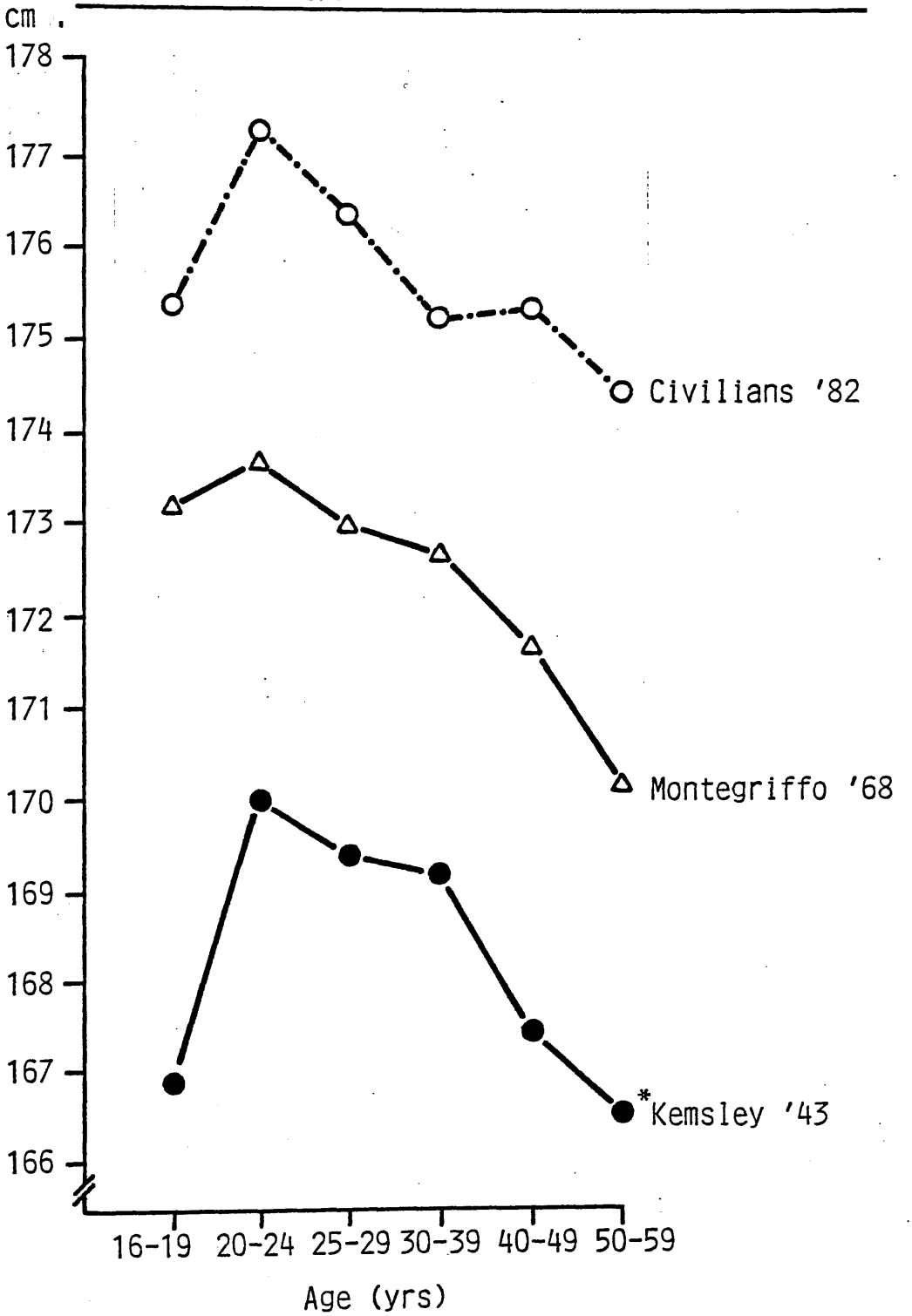
STUDIES	1943		1968		1982	
AGE GROUPS	n	*KEMSLEY	n	*MONTEGRIFFO	n	CIVILIANS
16–19	6336	54.8 (0.2)	984	56.2 (0.5)	136	55.5 (0.6)
20–24	6182	55.9 (0.2)	513	58.1 (0.7)	338	57.3 (0.4)
25–29	4241	56.1 (0.1)	367	58.5 (0.8)	171	56.7 (0.6)
30–39	7685	57.6 (0.1)	429	60.7 (0.9)	148	58.7 (0.7)
40–49	5544	60.4 (0.2)	306	62.4 (1.2)	173	62.2 (0.7)
50–55	2235	61.8 (0.3,0.5)[x]	203	64.3 (1.6)	178	63.0 (0.7)[+]

* Weight inoludes indoor clothing (allow 2kg)

[+] Age range 50- 59 yrs

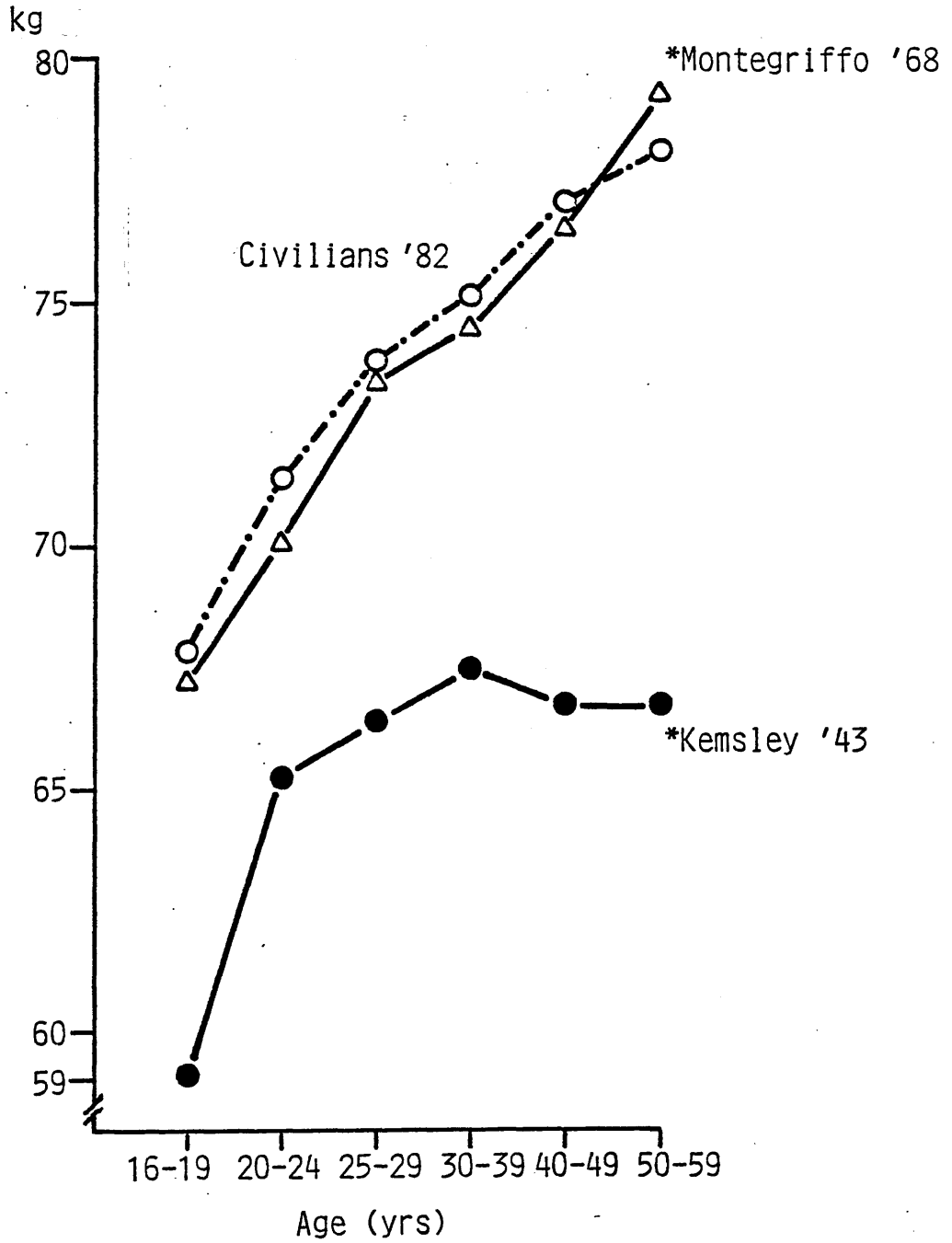
[x] Two standard errors due to the combination of age groups for comparison

Male mean heights within age groups
*Kemsley (1943)/Montegriffo (1968)/Forces (1981)/
Civilians (1982).



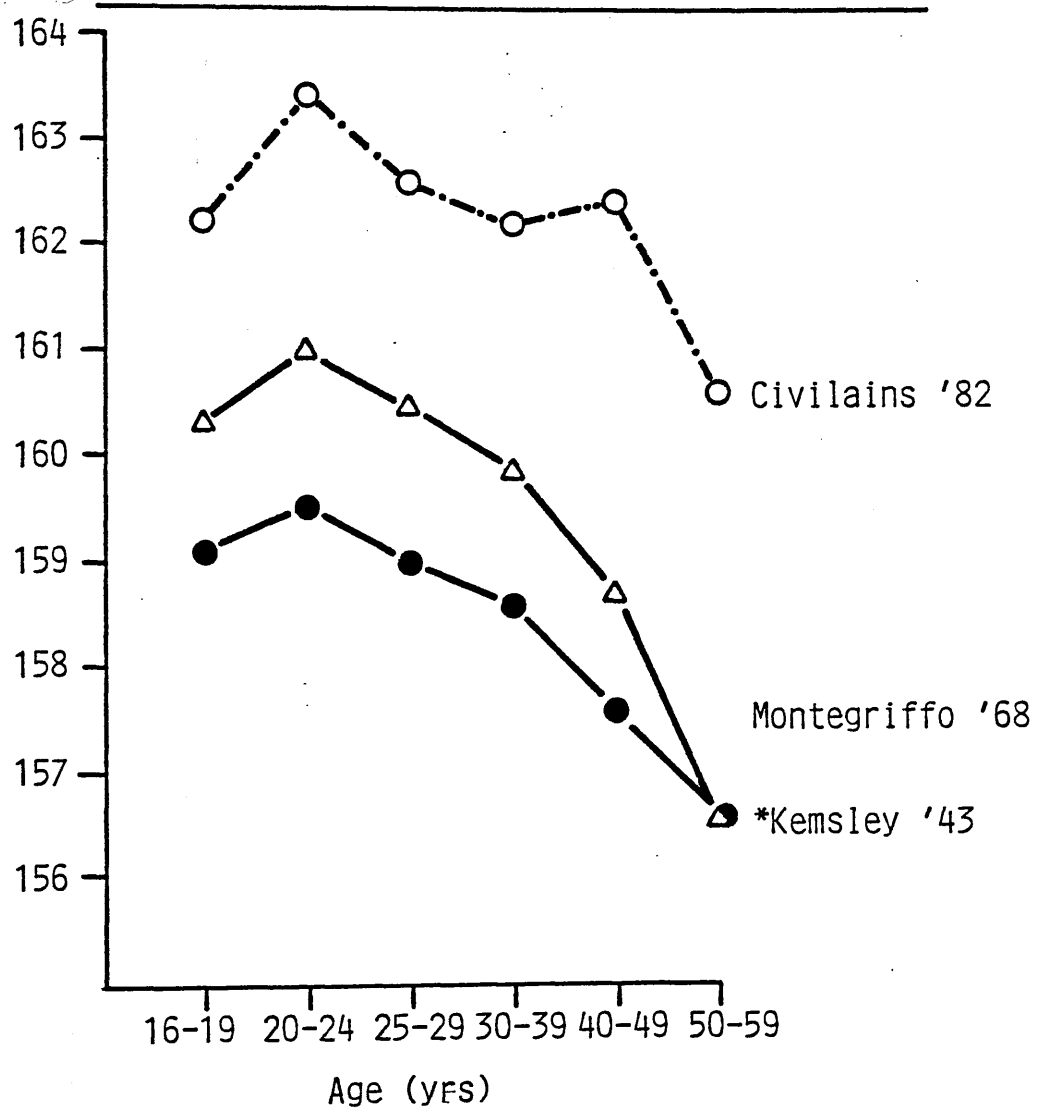
* Mean height includes shoes

Male mean weights in age groups
*Kemsley 1943/*Montegriffo 1968/ Civilians '82



* Mean weight includes indoor clothing

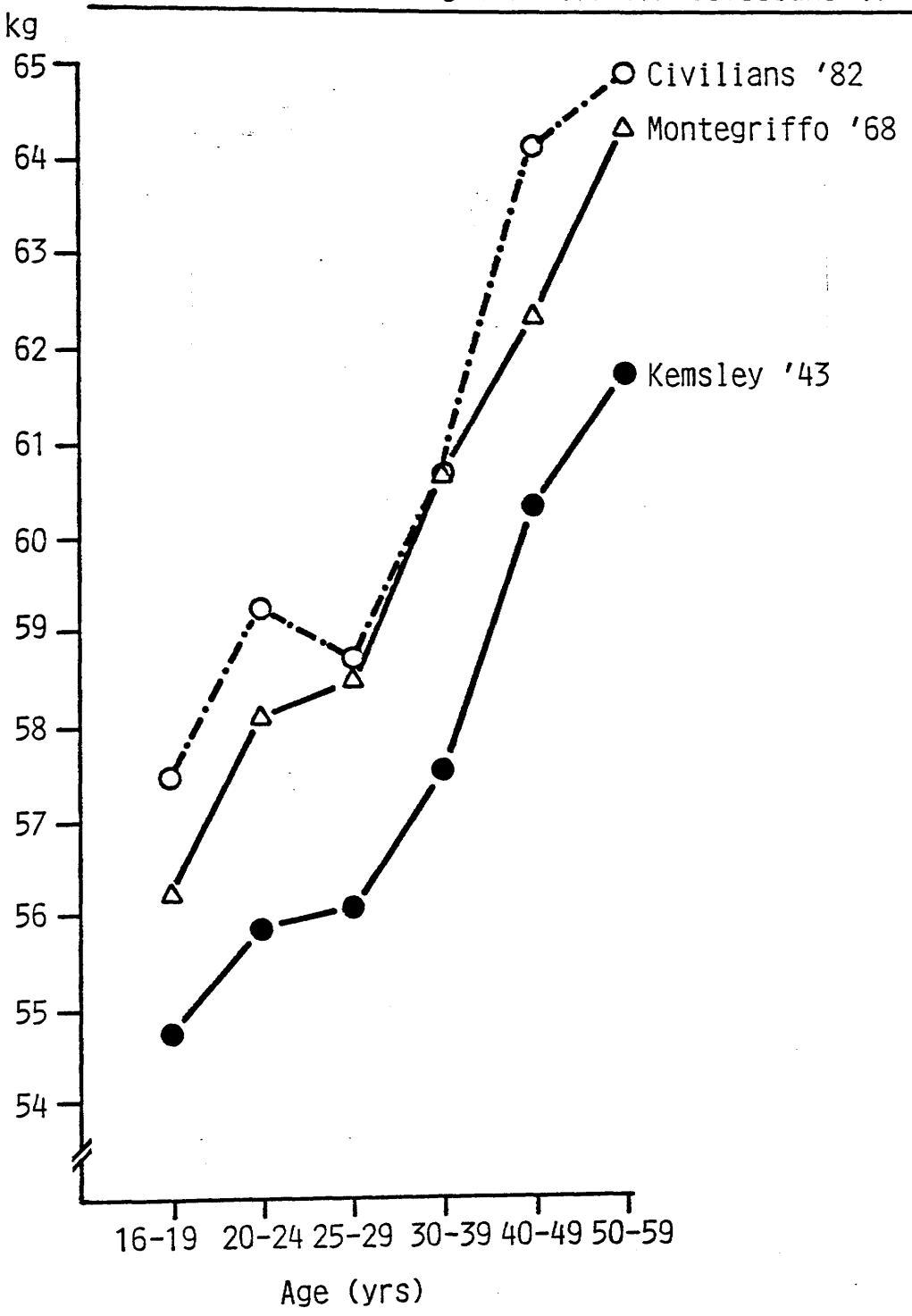
Female mean heights within age groups
*Kemsley (1943)/Montegriffo (1968)/Civilians (1982)



* Mean height includes shoes.

GRAPH 4

Female mean weights within age groups
*Kemsley (1943)/*Montegriffo (1968)/ Civilians (1982)



*Mean weights includes indoor clothing

3.4 COMPARISON OF MEAN RESULTS FOR ARMY, RAF AND NAVY

Tables 12 and 13 show the overall mean values for height, weight, % fat and fat free mass for both males and females in all three individual Services.

(a) Males (Table 12)

The male mean values for height are not significantly different between the navy and the RAF. However, the mean height for the Army is significantly smaller than that of the navy and RAF, both at the 1% level. the values for mean weight were within approximately 2kg of one another but all three were significantly different from one another. The army are the lightest and are significantly lighter than the navy and RAF, at the 0·1% level and 5% level respectively. This is then followed by the RAF being at the 0·1% level, lighter than the navy. Looking at % fat between the Services shows that overall the army are also the leanest. In comparison the army have less body fat than the navy and RAF, both at the 0·1% level of significance. The navy have the highest level of mean % fat and again are significantly fatter than the army and RAF, also at the 0·1% level of significance. Finally, it can be seen that FFM varies by less than 1kg between the individual Services. However, it was shown that the navy having the highest mean value for FFM was significantly different from both the army and RAF at the 5% and 0·1% levels respectively. Although the mean value for FFM was slightly higher for the army, compared to the RAF, this difference was not found to be significant.

(b) Females (Table 13)

The female mean values for height varied by approximately 0.5cm and the differences in height between the Services was not found to be significant. Mean weight again varied very little this time by about 1kg between the Services. The WRAC were found to be the heaviest and the WRAF the lightest but not significantly so. Looking at % body fat amongst the Services show that the WRNS also had the highest mean value and this proved to be significantly higher than the mean WRAC value at the 1% level and higher than the WRAF value at the 0·1% level.

Finally, as with males, the mean values for FFM only varied by about 1kg amongst the Services. The WRAC were found to have the highest mean value for FFM which was significantly higher than that of the navy at the 1% level but not significantly higher than the mean value for the WRAF. The WRNS had the lowest mean value for FFM but this was not found to be significantly less than the mean value for the WRAF but, as mentioned previously, was significantly lower than that of the WRAC mean FFM.

3.4.1 Comparison of the Mean Results for the Army, Airforce and Navy within Age Groups

Males

(a) Height (Table 14a)

There were few significant differences in mean height between the separate Forces. The main difference was that the RAF 16 year olds were significantly smaller at the 0·1% level than the army, but not the navy 16 year olds. The army age groups 17-19 years and 20-24 years were then found to be significantly smaller at the 5% level than the RAF equivalent groups. The 20-24 year olds in the army were also found to be smaller than the navy at the same level of significance. The army 40-44 year old age group were significantly smaller at the 5% level than the RAF and Navy. The results for the 16 year olds may well be affected by the low values for n in the RAF and the general tendency was for the army values to be slightly below the other two Services. This may largely have been a reflection on selection procedures in the Forces.

In the army, most regiments and corps stipulate minimum required heights of 60" (152.4cm) or 62" (157.5cm). The Household Cavalry and Footguards, however, have a minimum of 68" (172.7cm). The army sample included 249 males, i.e. approximately 16% from those regiments which would certainly effect the army mean height. Once the Household Cavalry and Footguards were excluded from the army sample, the mean height decreased from 175.4cm to 173.8cm.

The RAF also apply minimum height limits to certain occupations as described below:

(a) MT drivers : 157.5cm

(b) RAF policemen : 172.6cm

(c) RAF policewomen : 162.5cm

(d) Gunner: Age 17½ years : 163.5cm
Age 18 years : 165cm
Age 19 years and over : 166cm

(e) Firemen : Age 17½ years : 162.5cm
Age 18 years : 165cm
Age 19 years or over : 166cm

(f) Loadmasters: Between 157.5 and 190.5cm

About 200 males, i.e. approximately 10% of the RAF sample held these trades and therefore their mean height must have been influenced by these restrictions.

Royal Navy restrictions on height are 155cm for those aged 17½ years or less, 157.5cm up until 21 years and 160 cm for all those over 21 years of age.

Altogether, these height specifications probably had an influence on the height differences found within the three Forces, i.e. 175.4cm - army, 176cm - navy, and 176.1cm - RAF. Apart from the Guards and Household Cavalry the army selection was least orientated towards tall individuals therefore their mean height was the lowest of the three. The high baseline for the RN entrants and the relatively high minimum heights in the selected RAF trades pushed up both of their mean values for height.

(b) Weight (Table 14b)

Comparing mean values for weight for the separate Forces, there were no significant differences within the age groups 17 years to over 50 years. However, in the 16 year old age groups the army and navy were found to be significantly heavier, both at the 1% level, than the RAF. This result is reflecting the lower mean height and thus FFM in the RAF 16 year olds.

(c) Percent Fat (Table 14c)

Between the army and RAF samples, there were no significant differences at the 5% level in the percent fat values within the age groups, but the RAF means were slightly larger than the army means in 8 out of 9 groups, by an average of about 0.4% fat. Both the army and RAF 16-24 year olds had significantly less body fat at the 5% level than the equivalent navy age group. All these significant differences in fat content were fairly small, it should be noted, and ranged between 1.1% and 1.7% fat. Their overall consequences, therefore, would also be small. Beyond 29 years there were few differences between the fat contents of the three Services.

(d) FFM (Table 14d)

Below 39 years of age the mean FFM values in the army sample were larger than the other two Services,but these differences were significant only in the 16 year olds for all three Services and in the 30-34 year group between the army and RAF only. This result was fairly surprising considering that the army sample had tended to be the smallest and the possibility was that the army sample was the most largely 'built' of the three samples. The FFM differences were, however, small within the army, averaging only about 0.7kg more than the navy and RAF between 16 and 39 years. Beyond 39 years there was no obvious pattern of differences between the Services.

In conclusion, the three samples were very similar although the navy tended by a slight degree, to be the fattest. The army sample tended to be the smallest but again only by about 1cm and not in all age groups. Surprisingly, however, this sample also tended tohave the largest FFM values, suggesting slightly larger 'builds'.

3.4.2 Comparison of the Mean Results for the WRAC, WRAF and WRN within Age Groups

(This analysis was only carried out within the 16 to 34 year old age group because of the low sample size outwith this group).

Females

(a) Height (Table 16a)

There was no significant differences in mean height between the separate female Forces, when similar age groups were compared. There was also no obvious pattern with regards to which sample was tallest and which smallest. The maximum difference was 1.2cm.

(b) Weight (Table 16b)

As with height, there were no significant differences in mean weight amongst the separate Forces, and also no pattern from the largest to the smallest. Again the differences were small, ranging from 0.2kg to 2.2kg and they did not appear to be greatly influenced by height.

(c) Percent Fat (Table 16c)

In the first age group the 17-19 year olds the WRNS alone were significantly fatter than the WRAC and the WRAF at the 1% level of significance. For age groups 20-24 years and 25-29 years both the WRNS and the WRAC were significantly fatter than the WRAF at the 5% level. The WRNS were slightly fatter at age 30-34 years than the other two Services but this time the difference was not found to be significant. Overall, the WRNS were fatter than the WRAF and WRAC in all age groups but the maximum difference was only 2.3% fat.

(d) FFM (Table 16d)

The WRAC in the first two age groups had significantly higher mean FFM values at the 5% level when compared with the WRNS. There were no other significant differences in mean FFM amongst

the separate Forces samples and the differences ranged from 0.1kg to 1.5kg. Apart from fat content, there appeared to be no pattern within the other groups of measurements with regards tothe Services having the largest and smallest measurements.

3.4.3 Exercise Levels for Army, Airforce and Navy

Males

From the results of the questionnaire (Table 15) it can be seen that overall the army take more exercise than the RAF and navy (79% of the army exercise $\geqslant$ 2 week, compared to 58% for the RAF and 50% for the navy).

Within the Groups

In the army, 97% of the 16 year olds exercise $\geqslant$ 2 week. This figure gradually falls to 69% for the 40-44 year old age group. The percentage of those exercising $\geqslant$ 2 week was then found to drop to a level of 27% for the two oldest age groups.

In the RAF, 88% of the 16 year olds exercise $\geqslant$ 2 week. This figure decreased gradually to 56% for the 25-29 year age group. The percentage continued to fall gradually to again 27% of the oldest age group exercising $\geqslant$ 2 week.

However, in the navy sample onlly 63% of the 16 year olds exercised $\geqslant$ 2 week. The levels of exercise within age groups gradually decreased to 23% of the 45-49 year olds exercising $\geqslant$ 2 week. Those exercising $\geqslant$ 2 week were seen to increase for the navy 50-59 year olds but this was probably due to the low value of n. The levels of exercise within all but one of the navy age groups (30-34 year olds) were considerably less than those of both the army and RAF. The above exercise habits of the three Forces could possibly be an explanation for the higher levels of percent body fat found in the younger age groups of the navy.

Table 12

Forces Sample: Males

Mean Results within Each Service

	Mean Age	n	Height (cm)	Weight(kg)	Fat (%)	FFM (kg)
Army	24	1557	175.4 (0.2)	72.1 (0.3)	16.9 (0.1)	59.5 (0.2)
Navy	28	1750	176.0 (0.1)	74.4 (0.2)	19.0 (0.1)	59.9 (0.1)
RAF	27	2029	176.1 (0.1)	73.3 (0.2)	18.4 (0.1)	59.3 (0.1)

(Number in brackets = Standard Error of the Mean)

Table 13

Forces Sample: Females

Mean Results within Each Service

	Mean Age	n	Height(cm)	Weight(kg)	Fat (%)	FFM (kg)
WRAC	22	557	163.4 (0.3)	61.5 (0.4)	28.1 (0.2)	43.9 (0.2)
WRAF	21	329	163.6 (0.3)	60.6 (0.4)	27.8 (0.2)	43.5 (0.2)
WREN	22	200	163.9 (0.5)	60.9 (0.5)	29.1 (0.3)	43.0 (0.3)

(Number in brackets = Standard Error of the Mean)

Table 14a

Forces Sample: Males

Mean Results for Army, RAF and Navy

Height (cm)

Age	n	Army	n	RAF	n	Navy
16	285	174.9	47	173.4	38	175.0
17-19	298	174.9	526	176.0	233	175.8
20-24	356	175.5	433	176.5	485	176.5
25-29	191	175.9	293	176.8	309	176.3
30-34	198	176.1	292	175.6	292	175.7
35-39	146	175.8	203	175.9	230	175.4
40-44	60	173.7	110	175.8	99	175.8
45-49	11	176.8	83	176.1	48	177.3
50-59	11	175.4	42	175.4	13	174.9

Table 14b

Weight (kg)

Age	Army	RAF	Navy
16	65.7	62.4	67.7
17-19	68.2	68.2	68.2
20-24	72.5	72.4	73.1
25-29	75.1	75.0	75.5
30-34	77.3	76.2	76.8
35-39	77.2	77.0	76.8
40-44	76.8	79.0	78.4
45-49	80.3	79.7	81.5
50-59	80.5	79.8	80.1

Table 14c

Forces Sample: Males

Mean Results for Army, RAF and Navy

% Fat

Age	Army	RAF	Navy
16	13.0	13.2	16.7
17-19	15.0	15.3	16.2
20-24	16.0	16.4	17.2
25-29	16.8	17.3	17.7
30-34	20.7	21.1	21.1
35-39	20.8	21.2	21.0
40-44	24.0	24.9	24.5
45-49	26.9	25.4	25.4
50-59	27.2	27.4	26.5

Table 14d

FFM (kg)

Age	Army	RAF	Navy
16	57.0	54.1	56.2
17-19	57.8	57.5	56.9
20-24	60.6	60.2	60.3
25-29	62.1	61.6	61.7
30-34	61.0	59.8	60.3
35-39	60.9	60.4	60.4
40-44	58.0	58.9	58.8
45-49	58.4	59.2	60.5
50-59	58.2	57.4	58.5

PERCENTAGE DISTRIBUTION OF MALES WITHIN EACH ACTIVITY GROUP

	≥ 2/WEEK		< 2/WEEK		
Exercise / Unit	Daily	2/Week	2/Week	Occ/ Never	Total
ARMY	23%	56%	11%	10%	100%
RAF	14%	44%	14%	28%	100%
NAVY	18%	32%	19%	31%	100%

PERCENTAGE WITHIN EACH AGE GROUP WHO EXERCISE TWICE A WEEK OR MORE

AGE GROUPS	EXERCISE ≥ 2/WEEK		
	ARMY	RAF	NAVY
16	97%	88%	63%
17-19	88%	74%	59%
20-24	76%	75%	59%
25-29	71%	56%	50%
30-34	71%	41%	49%
35-39	70%	47%	35%
40-44	69%	32%	30%
45-49	27% *	37%	23%
50-59	27% *	27%	46% *

* n = 15

Table 16a

Forces Sample: Females

Mean Results for WRAC, WRAF and WRNS

Height (cm)

Age	n	WRAC	n	WRAF	n	WRNS
17-19	232	162.9	127	163.2	43	164.1
20-24	215	163.9	157	164.2	116	164.3
25-29	64	164.5	28	164.0	25	163.5
30-34*	21	160.6	5	160.5	11	159.3
35-39*	8	165.5	4	160.0	2	168.4
40-44*	7	162.5	3	162.8	3	161.7
45-49*	6	163.3	-	-	-	-
50-55*	3	163.3	1	156.2	-	-

Table 16b

Weight (kg)

Age	WRAC	WRAF	WRNS
17-19	60.9	60.0	60.2
20-24	62.4	60.7	60.9
25-29	60.4	61.7	61.9
30-34	57.8	60.0	59.7
35-39	65.2	64.0	62.3
40-44	68.3	67.2	67.0
45-49	60.9	-	-
50-55	67.6	74.8	-

* $n < 25$

Table 16c

Forces Sample: Females

Mean Results for WRAC, WRAF and WRNS

% Fat

Age	WRAC	WRAF	WRNS
17-19	27.8	27.8	29.7
20-24	28.4	27.4	28.6
25-29	25.8	28.5	28.6
30-34	28.9	29.6	31.2
35-39*	30.8	31.7	27.8
40-44*	34.2	34.7	33.0
45-49*	31.1	-	-
50-55*	36.3	38.5	-

Table 16d

FFM (kg)

Age	WRAC	WRAF	WRNS
17-19	43.7	43.1	42.2
20-24	44.3	43.8	43.2
25-29	44.1	43.9	44.0
30-34	40.8	42.1	40.9
35-39	44.8	43.7	44.9
40-44	44.0	43.5	44.7
45-49	41.9	-	-
50-55	42.8	46.0	-

* $n < 25$

3.5 A COMPARISON OF OFFICERS WITH NON-COMMISSIONED OFFICERS AND JUNIOR RANKS (ORS)

3.5.1 Males

The mean results for height, weight, percent fat and FFM within age groups were calculated for the Officers and other ranks (ORS). In this context, ORS represents all non-commissioned ranks.

A comparison was made between the two groups to detect any significant differences that may have existed (Tables 17a-d).

Looking at the results for mean height first of all, it can be seen that both samples reached their maximum mean height around their mid/late twenties. Following this, there appeared to be a non-significant and very gradual decrease of maximum magnitude (1.8cm for both groups). In every age group, excluding the 50-59 year olds at the 5% level of significance or above, the officers were significantly taller than the ORS by an average of 2.5cm.

Mean weight steadily increased by a total of approximately 11kg through the age groups in both samples, but in no age group was the difference in mean weight between the two groups significant. The Officers were on average 0.7kg heaver than the ORS.

Mean percent fat also increased steadily with age for both samples and when a comparison was made between those over the age of 30 years, the mean percent fat values were similar. Within the age groups 20-24 years and the 25-29 years, however, the ORS had significantly higher means for percent body fat than the Officers at the 0·1% and 5% levels respectively. Overall, the age groups the ORS had mean fat contents on average 0.4% greater than the Officers.

Mean FFM peaked at age 25-29 years in both samples and this was followed by a gradual decrease with age. This pattern of changes was discussed more fully in section 3.2.8. Within every age group the Officers had a slightly higher mean FFM than the ORS, the difference averaging about 1.1kg between the FFM figures in the two samples.

Overall therefore, although the Officers were on average 2.5cm taller than the ORS, their weights were not significantly greater and this was at least partly a reflection of the slightly lower fat content in the Officers. The differences in height were nevertheless reflected in the mean difference of 1.1kg between the FFM figures in the two samples.

It was not possible from these data to assess whether there were any differences in 'build' between the two samples and, in order to examine this point, a comparison was made between the two groups in height groups (Tables 18a-c).

The subject numbers were unfortunately not large enough to permit grouping by both age and height and therefore, in order to keep the mean age in each height group about constant, the junior ranks were removed from this comparison and Officers and NCO's only were compared. The mean ages within the height groups and the two samples were then within the range of 33 to 35 years.

Table 18 (a) to (c) compare the mean results for weight, percent fat and FFM within five height groups. From this table of similar mean heights and ages, the differences in body compositions between the two groups became clear. Within each height range the mean heights between the two samples were very similar and varied by a maximum of 0.2cm.

Table 18 (a) shows that in every height group analysed the NCO's were on average 2kg heavier than the Officer sample and significantly heavier at the 5% level for the height range 170-179 cm. It can also be seen that the NCO's were in every height range slightly fatter, the average difference being 0.7% fat. The NCO's also had a higher mean FFM than the Officers, the mean difference being 1kg. The difference in body fat was significant at the 95% level for the height group (175-179cm) and mean FFM was slightly different again at the 5% level for the height groups 170-174cm and 185-189cm.

These results are interesting and they again show the Officers have a slightly lower fat content than the NCO's. If the junior ranks had also been missed out in the initial age group analysis

those results on differences in percent fat between the two samples would not have changed greatly since, being on average younger, the junior ranks accounted for most of the younger groups and the NCO's most of the older age groups. Removing the junior ranks in this height group analysis increased the percent fat differences slightly because they were on average less fat than the NCO's.

The higher FFM in the NCO's was a reverse of the situation found within age groups and suggests that the NCO's were slightly more largely 'built' than the Officers, i.e. had larger muscle and skeletal masses. The probable reason for the Officers having the larger FFM values within age group analysis was because of their larger mean height. It cannot be assessed exactly from these data whether the junior ranks also had 'builds' which were larger than the Officers, but these junior ranks accounted for most of the youngest two age groups and the differences in mean FFM between the Officers and ORS were larger for these two groups, (about 2kg on average) compared to the difference between the other age groups, although the height differences were much the same. This suggests that if there was a difference within these ranks, it was not so large.

One possible reason for the difference in mean height between the Officers and ORS is that it may be partly a Social Class effect. Although social class groupings are generally not considered to be appropriate in the Forces, the Officers are likely to be equivalent to Social Classes I and II and the ORS a mixture of all Social Class. A social class effect on mean height was demonstrated, with the higher social classes being on average taller. There was also a tendency for the lower social classes to be slightly fatter which may explain the slightly higher mean fat content in the non-officer ranks.

The earlier studies, however, did not demonstrate a height independent social class effect on FFM and therefore some other factor must have caused the slight and often non-significant differences between the samples. Exercise habits, as shown in Tables 19a-c, were very similar between the two groups and were unlikely to cause any differences in FFM. The effect of occupations on body

composition may partly explain the slight difference in FFM between the Officers and NCO's. Both samples had approximately 2% of subjects who had definite active jobs (Appendix E). However, the numbers found for subjects with definite sedentary jobs (Appendix E) was approximately 39% for the Officer sample, compared to approximately only 10% for the NCO's. The possible effects of occupation on body composition are discussed in detail in a later section. However, it was found that within age groups, those subjects with sedentary occupations did have slightly lower values for mean FFM than those with active occupations. The initial training given to recruits may also help to produce higher mean values within height ranges for FFM for the NCO's. Physical exercise has also been shown in a later section to produce and maintain slightly higher mean values for FFM.

3.5.2 Females

The mean results for height, weight, percent fat and FFM were compared between the Officers and ORS of all three services combined, in order to detect any significant differences between the two groups. Due to the low values for n found in some the female age groups, only those aged between 17 and 34 years have been described in this discussion (Table 20).

Although the majority of the mean values within this age range were not significantly different between the two samples, the Officers were marginally taller and less fat than the ORS. The only significant difference was mean weight between the 25-29 year olds, where the ORS were significantly heavier than the Officers at the 5% level of significance. Looking at mean FFM and percent fat values it can be seen that this significant difference was due both to the ORS having a higher mean percent fat content within this age group, and also a slightly larger mean FFM. Within the other two age groups, nevertheless, mean FFM was the same between the two samples.

The social class analysis showed only a very slight tendency for the higher social classes to be taller than the lower ones, which may have accounted for the slight height difference between the two samples. No other social class effects had been noted however.

MEAN RESULTS FOR FORCES SAMPLE : MALES

A Comparison of Officers with Non-Commissioned Officers and Junior Ranks

NO. OF SUBJECTS

AGE	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50-55
OFFICERS	17	78	91	99	104	75	52	27
NCOS/JRS	1040	1196	701	682	495	194	90	39

MEAN HEIGHT (CM)

Table 17a

AGE	OFFICERS	ORS	LEVEL OF SIGNIFICANCE
17-19	178.1	175.6	***
20-24	178.0	176.1	*
25-29	178.6	176.1	***
30-34	178.5	175.4	***
35-39	177.8	175.2	***
40-44	178.5	174.5	***
45-49	178.3	175.5	**
50-55	176.8	174.3	NS

MEAN WEIGHT (Kg)

Table 17b

AGE	OFFICERS	ORS	LEVEL OF SIGNIFICANCE
17-19	69.2	68.2	NS
20-24	73.4	72.7	NS
25-29	75.8	75.1	NS
30-34	77.6	76.5	NS
35-39	77.1	77.0	NS
40-44	78.9	78.0	NS
45-49	80.4	80.4	NS
50-55	80.1	79.9	NS

NS: NOT SIGNIFICANT * SIGNIFICANT AT THE 5% LEVEL
** SIGNIFICANT AT THE 1% LEVEL *** SIGNIFICANT AT THE 0.1% LEVEL

MEAN RESULTS FOR FORCES SAMPLE : MALES

A Comparison of Officers with Non-Commissioned Officers and Junior Ranks

NO. OF SUBJECTS

AGE	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50-55
OFFICERS	17	78	91	99	104	75	52	27
NCO'S/JRS	1,040	1,196	701	682	475	194	90	39

MEAN FAT (%) Table 17c

AGE	OFFICERS	ORS	LEVEL OF SIGNIFICANCE
17-19	15.3	15.4	NS
20-24	15.2	16.7	***
25-29	16.5	17.5	*
30-34	20.7	21.0	NS
35-39	20.7	21.1	NS
40-44	24.4	24.6	NS
45-49	24.7	26.0	NS
50-55	26.7	27.4	NS

MEAN FFM (KG) Table 17d

AGE	OFFICERS	ORS	LEVEL OF SIGNIFICANCE
17-19	58.4	57.4	NS
20-24	62.0	60.2	*
25-29	63.1	61.6	NS
30-34	61.3	60.1	NS
35-39	60.9	60.4	NS
40-44	59.4	58.4	NS
45-49	60.3	59.2	NS
50-55	58.2	57.4	NS

NS: NOT SIGNIFICANT * : SIGNIFICANT AT THE 5% LEVEL

: SIGNIFICANT AT THE 1% LEVEL * SIGNIFICANT AT THE 0.1% LEVEL

Comparison of Officers and NCO'S in Height Groups: Males

Mean Weight (kg)

Table 18 (a)

HEIGHT GP (cm)	OFFICERS n		NCO'S n		LEVEL OF SIGNIFICANCE
165-169	46	68.3	201	70.4	NS
170-174	111	71.9	436	73.9	*
175-179	174	76.2	426	78.1	*
180-184	134	80.0	287	81.6	NS
185-189	56	85.4	103	87.8	NS

Mean % Fat

Table 18(b)

HEIGHT GP(cm)	OFFICERS	NCO'S	LEVEL OF SIGNIFICANCE
165-169	19.9	21.0	NS
170-174	20.3	21.0	NS
175-179	20.2	21.2	*
180-184	19.9	20.7	NS
185-189	21.3	21.3	NS

Mean FFM (kg)

Table 18(c)

HEIGHT GP (cm)	OFFICERS	NCO'S	LEVEL OF SIGNIFICANCE
165-169	54.3	55.3	NS
170-174	57.1	58.1	*
175-179	60.5	61.3	NS
180-184	63.8	64.3	NS
185-189	66.8	68.7	*

Key: NS = Not Significant
* = Significant at the 5% level

Mean Age within each group: 33-35 years

Forces Males

Exercise Levels of Officers (All 3 Services)

Table 19a

15% Exercise Daily	21% Exercise <2/ week
37% Exercise >2/ week	27% Exercise Occ/Never

Within Age Groups

Table 19b

Age	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50-
Daily	12%	19%	14%	10%	15%	17%	17%	10%
>2/wk	65%	53%	49%	38%	33%	27%	8%	24%
<2/wk	18%	20%	18%	26%	22%	20%	23%	14%
Occ/Never	5%	8%	19%	26%	30%	36%	52%	52%

Exercise Levels of NCO's and O.Ranks (All 3 Services)

Table 19c

18% Exercise Daily	14% Exercise <2/ week
44% Exercise >2/ week	24% Exercise Occ/Never

Within Age Groups

Age	16	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50-59
Daily	16%	18%	21%	22%	17%	14%	11%	15%	8%
>2/wk	76%	56%	45%	34%	35%	34%	26%	20%	18%
<2/wk	4%	11%	14%	17%	19%	17%	15%	12%	13%
Occ/Never	4%	15%	20%	27%	29%	35%	48%	53%	61%

3.6 SMOKING HABITS AND BODY COMPOSITION

The possible limitation of these results should be pointed out at this stage, as with all social surveys the accuracy of the results depends largely on:

(a) the honesty and accuracy with which each subject answered the questions

(b) the clarity of questions asked and the resultant interpretation by each individual. However, as these limitations are likely to arise in any survey it was felt that the following results are reasonably representative of the social habits of the Forces and civilian samples.

Smokers - applies to people who smoke cigarettes only. It does not include pipe or cigar smokers.

3.6.1 Male Smoking Habits : Forces (1981)

Table 1 shows that within the total male Forces sample almost half (45%) smoked, 35% had never smoked and 20% had given up smoking.

Overall Smoking Habits - Table 21

45% Smoked	35% Never Smoked	20% Given Up

Table 22 describes the smoking habits of the male Forces sample within age groups. Between the ages of 16-44 years approximately 45% of each age group smoked. The percentage of the 45-59 year age group who currently smoked fell to approximately 33%. The decrease seen in the percentage of smokers in the oldest groups is probably due to the small sample size in this group where n=21.

Percentage in Age Groups Who Smoked - Table 22

Age(years)		Age(years)	
16-19	46%	35-39	45%
20-24	46%	40-44	43%
25-29	48%	45-49	31%
30-34	44%	50-59	35%

Analysis of what age groups tended to give up the smoking habit are shown in Table 23 below.

Percentage in Age Groups who had Given Up Smoking - Table 23

Age	16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-59
%	12%	12%	17%	30%	35%	35%	46%	35%

As age increased there was also a 'general increase' in the proportion of people who had stopped smoking (apart from the oldest age group within which the results are not likely to be accurate due to the small sample size). The figure increased from 12% in the 16-24 year range, to an encouraging 46% of the 45-49 year age group. Taken in parallel with the decrease in the proportion of the male Forces sample who had never smoked as age increased, this resulted in a fairly constant percentage who still smoked between the ages of 16 years and 44 years, and a slight fall in later years.

Further analysis of ex-smokers showed that almost half (49%) of the sample who had given up smoking, smoked between 16 and 26 cigarettes per day and could be termed as 'moderate smokers' (Table 24). The percentage who gave up smoking who were light smokers (16 cigarettes per day) were slightly less. However, the percentage of heavy smokers who had given up smoking was in comparison very small.

Past Levels of Cigarettes Smoked by Ex-Smokers - Table 24

Cigs/Day	5	6-15	16-26	27-30	31-40	40
Percent	14	28	49	4	4	1

Further analysis also showed that of the total 20% of the Forces male sample who had given up smoking, almost half the ex-smokers (48%) had stopped smoking within the five years preceding this survey (Table 27). Related to age groups it was shown that approximately 75% of the ex-smokers aged 16-24 years, approximately 40% of the 25-39 year olds and approximately 20% of the 40-59 year olds had given up smoking within those preceding 5 years.

It was of interest to examine the average number of cigarettes within each age group (Table 25). It can be seen that beyond 16 years of age more than 16 cigarettes per day was the most common degree of smoking. Between the ages of 16 years and 29 years the percentage within each age group who smoked over 16 cigarettes per day increased with age from 29% to 72%. It then increased slightly until age 49 years and finally fell to 57% of the 50-59 year olds smoking more than 16 cigarettes per day.

The decreased level in the amount of cigarettes smoked in the oldest age group could be due to the low value for n in this age group (n=21) but the lower frequency of heavy smokers in the young age groups was probably because these individuals had not been smoking for as many years. They had therefore not had time to 'build-up' to the higher levels of cigarettes smoked.

Cigarettes Smoked per Day - Table 25

Age (yrs)	5 Cigs	6-10 Cigs	11-15 Cigs	16-20 Cigs	20 Cigs
16	7%	28%	36%	23%	6%
17-19	5%	19%	29%	37%	10%
20-24	3%	9%	23%	40%	25%
25-29	4%	6%	18%	43%	29%
30-39	4%	9%	14%	36%	37%
40-49	3%	9%	12%	33%	43%
50-59	10%	19%	14%	38%	19%

Table 26 gives a description of the percentage within age groups of subjects who had never smoked.

Percentage in Age Groups who had Never Smoked - Table 26

Age	16-19	20-24	25-29	30-34	35-39	40-44	45-49	50-59
%	42%	42%	35%	26%	20%	22%	23%	30%

Because of the low sample size (n=21) the results in the 50-59 year age group will be ignored. The proportion of each age group who had never smoked decreased from 42% in the 16-24 year olds to only 23% in the 45-49 year age group. There was therefore a trend in the younger age groups not to start smoking while about 80% of those over 35 years had smoked at one time or another.

Percent Age Groups who had Given Up Smoking in the Previous 5 Years - Table 27

Age(yrs)		Age(yrs)	
16-19	82%	35-39	34%
20-24	71%	40-44	23%
25-29	53%	45-49	17%
30-34	42%	50-59	44%

In conclusion therefore it appeared to be the case among the male Forces sample that a large proportion of the younger age groups were tending not to start smoking while more of the older age groups had given up the habit. The final percent who still smoked, however, was fairly evently distributed through the age groups. These findings are hopefully a reflection of the results of anti-smoking campaigns over the past few years.

3.6.2 Description and Comparison of Male Smoking Habits : Civilians 1982

Table 28 shows the overall percentages of those who smoked, never smoked, never smoked and had 'given up' smoking for both the Forces and civilian male samples.

Overall Smoking Habits - Table 28

	Smoked	Never Smoked	Given Up
Forces 1981	45%	35%	20%
Civilians 1982	20%	49%	31%

From the above table it can be seen that only 20% of the male civilians, compared to 45% of the male Forces sample, still smoked. Slightly higher values were found for the male civilians who had never smoked and given up smoking, being 49% and 31% respectively. Overall therefore, the Forces sample were heavier smokers than the civilians.

Table 29 described the smoking habits of the male civilian sample within age groups and comparison of the figures with the male Forces results.

Percentage in Age Groups who Smoked - Table 29

Age (years)	Forces 1981	Civilians 1982
16-19	46%	19%
20-24	46%	21%
25-29	48%	17%
30-34	44%	20%
35-39	45%	23%
40-44	43%	22%
45-49	31%	21%
50-64*	35%	16%

* 50-59 for male Forces sample

Within each male civilian age group the percentage who smoked was roughly constant at around 20% but fell in the 50-64 age group. These figures were about half the male Forces sample.

Table 30 gives a description of the percentages within age groups of subjects who had never smoked within the male civilian sample. A comparison of the figures with the male Forces sample can also be seen.

Percentage in Age Groups who had Never Smoked - Table 30

Age (years)	Forces 1981	Civilians 1982
16-19	42%	57%
20-24	42%	55%
25-29	35%	65%
30-34	26%	47%
35-39	20%	54%
40-44	22%	40%
45-49	23%	54%
50-64	30%	35%

Like the male Forces sample, there was a gradual decrease (apart from age group 25-29) from 57% to 35%, in the percentage who had

never smoked, as age increased. However, the figures for the male civilian sample were slightly higher for the first two age groups and almost double those of the male Forces sample between the age groups 25-29 years and 45-49 years.

Percentage of Each Age Group who had Given Up Smoking - Table 31

Age (years)	Forces 1981	Civilians 1982
16-19	12%	24%
20-24	12%	24%
25-29	17%	18%
30-34	30%	33%
35-39	35%	34%
40-44	35%	38%
45-49	46%	36%
50-64	35%	49%

The pattern was approximately the same as that seen in the male Forces results. As age increased there was a tendency for a higher proportion of the sample to have given up smoking (Table 31).

Between the ages of 16 and 24 years twice as many of the male civilians had given up smoking compared to the male Forces. Thereafter however, the figures between the two samples were similar. Coupled with the proportion who had never started, the result again was a fairly even distribution of the smokers throughout all the age groups.

Analysis of those male civilian 'ex smokers' who had given up smoking in the preceding 5 years showed that 32% of the 'ex smokers' fell into this category (Table 32), and that the proportion of each age group was larger for the younger age groups. This figure of 32% was slightly less than the total figure of 48% of the Forces male sample but this difference was largely related to the higher proportion of young people in the Forces sample. Within age groups, apart from the 16-19 year olds and the 45-49 year olds, the civilians showed similar or slightly smaller proportions who had stopped smoking over the previous 5 years when compared to the Forces groups. There was therefore little difference between the two samples in this aspect.

Percent Within Age Groups who had Given Up Smoking in the Previous 5 Years - Table 32

Age (years)	Forces 1981	Civilians 1982
16-19	82%	100%
20-24	71%	67%
25-29	53%	31%
30-34	42%	39%
35-39	34%	34%
40-44	23%	20%
45-49	17%	28%
50-59	44%	23%

A comparison between the data of Khosla and Lowe (1971) and these male findings showed an interesting trend. Between the ages of 20 and 34 years approximately 54% of their male sample smoked, compared to approximately 46% of the Forces and 19% of the civilian male samples within this age group. Between the ages of 35 and 39 years approximately 64% smoked, compared to only approximately 39% of the Forces and 26% of the civilian male samples in this age range.

To summarise the male Forces and civilian results, it appeared within the samples examined that about twice as many of the male Forces compared to the civilians smoked and this was for most age groups. Both samples showed an increased trend for the younger age groups not to start smoking and although a larger proportion of the civilians had not started, the gap between the two populations appeared to be becoming smaller. In parallel with these, younger groups tending not to start the smoking habit increased age groups were giving up the smoking habit. Between the ages of 25 years and 44 years there was little difference in the figures between the two samples which again suggests that the gap between the male civilian and Forces smoking habits may be closing. There still appears to be a 'hard core' of 45% of the male Forces sample and 20% of the male civilian sample within the younger and older age groups who still begin and continue to smoke. Overall it appeared that the anti-smoking trend was more obvious in the civilian than the Forces sample.

3.6.3 Female Smoking Habits : Forces 1981

The following is a discussion of the 'smoking habits' of the female Forces. However, in many cases analysis for the older age groups was restricted due to the low numbers of volunteers. For this reason only the 17-34 year olds were discussed in detail.

Table 33 shows that a similar percentage of females to the males were smokers, although slightly more females had never smoked and only 11% of the total sample had 'given up'.

Overall Smoking Habits - Table 33

46% Smoked	42% Never Smoked	11% Given Up

Table 34 describes the smoking habits of the female Forces sample within age groups. On average, within the 17-34 age range about 40% of the females smoked. Beyong the 34 years the percent of each age group who smoked varied greatly but this was largely a reflection of the small sample size and therefore no importance can be put on these figures.

Percentage in Age Groups who Smoke - Table 34

Age(yrs)		Age(yrs)	
17-19	47%	*35-39	21%
20-24	47%	*40-44	61%
25-29	37%	*45-49	33%
30-34	42%	*55-59	50%

*n = < 15

Degree of Cigarettes Smoked: Table 35

Below the age of 24 years, less than 50% smoked over 15 cigarettes per day, but between 24 and 34 years on average about 60% smoked 16 or more each day. Again because of the low sample size the figures beyond 34 years were not analysed as they were not considered representative. Examination of the number of cigarettes smoked per day showed that, generally, this increased with age, as was the case in the male Forces sample.

Cigarettes Smoked Per Day - Table 35

Age(yrs)	5 Cigs	6-10 Cigs	11-15 Cigs	16-20 Cigs	20 Cigs
17-19	11%	27%	27%	26%	9%
20-24	7%	18%	29%	29%	17%
25-29	10%	16%	16%	35%	23%
30-34	12%	12%	12%	39%	25%

Table 36 gives a description of the percentages within age groups of subjects who had never smoked.

Percentage in Age Groups who had Never Smoked - Table 36

Age	17-19	20-24	25-29	30-34
%	45	40	50	45

The proportion of each age group who had never smoked remained similar throughout age groups and in each case almost half the female sample had never smoked.

The analysis into what female age groups were giving up the smoking habit is shown below in Table 37.

Percent in Age Groups who had Given Up Smoking - Table 37

Age	17-19	20-24	25-29	30-34
%	8	13	11	36

As can be seen the lowest percentage is again seen in the youngest age group. The sudden jump to 36% of the 30-34 year olds who have given up smoking is probably an over-estimation due to the small number of subjects in this age group.

In conclusion, it is difficult to note the general changes which are occurring in the younger female age groups in comparison to the older age groups due to the low numbers in the latter categories.

The overall percentages within age groups are quite similar throughout the age groups 17-34 years. However, like the male Forces, the older age groups did have slightly higher percentages for those subjects who had given up smoking. Since the percentages in the younger females who had never smoked are similar to those seen in the male Forces sample, it could be assumed that the anti-smoking campaigns are affecting females in a positive way as well as the males.

3.6.4 Description and Comparison of Female Smoking Habits : Civilians 1982

Table 38 shows the overall percentages of those who smoked, never smoked, and had 'given up' smoking for both the Forces and civilian female samples.

Overall Smoking Habits - Table 38

	Smoked	Never Smoked	Given Up
Forces 1981	46%	43%	11%
Civilians 1982	26%	56%	18%

The above table shows that 26% of the female sample smoked compared to 46% of the Forces female sample, which again is almost half that of the Force sample. More than half (56%) of the female civilians had never smoked and 18% had given up smoking. This shows that again the civilians are lighter smokers than the Forces. However, it does also shows that slightly more female civilians smoked compared to the male civilians sampled.

Table 39 describes the smoking habits of the female civilian sample within age groups and a comparison of the figures with the female Forces results.

Percentage in Age Groups who Smoked - Table 39

Age (years)	Forces 1981	Civilians 1982
16-19	47%	21%
20-24	47%	23%
25-29	37%	25%
30-34	42%	22%
35-39	*21%	26%
40-44	*61%	28%
45-49	*33%	32%
50-64	*50%	23%

*n = 15

Within each female civilian age group who smoked the percentage increased slightly with age, apart from age group 30-34 years. Compared to the female Forces it can be seen that apart from age group 25-29 years, the civilian figures were again about half those of the Forces. This time the female civilians, within age groups can be seen to smoke on average about 5% more than the male civilians.

The analysis of the figures who had never smoked in the female civilians (Table 40) showed an increase from 46% in the oldest age group to 65% in the youngest age group. These decreasing figures with age again show a tendency for the young age groups not to start smoking. Compared to the female Forces 17-34 year olds this trend, although the percentages are slightly less, may also be apparent. However, as mentioned previously, it is difficult to speculate due to the low numbers sampled in the older age groups. These results for the 17-34 year old groups do again suggest that the differences between the civilian and Forces smoking habits may be becoming smaller.

Percent in Age Groups who had Never Smoked - Table 40

Age (years)	Forces 1981	Civilians 1982
17-19	45%	65%
20-24	40%	59%
25-29	50%	53%
30-34	45%	57%
35-39	*57%	38%
40-44	*15%	55%
45-49	*50%	42%
50-64	* 0%	46%

*n = 15

The results produced for the female civilians who had given up smoking could not be compared to those of the female Forces. This was due to the resulting values of n in the older age groups being too small for a worthwhile analysis.

Percent within Age Groups who had Given Up Smoking - Table 41

Age	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50-64
Percent	14	18	22	21	36	17	26	31

The trend was similar to that of male civilians in that as age increased so did the percent who had given up smoking. Although in the majority of age groups the percentage is less for the females than that of the male civilians.

Further analysis of the female civilian ex-smokers showed that 53% of them had given up smoking during the 5 years preceding this study. Table 42 again shows that the proportion is larger for the younger age groups.

Percent within Age Groups who had Given Up Smoking in the Previous 5 Years - Table 42

Age	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50-64
Percent	100	87	76	37	33	33	40	25

For reasons similar to the above, those findings cannot be compared to the female Forces. However, this time in comparison to the male civilians a slightly larger proportion of ex-smokers had given up the habit within the preceding 5 years.

In summary therefore, the comparison of female civilian and Forces results are similar to those of the male comparison. The percent of females who smoke between the ages of 17 and 34 years is twice as high as that of female civilians sampled. The female civilians showed a slight increase in the incidence of smoking with age but the findings for the female Forces older age groups could not be discussed. The civilian sample showed an increased trend for the younger age groups not to start smoking. The male Forces younger age groups compared to the civilians had slightly lower percentages for those who had never smoked but were still higher than those of older Forces. The younger age groups contained a higher percentage of subjects who had stopped smoking in the preceding 5 years. Like the male results there still appears to be a 'hard core' of 46% of the female Forces sample and 26% of the female civilian sample overall age groups who start and continue to smoke. Overall, the recent anti-smoking campaigns seem to have the most effect on the younger females by preventing them from starting to smoke.

3.6.5 Body Composition and Smoking : Forces Males

Tables 43 (a-d) are a comparison of the average values for height, weight % fat and FFM between smokers and non-smokers. (Any discrepancies involving total numbers analysed was due to the fact that some volunteers did not answer the questions and were therefore excluded from the analysis).

Within every age group except the 16 year olds, the non-smokers were on average taller than the smokers by over 1cm (Table 43a) This may have been a reflection of social class difference between the two groups. The higher social classes which would include the officers and NCO's, tended to be slightly taller than the other social classes (as described in Section 3.5). The non-smoker/smoker height differences were more marked in the older age groups, again probably because these groups held more officers and NCO's and also the 'non-smokers' included more officers and NCO's than the smokers.

The non-smokers also tended to be heavier than the smokers, by on average about 3kg weight within each group (Table 43b) and this difference, which averaged only about 1% fat, was significant at the 5% level or above, in all but two age groups (Table 43c). This result is also shown on Graph 5 .

Largely reflecting the height differences, within matched age groups the non-smokers had mean FFM values on average about 1kg heavier than the smokers in all groups except the 16 year olds (Table 43d). Again, the differences tended to be slightly larger in the older age groups.

Further analysis was then carried out on the smokers. This was done to see if heavy and light smokers had different levels of body fat. Table 44 shows the mean % body fat for each level of smoking. A comparison was then made between those smoking 6-10 daily and 16-20 daily (as these categories had the largest value for n). From Table 45 no general trend could be seen either way and none of the differences between those smoking 6-10 daily or 16-20 daily were shown to be significant.

This finding was not in agreement with those of Khosla and Lowe (1971) who, by comparing the Obesity Index (W/H^2) stated that heavy smokers (35 or more cigarettes/equivalents per day) were more obese than moderate smokers (15-34 cigarettes/equivalents per day). They suggested that the obesity of heavy smokers may possibly be related to their drinking habits, but they had no information on this point.

In order to examine how the ex-smokers differed from either the current smokers or those who had never smoked, the non-smoking group were divided into ex-smokers and those who had never smoked, and Graph 6 shows % fat within age group for these two groups and also current smokers. The ex-smokers aged between 16 and 24 years tended to have fat contents similar to but slightly less than those who had never smoked. The older ex-smokers, however, tended to have the highest fat content of the three groups. The magnitude of these differences were small however. Further analysis of the ex-smokers showed that above about 24 years of age those who had given up within the 5 years preceding the survey had higher values for % body fat than those who had given up more than 5 years beforehand. Graph 7 describes the phenomena, and the reason it was not seen below 24 years of age may have been that these young men had not been smoking for as long as when they gave up. They were therefore less likely to be affected by stopping the habit i.e. they may have found it less difficult and did not require to find substitutes such as eating more.

3.6.6 Body Composition and Smoking : Civilian Males

The sample sizes for the male civilian smokers within age groups were relatively small. However, it was of interest to see if similar differences in body fat existed between those who had smoked and those who had never smoked for the male civilian sample (Table 46).

Apart from age groups 25-29 year olds the smokers were again slightly leaner than those who had never smoked. The magnitude of the difference was, like the male Forces results, on average 1% body fat, but this time the difference was only significant in the age group 30-34 year old at the 5% level.

The differences were not as significant as those seen in the male Forces results which may have been due to the low values for n in the smokers sample.

Table 43a

Comparison of Mean Height and Weight between Smokers/Non Smokers

(Standard Error in Parenthesis)

Forces Sample: Males

Height (cm)

Age	n	Smokers	n	Non-Smokers	Level Significance
16	176	175.0 (0.4)	193	174.6 (0.5)	NS
17-19	480	175.2 (0.3)	572	176.0 (0.3)	NS
20-24	582	175.9 (0.3)	688	176.5 (0.2)	NS
25-29	376	175.6 (0.4)	413	177.2 (0.3)	***
30-34	343	175.4 (0.3)	436	176.1 (0.4)	NS
35-39	258	174.9 (0.4)	319	176.2 (0.4)	*
40-44	116	174.8 (0.6)	153	175.8 (0.6)	NS
45-49	45	175.3 (0.9)	97	177.1 (0.6)	NS
50-59	21	172.6 (1.6)	47	176.7 (1.1)	*
All Ages	2397	175.4 (0.1)	2914	176.3 (0.1)	

Table 43b

Forces Sample: Males

Weight (kg)

Age	n	Smokers	n	Non-Smokers	Level Significance
16	176	65.3 (0.6)	193	65.6 (0.6)	NS
17-19	480	67.3 (0.4)	572	68.9 (0.4)	**
20-24	582	72.2 (0.4)	688	73.2 (0.4)	NS
25-29	376	73.8 (0.6)	413	76.4 (0.5)	**
30-34	343	75.9 (0.6)	430	77.4 (0.5)	NS
35-39	258	75.9 (0.7)	319	77.9 (0.6)	*
40-44	116	76.7 (1.1)	153	79.9 (0.9)	*
45-49	45	78.7 (1.4)	97	81.2 (1.1)	NS
50-59	21	75.2 (2.7)	43	82.3 (1.9)	**
All Ages	2397	72.3 (0.2)	2914	74.2 (0.2)	***

FORCES SAMPLE : MALES

Comparison of Mean % Fat and FFM between smokers/non-smokers

(Standard Error in Parenthesis)

FAT (%)

Table 43c

AGE (yrs)	n	SMOKERS	n	NON-SMOKERS	LEVEL OF SIGNIFICAN
16	176	13.1 (0.2)	193	13.8 (0.2)	*
17-19	480	14.9 (0.2)	572	15.9 (0.2)	***
20-24	582	16.4 (0.2)	688	16.8 (0.2)	NS
25-29	376	17.0 (0.2)	413	17.7 (0.2)	*
30-34	343	20.6 (0.2)	436	21.3 (0.2)	**
35-39	258	20.5 (0.2)	319	21.5 (0.2)	**
40-44	116	24.1 (0.4)	153	24.9 (0.3)	NS
45-49	45	24.3 (0.7)	97	26.1 (0.4)	**
50-59	21	25.0 (1.0)	43	28.4 (0.8)	*
ALL AGES	2397	17.6 (0.1)	2914	18.6 (0.1)	***

FFM

Table 43d

AGE (yrs)	n	SMOKERS	n	NON-SMOKERS	LEVEL OF SIGNIFICANC
16	176	56.6 (0.4)	193	56.5 (0.4)	NS
17-19	480	57.1 (0.3)	572	57.7 (0.3)	NS
20-24	582	60.0 (0.3)	688	60.6 (0.2)	NS
25-29	376	60.9 (0.4)	413	62.6 (0.3)	***
30-34	343	59.2 (0.2)	436	60.5 (0.3)	***
35-39	258	60.0 (0.4)	319	60.9 (0.4)	NS
40-44	116	57.8 (0.6)	153	59.4 (0.5)	***
45-49	45	59.3 (0.8)	97	59.7 (0.6)	NS
50-59	21	56.0 (1.5)	43	58.4 (1.0)	NS
ALL AGES	2397	59.1 (0.1)	2914	60.0 (0.1)	***

NS NOT SIGNIFICANT
* Significantly different at the 5% level
** " " " " 1% level
*** " " " " 0.1% level

Forces Sample: MALES

Mean % Fat within Age Groups for degrees of Smoking

Table 44

Age (yrs)	n	5 Cigs/day	n	6-10 Cigs/day	n	11-15 Cigs/day	n	16-20 Cigs/day	n	>20 Cigs/
		%		%		%		%		%
16	13	13.3	50	13.9	63	12.4	41	13.0	10	13.0
17-19	24	16.0	93	14.3	124	15.0	180	14.9	61	14.7
20-24	19	14.7	54	16.7	132	16.2	234	16.2	143	16.9
25-29	15	18.6	22	17.7	69	17.3	162	16.7	107	20.8
30-34	10	22.3	27	19.2	52	20.6	134	20.7	119	20.2
35-39	14	20.6	24	21.1	33	20.7	88	20.8	98	23.9
40-44	6	21.1	9	24.4	15	24.7	35	24.6	61	24.4

TABLE 45

Forces Sample: MALES

(Mean % Fat and Standard Deviation in Parenthesis)

Age (yrs)	6-10/day	SD	16-20/day	SD	Sig
16	13.9	(2.9)	13.0	(4.3)	NS
17-19	14.3	(3.6)	14.9	(3.7)	NS
20-24	16.7	(4.5)	16.2	(5.0)	NS
25-29	17.7	(4.4)	16.7	(4.7)	NS
30-34	19.2	(4.3)	20.7	(3.9)	NS
35-39	21.1	(3.7)	20.8	(3.8)	NS
40-44	24.4	(5.7)	24.6	(5.6)	NS

NS : Not significant

Table 46

Comparison of Mean % Fat Levels between Smokers/Never Smoked

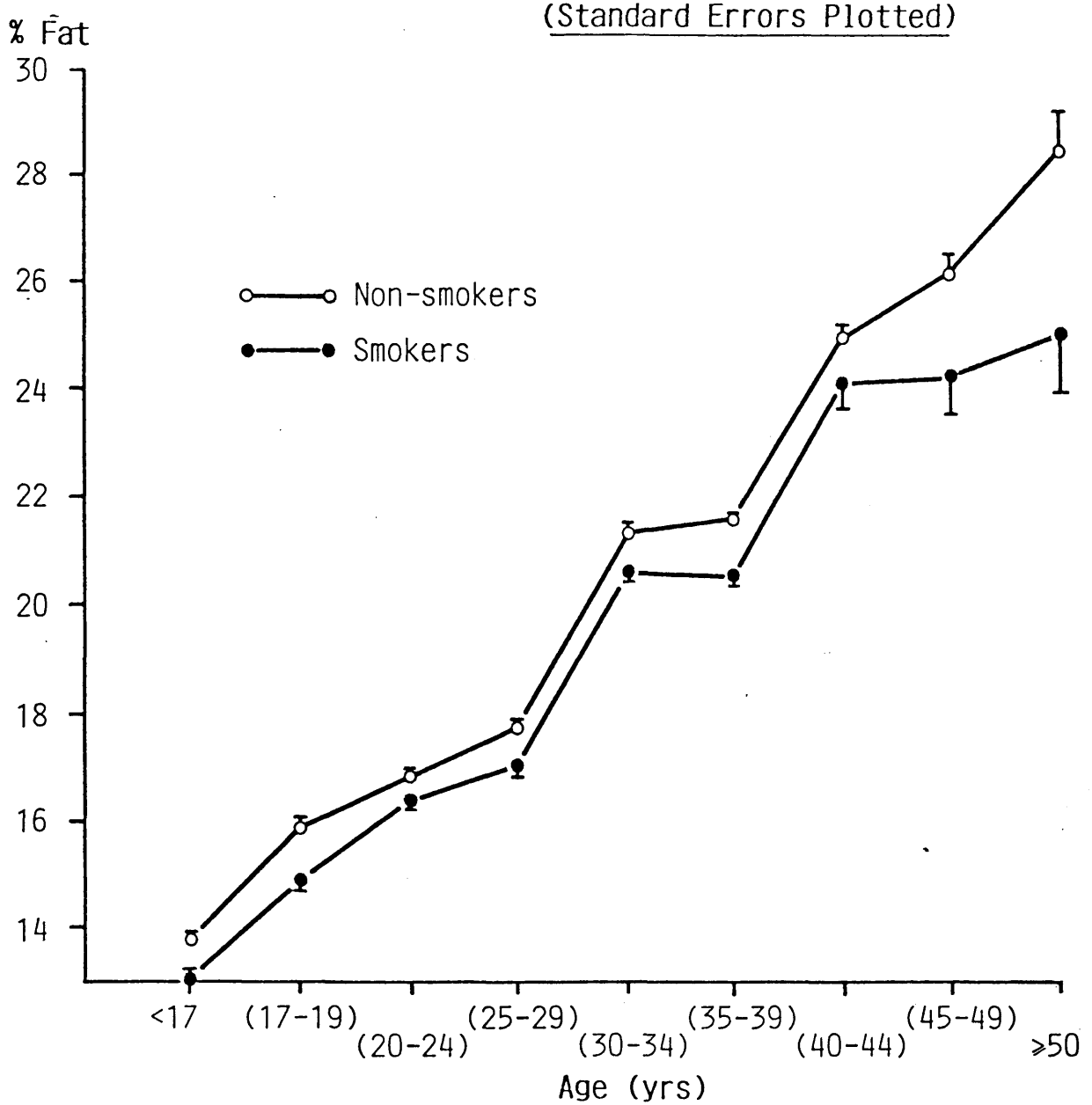
(Standard Error in Parenthesis)

Age	n	Smokers	n	Never Smoked	Level Significance
17-19	8	14.4 (1.1)	24	15.2 (0.8)	NS
20-24	30	15.6 (0.7)	80	16.6 (0.4)	NS
25-29	29	18.1 (1.0)	110	17.4 (0.4)	NS
30-34	23	19.2 (0.8)	54	21.6 (0.5)	*
35-39	29	21.2 (0.7)	54	20.8 (0.4)	NS
40-44	23	23.2 (1.2)	42	23.9 (0.6)	NS
45-49	22	24.1 (0.9)	46	24.5 (0.7)	NS
50-64	39	25.2 (0.9)	85	26.8 (0.5)	NS

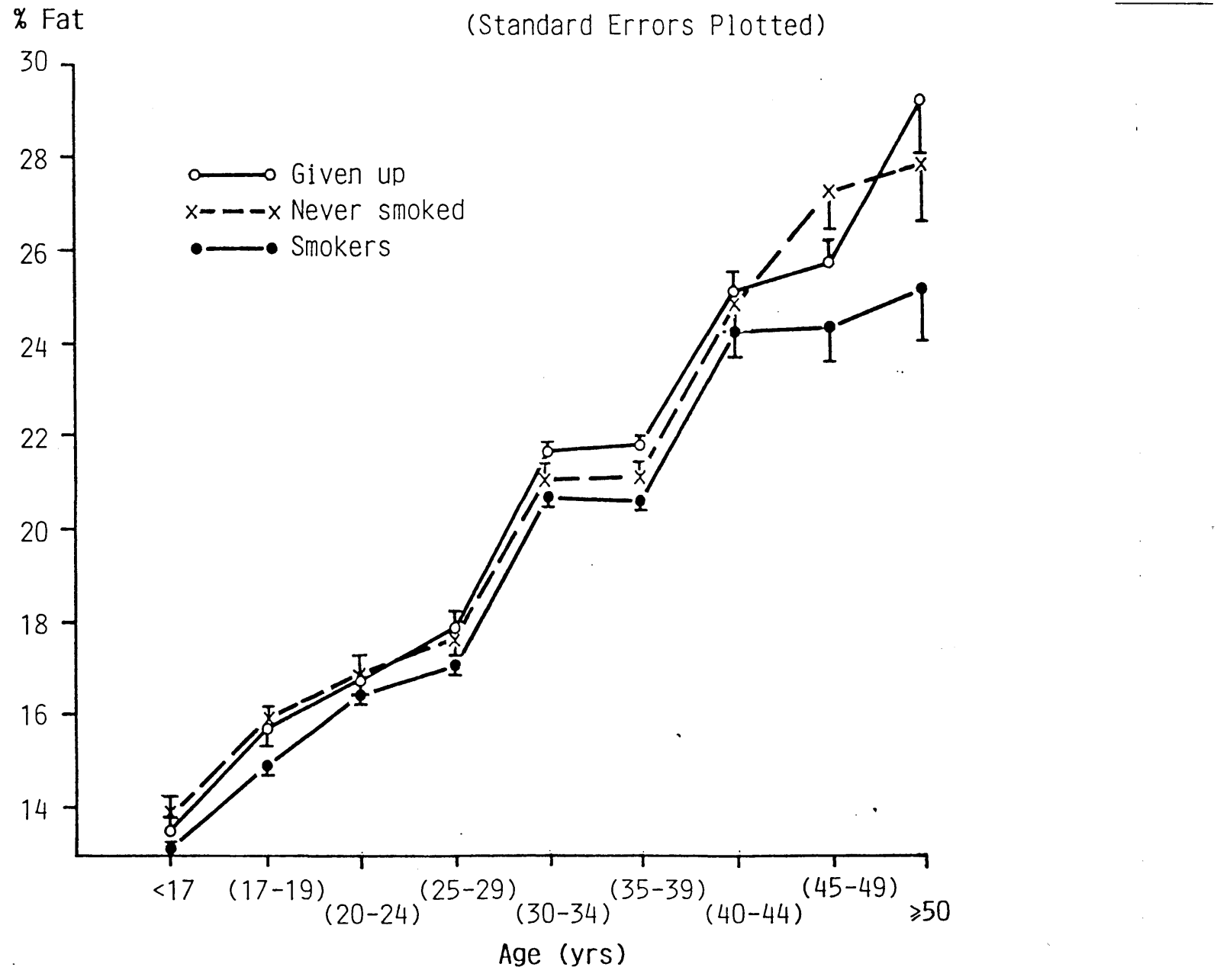
NS Not Significant
* Significantly different at the 5% level
** Signficantly different at the 1% level
*** Significantly different at the 0.1% level

Mean % Fat in Age Groups Forces : Males Males = 5311 GRAPH 5

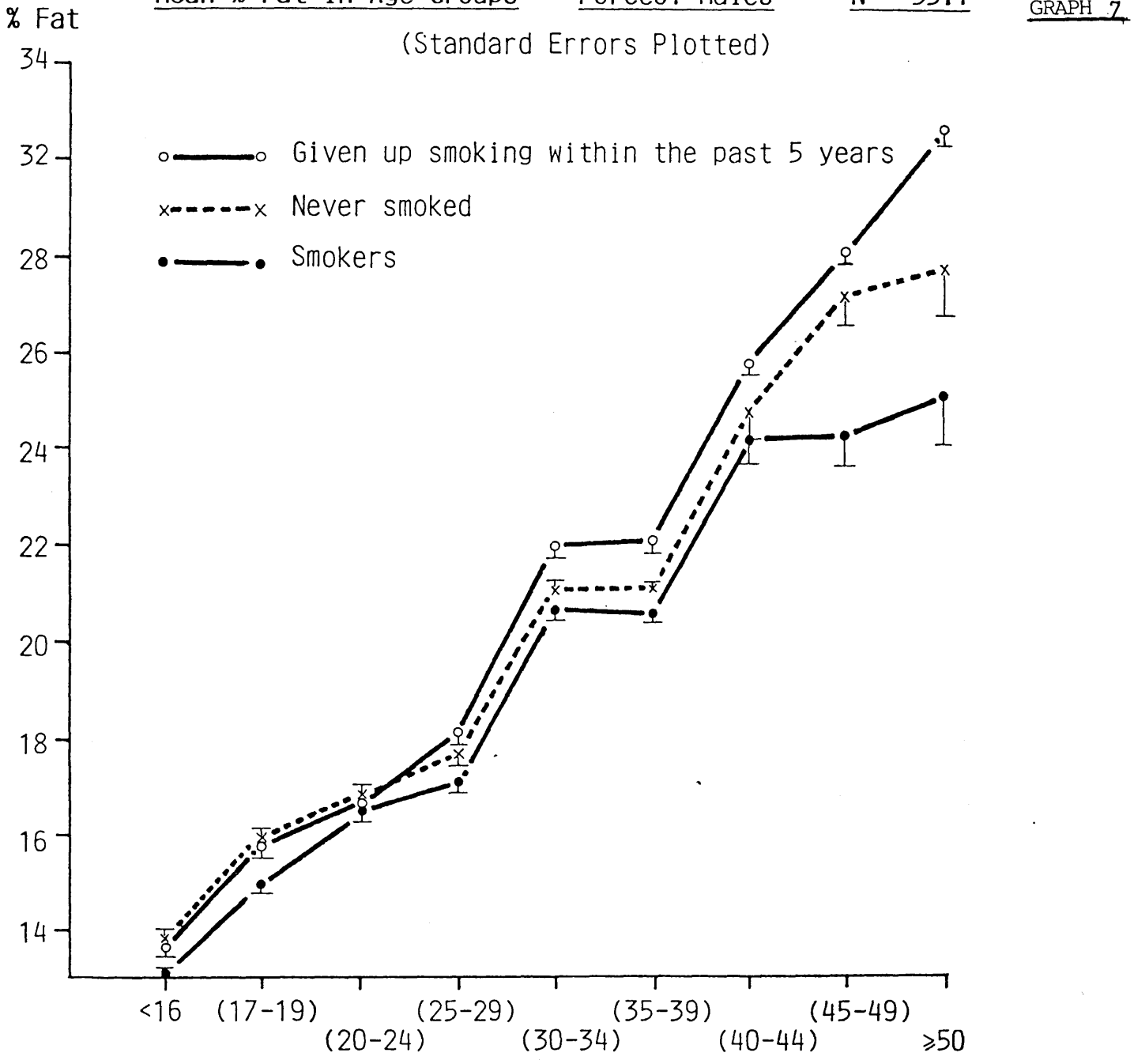
(Standard Errors Plotted)



Mean % Fat in Age Groups Forces : Males N = 5311 GRAPH 6



Mean % Fat in Age Groups Forces: Males N = 5311 GRAPH 7



3.6.7 Body Composition and Smoking Habits : Forces Females

Tables 47a-d describe the average values for height, weight, percent fat and FFM within age groups for smokers and non-smokers. Again because of the low sample sizes beyond 34 years of age, only mean values between 17 and 29 years were discussed.

Although small differences existed in mean height, Table 47a , with the female smokers being slightly taller than non-smokers,the differences were not significant.

In Table 47b mean weight was marginally less for smokers compared to non-smokers for the first two age groups only, but again the differences were not significant.

Again, mean percent fat was slightly less for the female smokers for the first two age groups only (Table 47c) and yet again, none of the differences were significant.

There were no general trends or significant differences found between the mean FFM values of the female smokers and non-smokers (Table 47d).

3.6.8 Body Composition and Smoking : Civilian Females

The results for the female civilians were very similar to the male findings. Apart from age groups 20-24 years, the female smokers were again slightly leaner than those who had never smoked in the civilian sample (Table 48). The magnitude of the difference for the female civilians was also, on average, 1% body fat but this time was not shown to be significant in any of the age groups.

Forces Sample: Females

Comparison of Mean Height, Weight, % Fat and FFM

Between Smokers and Non-Smokers

(Standard Error in Parenthesis)

HEIGHT (cm)

Table 47a

Age(yrs)	n	Smokers	n	Non-Smokers	Level of Significance
17-19	189	163.4 (0.4)	214	162.8 (0.4)	NS
20-24	228	164.2 (0.5)	257	164.1 (0.4)	NS
25-29	44	164.5 (0.9)	72	164.0 (0.9)	NS

WEIGHT (kg)

Table 47b

Age(yrs)	n	Smokers	n	Non-Smokers	Level of Significance
17-19	189	60.0 (0.5)	214	60.8 (0.5)	NS
20-24	228	61.1 (0.5)	257	61.8 (0.6)	NS
25-29	44	62.9 (1.6)	72	59.9 (1.0)	NS

% FAT

Table 47c

Age (yrs)	n	Smokers	n	Non-Smokers	Level of Significance
17-19	189	27.7 (0.3)	214	28.2 (0.3)	NS
20-24	228	27.7 (0.3)	257	28.4 (0.3)	NS
25-29	44	27.4 (0.8)	72	27.0 (0.6)	NS

FFM (kg)

Table 47 d

Age (yrs)	n	Smokers	n	Non-Smokers	Level of Significance
17-19	189	43.2 (0.3)	214	43.4 (0.3)	NS
20-24	228	43.9 (0.3)	257	43.9 (0.3)	NS
25-29	44	45.3 (0.8)	72	43.2 (0.5)	NS

NS = Not Significant

Table 48

Comparison of Mean % Fat Levels between Smokers/Never Smoked

(Standard Error in Parenthesis)

Civilian : Females

Age	n	Smokers	n	Never Smoked	Level of Significance
17-19	28	24.8 (0.7)	89	25.3 (0.4)	NS
20-24	79	26.5 (0.5)	200	26.1 (0.3)	NS
25-29	43	25.5 (0.6)	91	26.5 (0.5)	NS
30-34	15	26.7 (0.8)	38	28.6 (0.7)	NS
35-39	21	28.0 (0.7)	31	29.4 (0.7)	NS
40-44	24	31.7 (0.6)	47	32.5 (0.6)	NS
45-49	28	32.7 (0.9)	27	33.3 (0.6)	NS
50-64	57	25.9 (0.5)	90	35.7 (0.4)	NS

NS = Not Significant

3.7 EXERCISE HABITS AND BODY COMPOSITIONS

3.7.1 Forces : Males

Table 49 represents the 'exercise habits' of the male Forces. (Again, any discrepancy of n is due to the fact that some volunteers did not answer the questionnaire properly).

Looking at the sample as a whole, 62% can be seen to take exercise twice a week or more and 38% less than twice a week. When split into age groups (Table 50) the percent exercising twice a week or more was seen to decrease steadily with increasing age. This obviously produced the opposite effect for those exercising less than twice a week, i.e. the percentage in this activity level increased with age, with an approximate 50/50 level being reached between the two groups at age 30-34 years.

Looking generally at the mean values for height, weight, percent fat and FFM for all age groups together (Table 51) it can be seen that overall, even though those exercising daily have similar values for height, they were lighter, leaner and had a higher fat-free mass than those exercising only occasionally.

Tables 52a-d give the average values for height, weight, percent fat and fat-free mass within age groups for all four activity levels.

When these two extremes of activity levels are compared in age groups, i.e. daily exercise and occasionally/never (Tables 53 a-d) it is interesting to note the difference between the two samples.

Table 53a shows the mean height in age groups. Mean height peaked at age 25-29 years for both samples and then gradually decreased for the two extreme activity levels. There were no significant differences in height between the two extremes for those over the age of 17 years. The 16 year olds who exercised daily, however, were shown to be significantly smaller at the 1% level than those who exercised only occasionally. This was probably due to the low value of n sampled for the 16 year olds

who exercised only occasionally. Overall, those who exercised daily were slightly smaller by on average 0.7cm than those who exercised only occasionally.

Table 53b shows the mean weights in age groups. In both samples mean weight increased steadily with age but in comparison there was no general trend either way, except for age group 35-39 years where those who exercised daily were slightly lighter at the 0.1% level than those who exercised only occasionally. This may be partly due to the slight difference in mean height for this age group. Mean weight in the other age groups varies by a maximum of 3.9kg between the two samples.

Table 53c shows the percent body fat levels between the two activity levels. Mean percent body fat increases steadily with age for both samples. It is interesting to note that mean percent body fat is lower in every age group, except the oldest age group, for those who take the most exercise, and is significantly lower at the 95% level and above for those aged between 20 and 44 years. Graph 15(a) plots mean percent fat within age groups for those exercising daily and only occasionally. Table 53d shows mean FFM levels within age groups. Mean FFM increases to a maximum at age 25-29 years for both samples and then gradually decreases and can be seen to be a reflection of mean height. Despite the overall slight differences in mean height between the two samples mean FFM can be seen to be larger and significantly so at the 95% level for those between the age of 17 and 34 years who exercised daily.

The 35-39 year olds who exercised daily were, however, shown to have a significantly lower mean FFM at the 5% level than those who only exercised occasionally. This was probably again, a reflection of the differences in mean height. Over the age of 35 years mean FFM was not significantly different and varied by a maximum 1.9kg. Graph 15(b) plots mean FFM within age groups for those who exercised daily and those who exercised only occasionally.

To summarise, despite the fact that those who exercised daily were on average slightly smaller than those who exercised only occasionally, mean FFM can be seen to be slightly higher for

those who take the most exercise. Mean percent body fat also seems to be affected by the amount of exercise taken, in that for 8 out of 9 age groups the mean values for body fat were less, again for those who exercised the most.

3.7.2 Exercise Habits and Body Composition : Civilian Males

Since differences in body composition existed in the male Forces sample between subjects who exercised 'daily' or 'occasionally', similar analysis was carried out on the male civilians to see if the results were comparable.

The Forces sample was split into 4 categories of activity, and the two extremes, as mentaioned above, were compared. However, when the civilian sample was split into these 4 categories the resulting values for n in each group were too small for any worthwhile analysis. As a result of this the male civilian sample was split into 2 groups only, using the categories of:

(a) subjects who exercised < 2/weeks and

(b) subjects who exercised ≥ 2/weeks

(a) % Body Fat

Table 54a gives the mean values for % body fat for the 2 activity groups within age groups for the male civilian sample.

In every age group those who exercised more were slightly leaner than those who only exercised < 2/weeks. This difference between the mean values for % fat between the 2 groups was on average 1% fat and was significantly less for age groups 25-29 years, 40-44 years and 50-64 years. (The results for the 17-19 year olds were not considered as viable due to the low number who exercised < 2/weeks.)

(b) FFM

Table 54b gives the mean values for FFM within age groups for both the activity groups in the male civilian sample.

First of all, there were no significant differences found in mean height between the two groups for any of the age groups.

The mean heights were all within 1cm of one another and no one group was consistently taller than the other.

Apart from age group 17-19 years, subjects who took more exercise had higher mean values for FFM compared to the less active group and significantly more for the age group 30-34 years. (The non-significant finding for the 17-19 year olds was probably due to the low number of subjects who exercised 2/weeks).

3.7.3 A Comparison of the Forces Exercise Habits to those of Civilians

Table 55 shows the overall percentage of those who exercise (a) daily (b) greater or equal to twice a week (c) less than twice a week or (d) occasionally/never for both Forces and civilians.

Overall, the male forces sample take more exercise than the civilians sampled. However, when split into age groups a slightly different picture emerges. Between the ages of 16-39 years the male Forces sample take more exercise than the male civilian sample. However, between the ages of 40-44 years the percentage of the male Forces sample who exercise $\geqslant$ 2/weeks drops by 9% to 39%, but the percentage of male civilian sample increases by 12% so that almost half the civilian 40-44 year olds exercise $\geqslant$ 2/weeks. As age increases the percentage of those exercising $\geqslant$ 2/weeks continues to fall but it can be seen that the older male civilian sample take more exercise than the male Forces sample. The final percentages are similar for both groups where just less than a third of the samples exercise $\geqslant$ 2/weeks. (Table 56)

The findings for the 'Exercise and Body Composition' for the male civilian sample were very similar to those of the male Forces. In both samples, those subjects who took more physical exercise had less body fat and had higher mean values for FFM than those who exercised less frequently. The difference between the two civilian male groups in mean % body fat was on average 1% fat. This was slightly less than the average mean difference between the two activity groups in the male Forces sample. As with the differences in mean % body fat between the two civilian activity groups, the differences in mean FFM were not as pronounced or

as significant as the Forces results.

This may be attributed to the fact that the male Forces activity groups used wee 'daily' and 'occasional' exercise, compared to the broader categories of activity levels in the male civilian sample. Bearing this in mind, it is interesting to compare the male Forces and civilian groups who exercised the most. The male civilians over the age of 40 years who exercised ≥ 2/weeks had lower mean values for % body fat than the male Forces subjects over 40 years who exercised daily. This may be due to the fact that the older age groups of the male civilian sample were seen to take more exercise than similar age groups in the male Forces sample.

FORCES SAMPLE: MALES

n = 5297

ACTIVITY GROUPS

Table 49

18% of Male Forces sampled exercise daily

44% of Male Forces sampled exercise ⩾2/week

14% of Male Forces sampled exercise < 2/week

24% of Male Forces sampled exercise occasionally/never

LEVEL OF ACTIVITY WITHIN AGE GROUPS

Table 50

EXERCISE	AGE 16	17-19	20-24	25-29	30-34	35-39	40-44	45-49	50-59
⩾2/week	92%	75%	66%	57%	51%	48%	39%	30%	31%
< 2/week	8%	25%	34%	43%	49%	52%	61%	70%	69%

MEAN HEIGHT, WEIGHT, % FAT AND FFM WITHIN ACTIVITY GROUPS

Table 51

EXERCISE	n	HEIGHT(cm)	WEIGHT(kg)	%FAT	FFM(kg)
Daily	951	175.7 (0.2)	73.1 (0.3)	17.1 (0.1)	60.3 (0.2)
⩾2/week	2,311	175.8 (0.1)	71.9 (0.2)	17.0 (0.1)	59.3 (0.1)
< 2/week	775	176.0 (0.2)	74.5 (0.4)	19.4 (0.2)	59.6 (0.2)
OCC/Never	1,260	176.0 (0.2)	75.2 (0.3)	20.2 (0.1)	59.5 (0.2)

No. in brackets = Standard Error

Forces Sample: Males

(Standard Error in Parenthesis)

Table 52a

MEAN HEIGHT (cm) FOR EACH ACTIVITY LEVEL

AGE (YRS)	DAILY	≥2/WEEK	<2/WEEK	OCC/NEVER
16	172.6 (1.0)	175.1 (0.4)	175.4 (1.7)	175.6 (1.5)
17-19	175.3 (0.5)	175.7 (0.3)	175.2 (0.6)	176.3 (0.5)
20-24	176.3 (0.4)	176.0 (0.3)	176.8 (0.5)	176.2 (0.4)
25-29	176.6 (0.6)	176.4 (0.4)	175.3 (0.6)	176.9 (0.5)
30-34	176.0 (0.5)	176.0 (0.4)	176.2 (0.6)	174.9 (0.4)
35-39	174.8 (0.7)	175.7 (0.5)	175.9 (0.6)	175.9 (0.5)
40-44	174.9 (1.2)	174.6 (0.8)	175.6 (0.9)	175.7 (0.6)
45-49	176.7 (1.5)	176.9 (1.6)	176.1 (1.1)	176.5 (0.7)
50-59	172.3 (1.6)	177.7 (1.9)	177.8 (2.1)	174.2 (1.3)

MEAN WEIGHT (kg) FOR EACH ACTIVITY LEVEL

Table 52b

AGE (YRS)	DAILY	≥2/WEEK	<2/WEEK	OCC/NEVER
16	64.7 (1.0)	65.7 (0.4)	65.0 (2.2)	65.4 (2.2)
17-19	69.2 (0.7)	68.0 (0.4)	68.0 (0.9)	67.7 (0.7)
20-24	73.2 (0.6)	72.2 (0.4)	73.1 (0.7)	73.3 (0.7)
25-29	75.9 (0.8)	75.1 (0.6)	74.1 (0.9)	75.4 (0.9)
30-34	76.3 (0.9)	76.6 (0.6)	77.8 (0.9)	76.4 (0.7)
35-39	74.1 (0.9)	77.0 (0.7)	77.2 (1.0)	78.1 (0.7)
40-44	76.0 (1.9)	79.2 (0.7)	78.1 (1.7)	78.1 (1.0)
45-49	80.1 (2.2)	81.1 (2.0)	81.6 (1.8)	79.1 (1.2)
50-59	75.2 (3.3)	79.3 (3.4)	88.0 (4.5)	79.1 (2.1)

Forces Sample: Males

(Standard Error in Parenthesis)

Table 52c

MEAN % FAT FOR EACH ACTIVITY LEVEL

AGE (YRS)	DAILY	≥2/WEEK	<2/WEEK	OCC/NEVER
16	13.3 (0.3)	13.3 (0.2)	14.2 (0.9)	14.6 (1.2)
17-19	15.2 (0.3)	15.3 (0.2)	16.3 (0.4)	15.7 (0.3)
20-24	15.8 (0.3)	16.3 (0.2)	17.4 (0.3)	17.5 (0.3)
25-29	16.5 (0.3)	17.1 (0.2)	18.1 (0.4)	18.0 (0.3)
30-34	19.7 (0.3)	20.6 (0.2)	21.9 (0.3)	21.7 (0.3)
35-39	19.7 (0.4)	20.9 (0.3)	21.1 (0.4)	21.7 (0.2)
40-44	23.1 (0.8)	24.5 (0.5)	24.6 (0.7)	24.9 (0.4)
45-49	24.8 (0.9)	24.3 (0.9)	26.6 (0.7)	25.7 (0.5)
50-59	27.5 (1.7)	26.1 (1.3)	29.1 (2.4)	27.1 (0.9)

Table 52d

MEAN FFM (kg) FOR EACH ACTIVITY LEVEL

AGE(YRS)	DAILY	≥2/WEEK	<2/WEEK	OCC/NEVER
16	56.0 (0.8)	56.7 (0.3)	55.6 (1.5)	55.6 (1.5)
17-19	58.5 (0.2)	57.4 (0.2)	56.7 (0.6)	56.9 (0.5)
20-24	61.3 (0.4)	60.2 (0.3)	60.1 (0.4)	60.0 (0.4)
25-29	63.0 (0.6)	62.0 (0.4)	60.4 (0.5)	61.4 (0.6)
30-34	61.0 (0.5)	60.6 (0.4)	60.4 (0.5)	59.5 (0.5)
35-39	59.3 (0.6)	60.7 (0.5)	60.7 (0.6)	60.9 (0.5)
40-44	58.1 (1.2)	59.5 (0.8)	58.4 (0.9)	58.3 (0.6)
45-49	60.0 (1.2)	61.1 (1.2)	59.7 (1.1)	58.9 (0.7)
50-59	54.3 (1.4)	58.2 (1.9)	61.7 (1.5)	57.2 (1.2)

Forces Sample: Males

Effects of Exercise on Height and Weight

(Standard Error in Parenthesis)

Table 53a

HEIGHT (cm) WITHIN AGE AND ACTIVITY GROUPS

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNIFICANCE
16	60	172.6 (1.0)	14	175.6 (1.5)	**
17-19	191	175.3 (0.5)	151	176.3 (0.5)	NS
20-24	261	176.3 (0.4)	244	176.2 (0.4)	NS
25-29	167	176.6 (0.6)	203	176.9 (0.5)	NS
30-34	127	176.0 (0.5)	220	174.9 (0.4)	NS
35-39	82	174.8 (0.7)	198	175.9 (0.5)	NS
40-44	35	174.9 (1.2)	119	175.7 (0.6)	NS
45-49	22	176.7 (1.5)	75	176.5 (0.7)	NS
50-59	6	172.3 (1.6)	36	174.2 (1.3)	NS

Table 53b

WEIGHT (kg) IN AGE AND ACTIVITY GROUPS

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNIFICANCE
16	60	64.7 (1.0)	14	65.4 (2.2)	NS
17-19	191	69.2 (0.7)	151	67.7 (0.7)	NS
20-24	261	73.2 (0.6)	244	73.3 (0.7)	NS
25-29	167	75.9 (0.8)	203	75.4 (0.9)	NS
30-34	127	76.3 (0.9)	220	76.4 (0.7)	NS
35-39	82	74.1 (0.9)	198	78.1 (0.7)	***
40-44	35	76.0 (1.9)	119	78.1 (1.0)	NS
45-49	22	80.1 (2.2)	75	79.1 (1.2)	NS
50-59	6	75.2 (3.3)	36	79.1 (2.1)	NS

NS Not significant
* Significantly different at the 5% level
** " " 1% level

Forces Sample: Males

Effects of Exercise on Body Fat and Fat Free Mass

(Standard Error in Parenthesis)

Table 53c

% FAT CONTENT WITHIN AGE AND ACTIVITY GROUPS

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNIFICANCE
16	60	13.3% (0.3)	14	14.6% (1.2)	NS
17-19	0.7	14.4% (0.3)	151	15.7% (0.3)	NS
20-24	0.5	16.0% (0.3)	244	17.5% (0.3)	***
25-29	0.4	16.7% (0.3)	203	18.0% (0.3)	**
30-34	0.5	20.0% (0.3)	220	21.7% (0.3)	***
35-39	0.6	20.6% (0.4)	198	21.7% (0.2)	***
40-44	0.6	22.4% (0.9)	119	24.9% (0.4)	*
45-49	0.7	23.8% (0.9)	75	25.7% (0.5)	NS
50-59	0.6	25.6% (1.7)	36	27.1% (0.9)	NS

Table 53d

FFM (kg) WITHIN AGE AND ACTIVITY GROUPS

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNIFICANCE
16	60	56.0 (0.8)	14	55.6 (1.5)	NS
17-19	191	58.5 (0.5)	151	56.9 (0.5)	*
20-24	261	61.3 (0.4)	244	60.0 (0.4)	*
25-29	167	63.0 (0.6)	203	61.4 (0.6)	*
30-34	127	61.0 (0.5)	220	59.6 (0.5)	*
35-39	82	59.3 (0.6)	198	60.9 (0.5)	*
40-44	35	58.1 (1.2)	119	58.3 (0.6)	NS
45-49	22	60.0 (1.2)	75	58.9 (0.7)	NS
50-59	6	54.3 (1.4)	36	57.2 (1.2)	NS

NS	Not significant
*	Significantly different at the 5% level
**	" " 1% "
***	" " 0.1% "

Table 54a

CIVILIANS

Comparison of % Fat Levels between Two Activity Levels

(Standard Error in Parenthesis)

MALES

Age	n	Exercise ⩾2/week	n	Exercise <2/week	Level of Significance
17-19	22	14.4 (0.7)	12	16.9 (1.4)	NS
20-24	70	16.0 (0.5)	52	16.6 (0.5)	NS
25-29	85	16.7 (0.4)	74	18.3 (0.5)	*
30-34	51	20.0 (0.5)	62	21.2 (0.5)	NS
35-39	45	20.6 (0.6)	79	21.5 (0.4)	NS
40-44	50	22.4 (0.6)	55	24.3 (0.7)	*
45-49	42	23.8 (0.7)	63	25.2 (0.5)	NS
50-64	74	25.6 (0.6)	164	27.4 (0.3)	*

Table 54b

Comparison of FFM between Two Activity Levels

(Standard Error in Parenthesis)

MALES

Age	n	Exercise ⩾2/week	n	Exercise <2/week	Level of Significance
17-19	22	55.1 (0.9)	12	59.0 (2.8)	NS
20-24	70	59.3 (0.7)	52	57.8 (0.7)	NS
25-29	85	60.4 (0.7)	74	59.3 (0.9)	NS
30-34	51	59.1 (1.0)	62	56.4 (0.8)	*
35-39	45	58.1 (1.1)	79	57.6 (0.7)	NS
40-44	50	56.4 (0.9)	55	56.1 (1.0)	NS
45-49	42	57.0 (0.9)	63	57.0 (0.7)	NS
50-64	74	55.1 (0.7)	164	55.1 (0.4)	NS

* Significant at the 5%

Table 55

Comparison of Exercise Habits: Males

	Forces '81	Civilians '82
Daily	18%	11%
⩾ 2/week	44%	33%
< 2/week	14%	19%
Occ/Never	24%	37%

Table 56

Within Age Groups

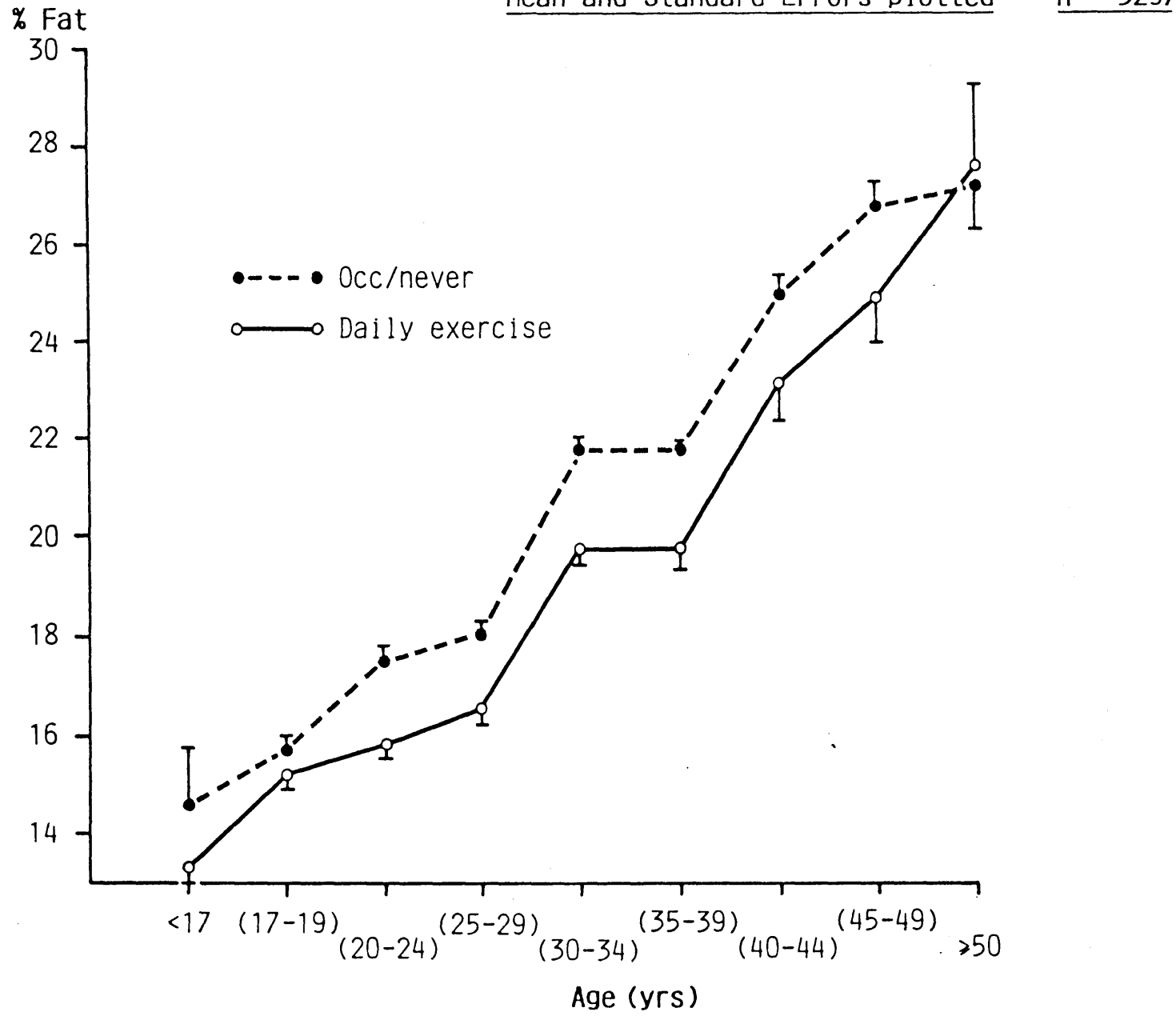
	Exercise ⩾ 2/week		Exercise < 2/week	
Age (YRS)	Forces '81	Civilians '82	Forces '81	Civilians '82
16	92%	-	8%	-
17-19	75%	65%	25%	35%
20-24	66%	57%	34%	43%
25-29	57%	53%	43%	47%
30-34	51%	45%	49%	55%
35-39	48%	36%	52%	64%
40-44	39%	48%	61%	52%
45-49	30%	40%	70%	60%
50-64	31%	31%	69%	69%

Forces : Males

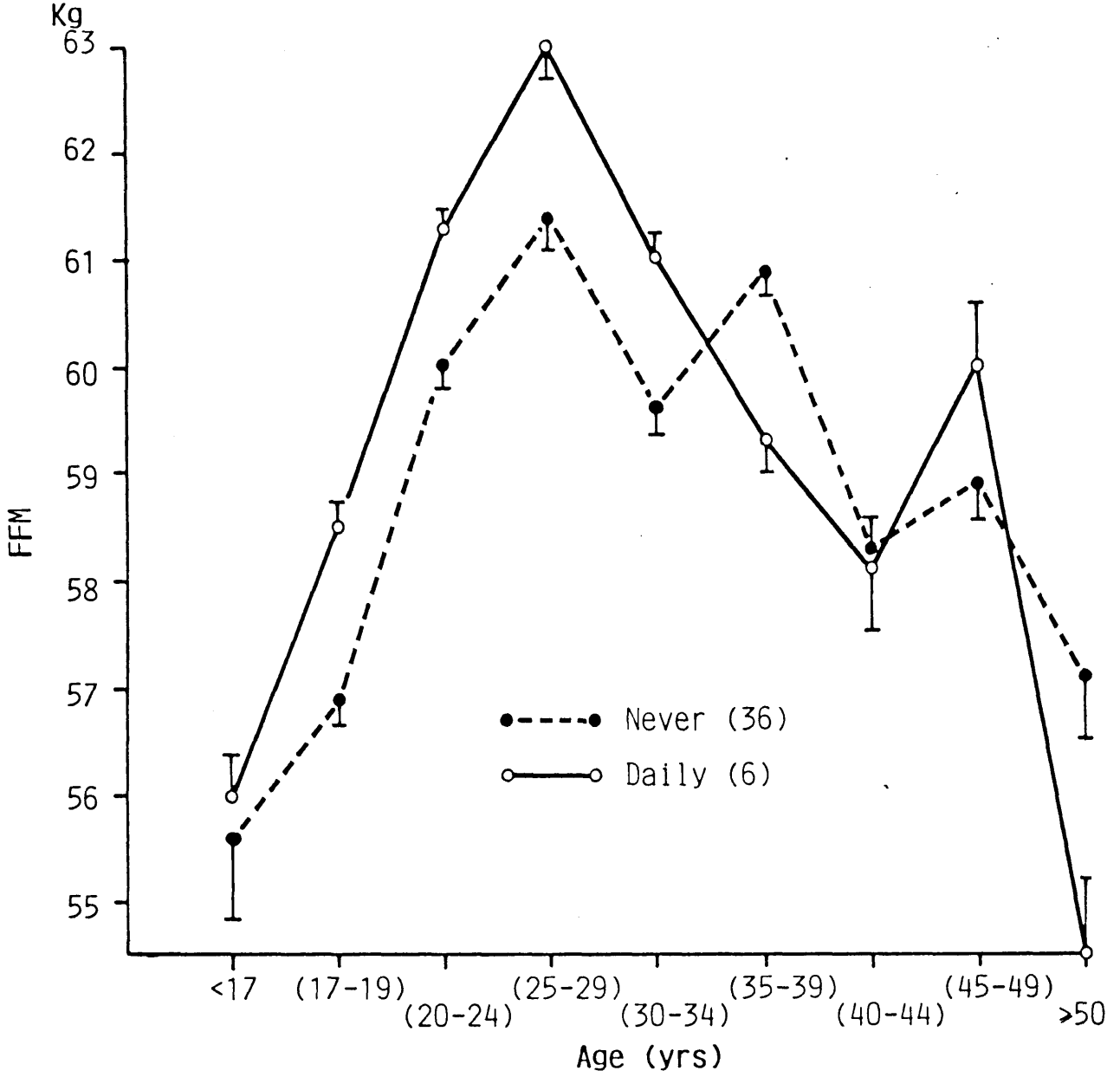
% Fat for Daily Activity/Occ. never

Mean and Standard Errors plotted

n = 5297



Forces : Males Levels of Activity v FFM



3.7.4 Exercise Habits and Body Composition : Forces Females

Table 57 (a) discusses the exercise habits of the female Forces sample.

In total only 41% of the females exercised more than twice a week compared to 62% for the male sample, which leaves 59% taking exercise less than twice a week.

Unlike the males, the percentage within the age groups 16-34 years (Table 58) who exercised more than twice a week decreases very little with age and likewise with those females exercising less than twice a week, the percentage increases only slightly compared to the males samples.

Looking generally at the mean values given for height, weight, percent fat and FFM for each activity level (Table 59 (c)), it is interesting to note that overall those exercising daily are again lighter, leaner and have a slightly higher level of fat-free mass than those only exercising occasionally. Although mean FFM may partly be due to the slight differences in mean height.

Tables 60 (a-d) give average values for height, weight, percent fat and FFM within age groups for each activity level. (For those over the age of 30 years Standard Error has not been calculated, as it is not worthwhile due to the low value of n in these categories).

Tables 61 (a-d) make a comparison of mean values in age groups 17-29 years only for height, weight, percent fat and FFM between those exercising daily and only occasionally.

In Table 61 (a), mean height between the two samples was significantly different at the 5% level for the age group 20-24 years with those exercising daily being 1.9cm taller than those exercising less than this. There were no other significant differences.

In Table 61 (b) mean weight between the two extreme activity levels was not significantly different and can be seen to be a reflection of height.

In Table 61(c) mean percent fat in the comparable age groups can be seen to be slightly lower for those who take exercise daily. The difference is significant between the ages of 20-29 years a the 1% and 0.1% levels respectively.

In Table 61(d) mean FFM was not significantly different between the two activity levels. Mean FFM can also be seen to be a reflection of height.

In summary, mean FFM for the female sample is not so greatly affected by exercise and the slight differences in FFM can be seen to be due mainly to the differences in mean height between the two activity levels. Mean percent body fat, however, does appear to be affected by exercise. Like the male results, mean body fat was significantly less for the sample who took the most exercise.

The fact that the effect of exercise is not quite so marked as in the male sample may be due to the fact that the female daily activity was not as strenuous as that of the male sample.

This analysis will hopefully point out the beneficial effects of exercise on body composition for the Forces male and female samples.

3.7.5 Exercise Habits and Body Composition : Civilian Females

The female civilian sample was also split into two activity groups similar to those found in the male civilian sample (Section 3.7.2).

% Body Fat

Table 62 gives the mean values for % body fat for the two activity groups within age groups for the female civilian sample.

All the age groups over the age of 20 years who exercised twice weekly or more were slightly leaner than those who took less exercise. Like the male sample, the magnitude of the difference between the two activity groups was, on average, 1% fat and was significantly less at the 5% level for the age group 30-34 years.

FFM

Table 63 gives the mean values for FFM for the two activity groups within age groups for the female civilian sample. Again there were no significant differences in mean height found between the two activity groups. Mean heights apart from age group 25-29 years were within 0.5cm of one another. The differences in mean height between the two groups for the 25-29 year olds was 2.2cm, the most active being the taller. It was found that for the majority of age groups those who took the most exercise had slightly higher mean values for FFM than those who exercised less frequently. The differences in mean FFM were found to be significant in age groups 17-19 years and 25-29 years. However, the significant differences found in the latter age group is probably partly reflecting the slight difference found in mean height between the two activity groups.

Overall, the differences found in the female civilian analysis were similar to those found in the male samples. The general trend was again that those subjects who took the most exercise were slightly leaner and overall had higher values for mean FFM than the less active group.

The differences, however, found between the two activity groups in mean FFM values, were not as pronounced as the differences seenbetween the two male civilian activity groups.

3.7.6 A Comparison of the Forces Exercise Habits to Those of Civilians

Females

Table 64 shows the overall percentage of those who exercise daily, greater than or equal to twice per week, less than twice per week and occasionally/never for both female Forces and female civilians.

Overall, as with the male results, the female Forces sampled take more exercise than the female civilians sampled. When split into age groups (up until age 34 years only) the Forces sample are again seen to exercise more than their civilian equivalents.

From age 35-39 years n is too low in the Forces age groups for a proper comparison (Table 65).

From the past two tables it can be seen that both the male and female Forces sampled took more sparing exercise than the civilian sample. The benefits of exercise, however, should still be emphasised and the use of Forces sporting facilities maximised. By looking at percent body fat within age groups for those who take daily exercise (Table 54a) it can be seen that the previously mentioned desirable level of body fat for men of around 15% has still to be reached and maintained by the older male age groups.

Forces Sample: Females

n* = 1,083

ACTIVITY GROUPS

Table 57

9% of Female Forces sampled exercise	Daily
32% of Female Forces sampled exercise	≥ 2/week
28% of Female Forces sampled exercise	< 2/week
31% of Female Forces sampled exercise	Occasionally/Never

LEVEL OF ACTIVITY WITHIN AGE GROUPS

Table 58

AGE (YRS) EXERCISE	17-19	20-24	25-29	30-34	*35-39	*40-44	*45-49	*50-55
≥ 2/week	42%	40%	38%	34%	64%	31%	50%	50%
< 2/week	58%	60%	62%	66%	36%	69%	50%	50%

* n < 15

MEAN HEIGHT, WEIGHT, % FAT AND FFM WITHIN ACTIVITY GROUPS

Table 59

EXERCISE	n	HEIGHT (cm)	WEIGHT (kg)	% FAT	FFM (kg)
Daily	94	164.8 (0.6)	60.3 (0.8)	26.5 (0.5)	44.1 (0.4)
≥ 2/week	348	163.4 (0.3)	61.5 (0.5)	28.1 (0.2)	43.9 (0.3)
< 2/week	304	163.5 (0.4)	61.5 (0.5)	28.5 (0.2)	43.7 (0.3)
Occ/Never	337	163.4 (0.3)	60.6 (0.4)	28.4 (0.2)	43.2 (0.2)

NOTE: Nos in brackets = Standard Error.

* 3 subjects did not answer

Forces Sample: Females

(Standard Error in Parenthesis)

Table 60a

MEAN HEIGHT (cm) FOR EACH ACTIVITY LEVEL

AGE (YRS)	DAILY	≥ 2/WEEK	< 2/WEEK	OCC/NEVER
17-19	164.6 (1.0)	163.2 (0.5)	162.9 (0.6)	162.9 (0.5)
20-24	165.6 (0.8)	163.6 (0.6)	164.7 (0.6)	163.7 (0.5)
25-29	163.3 (2.3)	164.5 (1.3)	163.6 (1.2)	164.7 (1.0)
30-34	162.9	161.0 (1.8)	159.5	159.7
35-39	163.2	166.5 (2.4)	163.5	160.5
40-44	-	160.7	159.0	165.2
45-49	-	159.6	161.9	177.0
50-55	160.7	156.2	162.8	166.4

Table 60b

MEAN WEIGHT (kg) FOR EACH ACTIVITY LEVEL

AGE (YRS)	DAILY	≥ 2/WEEK	< 2/WEEK	OCC/NEVER
17-19	60.5 (1.1)	60.5 (0.6)	61.6 (0.9)	59.6 (0.7)
20-24	60.9 (1.1)	62.3 (0.8)	61.7 (0.7)	60.7 (0.7)
25-29	57.3 (3.1)	61.0 (1.6)	59.8 (1.4)	63.4 (1.5)
30-34	56.3	59.9	58.9	58.0
35-39	60.8	63.6	64.6	67.2
40-44	-	68.6	80.2	61.0
45-49	-	57.8	63.1	66.0
50-55	71.5	74.8	58.5	72.8

Forces Sample: Females

(Standard Error in Parenthesis)

Table 60c

MEAN % FAT FOR EACH ACTIVITY LEVEL

AGE (YRS)	DAILY	> 2/WEEK	< 2/WEEK	OCC/NEVER
17-19	27.0 (0.6)	27.9 (0.3)	28.4 (0.4)	28.1 (0.4)
20-24	26.3 (0.7)	28.3 (0.4)	28.6 (0.4)	28.1 (0.3)
25-29	24.0 (1.8)	26.4 (0.8)	26.3 (0.9)	29.3 (0.7)
30-34	28.9	29.1 (0.9)	29.9	30.3
35-39	25.0	29.8 (1.0)	30.7	33.7
40-44	-	37.2	38.4	29.7
45-49	-	29.1	34.4	30.4
50-55	38.0	38.5	32.3	38.7

Table 60d

MEAN FFM (kg) FOR EACH ACTIVITY LEVEL

AGE (YRS)	DAILY	> 2/WEEK	< 2/WEEK	OCC/NEVER
17-19	44.0 (0.8)	43.4 (0.3)	43.9 (0.5)	42.6 (0.4)
20-24	44.7 (0.6)	44.3 (0.4)	43.8 (0.4)	43.4 (0.4)
25-29	43.1 (1.5)	44.2 (1.1)	43.7 (0.6)	44.5 (0.8)
30-34	40.0	42.4 (1.3)	41.0	40.2
35-39	45.6	44.4 (1.8)	44.8	44.3
40-44	-	42.8	49.1	42.4
45-49	-	41.0	41.2	45.9
50-55	44.3	46.0	39.6	44.6

Forces Sample: Females

(Standard Error in Parenthesis)

MEAN HEIGHT (Ages 17-29 only) Table 61a

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNIFICANCE
17-19	35	164.6 (1.0)	119	162.9 (0.5)	NS
20-24	44	165.6 (0.8)	159	163.7 (0.5)	*
25-29	10	163.3 (2.3)	36	164.7 (1.0)	NS

MEAN WEIGHT (Ages 17-29 only) (Kg) Table 61b

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNIFICANCE
17-19	35	60.5 (1.1)	119	59.6 (0.7)	NS
20-24	44	60.9 (1.1)	159	60.7 (0.7)	NS
25-29	10	57.3 (3.1)	36	63.4 (1.5)	NS

MEAN PERCENT FAT COMPARISON (Ages 17-29 only) Table 61c

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNFICANCE
17-19	35	27.0 (0.6)	119	28.1 (0.4)	NS
20-24	44	26.3 (0.7)	159	28.1 (0.3)	**
25-29	10	24.0 (1.8)	36	29.3 (0.7)	***

MEAN FFM COMPARISON (Ages 17-29 only) (Kg) Table 61d

AGE (YRS)	n	DAILY ACTIVITY	n	OCC/NEVER	LEVEL OF SIGNIFICANCE
17-19	35	44.0 (0.8)	119	42.6 (0.4)	NS
20-24	44	44.7 (0.6)	159	43.4 (0.4)	NS
25-29	10	43.1 (1.5)	36	44.5 (0.8)	NS

TABLE 62

CIVILIANS

Comparison of % Levels Between Two Activity Levels

(Standard Error in Parenthesis)

FEMALES

Age	n	Exercise ⩾ 2/week	n	Exercise <2/week	Level of Significance
x17-19	38	26.0 (0.7)	91	24.8 (0.4)	NS
20-24	99	25.9 (0.4)	219	26.5 (0.3)	NS
25-29	50	25.5 (0.6)	109	26.6 (0.4)	NS
30-34	19	26.8 (0.8)	43	28.8 (0.6)	*
35-39	21	28.2 (0.7)	57	29.3 (0.5)	NS
40-44	23	31.1 (0.7)	63	32.6 (0.5)	NS
45-49	18	32.4 (0.9)	69	33.1 (0.4)	NS
50-64	43	35.6 (0.5)	148	35.8 (0.3)	NS

Comparison of FFM Between Two Activity Levels

(Standard Error in Parenthesis)

Table 63

FEMALES

Age	n	Exercise ⩾ 2/week	n	Exercise <2/week	Level of Significance
x 17-19	38	42.5 (0.6)	91	40.7 (0.4)	*
20-24	99	42.3 (0.4)	219	41.8 (0.3)	NS
25-29	50	43.0 (0.6)	109	41.3 (0.4)	*
30-34	19	40.2 (0.9)	43	41.2 (0.7)	NS
35-39	21	41.6 (1.1)	57	42.3 (0.8)	NS
40-44	23	42.1 (1.6)	63	41.4 (0.6)	NS
45-49	18	42.1 (1.0)	69	41.8 (0.6)	NS
50-64	43	40.4 (0.6)	148	40.2 (0.4)	NS

Key: x: 16yr olds not included.
*: Significant at the 5% level
NS: Not Significant

Comparison of Exercise Habits: Females — Table 64

	Forces '81	Civilians '82
Daily	9%	11%
⩾ 2/week	32%	21%
< 2/week	28%	17%
Occ/Never	31%	55%

Within Age Groups — Table 65

	Exercise ⩾ 2/week		Exercise < 2/week	
Age (YRS)	Forces '81	Civilians '82	Forces '81	Civilians '82
17-19	42%	29%	58%	71%
20-24	40%	31%	60%	69%
25-29	38%	30%	62%	70%
30-34	34%	31%	66%	69%
35-39	*64%	27%	*36%	73%
40-44	*31%	27%	*69%	73%
45-49	*50%	21%	*50%	79%
50-64	*50%	22%	*50%	78%

* n < 15

3.8 EFFECT OF OCCUPATION AND EXERCISE HABITS ON BODY COMPOSITION

3.8.1 Occupation Only : Forces Males

Two samples were chos en from the total male Forces data who were known to have either (a) active occupations or (b) sedentary occupations (see Appendix G). Only those occupations which were clearly active or inactive were used. This unfortunately reduced quite markedly, the numbers found in some of the age groups. However, to obtain clear results these definite categories were necessary.

The samples were then divided into age groups and a comparison of mean height, weight, FFM and % fat was made between the two occupational groups (Table 66).

Mean heights were within 1.5cm of one another between the two groups and were not found to be significantly different. The mean heights for the first three age groups in the active sample formed a surprising pattern in that there was a decrease between the 16 year olds and the 17 year olds. This was probably an artefact of the 17-24 year old sample, since mean height was seen to increase considerably from the 24 year olds to the age group 25-29 years, and all previous analysis in this study demonstrated an increase in mean height with age.

Mean weight was also not seen to differ significantly between the two samples within any age group.

Although the mean % fat values between the active and inactive occupations were also not significantly different between age groups, looking generally at the two sets of mean % fat values it could be seen that those subjects with active occupations had consistently lower values for % fat than those with sedentary occupations.

Mean FFM values between the active and sedentary occupation groups were, apart from the age group 35-39 years, slightly higher for those with an active occupation. The differences in mean FFM values were significantly higher at the 5% level within the

age group 30-34 years for those subjects with an active occupation.

In conclusion, the subjects with active occupations appeared to be very slightly less fat, with less than 1% fat of a difference at most ages and also slightly larger mean FFM values.

A limitation of this comparison was that it was unknown how much of an effect the individual's sporting activities would have on the results. The two samples were therefore further divided into activity groups as well as types of occupations. By standardising the effects of sporting activity as much as possible, it was hoped that the sole effects of occupation or of exercising habits might become more apparent.

Subjects Exercising at least Twice a Week

Analysis was carried out firstly on those subjects who exercised at least twice a week. Information on exercise habits came from the questionnaire which is described in the Methods chapter. The subjects were then split into occupational and age groups (Table 67) and a comparison was made. The mean heights and weights within age groups between the two samples were not significantly different and any differences in weight could seem to be due largely to the slight differences in height. In 5 out of 7 comparable age groups the active group had smaller mean heights than the sedentary group. Looking at mean % fat values for both groups who exercised at least twice a week, showed that those who also had an active occupation had consistently lower % fat values than those with sedentary occupations, but again in no group were the differences significant, and the average difference was only about 1% fat.

Mean FFM values for those exercising at least twice a week showed that, with the exception of the 17-19 year olds, those with active occupations also had consistently higher values for FFM than those subjects with sedentary jobs. This difference averaged 1.5kg but in no age group was the different significant.

In all the the 17-19 year olds and the 40-44 year olds, mean height was smaller for those with active occupations. Despite

this, most of the active groups had larger 'builds' than those in sedentary occupations.

Subjects Exercising less than Twice a Week

Similar analysis was then carried out on those subjects who exercised less than twice a week and the sample was again split into occupation and age groups (Table 68) and a comparison made. Unfortunately the number of subjects with active jobs but who only played sport occasionally was limited. The only age groups with sufficient numbers to compare were those between the ages of 17 and 29 years. There were no significant differences between the two groups for height, weight, FFM or % fat. However, in both age groups mean values for % body fat were slightly lower for those with active jobs.

This comparison of active and sedentary jobs, with exercise levels standardised as much as possible, had shown slight anthropometric differences related to occupation. The more active occupational groups tended to have slightly lower fat contents although the differences were non-significant and only about 1% fat in magnitude. Within the subject groups who exercised at least twice a week, there also appeared to be a slight difference in 'build' with those holding active jobs having slightly larger 'builds' than those with sedentary jobs. The magnitude of these differences were, however, small and the quantification was complicated because of the height differences between groups.

3.8.2 Exercise Only : Forces Males

Instead of keeping exercise habits constant, in the following analysis occupation was kept constant and the effects of exercise levels discussed. Within the active occupation groups only the age range 17-24 years could be discussed because of the sample sizes (Table 69). Within this range, despite the fact that those who exercised at least twice a week were slightly smaller in stature, they had slightly larger mean FFM values, suggesting that they were slightly larger 'built'. There appeared to be no pattern to the differences in % fat or weight.

Within the two sedentary occupation groups (Table 70) neither group was consistently taller than the other, but those who exercised less than twice a week tended to be marginally fatter in terms of % fat, than the more active group. They also tended to have slightly smaller FFM values but the significance of this fact was complicated by the height differences. Weight differences merely reflected the FFM and % fat variations. As in the preceding analysis, the actual magnitude of these anthropometric differences was amall and generally non-significant.

The analysis showed that both exercise habits and occupation can affect anthropometric variables slightly. In the following analysis it was hoped that by comparing the two extreme samples, i.e. those subjects who had active occupations and exercised at least twice a week and those subjects who had sedentary occupations and only exercised occasionally, the combined effects of occupations and activity on the body composition might be shown to be significant (Table 71). This comparison showed a more marked pattern of differences than was previously shown.

There was no obvious pattern to the height differences between the two samples, as the active group were on average smaller within the 17-24 years age range and the situation reversed at all other ages. There was also no pattern to the weight differences, which were reflecIting % fat and FFM differences.

In all age groups, except the 16 year olds, the sedentary group were slightly fatter than the active group. The mean difference was 1.6% and it was significant at the 95% level between the ages of 25 and 34 years. FFM also differed between the two groups, with the active group having the larger values in the majority of age groups, despite sometimes having smaller values for mean height. Between the ages of 16 and 39 years, the active group were on average only 0.4cm taller than the more sedentary group and had FFM values on average 2kg larger. This result again suggests a difference in 'build' and the FFM differences were significant at the 5% level or above, between the ages of 25 and 34 years.

3.8.3 Effects of Exercise Habits and Occupation on Body Composition: Civilian Males

This analysis was carried out in a similar manner to that described in the male Forces sample but only on those civilian subjects who were known to have sedentary occupations. No analysis was carried out on active occupation groups due to the low numbers sampled.

Table 72 shows the mean results for height, weight, FFM and % fat for male civilians with sedentary jobs who (a) exercised at least twice a week or (b) exercised less than twice a week. Mean height in age groups was not shown to be significantly different between the two sampled. Table 73 , however, shows that between the ages of 20 and 64 years the mean height was marginally taller on average by about 0.9cm for those who exercised more often. Mean weight in age groups between 20-64 years was also not significantly different between the two groups. However, those aged between 17 and 19 years who exercised less than twice a week were significantly heavier than those who exercised at least twice a week. This was seen to be mainly a reflection of the differences in mean height and FFM.

Mean % fat for the active group with the exception of age group 20-24 years could be seen to be consistently lower than those within the less active group. The difference in mean % fat between the two samples was significantly for all age groups apart from the 20-24 year olds and 30-39 year olds, and averaged almost 2% fat. Between the ages of 20-49 years mean FFM values were slightly higher for those who exercised often compared to the less active group and this was significant at the 5% level for the age group 30-39 years.

Mean FFM for the 50-64 years age group was only marginally less for those who exercised at least twice a week, compared to those who exercised below this level. For the 17-19 year old age group the differences between the two samples were again mainly due to the differences in mean height. The remaining differences seen in the mean FFM values averaged only approximately 1.5kg and were probably mainly due to the slight difference in mean height.

Exercise habits did therefore appear to significantly affect the majority of age groups so that those subjects who exercised most frequently did appear to have lower mean values for % body fat. No differences in 'build' could be seen within this sample.

The conclusion from this male analysis is that activity, both in a male's occupation and in his exercise habits, can affect his 'fat' content and 'build'. In some individuals the effect is likely to be fairly large and in others negligible. The magnitude would depend exactly on how active or inactive he was and how much he ate. The questionnaire in this study only required approximate answers and therefore the magnitude of the differences recorded here should only be taken as a guide and an indicator that differences do arise.

FORCES: MALES

Table 66

Active Occupations* V Sedentary Occupations*

(Standard Deviation in Parenthesis)

	Active Occupations: Mean Results				Sedentary Occupations: Mean Results				
Ageyrs	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)
16	121	175.5 (7.1)	67.1 (8.2)	13.5 (3.2)	57.9 (6.0)	20	175.5 (6.7)	64.3 (8.1)	13.7 (2.7)	55.4 (6.3)
17-19	189	174.3 (7.5)	67.2 (7.9)	14.7 (3.7)	57.2 (5.7)	121	175.6 (6.6)	68.0 (8.9)	15.6 (4.2)	57.1 (5.7)
20-24	141	174.4 (7.2)	71.9 (9.2)	15.9 (4.1)	60.2 (6.1)	107	175.9 (6.7)	72.6 (10.1)	16.8 (5.1)	60.0 (5.8)
25-29	53	175.8 (9.2)	75.6 (13.1)	16.2 (4.3)	63.0 (9.1)	93	175.6 (7.0)	74.3 (10.6)	17.7 (4.5)	60.8 (6.9)
30-34	28	175.7 (6.5)	78.0 (8.4)	20.2 (3.7)	62.1 (5.5)	124	175.6 (6.4)	75.7 (10.7)	21.1 (3.9)	59.4 (6.6)
35-39	14	176.1 (7.6)	73.7 (8.6)	19.6 (3.0)	59.1 (6.3)	135	175.4 (6.3)	76.6 (10.2)	21.0 (3.6)	60.3 (6.6)
40-44	7	175.5 (4.9)	79.8 (8.5)	23.5 (3.0)	60.9 (5.5)	68	175.2 (6.5)	76.7 (10.9)	24.2 (4.9)	57.8 (6.2)
45-49	-	-	-	-	-	37	174.7 (6.0)	78.4 (10.3)	25.8 (4.2)	57.9 (6.0)
50-59	-	-	-	-	-	19	176.3 (5.8)	81.0 (11.3)	28.1 (5.1)	57.8 (5.9)

* See Appendix E

Table 67

FORCES: MALES

Active Occupations* V Sedentary Occupations*

For Subjects who Exercise ≥ 2/week

(Standard Deviation in Parenthesis)

	Active Occupations: Mean Results					Sedentary Occupations: Mean Results				
Ageyrs	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)
16	118	175.6 (7.1)	67.3 (8.1)	13.6 (3.2)	58.0 (5.9)	17	176.0 (6.7)	64.7 (8.6)	13.9 (2.8)	55.6 (6.6)
17-19	171	174.1 (7.6)	67.3 (8.0)	14.7 (3.7)	57.3 (5.8)	70	175.9 (6.1)	68.9 (8.7)	15.8 (4.2)	57.7 (5.4)
20-24	121	174.3 (7.4)	71.9 (9.5)	15.8 (4.1)	60.3 (6.2)	72	175.2 (7.0)	72.1 (9.4)	16.7 (4.3)	59.8 (5.9)
25-29	47	176.2 (9.6)	75.9 (13.6)	15.7 (4.1)	63.6 (9.4)	51	175.8 (5.8)	74.8 (9.9)	17.4 (4.7)	61.5 (6.2)
30-34	23	175.6 (6.4)	77.2 (8.7)	19.7 (3.7)	61.8 (5.6)	60	177.1 (6.2)	77.3 (11.1)	20.8 (3.8)	60.9 (6.9)
35-39	10	175.7 (7.6)	73.6 (9.4)	19.2 (3.2)	59.3 (6.8)	76	176.2 (7.0)	77.6 (9.7)	21.1 (3.7)	61.0 (6.3)
40-44	5	176.5 (5.4)	77.6 (7.5)	22.7 (3.4)	60.0 (5.6)	35	174.7 (7.2)	76.3 (10.5)	23.4 (4.7)	58.1 (6.5)
45-49	-	-	-	-	-	12	172.7 (8.3)	77.7 (11.2)	23.8 (5.1)	58.7 (9.9)
50-59	-	-	-	-	-	6	176.2 (7.0)	78.7 (12.1)	27.7 (2.8)	56.7 (7.0)

* See Appendix E

Table 68

FORCES: MALES

Active Occupations* V Sedentary Occupations*

For Subjects who Exercise < 2/week

(Standard Deviation in Parenthesis)

		Active Occupations: Mean Results					Sedentary Occupations: Mean Results			
Ageyrs	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)	n	Height (cm)	Weight(kg)	% Fat	FFM (kg)
16	3	169.2 (7.9)	58.1 (5.2)	11.5 (1.6)	51.4 (5.1)	3	172.3 (6.7)	61.8 (5.2)	12.3 (0.5)	54.1 (4.7)
17-19	18	176.6 (6.9)	65.8 (7.0)	14.0 (3.5)	56.4 (4.9)	49	175.1 (7.3)	66.3 (9.0)	15.2 (4.0)	56.0 (6.1)
20-24	20	175.2 (6.1)	72.1 (7.4)	16.8 (3.9)	59.9 (5.7)	34	177.4 (6.2)	74.0 (11.5)	17.1 (6.4)	60.7 (5.5)
25-29	6	173.1 (4.8)	73.4 (7.8)	20.3 (4.5)	58.2 (4.0)	39	175.5 (8.0)	72.9 (11.4)	17.9 (4.3)	59.5 (7.8)
30-34	5	176.0 (7.9)	81.9 (6.4)	22.6 (2.4)	63.4 (5.6)	62	174.1 (6.2)	74.3 (10.0)	21.5 (3.9)	58.0 (6.2)
35-39	4	177.2 (8.6)	73.9 (7.8)	20.6 (2.3)	58.6 (5.8)	58	174.6 (6.5)	75.6 (10.7)	20.9 (3.5)	59.5 (6.9)
40-44	1	172.9	90.5	27.7	65.4	33	175.7 (5.7)	77.2 (11.4)	25.1 (5.0)	57.4 (5.9)
45-49	-	-	-	-	-	24	175.5 (4.3)	78.1 (9.8)	26.5 (3.3)	57.2 (6.2)
50-59	-	-	-	-	-	12	176.2 (5.7)	82.5 (11.6)	28.4 (6.2)	58.6 (5.8)

* See Appendix E

Table 69

FORCES: MALES

+Active Jobs + Exercise ≥ 2/Wk V Active Jobs + Exercise < 2/Wk

Age	Height (cm)			Weight (kg)			% Fat			FFM (kg)		
	AJ, ≥ 2/wk		AJ, < 2/wk	AJ, ≥ 2/wk		AJ, < 2/wk	AJ, ≥ 2/wk		AJ, < 2/wk	AJ, ≥ 2/wk		AJ, < 2/wk
16	175.6	NS	x169.2	67.3	**	x58.1	13.6	*	x11.5	58.0	***	x51.4
17-19	174.1	NS	176.6	67.3	NS	65.8	14.7	NS	14.0	57.3	NS	56.4
20-24	174.3	NS	175.2	71.9	NS	72.1	15.8	NS	16.8	60.3	NS	59.9
25-29	176.2	NS	x173.1	75.9	NS	x73.4	15.7	*	x20.3	63.6	*	x58.2
30-34	175.6	NS	x176.0	77.2	NS	x81.9	19.7	*	x22.6	61.8	NS	x63.4
35-39	175.7		x177.2	73.6		x73.9	19.2		x20.6	59.3		x58.6
40-44	176.5		x172.9	77.6		x90.5	22.7		x27.7	60.0		x65.4
45-49	-		-	-		-	-		-	-		-
50-59	-		-	-		-	-		-	-		-

Key:

NS	Not Significant
*	Significant at the 5% level
**	Significant at the 1% level
***	Significant at the 0·1 % level
x	n < 6
+	See Appendix E

FORCES: MALES

Table 70

+Sedentary Jobs + Exercise ⩾ 2/Wk V Sedentary Jobs + Exercise < 2/Wk

Age	Height (cm)			Weight (kg)			% Fat			FFM (kg)		
	SJ, ⩾ 2/wk		SJ, < 2/wk	SJ, ⩾ 2/wk		SJ, < 2/wk	SJ, ⩾ 2/wk		SJ, < 2/wk	SJ, ⩾ 2/wk		SJ, < 2/wk
16	176.0	NS	172.3	64.7	NS	61.8	13.9	NS	12.3	55.6	NS	54.1
17-19	175.9	NS	175.1	68.9	NS	66.3	15.8	NS	15.2	57.7	NS	56.0
20-24	175.2	NS	177.4	72.1	NS	74.0	16.7	NS	17.1	59.8	NS	60.7
25-29	175.8	NS	175.5	74.8	NS	72.9	17.4	NS	17.9	61.5	NS	59.5
30-34	177.1	**	174.1	77.3	NS	74.3	20.8	NS	21.5	60.9	*	58.0
35-39	176.2	NS	174.6	77.6	NS	75.6	21.1	NS	20.9	61.0	NS	59.5
40-44	174.7	NS	175.7	76.3	NS	77.2	23.4	NS	25.1	58.1	NS	57.4
45-49	172.7	NS	175.5	77.7	NS	78.1	23.8	NS	26.5	58.7	NS	57.2
50-59	176.2	NS	176.2	78.7	NS	82.5	27.7	NS	28.4	56.7	NS	58.6

Key:

NS	Not Significant
*	Significant at the 5% level
**	Significant at the 1% level
***	Significant at the 0·1% level
+	See Appendix E

Table 71

FORCES: MALES

+Active Jobs + Exercise ⩾ 2/week (AJ ⩾ 2)/Sedentary Jobs + Exercise < 2/week (SJ < 2)

(Standard Error in Parenthesis)

Age	Height (cm)			Weight (kg)			% Fat			FFM (kg)		
	AJ, ⩾ 2/wk		SJ, < 2/wk	AJ, ⩾ 2/wk		SJ, < 2/wk	AJ, ⩾ 2/wk		SJ, < 2/wk	AJ, ⩾ 2/wk		SJ, < 2/wk
16	175.6 (0.6)	NS	x172.3 (3.9)	67.3 (0.7)	NS	x61.8 (3.0)	13.6 (0.3)	NS	x12.3 (0.3)	58.0 (0.5)	NS	x54.1)2.7)
17-19	174.1 (0.6)	NS	175.1 (1.0)	67.3 (0.6)	NS	66.3 (1.3)	14.7 (0.6)	NS	15.2 (0.6)	57.3 (0.4)	NS	56.0 (0.9)
20-24	174.3 (0.7)	*	177.4 (1.0)	71.9 (0.9)	NS	74.0 (2.0)	15.8 (0.4)	NS	17.1 (1.1)	60.3 (0.6)	NS	60.7 (0.9)
25-29	176.2 (1.4)	NS	175.5 (1.3)	75.9 (2.0)	NS	72.9 (1.8)	15.7 (0.6)	*	17.9 (0.7	63.6 (1.4)	*	59.5 (1.2)
30-34	175.6 (1.3)	NS	174.1 (0.8)	77.2 (1.8)	NS	74.3 (1.3)	19.7 (0.8)	*	21.5 (0.5)	61.8 (1.8)	**	58.0 (0.8)
35-39	175.7 (2.4)	NS	174.6 (0.8)	73.6 (3.0)	NS	75.6 (1.4)	19.2 (1.0)	NS	20.9 (0.4)	59.3 (2.1)	NS	59.5 (0.9)
40-44	x176.5		x175.7 (1.0)	x77.6		77.2 (2.0)	x22.7		25.1 (0.9)	x60.0		57.4 (1.0)
45-49	-		175.5 (0.9)	-		78.1 (2.0)	-		26.5 (0.7)	-		57.2 (1.3)
50-59	-		176.2 (1.6)	-		82.5 (3.3)	-		28.4 (1.8)	-		58.6 (1.7)

Key: * significant at the 5% level
** significant at the 1% level
*** significant at the 0.1% level
+ see appendix E

x n < 6

Table 72

CIVILIANS: MALES

Activity Levels of Males with Sedentary Jobs,* and their effect on Body Composition

Sedentary Occupations; Exercise ≥ 2/wk V Exercise < 2/wk

(Standard Deviation in Parenthesis)

	Exercise ≥ 2/wk: Mean Results					Exercise < 2/wk: Mean Results				
Age	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)
17-19	15	175.3 (6.0)	63.2 (5.9)	13.8 (2.5)	54.4 (4.1)	5	180.4 (4.9)	75.0 (10.4)	18.8 (4.1)	60.7 (7.6)
20-24	46	178.3 (5.9)	70.9 (8.3)	16.4 (3.8)	59.1 (5.7)	38	177.3 (6.6)	68.7 (7.4)	16.1 (3.3)	57.4 (5.1)
25-29	49	177.4 (7.0)	72.4 (9.0)	16.9 (4.3)	60.0 (6.0)	51	176.4 (6.6)	73.0 (10.3)	18.7 (3.8)	59.1 (6.8)
30-39	55	176.1 (6.6)	74.9 (12.9)	20.4 (4.3)	59.2 (8.2)	94	175.1 (7.4)	71.9 (9.2)	21.1 (3.5)	56.5 (6.0)
40-49	59	176.3 (6.0)	72.5 (9.0)	22.5 (4.4)	55.9 (5.4)	65	174.9 (6.5)	74.5 (12.4)	25.1 (4.2)	55.4 (6.9)
50-64	43	174.5 (6.4)	74.1 (9.8)	26.0 (5.3)	54.5 (5.4)	98	174.3 (6.7)	76.2 (8.2)	27.8 (4.4)	54.8 (4.7)

* See Appendix E

Table 73

CIVILIANS: MALES

Sedentary Jobs[+] + Exercise ≥ 2/wk V Sedentary Jobs + Exercise < 2/wk

Age	Height (cm)			Weight (kg)			% Fat			FFM (kg)		
	≥ 2/wk		< 2/wk	≥ 2/wk		< 2/wk	≥ 2/wk		< 2/wk	≥ 2/wk		< 2/wk
17-19	175.3	NS	x180.4	63.2	*	x75.0	13.8	**	x18.8	54.4	NS	x60.7
20-24	178.3	NS	177.3	70.9	NS	68.7	16.4	NS	16.1	59.1	NS	57.4
25-29	177.4	NS	176.4	72.4	NS	73.0	16.9	*	18.7	60.0	NS	59.1
30-39	176.1	NS	175.1	74.9	NS	71.9	20.4	NS	21.1	59.2	*	56.5
40-49	176.3	NS	174.9	72.5	NS	74.5	22.5	***	25.1	55.9	NS	55.3
50-64	174.5	NS	174.3	74.1	NS	76.2	26.0	*	27.8	54.5	NS	54.8

Key:

NS	Not Significant
*	Significant at the 5% level
**	Significant at the 1% level
***	Significant at the 0.1% level
x	n < 6
+	see appendix E

3.8.4 Effect of Occupation on Body Composition : Female Forces

Using the same methods as used in the male sample, two sub-samples of the female Forces sample were chosen to compare the possible effects of occupation on body composition. These sub-groups were 'moderately active' and 'sedentary' occupations (see Appendix E). Again, due to low numbers in the older age groups, only those aged between 17 years and 34 years have been included in the analysis.

As can be seen from Table 75, there were no general trends apparent in any of the variables. The only significant difference found was for the age groups 20-24 years, where those with 'moderately active' occupations were significantly fatter than those with sedentary trades. No 'build' differences were noted.

The lack of any pattern related to occupation within this sample does not necessarily suggest that differences in activity do not affect body composition in females. Instead, it is probably a reflection of the relatively small sample sizes and the lack of any obvious active occupational groups with which to compare the sedentary group.

No sub-division was made into activity groups related to exercise habits, because the sample size was too small to allow any worthwhile analysis.

3.8.5 Effect of Exercise Habits and Occupation on Body Composition: Civilian Females

For the same reasons described in the male civilian sample, this analysis was carried out only on those female civilian subjects who were known to have sedentary occupations (see Appendix E). Table 76 shows the mean result for height, weight, percent fat and FFM for those female civilians with sedentary jobs who (a) exercised at least twice a week or (b) exercised less than twice a week.

Mean heights between the two groups, Table 77 , were similar apart from the age group 25-29 years where those who exercised

more often were significantly taller at the 5% level than those who exercised less than twice a week. The mean weights were also similar apart from age groups 17-19 years where those who exercised at least twice a week were significantly heavier at the 1% level than those who exercised less than this. This could be seen to be mainly a reflection of the differences in the mean FFM values.

Mean percent body fat between the ages of 20-64 years was slightly less for those who exercised frequently, the mean difference being about 1% fat and was significantly less at the 5% level for the age groups 20-24 years and 30-39 years. Mean fat content was slightly higher for the 17-19 year olds who exercised over twice a week but not significantly so.

The 17-19 year olds who exercised were shown to have significantly higher mean FFM values at the 1% level than those who exercised less than twice a week despite the non-significant difference in mean heights between the two samples.

Most of the FFM differences, however, appeared to reflect only the differences in height and no 'build' differences could be seen.

In conclusion, this civilian analysis therefore basically agreed with the conclusions from the male samples. Activity related to exercise habits influenced fat content. In a comparison of 2 groups with similar occupations, those who exercised more often tended to have on average, lower fat contents although the difference was only about 1% of body weight. Again, no differences in 'build' were noticed although these had been suggested in the male Forces sample.

Activity related to occupation was not analysed because the sample sizes were too small in the active female civilian occupation groups.

Table 75

FORCES: FEMALES

Moderately Active Occupations* V Sedentary Occupations*

(Standard Deviation in Parenthesis)

	Active Occupations: Mean Results					Sedentary Occupations: Mean Results				
Age (yrs)	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)
17-19	82	162.6 (5.9)	62.2 (7.0)	29.2 (4.0)	43.8 (3.7)	47	163.6 (6.5)	62.7 (9.2)	28.4 (4.3)	44.7 (5.7)
20-24	115	163.8 (6.5)	62.6 (9.8)	28.9 (4.7)	44.2 (5.0)	101	163.9 (7.2)	60.7 (8.0)	27.6 (4.7)	43.7 (4.4)
25-29	35	163.6 (7.1)	59.5 (9.4)	26.2 (5.3)	43.5 (4.6)	28	162.7 (5.3)	59.4 (5.9)	26.4 (5.8)	43.5 (3.2)
30-34	14	159.9 (6.7)	56.5 (8.1)	28.5 (2.7)	40.2 (4.6)	9	161.3 (5.7)	59.7 (8.9)	28.9 (3.0)	42.2 (5.0)

* See Appendix E

Table 76

CIVILIANS: FEMALES

[+]Activity Levels of Females with [+]Sedentary Jobs and their Effect on Body Compostion

Sedentary Occupations; Exercise ⩾ 2/wk V Exercise < 2/wk

(Standard Deviation in Parenthesis)

	Exercise ⩾ 2/wk: Mean Results					Exercise < 2/wk: Mean Results				
Age(yrs)	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)	n	Height (cm)	Weight (kg)	% Fat	FFM (kg)
17-19	33	162.7 (4.9)	58.0 (7.0)	26.1 (4.5)	42.6 (3.4)	86	161.8 (5.8)	53.9 (6.2)	24.6 (3.6)	40.5 (3.8)
20-24	88	163.7 (6.0)	56.9 (7.2)	25.6 (3.8)	42.1 (3.9)	202	163.2 (6.1)	57.1 (7.5)	26.6 (4.5)	41.7 (4.0)
25-29	44	164.3 (5.3)	58.2 (7.9)	25.6 (4.1)	43.1 (4.4)	98	162.1 (5.6)	56.1 (6.7)	26.5 (4.1)	41.1 (3.7)
30-39	34	160.6 (5.3)	55.7 (7.6)	27.3 (3.3)	40.3 (4.6)	88	162.1 (6.7)	58.7 (9.8)	29.0 (3.8)	41.4 (5.2)
45 49	34	162.0 (5.9)	61.5 (8.5)	32.2 (3.3)	41.5 (4.7)	111	162.7 (6.8)	62.9 (9.8)	33.2 (3.9)	41.8 (5.0)
50-64	42	161.1 (5.7)	62.8 (8.3)	35.5 (3.1)	40.3 (4.4)	134	160.4 (6.2)	63.0 (9.7)	35.9 (3.9)	40.1 (4.9)

+ See Appendix E

Table 78

CIVILIANS: FEMALES

Sedentary Jobs[+] + Exercise ≥ 2/week V Sedentary Jobs + Exercise < 2/week

Age (yrs)	Height (cm)			Weight (kg)			% Fat			FFM (kg)		
	≥ 2/wk		< 2/wk	≥ 2/wk		< 2/wk	≥ 2/wk		< 2/wk	≥ 2/wk		< 2/wk
17-19	162.7	NS	161.8	58.0	**	53.9	26.1	NS	24.5	42.6	**	40.5
20-24	163.7	NS	163.2	56.9	NS	57.1	25.5	*	26.6	42.1	NS	41.7
25-29	164.3	*	162.1	58.2	NS	56.1	25.6	NS	26.5	43.1	**	41.1
30-39	160.6	NS	162.1	55.7	NS	58.7	27.3	*	29.0	40.3	NS	41.4
40-49	162.0	NS	162.7	61.5	NS	62.9	32.2	NS	33.2	41.5	NS	41.8
50-64	161.1	NS	160.4	62.8	NS	63.0	35.5	NS	35.9	40.3	NS	40.1

Key:
- NS Not Significant
- * Significant at the 5% level
- ** Significant at the 1% level
- *** Significant at the 0·1% level
- + See Appendix E

CONCLUSION

A large volume of social and anthropometric data ha been collected and analysed from a sample of 8799 British adults from both Forces and civilian populations.

Many previous studies of this nature have limited their data to height and weight measurements only. In this study measurements were taken of % bodyfat and fat free mass, by methods of skinfolds, in addition to height and weight. As a result it has been possible to make assessments on body composition based on a larger number of known factors.

Various social factors such as exercise and smoking have been known to affect body weight and this study has examined these two factors in detail and shown their effects on the % bodyfat and fat free mass components of the body.

It is hoped that the methods and detailed statistics compiled in this study can be utilised in future research in this field.

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Table 1

APPENDIX A

Establishment	Location	Total Seen	No of Males	No of Females
Army Bases				
Kirknewton - QOH	Midlothian	243	243	-
Glencourse Barracks	Midlothian	90	90	-
Middle Wallop - AAC	Hampshire	140	140	-
CAD Kineaton - RAOC	Warwickshire	187	114	73
Guards Depot, Pirbright	Surrey	275	272	3
Gaerlochhead - RIR	Dunbarton	33	33	-
Catterick	N Yorkshire	116	30	86
Guilford	Surrey	98	-	98
Aldershot & Cambridge Military Hospital	Hampshire	420	224	196
Arborfield - REME	Berkshire	171	171	-
Woolwich Military Hospital	London	78	-	78
RAOR - Osnabruch & Rhinedahlen	BAOR	313	264	49
	Totals	2,164	1,581	583

Table 2A

Navy Bases				
HMS Nelson	Hampshire	252	192	60
HMS Sultan	Hampshire	285	285	-
HMS Seahawk	Cornwall	412	360	52
HMS Collingwood	Hampshire	508	508	-
HMS Neptune	Dunbarton	146	100	46
Plymouth Bases	Devon	371	328	43
	Totals	1,974	1,773	201

Table 3A

RAF Bases				
RAF Linton-on-Ouze	Yorkshire	102	68	34
RAF Finningley	Yorkshire	118	98	20
RAF Buchan	Aberdeenshire	91	62	29
RAF Leuchars	Fife	124	105	19
RAF Lossiemouth	Morayshire	450	404	46
RAF St Athen	S Glamorgan	199	161	38

Establishment	Location	Total Seen	No of Males	No of Females
RAF Bases (cont)				
RAF Halton	Buckinghamshire	364	335	29
RAF Abingdon	Oxfordshire	192	180	12
RAF Hereford	Hereford	90	50	40
RAF Stafford	Staffordshire	242	181	61
RAF Kinloss	Morayshire	274	263	11
RAF Swinderby	Lincolnshire	168	168	-
	Totals	2,414	2,075	339

NOTE: Some Army personnel were examined at RAF Hereford.
Some RAF personnel were examined at Middle Wallop.

Total Females seen 1,123
Males seen 5,429

Table 4A

Civilian Sample: Description of the Number of People seen at each Location, and from each Company

Company	Location	MALES			FEMALES		
		Approx Total No	No Seen	% Seen	Approx Total No	No Seen	% Seen
Bank of Scotland	Glasgow	120	34	28	120	38	32
	Edinburgh		17	-		28	-
	London	130	35	27	290	72	25
British Rail	Glasgow	-	178		-	35	
Civil Service	Worthing	560	146	26	840	268	32
	London	750	52	7	750	47	6
MOD Civilians	Hampshire, Devon, SW England, Cardiff	-	8	-	-	18	-
Clydesdale Bank	Glasgow	474	22	5	347	58	17
University of Glasgow	Glasgow	-	23		-	31	
Hospital	Glasgow, Birmingham, Catterick	--	35	..	-	44	
DHSS	London	-	71		-	80	
Queens College	Glasgow	64	7	11	132	18	14
D Montgomery	Glasgow	156	8	5	50	25	50
Reo Stakis	Glasgow	43	7	16	97	11	11
Shell UK Ltd	Glasgow	130	16	12	130	12	9
Tennant Caledonian	Glasgow	579	10	2	320	15	5

Table 4A (cont)

Company	Location	MALES			FEMALES		
		Approx Total No	No Seen	% Seen	Approx Total No	No Seen	% Seen
Scottish Amicable	Glasgow	60	18	3	85	12	14
	Stirling	146	39	27	327	77	23
Royal Bank Of Scotland	Glasgow	15	-	-	31	18	58
	Edinburgh	37	21	57	73	17	23
Housewife	Glasgow	-	-	-	-	1	-
Local Transport	Birmingham		1	-	-	-	-
National Coal Board	Doncaster/ Sheffield	1,000	200	20	800	221	28
	Stoke-on-Trent	300	50	17	-	-	-
RAF Stafford Supply Depot	Stafford	500	68	14	500	63	13
Total Seen			1,066			1,209	

NOTE: 'Approx Total No' represents the approximate number of males or females at the individual offices or factories which were visited. It does not represent the number of people employed by the company in the entire city.

Forces Questionnaire

IN CONFIDENCE

Appendix B

Office use only

Date:

Time:

Int:

C.W.N:

Y.Bl.B:

E.G:

1. Surname

2. Date of entry to Service _____ mth _____ yr

3. Place(s) of residence over the first 15 years of your life (town and county only)

Place 1	Place 2	Place 3

4. Do you live 'IN'? (Mess/Billets) Please put a tick in relevant box YES ☐ NO ☐

5. Are you married? YES ☐ NO ☐

6. Date of Birth _____ day _____ mth _____ yr

7. Age last Birthday _____ yrs

8. Place of Birth (town and county) _____

9. Place of Birth of father: _____

of mother: _____

10. Which Corps/Regt do you belong to? _____

11. Present rank _____

12. Present trade _____

13. No. of years in this type of job _____

14. If you have been in the Services for less than 6 months please answer the following questions:

a. Trade/Occupation before joining the Services?

_____

b. No. of years?

_____

15. Have you ever smoked cigarettes? YES ☐ NO ☐

16. If Yes, for how long? _____ yrs

17. How many cigarettes per day?

less than 5	☐	26 - 30	☐
6 - 10	☐	31 - 35	☐
11 - 15	☐	36 - 40	☐
16 - 20	☐	41 - 45	☐
21 - 25	☐	more than 45	☐

18. Do you still smoke cigarettes? YES ☐ NO ☐

19. If NO, when did you stop?

Continued

20. Over the past 6 months has your weight been: steady ☐ rising ☐ falling ☐

21. Do you take any medicines or pills regularly? YES ☐ NO ☐

If Yes, please give details:

22. Is there anything else which might affect your weight YES ☐ NO ☐

If Yes, please give details:

---

23. How many times a week do you take exercise i.e. P.T. or sport?

Daily ☐
Twice a week or more ☐
Less than twice a week ☐
Only occasionally/never ☐

24. For how long have you maintained this level of exercise/lack of exercise? _____m

25. Do you play any sport? YES ☐ NO ☐

If Yes, please specify:

26. Over the past few weeks, have you had to cut down on your normal activity due to illness or injury?

YES ☐ NO ☐

If Yes, please give details:

Civilian Questionnaire

IN CONFIDENCE

Appendix B(2)

Date:

Am/Pm:

C.W.N:

Y.Bl.B:

1. Place(s) of residence over the first 15 years of your life (town and county only)

Place 1	Place 2	Place 3
_____	_____	_____
_____	_____	_____
No of years _____	No of years _____	No of years _____

2. Are you married? YES ☐ NO ☐

3. Date of Birth _____ day _____ month _____ year

4. Age last Birthday _____ yrs

5. Place of Birth (town and county) _____

Place of Birth of father: _____

Place of Birth of mother: _____

6. Name of the firm which employs you _____

7. Occupation _____

8. Number of years in this occupation _____ yrs

9. If you have held this post for less than 6 months, please state:

a. Previous occupation _____

b. Number of years _____ yrs

10. Have you ever smoked cigarettes? YES ☐ NO ☐

11. If Yes, please state for how long: _____ yrs

12. How many cigarettes per day?

less than 5	☐	26 - 30	☐
6 - 10	☐	31 - 35	☐
11 - 15	☐	36 - 40	☐
16 - 20	☐	41 - 45	☐
21 - 25	☐	More than 45	☐

13. Do you still smoke cigarettes? YES ☐ NO ☐

14. If No, when did you stop?

Continued

15. Over the past 6 months has your weight been: steady ☐ rising ☐ falling ☐

16. Do you take any medicines or pills regularly? YES ☐ NO ☐

If Yes, please give details:

17. Is there anything else which might affect your weight? YES ☐ NO ☐

If Yes, please give details:

---

18. How many times a week do you take exercise i.e. P.T. or sport?

Daily ☐
twice a week or more ☐
less than twice a week ☐
Only occasionally/never ☐

19. For how long have you maintained this level of exercise/lack of exercise? _____mt

20. Do you play sport? YES ☐ NO ☐

If Yes, please specify:

21. Over the past few weeks, have you had to cut down on your normal activity due to illness or injury? YES ☐ NO ☐

If Yes, please give details:

Appendix C

Body Composition Data

		VARIABLE	NO.
Subject		4	1
Card No.	1	5	
Geographical Area		7	2
Sex (M/F)		8	3
Civilian/Non Civilian (C/N)		9	4
Social Class		11	5
Examination Date	DAY MTH YR	17	6
Date of Birth	DAY MTH YR	23	7
Age (yrs)		25	8
Height	..	29	9
Weight	..	33	10
Skinfolds (mm) Biceps	.	36	11
Triceps	.	39	12
Subscapular	.	42	13
Supra-iliac	.	45	14
Total Skinfolds	.	49	15
% Fat	.	52	16
Fat Free Mass (kg)	.	55	17
Circumferences (cm) Calf	.	58	18
Thigh	.	61	19
Buttocks	.	65	20
Upper Arm	.	68	21
Diameters (cm) Ulna	.	70	22
Tibia	.	73	23
Biacromial	.	76	24
Biiliac	.	79	25
		80	26

Subject No.		4	
Card No.	2	5	
Time/Interviewer (F=1; S=2)		7	27
Ethnic Group		88	28
Date of Entry	MTH YR	12	29
M/S (M=2; S=1)		13	30
Corps/Regt/Employment		17	31
Location		20	32
Rank		23	33
Trade/Occupation		26	34
No. of Months	MTH'S	29	35
Previous job		32	36
No. of Months		35	37
Smoke?		38	38
No. of cigarettes		41	39
Still smoke?		45	40
Weight change?		48	41
Medication		51	42
Other factors		54	43
Exercise frequency		57	44
No. of months	MTH'S	60	45
Sport(s)		64	46
Illness		67	47
Live in/out		70	48

FMcK/SL

APPENDIX D

Computer Variables

The following section describes the variables on the computer sheet which originated from the questionnaire. It also includes the reasons behind the questions and the choice of answers. The total number of variables, from the questionnaire and anthropometric data, was 48.

Subject Number (Variable 1)

Geographical Area (Variable 2)

This was defined as the region in which the subject lived during the first ten years of his life or if he moved when under ten years old, the region in which he spent most of his first fifteen years, biased towards his early years. If he had moved between many regions, spending less than five years in any one region, he was coded as SCOTTISH, WELSH, ENGLISH, IRISH or NON-BRITISH, as was relevant.

Subjects, mainly from Forces families, who had travelled a lot throughout Britain or Forces based abroead, were coded as British -No-Area. Codes betwee 0 and 99 were given to the following categories and areas:

Missing Answer

SCOTLAND
ENGLAND
N IRELAND

ANTRIM
ARMAGH
AVON
BEDFORDSHIRE
BERKSHIRE
BORDERS
BUCKINGHAMSHIRE
CAMBRIDGESHIRE
CENTRAL
CHESHIRE
CLEVELAND
CLWYD
CORNWALL & ISLCES OF SCILLY
CUMBRIA
DERBYSHIRE
DEVON
DORSET
DOWN
DUMFRIES & GALLOWAY
DURHAM
DYFED
ESSEX
FERMANAGH
FIFE
GLAMORGAN
GLAMORGAN: MID/SOUTH/WEST

Non-British

WALES
S IRELAND
BRITISH-NO-AREA

ISLE OF MAN
ISLE OF WIGHT
KENT/LANCASHIRE
LEICESTERSHIRE
LINCOLNSHIRE
LONDON
LONDONDERRY
LOTHIAN
MANCHESTER
MERSEYSIDE
NORFOLK
NORTHAMPTONSHIRE
NORTHUMBERLAND
NOTTINGHAM
ORKNEYS
OXFORDSHIRE
POWYS
SHROPSHIRE$
SHETLAND
SOMERSET
STAFFORDSHIRE
STRATHCLYDE
SUFFOLK
SURREY
SUSSEX: EAST/WEST
TAYSIDE

APPENDIX D (cont)

GLOUCESTERSHIRE
GRAMPIAN
GWENT
GWYNEDD
HAMPSHIRE
HEREFORD AND WORCESTER
HERTFORDSHIRE
HIGHLAND
HUMBERSIDE
TYNE AND WEAR
TYRONE
WARWICKSHIRE
WESTERN ISLES
WEST MIDLANDS
WILTSHIRE
YORKSHIRE: NORTH/SOUTH/WEST

Male/Female (Variable 3)

Male Code

Female Code

Civilian/Non-Civilian (Variable 4)

Civilian Code

Non-Civilian Code

Work Background

Social Class (Variable 5)

FORCES: All forces personnel were coded as '99' because social class coding was not applicable

CIVILIANS: Civilians werecoded as per the Classification of Occupations 1970' produced by the Office of Population Censuses and Surveys, but using a modified class grouping.

OPCS Social Classes	Social Classes used in this Survey
I Professional, etc. occupations	I
II Intermediate occupations	
III Skilled occupations	II
(N) Non-manual	
(M) Manual	III
IV Partly skilled occupations	
V Unskilled occupations	IV

Examination Date: (Variable 6)

Date of Birth: (Variable 7)

Age: (Variable 8)

Geographical Background (Variable 26)

This variable indicated whether or not the subject and his family had lived in the geographical area coded in variable 2, for at least one generation.

Categories

1. Subject was born and brought up in the same region as both his parents were born in
2. Subject was not born in the same region as both of his parents.

Time/Interviewer (Variable 27)

This variable recorded whether the measurements were taken in the morning or in the afternoon, and who the examiner was.

Ethnic Group (Variable 28)

We wish to select for analysis only those subjects who were white caucasians, i.e. of European or white descent. Ethnic group was determind from the combination of skin colour, surname and the place of birth of both the subject and the subject's parents. The measurements from subjects whose ethnic group was outwith our specifications were never used in the statistical analysis. From the remaining acceptable ethnic groups, only those who had spent the first 15 years of their life in Britain or in the Forces bases were included in the analysis. (i.e. if their Geographical Area code was British).

N.B. In this context the word'British' includes the whole of Ireland.

Date of Entry (Variable 29)

This variable recorded the date of entry to the Armed Forces.
For the Civilian Sample this variable had a 'missing valve' code.

Married/Single (Variable 30)

Married category included people who were separated. Single category included people who were divorced.

Corps/Regiment/Employer (Variable 31)

Thsi variable coded either the branch of the Forces subject belonged to, or in the case of the Civilian subjects, what type of company or Establishment employed him.

The following categories were used for the Forces Sample:

RAF	NAVY
WRAF	WRNS
RAF REGIMENT	MARINES
RAF AUSTRALIAN	NAVY - AUSTRALIAN

ARMY

RAEC	ACC	APTC
INFANTRY	RAMC	RADC
REME	PARA. REGT.	RAVC
RA	RMP	MPSC
RE	RAPC	SASC
R. SIGNALS	H. CAVALRY	Ra Ch D
RAC	INT. CORPS.	GSC/RSC
RCT	AAC	SAS
RAOC	LS LIST	WRAC
FOOTGUARDS	RPC	QARANC

Ranks (Variable 33)

The following ranks were coded for each service:

ARMY & MARINES	RAF	NAVY
JUNIOR	JUNIOR	JUNIOR
PRIVATE	A/C	ORD RATE
L/CORPORAL	LAC	ABLE RATE
CORPORAL	SAC	LEADING RATE
SERGEANT - S/SERGEANT	J. TECH	P.O.
WO II	S. TECH	C.P.O.
WO I	CORPORAL	F.C.P.O.
POTENTIAL OFFICER	SERGEANT	MIDSHIPMAN
2nd LT	FLT/SERGEANT	SUB LIEUTENANT
LT	C. TECH	LIEUTENANT
CAPTAIN	WO	LIEUTENANT CDR
MAJOR	MEAO	COMMANDER
LT COLONEL	P. OFFICER	CAPTAIN
COLONEL	FLYING OFFICER	CHAPLAIN
BRIGADIER	FLT	COMMODORE
	LIEUTENANT	
	SQUADRON LEADER	
	WING COMMANDER	
	CHAPLAIN	
	GROUP CAPTAIN	

Civilians

Rank was given a 'missing value' code.

Trade/Occupation(Variable 34)

An extensive list of trades and occupations was produced for all the separate units within the Armed Forces. A similar list was also produced for the various occupations in the Civilian Companies included in this survey. See Appendix K.

Number of Months (Variable 35)

This variable recorded the length of time the subject had spent in his trade or occupation.

Previous Job/Number of Months (Variable 36 & 37)

These variables were disregarded unless the subject had changed his occupation within the six months prior to examination. If his job had changed the S.C. of the previous job was coded as Variable 36, and the number of months in the job as Variable 37.

SMOKING HABITS

Smoke (Variable 38)

This variable recorded whether the subject had ever smoked and if so, for what length of time. If the subject was a non-smoker then variables 38, 39 and 40 were coded as such.

No. of cigarettes (Variable 39)

This variable recorded the approximate number of cigarettes smoked per day. The following categories were given:

Less than 5	26 - 30
6 - 10	31 - 35
11 - 15	36 - 40
16 - 20	41 - 45
21 - 25	more than 45

(see 'Questionnaire' chapter, note on charges to questionnaire)

Still Smoke (Variable 40)

This variable showed whether the subject had given up smoking or still smoked cigarettes. If the former, then the date at which he gave up smoking was recorded on the data sheet.

Health Factors

Weight Change (Variable 41)

This variable was used to record whether the subjects weight, over the previous six months had been (a) steady (b) rising or (c) falling.

Medication (Variable 42)

This variable was used to detect any subjects who were taking drugs which may have affected the 'make up' of the fat component of the body, and therefore affect the accuracy of predicting percentage body fat from the skinfold measurements.

Factors Affecting Weight (Variable 43)

This variable gave the subject the opportunity to give an explanation for the fact that they perhaps answered either (b) or (c) to Variable 41.

Factor:

Diet
Pregnancy
Operation
Illness
Stopped smoking
Worry/Domestic problems
Miscarraige
Gastractomy
Hormone Imbalance
Diabetic
Spleen removed
Miscellaneous

Shifts/Overwork
Kidney malfunction
Leg/Knee injury
Bad Back
Thyroid troible
Apronectomy
Renal Glycosuria
Partial Gastrectomy
Growth Hormone treatment
Laporotomy
Glandular Illness
Hay Fever
Hysterectomy
Brain Operation

EXERCISE HABITS

Exercise Frequency (Variable 44)

A choice of four categories was given for this:

(a) Daily exercise
(b) Twice a week of more
(c) Less than twice a week
(d) Occasionally / Never

Length of Time (Variable 45)

This variable recorded the number of months or years that the subject had maintained the level of exercise chosen in Variable 44.

Sport (Variable 46)

This variable coded either one or in some cases, two sports, which were played most often.

Illness (Variable 47)

If the subject for any reason, had to cut down on his normal activity, then this variable recorded the cause.

Illnesses and Injuries coded were:

Injured leg
Injured chest
Flu
Other bacterial/viral infection
Injured arm/hand
Injured back
Cold
Stomach
Injured ribs
Facial Injury
Head Injury
Tuberculosis
Minor Operations
Miscarraige
Heart
Diabetic
Migraines
Renal Haematuria
Aneurysm
Crown's Disease
Allergy
Tonsillitis
Hypertension
Ulcer
Arthritis
Sinus
Asthma
Glandular Illness
Vasectomy

Hospital cases:

Chest
Leg
Whipples Disease
Virus
Heart Operation
Miscellaneous Operation
Motor cycle car crash
Miscellaneous (neither injury nor illness - unknown)
Appendix removed
Kidney Operation
Neuralgia

Live - In (Variable 48)

This variable recorded whether the subject lived in a Forces Mess/Barracks or lived out. For civilians a 'missing value' code was used.

APPENDIX E

Sedentary Trades: Civilians

MALES	FEMALES
General Clerk	General Clerkess
Administrator	Administrator
Manager	Manager
Bank Teller	Bank Teller
Computer Operator	Data Processor
	Secretary
	Computer Operator

Sedentary Occupations: Forces

MALES	FEMALES	
Administrators (Army, Navy RAF)	Administrators (all ranks)	all three services
Supply Clerks (Army RAF)	Chemical workers	
Air Traffic Controllers (RAF)		
Radio Operators (Army, Navy, RAF)		
Radar Operators (Army, Navy, RAF)		
Telegraphist (Army, RAF)		
Signaller (Army)		

Active Occupations: Forces

MALES	FEMALES	
Infanteers(Army)	Nurses (all ranks)	all three services
Parachutists(Army)	Auxillary Nurses	
P. T. Instructors (Army, Navy, RAF)		
Recruits(Army)