Alfailakawi, Noor Khaled (2017) The effectiveness of a knowledge-based health promotion intervention on multiple health behaviours in adolescent females. PhD thesis.

The Effectiveness of a Knowledge-based Health Promotion Intervention on Multiple Health Behaviours in Adolescent Females

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BSc, MSc

Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

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May/2017

Abstract

Background

The prevalence of Non-communicable diseases (NCDs) is growing globally and predominantly attributed to behavioural risk factors such as physical inactivity, unhealthy nutrition, tobacco smoking, and alcohol abuse according to the World Health Organisation. These behaviours have their roots in adolescence and can be prevented or modified. Kuwaiti adolescents have a considerable prevalence of physical inactivity and unhealthy dietary practices. This has contributed to the high proportions of overweight and obesity particularly in females. Tobacco smoking and substance abuse are also increasing in this population but are potentially underreported due to sociocultural barriers. School-based health promotion interventions have been proven to be effective in eliciting positive behavioural changes in other populations.

Aim

The general aim of this study was to evaluate the effectiveness of a school-based health promoting intervention on multiple health-related behaviours in adolescent females in Kuwait. These behaviours include physical activity (PA), healthy nutrition, tobacco smoking, substance abuse, and sun overexposure. The specific aims of the intervention were: i) increase PA and improve its related behaviours, ii) improve health-related fitness components, iii) improve dietary behaviours, iv) normalise weight measurements, v) discourage smoking and substance abuse, vi) promote sun protective behaviours, and vii) increase knowledge of each of the six health topics.

Methods

The study included 128 adolescent females between the ages of 14 and 18, the majority of whom were Kuwaitis (97%). They were randomly selected and allocated to an intervention group (n= 64) and a control group (n= 64). The intervention consisted of six educational sessions for each of the following: PA, healthy nutrition, prevention of tobacco smoking, prevention of substance abuse, bone health, and sun protection. Each session was 45-minutes’ duration and delivered once per month by the researcher. Both groups were assessed before and after the intervention in weight measurements, physical fitness, physical activity by accelerometry, and self-reported behaviours. The self-reported behaviours included PA, dietary behaviours, tobacco smoking, substance abuse, and sun exposure and protection. In addition, the knowledge of each health topic was assessed immediately before the session and a week after. A mixed model repeated measures analysis of variance (ANOVA) was used for analysis while proportions were compared by chi-squared test. The analysis was performed by an intention-to-treat approach.

Results

Physical fitness including flexibility, abdominal muscles strength, body balance and cardiorespiratory endurance (VO_2max) were significantly improved in the intervention group compared to the control group ($p < 0.05$). The intervention group also had increased energy expenditure, metabolic equivalent, light PA, walking time, moderate PA, and moderate-to-vigorous PA, while had decreased sedentary time and elevator use significantly compared to the control group. They also had improved a range of dietary practices by increasing consumption of total meals, breakfast, dairy, and water. Health knowledge of each topic was significantly increased in comparison to the control group. Weight measurements did not show any significant change after the intervention.

Conclusion

A school-based health educational intervention was successful in increasing physical activity and physical fitness, and improving dietary practices in adolescent females in Kuwait. Thus, such interventions are promising and should be implemented and expanded in this population. Future studies should also assess different educational strategies and have long-term follow-up to determine their sustainability. It is recommended that school interventions are supported by socio-environmental changes including families, youth organisations, and health policies.

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For every struggle, endured

For every sacrifice, made

For all the times, lost

For all the life, missed

For you, Sheikhah & Khaled

With love,

Noor

Acknowledgement

My utmost gratitude is to Almighty Allah for giving me the strength and the ability to get through this gruelling journey.

A special tribute to the late Prof. Hillis who was part of this work initiation, and provided profuse guidance and kindness.

I deeply thank my supervisors Dr. John MacLean and Dr. William Miller for their constant support and encouragement until reaching the finish line.

A great thanks to Al-Adan school administration and PE teachers for supporting and aiding this study. The thank extends to the participants and their parents for their cooperation.

An appreciation to Sheikhah Naeema Al-Sabah, the president of the Kuwait Women Sports Association, and to all the athletes in Salwa sports club for their support with the pilot study.

I would like to acknowledge the help of Dr. John McClure and Dr. Rachael Fulton with the statistical analysis.

I thank Dr. Jasem Ramadan from Kuwait University for his valuable advice on physical activity concepts.

A lot of thanks to Dr. Hassan Aldashti from Kuwait Metrological Department for his help in providing the climate report.

I would like to express my appreciation to Ms. Dorothy Ronney from the ICAMS for her great kindness and instant help with my studentship struggles.

My special gratitude to all my friends in Glasgow who have been my '*shelter in the storm*', wishing them all the best.

I am grateful to my dearest friends in Kuwait for their far-reaching support and care.

A boundless gratitude to every member of my family who always believed in me and supported me through my study.

Author’s Declaration

I hereby declare that this thesis constitutes my own work and has not been submitted for any other institutions. To the best of my knowledge and belief, this thesis contains no materials that have been previously published and any work of others was explicitly referenced.

Signature:

Printed Name: Noor Alfailakawi

List of Abbreviations

BF%	Body Fat percentage
BMI	Body Mass Index
BMIz	Body Mass Index z-score
CG	Control Group
cpm	Counts per Minute
CRDs	Chronic Respiratory Diseases
CVDs	Cardiovascular Diseases
DALYs	Disability Adjusted Life Years
DBP	Diastolic Blood Pressure
EE	Energy Expenditure
F&V	Fruit and Vegetables
HDL-c	High-Density Lipoprotein
HRBs	Health-related Behaviours
IG	Intervention Group
IHD	Ischemic Heart Disease
LPA	Light Physical Activity
MET	Metabolic Equivalent
MPA	Moderate Physical Activity
MVPA	Moderate-to-Vigorous Physical Activity
NCDs	Non-Communicable Diseases
PA	Physical Activity
SAR	Sit-and-Reach
SCT	Social Cognitive Theory
SUPs	Sit-ups
SVJ	Standing Vertical Jump
SBP	Systolic Blood Pressure
SSBs	Sugar Sweetened Beverages
TG	Triglycerides
UVI	Ultraviolet Index
UVR	Ultraviolet Radiation
VO_2max	Maximal oxygen consumption
VPA	Vigorous Physical Activity
WHO	World Health Organisation

Chapter 1
General Introduction

1.1 Non-Communicable Diseases and their Risk Factors

1.1.1 Non-Communicable Diseases (NCDs)

The World Health Organisation (WHO) defines non-communicable diseases (NCDs) as diseases which do not transfer from one person to another. They are also known as chronic diseases because they progress slowly and persist over a long duration (WHO, n.d.-a). NCDs are the major cause of morbidity and mortality worldwide. It accounted for 39.8 million deaths in 2015, representing 71.3% of the total global mortality according to the Global Burden of Disease (GBD) 2015 study (GBD, 2016a). Global deaths from NCDs increased by 14.3% between 2005 and 2015 (GBD, 2016a). NCDs also represent a significant economic burden on healthcare systems and individuals, hindering the development of communities (WHO, n.d.-a).

1.1.2 Types of NCDs and their Risk Factors

NCDs include four main types: cardiovascular diseases (CVDs) such as heart attacks and strokes, chronic respiratory diseases (CRDs) like asthma and chronic obstructive pulmonary disease, diabetes and cancers (WHO, n.d.-a). Together these are four main types are responsible for 82% of all NCD mortalities (WHO, n.d.-a). NCDs are attributed to two types of risk factors: behavioural risk factors and metabolic or physiological risk factors each of which are preventable. Behavioural risk factors include tobacco use, physical inactivity, unhealthy diet and alcohol abuse. Metabolic/physiological risk factors include elevated blood pressure, being overweight/obesity, raised blood glucose levels (hyperglycaemia) and increased levels of lipids in the blood (hyperlipidaemia) (WHO, n.d.-a). A representation of NCDs and their risk factors is displayed in Figure 1-1. CVDs were the leading cause of death globally among NCDs in 2015, accounting for 32% of all NCD mortality (GBD, 2016a). Cancers accounted for 16%, CRDs for 7%, and diabetes for 3% of NCD mortality in 2015 (GBD, 2016a).

1.1.3 Adolescents and Health

Adolescents are defined by the World Health Organisation (WHO) as young individuals between the ages of 10 and 19 years, and are often considered a healthy population (WHO, n.d.-b). However, many adolescents die prematurely due to preventable or treatable diseases, and more still suffer from chronic illness and disability. Adulthood NCDs, which result in significant morbidity and premature mortality, are linked to behavioural risk factors in adolescence such as tobacco use, unhealthy eating habits, and physical inactivity (WHO, n.d.-b). For a broader perspective on these behaviours, they will be referred to as ‘health-related behaviours’ (HRBs).

1.1.4 Health-Related Behaviours and their Types

Health-related behaviour (HRB) or health behaviour refers to “any behaviour that may affect an individual’s health or any behaviour that an individual believes may affect their physical health” (Sutton, 2008, p.94). HRBs can be described according to two behavioural contexts: health-enhancing and health-compromising behaviours. Health-enhancing behaviours are those positive and healthy behaviours (such as increased physical activity and low-fat/high nutrient diets) which should be promoted. On the other hand, health-compromising behaviours are those negative, unhealthy and risky behaviours such as tobacco smoking and substance abuse which should be discouraged. The present study targets both health-enhancing and health-compromising behaviours. The health-enhancing behaviours studied included increasing physical activity, healthy dietary practice, and protecting skin from the sun. Health-compromising behaviours include tobacco smoking, substance abuse, and skin tanning, both via sun or ultraviolet radiation (UVR) exposure. These specific behaviours were selected because they are prevalent in Kuwaiti adolescents and their rates are increasing which in turn increases the risk of NCDs as will be discussed next.

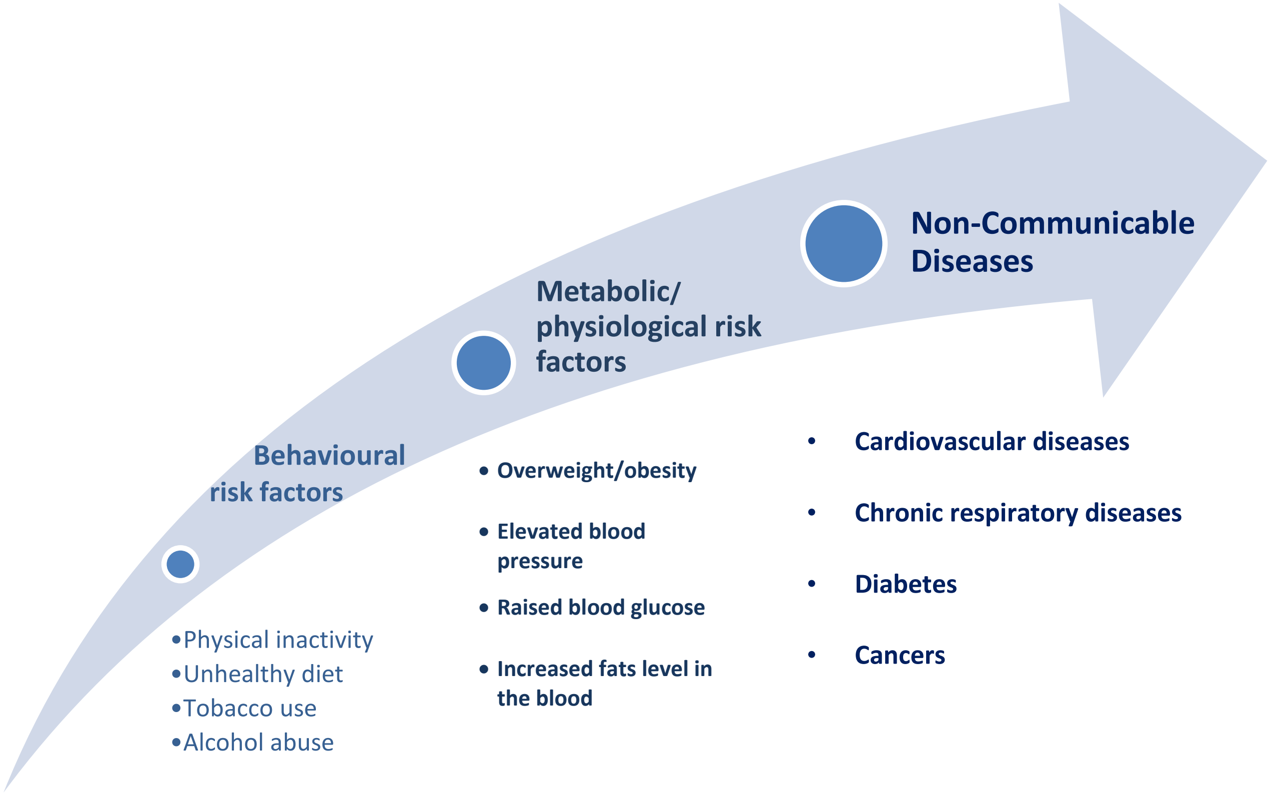

Figure 1-1 Non-communicable diseases and their risk factors according to World Health Organisation (WHO)

1.2 Epidemiology of NCDs and their Risk Factors in Kuwait

1.2.1 NCD Mortality in Kuwait

According to WHO's Global Health Observatory (GHO), the total NCD mortality rate in Kuwait in 2012 was 406.3 per 100,000, which represented 79% of total mortality (WHO, 2014a). CVDs were reported as the main cause of mortality among the total population and incidences were higher in males than females (61% vs. 56%, respectively) (WHO, 2014b, WHO, 2014c). These were followed by cancers, diabetes and CRDs all of which were slightly higher in females than males. Premature mortality between the age of 30 and 70 due to NCDs in Kuwait was estimated at 11.8% in 2012, while the total rate of mortality in under the age of 70 by gender was 49.7% in males and 51.0% in females. Mortality rate trends for NCDs between 2000 and 2012 in Kuwait showed a sharp decline in CVD mortality, a moderately progressive reduction in diabetes mortality, and a slight decrease in cancers and CRD mortality across both genders (WHO, 2014c). Ischemic heart disease (IHD) was the leading cause of mortality in 2015, with stroke fifth, breast cancer ninth, and diabetes tenth (GBD, 2016a).

1.2.2 Morbidity and Prevalence of NCD Risk Factors in Kuwait

Two of the ten leading causes for both years lived with disability (YLDs) and disability-adjusted life-years (DALYs) in both genders in Kuwait according to the Global Burden of Disease study in 2015 involved NCDs (GBD, 2016b; 2016c). Diabetes was the fifth and asthma was the tenth leading causes for YLDs for both genders in Kuwait in 2015 (GBD, 2016b). Whereas, IHD was the first and diabetes was the sixth leading causes for DALYs (GBD, 2016c). Additionally, the ten leading risk factors for the DALYs are led by high BMI followed by high systolic blood pressure, high fasting plasma glucose, high total cholesterol, tobacco smoking, low intake of wholegrains, ambient particulate matter pollution, low physical activity, iron deficiency, and low fruit intake (GBD, 2016d). This demonstrates that the morbidity of the Kuwaiti population is markedly affected by NCDs and their risk factors. The prevalence of these risk factors is detailed in the following section.

1.2.2.1 **Metabolic/Physiological Risk Factors**

1.2.2.1.1 Overweight and Obesity

Kuwaiti adult females have the highest rates of obesity among Gulf and Arab countries (Ng *et al.*, 2011; Rahim *et al.*, 2014). Mean BMI in adult females was 30.8 kg/m^2 compared to 29.5 kg/m^2 in males in 2014 as shown in Table 1-1 (WHO, 2014b). Mean BMI was greater than the healthy weight (>25 kg/m^2) in both males and females, and gradually increased between years 1975 and 2014 (with females approximately 2% higher) (WHO, 2017a). Kuwaitis are also projected to have the highest prevalence of overweight and obesity in the Eastern Mediterranean region by 2030, with >90% in males and >85% in females. Consequently, more obesity-related NCDs, such as diabetes, coronary heart disease, stroke, and cancers are expected. Mean BMI in adult Kuwaiti females was higher than in adult females in the United Kingdom (UK) in 2014 (30.8 kg/m^2 vs. 27.1 kg/m^2) (WHO, 2014b). Moreover, prevalence of overweight and obesity were also higher in Kuwaiti females compared to females in the UK in 2014 (76% vs. 59%) and (46% vs.29%), respectively (WHO, 2014b). Similar to adults, Kuwaiti adolescents had the highest prevalence of overweight and obesity among Arab countries in 2014 (Musaiger *et al.*, 2016). Adolescent females had the highest prevalence of obesity, with the second in overweight prevalence among eight Arab countries in 2014 (Musaiger *et al.*, 2016).

1.2.2.1.2 Raised Total Cholesterol

The prevalence of raised total cholesterol was shown to be high in the Kuwaiti population, at approximately 56% in males and 51% in females in 2008 as shown in Table 1-1 (WHO). Mean total cholesterol level demonstrated a slow and slight decline trend in both genders from 1990 to 2009 (WHO, n.d.-c). However, the mean total cholesterol level remained generally above the recommended level of 5 mmol/L or less. No data were available for the prevalence of raised cholesterol in the general population of Kuwaiti adolescents.

1.2.2.1.3 Elevated Blood Pressure

Elevated blood pressure (SBP ≥ 140 and/or DBP ≥ 90 mm Hg) was prevalent in 23% of males and 15% of females in Kuwait as shown in Table 1-1 (WHO, 2014b). In comparison with the UK, this is lower than seen in females while similar to males in 2014 (UK= 19% and 22%) (WHO, 2014b). Mean systolic blood pressure declined between 1975 and 2015 (WHO, 2017b). The decline was greater in females than males (-5.8 vs. -2.3 mm Hg) correspondingly. In Kuwaiti young adults in 2010, 40% were pre-hypertensive (SBP > 120 & <139 mmHg, or DBP >80 & <89 mmHg) and 7% were hypertensive (Al-Majed & Sadek, 2012). Pre-hypertension and hypertension were higher in males than females (14% vs. 36% and 86% vs. 64%, respectively). No data were available regarding the incidence of hypertension in Kuwaiti adolescents.

1.2.2.1.4 Raised Blood Glucose

Diabetes mellitus (fasting plasma glucose ≥ 7.0 mmol) is very prevalent among the population. Approximately, 20% of Kuwaitis of both genders had diabetes in 2014 and this progressively increased between 1980 and 2014 (WHO, 2016). It was also prominently higher in Kuwaiti females than their counterparts in the UK in 2014 (19% vs. 7%) (WHO, 2014b). Pre-diabetes (HbA1c between 39-46 mmol/mol (5.7%-6.4%)) was found in in 6% of Kuwaiti young adults (Haider & Ziyab, 2016). No data were found regarding hyperglycaemia among Kuwaiti adolescents.

1.2.2.2 **Behavioural Risk Factors**

1.2.2.2.1 Physical Inactivity

Physical inactivity is considered the fourth leading risk factor for mortality worldwide. Approximately, 23% of adults and 81% of school-attending adolescents in the world are physically inactive (WHO, 2017c). Physical inactivity is high in Kuwait, noted in 57% of the population in 2006 (49% in males and 64% in females) as shown in Table 1-2 (WHO, 2014b). It is even significantly higher in Kuwaiti adolescents, with 85%, with 77% in males and 93% in females in 2011 (WHO, 2014b). This is higher than the prevalence in the United Kingdom where 79% of adolescents (73% in males and 85% in females) were physically inactive in 2010 (WHO, 2014b).

Sedentary behaviours were investigated among Kuwaiti adolescents aged between 14 and 19 years old. It was found that females spent more time watching television (TV) than males (3.9 vs. 3.6 hours/day, respectively) (Allafi *et al.*, 2014). In addition, 73% of adolescent females and 70% of adolescent males watched TV for more than two hours per day. Computer-use was also higher in females than males (4.1 vs. 3.6 hours/day), with 70% of females and 62% of males using a computer more than two hours per day. In total, adolescent females spent eight hours on screen-time activities, and an hour less for males. Screen-time of more than two hours per day has been associated with an increased risk of overweight/obesity, increased serum cholesterol, increased systolic blood pressure, reduced musculoskeletal fitness, reduced VO_2max and aerobic fitness in school-aged children and adolescents (Tremblay *et al.*, 2011). It also led to lower academic achievement, and poor social behaviour. The mean time reported for sleep was five hours per day with 76% of males and 74% of females having less than seven hours of sleep. The recommended sleep time duration for adolescents between 14 and 17 years of age is eight to ten hours for optimal health and well-being (Hirshkowitz *et al.*, 2015).

1.2.2.2.1.1 Physical Activity Definition and Benefits in Adolescents

Physical activity (PA) is defined as “any bodily movement produced by muscles that results in energy expenditure” (Caspersen, Powell, & Christenson, 1985, p.126). PA includes sports, training, exercises, occupational/school activities, household activities and transport (Caspersen, Powell, & Christenson, 1985; Craig *et al.*, 2003).

PA has many physical health benefits, as well as a positive effect on mental health and academic performance in children and adolescents. It reduces body fat, improves cardiovascular health in overweight or obese individuals and their related disorders such as metabolic syndrome, high density lipoprotein (HDL) and triglycerides (TG). It also lowers blood pressure in those with hypertension (Janssen & LeBlanc, 2010). PA also improves aerobic fitness, muscular strength and endurance, and bone strength. In addition, it decreases symptoms of anxiety, depression, increases self-confidence and sport competence, and improves academic performance. Furthermore, PA reduces total cholesterol, TG, glycated haemoglobin (HbA1c), and BMI amongst those with type 1 diabetes mellitus (Quirk *et al.*, 2014). Swimming has been shown to be effective in reducing the severity of asthma symptoms and increases maximal oxygen consumption (VO_2max) and resting lung function (FEV1%) in asthmatic adolescents (Hallal *et al.*, 2006; Beggs *et al.*, 2013). PA can also improve forced vital capacity (FVC) in those with cystic fibrosis (Hallal *et al.*, 2006). Moreover, PA during adolescence was found to have a positive effect on adulthood PA, bone health, and may reduce the risk of breast cancer (Hallal *et al.*, 2006).

1.2.2.2.1.2 PA Recommendations for Children and Adolescents

There are a number of recommendations for levels of PA in adolescents according to country or region. Most commonly followed are the global recommendations on PA for children aged 5-17 years (WHO, 2011). It recommends a daily accumulation of at least 60 minutes of moderate-to-vigorous PA (MVPA) for children and adolescents and more would provide additional health benefits. It also recommended that the majority of daily PA to be aerobic. Vigorous PA (VPA), including activities that strengthen muscle and bone, should be incorporated at least three days per week. Activities that strengthen bone are 'bone-loading activities' such as jumping, turning, running, and game playing.

The Eastern-Mediterranean region of the WHO provides a number of PA recommendations as part of its healthy lifestyle recommendations (WHO, 2012). Children and adolescents were recommended a total of at least 90 minutes per day of PA. It also stated that increasing the level of PA via low-intensity but longer duration leisure PA, and moderate and vigorous exercise, would add greater health benefits. Engaging in MVPA for 60 minutes on most days of the week would maintain body weight and prevent weight gain, while engaging in 60 to 90 minutes every day will result in weight loss. Types of moderate intensity PA includes brisk walking, cycling, weight-lifting, and dancing. Types of vigorous intensity PA include swimming, jogging/running, soccer, tennis, and basketball. Many countries in the Eastern Mediterranean region including Kuwait follow the WHO's global recommendations as supposed to the more regional-specific guidelines.

One of the more recent sets of recommendations on PA is the Canadian 24-hour movement guidelines for children and youth aged 5 -17 years (Tremblay *et al.*, 2016). The Canadian recommendation integrated PA, sedentary behaviour (i.e. sitting), and sleep. The healthy 24-hour guidelines involve a '4S' concept: Sweat, Step, Sleep, and Sit which was developed by the Canadian Society for Exercise Physiology (CSEP, 2016). 'Sweat' refers to accumulating at least 60 minutes of MVPA per day, in addition to VPA, and muscle and bone strengthening activities for at least three days per week, similar to WHO global recommendations (2011).

'Step' refers to structured or unstructured light PA (LPA) which should be accumulated over several hours during the day. 'Sleep' refers to an uninterrupted night of sleep, which should be between nine and eleven hours for those aged between 5 and 13 years, and between eight to ten hours for those aged between 14 and 17 years, with consistent sleep and wake-up times. 'Sit' refers to sedentary behaviour which should be no more than two hours per day of leisure screen-time and limited sitting for extended periods.

1.2.2.2.1.3 PA in Kuwaiti Adolescents

Moderate PA was higher in adolescent males than in females (3.8 vs. 2.9 h/week, respectively) (Allafi *et al.*, 2014). Vigorous PA was substantially less in adolescent females than males (0.12 vs. 4.0 h/week). The total MET.min/week was estimated to be 3,708 in males and 999 in females. The study found that 45% of adolescent males and 76% of adolescent females did not meet the recommended 60 minutes per day (Allafi *et al.*, 2014).

1.2.2.2.2 Unhealthy Diet

1.2.2.2.2.1 Definition and General Recommendations

The WHO acknowledges that an unhealthy diet is a major risk factor for NCDs, as well as a key contributor to the obesity epidemic (WHO, 2014). A healthy diet, according to the WHO, was defined as one which is composed of five elements (WHO, 2014). Firstly, the consumption of dietary fibre like fruits, vegetables, legumes, wholegrains, and nuts. Secondly, an intake of at least five portions of fruits and vegetables (400g) a day excluding potatoes, sweet potatoes and other starchy roots. Thirdly, the total energy intake from free sugars, natural and refined sugars should constitute less than 10% of total intake (50g). Fourthly, salt intake of less than 5g is recommended (about one teaspoon) per day and preferably iodised. Fifthly, the total energy intake from fats to less than 30%, less than 10% for saturated fats and less than 1% for trans-fat. Unsaturated fats are favoured over saturated fats and industrial trans fats are better excluded from the healthy diet altogether. Unsaturated fats may be found in fish, nuts, canola, and vegetables' oils, while saturated fats are commonly found in butter, lard, ghee, cream cheese, palm and coconut oil, and fatty meat. Trans fats are commonly found in margarines, spreads, fast food and processed food (ibid.).

1.2.2.2.2.2 WHO Recommendations for The Eastern Mediterranean Region

The WHO developed a user-friendly dietary guide for the Eastern-Mediterranean region (WHO, 2012). It involved 14 recommendations which are as follows. Maintain a healthy body weight is achieved by balancing energy consumption and energy expenditure. Being active, which encourages individuals to engage in regular PA. Limit the intake of fats and oils (solid fat 8g/day, oils 24g/day), especially those that are high in traditional sweets and take-away foods, replacing full fat milk or cheese with low-fat options, and limiting the intake of red and processed meats and replacing them with white meat where possible. Limit the intake of sugars especially sweetened food such as traditional desserts and sugary sweetened beverages (SSBs) as in soft drinks. Limit salt intake to one teaspoon (5g per day) and choose unsalted nuts and seeds. Eat a variety of foods every day which include fruits, vegetables, wholegrains, meats and beans, and fat-free or low-fat milk and/or dairy. Eat cereals, preferably wholegrains (90g/day), as the basis of most meals (6 servings/day). Eat more fruits (4 servings/day) and vegetables (5 servings/day). Eat legume-based meals regularly (e.g. red bean stew, fava beans and chickpeas), and nuts and seeds (160g/day). Eat fish (180g) at least twice a week. Consume milk/dairy products, preferably low-fat, daily (3 cups/day). Choose poultry and the leanest meats (e.g. boneless chicken breast, turkey cutlets, and extra-lean ground beef) (160g/day), and avoid processed meats. Drink lots of clean water (3.4 L/day for males, 2.7 L/day for females). Finally, eat clean and safe food.

The WHO does not undertake any monitoring of such unhealthy dietary behaviour in relation to the above mentioned dietary recommendations. Therefore, there is no global epidemiological data for this specific risk factor. Many studies, nonetheless, have looked at one or more of these recommendations and/or the patterns of dietary behaviour.

1.2.2.2.2.3 Dietary patterns in Kuwaiti adolescents

A number of studies in Kuwait have investigated these dietary behaviours in adolescents. It has been found that 92% of Kuwaiti secondary school students consumed SSBs regularly, while only 30% consumed the adequate daily amount of milk (2 cups/day); only 45% consumed the adequate amount of dairy products (1 serving/day) (Nassar *et al.*, 2014). Another study found that adolescents consumed

SSBs an average of five times per week and 42% of males and 38% of females consumed it daily (Allafi *et al.*, 2014). Energy drinks, which can also be considered SSBs, were consumed once a week on average, and it was found that 5% of males and 7% of females consumed these daily (Allafi *et al.*, 2014). It has been found that consumption of SSBs was associated with the inadequate consumption of milk in Kuwaiti adolescents (Nassar *et al.*, 2014). Adolescent males consumed more milk and dairy products than females (5 vs. 4 times per week), and 36% of males and 25% of females consumed them daily (Allafi *et al.*, 2014).

It was found that most Kuwaiti adolescents did not consume breakfast daily, as only 28% of adolescent males and 18% of adolescent females ate daily breakfast (Allafi *et al.*,2014). Vegetable intake was around four times per week in both genders, with 26% of males and 22% of females consuming vegetables daily. Fruit intake counted approximately three times per week, with 18% of males and 12% of females consuming fruit daily. Kuwaiti adolescents consumed fast foods three times per week, with 9% of males and 10% of females consumed this type of food on daily basis. Fried chips were consumed also three times per week, 9% of males and 12% of females had daily consumption. Females consumed more cakes, doughnuts, and sweets than males, approximately eight times versus six times per week respectively. Moreover, 51% of females and 28% of males consumed one or more sugary snack daily. It has been found that the consumption of sugary foods and drinks among Kuwaiti adolescents was higher in comparison with other Western countries (Honkala, S., Behbehani & Honkala, E., 2012). Kuwaiti adolescents consumed about 194 g/day of sugar from snacks and 70g/day of fat (Al-Ansari, Al-Jairan, & Gillespie, 2006).

1.2.2.2.3 Tobacco Smoking

Kuwaitis' current rate of tobacco smoking, which is defined as smoking within last 30 days, was reported in 38% adult males and 2% in adult females; whilst daily smoking was 34% and 1% in 2010, respectively, as shown in Table 1-2 (WHO, 2015). This was more than the UK prevalence in 2010, 23% in males and 21% in females, this was only for cigarette smoking (WHO, 2014b). Current smoking decreased in adult males to 35% but increased in adult females to 4% in 2011 (WHO, 2014c). A study in Kuwaiti young adults found that 12% were cigarette smokers, 45% were shisha smokers, and 8% were dual tobacco smokers (i.e. smoking both cigarette and shisha) (Mohammed *et al.*, 2010). The majority of cigarette smokers were males (91%), while shisha smokers were mostly females (80%), and dual smokers were mostly males (91%). Dual tobacco smokers have been shown to experience more cardiovascular and respiratory symptoms such as rapid heart rate, high blood pressure, high blood glucose, persistent cough, chest pain, and frequent respiratory infections (Husain *et al.*, 2015).

In adolescents, 25% of males and 9% of females were current tobacco smokers in 2014 (WHO, 2015). Moreover, 24% of adolescent males and 8% of adolescent females were current cigarette smokers which indicates that about 1% of adolescents in both genders smoked other tobacco products (i.e. shisha). Another study showed that 15% of adolescents between the ages of 13 and 15 smoked shisha in 2001; this accounted for 20% of males and 11% of females which was higher than other Gulf countries in this respect (Al-Mulla *et al.*, 2008). The same study showed that 11% of adolescents smoked cigarettes, 18% of males and 4% of females, which is less than shisha smoking particularly in females. A study also found that 26% of Kuwaiti adolescents who smoked shisha but not cigarettes, were susceptible to become cigarette smokers (Veeranki *et al.*, 2015). Their susceptibility for becoming cigarette smokers ranked fourth among 21 other Arab countries.

1.2.2.2.4 Alcohol Use and Substance Abuse

Alcohol use was rare in the population due to the banning of alcohol in Kuwait. The prevalence of alcohol abuse in adults was 0.5% in males and 0.1% in females, and heavy episodic drinking during the last 30 days was at the same rate as displayed in Table 1-2 (WHO, 2014b; 2014c). It was significantly higher in adolescents, with 19% of adolescent males and 16% of adolescent females reported as current drinkers, but none for heavy episodic drinking (WHO, 2014d). However, alcohol use prevalence among adolescents was potentially overestimated as it exceeded tobacco smoking; which is implausible due to the banning and unavailability of alcohol in Kuwait. Drug use in Kuwait was only reported for adult males, which was 2.6% in 2005 and increased to 3.4% in 2010 (Mokdad *et al.*, 2014).

By recognising the paucity of alcohol use in Kuwait due to its ban, alcohol use as a risk factor have been replaced with ‘substance abuse’, which will focus on the abuse of medications and weight loss pills in this study. The most commonly abused medications among adolescents in Kuwait are tramadol hydrochloride tablets and pregabalin capsules based on anecdotal reports. Tramadol hydrochloride (knows as Tramadol) is an opioid while pregabalin (trade name Lyrica) is an antiepileptic drug according to the British National Formulary (BNF) (2017a; 2017b). Many studies have reported the abuse of tramadol hydrochloride and pregabalin in other populations (Bassiony *et al.*, 2017; Evoy, Morrison, & Saklad, 2017). These substances are recreationally taken for pleasure seeking and stress relief and can lead to physical dependence. Kuwaiti adolescents also had a high prevalence of self-medication which increased with age and was mostly used for pain relief (Abahussain, Matowe, & Nicholls, 2005). Females self-medicated mainly for pain relief, respiratory conditions, or dermatologic conditions, while males self-medicated for dermatologic conditions. On the other hand, illicit drugs use is also present among Kuwaiti youth. Marijuana has been found to be the most regularly used illicit substance among young adult males in Kuwait (Bajwa *et al.*, 2013). Stimulants, cocaine, and heroin were also used by a few individuals.

1.2.2.2.5 Sun Exposure and Protection

The Kuwait climate is sunny, with average maximum temperatures exceeding 30°C most of the year according to the Kuwait Meteorological Department (n.d.). The Ultraviolet Index (UVI) at midday also increases above three for most of the year (Ghoneim *et al.*, 2013). The WHO, along with United Nations Environment Programme, and the World Meteorological Organisation, developed the UVI as an alarm for sun protection. This defines UVI of three to five constitutes a moderate risk, six to seven a high risk, eight to ten a very high risk, and 11 or more an extreme risk (WHO, 2002).

1.2.2.2.5.1 Overexposure to The Sun

Excessive sun exposure, or overexposure, has harmful effects on the skin. It causes sunburn and importantly skin cancer including melanoma and non-melanoma (basal cell and squamous cell carcinomas) (Hoel *et al.*, 2016). Sun exposure for skin tanning has been an emerging trend among adolescents across the population. This could be due to social and peer influences in addition to that of the media. Although skin cancer rates are low in the gulf region compared to Australia and Western countries, it is still a significant risk to health (Al-Hilli, 2005). However, it has been scarcely investigated in Kuwait and the Gulf region. Sun exposure of over an hour once a week between 10 am and 4 pm among Kuwaitis was 39%, 32% on two to three days per week, and 18% on more than three days per week (Al-Mutairi, Issa, & Nair, 2012). Sun exposure of more than three days per week was higher in males than in females (36% vs. 5%). Sunscreen use, on the other hand, was more common in females than in males (86% vs. 72%), though only a few of them reapplied it every two hours or after swimming or sweating (28%). The use of sun protection methods was high in both male and females (79% and 82%), with more females than males being protected by protective clothing (78% vs. 43%). Females had more risk awareness of sun burn and photo-aging than males (86% vs. 70%) and (72% vs. 59%). Awareness of skin cancer risk due to sun exposure was similar in males (65%) and females (63%). However, sunscreen users were found to have higher rates of vitamin D deficiency and insufficiency than non-users, (61% vs. 55%) and (30% vs. 21%), correspondingly.

1.2.2.2.5.2 Inadequate Sun Exposure

Sun exposure provides more than 90% of human vitamin D requirement (Holick, 2003). Inadequate sun exposure can result in vitamin D insufficiency and deficiency (Kennel, Drake, & Hurley, 2010; Saki *et al.*, 2015; Hoel *et al.*, 2016). Vitamin D deficiency increases the risk of skeletal and musculoskeletal disorders in adults, such as osteoporosis and muscle weakness (Pludowski *et al.*, 2013). In addition, it increases the risk of breast, colon, prostate, ovarian, bladder and oesophageal cancers, as well as bacterial and viral infections (Pludowski *et al.*, 2013; Hoel *et al.*, 2016). Moreover, vitamin D deficiency is also associated with metabolic syndrome, an increased risk of type 2 diabetes mellitus, hypertension, congestive heart failure, multiple sclerosis, Crohn's disease, psoriasis, rheumatoid arthritis, liver disease, infertility, and may have negative effects during pregnancy and labour. Dementia has also been associated with vitamin D deficiency. In children, it is associated with rickets, type 1 diabetes mellitus, and dental caries (Holick, 2005; Hoel *et al.*, 2016).

Vitamin D deficiency (< 30 nmol/L or < 12 ng/ml) and insufficiency (30 – 50 nmol/L or 12-19.9 ng/ml) were found to be prevalent in 27% and 56% of Kuwaiti adults, respectively, in both males and females (Zhang *et al.*, 2016). Vitamin D deficiency is extremely prevalent in Kuwaiti females in particular despite the abundance of sunlight throughout the year. Ninety-nine percent of adolescent females had vitamin D deficiency, which was associated with veiling and waist-to-hip ratio > 0.75 (Alyahya *et al.*, 2014). In the study, the majority of Kuwaiti females (73%) had less than or equal to 10 minutes of sun exposure per day but this was not associated with low vitamin D deficiency. However, another study of Saudi (6 to 15 years old) indicated a significant association between sun exposure and vitamin D deficiency (Al Shaikh *et al.*, 2016). Sun exposure is avoided in the Gulf region during the summer, which is a longer season, because of the high temperatures but increased in the winter when temperatures are lowered; however, it is a shorter season (Haq *et al.*, 2016). Moreover, indoor sedentary activities that are common in adolescents may limit their sun exposure (Haq *et al.*, 2016).

Therefore, balanced and protected sun exposure has been recommended. Sun exposure between 10 am and 4 pm when the UVI is equal or greater than three (UVI ≥ 3) should be avoided (Stalgis-Bilinski *et al.*, 2011; WHO, n.d.-d). Taking additional precautions when UVI is equal or above three (WHO, n.d.-d). The use of a broad-spectrum sunscreen product with a sun protection factor (SPF) of 15+ has been recommended as has wearing protective clothing (i.e. wide brimmed hat, sunglasses, tightly woven and loose fitting clothes) (WHO, 2017b). Sunbeds should be avoided as they produce high levels of UVB (WHO, 2017b). A study has found that SPF 30 and ultraviolet A (UVA) protection factor 12 are more effective at blocking immune suppression more than SPF 15 with UVA 6 (Moyal, 1998). There are no regional-specific guidelines or recommendations for sun exposure and protection in the Middle East.

1.2.2.2.6 Bone Health

Low bone mineral density (BMD) resulting in osteopenia and osteoporosis of the spine and femur neck was found in over half of postmenopausal Kuwaiti females (Al-Shoumer & Nair, 2012). The incidence of hip fractures, which are attributed in part to osteoporosis, in both genders increased by 17% from 2009 to 2012 (Azizieh, 2015). Approximately 26% of bone calcium in adults is estimated to be accrued through the two years of peak skeletal growth which is around the time of puberty (Bailey *et al.*,2000). Additionally, as much as 60% of BMD is acquired in the following pubertal years (Bonjour *et al.*, 1991). Behavioural risk factors for osteoporosis include physical inactivity, nutritional insufficiency of calcium and vitamin D, or excessive consumption of caffeine and SSBs, tobacco smoking and alcohol abuse (Schettler & Gustafson, 2004; Loud & Gordon, 2006; Golden & Abrams, 2014). Having unhealthy weight (both thinness and overweight) also contributes to the risk of osteoporosis (Loud & Gordon, 2006). These risk factors account for 20% of the risk for osteoporosis and can be greatly reduced if such behaviours were prevented in adolescence (Schettler & Gustafson, 2004). Given the prevalence of these risk factors in the Kuwaiti population as discussed earlier, rates of osteoporosis and hip fractures are expected to escalate particularly in females.

1.3 **Sociocultural Factors:**

1.3.1 **Urbanisation and Globalisation**

Urbanisation is reportedly associated with physical inactivity, high BMI and diabetes mellitus among both genders (Allender *et al.*, 2011). In addition, it is positively associated with tobacco smoking and raised blood pressure in males (Allender *et al.*, 2010). The economic status of Kuwait has been immensely improved since the discovery of oil deposits in 1938. This led to substantial economic prosperity of the population, and the rapid urbanisation and globalisation of Kuwait. These changes, nevertheless, produced adverse health consequences for the population.

Many occupations have transformed from manual labour to office work and from outdoor to indoor work settings. This has subsequently reduced the level of PA (i.e. occupational PA) and diminished transport PA also known as active commuting. In addition, changes in infrastructure and the establishment of highways, as well as an expansion of the residential area across the country, has converted active commuting into passive commuting. This reduction in occupational and transport PA was not counterbalanced by leisure time PA (Ramadan *et al.*, 2010). The proliferation of technological innovations into daily life as a result of globalisation further reduced PA levels globally (Popkin, 2006). This is also prominent in the Kuwaiti, population especially among younger generations who are greatly attached to electronic devices and television. These changes have ultimately contributed to an increasingly sedentary lifestyle in the majority of Kuwaiti population.

The nutritional status of the country corresponds to a global nutrition transition towards energy-dense, sugary, processed and low in fibre food, known as 'the Western diet' (Popkin & Gordon-Larsen, 2004). The fast food industry was introduced to the country a few decades earlier and has been growing ever since. There has been also an increase in the availability and the variety of unhealthy foods (energy-dense with low nutritional value) and sugar sweetened beverages (SSBs). A 'Western diet' that is high in fat, salt, and sugar but low in fibre has been adapted by the population as a result (Al-Shawi, 1992). In addition, there has been an increase in fast-food outlets in the recent years. Eating out and trying out new restaurants had become part of the culture and many social gatherings have been moved from household settings into public eateries. All of these PA and nutritional changes have contributed to the obesity epidemic across the nation.

Females in Kuwait are greatly emancipated compared to other neighbouring countries. They have equal opportunities in educational, political, and employment as well as enjoying relatively high social freedom. Kuwait has three female sport clubs, many female fitness gyms, and an absolute freedom for outdoor PA participation. Therefore, differences in culture around gender by itself is unlikely to be a major barrier to PA among Kuwaiti females.

1.3.2 **Social Acceptability**

Female obesity seems to be culturally accepted in Kuwait. Approximately half of Kuwaiti female adolescents can be classified as obese, though most perceived their body image to lie within the normal range and only 23% perceived themselves to be obese (Shaban *et al.*, 2016). Moreover, a psychosocial score of health-related quality of life was not found to be impaired in obese adolescent females in Kuwait unlike other countries (Boodai & Reilly, 2013).

Health-compromising behaviours (i.e. tobacco smoking and alcohol use) have also been increasing in adolescents as previously discussed. Shisha smoking is very common in Middle Eastern countries as part of the culture (Maziak *et al.*, 2013). As mentioned earlier, Kuwaiti females mostly smoked shisha only, which might be due to the fact that it is more socially accepted or tolerated than smoking cigarettes (Akl *et al.*, 2013). However, tobacco cigarette smoking rates are potentially underreported due to the social unacceptability of cigarettes, especially in females. Alcohol use or substance abuse are even more culturally sensitive, religiously prohibited, and socially stigmatised, therefore making them less likely to be disclosed.

In summary, adolescent females in Kuwait have high prevalence of overweight and obesity in comparison with males and females in other regional countries. They also have high rates of physical inactivity and sedentary behaviours. Unhealthy dietary behaviours in terms of low rate of daily breakfast consumption, low daily fruit and vegetables intakes, and low consumption of milk and dairy products were also high in female adolescents from Kuwait. Moreover, they more frequently consume fast-food, fried foods, and sugary snacks. Despite the low prevalence of tobacco smoking among adolescent females, there is an increasing trend in this behaviour. Similarly, substance abuse of prescription medication is increasing in this population. Vitamin D insufficiency/deficiency which could be due to inadequate sun exposure is also highly prevalent. Osteoporosis, which is prevalent in post-menopausal females in Kuwait, is largely attributed to the abovementioned behaviours. Excessive sun exposure, which is associated with skin cancer, on the other hand, is also increasing for the purpose of skin tanning among them. Therefore, promoting physical inactivity, healthy diet, and sun protection as well as preventing tobacco smoking, substance abuse, and excessive sun exposure in adolescent females in Kuwait is crucial to protect their current and future health against NCDs and their metabolic risk factors. It may also contribute to future health protection of their offspring. There are different ways to achieve this mostly through school-based interventions which will be discussed next.

Table 1-1 Metabolic risk factors of NCDs in Kuwaiti population

Metabolic risk factors	2010				2014			
	Males		Females		Males		Females	
	Average	95% CI	Average	95% CI	Average	95% CI	Average	95% CI
Mean BMI (kg/m^2)								
Age-standardised	29.0	(28.1 - 29.8)	30.4	(29.5 - 31.4)	29.5	(28.4 - 30.6)	30.8	(29.7 - 32.1)
Overweight (BMI ≥ 25 kg/m^2)								
Age-standardised adjusted estimates (%)	72.8	(67.9 - 77.4)	73.9	(69.0 - 78.3)	75.2	(68.9 - 80.6)	75.8	(69.8 - 81.1)
Obesity (BMI ≥ 30 kg/m2)								
Age-standardised adjusted estimates (%)	32.5	(26.8 - 38.4)	43.2	(36.7 - 49.6)	35.5	(28.2 - 43.1)	45.9	(37.7 - 54.0)
Raised total cholesterol (≥5.0 mmol/L), 2008								
Age-standardised adjusted estimates (%)	56.2	(42.3 - 69.0)	55.7	(38.5 - 70.5)	NAD	NAD	NAD	NAD
Elevated blood pressure (SBP ≥ 140 and/or DBP ≥ 90 mm Hg)								
Age-standardised adjusted estimates (%)	31.1	(23.0 - 40.1)	25.0	(18.0 - 32.7)	23.1	(14.4 - 33.6)	15.0	(8.5 - 23.4)
Raised blood glucose (fasting glucose ≥ 7.0 mmol or on medication or diagnosis)								
Age-standardised adjusted estimates (%)	18.8	(12.2 - 26.8)	17.3	(10.9 - 25.0)	19.7	(12.8 - 28.1)	19.6	(12.9 - 27.7)

NAD, no available data

Table 1-2 Behavioural risk factors of NCDs in Kuwaiti population

Behavioural risk factors	2010				2014			
	Males		Females		Males		Females	
	Average	95% CI	Average	95% CI	Average	95% CI	Average	95% CI
Alcohol								
Pure alcohol consumption per person (litres)	0.2	(0.1 - 0.2)	0.0	(0.0 - 0.0)	NAD	NAD	NAD	NAD
Alcohol use disorders, 12 months prevalence (%)	0.5	(0.0 - 1.2)	0.1	(0.0 - 0.4)	NAD	NAD	NAD	NAD
Heavy episodic drinking, 30 days prevalence (%)	0.5	(0.0 - 1.3)	0.1	(0.0 - 0.3)	NAD	NAD	NAD	NAD
Inadequate physical activity								
Crude adjusted estimates (%)	48.3	(44.1 - 52.5)	62.8	(60.2 - 65.4)	NAD	NAD	NAD	NAD
Tobacco								
Current tobacco smoking	38.3	NAD	2.3	NAD	35.1	NAD	3.5	NAD
Daily cigarette smoking	24.5	NAD	1.1	NAD	NAD	NAD	NAD	NAD

NAD, no available data

1.4 Intervention Studies

The previously discussed health behaviours that are mostly initiated during adolescence have a major impact on the current and future health of adolescents. Thus, targeting such behaviours in this period would provide tremendous health benefits. Schools represent valuable settings for health promotion or primary prevention of these behaviours in adolescents; accordingly, many interventions have been implemented in them. School-based interventions have the potential to be effective in influencing adolescents' HRBs. In order to help inform the present study, a comprehensive review was undertaken to identify effective school-based interventions targeting HRBs in adolescent females between 13 and 18 years, in terms of:

1. Physical activity
2. Healthy nutrition
3. Bone health
4. Prevention of tobacco smoking
5. Prevention of substance abuse
6. Sun protection

The review also aimed to determine the effectiveness of such interventions and also their characteristics. A full systematic review was not feasible due to the search being branched into six fields and the profoundness of interventions in each of them. Therefore, a comprehensive literature search was performed.

1.4.1 Search Strategy

1.4.1.1 Inclusion/Exclusion Criteria

The search criteria were as follows: educational or curricular interventions implemented in schools, directed toward adolescents between 13 and 18 years, include females, must have a comparison group (i.e. control group), and have pre- and post-intervention assessments. Topics targeted by interventions are either physical activity, nutrition and dietary behaviours, bone health, tobacco smoking, substance abuse, or sun protection. Outcomes must include two or more of the following: health knowledge, weight measurements (weight, BMI, BMI percentiles or z-score, percentage of body fat, waist circumference), physical fitness, physical activity, dietary behaviours, tobacco smoking, substance use, sun exposure or sun protection. Interventions that targeted adolescents with medical conditions (e.g. secondary prevention); exclusively involved adolescents with low socioeconomic status (SES); were computer-based, internet-based or mobile-based; used psychological motivational skills; were conducted after-school; were community-based; involved only structured physical training; targeted cognitive performance and academic achievement; or addressed only alcohol abuse or eating disorders were excluded. Years and duration of interventions were not restricted.

1.4.1.2 Search Databases and Terms

The searched databases were OVID MEDLINE (from 1946 to Jan 2017), EMBASE (from 1947 to Feb 2017), and Health and Psychological Instrument, Child Development & Adolescent Studies, CINAHL, ERIC, PsycARTICLES, Psychology and Behavioural Sciences Collection, PsycINFO, and SocINDEX.

Search terms included (school* or in-school or classroom or in-classroom); (education* or curricul* or lesson*); (intervention* or program* or experiment*); (adolescent* or teen* or youngster* or youth); ((group*) and (control or reference or comparison)); (female* or girl* or women); (knowledge or aware*); ((“physical activity” or (nutrition* or diet* or eat* or drink* food* or beverage* or intake* or consumption*) or (bone* or skeletal*) or (tobacco smoking) or ((sun* and (protect* or exposure)) or (“substance use” or “use of substance*” or ((substance* and (abuse or misuse)). These specific terms were used in order to narrow down the interventions to only those relevant and to bring it to a reasonable number as there are an abundance of school-based interventions, not all relevant to the current thesis. The search was limited to English language and filtered for ages 13 to 18 where the database allowed.

1.4.2 Outcomes

The search retrieved 794 studies including 480 unduplicated results (as shown in Figure 1-2). Screening of the title and the abstract of unduplicated studies resulted in an exclusion of 380, giving 100 relevant studies. These studies were further assessed for eligibility which resulted in an exclusion of another 33 studies.

Reasons for exclusions were: reviews (n= 10), unavailability (n= 9), out of the specified age range (n= 5), after-school (n= 1), having a structured PA program without education (n= 1), delivered through computer or telephone (n=3), had no control or comparison group (CG) (n= 2), irrelevant targeted behaviour (n=1), and a thesis (n=1). Critical evaluation of the final selection of papers identified a number of features related to the design and construction of the studies, as well as their outcomes and findings. These are detailed below.

1.4.2.1 **Behaviour Combinations**

A wide range of previous studies in adolescents has targeted changes in the aforementioned behaviours as a primary outcome. Several addressed two or more behaviours according to the targeted purpose. The most combined topics were PA and nutrition for the prevention of obesity and cardiovascular disease. The second most commonly combination is tobacco smoking, and substance abuse/alcohol use for prevention of their detrimental health effects in adolescents who are considered to be at high risk of such behaviours.

1.4.2.2 **Designs and Size**

The search was limited to experimental designs with a comparison group. Most studies were quasi-experimental lacking randomisation and blindness. The size of the cohorts ranged from 54 (Fardy *et al.*, 1995) to 4,837 (Bell, Ellickson, & Harrison, 1993) including only one population, Americans in this case; and up to 7,079 involving different populations such as Europeans (Vigna-Taglianti *et al.*, 2014). Many were large-scale studies with cohort size exceeding 1000 participants (Pate *et al.*, 2005; Buller *et al.*, 2006; Zhou *et al.*, 2014; Maatoug *et al.*, 2015). Cluster randomised control design where recruitment occurred at the school level rather than the individual was commonly employed (Botvin *et al.*, 2001; Vigna-Taglianti *et al.*, 2009; McMurray *et al.*, 2002). The number of clusters (i.e. schools) ranged from three or five (Amaro *et al.*, 2006; McMurray *et al.*, 2002) to 42 schools (Willi *et al.*, 2012) including one population, and up to 143 schools involving different populations (Vigna-Taglianti *et al.*, 2014).

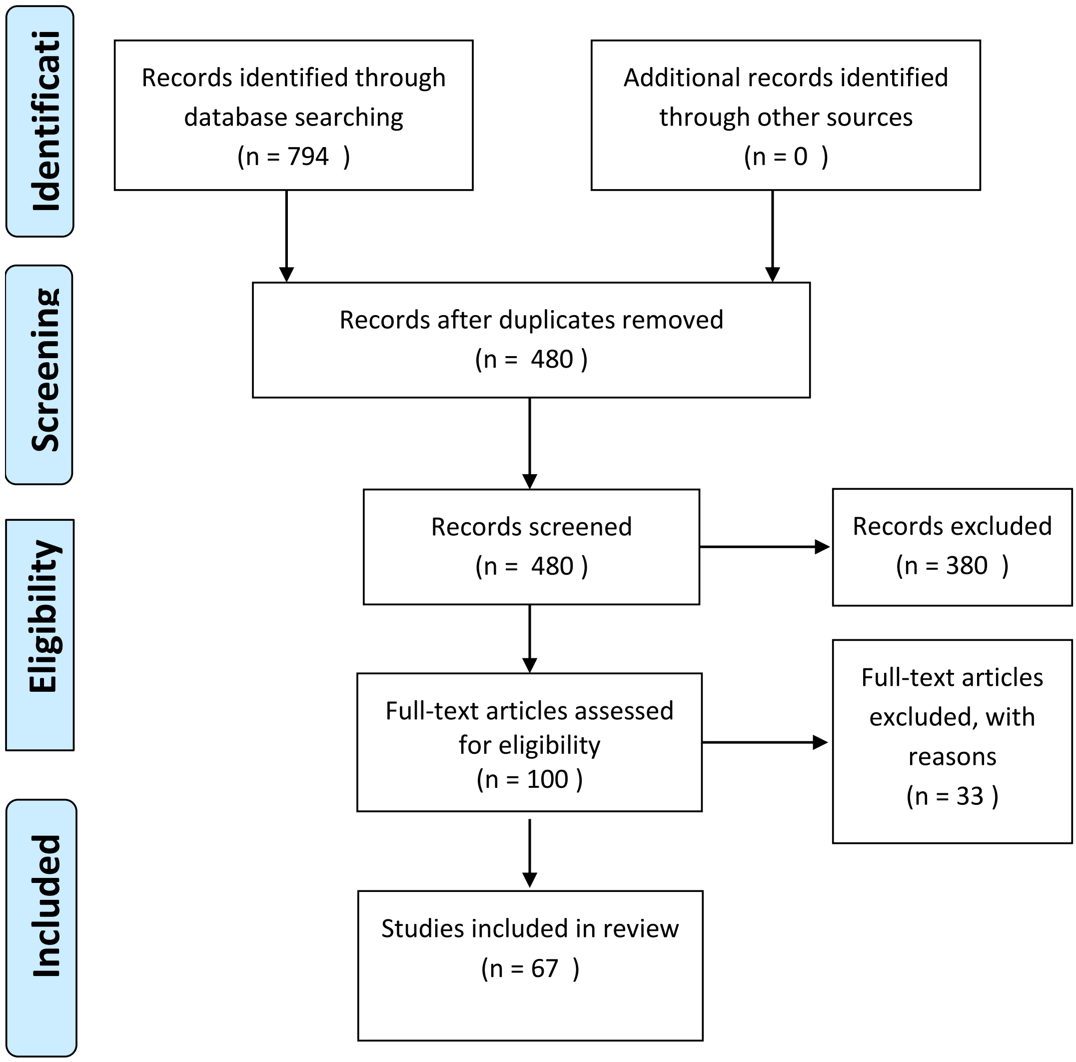

Figure 1-2 PRISMA 2009 Flow Diagram (Moher *et al*., 2009)

1.4.2.3 **Sociodemographic Characteristics of Participants**

1.4.2.3.1 Age

School-based interventions among adolescents were heterogeneous in their sociodemographic characteristics. Some involved a specific school year which corresponded to the targeted age. These include Year 7 corresponding to a mean age of 13 years (Bell, Ellickson, & Harrison, 1993; Botvin *et al.*, 2001; Hadi *et al.*, 2008; Lazorick *et al.*, 2011; Bogart *et al.*, 2014; Wang *et al.*, 2015a), Year 8 equivalent to mean age of 14 years (Vijayapushpam *et al.*, 2003; Prell *et al.*, 2005; Rao *et al.*, 2007; Tse & Yuen, 2009), Year 9 or mean age of 15 years (Lo *et al.*, 2008; Primack *et al.*, 2014), and Year 10 or mean age of 16 years (Podell *et al.*, 1978; Killen *et al.*, 1989; Fardy *et al.*, 1995). Others involved more than one school year such as Years 7 and 8 (Schofield, Lynagh, & Mishra, 2003), Years 9 and 11 (Anand *et al.*, 2013), and Years 11 and 12 (Ghrayeb *et al.*, 2013a; Ghrayeb *et al.*, 2013b).

1.4.2.3.2 Gender

Gender was also exclusive in some interventions which were gender-oriented such as female (Killen *et al.*, 1993; Neumark-Sztainer *et al.*, 2003; Bayne-Smith *et al.*, 2004; Pate *et al.*, 2005; Amani & Soflaei, 2006; Rao *et al.*, 2007; Neumark-Sztainer *et al.*, 2010; Dehdari *et al.*, 2013). Male-oriented interventions could not to be identified due to the search focusing only on interventions that included females.

1.4.2.3.3 Locations and Ethnicities

The localities of the selected studies were diverse. While most were from North America (n= 33) and Europe (n= 17), the list included few studies from Asia including Iran (n= 6), India (n=4), Palestine (n= 2), China (n=1), Thailand (n=1), and Turkey (n=1). There was also one from Tunisia in North Africa and one from Brazil in South America. No school-based health promotional interventions were found in the Gulf region.

A small number of interventions targeted specific ethnicities within the population such as Native Americans (Ritenbaugh *et al.*, 2003), African-Americans (Covelli, 2008), Hispanic-Americans (Melnyk *et al.*, 2009), Latin-Americans (Kilanowski & Gordon, 2015), African-Americans and Latinos (Chapman *et al.*, 2015), and Aboriginal Canadians (Ronsley *et al.*, 2013). Others targeted particular social class especially low income (i.e. socioeconomic status) (Frenn, Malin, & Bansal, 2003; Covelli, 2008; Puma *et al.*, 2013; Stolzel *et al.*, 2014).

1.4.2.4 **Delivery Strategies**

Educational interventions involved lessons that were mostly delivered traditionally or by a slideshow presentation with or without printed materials such as posters, brochures, or booklets (Brown & Schoenly, 2004; Ghrayeb *et al.* 2013; Schuz & Eid, 2013). There was an intervention that was delivered unconventionally through a board-game (Amaro *et al.*, 2006). Some interventions employed more than one strategy such as audio-visuals, printed materials, group discussions, skills building, games or competitions, drama, and computer activities (Bell, Ellickson, & Harrison, 1993; Fardy *et al.*, 1995; Covelli, 2008; Singhal *et al.*, 2010; Lazorick *et al.*, 2011; Bogart *et al.*, 2014; Sumen & Oncel, 2015). There were also a number of educational interventions completely delivered via a computer or using the internet. However, these were outside of the scope of the current study.

1.4.2.5 **Components of Interventions**

Many interventions integrated other components along with the educational one. These included social support (i.e. family, peers, teachers), behavioural enhancement (i.e. skills development, goal setting, planning, training), environmental changes (i.e. changes in schools' supplies, services, policies), or community-level incorporation (i.e. mass media campaign).

1.4.2.6 **Intervention Providers**

Educational interventions were delivered by providers with different expertise. Interventions were largely delivered by school teachers (Buller *et al.*, 2006; Mihas *et al.*, 2009; Vigna-Taglianti *et al.*, 2014), health professionals (Frenn, Malin, & Bansal, 2003; Rogers & King, 2013; Stolzel *et al.*, 2014), researchers (Ghrayeb *et al.*, 2013), or peer leaders (Lo *et al.*, 2008; Ronsley *et al.*, 2013; Bogart *et al.*, 2014).

1.4.2.7 **Dose of Interventions**

The frequency of educational interventions varied between the studies from just one session (Mary, D'souza & Roach, 2014; Zhou *et al.*, 2014; Sumen & Oncel,

2015) up to 38 sessions (Tsorbatzoudis, 2005). The duration of the educational session at one time also varied, ranging from five minutes (Fardy *et al.*, 1996; Bayne-Smith *et al.*, 2004) to 120 minutes (Lionis *et al.*, 1991). The duration of the entire intervention ranged from one day (Mary, D'souza & Roach, 2014; Sumen & Oncel, 2015) to three years (Lewis *et al.*, 1988).

1.4.2.8 **Follow-up and Retention**

Some interventions had no follow-up while others ranged from two weeks (Bayne-Smith *et al.*, 2004; Fahlman *et al.*, 2008) to ten years (Klepp, Tell, & Vellar, 1993). However, most interventions had no or short-term follow-up (≤ 6 months). Retention rate varied between the studies with higher retention in those with short-term follow-up which ranged from 61% (D'Amico & Fromme, 2002) to 100% (Toulabi *et al.*, 2012; Sumen & Oncel, 2015). Retention rate was also good in long-term studies ranging from 66% (Ross, Richard, & Potvin,1997; Bonsergent *et al.*, 2013) to 93% (Nicklas *et al.*, 1988).

1.4.2.9 **Outcome Measures and Effects**

There was a heterogeneity in the outcome measures between the interventions according to the targeted behaviours or purpose. These outcomes included knowledge and/or attitudes; behaviours; physical measurements, biochemical measurements, and physiological measurements. Cognitive functions such as memory and problem-solving skills, and psychological symptoms such as depression, anxiety, and stress, were excluded from the literature as they are beyond the scope of this study. Knowledge indicates the change in the level of cognition and retention of the information related to the targeted topic. Attitudes also involve health beliefs, intentions, and outcome expectations. Physical measurements include weight, fat measurements, and blood pressure. Biochemical measurements include haematological indices, blood glucose and lipids. Physiological measurements include energy expenditure and physical fitness. The majority of the studies used self-reported questionnaires alongside anthropometric measurements to assess these outcomes. The effects of the behavioural interventions are discussed in terms of the abovementioned outcome categories.

1.4.2.10 **Physical Activity and Nutrition**

Physical activity intervention often involved a structured exercise programme but only those with educational sessions were included in the review. An intervention combining school PA, physical and behavioural skills, and supportive school staff resulted in American adolescent girls increased amount of vigorous PA per day compared to a control group but not in weight categories (Pate *et al.*, 2005). This difference in vigorous PA was also significant after three years (Pate *et al.*, 2007). Conversely, a study combining school PA with educational and behavioural skills and parental involvement increased step counts, and decreased BMI and proportions of overweight more than the CG after six months (Melnyk *et al.*, 2013).

Nutrition was the most targeted behaviour by school-based educational interventions and has been frequently combined with PA programme. Most of these interventions increased nutritional knowledge in the short-term (Fardy *et al.*, 1995; Fardy *et al.*, 1996; Bayne-Smith *et al.*, 2004; Covelli, 2008; Blake, 2009; Toulabi *et al.*, 2012). Whereas, few did not result in significant increase in knowledge (Melnyk *et al.*, 2009; Ronsley *et al.*, 2013; Kilanowski & Gordon, 2015). Many also resulted in a significant improvement PA and dietary behaviours (Covelli, 2008; Saraf *et al.*, 2015; Viggiano *et al.*, 2015) and some on only dietary behaviours (Neumark-Sztainer *et al.*, 2010; Singhal *et al.*, 2010). Some of them resulted in reduction of excess weight and body fat (Mcmurray *et al.*, 2002; Toulabi *et al.*, 2012; Ronsley *et al.*, 2013; Kilanowski & Gordon, 2015). Other multi-component interventions alternatively did not result in a significant change in weight measurements at short-term or long-term follow-ups (Damon, Dietrich, & Widhalm, 2005; Neumark-Sztainer *et al.*, 2010). A number of studies also showed a maintenance and reduction of blood pressure (Mcmurray *et al.*, 2002; Bayne-Smith *et al.*, 2004; Ronsley *et al.*, 2013), improved physical fitness (Fardy *et al.*, 1996; Mcmurray *et al.*, 2002; Blake, 2009), and lowered blood lipids (Fardy *et al.*, 1995; Singhal *et al.*, 2010).

1.4.2.11 **Tobacco Smoking and Substance Abuse**

A number of multi-components interventions combining education of harmful substances with social pressure resistance skills in American adolescents resulted in a significant increase in knowledge while reducing the use of substances in a one-year follow-up (Botvin *et al.*, 2001; Lennox & Cecchini, 2008). Another multi-component educational intervention in Dutch adolescents combined education, school policy on substance use, support and counselling for those using substances, and parental involvement for three years (Cuijpers *et al.*, 2002). It resulted in a significantly higher knowledge, less positive attitude towards alcohol and marijuana, and lower reported use of tobacco, alcohol, and marijuana during the three years. Another drug education intervention combined with resistance skills training in American adolescents, on the other hand, did not result in a significant difference between the groups in terms of knowledge (Shope *et al.*, 1998). However, it resulted in less alcohol use and misuse, and less cigarette smoking after one year. Project studies in America compared an intervention with only educational components, an intervention combining educational component with behavioural skills, and a CG (Skara *et al.*, 2005; Sun *et al.*, 2008). The educational intervention resulted in the highest gain in knowledge, followed by the combined intervention, while the CG had the least gain after one month (Skara *et al.*, 2005). After one year, both intervention groups had significant reductions in the risk of hard drug use compared to the CG (Sun *et al.*, 2008).

1.4.2.12 **Bone Health and Sun Protection**

There were few educational studies with regard to bone health for the prevention of osteoporosis in adolescents. One intervention assessed knowledge and barriers to promoting behaviours in American adolescents and only knowledge was significantly increased compared to the CG and in females more than males (Brown & Schoenly, 2004). Another study compared two interventions on osteoporosis education, one with traditional lessons and the other by slideshow presentation, group discussion, role-playing activities, and printed materials in Iranian adolescents (Hazavehei, Taghdisi, & Saidi, 2007). The interactive intervention resulted in more gain in knowledge; higher perceived susceptibility, severity, and benefits; and decreased perceived barriers to promoting behaviours than both traditional and CG. Calcium intake, PA participation, and sun exposure were also higher in interactive intervention than others immediately after the intervention and at one-month follow-up. Sun protection interventions for the prevention of skin cancer were limited. Most of these interventions resulted in an increase in knowledge (Buller *et al.*, 2006; Sumen & Oncel, 2015), and improved attitude towards sun protection. Some showed a significant increase of sun protective behaviours such as use of sunscreen and clothing (Buller *et al.*, 2006). Moreover, few resulted in negative attitude towards sunbathing and skin tanning (Buller *et al.*, 2006).

1.4.2.13 Multiple Behaviours

An intervention targeting multiple behavioural risk factors of cancer in English and Scottish adolescents increased knowledge of the risk factors except for tobacco smoking, second-hand smoking, family history and HPV infection (Kyle *et al.*, 2013). Females showed a greater increase in knowledge of risk factors than males. A similar intervention targeting cancer risk factors in German adolescents also resulted in a significant increase in knowledge of these behaviours and knowledge of cancer risks compared to the CG (Stolzel *et al.*, 2014). It additionally resulted in a significantly higher intention score for healthful behaviours than the control group.

1.4.3 Conclusion

School-based interventions were diverse and heterogeneous in their characteristics along with the population targeted and the outcomes measured. The interventions were effective to produce significant short-term and some long-term changes in HRBs as well as in knowledge, physical, biochemical and physiological measurements, in adolescent females. However, it was difficult to identify which specific characteristics would have the greatest influence on those behaviours. There is a lack of school-based interventional studies targeting HRBs in adolescents, especially females, in Kuwait and in the Gulf region. In conclusion, school-based interventions were effective to positively influence HRBs in adolescent females between the age of 13 and 18 and therefore worth being investigated in Kuwait.

1.5 Study Rationale

Despite the alarming rate of unhealthy behaviours among the adolescent population of Kuwait, interventions targeting health-related behaviours among them are scarce. Such interventions are necessary to deter the detrimental consequences of these behaviours. A wide range of studies across the globe have demonstrated a favourable outcome of school-based educational programmes on health-related behaviours as well as physical and biochemical measurements. Therefore, this study is an initiative aimed at promoting the health of adolescent females in Kuwait. It aims to determine the effectiveness of a school-based health knowledge, promoting intervention which targets multiple health behaviours among adolescent females in Kuwait. The intervention addressed six health topics: physical activity, healthy nutrition, bone health, prevention of tobacco smoking, prevention of substance abuse, and sun protection. These topics, accordingly, targeted multiple behaviours including physical activity, dietary, tobacco smoking, substance misuse and abuse, and protection from sun and ultraviolet radiation (UVR).

1.6 Aims:

The specific aims for this study were to:

(i) Increase physical activity and improve its related behaviours
(ii) Improve health-related fitness components
(iii) Improve dietary behaviours
(iv) Normalise weight measurements
(v) Prevent tobacco smoking and substance abuse
(vi) Promote sun protective behaviours
(vii) Increase knowledge of each of the six health topics in adolescent females in Kuwait

It is hypothesised that the intervention will results in significant effects in terms of:

H_1: Increasing total health knowledge of the six topics and for each.

H_2: Increasing PA and improving its related behaviour.

H_3: Improving health-related fitness including trunk and hamstring flexibility, abdominal muscles strength, lower limb muscles strength and power, body balance, and cardiorespiratory endurance (VO_2 max) as a result of increasing PA.

H_4: Improving dietary behaviours with regard to increasing intake of daily breakfast, having regular daily meals, fruit and vegetables intake, milk and dairy products, healthy snacks, and water consumption. Conversely, reducing intake of unhealthy snacks, fried foods, and sugary foods and drinks.

H_5: Normalise weight measurements in BMI z-scores, percentage of body fat and its percentiles for age and gender, waist circumference and waist-to-height ratio, by increasing PA and improving dietary behaviours.

H_6: Discouraging and preventing tobacco smoking and substance abuse.

H_7: Encouraging use of sun protection while discouraging sunbathing and the use of sunbeds.

Chapter 2

Materials and Methods

2.1 Introduction

This chapter details the research process from the planning phase to the implementation phase. The first section describes the planning, design and development of the study's structure and content. The second section describes the procedures and instrumentations used for assessment, following the Consolidated Standards of Reporting Trials (CONSORT) 2010 statement guidelines (Schulz, Altman, & Moher, 2010). The third section defines and elaborates the intervention programme implemented in the school. Finally, the fourth section explains the statistical analysis approach of the quantitative data. A pre-post, randomised control design was used to examine the hypothesis.

2.2 Planning the Study

The initial plan was to develop a health education programme for adolescent athletes which would exclusively include female athletes from the three female sports clubs in Kuwait. Consequently, health interventions involving multiple health topics related to sports were researched. One of the interventions which was found to be relevant was the *Fédération Internationale de Football Association's* (FIFA) "11 for Health" programme (Fuller *et al.*, 2010; 2011). It involved 11 key health messages and were linked to the teaching of football skills. Each message targeted a risk factor for either communicable or non-communicable diseases and was connected to a symbolic football skill, as summarised in the Table 2-1. The intervention was implemented either in-school or out-of-school for a 5-month period. It integrated 11 sessions of 90 minutes, each divided into 45 minutes of football play (football skill) followed by a health education session. The programme significantly increased the health knowledge among the children, and they had positive responses toward the initiative.

Based on the above, a preliminary programme involving 11 health messages concerning health behaviours in female athletes was proposed. It targeted female athletes between the age of 15 and 18 and was given the title 'Sports for Health' as demonstrated in Figure 2-1. It was decided later that the study should involve non-athletic subjects from two public high schools for females in Kuwait in order to have a wide-ranging study sample representing the community. Thus, health topics had to be more generalised and concise. Subsequently, six general health topics were included and the title was changed to GLEAMs as an abbreviation of 'Girls Life Enhancing Attitudes and Motives'. Finally, only health-related topics were included to avoid sociocultural disagreement, and subjects from only one public high school were to be included due to time limitations and efforts to improve the feasibility of implementation.

Table 2-1 FIFA's 11 for health messages targeting diseases' risk factors and linked to football skills

	Health Message	Football Skill	Targeted Risk Factors
1.	**Play football (Physical exercise)**	Play football	Physical inactivity, unhealthy weight, cholesterol, high blood pressure
2.	**Respect girls and women**	Passing	Unsafe sexual encounter
3.	**Protect yourself from HIV**	Heading	Unsafe sexual encounter
4.	**Avoid alcohol and drugs**	Dribbling	Use of alcohol and tobacco
5.	**Drink clean water**	Trapping	Contaminated water supply
6.	**Wash your hands**	Defending	Poor hygiene and sanitation
7.	**Eat a balanced diet**	Building fitness	Inadequate fruit and vegetable intake, underweight and overweight.
8.	**Use treated bed nets**	Shielding	Malaria
9.	**Take your prescribed medication**	Goalkeeping	Inadequate health protection
10.	**Vaccinate yourself and your family**	Shooting	Inadequate health protection
11.	**Fair play**	Teamwork	Family and social support

Adapted from Fuller *et al*. (2010)

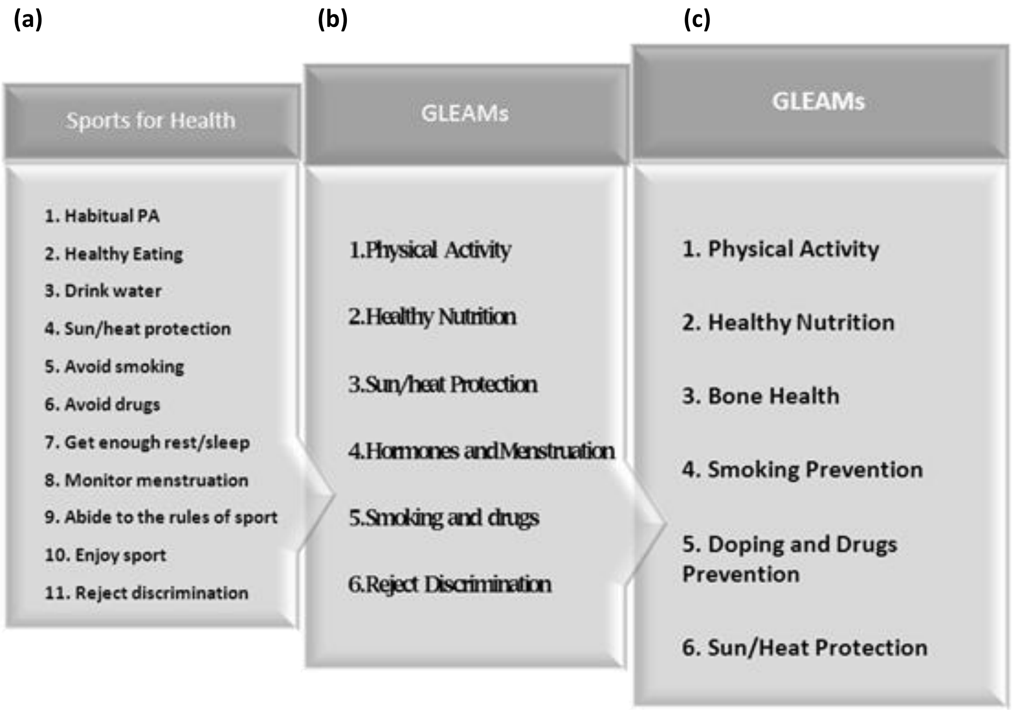

Figure 2-1 Proposed health messages for the intervention and their modifications, (a) the initial plan with messages for adolescent female athletes, (b) modified plan with topics for also non-athlete adolescent females, (c) final plan with only health-related topics

2.3 Research Design and Paradigm

A randomised controlled design was chosen for the purposes of facilitating the investigation and allowing for the implementation of the intervention. In addition, this design prevents the crossover contamination of the intervention effects between the compared groups. It also included school classes that represent the three secondary school years: 10^{th}, 11^{th} and 12^{th}.

This research follows an objectivist approach and was conducted using a quantitative research design that constitutes a pre-post-test randomised controlled trial (Cohen, Manion, & Morrison, 2013). Therefore, a positivist paradigm underpinned it.

2.4 Participants

2.4.1 Eligibility Criteria

The eligibility criteria for participants comprised age between 14 and 19 years. In addition, they would have no involvement in extracurricular activities such as school sport teams, or science or book clubs to ensure attendance and compliance. Finally, absence of any medical condition restricting participation in vigorous intensity exercise which is equivalent to the 20m shuttle run fitness test, which is one of the outcome measures that will be discussed later in section *2.7.2.2.1*. The exclusions include: having a congenital heart defect, severe bronchial asthma (including exercise-induced asthma), and severe anaemia. Furthermore, participants should have not suffered from a musculoskeletal condition or injury restricting exercise participation such as Osgood-Schlatters disease, acute ankle sprains, etc. They also should have not undergone a surgical procedure that restricts exercise participation at the time.

2.4.2 Data Collection Setting

The data were collected from one public secondary school for girls in Kuwait (Al-Adan secondary school for girls), primarily by the researcher. The school is located in an urbanised governorate and is representative of the general population.

2.5 Sampling Technique

A probability sampling technique by means of random selection was used. More specifically, the selection was based on stratified random sampling by school year group and study field on a class level. The school administration was asked to randomly assign six classes from each school year, including both study fields for the 11th and the 12th school years. Eligibility criteria for classes included not being involved in other studies or projects.

Public schools in Kuwait are governmentally directed and regionally supervised through educational governorates. Public secondary schools represent approximately 60% of total secondary schools and are separated by gender. The secondary school system in Kuwait has three year groups: 10th year group usually includes students between the ages of 14 and 15, 11th year group with students age between 16 and 17 and 12th year group between the ages 17 and 18. Hence, the age or year group in the sample selection had to be accounted for. Furthermore, the secondary system has two fields of study as a speciality: scientific and literary. Pupils study the same subjects in the 10th school year, and by the end of this year choose between scientific or literary as a learning speciality for the next two years. Accordingly, the field of study was considered as another stratum.

2.6 Intervention:

The intervention constituted of educational sessions which were delivered to each of the three classes separately during their physical education (PE) class. It included six educational sessions: physical activity, healthy nutrition, the prevention of tobacco smoking, the prevention of substance use, bone health, and sun protection. The session duration was 45 minutes; this was divided into five minutes for filling a baseline knowledge questionnaire, 30 minutes for presentation of the topic, and ten minutes for questions. Each topic was delivered in a single session and the sessions were delivered approximately a month apart as seen in Table 2-2.

The intervention was imparted by the researcher using a slideshow presentation software (Microsoft's PowerPoint©). It was delivered in Arabic, as this is the native language of the participants. The content was gathered from reliable sources such as NHS, CDC, and other professional websites. An outline of the educational curriculum is attached in Appendix I.

Table 2-2 Intervention sessions and assessments timetable

Pre-intervention		Intervention		Post-intervention	
Assessments	**Month**	**Health educational Sessions**	**Month**	**Assessments**	**Month**
Health behaviours questionnaire	November 2014	**Physical activity**	**December 2014**	Health behaviours questionnaire	April 2015
Anthropometrics	November 2014	**Healthy nutrition**	**January 2015**	Anthropometrics	April 2015
Physical fitness	December 2014	**Prevention of tobacco smoking**	**February 2015**	Physical fitness	April 2015
Accelerometers	December 2014	**Prevention of substance abuse**	**March 2015**	Accelerometers	May 2015
Health knowledge questionnaires	PA: Dec 2014 HN: Jan 2015 TS: Feb 2015 SA: Mar 2015 BH: Mar 2015 SP: Apr 2015	**Bone health**	**March 2015**	Health knowledge questionnaires	PA: Dec 2014 HN: Feb 2015 TS: Feb 2015 SA: Mar 2015 BH: Mar 2015 SP: Apr 2015
		Sun protection	**April 2015**		

PA, physical activity; HN, healthy nutrition; TS, tobacco smoking; SA, substance abuse; BH, bone health; SP, sun protection

The timetable does not show the time per week which can indicate a longer duration (i.e. HN knowledge pre-intervention was carried out on the last week of January and post-intervention a week later in February), *refer to the timetable in Appendix VIII for more details.*

2.7 **Outcome Measures:**

An assessment of outcome measures was performed during the same week for all classes during the PE class. For girls who were absent at the time of assessment, assessment was undertaken during the next available class. The assessments were carried out by the researcher, with the assistance of the PE teachers. Primary outcomes included total change in knowledge of the health topics, self-reported physical activity assessed by a questionnaire and by accelerometry in a subsample. Secondary outcomes included anthropometrics (height, weight, BMI-for-Age z-score, percentage body fat, and waist circumference), health-related physical fitness, and other self-reported health-related behaviours (HRBs) (dietary behaviour, medications and drugs, tobacco smoking, and sun and UVR exposure) as well as socio-demographic and personal health information. Health knowledge is the interventions main mediator for eliciting change in health behaviours and thus it is a primary outcome. Accordingly, it is hypothesised that mainly PA will increase as another primary outcome. Consequently, physical fitness will improve as a secondary outcome. Furthermore, other HRBs such as dietary practices, tobacco smoking, substance use, skin protection and sun exposure will be positively promoted as secondary outcomes. By increasing PA and improving dietary practices, weight measurements are hypothesised to be normalised.

2.7.1 **Primary Outcome Measures:**

2.7.1.1 **Health-Related Knowledge**

Structured questionnaires for the purpose of determining topic-related knowledge were constructed. There were six topic-related questionnaires each included 15 multiple choice questions (MCQs) which offered four choices (see Appendix IV). The questions ranged from general knowledge about the topics to more specific knowledge which was covered in the sessions. The questionnaire was administered just before the related-session to assess baseline knowledge. The girls were given five minutes to fill them in before they were collected and the session was then started. The questionnaires were administered again after a week during the PE class to assess post-intervention knowledge change.

The questionnaires were scored based upon correct answers out of the 15 questions and percentages were calculated for both baseline and post-intervention topic-specific knowledge. A total score of the knowledge was also calculated by combining all scores of the six questionnaires together giving a complete score of 90, again for both baseline and post-intervention knowledge and these were converted to percentages. In addition, the differences between percentages for both specific and total knowledge were calculated to assess the extent of change from the baseline.

2.7.1.2 **Self-Reported Physical Activity**

Physical activity (PA) is defined as “any bodily movement produced by muscles that results in energy expenditure” (Caspersen, Powell, & Christenson, 1985, p.126). PA includes sports, conditioning, exercises, occupational/school, household activities (Caspersen, Powell, & Christenson, 1985) and transportation. PA is a behaviour and it differs from energy expenditure (EE), which is a physiological consequence of PA (Pate, 1993). PA is measured in kilocalories (kcal) or kilojoules (kJ) to quantify the required amount of energy for accomplishing an activity (Caspersen, Powell, & Christenson, 1985). Metabolic equivalent (MET) is also a quantification unit of EE calculated from kcal, body weight in kg and time, given that one MET equals 1 kcal/kg/hour. An EE Assessment of PA among adolescents can be performed through subjective or objective methods, or a combination of both (Muller and Bosy-Westphal, 2003).

An initial PA questionnaire (Appendix V) was piloted in a small sample of 22 adolescent female athletes in Kuwait during April 2013. The subjects were all athletes from Salwa sport club for women and were between the ages of 14 and 17. The athletes were sampled from a number of different sports: four from volleyball, 6 from athletics, five from handball, two from table tennis, three from Taekwondo and two from basketball. The questionnaire was adapted from the Adolescent Physical Activity Recall Questionnaire (APARQ) (Booth *et al.*, 2002) and PA questionnaire from Arab Teens Lifestyle Study (ATLS) (Al-Hazzaa *et al.*, 2011). The questionnaire was divided into two main sections: weekday activities including school activities and weekend activities. The purposes of the pilot study were to assess its practicality and its limitations. Feedback from the subjects on the questionnaire was obtained from the comments box. The most frequently reported feedback was the difficulty of recalling activities for seven days and recommended to have a day by day or a maximum of 3-day. Additionally, it was suggested that the study change in intensity of the activities daily rather than weekly. However, a 3-day recall is unrepresentative of regular PA as it does not cover both weekday and weekend activities. Accordingly, the PA questionnaire has been modified and further developed based on the International Physical Activity Questionnaire for adolescents (IPAQ-A) (Hagströmer *et al.*, 2008) and a PA questionnaire from Arab Teens Lifestyle Study (ATLS) (Al-Hazzaa *et al.*, 2011).

The restructured PA section included four domains: school-related PA, housework and gardening, transportation, and sports and leisure time, as shown in (Appendix VI) over the seven days. This was followed by questions on whether the participant's father and mother engaged in PA, the participant's reason for participating in PA and the barriers to their participation. The school-related PA included questions on PA by frequency per week and duration per day, comprising PA during PE class, walking during breaks and sitting during breaks. The housework section also included questions on moderate and vigorous PA during housework or gardening by frequency and duration. The transportation section included the frequency and duration of walking PA for transportation and time spend travelling by car. The sports and leisure-time PA section asked about the frequency and duration of walking (not for transportation purpose), moderate PA, and vigorous PA out of school.

The provided options for the main reason for engaging in PA included: maintain or lose weight, acquire physical fitness, maintain and strengthen the muscles, promote healthy living, and/or enhance social interaction. Barriers to exercise, on the other hand, included personal, social, environmental, and health barriers. Personal barriers included interfering with study time, lack of time, disrupting aesthetic appearance, embarrassment of overweight, concern of muscularity, lack of motivation, lack of interest in PA, and unneeded PA. Social barriers included a lack of family support, lack of friend support, and tradition and culture. Environmental barriers included lack of facilities, difficulty reaching the place, lack of safety and security, and unsuitable weather. Health barriers included any health issues or conditions that restrict engagement in PA. Mother' and father's participation in regular PA, as has been explained earlier in the same questionnaire, was also assessed to investigate the association with the daughter PA. Scoring of PA was performed through multiplication of frequency and duration for each PA then calculating totals of walking, moderate, and vigorous PAs from the four parts. The questionnaire was administered at the beginning of the study before the intervention and after the intervention at the end of the study.

2.7.1.3 Physical Activity by Accelerometry

PA was also assessed in a subsample to investigate its feasibility and consistency with the self-reports due to its novelty in the population. It was monitored using a 7-day lower back tri-axial accelerometer - Actigraph GT3X+ (Actigraph™, Pensacola, FL, USA) on a subsample of students.

Accelerometers, also called activity monitors, measure activity acceleration in two or three axes; they are inexpensive, simple to use and objective and therefore, have been chosen to assess PA in the study. The GT3X+ Actigraph collects data on three axes: a vertical axis (standing), a horizontal axis (lying down), and a perpendicular axis (sitting). It is a small sized, (3.7 cm x 3.5 cm x 1.8 cm), light weight (27g), waterproof, and safe to wear device. Actigraph has been validated in children using spiroergometry (R^2=0.82) (Freedson *et al.*, 1997) and against energy expenditure measured by doubly labelled water (DLW) (^{r}=0.39 – 0.58) and was found to be accurate (Ekelund *et al.*, 2001). Furthermore, the Actigraph has been validated against oxygen consumption (VO_2) which resulted in a strong correlation (r = 0.81, p <0.001) (Kelly *et al.*, 2013).

The choice to apply accelerometers in a subsample was also due to their relatively high cost of the device ($225 ≈ £170) within the limits of research budget. A self-selection sampling strategy was used for selecting the subsample to ensure the adherence and retention of the participants. Information about the accelerometer was distributed to all participants (see Appendix III). The PE teachers were instructed to ask for two volunteers from each of the study's classes to wear the accelerometer for seven consecutive days. This was done before the intervention at the beginning of the study and after the intervention.

The accelerometers were individually calibrated by inputting the participant's data (ID number instead of name, gender, height, weight, date of birth, and site of attachment) into the ActiLife 6 software connected to the accelerometer. The duration of monitoring including the exact time and dates, was also set via the software for a 7-day duration. Counts were collected in 10-second epochs. Energy expenditure was calculated according to tri-axial vector magnitude (VM3) cut-points (Sasaki, John, & Freedson, 2011) and PA intensities, METs, and MVPA, according to Freedson *et al*. for children (2005). After calibrating the accelerometer, it was disconnected from the computer and attached to the participant's lower back by a one inch (2.54 cm) elastic belt. This particular site of attachment was used because it was reported to be less influenced by the gravitational component, causes minor discomfort to the subjects, and does not affect their performance in activities (Bouten *et al*., 1997). In addition, a lower back attachment site provided the best prediction of EE during walking (r= 0.92 to 0.97) than head/trunk, upper arm, lower arm/hand, upper leg, and lower leg/foot attachment sites (Bouten *et al*., 1997).

The participants were asked to wear the accelerometer continuously for seven days and not to remove it unless necessary. They were also instructed to make sure that the belt was moderately tightened around the waist to avoid flipping the accelerometer, which can result in erroneous data. After the 7-day duration, subjects returned the accelerometers to the PE teacher, who in turn gave it to the researcher. The seven-day duration was chosen to make sure that the data covered both weekdays and weekend days to avoid misrepresentation of PA due weekday/weekend PA fluctuation. In addition, seven-day monitoring has been recommended to provide a reliable estimate of daily PA among adolescents (Trost, McIver, & Pate, 2005).

The data were retrieved by attaching the accelerometer to the computer and using the same software to extract the data. The data were then auto-calculated to estimate Kcals, METs and minutes of duration for light, moderate, MVPA, and vigorous PA.

2.7.2 Secondary Outcome Measures

All secondary measures were taken at the beginning of the study before the intervention and at the end of the study after the completion of the intervention.

2.7.2.1 Anthropometrics

2.7.2.1.1 *Height*

The height of the participants was measured using a portable stadiometer (Seca® 213, Hamburg, Germany) positioned against the wall, following World Health Organisation's (WHO) STEPwise Approach to Surveillance (STEPS) protocol for measuring height (WHO, 2008). The participants were asked to remove their footwear and any top head/hair accessory and stand on the stadiometer. They were measured in an erect standing position with arms by the side, feet together, knees straight, heels against the back board, and head straight not tilted. The height in centimetres (cm) was recorded.

2.7.2.1.2 *Weight*

Weight and the percentage of body fat were measured by a bioelectric impendence scale Tanita® BF-522w (Tanita® Corp., Illinois, IL, USA) following the WHO's STEPS protocol for measuring weight. The scale was placed on a firm and even surface. Participants were measured in their light-weight clothes and barefooted. They were asked to stand still on the scale placing each leg on the metal plates (electrodes) with arms on the side, facing forward until asked to step off. The displayed weight in kilograms (kg) and the body fat percentage (BF%) were recorded.

2.7.2.1.3 *BMI-for-Age*

Since children and adolescents continue to physically grow, their weight and height vary according to their age and gender (Rolland-Cachera *et al.*, 1982). Their healthy development is monitored through a standard growth reference according to their age and gender. Therefore, their body mass index (BMI) is determined based on their age and gender and classified by a reference standard (Rolland-Cachera *et al.*, 1982; Must and Anderson, 2006).

There are three main reference systems for classifying BMI-for-Age: the International Obesity Task Force (IOTF), the Centre for Diseases Control and Prevention (CDC), and WHO growth references. The WHO growth reference is the most sensitive when identifying overweight and obesity among children and adolescents and it is specific by month, unlike the IOTF (Gonzalez-Casanova *et al.*, 2013).

BMI-for-age can be measured either through z-scores or percentiles which are relative to a smoothed reference distribution and are adjusted for age and varied by gender (Flegal and Ogden, 2011). BMI z-scores are the standard deviation (SD) below or above the mean of the reference population distribution (Flegal and Ogden, 2011; Wang and Chen, 2012). BMI percentiles are the percentage of observations in the reference population which fall below a given value of BMI (Wang and Chen, 2012).

BMI, consequently, was calculated and evaluated by BMI-for-age z-score (BMIz) according to the WHO reference system for determining the weight categories for children and adolescents between the age of 5 and 19. The 'underweight or thinness' category is defined by a BMI-for- age less than -2 standard deviation (SD) and 'healthy weight' is between -2 to +1 SD (Onis *et al.*, 2007). The 'overweight' category is greater than +1 SD while 'obesity' is defined at greater than +2 SD. BMIz has been evaluated using WHO growth monitoring software called AnthroPlus for children and adolescents based on WHO's 2007 growth references (WHO, 2009; 2011).

2.7.2.1.4 *Percentiles of Percentage Body Fat for Age*

Although BMI is the most commonly used measure to identify weight status, it does not discriminate those who are overweight due to excess lean mass from those overweight due to excess fat mass (Must and Anderson, 2006; Flegal and Ogden, 2011). Thus, percentiles of BF% for age and gender were additionally assessed. The BF% categories were defined as 'under-fat' which is set at 2^{nd} percentile, 'normal-fat', lay between greater than 2^{nd} percentile and less than the 85^{th} percentile (McCarthy *et al.*, 2006). 'Over-fat' was defined at 85^{th} percentile and 'obese' at and above the 95^{th}. Body fat categories according to percentiles of BF% for age and for girls are summarised in Table 2-3, which included only the study's sample age range. The BF% assessment tool and procedures were previously stated (*see section 2.7.2.1.3*). The recorded values were evaluated according to McCarthy's fat categories.

2.7.2.1.5 *Waist Circumference*

Waist circumference (WC) was measured using a standard tape measure and following the WHO STEPS protocol for measuring waist circumference (WHO, 2008). Participants were measured over light-weight clothes in a standing position with arms relaxed at the sides by and body weight evenly distributed on feet. WC was taken at midpoint between the last rib and the top of the iliac crest at the end of a normal expiration. The measure tape was moderately wrapped, horizontally passed across the back and front of the participants and parallel with the floor. WC was recorded at the nearest 0.1 cm shown on the tape.

WC at or above the 90th percentile has been commonly recognised as a cut-off for excess abdominal fat, which is associated with an elevated risk of cardiovascular disease (CVD) and metabolic syndrome (Freedman *et al.*, 1999; Weiss *et al.*, 2004; Lee *et al.*, 2009). WC percentiles by age and gender were developed for Kuwaiti children and adolescents between the age of 5 and 19 which used the same cut-off percentile (Jackson *et al.*, 2011). Table 2-4 includes the 90th percentile cut-off values of WC for females between the ages of 14 and 18.9 used for the present study sample.

2.7.2.1.5.1 Waist-to-Height Ratio

Waist-to-height ratio (WHtR) has been calculated additionally to identify the CVD risk among the sample in relation to WC and height. WHtR was recommended as a better indicator of body fatness and central adiposity than BMI, associated with CVD risk among children and adolescents (Savva *et al*, 2000; McCarthy and Ashwell, 2006; Garnett, Baur, & Cowell, 2008). A WHtR of greater than or equal to 0.50 was recognised as the cut-off for being at risk of CVD (Ashwell, Lejeune, & McPherson, 1996; McCarthy and Ashwell, 2006; Garnett, Baur, & Cowell, 2008).

Table 2-3 Body fat categories according to body fat percentiles for age and for girls

Age (years)	Under-fat ≤ 2nd percentile	Normal-fat > 2nd - < 85th percentile	Over-fat 85th - < 95th percentile	Obese ≥ 95th percentile
14.0	⩽ 16.0%	16.1% – 29.5%	29.6% – 33.5%	⩾ 33.6%
15.0	⩽ 15.7%	15.8% – 29.8%	29.9% – 33.7%	⩾ 33.8%
16.0	⩽ 15.5%	15.6% – 30.0%	30.1% – 34.0%	⩾ 34.1%
17.0	⩽ 15.1%	15.2% – 30.3%	30.4% – 34.3%	⩾ 34.4%
18.0	⩽ 14.7%	14.8% – 30.7%	30.8% – 34.7%	⩾ 34.8%

Adapted from McCarthy *et al.* (2006)

Table 2-4 Smoothed waist circumference percentiles (in cm) for Kuwaiti female adolescents

Age (years)	90^{th} Percentile
14	98.5
15	101.3
16	103.6
17	105.4
18	107.0

Adapted from Jackson *et al*. (2011)

2.7.2.2 **Physical Fitness**

Physical fitness (PF) is defined as “the ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies” (President's Council on Physical Fitness and Sports, 1965, p.5) or as “general functional adequacy to withstand physical challenges without overstrain” (Oja and Tuxworth, 1995, p.6).

PF has two components: health-related fitness (HRF) and skill-related fitness (SRF) (Caspersen, Powell, & Christenson, 1985). HRF comprises cardiorespiratory endurance, muscular endurance, muscular strength, body composition, and flexibility. SRF, on the other hand, comprises agility, balance, coordination, speed, power and reaction time. HRF is more concerned with public health while SRF is more concerned with athletic ability (Caspersen, Powell, & Christenson, 1985). Therefore, only HRF was assessed for the purpose of this study.

HRF components can be assessed by several procedures depending on the facility and the purpose, whether laboratory, epidemiologic or self-assessment as demonstrated in Table 2-5 (Caspersen, Powell, & Christenson, 1985). As this study has a pre-post experimental design and has been conducted in a school field setting, the self-assessment procedures were the most relevant. There are a number of field-based test batteries for the assessment of HRF among adolescents (Bianco *et al.*, 2015). An adapted version of EUROFIT test battery was chosen for assessing the HRF among participants (Adam *et al.*, 1988). The adapted version involves five HRF tests: a 20-meter shuttle run (20m-SR) test to assess cardiovascular endurance (VO_2max), a sit-and-reach (SAR) test to assess trunk and leg flexibility, dynamic sit-ups (DSU) to assess trunk muscle strength and endurance, standing vertical jump (SVJ) to assess leg muscle power, and single leg stand (SLS) to assess body balance. Details and illustrations of the tests are supplemented in Appendix II.

2.7.2.2.1 *20-Meter Shuttle Run Test*

The 20m-SR test is a maximal running test to assess cardiorespiratory endurance and to estimate maximal aerobic power (VO_2max) (Léger *et al.*, 1988). The test has 20 stages and starts at slow running pace, at 8km/hour, and gradually increases the speed until it reaches a maximal running speed of 18km/h.

The test was conducted in the PE gymnasium with the floor marked by two inches (5.08 cm) of black tape at the start line, and 20 meter from the end line; while allowing two additional meters beyond these lines to allow for turning and deceleration. The width of each lane was one meter, which was also marked with tape.

An audio recording of the test, which used bleeps, and a whistle blown by the PE teacher were used to direct participants through the stages. The participants were asked to stand on the start-line and start running to the end-line on hearing the sound, remaining in their lane, and to touch the end-line with one foot. They were then instructed to run back to the start-line on hearing the next sound. They were instructed to stop running when they were no longer able to sustain their pace; that is, if they felt undue exhaustion or if they missed touching any line on the sound two consecutive times. They were asked to remain in their lane if stopped until all participants were stopped to avoid any interruptions or injuries.

The test was assessed by two investigators, the researcher and a PE teacher, each one standing on a line to record the last stage the participant was able to complete. The investigators checked the ID number of the participants first and marked it on the running form before the start of the test.

The Quadratic Model (QM) equation has been used to estimate VO_2max which accounts for age, weight, gender, and speed unlike the Leger's equation (1988), which only accounts for age and speed (Mahar *et al.*, 2011). When it was validated against indirect calorimetry and compared with Leger's and others, QM provided the closest agreement (Mahar *et al.*, 2011).

2.7.2.2.2 *Sit-and-Reach Test*

The SAR test assesses the flexibility of the legs (hamstring muscles) and trunk, and was tested with a foldable sit-and-reach box (Apollo® Newitts, York, UK), as illustrated in Appendix II.

The participant was instructed to remove her footwear, sit in front on the testing box with feet against the end of the box, knees straight, and push the sliding bar over the scale with fingertips as far as possible. The examiner sat on the side keeping the participant's knees straight. The final position was held steady for three seconds without bouncing. The participant performed three attempts and the best score was recorded.

2.7.2.2.3 *Dynamic Sit-Ups*

DSU was used as a measure of the strength and endurance of the trunk muscles. Participants were asked to lie on their back with their knees bent at 90°with their peers holding their feet, one to one. They were asked to do five consecutive sit-ups with hands touching their knees. The next five sit-ups were performed with hands crossed over chest and touching the thighs with elbows. The last five sit-ups were performed with fingertips over the back of the earlobes and touching the thighs with elbows. There is short pause for about 30 seconds between each of the three sets for recording of the score and giving instruction for the next move. The number of completed repetitions out of 15 was recorded.

2.7.2.2.4 *Standing Vertical Jump*

The SVJ test also called countermovement jump (Linthorne *et al.*, 2001; Vanrenterghem *et al.*, 2004) was used to assess the muscle strength, power and coordination of the legs using a contact mat (Probotics, Inc. Just Jump or Just Run system, Huntsville, AL, USA). The contact mat calculates height of the jump based on the hang time in the air. The participant was asked to step on the mat and jump as high as possible three times. The distance shown on the display screen of the monitor was recorded.

2.7.2.2.5 *Single-Leg Stand*

The SLS was implemented to assess whole body balance on a firm flat surface. The participant was asked to remove all footwear, choose a leg to stand on, lift the other off the floor and close the eyes. They were asked to try to balance themselves on one leg for 30 seconds and were allowed to touch the floor with the lifted leg if they lost their balance. The number of attempts used to balance during the 30 second period was recorded.

Table 2-5 Health-related fitness components and assessment methods

Fitness component	Testing procedures		
	Laboratory	*Epidemiologic*	*Self-assessment*
Cardiorespiratory	Maximum Oxygen Consumption (VO_2max) on treadmill or cycle ergometer	Canadian Home Fitness Test Cycle ergometer	Canadian Home Fitness Test 12-minute run
Body composition	Underwater weighing Potassium-40	Skinfold thickness Body mass index (weight/height2)	Skinfold pinch test
Muscular strength	Cable tensiometer	Handgrip dynamometer	Upper-lower trunk lift Hanging leg lift
Muscular endurance	Isokinetic tests	----	Pull-ups Flexed arm hang Sit-ups
Flexibility	Leighton flexometer	Sit-and-reach flexometer	Sit-and-reach test

Adapted from Caspersen *et al*. (1985)

2.7.2.3 **Health-related Behaviours**

A semi-structured health-related behaviours and attitudes questionnaire (HRBQ) was designed in order to gather socio-demographic data and to determine the change in intervention-targeted behaviours including physical activity as discussed earlier, eating behaviours, use of medications and other drugs, tobacco smoking, and UVR exposure/ sun protection (Appendix VI).

2.7.2.3.1 *Nutrition and Eating Behaviours*

A dietary questionnaire, including eating habits and the frequency of food intake on daily and weekly basis, was developed from Turconi *et al.* (2003) and Al-Hazzaa *et al.* (2011) questionnaires. It is comprised of two parts: weight and eating habits. The weight part included questions on body image (self-perception of body weight and embarrassment), dieting, and intention to undergo weight loss surgery. The eating habits part included three divisions: meals and major foods, snacks and minor foods, and beverages. The meals and major foods category assessed the frequency of main meals per week, the daily consumption of dairy, daily intake of fruits and vegetables, and weekly intake of animal proteins. Moreover, snacks and minor foods assessed snacks types and frequency, the frequency of consuming sugar-rich foods, fried foods and amount of salt in food preference. Snacks type was defined for the purpose of identifying snacking quality given the fact of high consumption of sugary snacks in the population (*see section 1.2.2.2.2.3*). Healthy snacks included fruits, vegetables, and nuts/seeds while unhealthy snacks included candies, chocolate, candies, chips, popcorn, cookies and biscuits. It also assessed the frequency of eating out or ordering from food delivery service per week. Beverages questions included the daily consumption of water, fruit juice, sugary soda, energy drinks, and coffee and tea.

2.7.2.3.2 *Medications and Drugs*

Intake of medications and dietary supplements was specifically assessed to determine substance use and abuse by participants in addition to their health status. Intake of weight loss drugs was also assessed due to their potential harmful effects on adolescents (Pomeranz *et al.*, 2015). Tramadol[1] (tramadol hydrochloride - tablet; oral) and Lyrica® (pregabalin – capsule; oral) are two

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[1] Tramadol is locally known by its generic name and sometimes has very similar brand names

commonly abused prescription drugs among the population (*see section 1.2.2.2.4*) and thus their intake was assessed.

2.7.2.3.3 *Tobacco Smoking and UVR Exposure*

Smoking status, type (cigarettes or shisha), quantity and frequency in participants were examined. Other associated factors like number of smokers in the family, having female friends who smoke, and tendency to smoke were also examined. Sun and UVR protection and exposure were assessed. Use of sun protection and the method (ointment, spray, umbrella or hat) were assessed, as well as any use of sunbathing or sunbeds for tanning and the duration of these activities.

2.7.2.4 **Socio-Demographic Characteristics**

2.7.2.4.1 *Social Information*

Social characteristics of the participants were assessed in the social section of the HRBQ, which asked for information about their families and home milieus. Such factors can have an indirect influence or act as confounding factors on their health-related behaviours (HRBs). They included geographical residential area, living with one or both parents, number of family members and domestic workers in the home, type of residence and if it has an elevator, and the daily frequency of use.

2.7.2.4.2 *Personal Health Information*

Personal health information also includes information about participant's menstruation. It assessed its regularity (monthly occurrence), the age of menarche, the use of any medications to regulate or alter the menstrual cycle, and the use of medications to control its symptoms. Early menarche (<12 years) is associated with being overweight and obese (Maddah, 2009; Datta Banik, Mendez & Dickinson, 2015) and with eating disorders (Gargari *et al.*, 2011). Additionally, it is associated with substance use, including smoking (Dick *et al.*, 2000; Jaszyna-Gasior *et al.*, 2009).

2.8 **Sample Size**

The appropriate sample size to produce a statistical significance has been determined through power calculation based on the aforementioned FIFA study which produced an average of 18%-20% improvement in the knowledge base of children. Assuming 5% improvement in the control group by chance, the intervention group must improve 25% in knowledge for the efficacy of the intervention to be ensured by 2-proportion test analysis. Based on 80% power, the sample size required is n= 49 in each group which gives a sample size of 98. However, as the sample had two strata and by allowing 20% drop-out rate, the sample size was increased to 120.

2.9 Sample Allocation:

Each arm of the trial, intervention and control, included three blocks representing different school years (as displayed in Figure 3-2). As mentioned earlier, stratification by school years and study fields was used for sampling and, thus, informed block allocation. Specifically, each group had one scientific and one literary study field to ensure balance and comparability. The classes were randomly allocated by the researcher accounting for these strata.

Each participant was given an ID number from 1 to 128 to memorise to ensure their anonymity and correspondence for re-measurements. PE teacher also had a back-up sheet of the participants' names along with their ID numbers to check their consistency before the data collection.

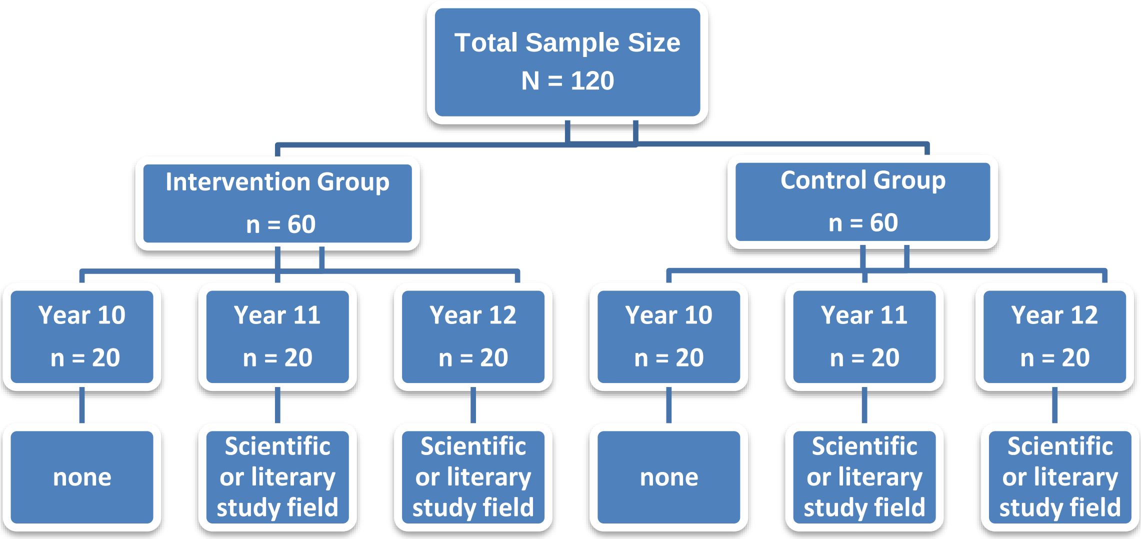


Figure 2-2 Blocks allocation and stratification by size

2.10 Ethical Approval

2.10.1 Approvals

Ethical approval was obtained from the University of Glasgow, the College of Medical, Veterinary, and Life Sciences (MVLS) ethics committee (Appendix VII) and the Research and Development (R&D) department at Ministry of Education in Kuwait. A flow chart of the research implementation process is demonstrated in Figure 2-3.

2.10.2 Consent Form

An information sheet describing the study was given to all students as an introduction and an invitation to the study (Appendix VIII). Once the pupils' eligibility was ensured and they had decided to participate, they were given a proxy consent form (Appendix IX) to be completed by the parent or the legal guardian. The student was then required to return it back to their PE teacher within three days.

2.10.3 Health Screening Form

A health screening form was included with the information sheet and consent form (Appendix X). Its purpose was to identify any health condition that may pose a risk to the participant when participating in vigorous physical effort, such as the 20-m shuttle run test. Such conditions included: heart disease, severe blood conditions (i.e. anaemia or thalassemia), type 1 diabetes mellitus, severe asthma, inflammation in joints or tendons of knees or ankles, recent lower extremity injury (i.e. ankle sprain), or any other conditions restricting exercise participation or otherwise advised against engaging in vigorous physical effort by a physician or a specialist. Student were excluded if they had any of the above health conditions.

2.10.4 Statistical Analysis

Data were analysed by SPSS statistical software version 22.0 (IBM® SPSS®, Inc., Chicago, IL). BMI-for-age z-scores was calculated using WHO's AnthroPlus software (WHO, 2009; 2011). Accelerometer data were retrieved and calculated by ActiLife software version 6.0 (Actigraph, LLC, Fort Walton Beach, FL). Statistical significance was set at *p* less than 0.05.

2.10.4.1 **Analysis Approach**

An intention-to-treat (ITT) analysis was applied by including all randomised cases in hypothesis testing analysis.

2.10.4.2 **Normality of Data**

The data were considered normally distributed based on Central Limit Theorem. According to the theorem, for a large sample size (≥ 30 subjects per group) with random independent variables from the population, the sample mean will approximate a normal distribution (Brase & Brase, 2011, p. 299). Therefore, a parametric analysis of variance (ANOVA), was used for comparing the means of the variables between the groups, except for the accelerometer's, which included a small subgroup (n=11) and was voluntarily sampled. Thus, normality of accelerometer's data was checked using Shapiro-Wilk test which revealed non-normality for some of the variables. A non-parametric Mann-Whitney U test was used to analyse these data accordingly.

2.10.4.3 **Missing Data**

The missing data were firstly analysed using Missing Value Analysis (MVA) procedure for the quantitative data. The highest missing data were found in the total knowledge difference, which was missing in 27% of the sample (as it constitutes the sum of all six questionnaires; if one was missing the total would be missing), though none from the age variables. Total missing data from all variables were 4%, which is less than 5% and thus considered minor (Schafer, 1999). Cases with complete data represented 59% (n = 76) of the sample while 41% (n = 52) had one or more missing variables. The missing data in the present study were most likely to be related to the observed (pre-test) but not to the unobserved values (post-test), which implies that mechanism of missing data is *missing at random* (MAR) (Rubin, 1976). Moreover, MAR can reasonably result from the design itself as in longitudinal studies (Dong & Peng, 2013). According to the MAR mechanism, there are a number of suggested methods to control the effect of the missing data and preserve the power of sample size such as multiple imputation, maximum-likelihood, and expectation-maximization algorithm (Dong & Peng, 2013). Therefore, the model used for analysis accounted for the missing data as will be explained next in hypothesis testing.

2.10.4.4 **Hypothesis Testing**

Given that the design of the study was a pre-test-post-test randomised controlled trial (RCT), which combines case-control and cohort designs, the relevant hypothesis testing was repeated measures ANOVA using a restricted maximum likelihood (REML) approach to fit a linear mixed model (Welham & Thompson, 1997; Mallinckrodt *et al.*, 2004). REML is of particular use when data are missing and provides unbiased estimates using maximum-likelihood method with expectation-maximization algorithm (Rubin & Little, 2002). The REML approach was recommended as it decreases the bias found in full maximum-likelihood (Little, 1995). The ANOVA main factors were Group (Control or Intervention); and Time (pre, post). Frequencies in the contingency tables were compared by Pearson Chi-Square test. If more than 20% of the expected counts had a value of less than 5, Fisher’s Exact test was used instead, as generally recommended (Cochran, 1952, p.334).

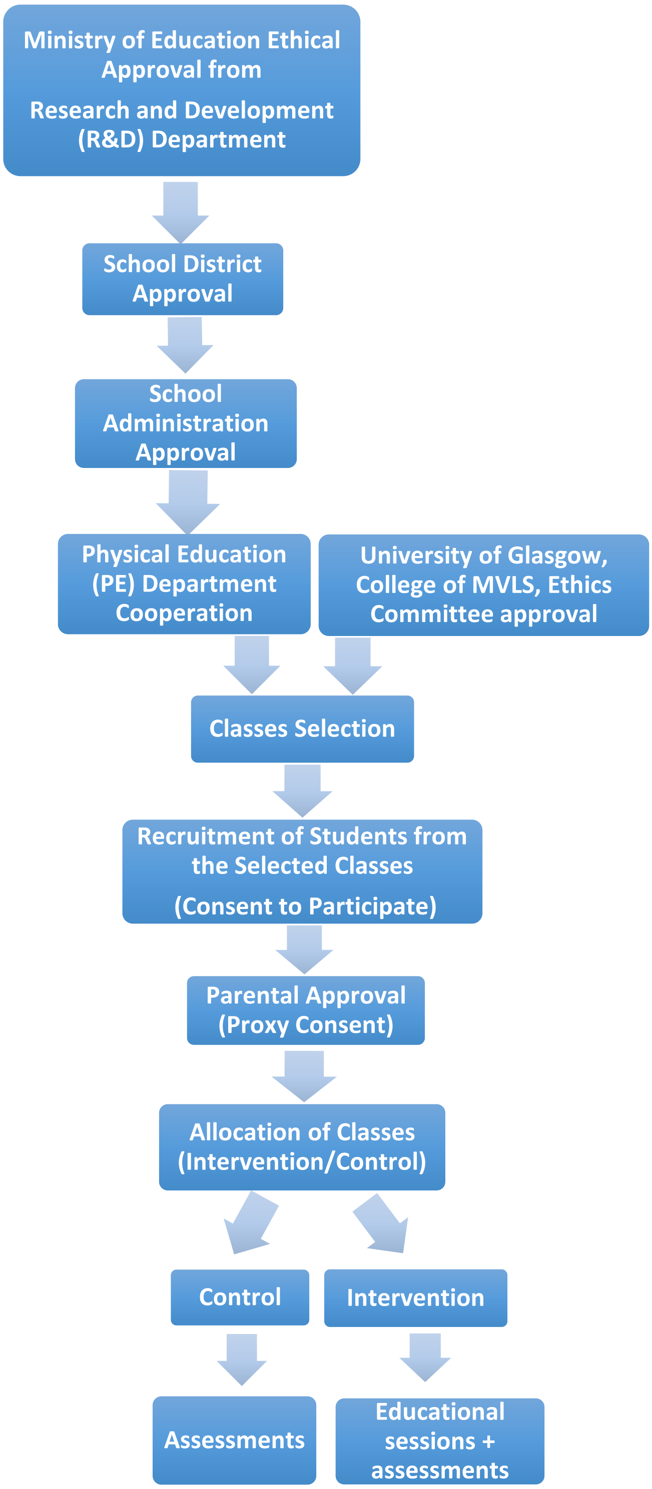


Figure 2-3 Implementation process

Chapter 3

Effect of a Health Education-Based Intervention on Health Knowledge and Physical Activity in Adolescent Females

3.1 Introduction:

A school-based intervention was implemented in a secondary school setting in order to promote multiple health-related behaviours among adolescent females in Kuwait, as outlined in the previous chapter. The aim of the overall study is to evaluate the effectiveness of a knowledge-based approach intervention on a number of behaviours including physical activity, healthy eating behaviours, the prevention of tobacco smoking, the prevention of substance abuse, and sun protection. In addition, this approach was employed to evaluate the intervention effectiveness on physical measurements including weight and physical fitness. The prevalence of unhealthy behaviours such as physical activity, high-calorie low-nutrient diet, tobacco smoking, substance abuse, and ultraviolet radiation (UVR) overexposure is increasing among adolescents. Therefore, it is crucial to target such behaviours among the adolescent population to avoid the adverse consequences on health. Many school-based studies with a curricular component resulted in significant changes in behaviours and physical measurements in different populations. Mary, D'souza & Roach (2014) showed a significant effect on health knowledge and health-enhancing behaviours like dietary intake, physical activity, and daily tobacco smoking in Indian adolescents. Tse and Yuen (2009) also showed a significant increase in nutritional knowledge, improved dietary pattern, and physical activity and its related behaviours among Chinese adolescents. There is a lack of non-clinical interventions to promote healthy behaviours among adolescents in the gulf region. The current study implemented a school-based health educational intervention among adolescent females in Kuwait as part of efforts to promote health-related behaviours. The intervention has seven specific aims. The first objective is to increase physical activity, while the second objective is to improve health-related physical fitness components. The third objective is to improve dietary behaviours, and fourth objective is to normalise and control weight measurements. The fifth objective is to prevent tobacco smoking and substance abuse. The sixth objective is to promote sun protective behaviours. The seventh and final objective is to increase health knowledge of each of the six health topics.

3.2 Aims

This chapter aims to investigate the intervention effect on health-related knowledge, and physical activity assessed by a questionnaire and by accelerometry to meet the study objectives. It is hypothesised that the intervention will result in a significant difference between those groups in favour of the intervention groups across these outcomes stated in the objectives. This difference will be in total and topic-specific knowledge in the six areas. In addition, it will be in physical activity and its related behaviours.

3.3 Methods

The study had a pre-post-test randomised controlled trial design comparing an intervention and a control groups. The health-related knowledge is related to the topics targeted by the intervention curriculum which encompassed physical activity, healthy nutrition, bone health, prevention of tobacco smoking, prevention of substance abuse, and sun protection. Physical activity was assessed by 7-day recall questionnaire and 7-day triaxial lower back accelerometer in a subsample (n=11). Health knowledge was assessed by 15-item, topic-specific questionnaire immediately before the educational session and a week later. Physical activity was assessed both before the intervention (PRE) and after the intervention at the end of the study (POST). The instrumentations and the methods used for assessments were explained in greater detail earlier (*see Chapter 3: Materials and Methods*). A discussion of the findings of this chapter will follow and will end with the conclusion. The data will be presented for both pre-intervention at baseline and post-intervention at end-point for both IG and CG which were compared. All analysis was performed on an ITT basis using a mixed model repeated measure ANOVA, except for the subsample's accelerometer data which were analysed non-parametrically using Mann-Whitney U test.

3.4 Results

The reporting of the findings is based around the Consolidated Standards of Reporting Trials (CONSORT) 2010 statement (Schulz, Altman, & Moher, 2010). The results will start with recruitment and allocation of participants, followed by a flow diagram of the participants, their baseline demographic characteristics, the abovementioned outcome measures, subgroup analysis, and adverse events.

3.4.1 Participants:

3.4.1.1 Recruitment and Allocation:

The recruitment process took place over the course of one week in November, 2014. The participants were then followed-up until the end of the study in late April, 2015.

The enrolment, allocation, follow-up and analysis of the participants have been stated according to the CONSORT 2010 flow diagram (CONSORT, 2016), as shown in Figure 3-1. One hundred and thirty-six girls were assessed for eligibility from 6 classes as blocks and the number of pupils initially ranged from 20 to 26 in each.

Four girls were excluded for health reasons (severe anaemia, bronchial asthma, scoliosis, and ankle tendinopathy). One girl declined to participate due to parental failure to provide proxy consent. Three other girls were excluded because of their involvement with other school activities: two with sports competitions and one with a science club.

The total sample size at the beginning of the study was 128, which was then divided equally; n = 64 in each group (as displayed in Figure 3-2). The intervention group had three classes: one from year group 10, one from year group 11 with literary specialism and one from year group 12 with scientific specialism. The control group also included three classes: one from year group 10, one from year group 11 with scientific specialism and one from year group 12 with literacy specialism.

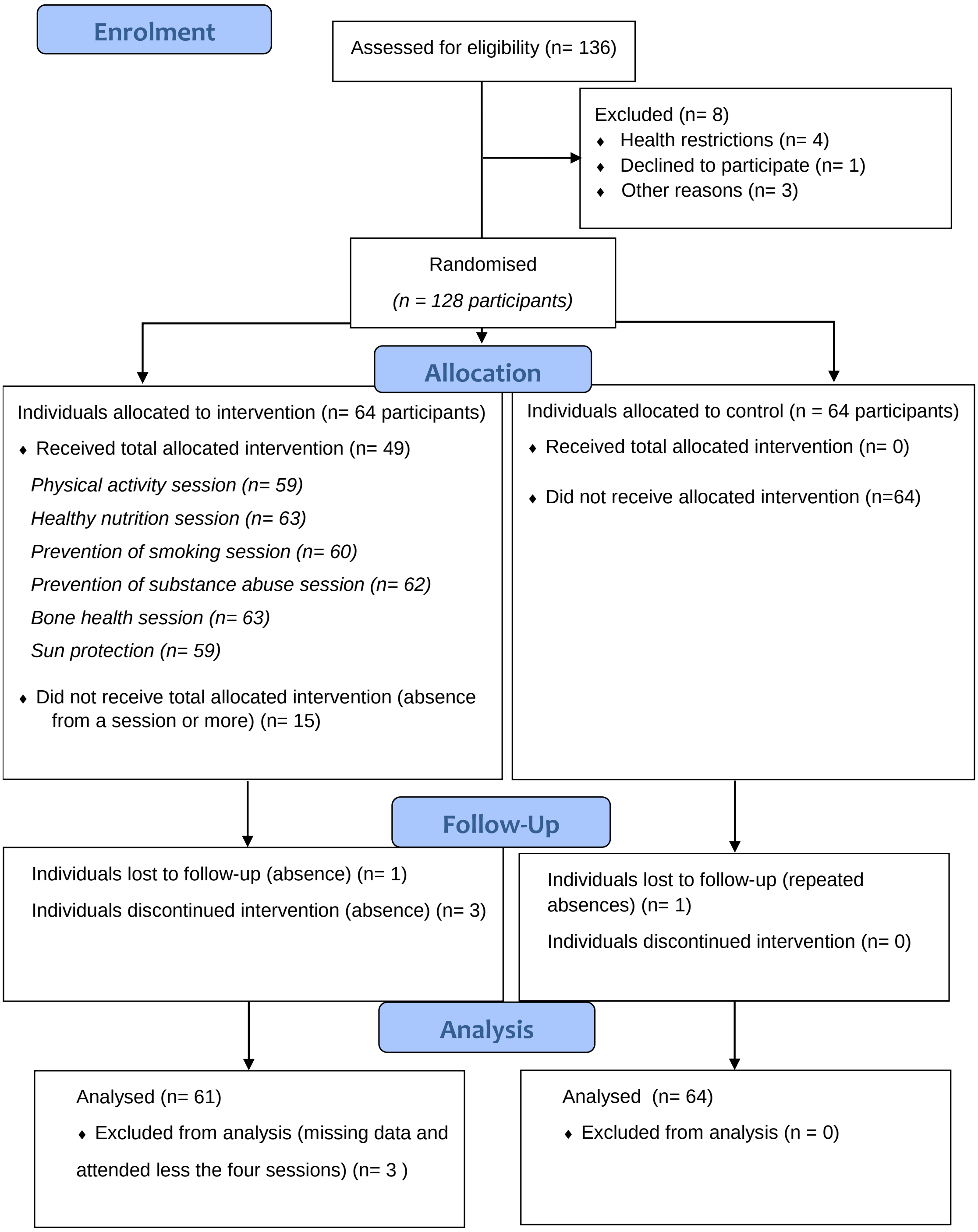


Figure 3-1 CONSORT 2010 Flow Diagram of the Study

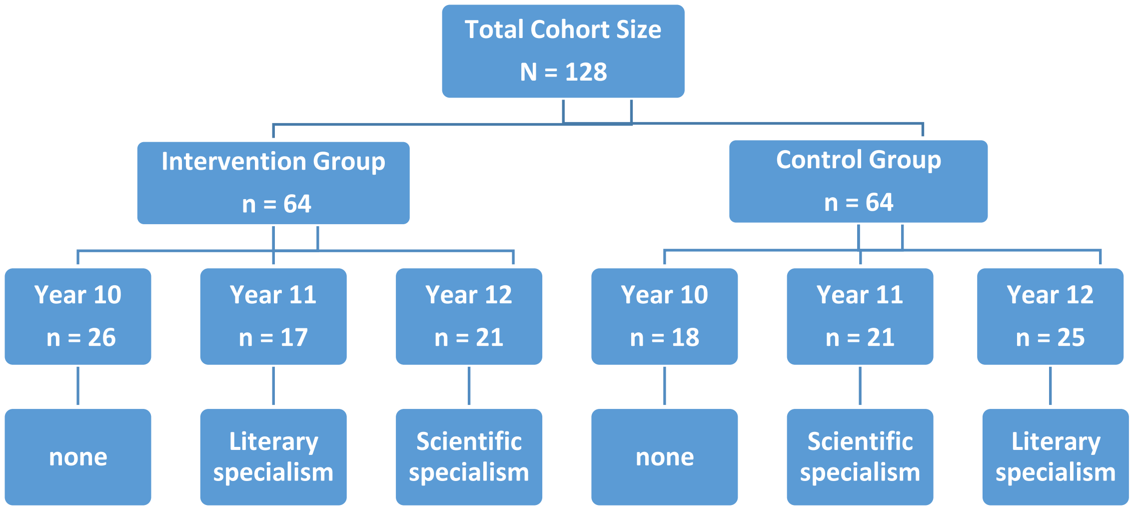


Figure 3-2 Cohort allocation by school year and study specialism

3.4.1.2 **Baseline Demographic Characteristics of Participants**

The baseline demographic characteristics of the participants are displayed in Table 3-1. Participants were all female and the mean age was 16 years, and the age ranged between 14 and 18 years. Mean height was 158.5 cm and mean weight was 60.7 kg, with the BMI z-score for age and gender equals to 0.66 standard deviation (SD), which is within the normal limits, -2 to 0.99 SD, according WHO growth reference standards (Onis *et al.*, 2007). In addition, mean body fat percentage was 28.2%, which was also within the normal range for adolescent girls between 14 and 19 years of age (McCarthy *et al.*, 2006). Mean WC was 77.40 cm, which is less than the 90th percentile cut-off corresponding to CVD risk among Kuwaiti female adolescents between the ages of 14 and 18 (Johnson *et al.*, 2011). Nevertheless, mean Waist-to-height ratio (WHtR) for the total sample was about 0.49, which is considered a marginal risk of CVD according to McCarthy & Ashwell's 0.5 cut-off (2006). The sample included 97% Kuwaiti nationals, with the majority residing in nearby geographical areas to the school.

Age at baseline was significantly different between the groups when compared by an independent samples *t* test (0 =0.021), with CG slightly older than IG by +0.4 years. However, the age in the CG and the IG was not significantly different at post-intervention (16.73 vs. 16.45 years, p= 0.176, respectively). The other anthropometrics were not significantly different between the groups (P >0.05).

3.4.1.3 **Adherence:**

3.4.1.3.1 Receipt of Intervention

A receipt of intervention was achieved by attending educational sessions. The average total attendance for the educational sessions by the three classes was 95%, comprising of 92% for PA, 98% for healthy nutrition, 94% for prevention of tobacco smoking, 97% for prevention of substance abuse, 98% for bone health and 92% for sun protection sessions.

3.4.1.3.2 Drop-out Rate

Drop-out rate was 2.4% (n = 3) among the total sample mainly due to repeated absence from PE class. All drop-outs were from the IG, one case from the year 11 and two cases from the year 12 science class. Missing data within each assessment varied, again due to absences.

Table 3-1 Baseline Demographic Characteristics for the Cohort

	Total			Control Group			Intervention Group			P-value[c]
	n	Mean ± SD	95% C.I.	n	Mean ± SD	95% C.I.	n	Mean ± SD	95% C.I.	
Age (years)	128	16.00 ± 1.00	(15.82 – 16.18)	64	16.20 ± 1.03	(15.95 – 16.46)	64	15.80 ± 0.95	(15.56 -16.03)	0.021
Height (cm)	127	158.52 ± 5.11	(157.62 – 159.41)	64	158.28 ± 5.10	(157.00 – 159.56)	63	158.75 ± 5.15	(157.46– 160.05)	0.604
Weight (kg)	127	60.68 ± 16.91	(57.71 – 63.65)	64	60.70 ± 15.27	(56.89 – 64.52)	63	60.66 ± 18.54	(55.99 – 65.33)	0.990
BMI (kg/m^2)	127	24.03 ± 6.00	(22.97 – 25.08)	64	24.15 ± 5.56	(22.76 – 25.54)	63	23.90 ± 6.46	(22.28 – 25.53)	0.817
BMI-for-age z-score[a]	127	0.66 ± 1.37	(0.42 – 0.90)	64	0.75 ± 1.25	(0.43 – 1.06)	63	0.58 ± 1.50	(0.20 – 0.95)	0.494
BMI category*										
Thinness, n (%)	127	2 (1.6%)	-	64	1 (0.8%)	-	63	1 (0.8%)	-	1.000
Healthy weight, n (%)	127	78 (61.4%)	-	64	39 (30.7%)	-	63	39 (30.7%)	-	0.911
Overweight, n (%)	127	27 (21.3%)	-	64	15 (11.8%)	-	63	12 (9.4%)	-	0.545
Obese, n (%)	127	20 (15.7%)	-	64	9 (7.1%)	-	63	11 (8.7%)	-	0.599
Percentage of body fat (%)	126	28.22 ± 9.05	(26.63 – 29.82)	64	28.78 ± 8.20	(26.74 – 30.83)	62	27.64 ± 9.89	(25.13 – 30.15)	0.463
Body fat category[b]										
Underfat, n (%)	126	8 (6.3%)	-	64	2 (3.1%)	-	62	6 (9.7%)	-	0.161
Normal fat, n (%)	126	70 (55.6%)	-	64	38 (59.4%)	-	62	32 (51.6%)	-	0.381
Overfat, n (%)	126	20 (15.9%)	-	64	11 (17.2%)	-	62	9 (14.5%)	-	0.682
Obese, n (%)	126	28 (22.2%)	-	64	13 (20.3%)	-	62	15 (24.2%)	-	0.600
Waist circumference (cm)	124	77.40 ± 11.65	(75.33 – 79.47)	64	78.25 ± 11.18	(75.45 – 81.04)	60	76.50 ± 12.16	(73.36 – 79.64)	0.368
Waist-to-height ratio	124	0.49 ± 0.07	(0.48 – 0.50)	64	0.50 ± 0.07	(0.48 – 0.51)	60	0.48 ± 0.07	(0.46 – 0.50)	0.259

[a] BMI-for-age z-score based on WHO 2007 growth references (Onis *et al.*, 2007)

[b] Body fat category is according to body fat percentiles for age and for girls based on body fat reference curves (McCarthy *et al.*, 2006)

[c] Anthropometrics compared by independent samples *t* test and frequencies compared by Chi-square or Fisher's Exact test

n, number of subjects; SD, standard deviation; C.I. confidence interval; %, percentage, cm, centimetre; kg, kilogram; m^2, square metre; BMI, body mass index

3.4.2 Change in Health-Related Knowledge About the Topics

A comparison between the groups in percentages of total health knowledge at pre-intervention and post-intervention is presented in Table 3-2. There was a highly significant interaction between groups and time in health knowledge ($F(1,101.35) = 456.51$, $p < 0.0005$) which indicates that the groups had significant changes over time. The IG had substantially increased total health knowledge over time compared to the CG (+29% vs. +6%) with a difference of 23% as demonstrated in Figure 3-3. All the six topic-specific knowledge also increased more significantly in the IG compared to the CG as seen in Figure 3-4. The physical activity knowledge significantly increased more in the IG by +28% compared to +4% in the CG ($F(1, 118.87) = 81.02$, $p < 0.0005$). Nutrition knowledge also increased more in the IG by +26% compared to +8% ($F(1, 121.71) = 41.07$, $p < 0.0005$). Knowledge about tobacco smoking increased by +24% in the IG compared to +2% in the CG ($F(1, 119.09) = 100.80$, $p < 0.0005$). Knowledge about harmful substances increased by +22% in the IG compared to +6% in the CG ($F(1, 122.38) = 44.09$, $p < 0.0005$). Bone knowledge increased in the IG by +34% compared to +8% in the CG ($F(1, 124.88) = 131.73$, $p < 0.0005$). Sun and UVR knowledge increased in the IG by +41% compared to +8% in the CG ($F(1, 114.41) = 337.04$, $p < 0.0005$)

Table 3-2 Comparison of percentage of total and specific health knowledge in mean (95% confidence interval)

	Control				Intervention				P-value[a]
	n	Pre	n	Post	n	Pre	n	Post	
Total Knowledge (%)	52	39 (38 – 41)	57	46 (44 – 47)	48	41 (39 – 42)	60	70 (68 – 72)	<0.0005
PA knowledge	63	41 (38 – 44)	63	45 (41– 49)	59	42 (39 – 45)	62	70 (66 – 74)	< 0.0005
Nutrition knowledge	61	35 (32 – 39)	63	43 (39 - 48)	62	35 (32 - 38)	63	61 (56 - 65)	<0.0005
Tobacco smoking knowledge	62	42 (39 – 44)	62	44 (41 - 47)	60	45 (42 – 47)	64	69 (66 – 72)	< 0.0005
Substance abuse knowledge	61	44 (41 – 47)	62	50 (47 – 54)	62	44 (42 – 47)	64	66 (63 – 70)	<0.0005
Bone health knowledge	62	35 (33 – 38)	64	43 (40– 46)	63	38 (36 – 41)	63	72 (69 – 75)	< 0.0005
Sun protection and exposure knowledge	62	39 (37 – 42)	62	47 (44 – 50)	59	39 (37 – 42)	62	80 (77 – 83)	<0.0005

[a]Estimated by repeated measure ANOVA

n = number of subjects, % (95% Confidence Interval)

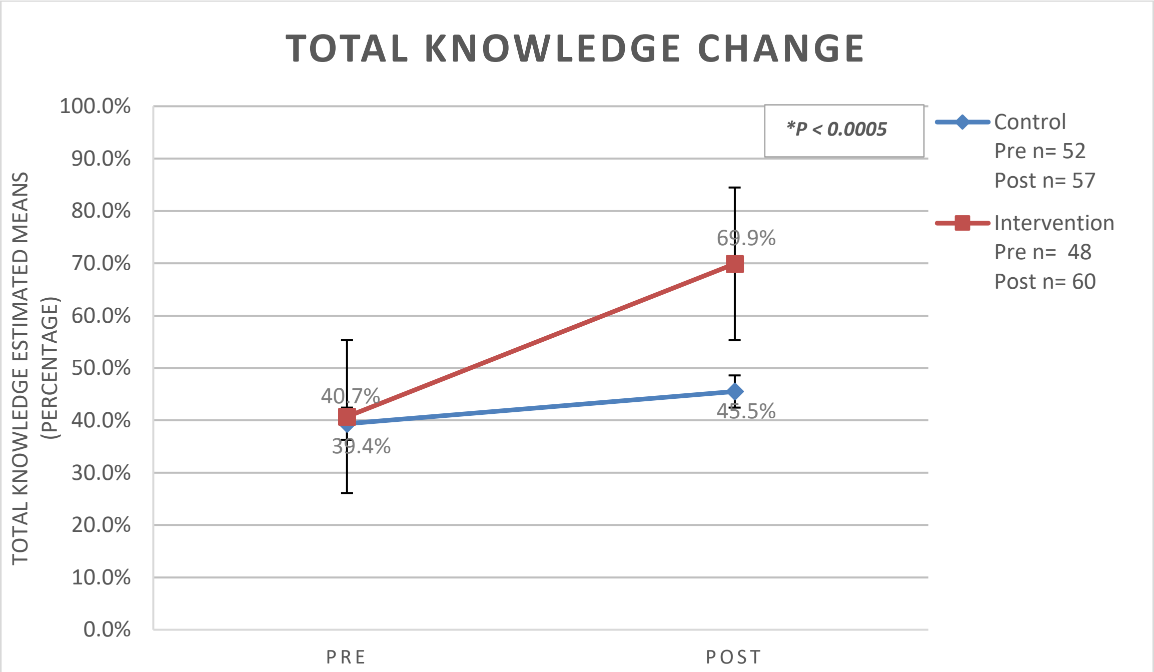


Figure 3-3 Change of total knowledge in control and intervention groups
**P-value for the interaction between groups and time (repeated measures ANOVA)*

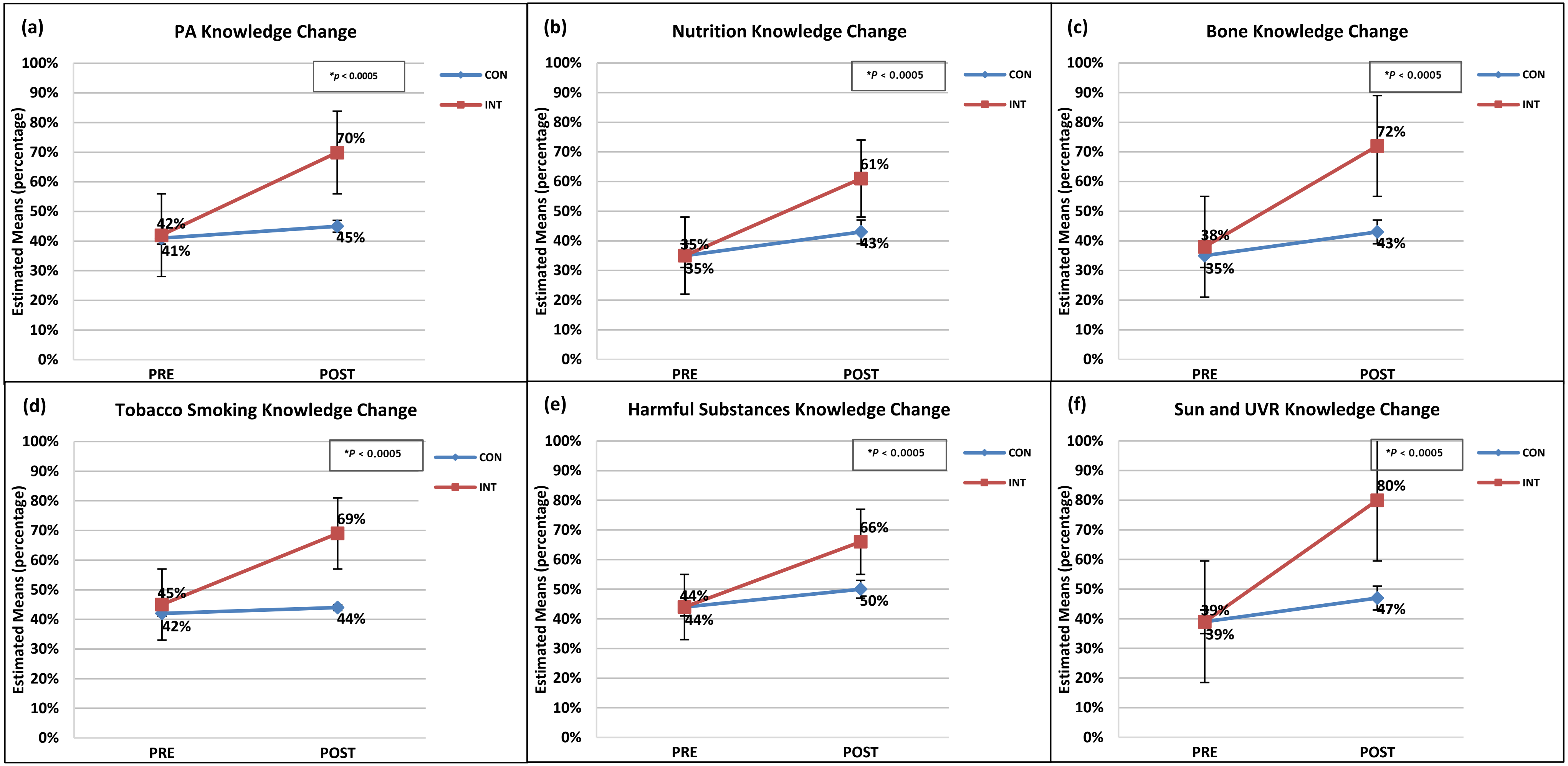


Figure 3-4 Change in health knowledge by each topic
(a) physical activity, (b) nutrition, (c) bones, (d) tobacco smoking, (e) harmful substances, and (f) sun and UVR, in control and intervention groups from pre-intervention (PRE) to post-intervention (POST), **P-value for the interaction between groups and time (repeated measures ANOVA)*

3.4.3 Self-reported Physical Activity and Related Behaviours

The self-reported physical activity behaviours during the week are summarised in Table 3-3 which includes times of elevator use per day, sitting time during breaks, walking time during breaks, walking for transportation, walking for leisure, and total walking per week. Additionally, moderate intensity housework, moderate intensity exercises and sports, and total moderate PA per week. Vigorous PA and MVPA were also reported. There were many positive changes in the reported PA and its related behaviours, seven out of eleven, among the girls as explained below. Reasons and barriers to PA are summarised in Tables 5-3 and 5-4. Parent's participation in PA were also analysed and correlated with the girls.

3.4.3.1 Frequency of Elevator Use

There was a significant interaction between groups and time over frequency of elevator use ($F(1,120.6) = 5.33$, $p = 0.023$) which indicates that the groups had significant difference in the times of use over period of study. The CG has minimal increase by +0.07 time vs. a decrease by -0.13 time in IG as demonstrated in Figure 3-5.

3.4.3.2 Time of Sitting during Breaks/Recesses

There was no significant interaction between group and time ($F(1,123.21) = 1.81$, $p = 0.181$) on time spent sitting during breaks even though the IG had more reduction than the CG by 9.93 minutes difference as seen in Figure 3-6.

Table 3-3 Comparison of self-reported physical activity behaviours per week in mean (95% CI) between groups

	Control				Intervention				*P-value*[a]
	n	Pre	n	Post	n	Pre	n	Post	
Elevator use (times)	64	0.66 (0.31 – 1.00)	61	0.73 (0.39 – 1.06)	63	0.83 (0.48 – 1.18)	60	0.70 (0.36 – 1.03)	0.023
Sitting during breaks (mins)	64	67.58 (56.23 – 78.93)	61	57.69 (47.01 – 68.38)	63	68.18 (56.74 – 79.61)	61	48.36 (37.65 – 59.07)	0.181
Walking during breaks (mins)	63	51.64 (43.21 – 60.07)	61	50.60 (41.72 – 59.48)	61	33.89 (25.39 – 42.39)	61	61.56 (52.65 – 70.46)	<0.0005
Walking for transportation (mins)	64	27.66 (19.48 – 35.83)	61	19.45 (12.11 – 26.79)	63	33.57 (25.33 – 41.81)	61	38.50 ± (31.15 – 45.86)	0.017
Walking for Leisure (mins)	64	28.83 (19.84 – 37.82)	61	19.58 (11.06 – 28.10)	63	22.62 (13.56 – 31.68)	61	35.08 (26.55 – 43.61)	0.002
Total walking time (mins)	64	108.13 (90.27 – 125.98)	61	89.69 (71.04 – 108.33)	63	90.08 (72.09 – 108.07)	61	135.16 (116.45 – 153.87)	<0.0005
Moderate intensity housework (mins)	64	18.75 (12.53 – 24.97)	61	18.20 (12.47 – 23.94)	63	13.97 (7.70 – 20.24)	61	18.87 (13.13 – 24.61)	0.250
Moderate exercise/sports (mins)	64	36.72 (23.28 – 50.16)	61	33.31 (20.28 – 46.33)	63	38.25 (24.71 – 51.80)	61	56.74 (43.69 – 69.78)	0.037
Total Moderate PA (mins)	64	55.47 (36.58 – 74.35)	61	51.54 (34.17 – 68.90)	63	52.22 (33.19 – 71.26)	61	75.63 (58.24 – 93.02)	0.051
Total Vigorous PA (mins)	64	18.91 (8.43 – 29.39)	61	8.07 (0.41 – 15.72)	63	23.41 (12.85 – 33.97)	61	23.59 (15.93 – 31.26)	0.177
Total MVPA (mins)	64	55.63 (34.16 – 77.10)	61	41.61 (22.53 – 60.69)	63	61.67 (40.03 – 83.31)	61	80.68 (61.57 – 99.79)	0.039

[a]Estimated by repeated measure ANOVA

n, number of subjects; SD, standard deviation; mins, minutes; CI, confidence interval

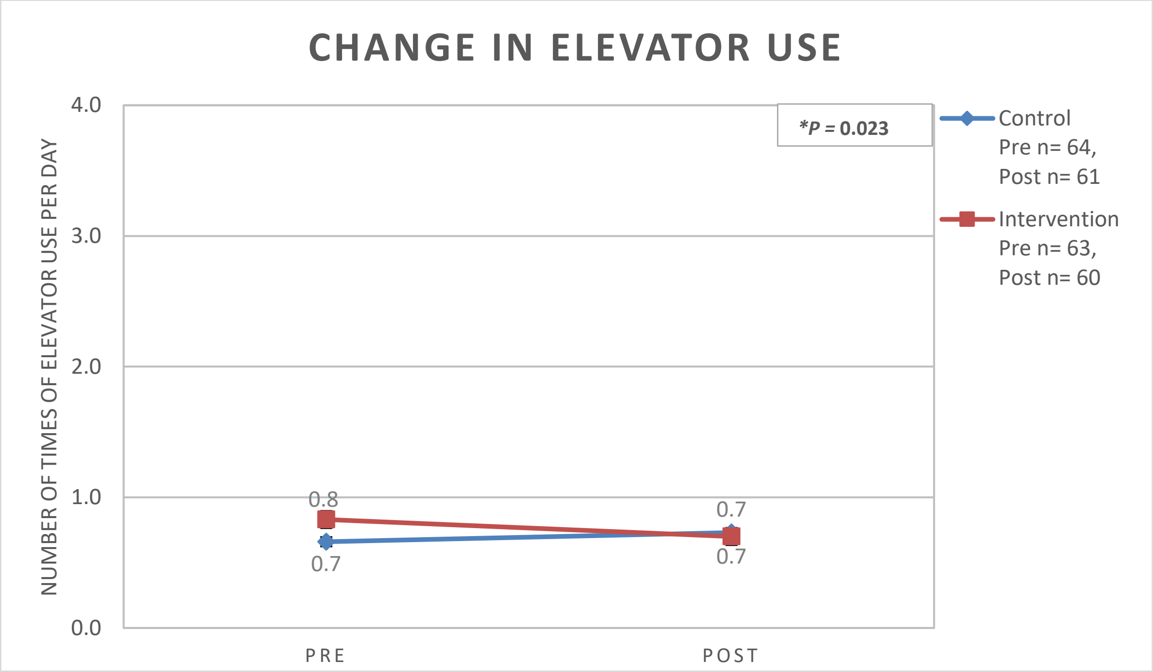


Figure 3-5 Change in times of elevator use per day in control and intervention groups
**P-value for the interaction between groups and time (repeated measures ANOVA)*
(Data presented by means (SD), with the error bars too small to be seen)

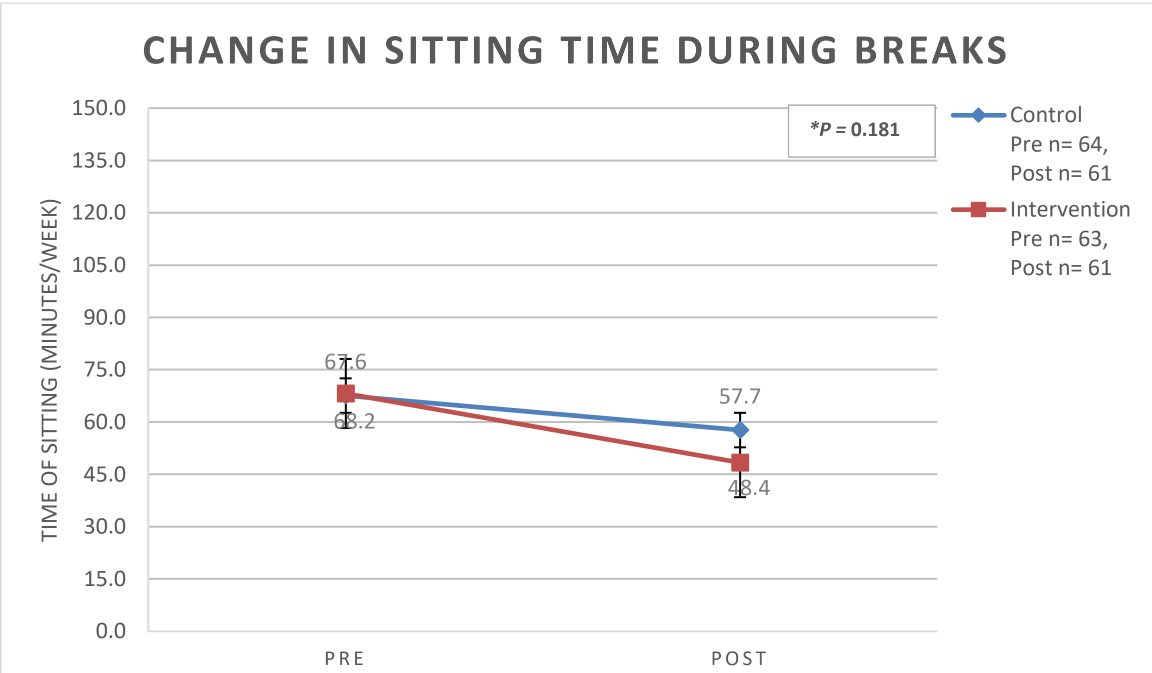


Figure 3-6 Change in total sitting time per week in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

3.4.3.3 **Total Time Walking**

Walking during breaks, walking for transportation, and walking for leisure were added together to give a total walking time. There was a highly significant interaction between groups and time (F(1,122.3) = 34.02, p <0.0005) in which the IG increased total walking time by +45.08 minutes compared a reduction by -18.44 minutes in the CG as seen in Figure 3-7.

3.4.3.3.1 *Time Walking during Breaks/Recesses*

There was a highly significant interaction between groups and time for total walking time during breaks (F (1, 121.2)= 28.87, p <0.0005) indicating a difference of change over time between the groups. The CG decreased by -1.04 minutes while the IG increased by +27.67 minutes per week as displayed in Figure 3-8.

3.4.3.3.2 *Time Walking for Transportation*

There was significant interaction between groups and time for time of transport walking (F(1,123.6) = 5.88, p= 0.017) which showed that IG increased time spent in transport walking while CG decreased it (+4.93 minutes/week vs. -8.21 minutes/week, respectively) as seen in Figure 3-9.

3.4.3.3.3 *Time Walking for Leisure*

There was a significant interaction between group and time (F(1,123.32)= 10.16, p= 0.002). The CG decreased time of leisure walking by -9.25 minutes/week while the IG increased it by +12.46 minutes/week as shown in Figure 3-10.

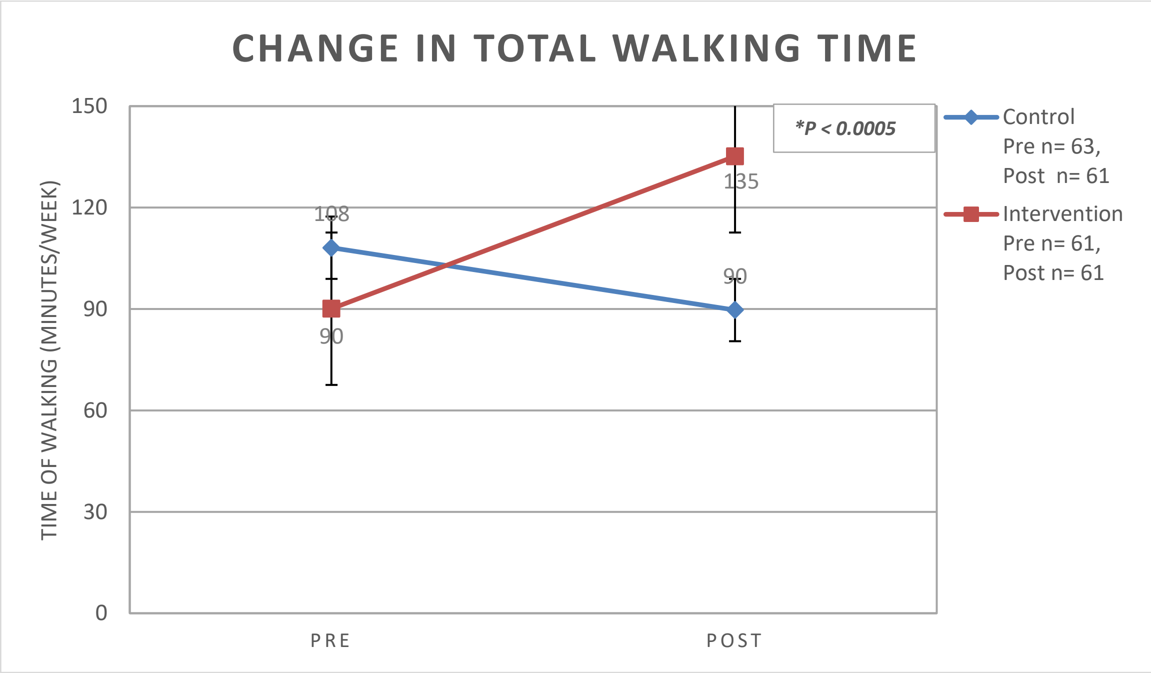


Figure 3-7 Change in total walking time per week in control and intervention groups
**P-value for the interaction between groups and time (repeated measures ANOVA)*

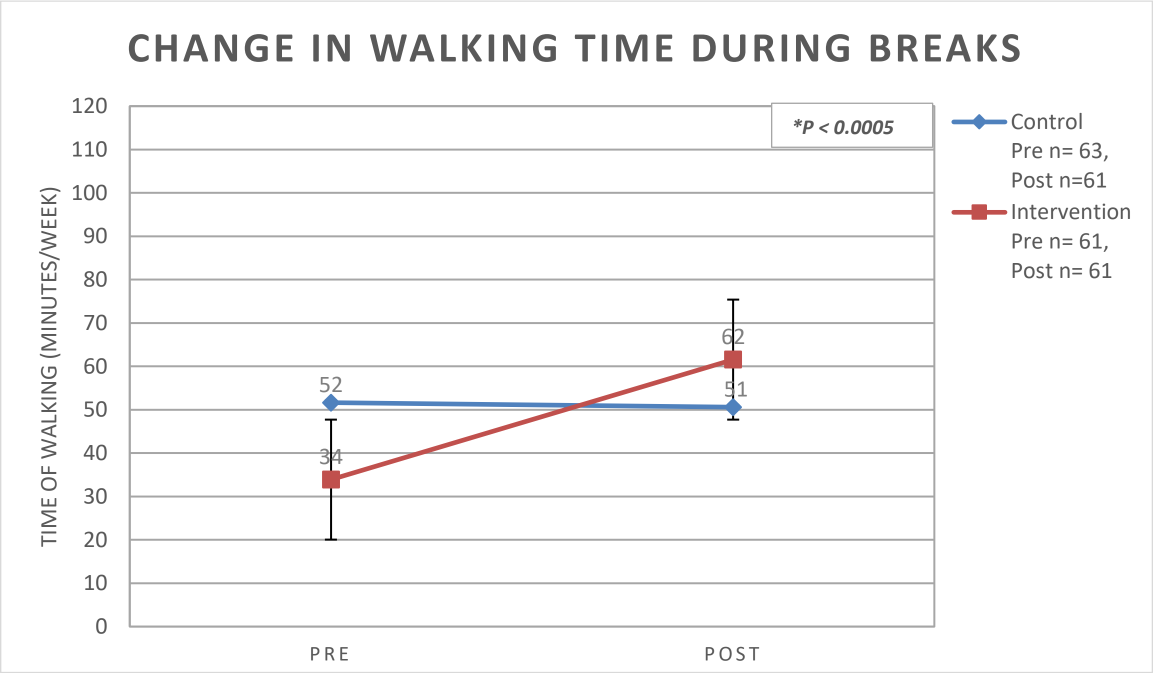


Figure 3-8 Change in walking time during school breaks in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

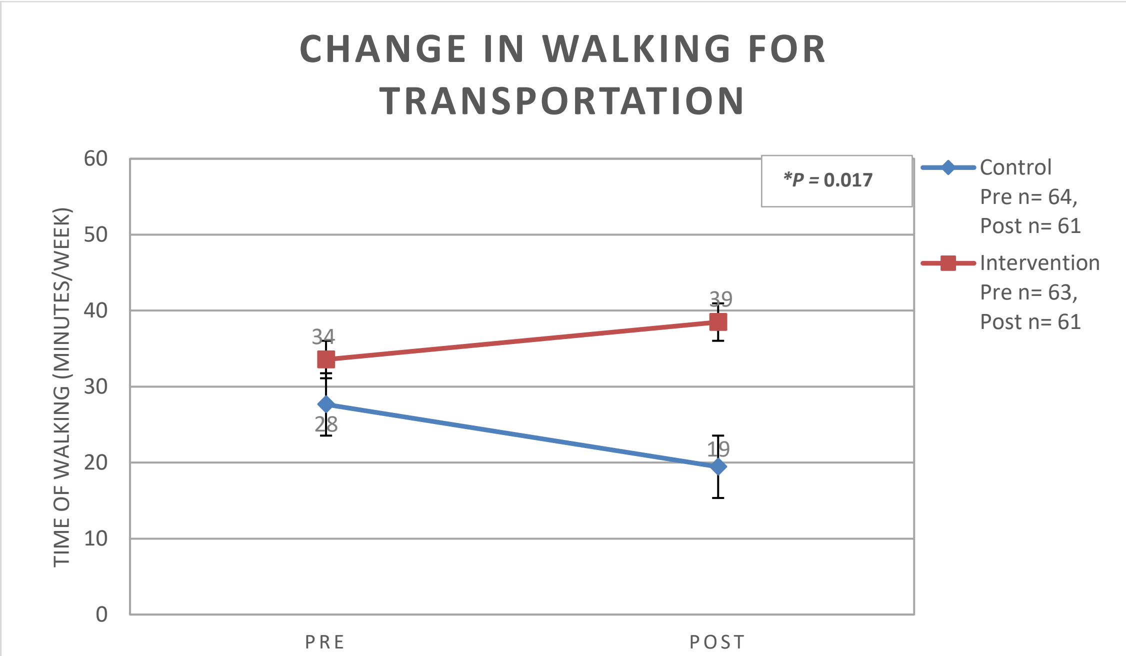


Figure 3-9 Change in walking time for transportation in control and intervention groups
**P-value for the interaction between groups and time (repeated measures ANOVA)*

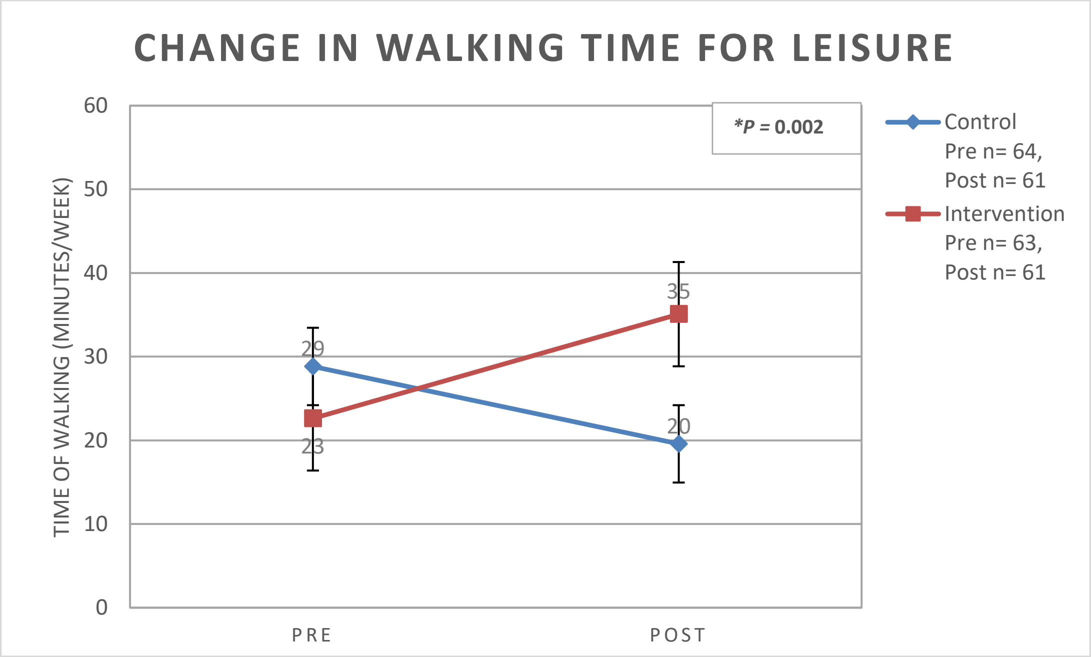


Figure 3-10 Change in walking time for leisure in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

3.4.3.4 Total Moderate PA

Moderate housework and moderate exercise and sports were added together to give a total time of moderate PA. There was a trend for a significant interaction between groups and time ($F(1,118.420)= 3.79$, $p= 0.054$) which showed that the CG had decreased the time spent in moderate PA by -3.93 minutes/week compared to a significant increase in the IG by +23.41 minutes/week as seen in Figure 3-11.

3.4.3.4.1 *Time spent carrying out Moderate Intensity Housework*

These was no significant interaction between groups and time over time spent in moderate intensity housework ($F(1,123.0)= 1.33$, $p= 0.250$) but the IG increased the time by +4.9 minutes/week while CG decreased it by -0.55 minutes/week as seen in Figure 3-12.

3.4.3.4.2 *Time spent carrying out Moderate Intensity Exercises and Sports*

There was a significant interaction between groups and time for total time of moderate intensity exercises and sports ($F(1,121.58)= 4.45$, $p=0.037$) where IG had an increase in time by +18.49 minutes/week compared to a slight decrease of -3.41 minutes/week in the CG as shown in **Error! Reference source not found.**

3.4.3.5 Total Vigorous PA

There was no significant interaction between groups and time for total time spent in vigorous PA ($F(1,120.3)= 1.85$, $p= 0.177$), however; the IG slightly increased the time by +0.18 minutes/week whereas the CG decreased it by -10.84 minutes/week as displayed in Figure 3-14.

3.4.3.6 Total MVPA

There was a significant interaction between groups and time ($F(1, 121.3)= 4.35$, $p= 0.039$) in which the CG had a decrease in time by -14.02 minutes/week while the IG increased it by +19.01 minutes/week as seen in Figure 3-15.

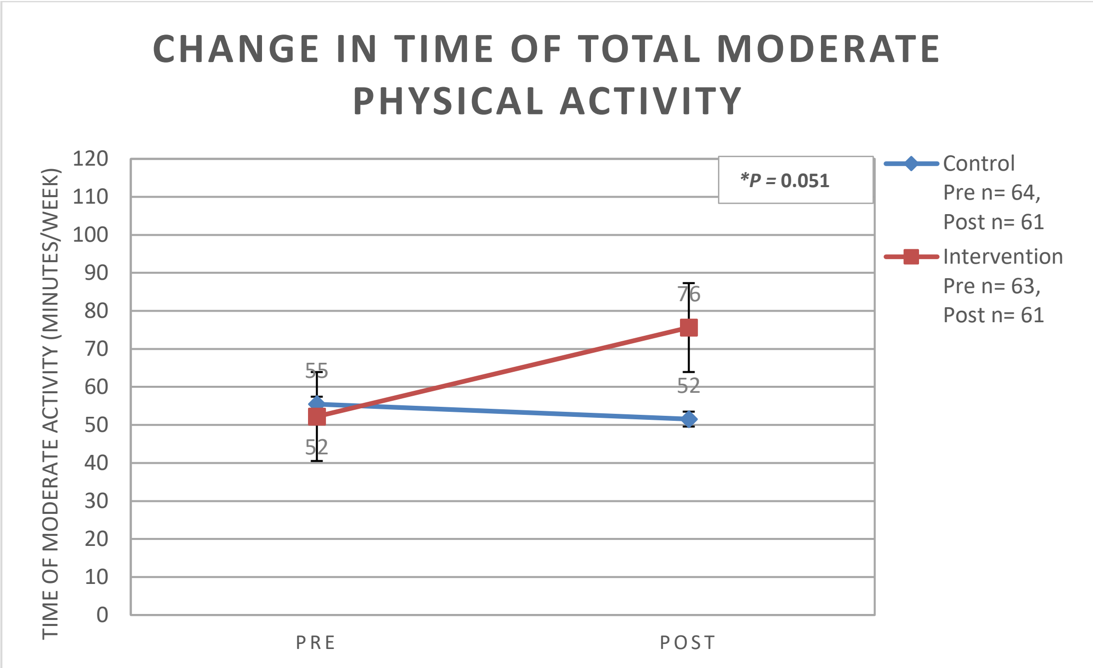


Figure 3-11 Change in total time of moderate PA in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

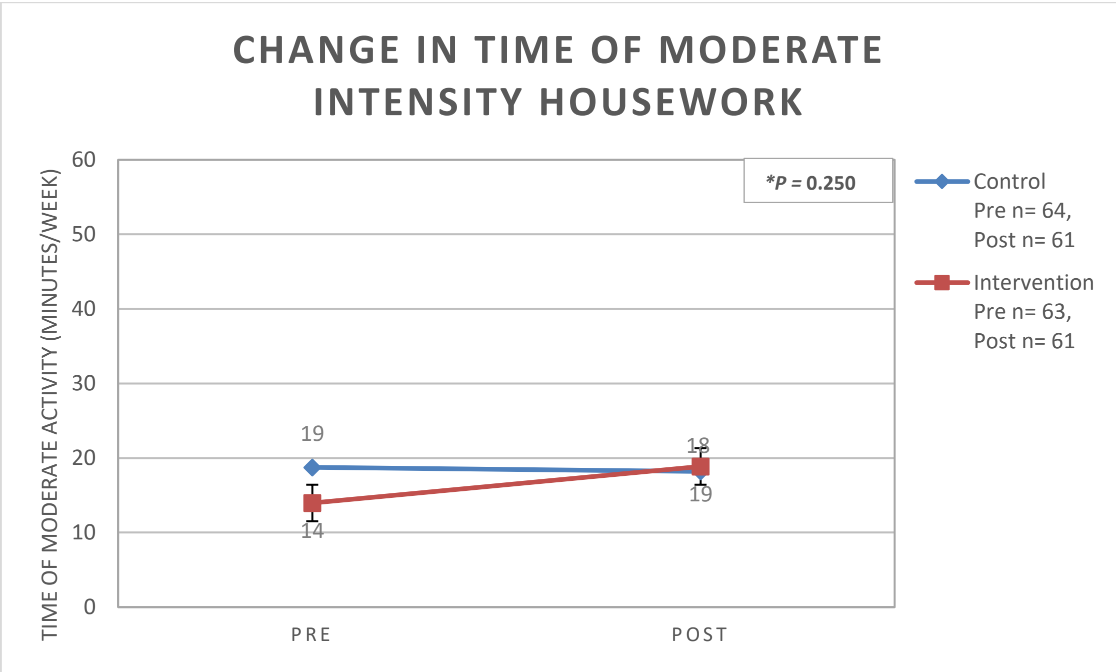


Figure 3-12 Change in moderate intensity housework in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

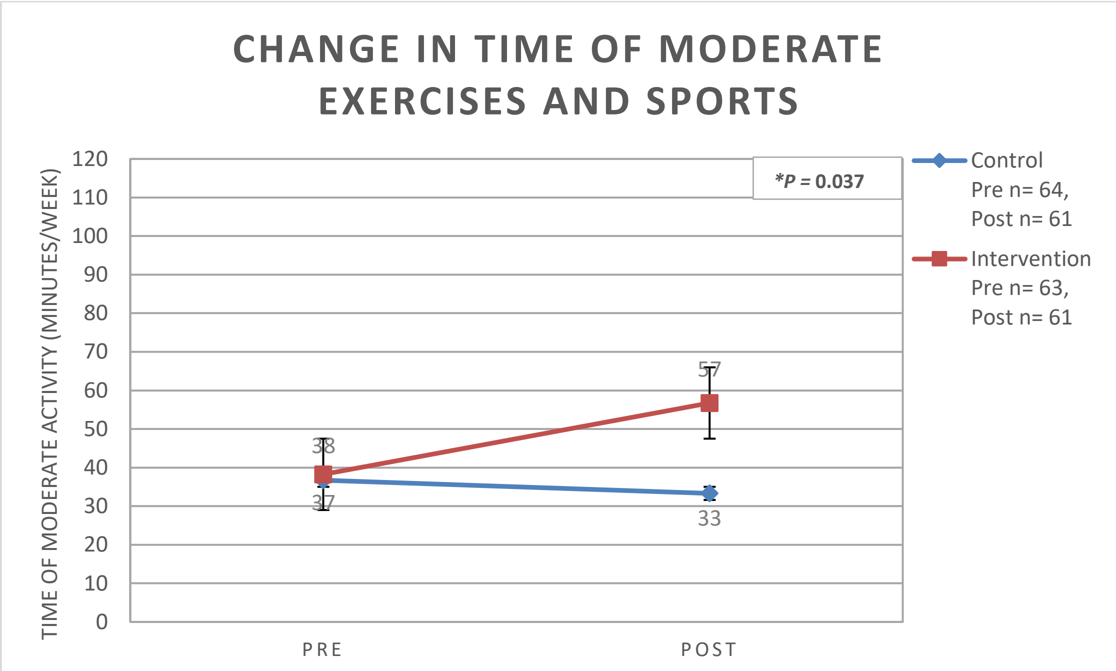


Figure 3-13 Change in walking time of moderate intensity exercises and sports in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

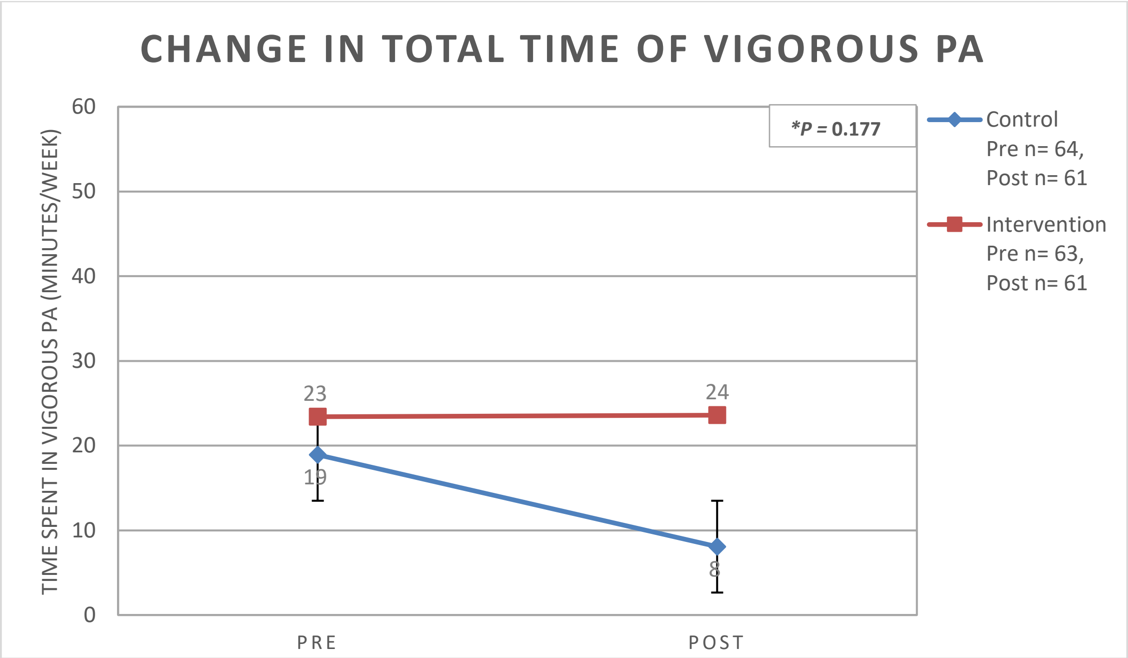


Figure 3-14 Change in total time of vigorous PA from in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the intervention group

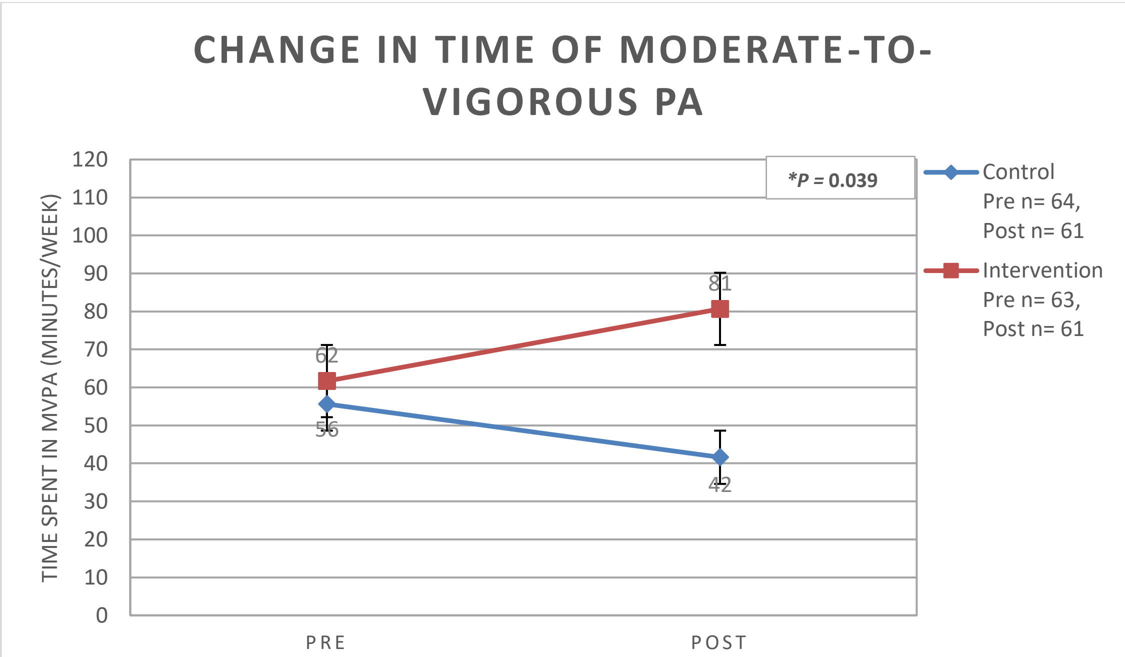


Figure 3-15 Change in time of MVPA in control and intervention groups
**P-value for the interaction between groups and time (repeated measures ANOVA)*

3.4.3.7 **Reasons to Engage in Physical Activity**

Most reported reasons for PA at both pre- and post-intervention were to maintain or lose weight, and to maintain or acquire physical fitness (> 30%) and the least was to enhance social interaction (< 4%) as summarised in Table 3-4. PA to maintain or strengthen muscles and to improve self-image and confidence had similar percentages (Pre=8% and Post= 9%). The IG increased reporting PA to maintain or lose weight after the intervention by +14.1% but decreased by -4.5% in PA to enhance social interaction. However, there were no significant differences between the groups when compared for the difference in reasons.

3.4.3.8 **Physical Activity Barriers**

The most reported barriers at both pre-and post-intervention and in both groups, were interruption of study and lack of time (> 60%) as shown in Table 3-5. Lack of motive and unsuitable weather followed at both times and in both groups (>30%). The least reported barriers to PA were overweight embarrassment, lack of safety and security, traditions and cultures, and medical restrictions (< 10%). The barriers in general decreased at post-intervention except for unsuitable weather (+9.7%), lack of facilities (+7.8), and lack of time (+4.2%). The IG has significantly decreased ‘no need for PA’ barrier by -19% compared to -4% in the CG (p= 0.004). Lack of motive was also decreased by -15% in the IG compared to -5% in the CG but the level significance was marginal (p= 0.05). There were no significant differences between the groups in other barriers.

Table 3-4 Comparison between the groups in reported reasons to engage in regular physical activity

Reasons for PA	Pre-intervention		Post-intervention		P-value for the difference
	Control n = 64	Intervention n = 63	Control n = 61	Intervention n = 61	
Maintain or lose weight	39 (30.7%)		46 (37.7%)		
Group, n (%)	20 (31.3%)	19 (30.2%)	19 (31.1%)	27 (44.3%)	0.246*
Maintain or acquire physical fitness	45 (35.4%)		40 (32.8%)		
Group, n (%)	21 (32.8%)	24 (38.1%)	16 (26.2%)	24 (39.3%)	0.716
Maintain or strengthen muscles	10 (7.9%)		11 (9.0%)		
Group, n (%)	6 (9.4%)	4 (6.3%)	6 (9.8%)	5 (8.2%)	1.000**
Improve self-image and confidence	12 (9.4%)		12 (9.8%)		
Group, n (%)	6 (9.4%)	6 (9.5%)	7 (11.5%)	5 (8.2%)	0.758**
Enhance social interaction	4 (3.1%)		1 (0.8%)		
Group, n (%)	0 (0%)	4 (6.3%)	0 (%)	1 (1.6%)	0.057**

*Compared by Pearson chi-square

**Compared by Fisher's Exact test

Table 3-5 Comparison between the groups in reported barriers to engage in regular physical activity

Barriers	Pre-intervention		Post-intervention		P-value for the difference
	Control n = 64	Intervention n = 63	Control n = 61	Intervention n = 61	
Interruption of study	87 (68.5%)		82 (67.2%)		
Group, n (%)	45 (70.3%)	42 (66.7%)	44 (72.1%)	38 (62.3%)	0.418*
Lack of time	81 (63.8%)		83 (68.0%)		
Group, n (%)	43 (67.2%)	38 (60.3%)	46 (75.4%)	37 (60.7%)	0.104*
Lack of motive	51 (40.2%)		37 (30.3%)		
Group, n (%)	23 (35.9%)	28 (44.4%)	19 (31.1%)	18 (29.5%)	0.050*
Unsuitable Weather	47 (37.0%)		57 (46.7%)		
Group, n (%)	25 (39.1%)	22 (34.9%)	29 (47.5%)	28 (45.9%)	0.942*
Lack of facilities	36 (28.3%)		44 (36.1%)		
Group, n (%)	22 (34.4%)	14 (22.2%)	29 (47.5%)	15 (24.6%)	0.532*
Far distance, heavy traffic	36 (28.3%)		34 (27.9%)		
Group, n (%)	18 (28.1%)	18 (28.6%)	16 (26.2%)	18 (29.5%)	0.752*
Lack of interest in PA	36 (28.3%)		32 (26.2%)		
Group, n (%)	16 (25.0%)	20 (31.7%)	19 (31.3%)	13 (21.3%)	0.123*
Lack of family support	33 (26.0%)		27 (22.1%)		
Group, n (%)	19 (29.7%)	14 (22.2%)	16 (26.2%)	11 (18.0%)	0.665*
No need for PA	19 (15.0%)		8 (6.6%)		
Group, n (%)	5 (7.8%)	14 (22.2%)	6 (9.8%)	2 (3.3%)	0.004**
Lack of friends support	17 (13.4%)		12 (9.8%)		
Group, n (%)	10 (15.6%)	7 (11.1%)	9 (14.8%)	3 (4.9%)	0.268**
Concern of muscularity	17 (13.5%)		5 (4.1%)		
Group, n (%)	6 (9.5%)	11 (17.5%)	4 (6.6%)	1 (1.6%)	0.077**
Disrupt appearance	13 (10.2%)		6 (4.9%)		
Group, n (%)	5 (7.8%)	8 (12.7%)	3 (4.9%)	3 (4.9%)	0.594**
Overweight embarrassment	10 (7.9%)		5 (4.1%)		
Group, n (%)	3 (4.7%)	7 (11.1%)	2 (3.3%)	3 (4.9%)	0.717**
Lack of safety and security	10 (7.9%)		5 (4.1%)		
Group, n (%)	4 (6.3%)	6 (9.5%)	4 (6.6%)	1 (1.6%)	0.173**
Traditions and culture	10 (7.9%)		4 (3.3%)		
Group, n (%)	2 (3.1%)	8 (12.7%)	2 (3.3%)	2 (3.3%)	0.275**
Medical restrictions	9 (7.1%)		4 (3.3%)		
Group, n (%)	5 (7.8%)	4 (6.3%)	3 (4.9%)	1 (1.6%)	1.000**
Total barriers, , mean ± SD	4.10 ± 3.04		3.75 ± 2.52		0.181***
Group, mean ± SD	3.97 ± 2.98	4.22 ± 3.11	4.15 ± 2.48	3.36 ± 2.52	0.081***

* Compared by Pearson chi-square test

** Compared by Fisher's exact test

*** Compared by repeated measure ANOVA

3.4.3.9 **Parents Participation in Regular Physical Activity**

Fathers were reported to be engaging in regular PA more than mothers (50% vs. 40%, respectively) as seen in Table 3-6. However, the difference was not significant.

3.4.3.9.1 *Association of Parents PA with Daughters*

Mothers' PA was significantly positively correlated with fathers' PA (r= 0.33, p= <0.0005). Total walking was not significantly correlated with either mother's or father's PA at baseline (r= 0.13, p= 0.151 or r= 0.15, p= 0.101, respectively). Total moderate PA at baseline was significantly correlated with father's PA (r= 0.23, p= 0.010), but not mother's (r= 0.14, p= 0.130). Alternatively, vigorous PA was only significantly correlated with mother's PA (r= 0.29, p= 0.001). Total MVPA at baseline was significantly correlated with both mother's PA (r= 0.25, p= 0.005) and father's PA (r= 0.19, p= 0.037). However, the correlations were weak (< 0.40) (Evans, 1996).

Table 3-6 Parents participation in physical activity

	Total n (%)	Control n (%)	Intervention n (%)
Participation in regular PA			
Mother	50 (39.7%)	21 (33.3%)	29 (46.0%)
Father	62 (49.6%)	28 (45.2%)	34 (54.0%)

3.4.4 **Physical Activity Measurements from the Actigraph Accelerometer**

The physical activity measurements collected and analysed by accelerometers for a subsample (n=11) were compared by a non-parametric Mann-Whitney U test as displayed in Table 3-7. The analysis found that the CG were more physically active than the IG at baseline, according to their expended Kcals, METs, Steps counts, time spent in light, moderate, vigorous, and MVPA. After the intervention, the IG slightly exceeded the CG in average kcals per day and per hour, METs, steps max counts, steps per minute, time spent in light and very vigorous PA. However, the difference of change showed a pronounced increase in the IG compared to an overall decrease in the CG.

The IG expended more total Kcals, Kcals per day, and had higher metabolic rate ($p = 0.017$) than the CG as displayed in Figure 3-16 and Figure 3-17. Moreover, the IG walked more steps per minute (+1.3 step, p=0.030), spent less time on sedentary activities (-409 minutes/week, p=0.030), and spent more time in light PA than the CG (+328 minutes/week, p=0.030), presented in Figure 3-18 to Figure 3-20. The differences between the groups in total steps counts, time spent in MVPA and average time spent in MVPA per day were near significant, and increased in the IG while it decreased in the CG (p = 0.052) (Figure 3-21 to Figure 3-23). The difference between the groups in moderate PA indicated that the IG increased time spent by 37 minutes/week, while the CG decreased by 29 minutes/week (Figure 3-24), but was statistically not significant (p= 0.082). There was no significant difference between the groups in vigorous PA, although it increased by +3 minutes/week in the IG, it decreased by -2 minutes/week in the CG (p= 0.082) as seen in Figure 3-25.

Table 3-7 Accelerometer 7-day measured data comparisons between the groups

	pre-intervention				post-intervention				Difference*				P – value [a]
	Control n = 6		Intervention n = 5		Control n = 6		Intervention n = 5		Control n = 6		Intervention n = 5		
	median	IQR	median	IQR	Median	IQR	median	IQR	median	IQR	median	IQR	
Total kcal	2022.92	743.92	1576.13	820.96	1922.63	1158.44	1854.82	940.89	-139.71	577.19	278.68	257.18	0.017
Average kcal/day	252.87	91.74	178.23	101.98	240.33	149.05	246.99	122.85	-19.96	115.66	62.46	57.25	0.017
Average kcal/hour	12.01	4.38	10.41	4.01	11.41	6.80	13.27	5.66	-0.88	3.93	3.47	4.08	0.082
METs	1.15	0.07	1.13	0.07	1.14	0.07	1.20	0.10	-0.02	0.04	0.05	0.04	0.017
Steps counts	38960.83	11356	30804.60	15631	38519.83	19993	43203.40	21846	-441.00	19497	12398.80	13763	0.052
Steps average counts	0.68	0.10	0.52	0.20	0.73	0.30	0.72	0.30	0.05	0.40	0.20	0.20	0.177
Steps max counts	27.50	5.0	27.00	6	28.50	12	29.80	10	1.00	8.0	2.80	5.0	0.429
Steps/ minutes	3.87	1.1	3.06	1.6	3.93	2.1	4.40	2.2	0.07	2.1	1.34	1.5	0.030
Sedentary (mins)	8178.61	469.13	8269.50	401.17	8325.61	922.58	8008.13	595.17	147.33	478.88	-261.37	279.58	0.030
Light (mins)	1586.81	465.33	1603.23	434.92	1480.36	842.58	1824.70	591.58	-106.45	418.04	221.47	217.58	0.030
Moderate (mins)	295.45	72.83	176.93	98.50	266.86	102.83	213.83	55.67	-28.58	77.08	36.90	85.08	0.082
Vigorous (mins)	35.81	28.25	30.33	34.75	33.83	31.83	33.33	31.08	-1.97	5.58	3.00	8.33	0.082
Total MVPA (mins)	331.25	99.04	207.27	115.92	300.69	127.92	247.17	84.50	-30.56	78.63	39.90	89.58	0.052
Average MVPA/day (mins)	20.82	4.0	15.28	5.5	19.25	6.9	17.26	2.4	-1.56	3.5	1.98	4.1	0.052

[a] using non-parametric test (Mann-Whitney U test) with level of significance set at 0.05

n = number of subjects, IQR= interquartile range , mins= minutes

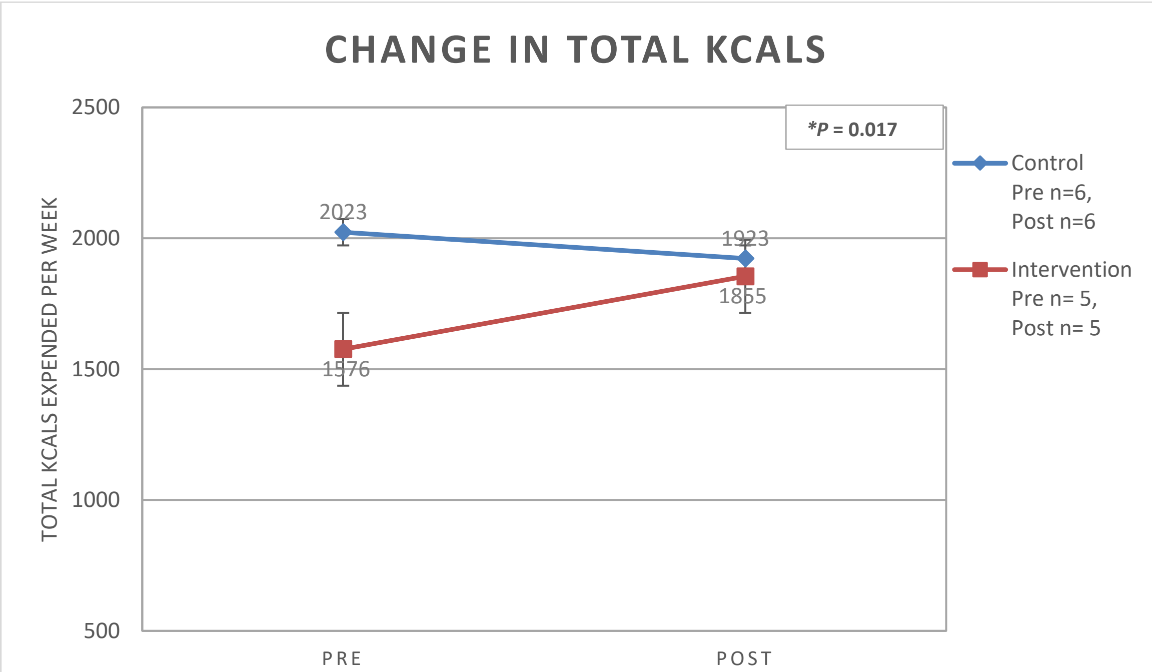


Figure 3-16 Change in total kcals between control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

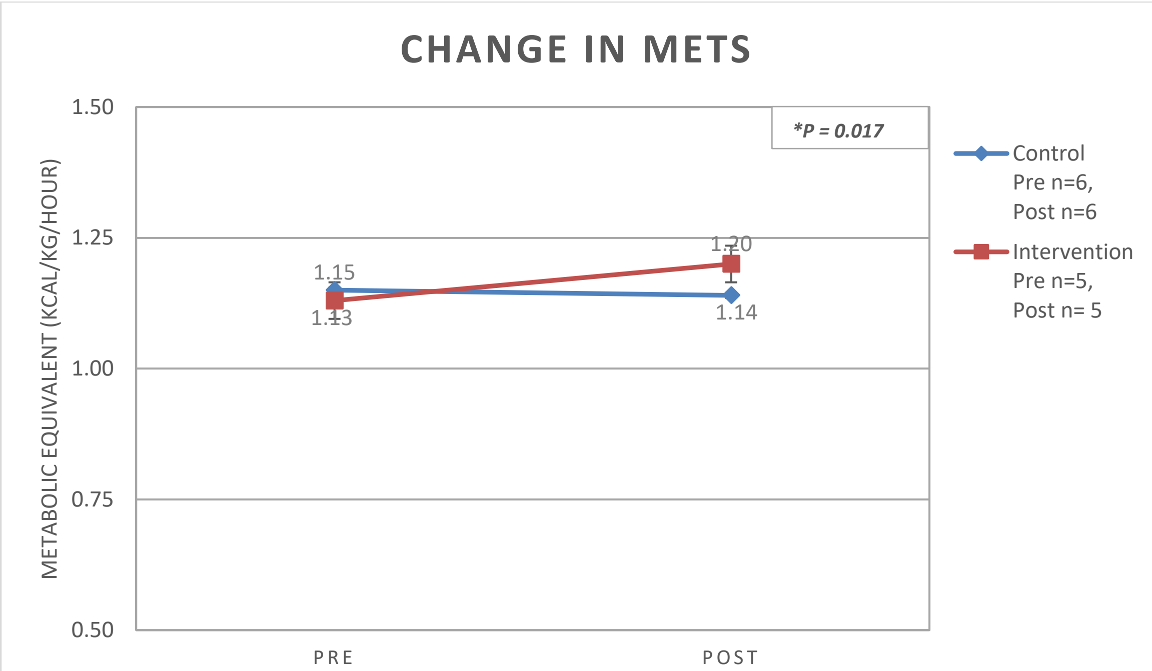


Figure 3-17 Change in metabolic equivalents (METs) between control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

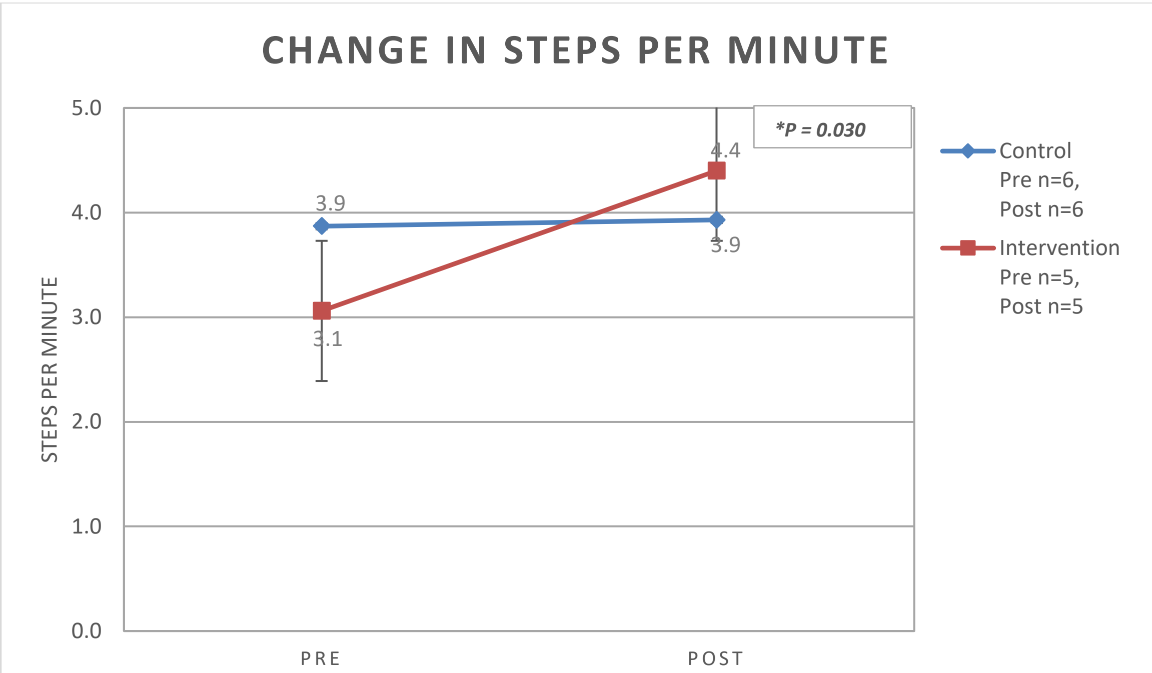


Figure 3-18 Change in number of steps per minute between control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

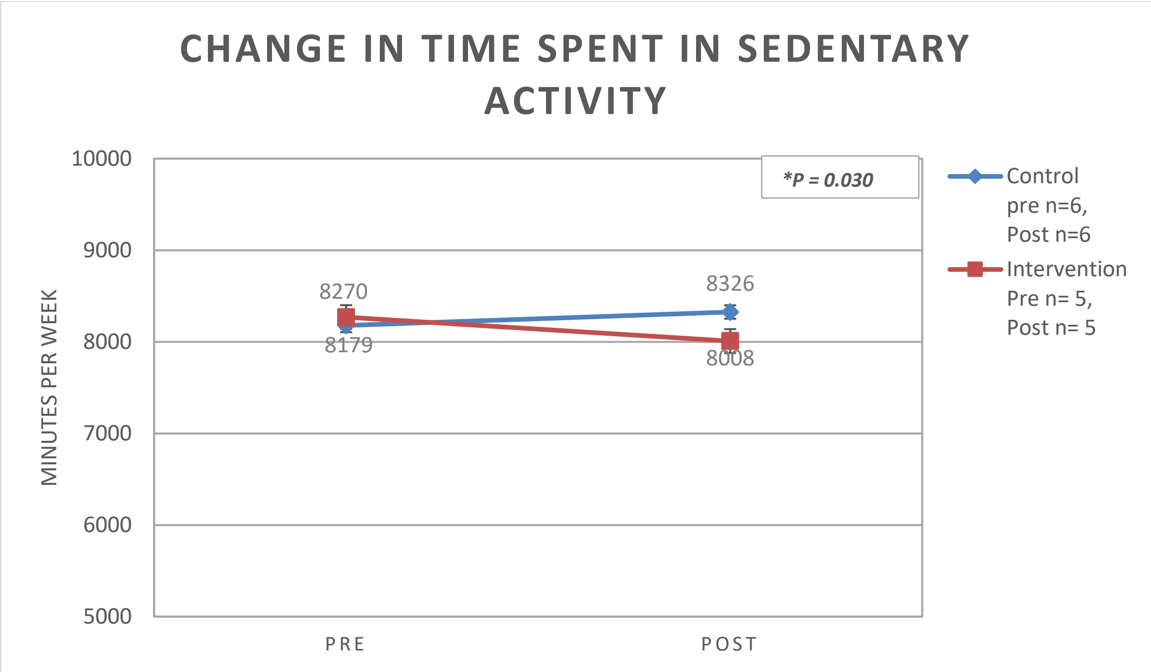


Figure 3-19 Change in total time spent in sedentary activity in minutes in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

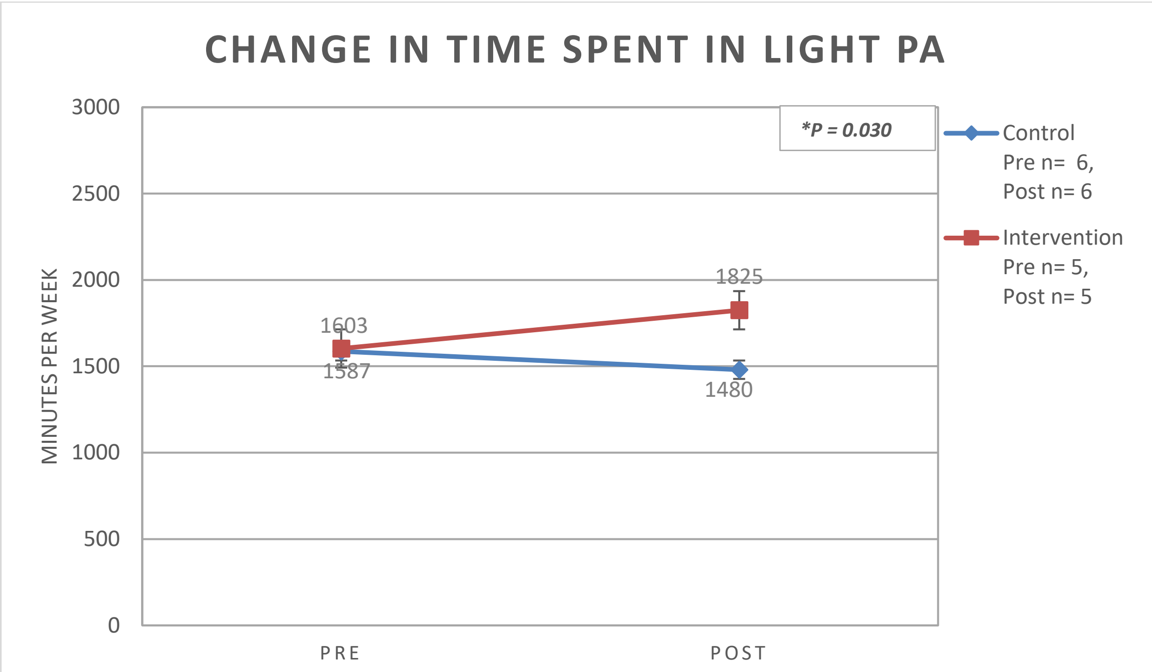


Figure 3-20 Change in total time spent in light PA in minutes in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

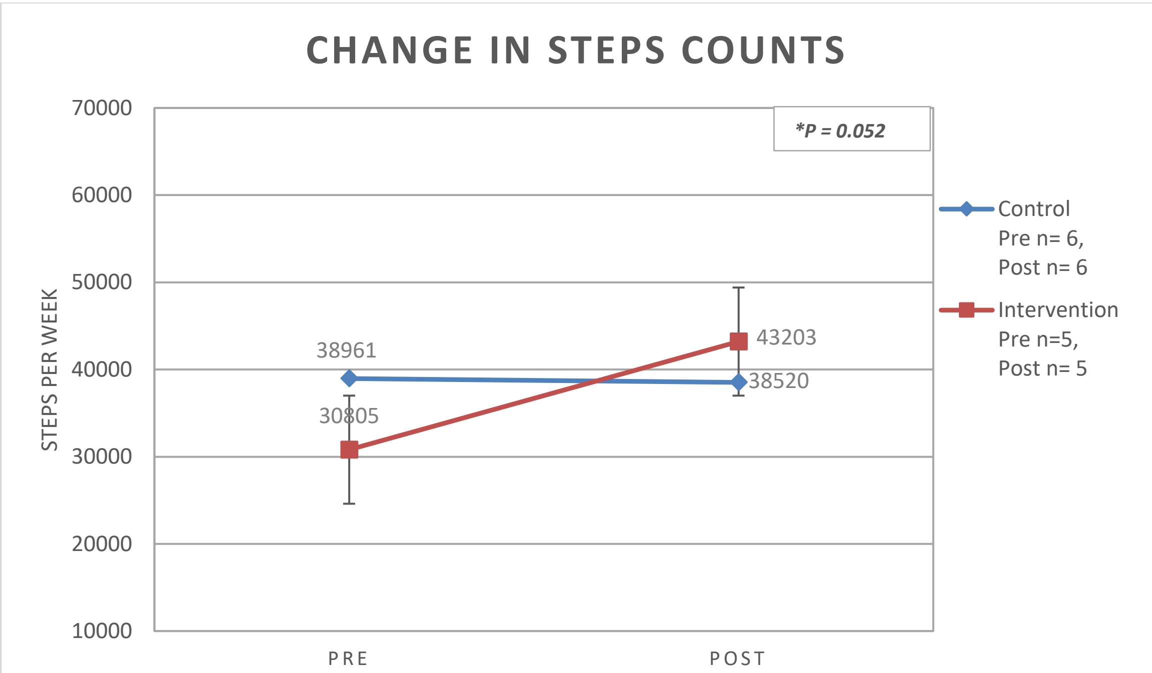


Figure 3-21 Change in total steps counts between control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

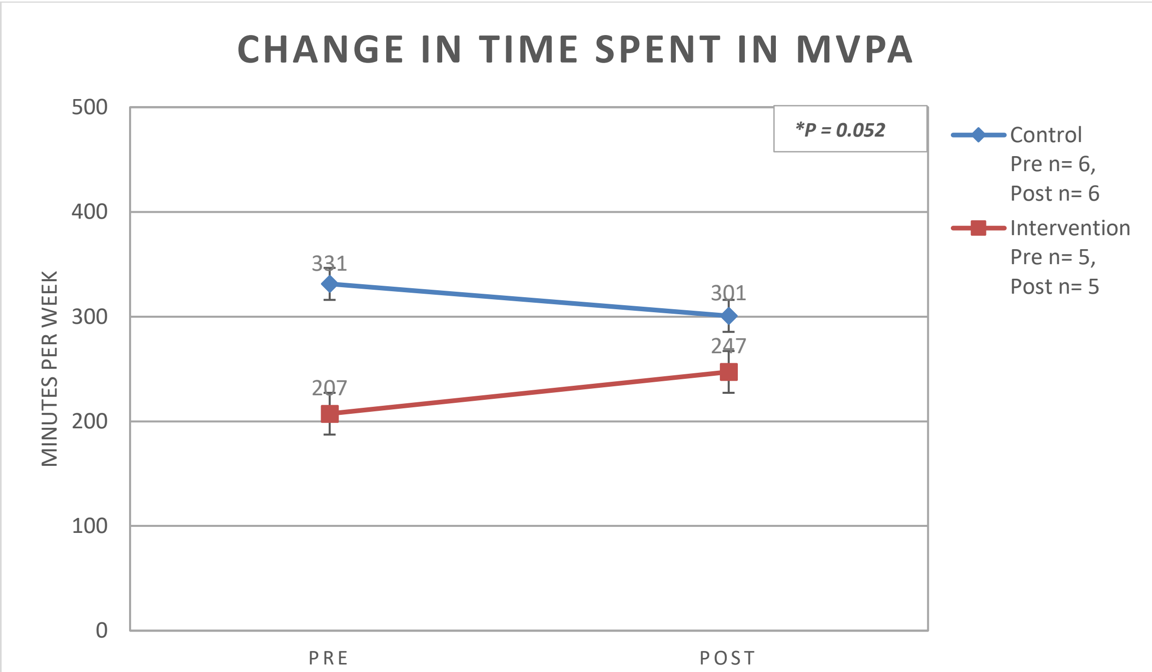


Figure 3-22 Change in total time spent in MVPA in minutes in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

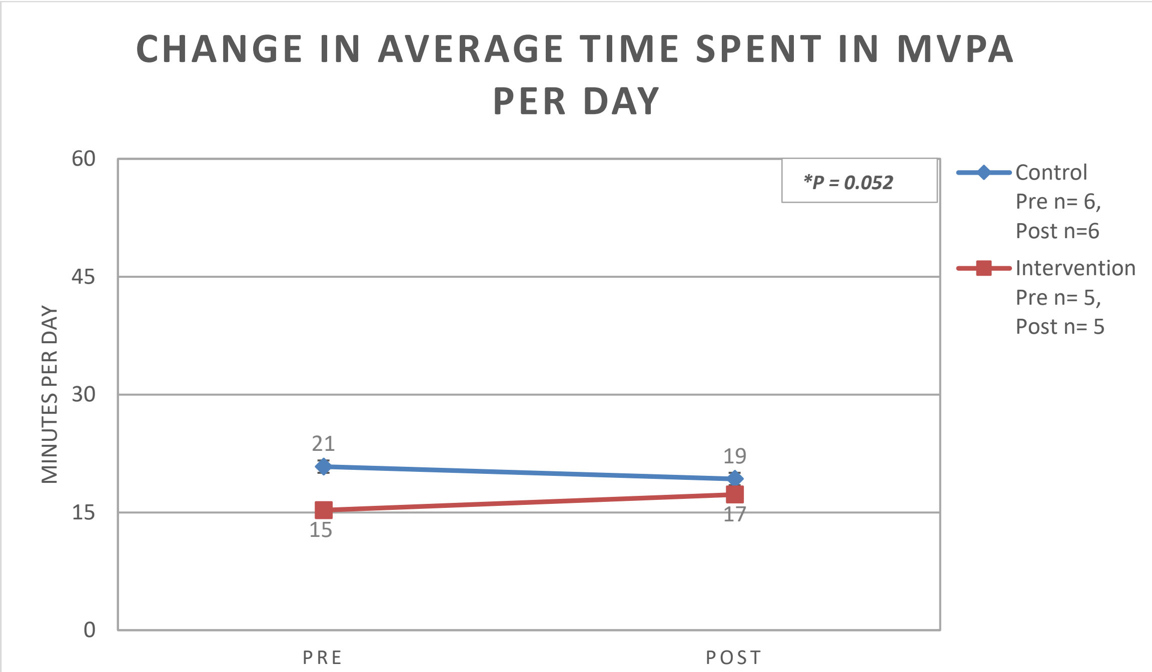


Figure 3-23 Change in average time spent in MVPA per day in minutes in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen

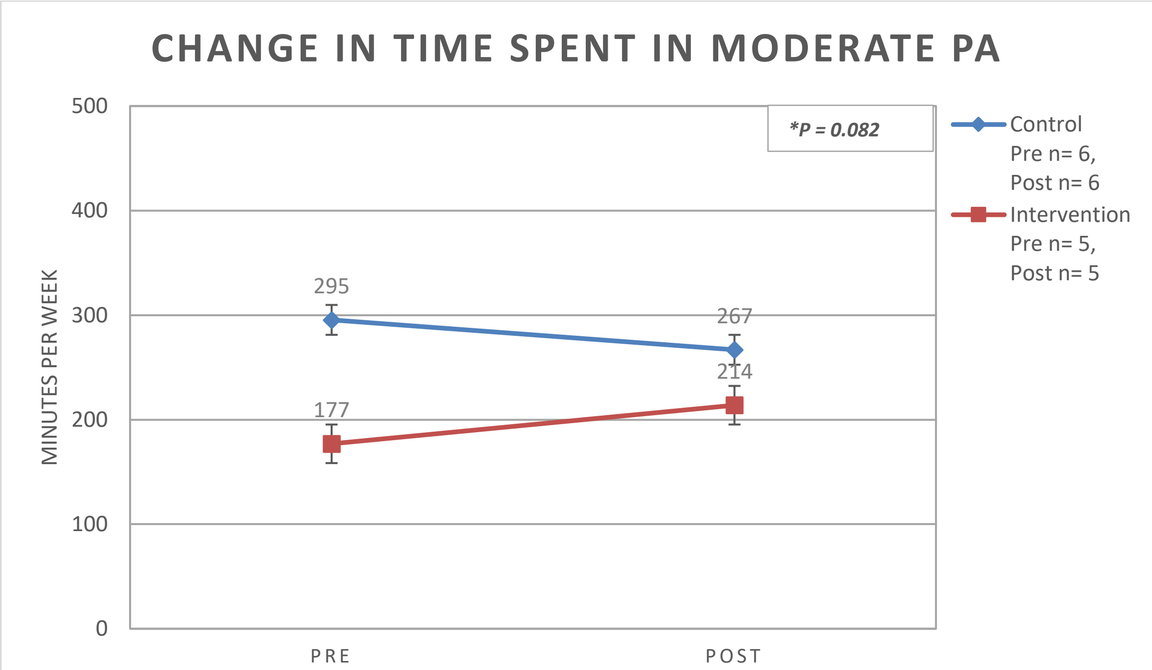


Figure 3-24 Change in total time spent in moderate PA in minutes in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

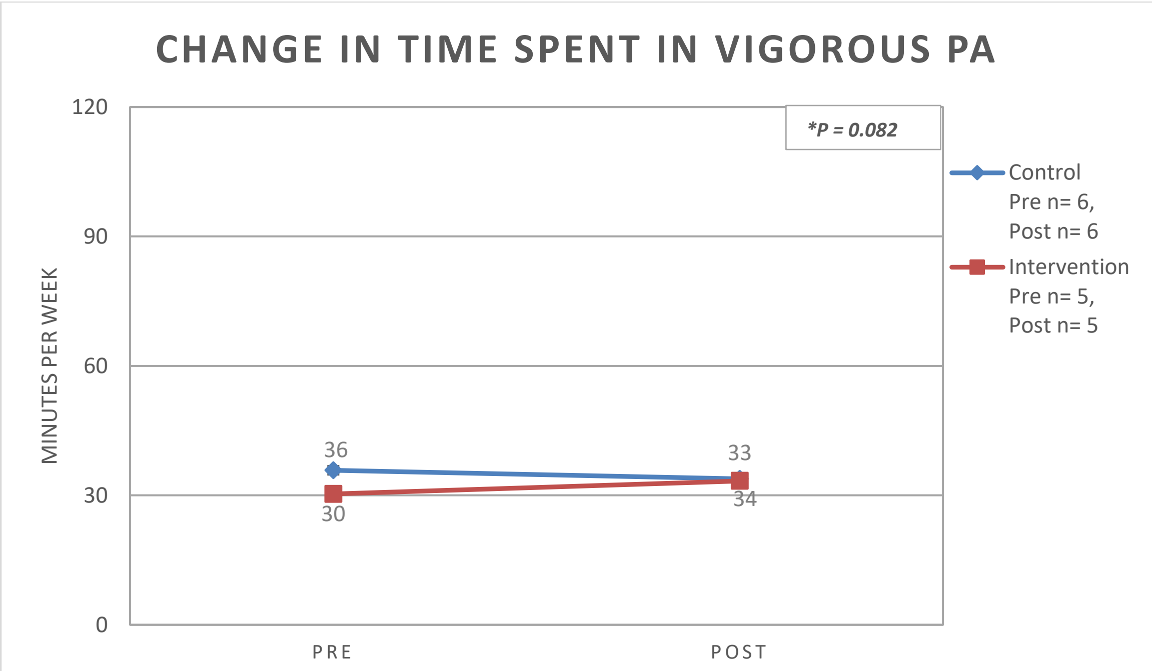


Figure 3-25 Change in total time spent in vigorous PA in minutes in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

3.4.5 **Adverse Outcomes:**

No adverse effects were reported as part of the intervention. After the second knowledge assessment, the CG were told the correct answers for each health topic to make sure the girls recognise the benefits of physical activity and healthy nutrition and be aware of the risks associated with unhealthy behaviours such as tobacco smoking, substance abuse, and sun overexposure or using sunbeds.

3.5 **Discussion:**

3.5.1 **Health Knowledge**

The IG significantly increased total health knowledge by +29.2% after the intervention while the CG increased by only +6.2%. This difference of change between the groups met the hypothesis in the power calculation. Allowing 5% increase by chance in the CG, the IG had to increase by 25% to demonstrate a significant effect of intervention on total knowledge (*See section 3.8.0*). Because CG increased more than 5%, the IG had to increase to at least +26.2% which it was reached and exceeded in the IG meeting the targeted hypothesis.

Similar to the effect of the current study on health knowledge, a great number of previous school-based interventions have resulted in a significant increase in health knowledge. A 10-session high school curricular intervention with the assistance of peer-leaders resulted in a significant increase in knowledge of healthy food choices by +7.8% while decreased by -1.4% in the CG ($p < 0.0005$) among American adolescents (Perry *et al.*, 1987). In addition, it increased knowledge of healthy exercising by +2.1% in the IG while decreased by -1.50% in the CG ($p < 0.05$). Another intervention targeted students, parents, teachers, changes to school meals, as well as community in Finland. It resulted in an increase of total health knowledge among adolescent girls at two years' follow-up by +15.2% in the IG compared to an increase of +10.3% in the CG ($p < 0.05$) (Puska *et al.*, 1982).

A personalised self-directed intervention using goal setting strategy significantly increased nutritional knowledge by +9.1% in American adolescents ($p < 0.001$) (White & Skinner, 1988). When another IG was combined with nutritional curriculum, it significantly increased the knowledge further by +20.2% ($p < 0.001$) compared to a non-significant decrease in the CG by -0.1%. The differences between the IGs and the CG were significant ($p < 0.001$). Another intervention used learning by teaching strategy increased nutritional knowledge in American adolescents by +12.4% in the IG compared to +0.3% in the CG ($p < 0.001$) (Anliker *et al.*, 1993). Additionally, a nutrition curricular intervention increased the knowledge of American adolescents to +47.73% in the IG compared to +32.5% in the CG ($p \leq 0.0001$) (Byrd-Bredbenner *et al.*, 1988). Another curricular intervention in American adolescents resulted in slightly higher nutritional knowledge in the IG than the CG (66.9% vs. 64.67%, $p \leq 0.05$) (Lewis *et al.*, 1988). Knowledge delivery strategies by audio-visual or traditional print materials increased nutritional knowledge with no significant difference between the two strategies in Indian adolescents (Rao *et al.*, 2007). A tobacco smoking prevention program with curricular component also resulted in a significant increase in knowledge in the IG compared to the CG among Palestinian adolescents in both genders (+24.5% vs. -0.1%, $p < 0.001$) (Ghrayeb *et al.*, 2013). In addition, there was no significant difference by study specialism in both groups.

It has been found that socioeconomic status (SES) moderated the effect of an intervention on nutrition knowledge with more knowledge gain in adolescent with high SES compared to low SES in India (9.0% vs. 12.3%, respectively) (Vijayapushpam *et al.*, 2003).

3.5.2 **Physical Activity**

3.5.2.1 **Physical Activity by Self-Reported Questionnaire**

3.5.2.1.1 ***Elevator Use and Sitting Time During Recess***

The intervention had a small but significant effect on self-reported physical activity related measurements. It led to a significant decrease in frequency of using elevator in the IG compared to a slight increase in the CG (-0.13 vs. +0.07, $p = 0.023$). A school-based curricular intervention also led to increased using the stairs instead of elevator among Chinese adolescents ($p<0.01$) (Tse & Yuen, 2009).

Time spent sitting during school breaks decreased more in the IG than the CG by approximately 10 minutes' difference but it was not significant. Girls have been reported to stay indoors or in schoolyards during school recesses while boys stayed at school football fields in Denmark (Pawlowski *et al.*, 2016). Those girls reported to prefer outdoors but stayed indoor because of lack of exciting outdoor facilities. Their findings show that school's environment plays an important role on PA level during recesses among adolescents. This may explain why girls in the current study prefer to sit during recess which could be due to the lack of appealing school outdoor facilities. In addition, it could be due to the increased weather temperature at the end of the study.

3.5.2.1.2 ***Walking***

Change in walking during breaks was significantly different between the groups. Walking increased in the IG while decreased in the CG (+29 vs. -1 minute, $p < 0.0005$). Walking for transportation and leisure walking were also significantly increased in the IG while decreased in the CG (+5 vs. -8 minutes, $p = 0.017$) and (+5 vs. -8 minutes, $p = 0.017$), respectively. Total time of walking was consequently increased in the IG while decreased in the CG (+45 vs. -18 minutes, $p < 0.0005$). This was similar to a curricular school-based intervention among Chinese adolescents which resulted in increasing walking for transportation and decreasing inactive transport ($p < 0.01$) (Tse & Yuen, 2009).

3.5.2.1.3 ***Moderate, Vigorous & MVPA***

Moderate intensity housework increased in the IG while decreased in the CG but the difference was not significant. Alternatively, change in moderate intensity exercises and sports was significant between the groups which increased in the IG while decreased in the CG. Total moderate PA also increased in the IG while decreased in the CG but the difference in changes was borderline significant. Vigorous PA reached by sports or exercises increased slightly in the IG while decreased in the CG but was not significantly different. Furthermore, total MVPA as a result was increased in the IG while decreased in the CG with a significant difference between the groups. Despite the increases in PA, the average MVPA did not reach the global recommendation of 60 minutes per day for children and adolescents (WHO, 2011). This low PA levels have also been found in another study in the same population where females were reported to spend three hours per week in moderate PA while males reported four hours per week ($p = 0.001$) (Allafi *et al.*, 2014). Vigorous PA was even much less in females than in males (7.2 vs. 240 minutes/week, p= 0.006).

A school-based educational intervention in Chinese adolescents increased housework activity (p< 0.01) (Tse & Yuen, 2009). Another school-based study increased proportions of adolescents who started participating in PA at least 30 minutes per day by +3% in India (Mary, D'souza & Roach, 2014). Alternatively, other school-based interventions with a curricular component did not result in a significant increase of PA (Fardy *et al.*, 1995; Singhal *et al.*, 2010) or a significant difference between the groups in PA (Neumark-Sztainer *et al.*, 2003; Saraf *et al.*, 2015). Conversely, a long-term school-based study with curricular and school environmental components in Tunisia found that proportions of adolescents who met PA guidelines significantly decreased in the IG (-4%, p= 0.01) while did not change in the CG after three years of intervention (Maatoug *et al.*, 2015). This could be due to the fact that the intervention was implemented in different schools than the control which may have a different PE curriculum and more sports' teams in CG schools. Nevertheless, the proportions of adolescents walking or biking for transportation to school did not change in the IG while significantly decreased in the CG (-8%, p< 0.001).

3.5.2.1.4 ***Reasons and Barriers for PA***

The most reported reason for PA in the cohort was to maintain or acquire fitness and to maintain or lose weight (> 30%) which was similar to Kelder *et al.* (1995) who found weight and appearance to be the most reported reasons for exercise in American girls whereas muscular build and endurance in boys. The change in the reasons for PA did not significantly differ between the groups but the IG decreased 'enhance social interaction' compared to no change in the CG but the significance was marginal (-5% vs. 0, p= 0.057).

The most reported barriers alternatively were interruption of study and lack of time (> 60%) then lack of motive and unsuitable weather (> 30%). Unsuitability with traditions and culture was only reported by few girls (<10%). Reported barriers 'lack of time', 'lack of facilities' & 'unsuitable weather' in groups were increased at post-intervention probably due to final exams, termination of school PE, and approaching summer season. The difference between groups in the reported barriers was not significant except for ‘no need for PA’ which was significantly decreased in the IG compared to the CG (-18.9% vs. -2%, p= 0.004). ‘Lack of motive’ and ‘concern of muscularity’ barriers were significantly reduced in the IG compared to CG but with borderline significance. Moreover, the number of reported barriers increased in the CG while decreased in the IG but with marginal significance (+0.18 vs. -0.86, p= 0.08).

A study showed that number of reported barriers was higher in older Canadian girls than younger ones (Sherar *et al.*, 2009). The type of barriers also differed according to age with younger girls between ages 9 to 12 reported more interpersonal barriers (i.e. social that is related to family and friends) while ages 14 to 16 reported more institutional barriers (i.e. school PE and study schedule). This was similar to the age-group in the current who mainly reported study interruption as the main barrier where social barriers were reported much less.

Barriers to PA among adolescents in the Arab region were stated to be: lack of motivation, lack of support from teachers, and lack of time with more barriers been reported by females than males (Musaiger *et al.*, 2013). In Kuwait, most reported barriers considered important by adolescent females were lack of time, unsuitable climate, inaccessibility to PA places, cultural factors, and lack of information to increase PA, and lack of support from teachers. In another regional study, the main reported barriers by Iranian children and adolescents were schoolwork, lack of safe and accessible place for PA and lack of support for PA from family (Kelishadi *et al.*, 2010). In addition, intrapersonal barriers such as low self-esteem and lack of self-confidence have also been reported.

3.5.2.1.5 *Association of Parents PA with Daughters*

This study found that mothers’ PA was positively correlated with fathers’ PA (r= 0.33, p= <0.0005). Girls’ total moderate PA was positively correlated with fathers’ PA (r= 0.23, p=0.01) while vigorous PA was positively correlated with mothers’ PA (r=0.29, p=0.005). Total baseline MVPA was positively correlated with both mothers’ (r= 0.25, weak) and fathers’ PA (r=0.19, very week). This indicates that PA participation was strongly associated with parents. This was similar to other studies in other European populations. Meeting PA recommendations in young and adolescent Scottish girls was associated with mothers’ meeting recommended PA but not father's (Scottish health survey, 2016). Seventy-three percent of active girls had active mothers who met recommended PA, while 65% active girls had inactive mothers who did not meet it. Sixty-nine percent of active girls had active fathers while 70% active girls had inactive fathers. Furthermore, it has been reported that PA and screen-time activities in girls were positively associated with mothers ($p< 0.01$) but not with fathers in five other European countries (Schoeppe *et al.*, 2016). Another study showed that girls' PA was affected by both parents' PA and screen-time but more by the mothers' in Czech (Sigmund *et al.*, 2015).

3.5.2.2 **Physical Activity by Accelerometry**

The Food and Agriculture Organisation (FAO) of the United Nations (UN), estimated the average energy expenditure (EE) for children and adolescents based on Basal Metabolic Rate (BMR) and metabolic equivalent (MET) for age and gender as shown in the following Table 3-8. The average EE for girls within the research sample age range according to FAO is between 2,130 and 2,160 kcal/day and accordingly between 14,910 and 15,120 kcal/week. Moreover, the Mean Resting EE has been stated to be 1.34 kcal.kg^{-1}.h^{-1} in adolescent females between 12 and 14 years of age, and 1.16 kcal.kg^{-1}.h^{-1} between 15 and 18 years while it is 1.00 in adults (Harrell *et al.*, 2005). The research subsample average daily EE was 253.7 kcal/day at baseline and 251.4 kcal/day$^{=}$ at post-intervention, while weekly average was 2,050 and 2,010, correspondingly. Although the IG significantly increased their average daily and weekly EE compared to decreases in the CG, their average EE was still extremely low compared to the FAO estimated EE values. This could be due to the sedentary lifestyle of the community and in females in particular (*see introduction section 1.2.2.2.1*).

Table 3-8 Estimated average energy expenditure for adolescent girls by age

Age (years)	**BMR** (kcal/day)	**Expenditure[a]** **(MET)**	**Expenditure** **(kcal/day)**
14 - 15	1,375	1.57	2,160
15 - 16	1,395	1.54	2,140
16 – 17	1,405	1.53	2,130
17 - 18	1,410	1.52	2,140

Adapted from Food and Agriculture Organisation (FAO, n.d.)

MET, metabolic equivalent; BMR, basal metabolic rate

[a]Average MET for light activity

Analysis of the accelerometers results noted that the total Kcal, the average kcal per day, and METs significantly increased after the intervention.

The recommended step count per day assessed by accelerometer should be at least 11,500 for adolescents and for both genders, which corresponds to 60 minutes or more of MVPA (Adams, Johnson, & Tudor-Locke, 2013). The subsample in the current study had a total of 36,355 step counts per week at baseline and 43,303 at post-intervention giving an estimated step counts of 5,194 and 6,186 per day, respectively. The IG increased steps count reaching 43,203.4 at post-intervention (≈ 6,172 step counts per day) while step counts decreased in the CG to 38,519.8. Nevertheless, the IG did not reach the abovementioned recommended step counts. Moreover, the total subsample spent 19.5 minutes of MVPA at baseline and 18.3 minutes at post-intervention. Though the IG increased by about +2.0 minutes accumulating 17.3 minutes while the CG decreased by -1.6 minutes, the IG did not meet the recommended MVPA of 60 minutes per day (WHO, 2011). This could be due to the girls' sedentary lifestyle and spending more time indoors that are limiting their PA and steps per day especially at school days.

Sampling for monitoring PA by 7-day accelerometer was done by self-selection i.e. volunteering. This could have caused self-selection bias, with those with relatively higher PA levels or those with lower BMI to be more willing to be monitored. 'Wear effect' could also have increased the PA level among the wearers compared to their usual conditions which can lead to overestimation of PA (MacMillan & Kirk, 2010). Accelerometers were stated to detect less prevalence of inadequate PA in adolescents compared to questionnaires (Jurakic & Pedisic, 2012), which may confirm the previous arguments.

Factors that could affect adherence to wearing the accelerometer included incentives to increase adherence like vouchers per return of the device or individualised graph of output (Audrey *et al.*, 2013). Other factors that could impede wearing's adherence are appearance concerns especially in girls, discomfort in hot weather and or during high activity, and concerns of losing or breaking the accelerometers due contact sports or traveling overseas (Audrey *et al.*, 2013). Novelty and unfamiliarity with the accelerometer in the region could also represent another barrier to wearing the accelerometer in culturally sensitive and private settings particularly for females.

Although accelerometers are considered reliable instruments to measure total EE, they are based on estimated predictive equations with different intensity thresholds according to the reference used (Ainslie, Reilly, & Westerterp, 2003). They have been validated against the doubly labelled water (DLW), 'gold standard', or indirect calorimetry as they are considered highly reliable techniques for assessing EE in free-living conditions (Ainslie, Reilly, & Westerterp, 2003). The use of epoch length of five seconds in children and adolescents has been recommended in order to detect their VPA and sedentary time which is habitually short and intermittent (Edwardson & Gorely, 2010). Whereas, we used an epoch time of ten seconds.

A school-based intervention involving computer-based tailored feedback guided by Transtheoretical model (stages of change), environmental, and parental components resulted in not significant reduction in sedentary activity by -18.4 minutes/day in the IG compared to -35.7 minutes/day in the CG after one year, and -17.5 minutes/day compared to -13.1 minutes/day respectively after two years in girls (Haerens *et al.*, 2006). Light PA also decreased by -7.4 minutes/day in the IG and -24.4 minutes/day in the CG after one year, and -2.2 minutes in the IG and -19.6 minutes/day in the CG with a significant difference after two years (p <0.05). MVPA was increased by +5.0 minutes/day in the IG and +0.4 minutes/day in the CG after one year, and +4.3 minutes/day in the IG and +4.2 minutes/day in the CG after two years. However, changes in the MVPA at both times were not significant. In another study, the same multi-component intervention but without parental component, and CG were compared in both genders (Haerens *et al.*, 2007). Post hoc analyses revealed that the intervention alone spent more LPA compared to the CG but was near the point of significance (p<0.08) while the comprehensive intervention significantly spent more LPA than the CG (p <0.05). In MVPA, the comprehensive intervention significantly spent more time than the CG (p<0.05) and near significant (p<0.08) compared to the intervention alone.

A similar intervention including a web-based individually tailored PA feedback and advice to a linked-accelerometer data was compared to a CG that only received a brochure with PA information and general recommendations (Slootmaker *et al.*, 2010). Girls in the IG decreased sedentary time at 3-month follow-up by -52 minutes/week/ compared to -165 minutes/week in the CG but the difference between them was not statistically significant. At 8-month follow-up, the IG increased sedentary time by +133 minutes/week from baseline compared to a decrease in the CG by -85 minutes/week but again the difference was not significant. Girls in the IG in both groups decreased the time spent in LPA per week with an adjusted difference for baseline of 316 minutes at 3-month follow-up, and 253 minutes at eight months less in the IG yet again the differences were not significant. MPA was significantly higher in girls in the IG than the CG by 411 minutes adjusted difference for baseline at three months ($p<0.05$), while it was lower by -13 minutes at eight months but was not statistically significantly. Difference in VPA was lower in girls in the IG at both three and eight months but the differences at both times were not statistically significant. Although the difference in time spent in MVPA was significantly higher in girls in the IG by +357 minutes at 3-month and less by -46 minutes at 8-month follow-ups, they were not significant.

A 24-month school-based intervention with curricular, environmental, parental, and community PA providing components resulted in an increase in total MVPA by 3.9 minutes/day ($p= 0.01$), MPA by +1.4 minutes/day ($p= 0.15$), and VPA by +2.5 minutes/day ($p= 0.002$) (Sutherland *et al.*, 2016a). However, change in minutes of MVPA per day among females was not significant ($p= 0.35$) while it was significant in males ($p= 0.02$). After two years, the difference between groups in total MVPA was 7.0 minutes/day ($p = 0.005$), MPA was 4.5 minutes/day ($p= 0.002$), and VPA was 2.5 minutes/day ($p= 0.026$) to the advantage of IG in both genders (Sutherland *et al.*, 2016b). The changes in minutes of MVPA and MPA per day were significant in both genders with a larger difference in males. A multi-sectorial and multi-component intervention also resulted in a significant MVPA increase in the IG with time ($p= 0.017$) and not significant MVPA decrease in the CG with time ($p= 0.081$) (Pardo *et al.*, 2014).

A multi-component intervention which incorporated different theories and was guided by social-ecologic framework decreased minutes of MVPA by -1.3 in the IG and -2.9 in the CG after two years, giving a difference of 1.6 minutes more in the IG (p <.05) (Webber *et al.*, 2008). The difference in MET-weighted minutes of MVPA after two years was also significantly higher in the IG by +10.9 METs (p<0.05). Moreover, time spent sedentary reduced significantly in the IG compared to the CG with a difference of -8.2 minutes (p<0.05). Nevertheless, the total time spent in PA did not differ significantly between the IG and the CG. Similarly, a multi-component and theoretically based school-based intervention incorporated an exercise component, curricular, parental involvement, pedometers for self-monitoring, and social support through text messages. Both groups decreased counts per minute (CPM) and MVPA after one year and in the IG more than the CG, but the differences were not significant (Lubans *et al.*, 2012).

Another multi-component intervention targeted the PA setting including school outdoors, playgrounds, active transport, and fitness clubs (Toftager *et al.*, 2014). After two years, all PA measures decreased while sedentary time increased in both groups. Nonetheless, the IG spent more time in MVPA per day than CG by +2.2 minutes adjusted difference for baseline PA, age, gender, and weekdays/weekend, and less time sedentary by -6.0 minutes of adjusted difference but the differences were not significant. CPM were higher in the IG for weekdays PA, weekend PA, school-time PA, and overall PA but all were statistically not significant. The IG has significantly more CPM in PA during school recess by +95.0 counts of adjusted difference for baseline PA, age, and gender (p= 0.046).

3.5.2.3 Self-Reported PA versus Accelerometer Measured PA

These data were broadly consistent with those measured by the accelerometer. Similarly, light PA which include walking significantly increased in the IG while decreased in the CG (p= 0.030). Additionally, both moderate PA and vigorous PA were increased in the IG while decreased in the CG but the differences were not statistically significant. Total MVPA was also increased in the IG while decreased in the CG but the difference in change between the groups was borderline significant. Accordingly, the change in PA was underestimated by self-reports in comparison with the accelerometer. This could be explained partially by the aforementioned ‘self-selection bias’ and ‘wear effect’ for accelerometry data (*see Chapter 4, section 4.7.3.1*), but these do not explain the higher PA decline in the CG accelerometer’s data.

3.5.2.4 **General Factors Influencing PA**

A ‘seasonal effect’ has been stated to have an influence on PA levels with the lowest PA during the winter and highest in the summer, noted in the UK (Rich, Griffiths, & Dezateux, 2012). Given the fact that Kuwait has an arid climate, this could reverse such seasonal influence with higher PA in the winter than the summer (Maximum average temperature > 40ºC in the summer) (Kuwait Metrological Department, n.d.). However, the baseline assessment took place during the winter and the post-intervention during the spring with no summer assessment which may attenuated the seasonal influence. PA could also have been reduced due to academic examinations (Steptoe *et al.*, 1996).

PA has been shown to vary by hour of the day and days of the week (as in weekdays vs. weekend days) in adolescents. In both genders, overall PA was more accumulated on weekdays whereas MVPA was more accumulated on weekend days (Brooke *et al.*, 2014). In addition, active transport was more accumulated out-of-school, while MVPA was more accumulated in school during weekdays. Conversely, active transport was slightly less accumulated on weekend days than weekdays.

Adolescent males were more active than adolescent females on both weekdays and weekends and in school and out-of-school times (Li, K. *et al.*, 2016). Adolescent females were reported to accumulate more and longer sedentary bouts with more ‘sedentary breaking’ activities during the weekdays compared to weekends (p <0.001) (Harington *et al.*, 2011). Moreover, they accumulated more numbers of longer sedentary bouts (> 20 mins) during school hours and more numbers of shorter sedentary bouts (≤ 5 mins) after school hours. Nevertheless, the total sedentary time did not significantly differ between weekdays and weekend days or between during school hours or after school hours. The Scottish health survey (2016) found that adolescent females spent more sedentary time on weekend days than on weekdays. Alternatively, another study revealed that more sedentary time was spent during the weekdays than the weekend days in Australian adolescent girls (Carson *et al.*, 2013).

The sedentary time was found to be the highest in the evening time then during school hours and the least during after school hours which could be explained by active transport from the school (Carson *et al.*, 2013). A study by K. Li *et al.* (2016)

has found more numbers of sedentary bouts per hour and per day during the weekdays compared to the weekend but the length of sedentary bouts did not differ significantly. In addition, more sedentary bouts of both short and long durations per day were accumulated during the school hours while more sedentary bouts per hour were accumulated in the evening which could indicate intermittent activity. On the other hand, studies reported more MVPA among adolescent females during the weekdays compared to the weekend days (Aznar *et al.*, 2011; Konharn, Santos, & Ribeiro, 2015). Moreover, they spent more MVPA time in the afternoon compared to the morning but was marginally significant in 15-year-old adolescent females (26.67 mins vs. 19.37 mins, p= 0.06) (Aznar *et al.*, 2011).

Normal weight adolescents were more active than overweight on weekdays in the year after secondary school and on weekend days in the 10th school year (Li, K. *et al.*, 2016). Increased BMI throughout progression of secondary school years led to decrease MVPA. MVPA during weekend days did not significantly change with the progression in secondary school years.

The aforementioned variations could have resulted from other factors. Aging during adolescence decreases PA which is more pronounced between the ages of 13 and 14 (Konharn, Santos, & Ribeiro, 2015). Overweight adolescents had a negative intervention effect on enjoyment and self-efficacy which are mediators for PA (Bergh *et al.*, 2012). It has been found that weight status moderated the mediating effect of enjoyment in particular on the intervention. Parental safety and security concerns could also lead to a decrease in out-of-school PA among adolescent females (Carver *et al.*, 2010).

The PA during the weekdays could be related to school activity level and PE curriculum with more PA would be accumulated in active schools and in case of having more organised sports teams within the school. Whereas, PA during the weekends could be more related to parental, peers, and community PA recreation sites such as public parks, sport clubs, outdoor sport courts, theme parks…etc. Nevertheless, PA planning, but not peer PA or family support for PA, was found to positively associated with MVPA in secondary school years 10 to 12 (Li, K. *et al.*, 2016).

Energy expenditure has been reported to vary throughout the menstrual cycle. EE assessed for 24 hours (24-h EE) was shown to be increased during luteal phase of the menstrual cycle (Webb, 1986; Bidsee, James, & Shaw, 1989; Howe, Rumpler, & Seale, 1993). The mean 24-h EE increase was stated to range between 2.5% to 11.5% corresponding to 89 to 279 kcal (Bisdee, Garlick, & James, 1989; Webb, 1993; Davidsen, Vistisen, & Astrup, 2007). This variation has been reported to be associated with hormonal changes predominantly with progesterone (Webb, 1986; Howe, Rumpler, & Seale, 1993). However, this association was stated to be diminished in case of irregular or 'anovulatory' cycles (Tworoger *et al.*, 2007). Conversely, premenstrual syndrome was suggested to be associated with reduced PA in the luteal phase (Singh *et al.*, 2008). PA may also be reduced because of dysmenorrhoea (Chen *et al.*, 2006; Chantler, Mitchell, & Fuller, 2009). Therefore, such factors in regular menstrual cycle, which was not controlled in the monitored subsample, if occurred, it might have confounded the recorded EE and general PA assessed by accelerometer or by self-reports.

Most PA interventions resulting in increased MVPA involved an exercise component. Some studies used non-curricular strategies to increase PA such as PA during school break, active commuting, extracurricular school-based PA involvement and summer camps (Jago & Baranowski, 2004). However, they involve some limitations such as traffic congestion and safety concern in active commuting, low attendance in extracurricular PA, and maintaining PA levels after summer camps. Successful PA components included schools involving family or community, and multi-components interventions can increase PA among adolescents (Van Sluijs, McMinn, & Griffin, 2007). Involving environmental and social components in PA school-based interventions facilitates and promote PA (Morton *et al.*, 2016).

3.5.3 **Methodological Limitations:**

Health knowledge could have been cross-contaminated given that both groups were in the same site. Moreover, Students it could also have been affected by their study specialism with those in science presumed to have more information and knowledge about health topics. However, subgroup analysis did not show any significant effect of specialism over the knowledge at both time points.

The reliability and validity of questionnaires were not tested and therefore could compromise the reliability of the self-reported findings. Reliability of data collected by self-reports are already jeopardised by cognitive subjectivity, recall difficulty in case of retrospective investigation, and response bias (Brener, Billy, & Grady, 2003).

Total daily sedentary time was not assessed by the self-reports to determine whether the intervention would be able change it or not. However, it was assessed by the accelerometer in the subsample.

3.6 Conclusion

The intervention effectively increased total and specific health knowledge significantly more in the IG than the CG which met the hypothesis in the sample calculation. Self-reported PA have also been changed in the targeted direction such as reducing times of elevator use, total walking time, and total MVPA but to a level less than recommended. In addition, it was effective in increasing total EE per week and average EE per day, maintaining METs, increasing average steps counts per minute, reducing sedentary time, and increasing LPA as assessed by 7-day triaxial accelerometer in the IG compared to the CG. The modest change in PA could be to the absence of structured PA component such as exercise programme. However, this small increase demonstrates a positive effect of the intervention given the sedentary lifestyle of the population. The consistency between PA by self-reports and by accelerometer indicates that the use of accelerometry in assessing PA is feasible and should be expanded in the population

Chapter 4

Effect of a Health Education-Based Intervention on Weight Measurements, Physical Fitness, and Health-Related Behaviours in Adolescent Females

4.1 Introduction

The intervention as explained earlier was a school-based health-promoting, educational intervention among adolescent females. It covered six topics: physical activity, healthy eating, bone health, prevention of tobacco smoking, prevention of substance abuse, and sun protection. The overall aim of the intervention was to promote health-related behaviours related to the involved topics. These behaviours are much more common in the adolescent population and often persist into adulthood. Thus, targeting such behaviours at this age is essential for current and future health promotion. Schools are key settings to introduce adolescents' health-related behavioural promotion. There is an immense number of school-based health promoting intervention targeting health-enhancing and compromising behaviours among adolescents. Lazorick *et al.* (2011) demonstrated a long-term significant decrease in BMI z-score as a result of physical activity and nutritional education among different races of American adolescents. Sumen and Oncel (2015) also showed a significant increase in health knowledge and an improvement in sun protective behaviours among Turkish adolescents as a result of educational school-based intervention. There is a limited number of health-promoting interventions carried out in a school setting in the gulf region. The current study applied an in-school health educational enhancement intervention targeting physical activity, dietary behaviours and patterns, tobacco smoking, substance abuse, and UV radiation exposure and sun protection behaviours in adolescent Kuwaiti females. The effect of the intervention on weight measurements, physical fitness, and physical activity was discussed in the previous chapter.

4.2 Aims

This chapter aims to evaluate the effect of the intervention on weight measurements, health-related physical fitness, and self-reported health behaviours in the same cohort. It is hypothesised that the intervention will result in a significant difference between the intervention and the control groups in favour of the intervention group. This difference will be in weight measurements and physical fitness. Moreover, it will be in reported health-related behaviours including dietary behaviours, smoking intention and behaviour, and substance abuse intake.

4.3 **Methods**

The study had a randomised controlled trial design with pre- and post- tests comparing an intervention and a control groups. Body weight and body fat were measured by bioelectrical impedance scale, height by a stadiometer, and waist circumference by standard tape measure. Physical fitness was assessed by a modified EuroFit test battery: sit-and-reach (hamstrings and trunk flexibility), sit-ups (abdominal muscles strength), single leg stand (body balance), vertical jump (lower limb muscles power), and 20-m shuttle run test (cardiorespiratory endurance - VO_2max). The self-reported health behaviours included physical activity, dietary patterns, and risky behaviours such as tobacco smoking, substance abuse, and sun overexposure. Health-related behaviours were assessed by 71-item self-administered questionnaire. The questionnaire included sociodemographic and personal health information sections, physical activity and related behaviours section, nutrition section, medications and drugs section, and tobacco smoking, UVR exposure and sun protection section. The Materials and methods have been previously discussed in detail in Chapter 3. Physical activity section was also discussed previously in chapter 3. Analysis was performed on the same ITT basis using a mixed model repeated measure ANOVA or Pearson's Chi-Square test/Fisher's exact test for percentages and proportions in contingency tables. This chapter will report the pre- and post-intervention findings in both intervention and control groups directly and they will be discussed thereafter.

4.4 **Results**

Reporting of the findings followed the same CONSORT 2010 protocol and the process of participants' recruitment and allocation, and their baseline demographic characteristics were as reported in Chapter 3.

4.4.1 **Weight Measurements**

Weight measurements by groups and by time of assessment (pre- and post-intervention) are summarised in **Table 4-1** are detailed below.

4.4.1.1 **Weight and BMI**

There were no significant interactions between the groups and time in both weight and BMI ($F(1, 122.0)= 0.88$, $p= 0.767$) and ($F(1,121.9)= 0.30$, $p =0.588$), this indicates that the groups did not significantly change in these measurements over the period of study.

4.4.1.2 **BMI z-score for Age and Gender**

There was no significant interaction between groups and time on BMI z-score ($F(1, 121.9) = 0.05$, $p=0.818$), as shown in **Figure 4-1.**

4.4.1.2.1 *Weight Status Based on BMI z-score for Age and Gender*

The groups had similar percentages of underweight and normal weight categories based on BMI z-score for age and gender at the baseline, as presented in **Table 4-2.** However, the CG had 4.4% more overweight girls than the IG while the IG had 3.1% more obese girls than the CG at baseline, as shown in **Figure 4-2.** After the intervention, the IG had no girls within the thinness category (-1.6%) compared to one in the CG. Girls in the normal weight in the IG increased by +4.8% compared to a decrease by -6.2% in the CG. Moreover, the IG had a decreased prevalence of overweight participants of -2.3% compared to an increase of +3.2% in the CG. The CG had an increased prevalence of obese girls of +3.2% (n=2) compared to a decrease of -0.5% in the IG. There were no significant differences between the groups across all weight categories.

4.4.1.2.1.1 Statuses of Changes in Weight Categories

Weight categories changes, according to status of weight change after the intervention, varied between the groups (as seen in **Table 4-3**). Positive weight loss was defined as changing weight category from the obese to overweight or to the normal category, or from overweight to the normal category. Negative weight loss otherwise was defined as moving from normal weight to an underweight category, while positive weight gain was defined as moving from the underweight to the normal weight category. Furthermore, negative weight gain was defined as moving from normal to the overweight or to obese category.

The IG and CG had a similar prevalence of positive weight loss after the intervention, n= 2 (3.1%) vs. n= 3 (5.0%), respectively, as demonstrated in **Figure 4-3**. Alternatively, the CG had +9.2% more negative weight gain prevalence than the IG, while the IG had +1.7% of positive weight gain. Moreover, the IG had reduced unchanged overweight status by -3.9% less than the CG, but had +3.4% higher unchanged obese status. Nonetheless, all those changes were statistically not significant based on Pearson Chi-Square and Fisher's Exact tests for these differences.

Table 4-1 Change in weight measurements in means (95% CI) before and after the intervention

Weight Measurements	Control				Intervention				P-value[a]
	n	Pre-intervention	n	Post-intervention	n	Pre-intervention	n	Post-intervention	
Weight	64	60.70 (56.50 – 64.90)	64	61.62 (57.38– 65.87)	63	60.66 (56.43 – 64.90)	60	61.44 (57.16 – 65.72)	0.767
BMI (kg/m^2)	64	24.15 (22.66 – 25.64)	63	24.41 (22.91 – 25.91)	64	23.90 (22.40 – 25.40)	60	24.05 (22.54 – 25.57)	0.588
BMI-for-age z-score (SD)	64	0.75 (0.41 – 1.09)	64	0.77 (0.43 – 1.11)	63	0.58 (0.24 – 0.92)	60	0.59 ± (0.25 – 0.94)	0.818
Body fat (%)	64	28.83 (26.58 – 31.08)	62	29.44 (27.22 – 31.66)	64	27.81 (25.54 – 30.08)	60	28.21 (25.97 – 30.45)	0.603
Waist circumference (cm)	64	78.40 (75.48 – 81.33)	60	76.75 (73.83 – 79.66)	63	76.20 (73.23 – 79.16)	60	74.80 (71.85 – 77.75)	0.791
Waist-to-height ratio	64	0.50 (0.48 – 0.51)	60	0.48 (0.47 – 0.50)	63	0.48 (0.46 – 0.50)	60	0.47 (0.45 – 0.49)	0.796

[a]Estimated by repeated measure ANOVA

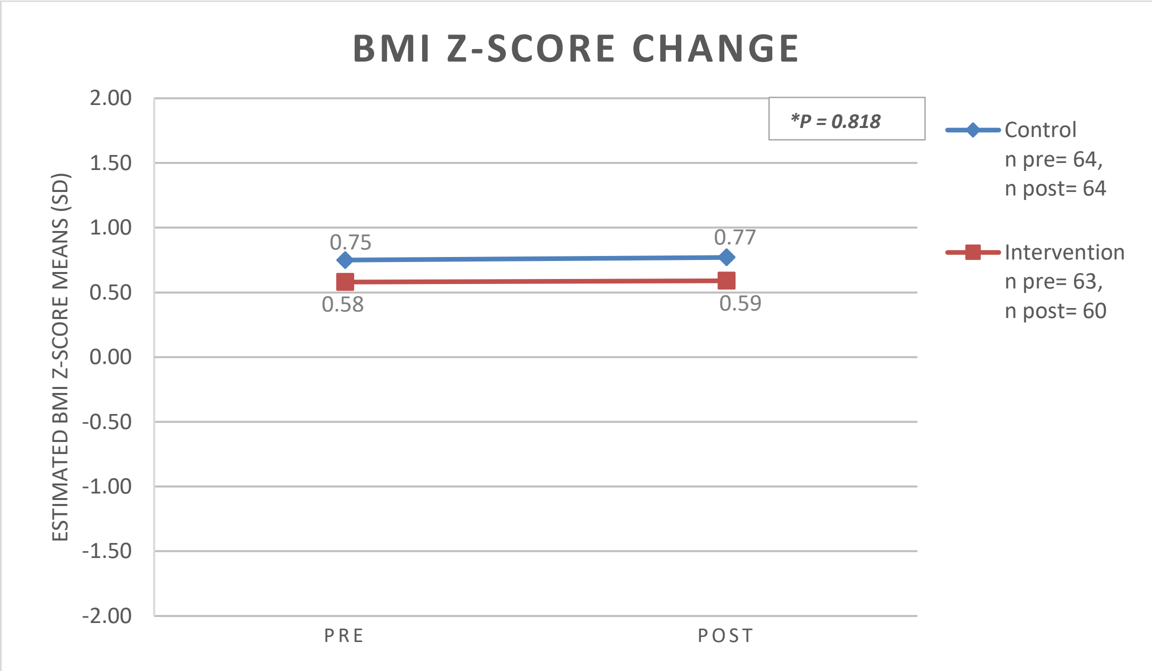


Figure 4-1 Change of BMI z-score in control and intervention groups.

**Interaction between groups and times (repeated measures ANOVA)*
Data presented by means (SD), with the error bars too small to be seen

Table 4-2 Comparison between the groups in prevalence of BMI z-score weight categories

BMI Category[a]	Pre-intervention		Post-intervention		P-value of the difference[b]
	Control n = 64	Intervention n = 63	Control n = 63	Intervention n = 60	
Thinness, n (%)	1 (1.6%)	1 (1.6%)	1 (1.6%)	0 (0%)	0.484
Healthy weight, n (%)	39 (60.9%)	39 (61.9%)	35 (54.7%)	40 (66.7%)	0.050
Overweight, n (%)	15 (23.4%)	12 (19.0%)	17 (26.6%)	10 (16.7%)	0.387
Obese, n (%)	9 (14.1%)	11 (17.5%)	11 (17.2%)	10 (16.7%)	0.456

[a] BMI categories according to BMI-for-age z-score based on WHO 2007 growth references (Onis *et al.*, 2007)
[b] Compared by Fisher's Exact test
n, number of subjects, %, percentages

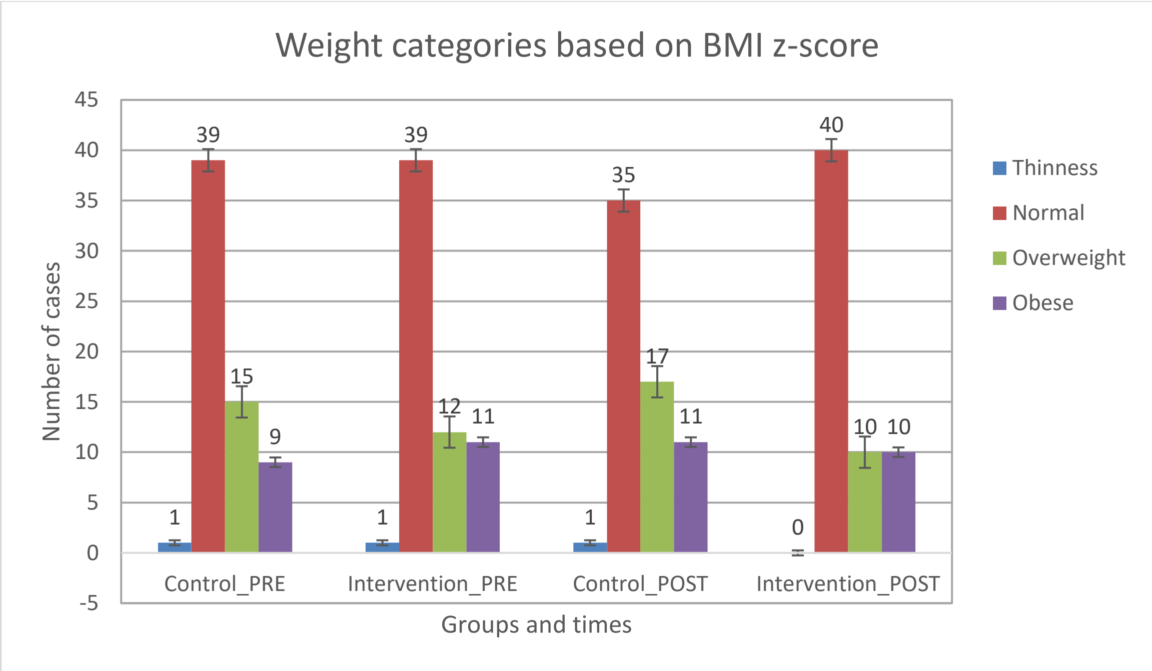


Figure 4-2 Frequency of weight categories based on BMI z-score for age and gender
Normal weight difference in prevalence was at borderline of statistical significance ($p = 0.05$). No significant differences in other weight categories

Table 4-3 Changes of weight status based on BMI z-scores for age and gender

Weight change status	Control (n = 64)		Intervention (n = 60)		*p* - value
	n	%	n	%	
Unchanged underweight	1	1.6%	0	0%	1.000*
Unchanged normal weight	33	51.6%	38	63.3%	0.185**
Unchanged overweight	11	17.2%	8	13.3%	0.552**
Unchanged obesity	7	10.9%	8	13.3%	0.683**
Negative weight loss	0	0%	0	0%	-
Negative weight gain	8	12.5%	2	3.3%	0.097*
Positive weight loss	2	3.1%	3	5.0%	0.672*
Positive weight gain	0	0%	1	1.7%	0.484*

*Compared by Fisher's Exact test

**Compared by Pearson's Chi-square

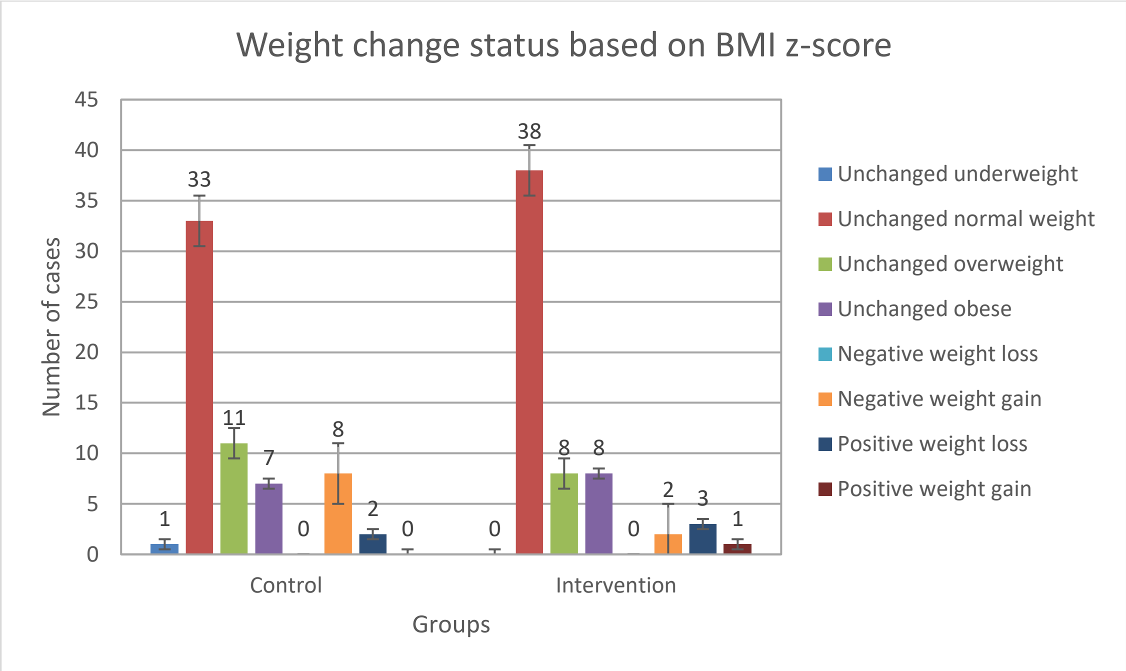


Figure 4-3 Change of weight status based on BMI z-scores for age and by gender.
No significant differences in changes of weight status between the groups

4.4.1.3 **Percentage of Body Fat**

There was no significant interaction between the groups and time with regard to percentage of body fat ($F(1, 120.9) = 0.27$, $p= 0.603$) as displayed in **Figure 4-4.**

4.4.1.3.1 *Body Fat Status Based on Body Fat Percentiles for Age and Gender*

The IG had 6.6% more participants with 'underfat' based on body fat percentiles for age and gender than the CG at baseline, as shown in **Table 4-4** and **Figure 4-5.** The CG, however, had 7.8% more participants with 'normal fat' and 2.7% with over-fat than the IG but the IG had 3.9% more obese participants. Underfat prevalence increased by +1.6% in the CG but decreased by -3% in the IG after the intervention. Furthermore, the CG group had -6.3% decreases of participants with 'normal fat' while the IG had almost no change (-0.1). The IG had +2.2% increase of participants with 'overfat' while there was no change in 'overfat' in the CG. The obese category increased by +4.7% in the CG and +0.8% in the IG. However, none of the above differences were statistically significant between groups.

4.4.1.3.1.1 Statuses of Changes in Body Fat Categories

Changes of body fat categories, and their status of change after the intervention, followed the same definitions of the abovementioned changes of weight status (section 3.4.2.2.1) but for fat categories: 'underfat', 'overfat', 'normal fat', and 'obese'. CG and IG had similar prevalence of unchanged 'underfat', 'normal fat' and 'over-fat' statuses as demonstrated in **Table 4-5** and **Figure 4-6.** The CG had -3.2% fewer unchanged 'obese' participants than the IG as displayed in Figure 4-7. Moreover, the CG had -3.9% more negative fat gain. Positive fat loss was +2.3% higher in the CG groups, though the IG had more positive fat gain (+5.1%) compared to no incidences in the CG. Nevertheless, none of the above changes were statistically significant.

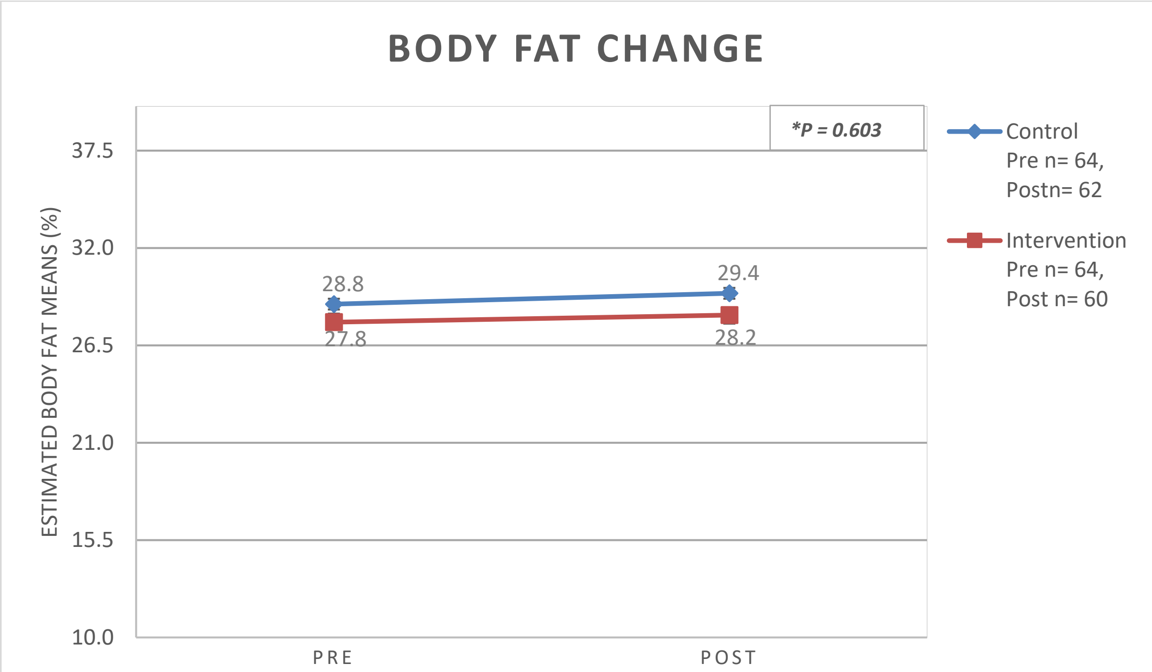


Figure 4-4 Change in percentage body fat

**Interaction between groups and times (repeated measure ANOVA)*
Data presented by means (SD), with the error bars too small to be seen

Table 4-4 Comparison between the groups in proportions of body fat Categories

Fat category[a]	Baseline		Post-intervention		P-value for the difference[b]
	Control n = 64	Intervention n = 62	Control n = 64	Intervention n = 60	
Underfat, n (%)	2 (3.1%)	6 (9.7%)	3 (4.7%)	4 (6.7%)	0.176
Normal fat, n (%)	38 (59.4%)	32 (51.6%)	34 (53.1%)	31 (51.7%)	0.472
Overfat, n (%)	11 (17.2%)	9 (14.5%)	11 (17.2%)	10 (16.7%)	0.858
Obese, n (%)	13 (20.3%)	15 (24.2%)	16 (25.0%)	15 (25.0%)	0.620

[a] Body fat category is according to body fat percentiles for age and for girls based on body fat reference curves (McCarthy *et al.*, 2006)

[b] Compared by Fisher's Exact test

n, number of subjects, %, percentages

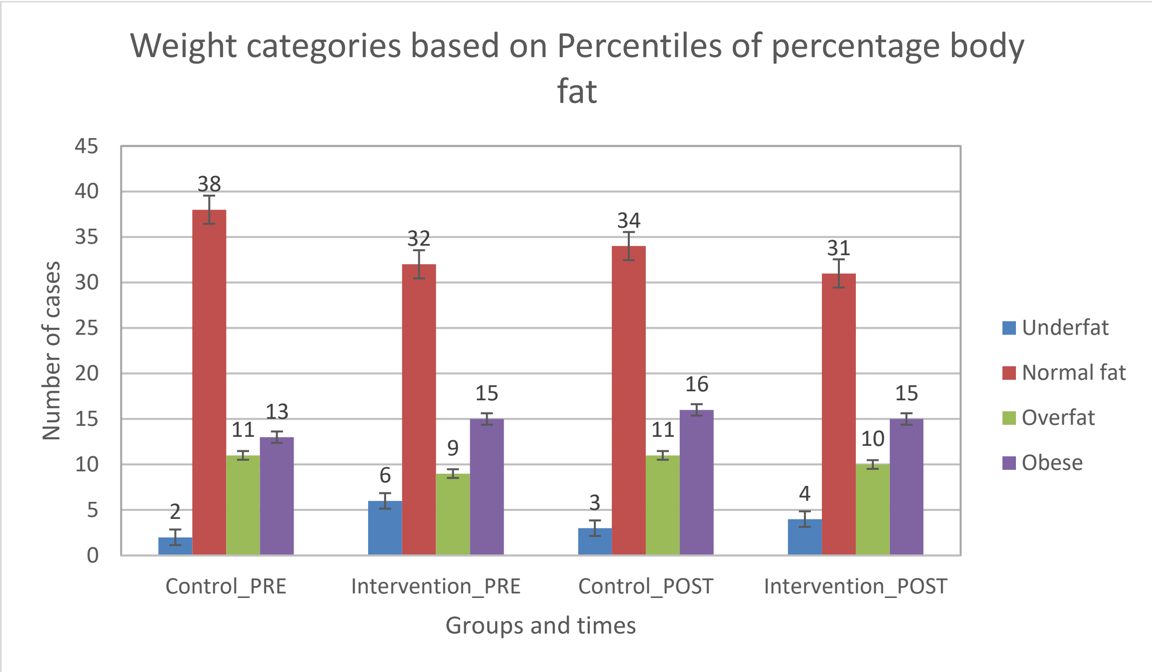


Figure 4-5 Frequency of weight categories based on percentiles of percentage body fat for age and gender

No statistically significant difference between the groups in body fat categories

Table 4-5 Changes of body fat status based on body fat percentiles for age and gender

Body fat status	Control n = 64		Intervention n = 59		*p* – value of the difference
	n	%	n	%	
Unchanged underfat	2	3.1%	3	5.1%	0.670*
Unchanged normal fat	32	50.0%	25	42.4%	0.397**
Unchanged overfat	6	9.4%	6	10.2%	0.882**
Unchanged obese	12	18.8%	13	22.0%	0.651**
Negative fat loss	1	1.6%	1	1.7%	1.000*
Negative fat gain	9	14.1%	6	10.2%	0.510**
Positive fat loss	8	12.5%	6	10.2%	0.684**
Positive fat gain	0	0%	3	5.1%	0.107*

* Compared by Fisher's Exact test

** Compared by Pearson Chi-Square test

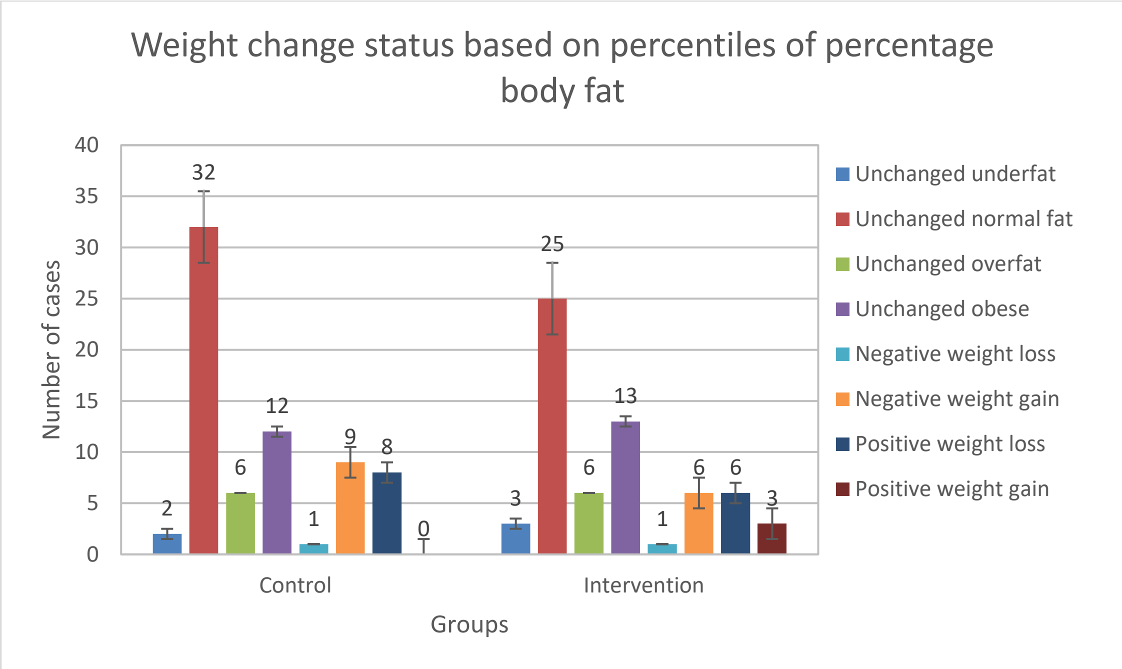


Figure 4-6 Change of weight status based on percentiles of percentage body fat
No significant difference between the groups in change of body fat categories

4.4.1.4 **Waist Circumference**

WC interaction between the groups and time was not significant (*F*(1,117.6)= 0.70, *p*= 0.791) as seen in **Figure 4-7**. CVD risk according to WC (WC ≥ 90th percentile) decreased in CG by -3.1% and in IG by -1.7% after the intervention as shown in **Table 4-6**. The difference, however, was not significant between the groups according to Fisher's Exact test.

4.4.1.4.1 *Waist-To-Height Ratio (WHtR)*

There were no significant interactions between the groups and time (*F*(117.62)= 0.07, p= 0.796), as shown in **Figure 4-8**. CVD risk according to WHtR cut-point of greater than or equal 0.5 (Garnett, Baur and Cowell, 2008) showed a decreased prevalence of CVD risk in both groups with IG slightly more than CG but was not statistically significant (-11 vs. -9, p= 0.862, respectively) as seen in **Table 4-6**.

Table 4-6 Prevalence of CVD risk according to waist circumference and waist-to-height ratio in the groups

CVD Risk	Intervention		Control		P-value of the difference
	Pre-intervention n = 60	*Post-intervention n = 60*	*Pre-intervention n = 64*	*Post-intervention n = 63*	
WC, n (%)	3 (5.0%)	2 (3.3%)	3 (4.7%)	1 (1.6%)	0.497[a]
WHtR, n (%)	39 (65.0%)	28 (46.7%)	50 (78.1%)	41 (65.1%)	0.862[b]

[a]Fisher's Exact Test

[b]Pearson Chi-Square Test

WC, waist circumference; WHtR, waist-to-height ratio

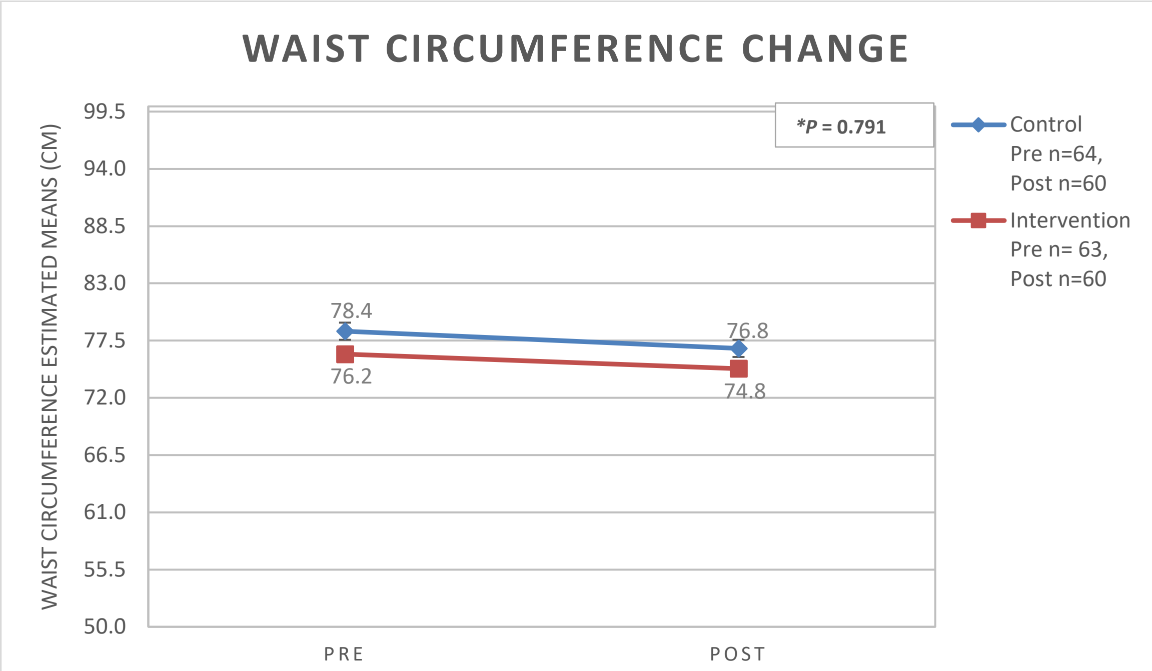


Figure 4-7 Change in waist circumference (WC) in control and intervention groups
**Interaction between groups and times (repeated measures ANOVA)*
Data presented by means (SD), with the error bars too small to be seen

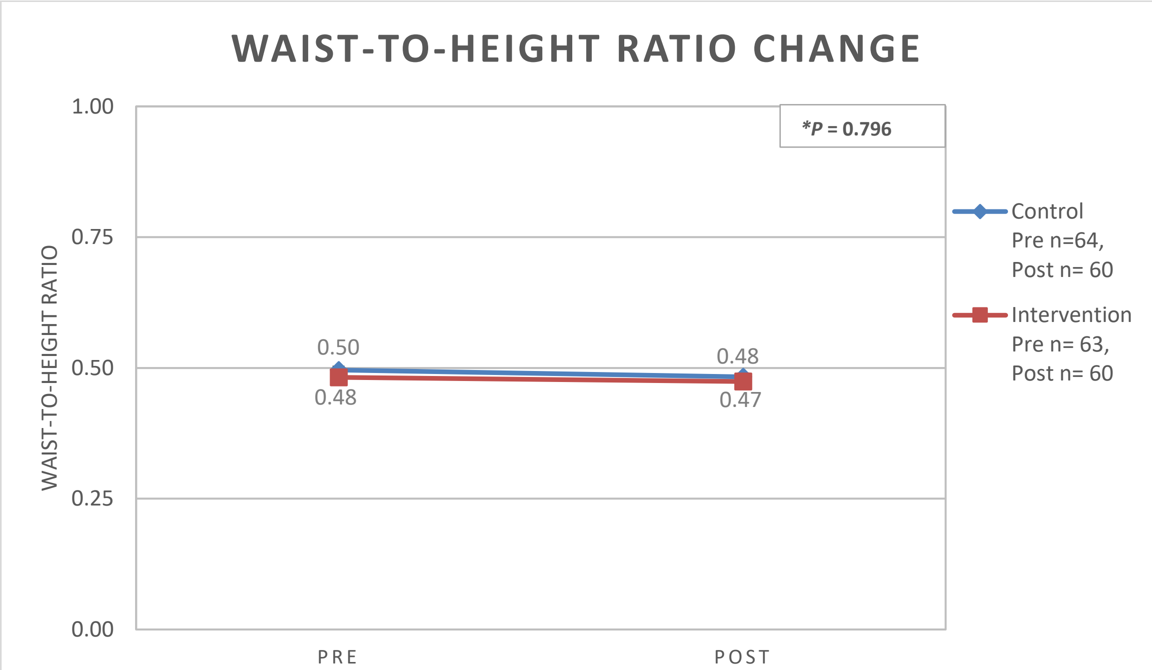


Figure 4-8 Change in waist-to-height ratio (WHtR) in control and intervention groups
**Interaction between groups and times (repeated measures ANOVA)*
Data presented by means (SD), with the error bars too small to be seen

4.4.2 Physical Fitness Tests

Table 4-7 demonstrates the physical fitness tests comparisons between the groups at pre- and post-intervention, as discussed below.

4.4.2.1 Sit-and-Reach Test

There was a significant interaction between the groups and time in the sit-and-reach test ($F(1,121.0) = 4.25$, $p = 0.041$) as displayed in **Figure 4-9**. It indicates that, although the IG started at a lower level, there was a significant increase in the sit-and-reach distance compared to the minor reduction in the CG (+1.29 cm vs. -0.14 cm, respectively).

4.4.2.2 Sit-ups Test

There was a significant interaction between the groups and time in the number of sit-ups ($F(1,122.3) = 5.63$, $p = 0.019$), which indicates a significant difference between the groups. The number increased in the IG by +0.99 more than the CG, which increased minimally by +0.08; with a difference of +0.91 cm higher in the IG (see **Figure 4-10**).

4.4.2.3 Balance Test

The interaction between groups and time was found to be significant ($F(1,122.9) = 4.85$, $p = 0.030$), which indicates that the groups differed in balance attempts over the period of study (**Figure 4-11**). The IG decreased attempts by -3.54, while the CG decreased attempts by -2.03, resulting in a difference of -1.51 reduction in the IG.

4.4.2.4 Vertical Jump Test

There was no significant interaction between the groups and time in this test ($F(1,119.2) = 3.23$, $p = 0.075$), though IG increased more than the CG by +1.27 cm, as shown in **Figure 4-12**.

4.4.2.5 20-m Shuttle Run Test (VO_2max)

The interaction between the groups and time in VO_2max was highly significant ($F(1,119.4) = 7.17$, $p = 0.008$), which indicates that groups had a significant difference in VO_2max over the period of study. The IG had increased their VO_2max by +0.82 $ml.kg^{-1}.min^{-1}$ compared to the small decrease observed in the CG by -0.15 $ml.kg^{-1}.min^{-1}$; this resulted in a difference of +0.97 $ml.kg^{-1}.min^{-1}$ gain in the IG as displayed in **Figure 4-13.**

Table 4-7 The effect of health-promoting intervention on physical fitness tests between the groups at pre- and post-intervention

	Control				Intervention				P-value[a]
	n	Pre	n	Post	n	Pre	n	Post	
Sit-and-reach (cm)	62	24.23 (22.47 – 25.99)	63	24.09 (22.32 – 25.86)	62	22.01 (20.24 – 23.78)	62	23.30 (21.52 – 25.09)	0.041
Sit-ups (times)	63	13.84 (13.19 – 14.48)	62	13.92 (13.45 – 14.39)	61	13.49 (12.84 – 14.14)	63	14.48 (14.01 – 14.95)	0.019
Balance (times)	63	13.50 (12.02 – 14.98)	63	11.47 (10.29 – 12.65)	62	12.15 (10.65 – 13.64)	61	8.61 (7.42 – 9.81)	0.030
Vertical jump (cm)	63	24.43 (22.56 – 26.29)	61	25.53 (23.76 – 27.30)	61	23.23 (21.33 – 25.13)	61	25.60 (23.81 – 27.39)	0.075
VO_2max ($ml.kg^{-1}.min^{-1}$)	63	32.36 (31.14 – 33.59)	64	32.21 (30.98 – 33.44)	62	31.71 (30.47 – 32.95)	61	32.53 (31.28 – 33.79)	0.008

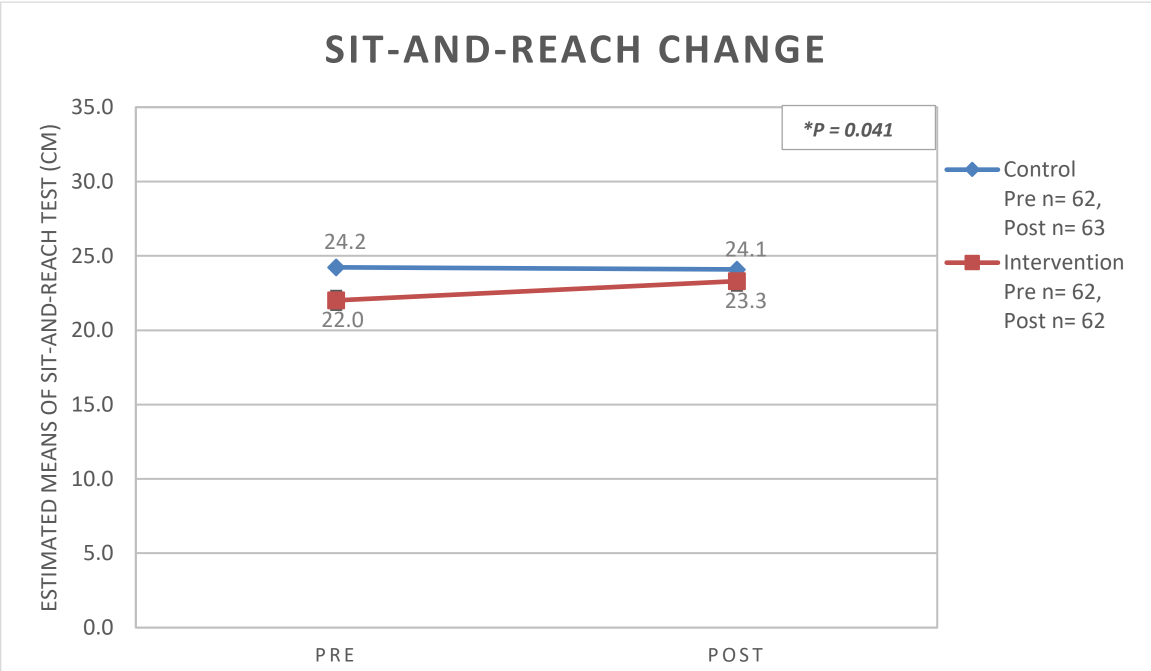


Figure 4-9 Change of sit-and-reach distance in the control and the intervention groups

**Interaction between groups and times (repeated measures ANOVA)*
Data presented by means (SD), with the error bars too small to be seen

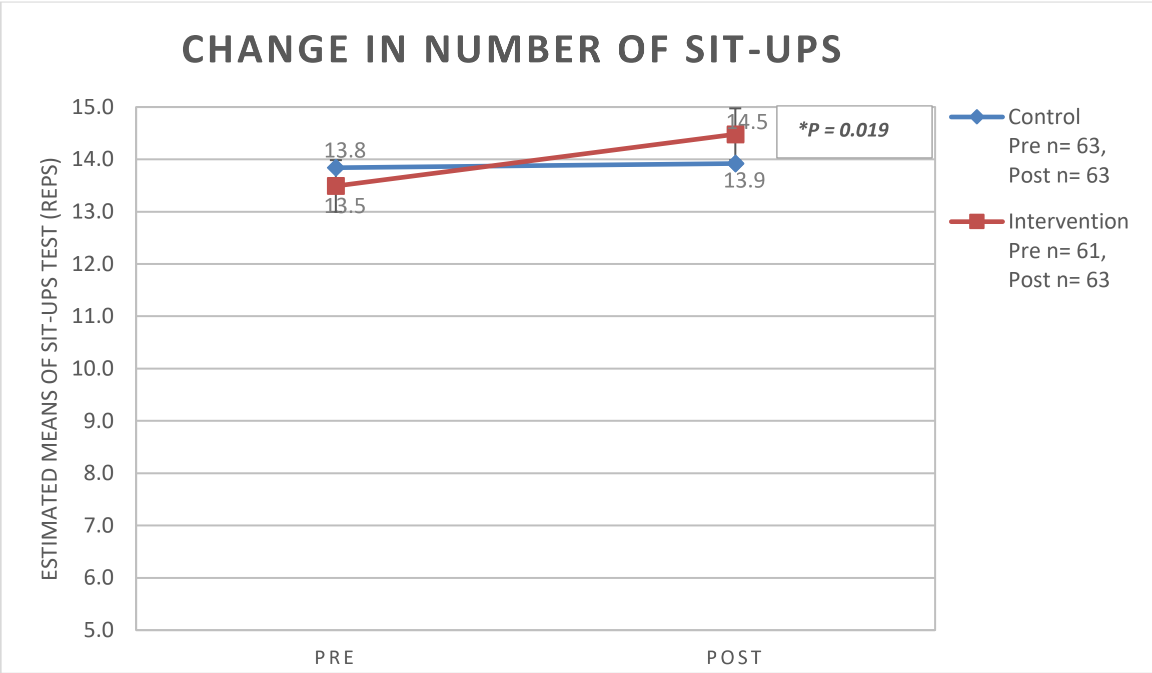


Figure 4-10 Change of number of sit-ups in control and intervention groups f

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

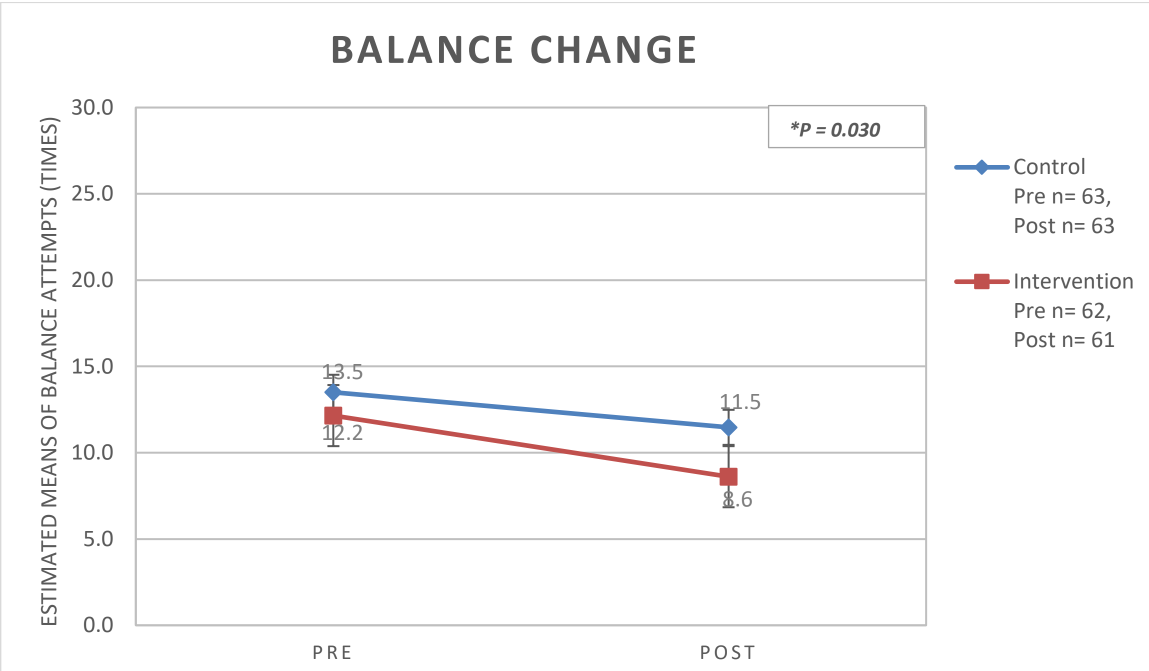


Figure 4-11 Change of number balancing attempts in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

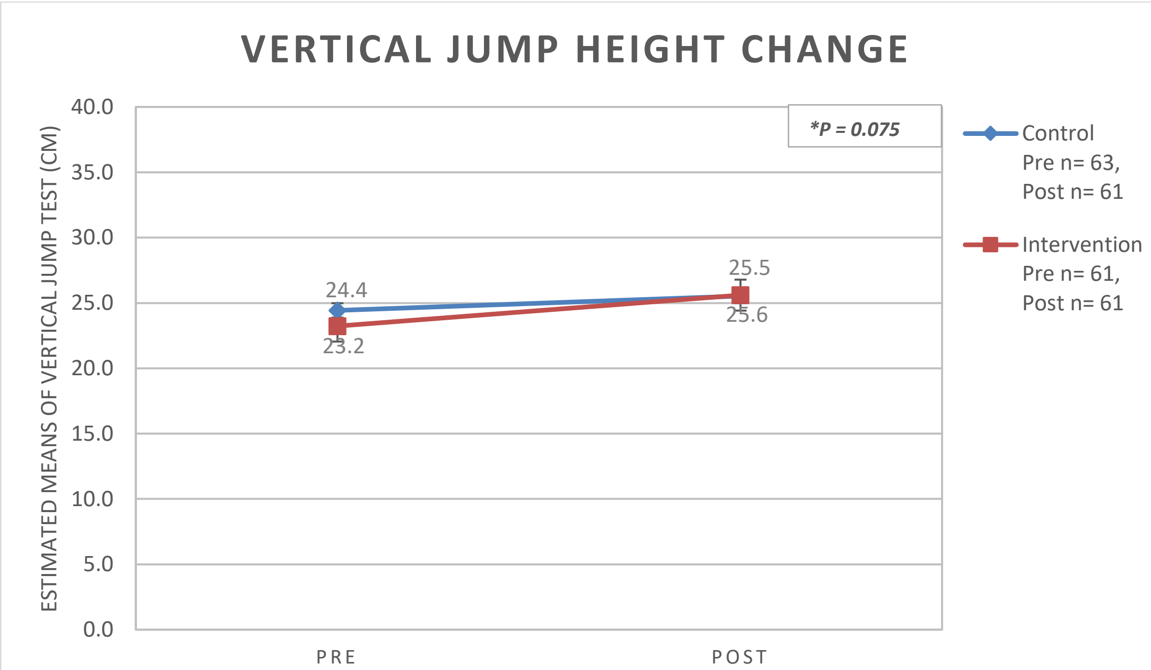


Figure 4-12 Change in height of vertical jump in control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen

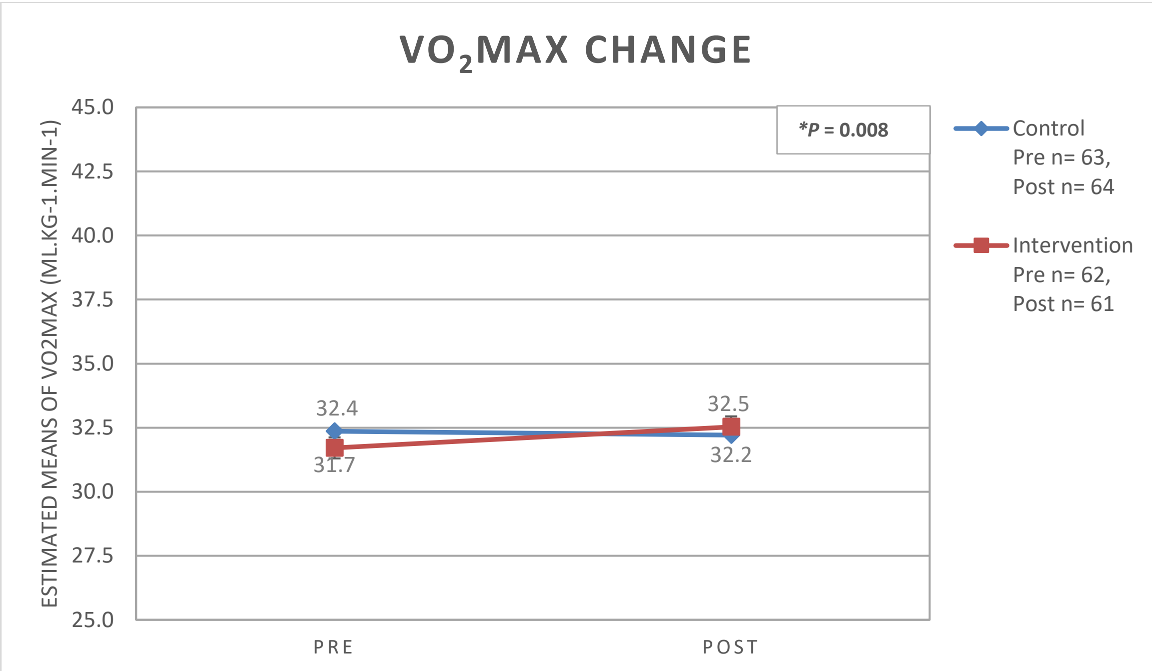


Figure 4-13 Change in VO_2max between control and intervention groups

**Interaction between groups and times (repeated measures ANOVA)*
Data presented by means (SD), with the error bars too small to be seen

4.4.3 Change in Self-Reported Behaviours

4.4.3.1 Eating Behaviours

Reported eating patterns and behaviours of control and intervention groups are summarised in Table 4-8. The behaviours were compared between the groups. These behaviours are discussed in detail below.

4.4.3.1.1 *Total Meals per Week*

There was a significant interaction between groups and time (F(1,123.5)= 5.05, p= 0.026) where the IG had increased the intake by +1.7 meal compared to minor decrease by -0.1 meal which indicate that there was no change in the CG as shown in Figure 4-14.

4.4.3.1.2 *Breakfast per Week*

There was a significant interaction between group and time (F(1,121.2)= 4.15, p= 0.044) in times of breakfast intake per week, which showed that the IG increased by +0.66 time compared to about no change in the CG over the time as seen in Figure 4-15.

4.4.3.1.3 *Dairy Intake per Day*

There was a significant interaction between groups and time on dairy intake per day (F(1,123.16)=5.69, p= 0.019) which showed that the IG had increased by +0.35 intake compared no almost no change (+0.03) in the CG as seen in Figure 4-16.

4.4.3.1.4 *Fruits and Vegetables Intake per Day*

There was no significant interaction between groups and time over fruits and vegetables intake per day (F(1,122.0)= 2.76, p= 0.099), but IG increased intake slightly by +0.4 compared to almost no change in the CG (-0.03) as shown in Figure 4-17.

Table 4-8 Change in self-reported eating behaviours (mean (95% CI) in intervention and control groups

Eating Behaviours	***Control***				***Intervention***				*P-value[a]*
	n	Pre	n	Post	n	Pre	n	Post	
Total meals per week (number)	64	13.00 (11.53 – 14.47)	64	12.92 (11.54 – 14.30)	63	12.86 (11.38 – 14.34)	61	14.52 (13.11 – 15.92)	0.026
Breakfast intake per week (number)	64	3.78 (3.10 – 4.46)	61	3.78 (3.09 – 4.46)	63	2.98 (2.30 – 3.67)	61	3.64 (2.95 – 4.33)	0.044
Dairy intake per day (number)	64	1.20 (0.97 – 1.44)	61	1.23 (1.01 – 1.45)	63	1.14 (0.91 – 1.38)	61	1.49 (1.27 – 1.71)	0.019
Fruits and vegetables intake per day (number)	64	2.03 (1.64 – 2.42)	61	2.00 (1.64 – 2.37)	63	2.13 (1.73 – 2.52)	61	2.50 (2.14 – 2.86)	0.099
Sweet foods intake per week (number)	64	2.56 (2.30 – 2.82)	61	2.46 (2.22 – 2.71)	63	2.73 (2.47 – 2.99)	61	2.33 (2.09 – 2.58)	0.084
Fried food intake per week (number)	63	1.90 (1.66 – 2.13)	61	1.80 (1.57 – 2.02)	62	2.53 (2.29 – 2.77)	61	2.25 (2.02 – 2.47)	0.275
Healthy snacks intake (number)	64	0.58 (0.41 – 0.75)	61	0.61 (0.43 – 0.79)	63	0.41 (0.24 – 0.58)	61	0.52 (0.34 – 0.69)	0.517
Unhealthy snacks intake (number)	64	1.38 (1.13 – 1.62)	61	1.45 (1.22 – 1.69)	63	1.35 (1.11 – 1.59)	61	1.21 (0.97 – 1.44)	0.118
Eating out/ delivery per week (times)	64	1.94 (1.69 – 2.19)	61	1.92 (1.71 – 2.13)	63	2.11 (1.86 – 2.37)	61	2.02 (1.82 – 2.23)	0.620
Water intake per day (times)	64	1.92 (1.71 – 2.14)	61	1.81 (1.60 – 2.02)	63	1.94 (1.72 – 2.15)	61	2.23 (2.02 – 2.44)	0.003
Sweetened beverages intake per day (times)	64	1.23 (0.89 – 1.58)	61	1.00 (0.73 – 1.28)	63	1.67 (1.31 – 2.02)	61	1.31 (1.03 – 1.59)	0.431

[a]Estimated by repeated measure ANOVA

n = number of subjects, CI= confidence Interval

4.4.3.1.5 *Sweet Foods Intake per Week*

There was no significant interaction between groups and time over intake of sweet foods per week (F(1,123.2)= 3.04, p= 0.084) which was showed a slight decrease by -0.1 in the CG and by -0.4 in the IG as displayed in Figure 4-18.

4.4.3.1.6 *Fried Foods Intake per Week*

There was no significant interaction between groups and time over intake of fried foods per week (F(1,120.2)= 1.21, p= 0.275), with IG and CG both slightly decreased their intake by (-0.3 and -0.1, correspondingly) as seen in Figure 4-19.

4.4.3.1.7 *Healthy Snacks Intake*

There was no significant interaction between groups and time (F(1,121.1)= 0.42, p= 0.517) where both groups had no significant change as shown in Figure 4-20.

4.4.3.1.8 *Unhealthy Snacks Intake*

There was no significant interaction between groups and time over intake of unhealthy food (F(1,122.2)= 2.48, p= 0.118) in which both groups had almost no change as seen in Figure 4-21.

4.4.3.1.9 *Eating Out or Ordering Food for Delivery per Week*

There was no significant interaction between groups and time over eating out or ordering food (F(1,120.0)= 0.25, p= 0.620) where both groups having almost no change as shown in Figure 4-22.

4.4.3.1.10 *Water Intake per Day*

There was a significant interaction between groups and time over water intake per day ($F(1,121.7)= 9.3$, p= 0.003) where there was almost no change in the CG (-0.1) while it slightly increased in the IG by +0.3 as shown in Figure 4-23.

4.4.3.1.11 *Sweetened Beverages Intake per Day*

There was no significant interaction between groups and time over intake of sweetened beverages per day ($F(1,118.1)= 0.62$, p= 0.431) where both groups decreased slightly (IG = -0.4 and CG= -0.2) as seen in Figure 4-24.

4.4.3.1.12 *Salt Amount in Food Preference*

Salt amount in food preference was categorised as low, moderate, and high. There was no significant difference between the groups in the change of the salt amount preference with time (p= 0.91) as seen in Table 4-9. However, the IG increased percentage of girls preferring moderate amount of salt in food (+3%) and decreased in preferring high amount (-3%). The CG increased percentage of girls with low preference (+4%), and decreased slightly in moderate (-1%) and high (-3%) as shown in Figure 4-25.

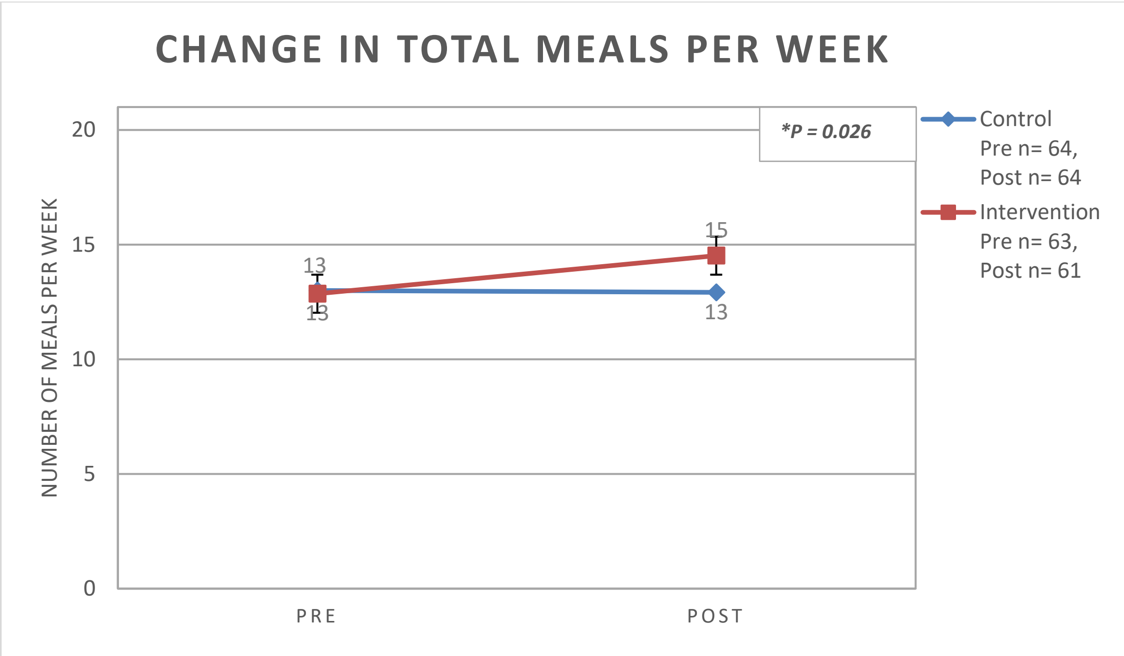


Figure 4-14 Change in total meals consumed per week in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

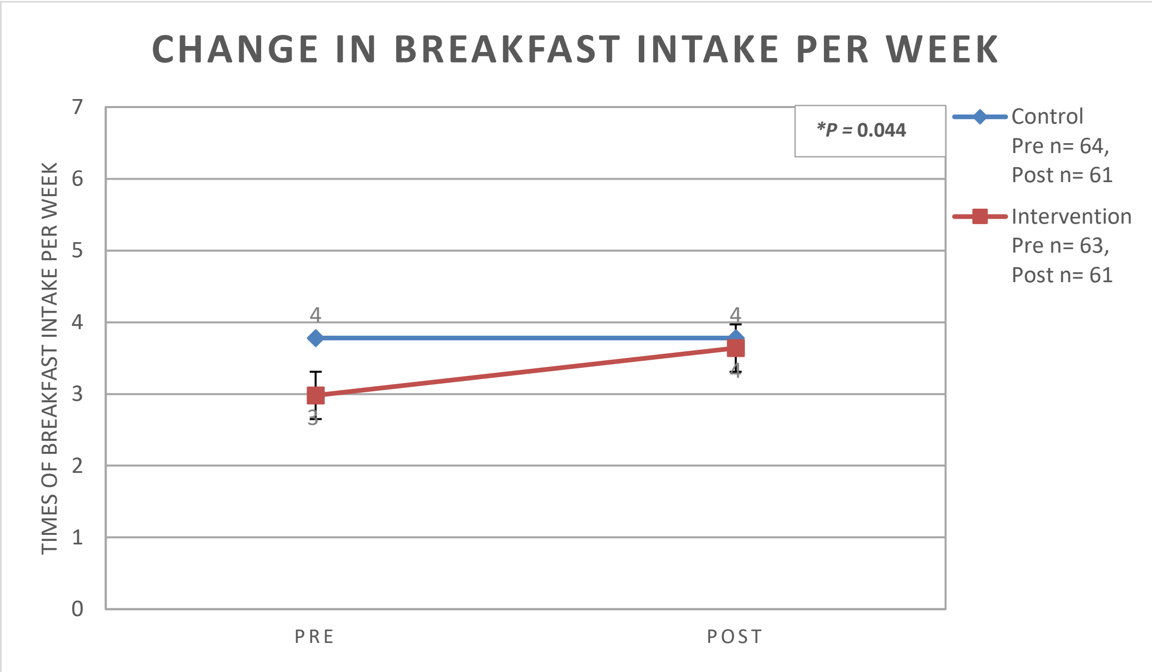


Figure 4-15 Change in total breakfast intake per week in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

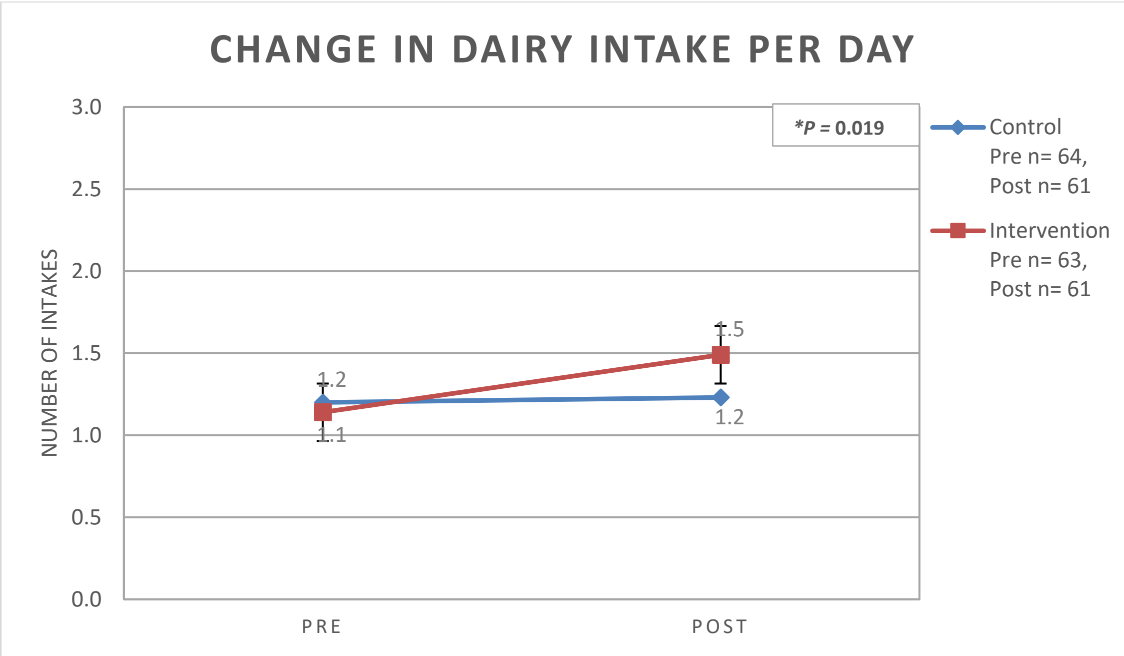


Figure 4-16 Change in dairy intake per day in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

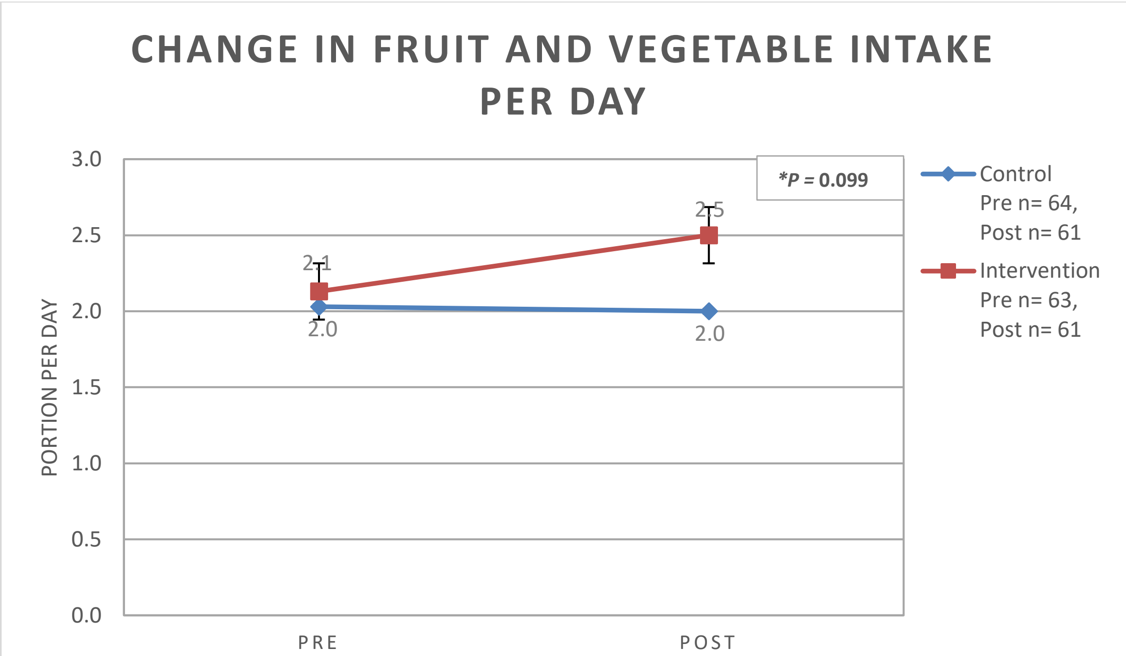


Figure 4-17 Change fruit and vegetable intake per day in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

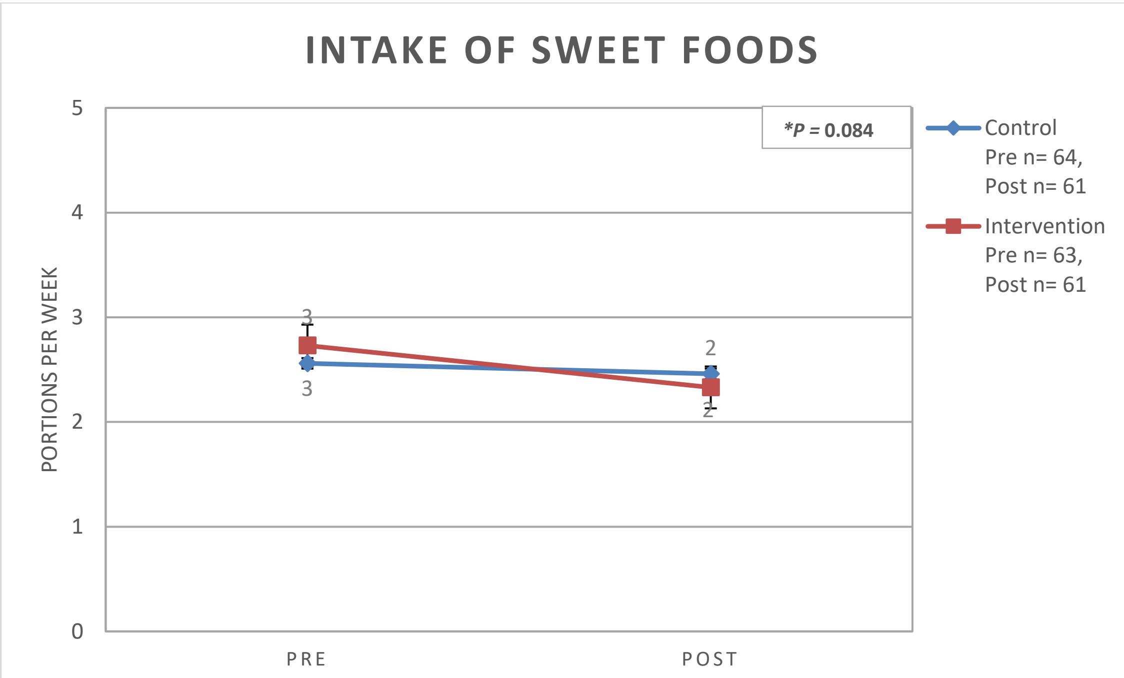


Figure 4-18 Change sweet foods intake per week in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

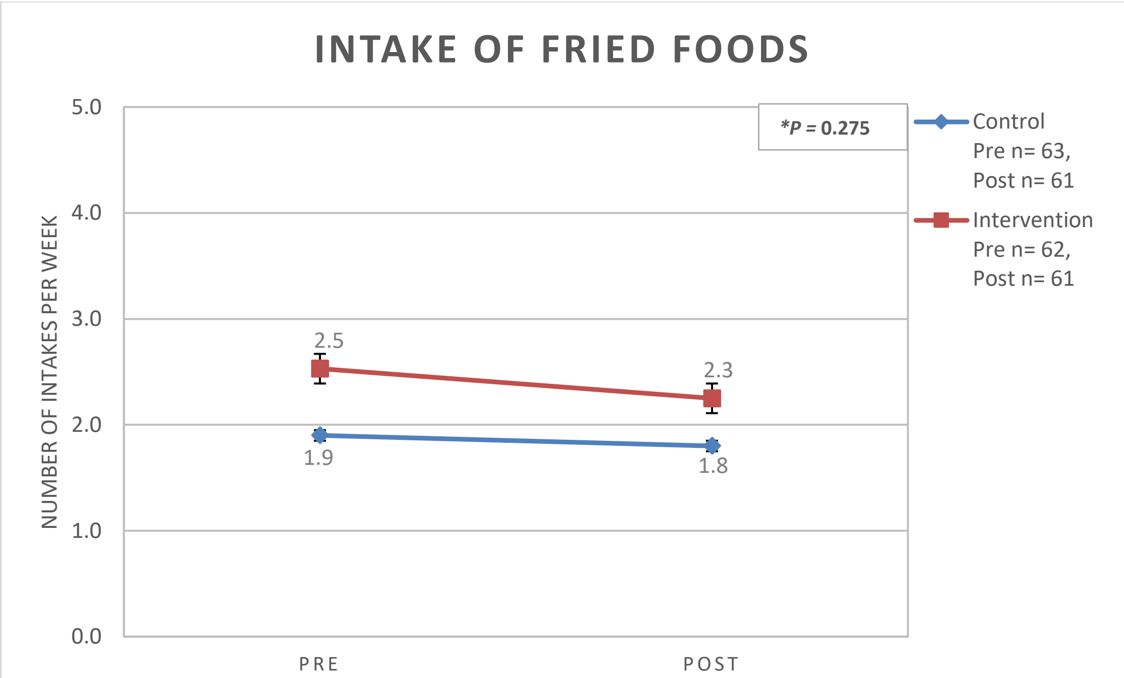


Figure 4-19 Change fried foods intake per week in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

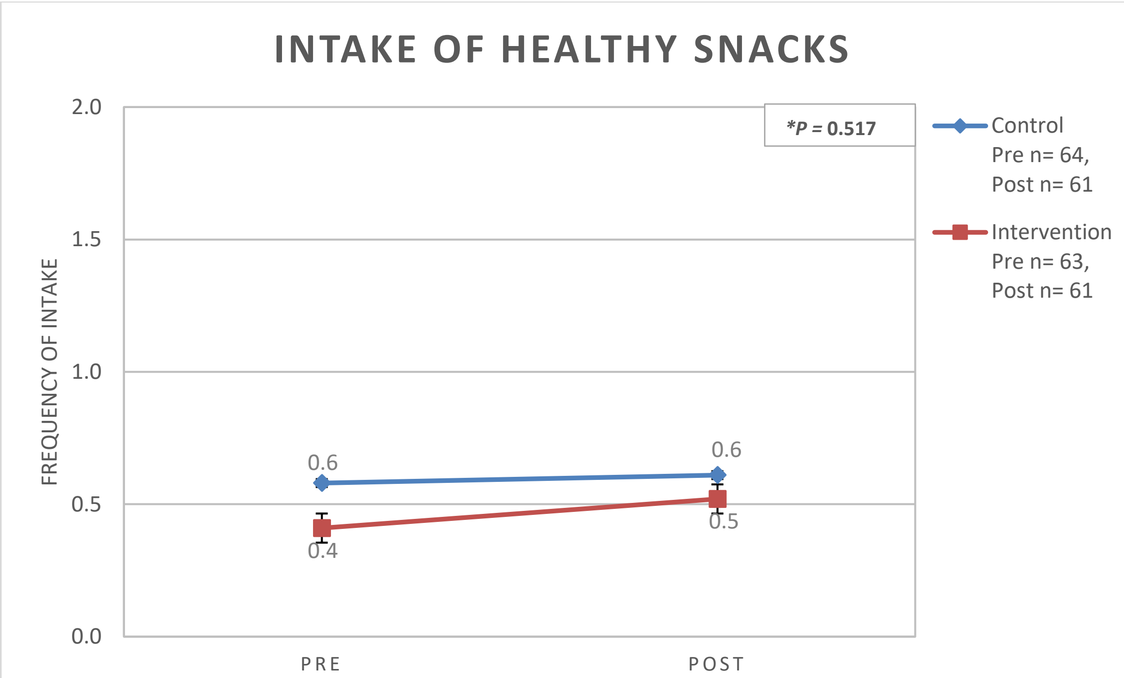


Figure 4-20 Change healthy snacks intake per day in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

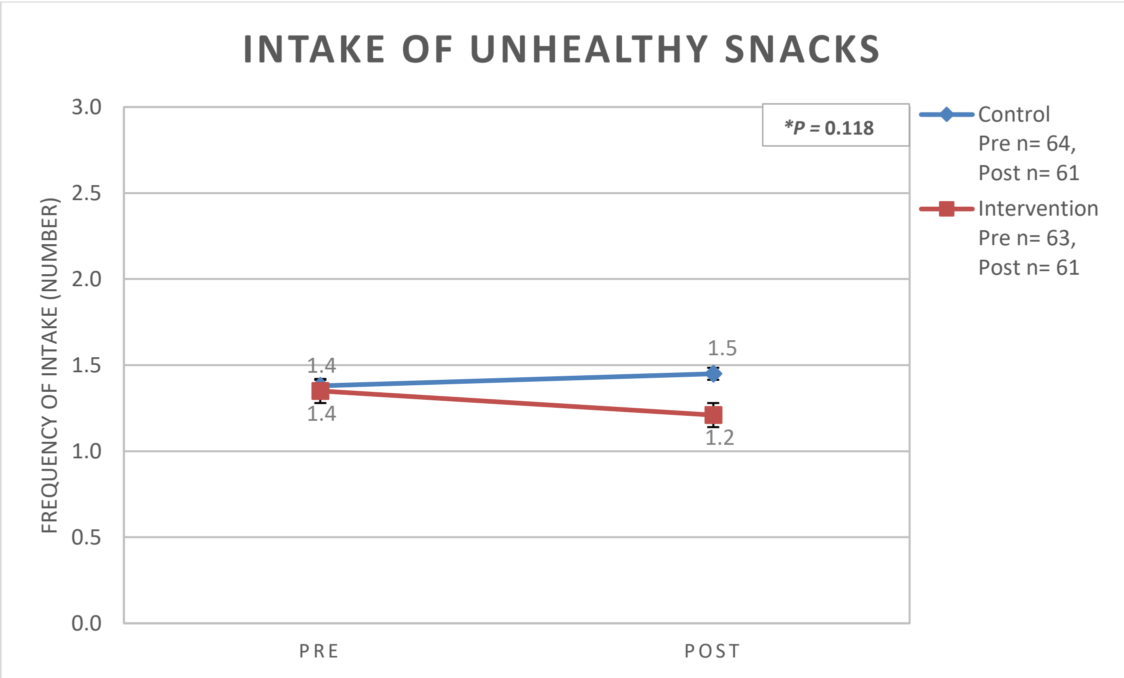


Figure 4-21 Change unhealthy snacks intake per day in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

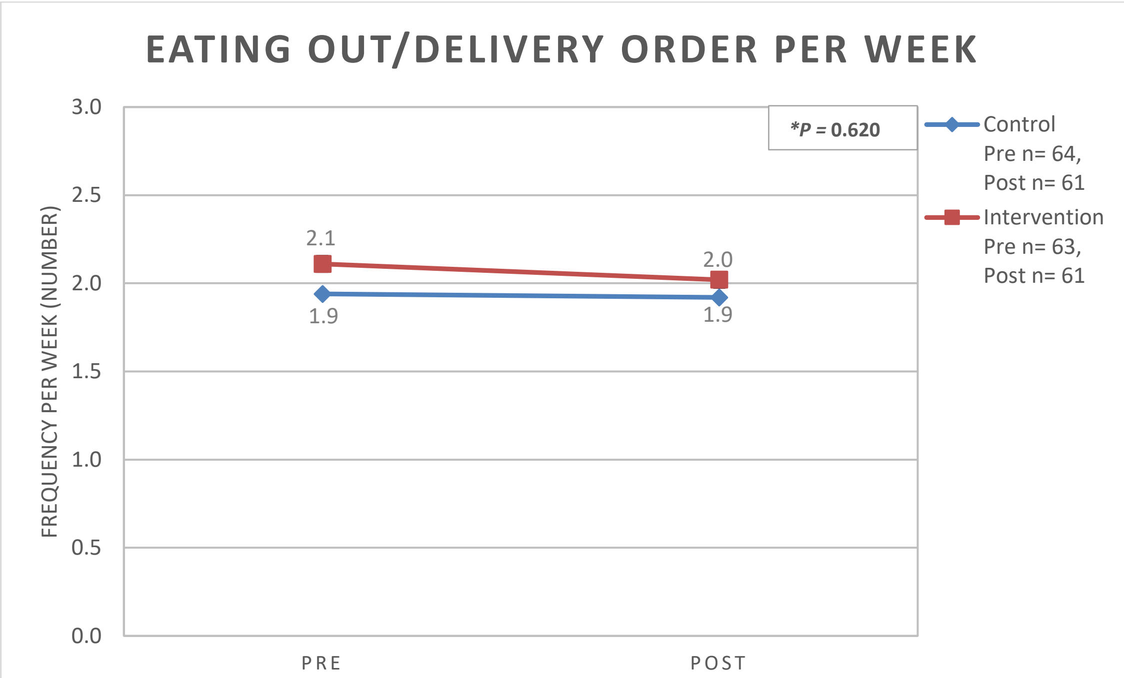


Figure 4-22 Change in frequency of eating out or order from delivery per week in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen

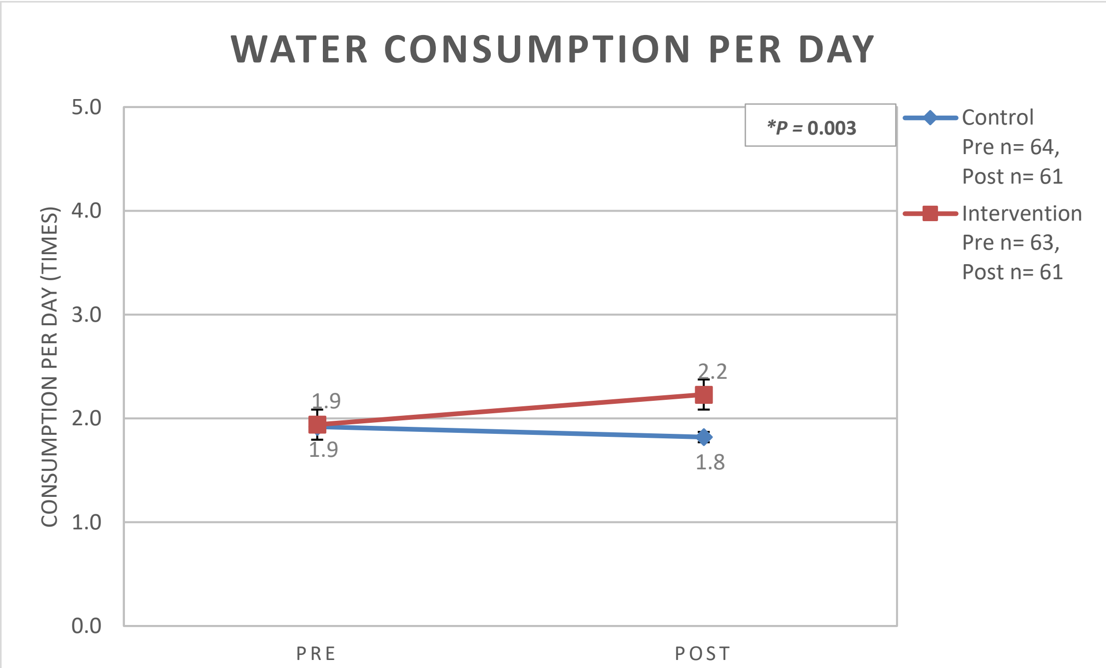


Figure 4-23 Change in water consumption per day in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Data presented by means (SD), with the error bars too small to be seen for the control group

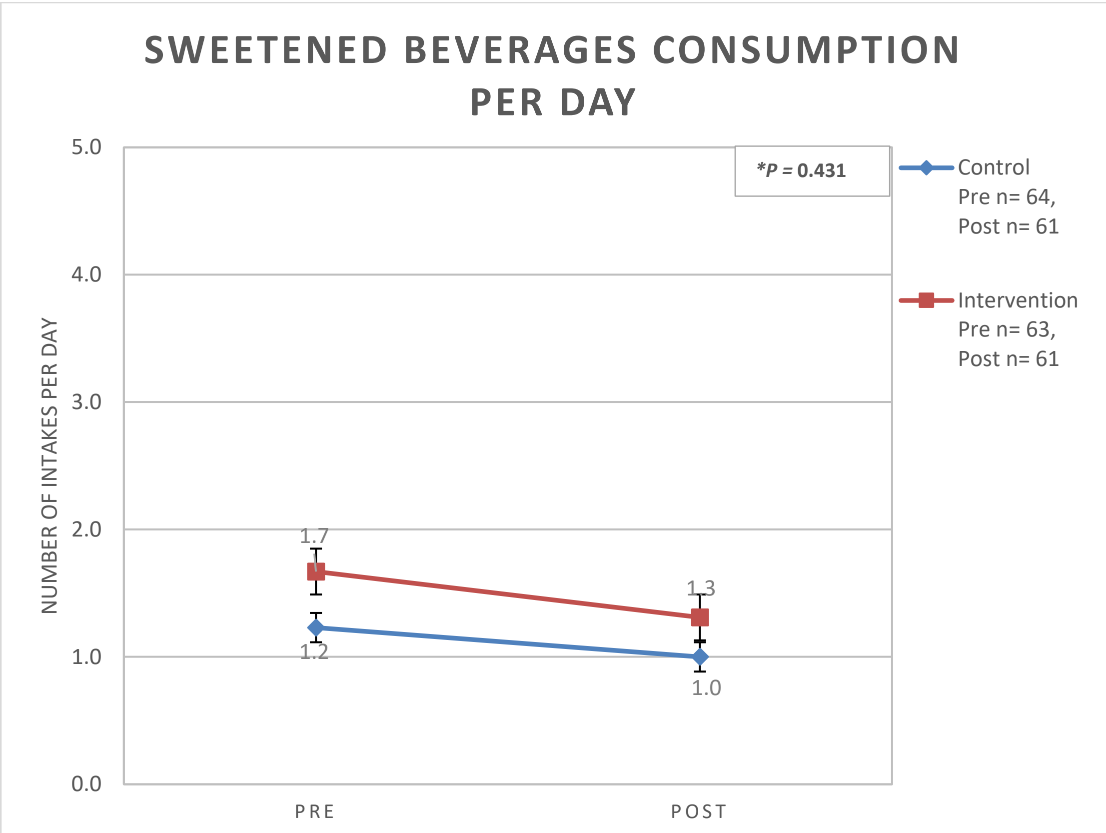


Figure 4-24 Change in consumption of sweetened beverages per day in control and intervention groups

**P-value for the interaction between groups and time (repeated measures ANOVA)*

Table 4-9 Change of salt amount in food in the intervention and control groups

Salt amount preference	Pre-intervention		Post-intervention		P-value for the difference[a]
	Control n = 64	Intervention n = 61	Control n = 62	Intervention n = 61	
Low	2 (3.1%)	1 (1.6%)	4 (6.6%)	1 (1.6%)	0.909
Moderate	52 (81.3%)	46 (74.2%)	49 (80.3%)	47 (77.0%)	
High	10 (15.6%)	15 (24.2%)	8 (13.1%)	13 (21.3%)	

[a] Compared by Fisher's Exact Test

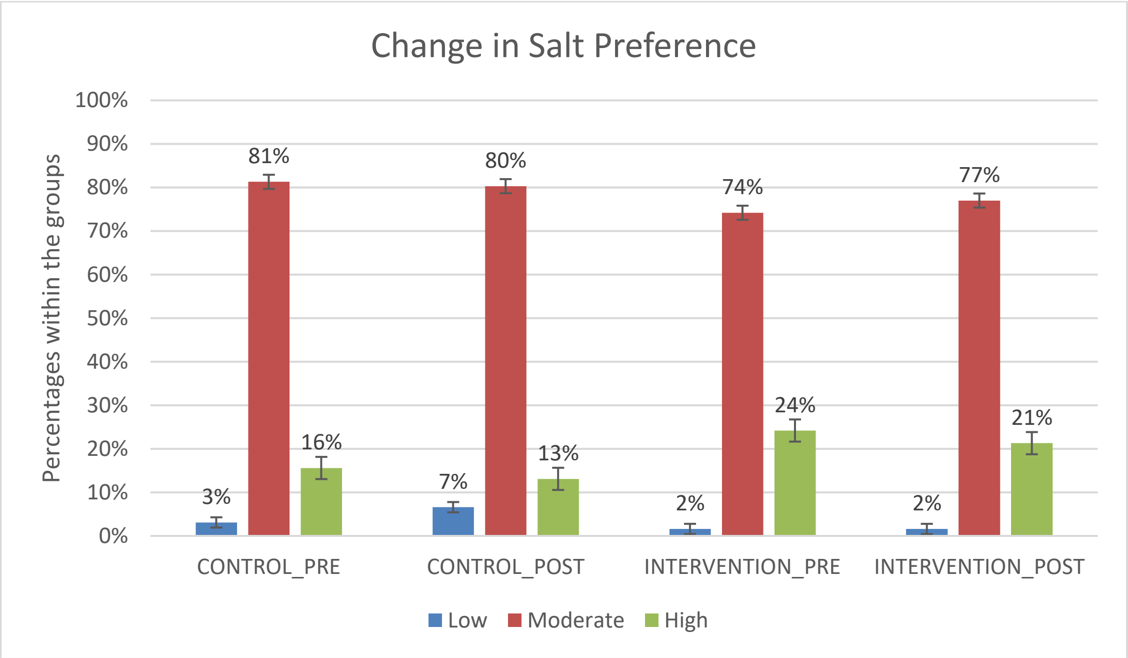


Figure 4-25 Proportion of girls with preference of low, moderate and high salt amount in food

No significant difference between the groups in the categories

4.4.3.2 Tobacco Smoking and Substance Abuse

Only one case of tobacco smoking was reported at baseline which was in the IG, but was changed to zero at post-intervention. Intention to smoke at baseline was present in 4.8% (n=3) in the CG compared to 1.6% (n=1) in the IG, but reduced to 1.6% (n= 1) in the CG and to none in the IG at post-intervention. However, there was no significant difference between the groups when it was compared by Fisher's Exact test (p= 0.24). Substance abuse of Tramadol, Lyrica, or non-prescribed weight loss pills was not reported in either group.

4.4.3.3 Sun Protection and UV Radiation Exposure

The use of sun protection and sunbathing prevalence among groups are shown in Table 4-10. The percentage of girls using sun protection in the IG was increased by +33.7% compared to +19.5 in the CG, but was statistically not significant (p= 0.23). Sunbathing was more prevalent at the IG at baseline (31.7%) than the CG (26.6%), however; the IG had decreased it by -21.9% compared to small decrease by -5.3% in the CG. Again, the difference between the groups was not significant. Only one case (1.6%) in the CG used sunbed at baseline and remained using it at post-intervention.

4.4.4 Adverse Outcomes

There were no known adverse outcomes resulting from the intervention. Participants who were underweight, overweight, and obese in both groups were informed of their weight and body fat status after each assessment. They were advised to consult a dietician to normalise their weight after the second assessment to avoid the consultation confounding with the findings. There were no injuries caused by the physical fitness tests. Moreover, the CG were informed of the risks of sunbathing and using sunbeds at the end of the study.

4.5 Discussion

4.5.1 Weight Measurements

The findings indicated that there were no significant differences between the groups in weight measurements after the intervention. The IG was able to increase the number of girls in the healthy weight category according to BMI z-score, while it was decreased in the CG, the difference was at borderline to be statistically significant (+4.8% vs. -6.2%, p = 0.05). The normal fat category, however, was maintained in the IG while decreased in the CG, again the difference was not statistically significant (+0.1% vs. -6.3%, p = 0.47).

Waist circumference (WC) and waist-to-height ratio (WHtR) were decreased in both groups with no significant differences, which could be related to physical maturity with time as height increased. However, the WHtR showed almost no difference between the groups over the study period (-0.01) while the WC difference between the groups was -0.25 cm less in the CG. There were no significant correlations between the differences in WC and age or height (r= -0.08, p= 0.410 and r= -0.05, p=0.582, respectively) and similarly for the WHtR in the current study (r= -0.01, p= 0.919 and r= -0.05, p=0.286, respectively).

Periodic weight gain could result from many factors among females including psychological and biological factors. Stress and anxiety due to academic examination could result in weight gain because of stress eating behaviour (Michaud *et al.*, 1990; Epel *et al.*, 2004), which is usually induced by an elevated cortisol hormone levels (Björntorp, 2001). Moreover, the prevalence of obesity is associated with the season, as it was found to be the highest during the winter and fall, and lowest during the summer (Dietz & Gortmaker, 1984). Additionally, a slight weight gain may take place during the luteal phase of the menstrual cycle which occurs before menstruation. Some studies linked such weight gain to water retention during this phase (Bruce & Russel, 1962; Janowsky, Berens, & Davis, 1973; Øian et al., 1987). Other studies linked it to increase in food intake as a result of ovarian hormonal changes (Gong, Garrel, & Calloway, 1989; Buffenstein *et al.*, 1995). Another study contradicted the claims against the weight gain itself, showing that there was no significant change in total body weight as assessed by air displacement plethysmography during different phases of the menstrual cycle (Francek, 2008). In addition, weight gain and bloating were commonly reported as premenstrual symptoms according to WHO's ICD-10 (WHO, 1996) diagnosis of premenstrual syndrome (PMS) and the American Psychiatric Association's (APA) (1994) Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) diagnosis of Premenstrual Dysphoric Disorder (PMDD). However, it was unpractical to assess such symptoms or to arrange weighing of girls in the follicular phase after their menstrual cycle. It was also not feasible to totally avoid the academic examination period as the study required repeated assessments and implemented educational sessions during the academic year which overlapped with short and practical exams.

Although students were instructed to fast on the day of weighing, they did not fast from fluids, which could have had an effect on weight. Requesting total fasting during a school day is unhealthy for the girls due to the warm and dry climate, which increases the risk of dehydration. The maximum average temperature was 39.8°C during the academic year 2014-2015, according to the Kuwait Meteorological Centre report (see Appendix XI). History of urinary voiding and bowel movement were not monitored, which could also have had an effect on weight. It is also considered sensitive information to be gathered in a school setting. However, it was similar in both groups and therefore would make no difference to the comparison. Weight sensitivity and the embarrassment of being overweight and obese, or the stigma of gaining weight, may have led to the absence from anthropometric assessment as the girls had prior knowledge of it. Screen-time activities, such as watching TV and playing video games, which has been associated with an increase in obesity indicators and decreased physical fitness among children and adolescents (Tremblay *et al.,* 2011), was not assessed in the present study.

Many previous short-term school-based educational interventions among adolescents did not result in a significant reduction in weight measurements in those overweight and obese (Meiklejohn, Ryan, & Palermo, 2016; Amini *et al.*, 2015). This could be due to fact that there were no structured dietary and/or exercise programs which could facilitate weight loss in overweight and obese girls in other studies. In addition, there are other influential factors on dietary behaviour beyond personal perception such as social and environmental factors (*see Chapter 6: Determinants of Health-related Behaviours*).

4.5.2 **Physical Fitness**

All physical fitness tests showed significant positive differences between the IG and the CG, with the exception of the vertical jump. Each physical fitness test will be discussed in more detail in the following sections.

4.5.2.1 **Sit-and-Reach Test**

The mean of SAR test in the total sample was 23.41 cm; the CG slightly decreased over the study period by -0.14 cm reaching 24.09 cm while the IG increased by +1.29 cm reaching 23.30 cm (p = 0.041). The scores were considered very low according to Canadian Society for Exercise Physiology (2003) and fell slightly lower than British norms (Riddoch, 1990). The Canadian norms used criterion-reference with greater than or equal to 40 cm is categorised as ‘excellent’, and less than or equal 25 cm is categorised as ‘needs improvement’. British norms range from 24.5 cm to 26.0 cm for girls between 14 to 17 years (Riddoch, 1990).

All of the in-school interventions that resulted in an increase in the SAR score all included an exercise component. Perry *et al.* (2002) included both aerobic and resistance training intervention in a school setting. However, the intervention resulted in a decrease in both the IG by -2.01 cm compared to -3.97 cm in the CG (p= 0.009). A sole resistance training intervention also resulted in an increase in back saver SAR score, SAR with one leg flexed at a time, by +0.2 cm in the IG compared to a significant decrease by -3.4 cm in the CG, with an adjusted difference of 3.0 cm (Eather, Morgan, & Lubans, 2016). Rodriuguez *et al.* (2008), alternatively, included only hamstring stretching twice a week for 32 weeks, which resulted in an increase of +7.22 cm in the IG (p <0.001) and a decrease in of -2.31 cm (p >0.05) in the CG, which gave a difference of 9.53 cm. A school-based daily 20-minutes walking intervention for 180 days resulted in an increase in hamstring flexibility, which was measured by active knee extension range of motion, by +5.59º from pre-intervention assessment acting as a CG (Monness & Sjolie, 2009). Another study used multi-component intervention, consisting of, curricular, family, and environmental interventions for 8 weeks. It involved a practical PE session as part of a curriculum on gross motor-warm up, dynamic stretching, skill development activities, modified games and cool-down, in addition to home activities. It increased the back saver SAR score by +1.68 cm in the CG, compared to +1.77 cm in the IG (p= 0.001). Additionally, Kamandulis, Emeljanovas, & Skurvydas (2013) implemented ten 45-minute PE sessions for five weeks on number of different stretching exercises. The IG received four exercises with four repetitions had the highest increase (+21.6%, p<0.05), followed by IG receiving only one exercise with four repetitions (+12.6%, p<0.05), then the group receiving only four trials of SAR test (+5.1%, p<0.05), and lastly, a small but not significant increase in the CG (+1.7%, $p>0.05$). An exercise programme combining both stretching and strengthening exercise twice a week, in 30-min sessions for four months, also produced a significant increase in the IG by +5.46 cm ($p= 0.003$) and non-significant increase by +1.86 cm in the CG ($p= 0.142$) in adolescent females (Schwanke *et al.*, 2016).

After school activity based interventions also showed significant effect on SAR scores. One study used low intensity taekwondo training for 50 minutes twice a week for 12 weeks (Kim *et al.*2011). It resulted in a +2.0 cm ($p <0.05$) increase in SAR in the IG compared to a non-significant slight decrease by -0.3 cm in the CG. It increased flexibility by +7.37 cm from baseline ($P< 0.02$). Additionally, a resistance training intervention performed for 60 minutes twice a week for six weeks increased the SAR score by +3.38 cm in the IG and +0.59 cm in the CG resulting in a difference of 2.79 cm (Moreira *et al.*, 2012).

The SAR score has been suggested to be inversely associated with body fat (Andreasi *et al.*, 2010). A significant, but very weak, inverse correlation between the baseline SAR score and weight, and WC, was found in our study ($r= -0.19$, $p= 0.034$ & $r= -0.19$, $p= 0.041$, respectively). However, it was not significant for the post-test or for the difference across the sample.

4.5.2.2 Sit-Ups (Sups)

The mean number of SUPs in the total sample was 13.93. The IG increased by 1.0 while the CG had almost no change (0.1) giving a difference of 0.9 for the IG ($p = 0.019$).

A combined school-based stretching and strengthening intervention resulted in an increase in the number of sit-ups by +6 in the IG and by +1 in the CG (Schwanke *et al.*, 2016). However, the difference between the groups was not significant ($p= 0.410$). Another study combined aerobic and resistance training, which resulted in a significant effect on the number of SUPs ($p= 0.001$), which increased by +7.69 in the IG compared to a small increase by +1.51 in the CG (Perry *et al.*, 2002). Physical exercise and yoga interventions increased number of SUPs in by +2.74 in the physical exercise group and +2.57 in the yoga group ($p <0.001$) (Telles *et al.*, 2013). A school-based multi-component intervention comprising curricular, environmental and family components also produced a significant but negative effect on 7-stage SUPs, with a slight decrease by -0.25 in the IG compared to -0.57 (*p*= 0.003) (Eather, Morgan, & Lubans, 2013). Nonetheless, these studies used the maximum number of SUPs performed in 30 seconds, while the present study used a maximum of 15 divided into five repetitions in three different positions as instructed by the EUROFIT. This methodological difference results in incomparable values between the abovementioned studies and our study. Despite this difference, the IG demonstrated a significant increase compared to the CG when using the same testing method. Given the fact that the test involves small number of repetitions, this may not show greater change or a higher difference between the groups to demonstrate physical effectiveness of the intervention.

4.5.2.3 **Balance**

The mean single leg balance with eyes closed (SLB-EC) in the total sample was 11.43; the IG significantly decreased by -3.53 compared to -2.04 in the CG, resulting in a difference of 1.49 to the advantage of the IG (p = 0.030). The SLB-EC norms, according to the ability to maintain balance, has been stated to be about 60 seconds in adolescents between 12 and 15 years (Condon & Cremin, 2014). These normative values for SLB-EC in children and adolescents are based on the total time spent maintaining balance within 120 seconds to restrict muscles endurance (Condon & Cremin, 2014). Most studies used a testing duration of 60 seconds (Telles *et al.*, 2013). The present study's SLB-EC scoring however was based on balancing attempts during 30 second period as instructed by the EUROFIT.

A short-term lower-extremity strengthening intervention resulted in decreased centre of pressure (COP), the point of the body's pressure over the soles of the feet while standing, by -11.9%; indicating an increase in SLB with eyes open (SLB-EO) in the IG compared to small decrease by -6.4% in the CG (Granacher *et al.*, 2011). Sole balance training also resulted in a significant decrease in COP displacements at the sagittal plane during SLB-EO in the IG more than that of the CG ($p < 0.05$) (Granacher *et al.*, 2010). Another study implemented core strengthening training on a stable and unstable surface; the results were compared, alongside the trained group on unstable surfaces. It increased balance by +2% and the group trained on stable surfaces increased by +3% ($p < 0.05$) in Y

SLB-EO which is a dynamic SLB with contralateral leg reaching as far as possible in anterior, posteromedial and posterolateral directions on the floor (Granacher *et al.*, 2014). However, a conflicting study found that physical exercise increased the number of falls during the flamingo balance test with eyes open by +1.54 (p =0.001) (Telles *et al.*, 2013). A combined stretching, strengthening, balance, agility and coordination training programme among obese children increased SLB-EC with decreased weight following intervention as well as a decrease in falling index, which is an algorithmic calculation of number of standard deviations from a normative database for postural stability (Steinberg *et al.*, 2013). Another balance training intervention, this time home-based, also increased SLB-EC balance by decreasing balancing attempts with a difference of -2.4 seconds between the IG and the CG after 2 weeks and -26.4 seconds adjusted for cluster randomisation after 6 weeks ($p < 0.004$) (Emery *et al.*, 2005). A daily school-time walking intervention increased in SLB-EC by 69%, +11.1 seconds adjusted for age (Monness & Sjolie, 2009). It was inapplicable to compare the balance values from these studies with our study due to methodological variations across the studies. Again, despite these differences, the IG had significantly decreased balance attempts when compared to that of the CG using the same testing method.

4.5.2.4 **Standing Vertical Jump Test**

The mean of the standing vertical jump (SVJ) in the total sample was 24.7 cm which is considerably less than other populations in similar age group. Germans ≥ 25.1 cm (Richter *et al.*, 2010), British ≥ 26.9 cm (Taylor *et al.*, 2010); Frenchs ≥ 33.2 cm (Temfemo *et al.*, 2009); and Canadians ≥ 34 cm (Payne *et al.*, 2000). The IG in this study increased more in the IG (+2.4 cm) than the CG (+1.1 cm) with a difference of 1.3 cm in favour of the IG, but was not statistically significant.

Most school-based studies among adolescents that assessed standing jump included an exercise component (Granacher *et al.*, 2011; Eather *et al.*, 2011; 2016). However, many of them assessed standing long jump but not SVJ. A number of studies examined the SVJ alternatively (Granacher *et al.*, 2011). A study involved a short-term resistance training component which resulted in an increase of +2.1 cm in the IG while the CG decreased by -1.8 cm giving a difference of 3.9 cm. A similar study resulted in an increase in the IG by +2.1 cm and a decreased in the CG by -1.2 giving a difference of 3.3 cm (Muehlbauer, Gollhofer, &

Granacher, 2012). A short-term high intensity training study also demonstrated a significant change over SVJ with an increase by +1.0 cm in the IG and a decrease in the CG by -2.1 cm with a difference of 3.1 cm (Buchan *et al.*, 2013). A study by Racil *et al.* (2015) included high-intensity interval training (HIIT) combined with plyometric exercises for 12 weeks among obese adolescent females. The intervention resulted in an increase of +3.7 cm in SVJ compared to +2.3 cm in HIIT alone and to +0.4 cm in the CG. A balance training also resulted in increased SVJ height by +1.8 cm in the IG compared to a decreased in the CG by -1.2 cm ($p < 0.01$) (Granacher *et al.*, 2010). On the other hand, Andrade *et al.* (2016) applied an intervention with no exercise component but with both curricular, environmental, and parental components. Their intervention effect on SVJ showed no significant difference between the groups according to their BMI categories. However, the effect on SVJ was significant according to fitness level with greater effect on adolescents with low fitness level by +0.7 cm, and +2.4 when adjusted for BMI z-score, gender, and SES.

The non-significant difference in the current study might be due to the increased weight over the time in both groups as indicated by BMIz and BF%, which could result in the decreased height of vertical jump as the weight and gravity act against ground reaction force during vertical jump (Linthorne, 2001). Andrade *et al.* (2016) had a significant difference in SVJ according to BMI categories wherein underweight and normal weight categories had higher jump than overweight. There was a significant but weak inverse correlation between SVJ height and weight measurements at both pre- and post-intervention in our study (r= 0.2 – 0.3, $p < 0.05$). Nevertheless, no significant correlation was found for the differences in SVJ height and weight measurements. Muscles activation and strength has the main role on the height of vertical jump and can be independent of the body size (Markovic & Jaric, 2007). Therefore, our findings suggest that the strength of lower extremity muscles did not increase significantly after the intervention.

4.5.2.5 **20-m Shuttle Run Test (VO_2max)**

The means score of shuttles in the total sample was 11.72 which equals level 2.5. The IG increased shuttles from 10.23 to 12.36 (+2.13) while the CG decreased from 12.31 to 12.00 (-0.31) giving a difference of 2.44 shuttles. This was significantly less than British norms for the age group which range between 49 – 50 shuttles

(Riddoch, 1990). A resistive training intervention resulted in a significant increased by +16.1 shuttles compared to +4.4 increase in the CG with an adjusted difference in change by 10.3 shuttles in favour of IG (p= 0.02) (Eather, Morgan, & Lubans, 2016).

The mean VO_2max in the total sample was estimated to be 32.2 $ml.kg^{-1}.min^{-1}$ which is considered to be within 'Fair' category for adolescent females between the age of 13 and 19 (Haywood, 1998). Although the VO_2max had significantly increased in the IG compared to the CG (+1.2 vs. -0.2, p = 0.008, respectively), the overall level of both groups remained in the same 'Fair' category. In addition, the increase in the IG was small and not clear if this would be of any physiological significance. The aforementioned intervention by Andrade *et al.* (2016) with no exercise component revealed that speed of shuttle run was significantly increased in only overweight and obese participants in the IG by -1.5 seconds less compared to their counterparts in the CG (p= 0.006). However, that time was very short to complete even a shuttle at any level. This could be explained by the fact that the intervention had no exercise component to produce a larger difference in a similar case to our study. Alternatively, school-based interventions involving exercise component (i.e. aerobic or anaerobic training) demonstrated larger effect which ranged from +1.8 to +5.0 $ml.kg^{-1}.min^{-1}$ in normal weight adolescents (Fardy *et al.*, 1996; Bayne-Smith *et al.*, 2004; Bonhauser *et al.*, 2005; Carrel *et al.*, 2009; Walther *et al.*, 2009). In overweight and/or obese adolescents, it ranged from +2.2 to +3.7 $ml.kg^{-1}.min^{-1}$ (Carrel *et al.*, 2005; Chae *et al.*, 2010; Kelishadi *et al.*, 2014). Nonetheless, VO_2max has been measured by different methods, by different protocols and by different estimation equations which could led to methodological variations on VO_2max values across the studies. Carrel *et al.* (2005; 2009), Walther *et al.* (2009), and Chae *et al.* (2010) used indirect calorimetry method by treadmill testing with spirometry which is considered the gold standard method for measuring VO_2max. However, Carrel *et al.* (2005; 2009) and Walther *et al.* (2009) used different testing protocols while Chae *et al.* (2010) did not mention the protocol. Fardy (1996) and Bayne-Smith (2004) used the same Queens College Step test where VO_2max is estimated from the heart rate. Bonhauser *et al.* (2005) used YO-YO intermittent recovery test, and Kelishadi *et al.* (2014) used the 20-m shuttle run test. Furthermore, a school-based multi-component intervention with environmental, policy, social, and after-school exercise components increased the running distance in the 20m shuttle run test by an adjusted difference of +6 metres in the IG more than the CG but was statistically not significant (Christiansen *et al.*, 2013).

EUROFIT test battery is specifically designed and validated for European population. Validity and generalisability in cross-population or cross-cultural is unknown. Moreover, its reference norms would be different from other populations. Fitness reference norms in the region are lacking. However, generalisability of reference norms has been criticised due to individual variations based on physical maturity and genetic inheritance (Stratton & Williams, 2007). Criterion reference standards has been recommended instead. Although this study found statistically significant increases in many fitness measures, whether these are of physiological significance and will result in improvements in long-term health outcomes remains to be tested in future studies.

Table 4-10 Change in sun protection and sunbathing in intervention and control groups

	Pre-intervention		Post-intervention		P-value[a] for the difference
	Control n = 64	Intervention n = 63	Control n = 61	Intervention n = 61	
Use of sun protection, n (%)	20 (31.3%)	17 (27.0%)	31 (50.8%)	37 (60.7%)	0.233
Sunbathing, n (%)	17(26.6%)	20 (31.7%)	13 (21.3%)	6 (9.8%)	0.098

[a]Compared by Fisher's Exact test

4.5.3 Self-reported behaviours

4.5.3.1 Eating Behaviours

4.5.3.1.1 *Total Meals and Breakfast Consumption per Week*

The intervention increased number of meals consumed per week significantly in the IG while there was no change in the CG. However, the IG only reached 15 meals per week while the CG consumed 13 meals per week relative to standard 21 meals per week. It also increased number of breakfast consumed per week by (+1 vs. 0, p= 0.044). However, both groups consumed breakfast on four days of the week which is less than ideal. This is a common practice by adolescents in the population. A study by Allafi *et al* (2014) found that the majority of Kuwaiti adolescent females consumed breakfast three days/week while it was higher in males who consumed it on four days/week (*p*= 0.001). In general, low frequency of meals per day has been associated with abdominal obesity and higher BMI in children and adolescents (Ahadi *et al*., 2016; Franko *et al*., 2008). Whereas, a higher number of meals is associated with lower risk and prevalence of overweight and obesity (Smetanina *et al*., 2015; Koletzko & Toschke, 2010). Consuming breakfast has also been suggested to be associated with reduced BMI and risk of overweight and obesity in children and adolescents (Szajewska & Ruszczynski, 2010). Moreover, it may regulate caloric intake from other meals during the day (Nicklas *et al*., 2003). Nonetheless, these suggestions remain controversial (Kant & Graubard, 2015; Blondin *et al*., 2016). It has also been suggested to improve their cognitive functions and academic performance (Hoyland, Dye, & Lawton, 2009).

A school-based curricular intervention on healthy lifestyle behaviours resulted in higher percentages of Indian adolescents consuming three meals per day (+3.6%) but the statistical significance was not stated (Mary, D'souza & Roach, 2014). A nutritional education intervention resulted in an increase in breakfast consumption among American adolescent girls by +8.7% in the IG compared to +2.7% increase in the CG (p< 0.05) (Bayne-Smith *et al*., 2004). Another curricular intervention targeting healthy eating habits also resulted in increased breakfast consumption among American adolescent girls (+5%, p= 0.036) (Heo *et al*., 2016).

4.5.3.1.2 *Dairy Intake and Fruit and Vegetables Intake per Day*

Dairy intake per day increased in the IG more than the CG (+0.35 vs. +0.03, p= 0.019) it reached 1.5 time per day in the IG and 1.2 time in the CG. However, the exact type of dairy and its fat content are unknown (i.e. low fat yogurt or skimmed milk vs. full cream cheese). This can be considered as a good indicator given the fact that osteopenia and osteoporosis in postmenopausal females, and vitamin D deficiency in adolescent females are prevalent among the population (Al-Shoumer & Nair, 2012; Al-Mutairi, Issa, & Nair, 2012; Alyahya *et al.*, 2014). Vitamin D promotes absorption of dietary calcium which is essential for bone health and the prevention of osteoporosis (Holick, 2005). A study among Kuwaiti adolescents reported less mean intake of milk and milk produce of 3.6 per week (Allafi *et al.*, 2014). Another study in the same population but in both genders found that inadequate consumption of milk was associated with higher consumption of carbonated beverages (p= 0.019) and marginally by packed fruit juice (p= 0.089) (Nassar *et al.*, 2014). It was also marginally associated with higher consumption of caffeinated beverages in adolescent females (p= 0.069). Inadequate consumption of milk has been found to increase risk of vitamin D deficiency by threefold among Kuwaiti adolescent females (Alyahya *et al.*, 2014).

Fruits and vegetables (F&V) intake increased in the IG while did not change in the CG but the difference was not significant. The IG F&V intake reached three portions per day while CG remained at intake of two portions per day which is still less than the recommended five per day. This was more than another study in the Kuwaiti female adolescents in which F&V intake was 2.8 and 3.5 servings/week, respectively. It was found that the adolescent females consumed slightly less F&V intake than males (2.8 vs. 3.4 and 3.5 vs. 3.8, p< 0.05) (Allafi *et al.*, 2014). This indicate that the average intake of F&V in the adolescent national population is much less than the recommended intake. This could be because of unavailability of F&V at both home and school or due to the general social norms.

A school-based study reported a small decrease of milk and F&V after a nutrition education intervention in American adolescents in the IG (-0.01, -0.09 & -0.13, respectively), but the decrease was not significant and not different from the CG (Blake, 2009). A school-based intervention combining nutrition education, social support and school canteen in India change resulted in increased percentages of adolescents who consumed two glasses of milk per day in the IG (+32.8%, p< 0.001) compared to the CG (-7.8, *p*=0.152) but not in F&V intakes of more than three times per week (Singhal *et al.*, 2010). Moreover, a nutritional education intervention was associated with increased consumption of milk and cheese at least twice a day among American-Latin adolescents with low SES (*p*= 0.02) (Kilanowski & Gordon, 2015).

A school-based intervention in American adolescent females involving curriculum targeting consumption of F&V of five and more servings per day increased F&V consumption in the IG while this was decreased in the CG (+0.2 vs. -0.2, *p*= 0.003) (Gortmaker *et al.*, 1999). Nonetheless, the IG consumption of F&V reached four servings per day which did not meet the targeted five servings, and it equated the CG who remained consuming four servings per day. A multi-component school-based intervention combining curriculum, environmental and family or community components resulted in an increase in intake of fruits and vegetables at least three to four times per week (p ≤0.01) in Indian adolescents (Saraf *et al.*, 2015). However, it is still lower than the recommended five servings per day. A long-term combined curricular and school environment intervention among Tunisian Adolescents significantly increased proportions of adolescents who met the five servings of F&V in the IG (+3%, p= 0.03) while were decreased in the CG (-6%, p= 0.001) (Maatoug *et al.*, 2015). Another nutritional education intervention resulted in increased F&V intake in the IG while slightly decreased in the CG (+1.69 vs. -0.27, p<0.05) among American adolescents (Fahlman *et al.*, 2008). The IG reached the consumption of five servings of F&V per day whereas the CG stayed at four. It also increased dairy intake in IG compared to slight decrease in CG but the difference was not significant. Similarly, a nutrition education intervention targeting African-American adolescents resulted in a significant increase in F&V intake in the IG from three servings to five serving per day, compared to almost no change in the CG (p<0.0001) (Covelli, 2008). On the other hand, a school-based intervention based on social cognitive theory integrated PA, social support and nutritional guidance taught in classroom resulted in slightly higher consumption of F&V in the IG compared to the CG at both post-intervention and 8-month follow-up in American adolescents (Δ= +0.22 and +0.27, respectively), but were not statistically different (Neumark-Sztainer *et al.*, 2003). This non-significant difference could be due to the fact that the CG also received written materials on nutrition.

4.5.3.1.3 *Sweet and Fried Foods Intake per Week*

Sweet foods intake per week was reduced more in the IG than the CG but the difference was not significant (-0.4 vs. -0.1, p= 0.084). The IG intake reduced from three to two times while the CG remained at three intakes of sweets per week. Similarly, fried foods intake per week was reduced in the IG more than the CG (-0.3 vs. -0.1, p= 0.275). Although it was not significant but the IG showed more positive decline trend in both sweet and fried foods intakes. Kuwaiti adolescents were found to have high consumption of sweets and cakes/doughnuts significantly more in females than in males (4.6 vs. 3.8 times/week, *p*= 0.001) and (3.0 vs. 2.5 times/week, *p*= 0.001), respectively (Allafi *et al.*, 2014). Intake of fried chips was also high among both females and males with no significant difference (3.2 and 3.1 times per week, *p*=0.36). A school-based curricular intervention resulted in significant decrease in fried food intake per day (< 0.01) but not in deserts intake per day in Chinese adolescents (Tse & Yuen, 2009).

4.5.3.1.4 *Healthy and Unhealthy Snacks Intakes*

Both groups slightly increased healthy snacks intakes with more in the IG than the CG but not significantly different both reaching about one (+0.11 vs. +0.03, p= 0.517). Alternatively, unhealthy snacks intake was slightly reduced in the IG while slightly increased in the CG but again not significantly different (-0.14 vs. +0.07, p= 0.118). Both remained consuming one unhealthy snacks per day.

Secondary school time in Kuwait is between 7:30 am till 1:35 pm which is earlier than Western countries. There are two school breaks: first starts at 10:05 am and lasts for 15 minutes, and the second starts at 11:55 am and lasts for 10 minutes. Thus, students may not have the chance to have a breakfast before the school. Additionally, school canteens do not provide freshly prepared meals or fresh snacks which could lead to poor diet quality and increase snacking on sugary foods and drinks.

A school-based curricular intervention increased healthy snack choices among Chinese adolescents (p=0.04) and decreased a preference for unhealthy ones (p= 0.03) (Tse & Yuen, 2009). However, biscuit and sponge cake was considered as healthy snacks. A multi-component intervention combining curricular, environmental, and family or community did not change intake of salted snacks among Indian adolescents due school not banning their sale as part of environmental change (Saraf *et al.*, 2015). This indicate the importance of healthy snack availability in school to promote healthy eating behaviours. Banning high-fat and high-sugar containing snacks at school contributed to a significant reduction in total fat percentage of energy by -2% ($p < 0.05$) in Canadian children and adolescents (Saksvig *et al.*, 2005).

4.5.3.1.5 *Frequency of Eating Out or Using Food Delivery Service per Week*

The frequency of eating out or using food delivery service per week was decreased in the IG more than the CG (-0.09 vs. -0.02, $p = 0.620$). Both groups remained at a frequency of two times per week. A study in Kuwaiti adolescents reported a fast foods intake of three times per week in both males and females (Allafi *et al.*, 2014). The non-significant difference between the groups in our study can be due to the overall sociocultural dietary factors like regularly eating in restaurants, consuming fast food, and preferring high amount of salt in food (Al-Kandari, 2006). It also could be because most social gatherings are held at restaurants and coffee shops particularly in the weekend, and trying out newly opened food outlets which are rapidly and vastly increasing in the country.

A school-based curricular intervention on nutrition decreased the intake of fast food per week by -14% ($p<0.01$) (Rani *et al.*, 2013) and by -2.9% in Indian adolescents (Mary, D'souza & Roach, 2014). Additionally, a multi-component intervention combining curriculum, social support, and environment reduced the intake of fast food for more than 3 times per week ($p = 0.031$) among adolescents. However, our study did not consider the type of food consumed at restaurants which could be as healthy as homemade prepared one. An education intervention on nutrition in American adolescents increased consumption of healthy foods at fast-food restaurant more in the IG than in the CG ($p<0 .05$) (Fahlman *et al.*, 2008).

4.5.3.1.6 *Water and Sugar-Sweetened Beverage Consumptions*

Water intake significantly increased more in the IG while slightly decreased in the CG. However, both groups remained consuming water only twice per day which is extremely low considering the hot-arid climate. Sweetened beverages was reduced slightly more in the IG than the CG but with no significant difference. The IG decreased consumption two to one sweetened beverage per day while the CG remained consuming one per day. This was also reported by a study of Kuwaiti adolescents' dietary behaviour, where it was found that both genders consumed about five sugar-sweetened beverages per week (Allafi *et al.*, 2014). It also found that they consumed about one energy drink per week which was slightly more in adolescent males than females (1.3 vs. 1.1, p= 0.003).

A knowledge-based intervention using curricular and social support targeting healthy eating, PA, and mental resilience reduced SSB intake significantly only in adolescent American girls (p= 0.007) (Heo *et al.*, 2016). A multi-component school-based intervention also reduced the SSB intake of more than three times per week in Indian adolescents significantly (p= 0.001) (Singhal *et al.*, 2010).

4.5.3.1.7 *Salt Amount in Food Preference*

There was no significant difference between the proportions of girls in both groups in the amount of salt in food preference. Although moderate amount of salt preference increased and high amount of salt preference decreased more in the IG than the CG. Salt preference in the food has been found to be positively associated with BMI in the population (Al-Kandari *et al.*, 2006).

A school-based nutrition education intervention for preventing CVD in American adolescents reduced frequency of salt adding to food significantly compared to a CG (girls= -0.51 vs. +0.14, p= 0.01) (Perry *et al.*, 1987). Another school-based study targeted salt intake as a risk factor for hypertension in African-American adolescents resulted in a reduction of SBP in the IG compared to almost no change in the CG but was not significantly different (-3.5 vs. -0.1, p= 0.56) (Covelli, 2008).

4.5.3.2 **Tobacco Smoking and Substance Abuse**

One case of tobacco cigarette smoking was reported at baseline in the IG but not at post-intervention. Intention to smoke was more reported in CG than IG at baseline but was not significantly different. Intention to smoke decreased in both CG and IG but again was not significant (-3.2% vs. -1.6%, respectively). Substance abuse was not reported in either groups. The low reports of such behaviours could be due to social and cultural unacceptability making the girls reluctant to report what is considered acceptable by the society or culture this is known as social desirability bias (Brener, Billy, & Grady, 2003). It could be also due to stigmatisation of such behaviours particularly among females in culturally conservative communities (Momtazi & Rawson, 2010). It was not possible to determine the effect of the intervention on tobacco smoking or substance abuse behaviours due to non-prevalence or underreporting of these behaviours.

4.5.3.3 Sun Protection and UV Radiation Exposure

Both groups increased using sun protection with a greater increase in the IG than the CG at post-intervention assessment but it was not significantly different. The increase in use of sun protection in the CG can be related to the increase in weather's temperature because of summer time approaching by the time of final assessment. Fifty-one percent of CG and 61% of IG used sun protection at post-intervention. The relatively low use of sun protection in both groups in general could be due to the fact that sun exposure in the Kuwaiti population is limited especially in females (Al-Mutairi, Issa, & Nair, 2012; Alyahya *et al*, 2014). This can be due to the typical adverse weather conditions (i.e. typical hot and frequent dusty weather) and skin being already protected by body-covered clothing in females.

4.5.4 Methodological Limitations:

As mentioned earlier in chapter 3, the reliability and validity of questionnaires were not assessed and therefore could undermine the self-reported findings. Questions about eating behaviours were designed for the purpose of identifying general dietary patterns rather than a full and proper dietary assessment. Caution must therefore be taken when interpreting this data. Self-reports of sensitive and socially/culturally unaccepted or condemned behaviours such as adolescents' tobacco smoking, substance abuse, and eating disorders can also lead to underreporting as a result of social desirability bias (Brener, Billy, & Grady, 2003; Tourangeau & Yan, 2007).

4.6 Conclusion:

The school-based health promoting intervention was effective in producing a small but significant increase in health-related physical fitness that included hamstring and trunk flexibility, abdominal muscle strength, body balance and cardiorespiratory endurance compared to the CG. A number of dietary habits also improved such as increasing total meals consumed per week, number of breakfasts consumed per week, dairy intake per day, and water consumption per day. Health-compromising behaviours such as tobacco smoking and substance abuse were scarcely reported which might be due to social and cultural factors. Although not significantly different, sunbathing decreased and skin protection increased to a greater extent in the IG in comparison with the CG. However, there were no significant differences in weight measurements, weight categories, and fat categories between the groups after the intervention. The could be due to the fact that the intervention had no structured PA component or nutritional program, and was not guided by behavioural theory to induce a significant change on weight parameters or to produce larger effect on physical fitness and PA. Future school-based interventions should incorporate multi-strategies and components alongside curricular component that target PA and healthy nutrition to yield more significant physical outcomes associated with health-related behaviours.

Chapter 5
General Discussion

5.1 Introduction

The results of a school-based health promoting intervention among adolescent females were reported and discussed in the previous chapters. Chapter 4 reported and discussed the effect of the intervention on weight measurements, physical fitness, and physical activity assessed by accelerometry. Chapter 5 reported and discussed the effect of the intervention on health knowledge by topic, and self-reported behaviours which included physical activity, eating habits, substance use, tobacco smoking, and sun protection and exposure. Since the intervention was completely a knowledge-based, the association between health knowledge and behaviour has to be elucidated. This chapter aims to discuss the association between health knowledge and health-related behaviours among adolescents and explain the factors influencing this association. This chapter will also include research contribution, strengths, and limitations. It will then discuss the implications for future research in the conclusion.

5.2 Summary of main findings

The research investigated the effectiveness of an intervention targeting multiple health-related behaviours by a health education curriculum. The intervention promoted healthy behaviours such as physical activity, healthy nutrition, and sun protection. It also warned against tobacco smoking, substance abuse, and ultraviolet (UV) radiation exposure for the purpose of skin tanning. The investigations included weight measurements, physical fitness testing, physical activity (accelerometry), health knowledge, and self-reported physical activity, dietary habits, substance abuse, tobacco smoking, and sun protection and UV radiation exposure. The intervention did not change weight measurements, proportions in weight categories, or the status of change in weight categories. However, a number of significant positive outcomes were found in the intervention group (IG). The IG increased hamstring flexibility, abdominal muscle power, body balance and cardiorespiratory endurance (VO_2max) but not lower extremities power. It also increased total energy expenditure, average energy expenditure per day, METs, steps per minutes, and light PA while decreased sedentary time assessed by 7-day lower back accelerometry. Total step counts, total MVPA, and average MVPA per day were marginally increased. Self-reported PA showed that the IG decreased times of using elevator per day and increased times spent walking during breaks, walking for transportation, walking for leisure, and total walking per week. It also increased time spent in moderate intensity exercise or sports and total MVPA while marginally increased moderate PA. Additionally, it marginally reduced reported total barriers to PA. Self-reports also showed that the intervention changed some dietary behaviours positively. It increased consumption of total meals and breakfasts per week, dairy intake per day, and times of water consumption per day. Substance abuse was not reported and tobacco smoking was scarcely reported which could be underreported due to social and cultural concerns. It also could be due to the fact that such behaviours are uncommon among adolescent females in the population and it is less likely to be identified with the study relatively small sample size. Using sunbed for skin tanning was also hardly reported while sunbathing was moderately reported. Protecting skin against sun was increased in both groups. Finally, total health knowledge increased markedly after the intervention which would been expected since the intervention was based on knowledge improvement. These findings are summarised in Table 5-1.

Table 5-1 Summary of the changes in the outcome variables in intervention and control groups

Outcome variables	Change in the Groups		Significance*
	Intervention	Control	
Weight measurements			
BMI z-score	—	—	NS
%Body fat	—	—	NS
Waist Circumference	—	—	NS
Waist-to-height ratio	—	—	NS
Physical fitness components			
Flexibility (sit-and-reach)	↑	—	0.04
Abdominal muscles strength (sit-ups)	↑	—	0.02
Body balance (single-leg stand)	↓ ↓	↓	0.03
Lower extremity muscle strength (vertical jump)	—	—	NS
Cardiorespiratory endurance – VO_2max (20-m shuttle run test)	↑	—	0.01
Physical activity - accelerometry			
Total kcal	↑	↓	0.02
Average kcal/day	↑	↓	0.02
METs	↑	—	0.02
Steps counts	↑	↓	0.05
Steps average counts	—	—	NS
Steps max counts	—	—	NS
Steps/ minutes	↑	—	0.03
Sedentary (mins)	↓	↑	0.03
Light (mins)	↑	↓	0.03
Moderate (mins)	—	—	NS
Vigorous (mins)	—	—	NS
Total MVPA (mins)	↑	↓	0.05
Average MVPA/day (mins)	↑	↓	0.05
Physical activity – self-reports			
Frequency of elevator use	↓	↑	0.02
Sitting during breaks	—	—	NS
Walking during breaks	↑	↓	<0.0005
Walking for transportation	↑	↓	0.02
Walking for leisure	↑	↓	0.002
Total walking time	↑	↓	<0.0005
Moderate housework PA	—	—	NS
Moderate exercise/sports	↑	↓	0.04
Total moderate PA	↑	↓	0.05
Total vigorous PA	—	—	NS
Total MVPA	↑	↓	0.04
PA barriers	—	—	NS
Dietary behaviours			
Frequency of meals intake per week	↑	—	0.03

Outcome variables	Change in the Groups		Significance*
	Intervention	Control	
Frequency of breakfast intake per week	↑	—	0.04
Frequency of dairy intake per day	↑	—	0.02
Fruits and vegetables intake per day	—	—	NS
Sweet foods intake per week	—	—	NS
Fried foods intake per week	—	—	NS
Healthy snacks intake	—	—	NS
Unhealthy snacks intake	—	—	NS
Eating out/ delivery per week	—	—	NS
Frequency of water consumption per day	↑	—	0.003
Frequency of sweetened beverages intake per day	—	—	NS
Sunbathing & sun protection			
Sunbathing	—	—	NS
Use of sun protection	—	—	NS
Health knowledge			
Physical activity	↑ ↑	↑	<0.0005
Healthy nutrition	↑ ↑	↑	<0.0005
Bone health	↑ ↑	↑	<0.0005
Harmful substances	↑ ↑	↑	<0.0005
Tobacco smoking	↑ ↑	↑	<0.0005
Sun protection	↑ ↑	↑	<0.0005
Total knowledge	↑ ↑	↑	<0.0005

*Compared with the control group
Green arrow denotes positive change, Red arrow denotes negative change, ‘double’ arrows denote more change compared to the other group, and a thick dash (—) denotes no change.

5.3 Does an increase in health knowledge change health-related behaviours?

Health education in terms of knowledge about health and its determinants is an essential part of health promotion (Lister-Sharp *et al.*, 1998). The present study targeted behavioural changes among adolescent females by means of increasing health knowledge. The relationship between health knowledge and health-related behaviours however is conflicting. Having adequate health knowledge does not always translate into healthy behaviours. Increasing health knowledge also does not necessarily improve health behaviours among adolescents. Alternatively, change in health behaviours does not require change in health knowledge. These propositions are discussed in detail next.

5.3.1 Does Health Knowledge Equate with Health Behaviour?

Several studies have demonstrated that having good health knowledge does not necessarily impact on the health behaviour. American adolescents were found to have ample knowledge about healthy diet but did not have a healthy eating behaviours (Croll, Neumark-Sztainer, & Story, 2001). The adolescents stated that lack of time to prepare healthy meal, peer social pressure, limited availability of healthy foods in schools, and lack of concern in following healthy dietary recommendations were the barriers to healthy eating. A study among Iranian adolescents also found that the most had a good nutritional knowledge, 82% in females and 75% in males, but dietary behaviour was good in only 15% of females and 25% of males (Mirmiran, Azadbakht, & Azizi, 2007). Similarly, a study found that 69% of Serbian adolescents had good health knowledge but only 45% of them had good eating behaviours (Djordjevic-Nikic, Dopsaj, & Veskovic, 2013). A study on sun protection found that American adolescents had a good knowledge of the risks of ultraviolet radiation exposure but that did not result in a sun protective behaviour (Cohen, Tsai, & Puffer, 2006). Approximately, 30% used sunscreen during outdoor sports, 26% used sunscreen in non-sports outdoor activities, and 23% had experienced a blistering sunburn the year before. It was also found that 85% of Saudi adolescents knew the harmful effects of first and second-hand tobacco smoking, however; 22% were current cigarette smokers and 14% were current smokers of other tobacco products (Abdalla *et al.*, 2007). This was also similar to a study in Irish adolescents which found that they had a high level of health knowledge but it was not associated with health-related behaviours such as tobacco smoking, alcohol drinking, exercise, eating habits, and dental hygiene (O'Reilly & Shelley, 1991).

5.3.2 **Does Changing Health Knowledge Guarantee Changes in Health Behaviour?**

Given that some studies have failed to show an association between health knowledge and health behaviour, a number of studies investigated whether increasing health knowledge would change behaviours. Many of these studies showed an improvement in both the knowledge and the behaviours as previously discussed in the literature review. In contrast, many school-based interventions significantly increased health knowledge but did not reach the targeted behavioural change. Davis *et al.* (2015) targeted sun protective behaviours in American adolescents in middle and secondary schools by a curricular intervention delivered by university students. The intervention significantly increased knowledge (p<0.0001) and attitude towards tanned skin (p< 0.001), but not in tanning behaviours and sunscreen use in secondary school adolescents. Similarly, an intervention targeting sun protective behaviour also resulted in a significant increase in sun protection knowledge ($p \leq 0.01$) but had no significant effect on use of sunscreen and sunbeds in females (Swindler, Lloyd, & Gil, 2007). Another educational intervention targeted dietary iron intake for prevention of iron deficiency anaemia among Iranian adolescent girls (Amani & Soflaei, 2006). It significantly increased nutritional knowledge (p< 0.001), mean corpuscular volume (MCV) (p< 0.001), and food frequency score (p< 0.05) in the IG but not in the CG. However, lifestyle scores (sleep and exercise) and haemoglobin, and serum ferritin did not change in both groups except serum ferritin in the CG was significantly decreased.

Two interventions using different methods of delivery (compact disc (CD) vs. traditional) targeting obesity and non-communicable diseases (NCDs) by nutrition and PA education were compared alongside a CG in American adolescents (Casazza &Ciccazzo, 2007). The intervention resulted in significant increase in knowledge in both interventions (p< 0.01) and decreased in caloric intake (p< 0.01) but not in the CG. Unlike CD education group, traditional education group did not show a change in BMI, PA scores, number of skipped meals, intake of dairy, and intake saturated fat. Another intervention combined knowledge, social support, parents, and school environment change targeting tobacco smoking behaviour among Australian adolescents for two years (Schofield, Lynagh, & Mishra, 2003). The intervention significantly increased tobacco smoking knowledge in the IG compared to the CG (p= 0.001), but there was no significant difference between the groups in the reported last week smoking behaviour. Another intervention combined health and nutrition education with vigorous exercises to target cardiovascular risk factors (Bayne-Smith *et al.*, 2004). It significantly increased health knowledge in the IG compared to the CG ($p < 0.001$) but not in dietary intake of unhealthy foods, non-school PA, BMI, VO_2max, and total serum cholesterol. Nevertheless, it significantly decreased percentage of body fat ($p < 0.001$), systolic and diastolic blood pressure ($p < 0.05$), and increased frequency of breakfast consumption ($p < 0.05$). Byrd-Bredbenner *et al.* (1988) targeted eating behaviours by a nutritional education intervention in American adolescents. The intervention significantly increased nutrition knowledge in the IG compared to the CG ($p \leq 0.0001$) but not in food choices and dietary behaviours.

Lewis *et al.* (1988) also targeted food choice behaviour in American adolescents by nutrition education intervention integrated into school curriculum of four subjects. It resulted in a significantly higher increase in nutritional knowledge in the IG compared to the CG ($p \leq 0.05$) but not in food-choice behaviour. Another study combined health education with parental involvement and also resulted in significant increase of nutrition knowledge in the IG compared to the CG ($p < 0.01$) but not in changes of dietary intake in Greek adolescents (Lionis *et al.*, 1991). However, the IG had significantly higher knowledge of blood pressure and exercise, lower BMI, lower diastolic blood pressure, lower total serum cholesterol, and low density lipoprotein (LDL), and LDL/HDL ratio than the CG after the intervention. This equivocal influence of knowledge over behaviour was also found in a review of interventions targeting dietary behavioural change among children and adolescents (Koivisto Hursti & Sjoden, 1997). Wang *et al.* (2015a) also targeted eating behaviours but by combining nutritional education with peer support in Chinese adolescents. After the intervention, the IG had higher nutrition knowledge ($p \leq 0.001$), lower intake of fried foods (p= 0.009), higher vegetables daily intake (p= 0.003), and more consumed breakfast daily (p= 0.041) than the CG. However, there were no significant difference between the groups in not drinking sugar sweetened beverage, not eating dessert, eating fresh fruits daily, and consuming at least one portion of dairy per day.

5.3.3 Can Health Behaviour Change in the Absence of Changes in Health Knowledge?

Some school-based interventions conversely did not significantly increased knowledge but resulted in significant behavioural changes and/or physical measurements. Kilanowski & Gordon (2015) found that while more than 60% of Latino students in the IG increased knowledge this increase was not statistically significant. Despite this, they significantly increased consumption of dairy at least twice a day ($p= 0.02$) and decreased BMI percentile ($p= 0.02$). Another intervention but peer-led resulted in a decrease in BMI z-score among aboriginal Canadian adolescents in the IG (-0.06, $p=0.028$) while it increased in the CG (+0.09, $p= 0.046$) (Ronsley *et al.*, 2013). It also decreased percentage of students with elevated BP in the IG while increased in the CG (-2.2% vs. +15%, $p= 0.026$). However, knowledge, dietary and PA behaviours did not significantly differ between the groups. Furthermore, a multi-component intervention incorporated curricular, behavioural skills, family, and peer leaders among American adolescents (Klepp & Wilhelmsen, 1993). It resulted in healthier eating behaviours in the IG than the CG in both genders, but nutrition knowledge was only significantly different between the groups in males.

5.3.4 Measured Association Between Health Knowledge and Related Behaviour

Few previous studies have investigated the direct association between knowledge and behaviours. Heo *et al.* (2016) found that increased nutrition knowledge predicted increased well-being in American adolescent girls from different ethnicities ($\beta= 0.03$m $p= 0.039$). Increased nutrition knowledge predicted a decrease in sugar-sweetened beverages (SSB) and high energy dense foods (HEDF) intakes ($\beta= -0.03$, $p= 0.002$), and an increase in acceptance of new fruits and vegetables (F&V) intake among adolescent girls ($\beta= 0.04$, $p <0.001$). Similarly, increased PA knowledge predicted a decrease in SSB and HEDF intakes ($\beta= -0.02$, $p= 0.010$), and increased acceptance of new F&V intake among adolescent girls ($\beta= 0.04$, $p <0.001$). Interestingly, it found that increased knowledge about nutrition, PA, and mental health predicted more changes in behaviours among adolescent boys than adolescent girls indicating a gender role on such association. Likelihood of breakfast consumption was only significant with mental health knowledge in both genders. Grosso *et al.* (2013) found that nutritional knowledge was positively associated with intake of healthy foods (i.e. fruit, vegetables, fish…etc.), whilst negatively associated with unhealthy ones (i.e. fried foods, sweets), snacking, and SSB consumption in rural Italian adolescents. In addition, those with higher nutritional knowledge were less likely to spend time in sedentary activities for more three hours per day (OR= 0.92), and less likely to consume two or more snacks per day (OR= 0.89). Also positive associations were found between nutritional and activity knowledge and MVPA, and a negative association with TV watching (Nelson, Lytle, & Pasch, 2009). Nevertheless, no associations were found between nutritional and activity knowledge and fast food intake, SSB consumption, weight parameters. In contrast, poor nutritional knowledge was found to be a predictor for steroid use in adolescent females (Neumark-Sztainer, Cafri, & Wall, 2007). Puska *et al.* (1982) applied an intervention that combined tobacco smoking and nutrition knowledge, taught skills to resist social pressure for smoking, and changes in school lunch. The intervention resulted in a significant increase in health knowledge in only females, and significant reduction in smoking, serum total cholesterol, and fat intake from milk and butter. However, the authors stated that changes were due to the intervention’s taught skills, and changes in physical and social environments but not to the increase in health knowledge *per se*. Regression analysis found no relationship between nutrition knowledge and weekly vegetable intake in Caucasian Italian adolescents (Amaro *et al.*, 2006).

Taken together, the inconsistency across these various findings can be explained by the fact that health behaviour is affected by various influencing factors in addition to individual’s health knowledge. These influencing factors are called determinants of HRBs (Sutton, 2008). Sutton (2008) referred to two types of determinants: cognitive and socio-environmental.

5.4 Determinants of Health-related Behaviours

These determinants can be described as cognitive and socio-environmental as detailed below but first it is important to know how these influences interact with the behaviour.

Human behaviour is explained by Social Cognitive Theory by a triadic reciprocal causation model (SCT) (Bandura,1989) as in Figure 5-1. The model conceptualises human behaviour as a dynamic element that bi-directionally interacts with personal cognitive factors and socio-environmental influences defined as *triadic reciprocal determinism* (Bandura,1989, p.2). Individual cognitive factors include thoughts, beliefs, self-perceptions, expectations, intentions and goals. They also involve biological properties and physical characteristics such as age, gender, and physique. On the other hand, socio-environmental influences involve the social and physical environments. Behavioural factors include behavioural experience. The SCT nevertheless emphasises on the social environment rather than the physical and societal ones. Ecological models alternatively explained behaviour in a more comprehensive framework that encompass physical environment, organisational, community, and policy influences. These models will be discussed later in socio-environmental determinants of behaviour.

5.4.1 **Cognitive Determinants of Health-Related Behaviours**

The internal influences are the intrapersonal or individual factors that affect the individual's behaviour. These influences can be separated into personal and behavioural factors as described by Perry (1999).

5.4.1.1 **Personal Factors**

These factors relate to the factors within individuals. These factors include knowledge related to a behaviour, attitudes (behavioural beliefs), values (importance of a behaviour), functional meanings (purpose of a behaviour), self-image (self-perception), self-efficacy, and outcome expectations (Ajzen & Fishbein, 1980; Bandura, 1989; Perry, 1999). They also include and perceived behavioural control (Ajzen, 1991). Knowledge refers to understanding the benefits and risks of different health-related behaviours and the information required to perform a certain behaviour (Kelder, Hoelscher, & Perry, 2015). Self-efficacy is individuals' confidence of their ability to perform a behaviour. Outcome expectation is the ability to anticipate the consequences of an executed behaviour. These personal factors can also be enhanced to produce a behavioural change on an individual-level.

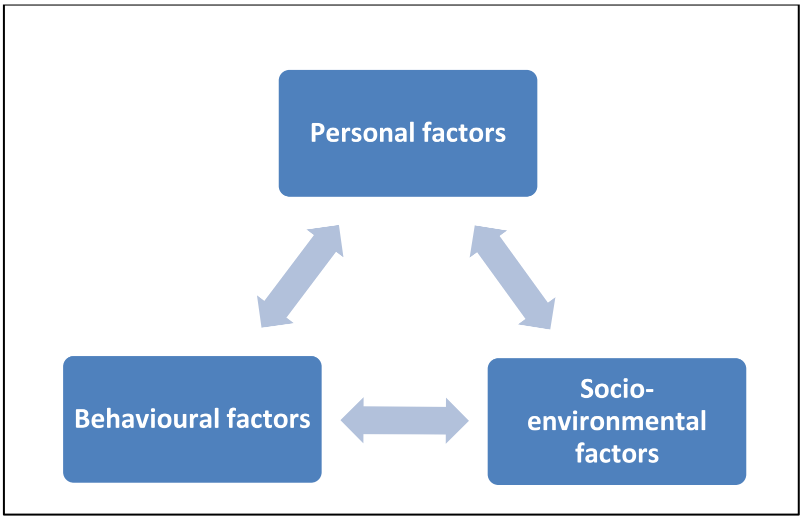


Figure 5-1 Triadic reciprocal causation model of Social Cognitive Theory (Bandura, 1989)

5.4.1.2 **Behavioural Factors**

Behavioural factors are those directly related to the execution of the behaviour (Perry, 1999). These factors include coping skills, intentions and goals-setting, and reinforcement and punishment (Perry, 1999). ‘Behavioural capability’ or ‘coping skills’ is the combination of knowledge that is specifically related to a behaviour and skills to perform it. Behavioural factors have been mostly used to direct and influence a health-related behavioural change.

5.4.2 **Socio-Environmental Determinants of Health-Related Behaviours**

Health-related behaviours are not only influenced by an individual’s cognitive factors but also by their surroundings such as social, environmental and societal factors. As mentioned earlier, SCT explained that personal cognition and behaviours influence and are influenced by the social and physical environment. The socio-environmental factors according to SCT involve observational learning from significant role models, social support, normative beliefs which are the cultural beliefs of perceived prevalence and social acceptance of a behaviour (social norms), and opportunities and barriers to perform a behaviour (Perry, 1999).

Other environmental and societal factors are best described by ecological models as systems and levels of influence (Sallis & Owen, 2015) as demonstrated in Figure 5-2. Bronfenbrenner (1979) identified four systems of environmental influences: microsystem, mesosystem, exosystem, and macrosystem. Microsystem comprises activities, social role (i.e. daughter or mother) and interpersonal relations that are experienced and perceived by individuals in a given setting. Mesosystem involves interrelations between two or more settings like home, school, and neighbourhood peer group for young individuals. Exosystem includes one or more settings that the individual does not involve in them actively but is affected by events occur in these settings. Examples of exosystem are, parents’ workplaces and situations within them, local school panel activities, mass media, neighbourhood conditions, and community policies. Macrosystem refers to the larger societal system of culture, belief systems, and ideology which includes socioeconomic, ethnic, and religious variation within the community. McLeroy *et al.* (1988) defined five levels of influence: intrapersonal, interpersonal, organisational, community and policy. Intrapersonal factors include factors within the individual such as knowledge, attitudes, skills, intentions, and others. Interpersonal factors represent the social relationships with family members, friends, peers, and significant others. Organisational factors involve the settings in which individuals function like schools, universities, and workplaces. Community factors can be perceived as mediating structure such as family, religious places, voluntary associations, and neighbourhoods. It also can be perceived as the relationships between different organisations and institutions within the community. Additionally, it can be perceived as a power structures by geographical economy and politics. Finally, public policy involves regulatory policies, laws, and procedures targeting the health of the community. These systems and levels represent not only influencing factors but also opportunities for behavioural health-promoting interventions.

The current study was designed to target the health knowledge and behaviours on an individual level as it was more feasible to implement and to evaluate, unlike those implemented on a socio-environmental level. Nonetheless, the intervention considered some sociocultural factors in the delivered health messages. In addition, this study is an attempt to expand the knowledge of individual level-based interventions and to inform policy and environmental changes.

5.4.3 Empirical Evidence of the Influence of Determinants of HRBs

Education of healthy choices alone or preventing unhealthy ones within an unsupportive environment can result in a weak and short-term behavioural change (Thomas, McLellan, & Perera, 2013; Sallis & Owen, 2015). Environmental changes by itself also result in weak effect over behaviours (Erwing & Cervero, 2001; Bonell *et al.*, 2013). Combining both elements produced a stronger influence on HRBs. This have been shown in many studies conducted in a school setting with an educational component as well as in systematic reviews and meta-analyses (Langford *et al.*, 2015; Morton *et al.*, 2016). It has been shown that an intervention which integrates environmental and parental components with a nutrition curriculum was more effective to promote healthy eating behaviour among Chinese adolescents than curricular intervention alone (Wang *et al.*, 2015b). Alternatively, it was suggested that decreased adolescent smoking rate was enhanced by either cognitive behaviour or behavioural skills with or without school-community setting (Hwang, Yeagley, & Petosa, 2004).

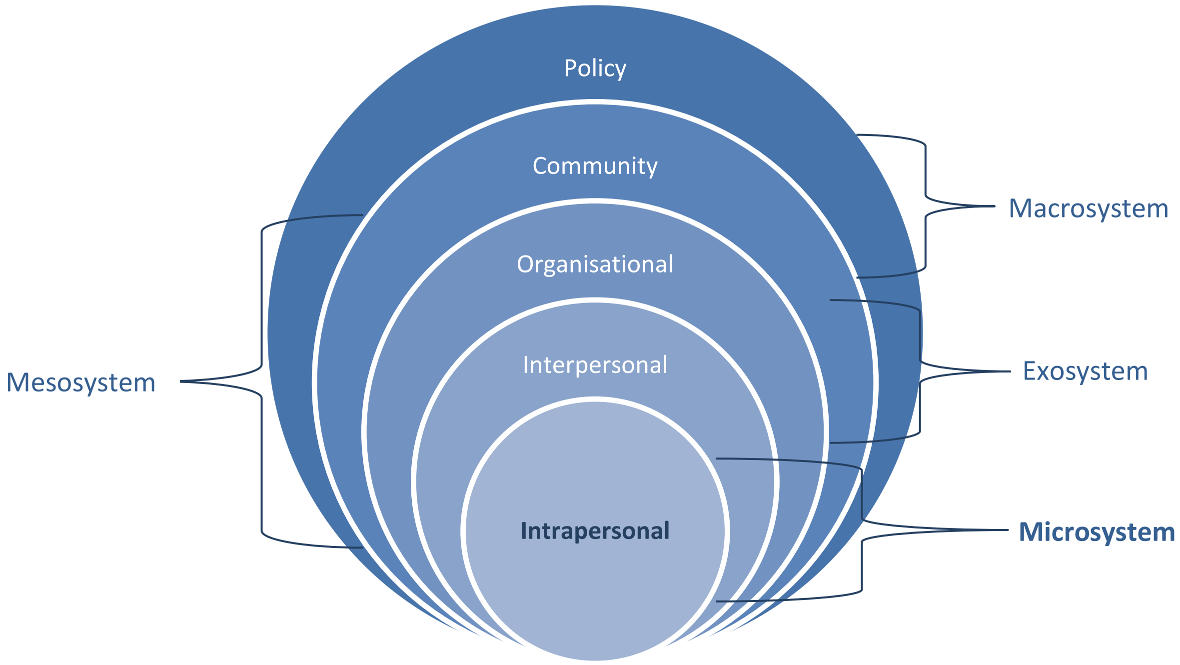


Figure 5-2 Integration of Bronfenbrenner’s (1979) and McLeroy (1988) ecological models.

The current study tackled the intrapersonal level/microsystem in terms of individuals’ knowledge. The other levels were beyond the scope of this study but are likely to be important in effecting positive changes observed in the present study in a wider context.

5.5 Strengths and Limitations

This study has a number of strengths that emphasise the reliability of its findings and the efficacy of the intervention. To our knowledge, this study is the first of its kind, using health promotion to target multiple health-related behaviours, to be implemented in the Gulf region. The study design is a randomised controlled trial with pre- and post-testing which is considered as the gold standard for interventional studies and adds a robustness to its findings. In addition, it included all of the three secondary school years and both science and literary specialisms which ensures representation of the whole secondary school population, diminishes selection bias, and enhances comparability of the participants. Furthermore, a power calculation for the size of the cohort was performed and the size of the sample was based on it. It is also considered large enough to approximate a normal distribution according to the *central limit theorem (*Brase & Brase, 2011, p. 299). The duration of intervention was six months which many systematic reviews found to be effective in positively influencing health-related behaviours (Guerra, da Silveira, & Salvador, 2016). The study involved several outcome measures including physical measurements; physical fitness; physical activity (recorded by accelerometry in a subsample, n=11); together with topic-specific health knowledge and health-related behaviours. Thus, it combined both subjective and objective measures resulting in rigorous findings. Although the intervention was carried out during PE class, it did not interrupt their teaching. There were also no known previous studies that assessed PA by accelerometry among child and adolescent females in the region. Finally, the study had high adherence to the intervention, low drop-out rate, and no adverse effects.

It is also essential to acknowledge the limitations of this research and the challenges it faced. The clustering of the classes by study specialisms within the groups was not equivalent and therefore incomparable. There was only one specialism from each specialised school years (i.e. Year 11 and 12), in each group. Ideally, it would require one scientific and one literary specialism classes from each school year (Year 11 and 12), and one non-specialised class (Year 10) in each group. However, this could not be accommodated in the current study due to the limited time of study, overcrowded school curriculum, and small number of investigators. Moreover, blinding research participants to the intervention was not possible because of the type of intervention, and blinding principal investigator

was also not feasible due to the research purpose. Consequently, unavoidable response bias could have been resulted. Implementation in a single research site (i.e. school) hinders the generalisability of the data in addition to the risk of contamination between the groups. Increasing the number of sites was not possible due to limited time and a single researcher. Increasing research sites could also result in heterogeneity of school environmental factors. These factors can be school physical activity in relation to level and amount of exercise in PE, sports competitive activities, and available fitness tools.
Moreover, it could be also related to the type of food and snacks provided in the school canteen and different policies enforced in the schools.

Sample size calculation was performed for only the health knowledge outcome and not for the other outcomes which could have resulted in failing to detect more significant effects of the intervention. Nevertheless, since the health knowledge was the proposed agent for changing other outcomes, it was quite reasonable to base the health knowledge on it. There was also no follow-up to determine the maintenance of the intervention's effect on the outcomes. However, this was not one of the study aims. PA accelerometry was only assessed in a small sample (n= 11) as a pilot study due to the relatively high cost of the equipment and novelty of this assessment method in the population.

Socioeconomic status (SES), which is strongly associated with health-related behaviours (Hanson & Chen, 2007), was ultimately unable to be assessed in this study. Adolescents' SES corresponds to their parents and therefore parental SES was assessed in adolescents' studies. The SES of parents has been measured by one or more of three indicators: educational attainment, occupational status, and income (Hernandez & Blazer, 2006). This was difficult to assess in this study for three reasons. The first reason is related to the fact that there is no national SES classification pertaining to those indicators. One of the methods used to determine the SES in the population included seven indicators and about fifteen questions which is too many (Shah, N.M., Shah, M.A., & Radovanovic, 1999). It included questions about type of residence, size and capacity of the household, total family and father's income, and parents' educational level and occupational status. The second reason is that individual or family income is considered too sensitive and private in the study population to be declared. The third reason is the difference of SES between adolescents and adults (Currie *et al.*, 1997).

Although SES of adolescents is dependent on their parental SES, it does not totally reflect it as it depends on the amount and frequency of the allowance they receive from their parents and means of spending. Therefore, family affluence scale based of material conditions of the household such as car ownership, bedroom occupancy, home computers, and holidays, in addition to parental occupation, was used to determine the SES of adolescents (Currie *et al.*, 2008). However, these material conditions are almost fundamental in the studied population which thus would fail to differentiate between social classes.

The intervention was not guided by a behavioural change theory which could have facilitated more significant behavioural changes. Although theoretical underpinning reinforces the effect of health-related behavioural interventions, it does not guarantee a behavioural change or provide superiority over interventions that are not theory-grounded (Diep *et al.*, 2014; Prestwich *et al.*, 2014; Ayling *et al.*, 2015). In addition, effectiveness of behavioural theories over each other is still unclear and testing them is suggested (Guerra, da Silveira, & Salvador, 2016). Moreover, the study intervention involved contrasting health-related behaviours, health-enhancing versus health-compromising behaviours, which would require different theoretical models and constructs. Even within the same behavioural context, different behaviours can have different mediators. Self-efficacy, intention, intrinsic motivation, enjoyment of PA, self-regulation, autonomy support, school efficacy were significant mediators for PA in girls (van Stralen *et al.*, 2011). Knowledge, attitude and strength of habit instead were mediators for of dietary behaviour. This would require targeting each health behaviour with different theoretical constructs. It has been suggested that adolescent females respond better to educational and socio-behavioural interventions while adolescent males respond better to environmental changes (Kropski, Keckley, & Jensen, 2008). This also indicates that gender is a factor in determining the level of influence and thus the type of theoretical model to be used to achieve the targeted health-behaviour.

Sedentary behaviours were not assessed in the current study which would have provided a better understanding of the type of activities that adolescents spend most their sedentary time in. This would direct future interventions in adolescents to specifically target these behaviours for optimal physical activity promotion.

5.6 Conclusion:

Many behaviours that are initiated during adolescence are associated with NCDs and their metabolic/physiological risk factors such as overweight or obesity, hyperglycaemia, hyperlipidaemia, and elevated blood pressure. These diseases and risk factors are highly prevalent in the Kuwaiti population which reflect the growth of negative health-related behaviours such as physical inactivity, unhealthy dietary practices, tobacco smoking, and substance abuse among the adolescents. Most of these risk factors are attributed to physical inactivity and unhealthy dietary habits which are significantly more prevalent in females than in males. Therefore, it is essential to intervene at an early stage to prevent the detrimental consequences of such behaviours on the current and the future health of this population. There is a limited number of interventional studies targeting health-related behaviour among adolescents in Kuwait and in the Arab region. A knowledge-based health promoting intervention targeting multiple health-related behaviours therefore was developed and implemented among adolescent females in Kuwait. The intervention involved six topics targeting the major behavioural risk factors in this population. These topics were physical activity, health nutrition, bone health, prevention of tobacco smoking, prevention of substance abuse, and sun protection. A pre-and post-test, randomised controlled trial design comparing an intervention group with a control group was used to evaluate the effectiveness of the intervention.

The study had seven aims:

(i) increase physical activity
(ii) improve health-related physical fitness components
(iii) improve dietary behaviours
(iv) normalise weight measurements
(v) prevent tobacco smoking and substance abuse
(vi) promote sun protective behaviours
(vii) increase knowledge of each of the six health topics

These aims were addressed as follows:

(i) Sedentary time and elevator use were decreased while light, moderate, and moderate-to-vigorous PA all increased.
(ii) Four out of five fitness components were significantly improved.
(iii) A range of dietary behaviours were improved.
(iv) The intervention did not significantly influence a change on weight measurements.
(v) Prevention of tobacco smoking and substance abuse could not be demonstrated due to pre-existing low prevalence.
(vi) Whilst not significant, there was a trend towards increased use of sun protection and decreased sunbathing following the intervention.
(vii) Overall health knowledge was significantly improved.

The positive findings of the study indicate that a knowledge-based health intervention was effective to promote multiple health behaviours among adolescent females in Kuwait. It is thus worthwhile to integrate these messages into the secondary school mandatory curriculum and to involve the targeted behaviours. For example, reinforce and increase PA in PE class with the emphasis on enjoyment rather than competition. Encourage walking during school recesses. Integrate nutritional education including healthy eating recommendations within the curriculum. Incorporate information about the health risks of tobacco smoking and commonly abused substances into the curriculum with information about dependency and benefits of an early cessation.

Promoting health-related behaviours is affected by environmental and social factors other than an individual's cognition alone. Accordingly, a combination of both individual-level and environmental-level interventions including policy is hence the best way to achieve and maintain positive health behavioural changes in a school setting. Therefore, a number of changes in the school environment are recommended. Provide healthy snacks including fresh fruits and sandwiches in the school canteen and ban sugar sweetened beverages and other energy-dense but low-nutrient foods such as chips, chocolate, and candies. Increase the number of water coolers in the schools and include one in the PE hall. This would be more enhanced if it also involved home such as family reinforcing the behaviours (i.e.

PA, healthy food choices, no smoking). It will further be enhanced if such behaviours are endorsed by different organisations (governmental and non-governmental) alongside advocating policies in the community. This requires a solid and broad collaboration between different sectors of the community, including policymakers.

Further investigation on the intervention effect on a bigger population with a diverse sociodemographic is needed. Examining its effect also on a younger age group, on males, and in private schools would provide additional knowledge of its efficacy across different populations within the same community. There is also a need for studies investigating facilitators and barriers of health-enhancing behaviours, and causes and correlates of health-compromising ones. Identification the sociocultural factors that affect these behaviours as well. In addition, determining the effect of such behaviours on physical, biochemical measurements, and mental health of adolescents. Moreover, assessment of PA by accelerometers in a larger sample, different populations (i.e. younger/older age, males, normal weight/overweight/obese), and under different conditions (i.e. weekday/weekend, summer/winter, academic year/school holiday). Accordingly, it is important to plan and implement health interventions that not only target these behaviours but also their underlying factors. It is important that such interventions are preceded with careful assessment of the personal and socio-environmental factors including cultural ones especially in female adolescents. Underpinning interventions with theory could facilitate behavioural change if theory was carefully selected and properly implemented for the population. In addition, identification of the best method of delivery that adolescents would receive and respond to such interventions (i.e. social media, school curriculum, schools or community-wide campaigns) would provide better outcomes. Interventions should also be proceeded with continuous evaluation and improvement to reach and maintain the targeted behaviours and a long-term follow-up. A multi-component interventions integrating different factors at various levels targeting the adolescent population are imperative for behavioural health promotion in the nation. This will require consistent, sustained, and dynamic partnership between various sectors in the community such as education, health, youth, and policymakers.

Appendices

Appendix I Outline of Educational Curriculum

Outline of Educational Curriculum

Physical Activity

- Definition of physical activity
- Types of physical activity

A. Exercises and sports
   - I. Aerobic
   - II. Anaerobic

B. Transportation (active commuting)
   - I. Walking
   - II. Cycling
   - III. Public transportation
   - IV. Using stairs

C. Occupational
   - I. Desk jobs
   - II. Field jobs
   - III. Labour jobs

D. Household
   - I. Cleaning: wiping, sweeping, and vacuuming
   - II. Grooming
   - III. Laundry and ironing
   - IV. Cooking
   - V. Using stairs

- Intensities of physical activity

A. Light
   - I. Unobserved increase in respiration and heart rate
   - II. No sweating and ability to easily talk

B. Moderate
   - I. Slight increase in respiration and heart rate
   - II. Slight sweating and ability to talk

C. Vigorous
   - I. Great increase in respiration and heart rate
   - II. Sweating and difficult to talk (only able to speak short sentences)

- Benefits of physical activity

A. Physical benefits

   I. Musculoskeletal
   II. Cardiovascular
   III. Neuromuscular
   IV. Physiological/metabolic (weight, fat, and insulin)

B. Therapeutic and preventive benefits

   I. Coronary heart disease
   II. Diabetes mellitus
   III. Breast and colon secondary prevention
   IV. Reduce mortality from heart CVDs, diabetes and cancers.
   V. Increase bone mineral density in osteoporotic females.

C. Cognitive benefits

   I. Improve memory
   II. Increase motor response
   III. Improve task performance
   IV. Increase speed of reaction time
   V. Improve academic performance
   VI. Improve sleep

D. Psychological and social benefits

I. Reduce stress and depression
II. Increase self-efficacy and confidence
III. Enhance social interaction

- Benefits and risk of physical activity in certain conditions

A. Menstruation

B. Pregnancy

- Risks of physical inactivity

   A. Overweight and obesity
   B. Heart diseases
   C. Diabetes mellitus type II
   D. Cancers (breast and colon)
   E. Premature death

- World health organisation (WHO) recommended physical activity for all ages:

   A. 5 years and younger
   B. 5 – 18 years

      I. Moderate to vigorous physical activity for at least 60 minutes per day all week.
      II. More than 60 minutes will result in additional benefits.
      III. Strengthening and weight bearing exercises at least 3 times per week.

C. 19 – 64 years

D. 65 years and older

- Activity pyramid
- Compendium of physical activity

A. Metabolic equivalents (METs) defined by intensity with some examples

I.	Sedentary	< 1.6 METs
II.	Light	1.6 - < 3 METs
III.	Moderate	3 - 6 METs
IV.	Vigorous	> 6 METs

B. Household examples by METs

C. Exercises/sports examples by METs

Healthy Nutrition

- Purpose of food

I. Survive and function

- Additional benefits of foods

A. Reduce stress (B complex vitamins)

B. Boost immune system (Vitamin C, zinc and beta-carotenes)

C. Improve vision (B complex vitamins, green leaves, beta-carotenes, and vitamin C)

D. Prevent depression

E. Improve skin (Vitamin A and C, beta-carotenes, omega 3 oils, vitamin E, zinc and iron)

F. Reduce PMS (soluble fibres and magnesium)

G. Improve sleep (avoid caffeine containing beverages).

H. Improve vigour and concentration (iron)

I. Iron deficiency anaemia

a. Cause

b. Symptoms

J. Strengthen bones (calcium and vitamins D sources)

- Irritable bowel syndrome (IBS)

A. Definition

B. Prevent irritating foods (high fat, caffeine and artificial sweeteners foods beverages, sodas, legumes and cabbage)

C. Reduce and avoid stresses

D. Eat (small meals or portions, food with high fibre, water and fresh juices)

- Benefits of healthy breakfast

A. Weight management

B. Improve memory, alertness, concentration and therefore school grades

C. Improve cardiovascular and skeletal functions

D. Reduce risk of heart diseases

E. Strengthen the bones

- Main food groups, their function, sources and recommended intakes

A. Carbohydrates

B. Proteins

C. Dairies

D. Fat and sugar

E. Fruits and vegetables

- Food pyramid with recommended servings
- Recommended intake by serving (plate)
- Foods with high cholesterol per standard portion (egg the highest)
- Sugar

A. Beverages with high sugar content (sodas with amount of sugar they include)

B. Added sugar amount per day limit ($\leqslant$ 25 grams for females)

C. Sugar crash (glucose crash) definition and symptoms

D. Types of sugar and their sources, calories and taste.

E. Artificial sweeteners (types and risks) and some foods that contain them.

I. Types (saccharin, sucralose, aspartame, and stevia)

II. Some foods and medicines that contain them

III. Some reported risks on them (bladder cancer and headache from saccharin, headache and migraine, nausea, tachycardia, skin rash, increase risk of cancers in animals

- Sodium in salt

A. Benefits and risks

B. Types (processed table salt, sea salt) same sodium amount per weight.

C. Recommended daily intake (6 grams of salt – 2.4 gram of sodium) already consumed from daily diet (bread, cereals or ready-made foods)

D. Salt quantity in some foods and foods with high salt content.

E. Monosodium glutamate (MSG) risks and some foods containing it

- Water

A. Benefits

B. Recommended daily intake

- Caffeine

A. Sources

B. Action

C. Risks when consuming high amounts

D. Energy drinks and their risks

E. Examples of beverages with amount of caffeine in them

- Sports drinks and their benefits
- Dietary supplements (not to over-consume them)
- Weight loss supplements

A. Those sold through social media or online can be uncertified or fake (same appearance but different content)

B. Risks of Sibutramine and some slimming products that has it but unstated (FDA's Medication Health Fraud)

- Eating disorders
  A. Types (anorexia nervosa, bulimia nervosa, binge-eating disorder)
  B. Risks of each type

Prevention of smoking:

- Tobacco definition and source
- Nicotine definition and physiological action (highly addictive substance)
- Other chemical ingredients in cigarettes
- Risks of smoking on body
  A. Mouth and nose
  B. Vision
  C. Skin and face
  D. Heart
  E. Intestine
  F. Lungs
  G. Blood
  H. Bones and joints
  I. Reproductive system
  J. Cancers
- Light cigarettes

A. Definition and synonyms

B. Risks (same harmful ingredients)

- Electronic cigarettes (e-cigarettes)
- Shisha
  A. Nicotine and toxins amounts are higher than cigarettes
  B. Risks
- Difference between cigarettes and shisha
- Toxic gases produce from tobacco smoking (butane, toluene, ammonia, carbon monoxide, and cyanide)
- Second-hand smoking (passive smoking)
  A. Definition
  B. Risks
- Risk of smoking during pregnancy
- Short term effect of smoking
- Cessation of smoking is difficult but beneficial no matter when
- Physiological effects of smoking cessation by duration
  A. Starts after 20 minutes (decrease in heart rate and blood pressure)

B. After 12 hours (carbon monoxide in blood decreases to normal level)

C. After 2 to 3 months (circulation and lung function improve)

D. After 1 to 9 months (coughing and shortness of breath reduce because lungs cilia have regrown)

E. After 1 year (decrease in risk of heart disease by 50%)

F. After 5 years (decrease in risk of mouth, pharynx, oesophagus and bladder cancers by 50%),

G. After 10 years (decrease risk of lung cancer by 50% and decrease risk of throat and pancreatic cancers)

H. After 15 years (Elimination in risk of heart disease)

- Withdrawal symptoms

A. Definition

B. Duration

C. Symptoms

- Negative role of media in smoking promotion
- True stories of former smokers (Videos)

Prevention of substance abuse

- Definition of drug
- Definition of substance abuse (SA)
- Types of SA

  A. Tobacco

  B. Medications

  C. Illicit drugs

- Definition of addiction
- Definition of dependency
- Definition of tolerance
- Causes of SA
- Physiological and psychological effects of SA
- Risks of medications (its danger can equate illicit drugs if misused)
- Illicit substances, types and risks

  A. Opioids

     I. Heroin

     II. Morphine

     III. Methadone

     IV. Opium

  B. Depressants

     I. Alcohol

     II. Cannabis (most common) and marijuana

  C. Stimulants

I. Cocaine and crack cocaine
II. Amphetamines (speed, crystal meths)
III. Ecstasy
IV. Anabolic-androgenic steroids

D. Hallucinogens
I. Cannabis
II. Lysergic Acid Diethylamide (LSD)
III. Ecstasy
IV. Psilocybin (magic mushroom)

- Licit/legal substances types and risks
  I. Tobacco
    a. Cigarettes
    b. Shisha
  II. Prescription medications
    a. Opioids
      i. Morphine
      ii. Methadone
      iii. Fentanyl
      iv. Tramadol
      v. Oxycodone (e.g. Tylox, Percodan)
      vi. Pregbalin (Lyrica)
    b. Depressants
      i. Barbiturates
      ii. Benzodiazepines (e.g. Valium, Xanas, Halcion, Ativan, Librium)
      iii. Sleep aid pills (Ambien, Sonata, Lunesta)
    c. Stimulants
      i. Dextroamphetamine (Dexerdrine)
      ii. Biphetamine (Adderall)
      iii. Methylphenidate (Ritalin)
    d. Anti-depressants (do not generally cause physical dependency)
      i. Uses (obsessive compulsive disorder, post-traumatic stress disorder, general anxiety disorder)
  III. Non-prescription medications
    a. Stimulants
      ii. Dextromethorphan (cough suppressants)
      iii. Oxymetazoline (nasal decongestant spray use over long period)
- Withdrawal symptoms

Bone Health

- Bone composition
  - A. Mineral matrix (inorganic mineral salts) 60-70%
  - B. Non-mineral matrix (collagen and noncollagenous proteins) 22%
  - C. Water 10 – 20%
  - D. Osteoblasts and osteocytes
  - E. Osteoclasts
- Bone properties
  - A. Elasticity (softness)
  - B. Plasticity (roughness)
  - C. Remodelling (renewal)
- Bone structure
  - A. Cancellous bone (spongy)
  - B. Cortical bone (compact)
  - C. Periosteum (membrane)
  - D. Bone marrow (red and yellow)
- Type of bones
  - A. Long bones like femur (thigh bone)
  - B. Short bones like carpals and tarsals (wrist and foot bones)
  - C. Flat bones like skull bones, scapula (shoulder blade), pelvis and ribs.
  - D. Irregular bones like vertebrae, sacrum, and mandible
  - E. Sesamoid bones like the patella (knee cap).
- Bone formation (ossification) and remodelling
  - A. Formation starts at 3rd month of foetal life.
  - B. Remodelling continue through lifetime through two processes:
  - I. Resorption (breakdown of old bone)
  - II. Ossification (formation of new bone)
- Number of bones in the body
  - A. Humans born with 300 the some fused together until puberty and end with 206 bones)
  - B. Most of bones are in the spine (n =33)
- Functions of the skeleton
  - A. Support the body
  - B. Protects vital organs (brain, heart, lungs and spinal cord)
  - C. Production of blood cells through the bone marrow
  - D. Store minerals (calcium and phosphate)
  - E. Store fatty acids
  - F. Balance acid and base in the blood

G. Assist in movement

H. Detox heavy metals and other toxins from the blood

I. Release of osteocalcin which increase production of insulin and reduces excessive fat storage.

- Bone height
    A. Long bones continue grow during childhood and adolescence
    B. Stops at 18 years in females and 20 in males
    C. Can be increased before that time through:
        I. Weight-bearing exercises like jumping
        II. Stretching exercises
        III. Nutrition (calcium and vitamin D)
- Bone density
    A. Mostly complete by 18 years until about 28 years
    B. Factors related to bone density
        I. Genes (dark skin > white > Asian)
        II. Gender (males > females)
        III. Age (90% at 18 years, peaked at 30 years and then decreases)
        IV. Body weight (thinness and low body weight has less)
        V. Hormones
            a. Oestrogen in females
            b. Testosterone in males
            c. Growth hormone
            d. Hyperparathyroidism
        VI. Physical activity (increases bone density)
        VII. Nutrition (calcium and vitamin D)
            a. Main sources of calcium (recommended daily intake is 800mg for 11 – 18-year-old girls)
                i. Dairy (yogurt has the highest)
                ii. Fish with bones (sardines and pilchards)
                iii. Orange juice and figs
                iv. Broccoli and kale
                v. Soya beans
                vi. Nuts
            b. Main sources of vitamin D (recommended daily intake for adolescents is 15 mcg or 600 international unit)
                i. Sunlight
                ii. Dairies (milk and cheese)
                iii. Fish (salmon, tuna and sardines)
                iv. Beef liver

v. Orange juice

vi. Eggs

VIII. Behaviours

a. Smoking

b. Alcohol consumption

c. Anorexia nervosa

IX. Medical conditions

a. Chronic liver disease

b. Thyrotoxicosis

c. Prolonged use of corticosteroids

- Fractures

I. Causes of fractures

a. Fall from height or on a hard surface

b. Collision with a hard object

c. Tripping and spraining foot with tight muscles

d. Overuse bones

II. Types of fractures

a. Oblique

b. Comminute

c. Transverse

d. Spiral

e. Fissure

f. Open compound (most dangerous)

III. Healing time

a. Takes about 3 weeks up to 3 months depending on fracture site and type

- Osteoporosis

I. Definition (silent disease)

II. Risks (fractures)

III. Causing factors

a. Menopause

b. High intake of fatty foods

c. Anorexia nervosa

d. Inadequate intake of dietary calcium and vitamin D

e. Prolonged use of corticosteroids and anticonvulsants

f. Smoking

g. Alcohol consumption

IV. Prevention

a. Physical activity (weight-bearing activities)

i. Walking
ii. Jogging
iii. Jumping
iv. Stairs
v. Tennis
vi. Volleyball and basketball

b. Nutrition

i. Foods containing calcium and vitamin D
ii. Reduce intake of fats
iii. Reduce intake of caffeine
iv. Intake of dietary supplements (calcium and vitamin D) if diet is limited

c. Safe exposure to sun light (early morning up to 1 hour)

d. Refer to physician in case on menstrual irregularity or absence

e. Avoid smoking

f. Maintain healthy body weight

Sun protection:

- UV exposure tanning methods
  - A. Sunbath
  - B. Sunbed
- Type of sun radiations:

A. Visible light

B. Infrared radiations (IR)

C. Ultraviolet radiations (UV)

I. UVA (most dangerous because it penetrates the skin deeper)
II. UVB
III. UVC

- Environmental factors which control the level of UV radiations
  - A. Clouds cover (more than 90% UV penetration)
  - B. Altitude (4% increase in UV for every 300m ascending)
  - C. Latitude (more UV levels closer to the equator)
  - D. Sun height (up to 60% UV received between 10am and 2pm)
  - E. Season (at mid-latitude in the summer)
  - F. Shade (up to 50% ambient UV)
  - G. Ground reflection
    - I. Sand (reflects up to 15% UV)
    - II. Water (95% UV penetrates water, 40% UV in 50cm underwater)
    - III. Fresh snow (reflects up to 80% UV)

- Benefits of UV
    A. Provide vitamin D
    B. Treat many diseases
        I. Rickets
        II. Psoriasis
        III. Eczema
        IV. Lupus vulgaris
        V. Vitiligo
- Risks of UV
    A. Sunburns (frequent sunburns can lead to melanoma)
    B. Skin diseases
        I. Photodermatosis
        II. Actinic keratosis
    C. Premature skin ageing
        I. Wrinkles
        II. Dark spots
        III. Leathery (thick) skin
    D. Eye diseases
        I. Photokeratitis
        II. Photoconjunctivitis
        III. Cataracts
    E. Suppress immunity
        I. Enhance risk of infection
        II. Reduce defence against skin cancer
        III. Decrease the effectiveness of vaccinations
    F. Skin cancers
        I. Melanoma
        II. Non-melanoma (mostly occurs in exposed area like face, ears, ears, neck, lips and back of hands)
            a. Basal cell carcinomas
            b. Squamous cell carcinomas
- Skin colour and skin cancers
    A. Fair and light coloured people have less melanin (more susceptible to skin cancers)
    B. Dark skinned people are less susceptible to skin cancers but more seriously (usually detected at advance stage)
- Risks of sunbeds
    A. Can have more UV radiations than in midday
    B. Has an equal risk to sunbath
    C. Not to be used for people under 18

- Non-UV tanning products (self-tan)
    A. Most has dihydroxyacetone (DHA) which interacts with amino acids in dead skin cells producing a brown colour.
    B. Its exact risks are unknown but the FDA recommends to use it only externally (avoid eyes, nose and mouth areas)
- UVR protection methods
    A. Sunblock (blocks both UVA and UVB)
    B. Sunscreen
        I. Protects against UVA and UVB
        II. Breaks down after couple hours which needs to be reapplied
        III. Sun protection factor (SPF) only measures the protection from UVB
            a. SPF 15 prevents 93% of UVB
            b. SPF 30 prevents 97% of UVB
            c. SPF 50 prevents 98% of UVB
    C. Clothes (light weighted and light coloured)
    D. Hat (protect the face but can get reflected UVR from grounds)
    E. Sunglasses (protect the eyes against UVR)
- Thermal regulation
    A. Normal oral body temperature ranges between 33.2° to 38.1°c.
    B. If body temperature increased over 43°c, a slow tissue burning starts.
    C. The lowest core body temperature occurs in sleep and the highest during early evening
- Mechanisms of thermal regulation during the day
    A. Conduction (15% from ground)
    B. Convection (15%)
    C. Radiation (5%)
    D. Evaporation (80% from sweating and 2% from respiration)
- Types of Heat injuries
    A. Heat stroke (most dangerous)
    B. Heat exhaustion
    C. Heat cramps
- Factors that increase risk of heat injuries
    A. High outside temperature
    B. Humidity
    C. Dehydration
    D. Excess body weight
    E. Heavy or isolated clothes

- Water content in the body
    A. Body is composed of 60% water which varies by:
        I. Body weight (fat mass reduces water content)
        II. Gender (females less than males)
        III. Age (Older less than younger)
        IV. Physical fitness (athletes more than non-athletes)
    B. Water distribution in the body
        I. Blood (83%)
        II. Kidneys (83%)
        III. Heart (79%)
        IV. Lungs (79%)
        V. Spleen (76%)
        VI. Muscles (76%)
        VII. Brain (75%)
        VIII. Intestine (75%)
        IX. Skin (72%)
        X. Liver (68%)
        XI. Bones (22%)
        XII. Adipose tissues (10%)
- Prevention of heat injuries
    A. Hydration (drinking water)

Usually 2 litres per day in regular temperature

The amount increases 4 to 6 litres in hot and humid climate or when exercising.

    B. Wear cotton clothes to allow heat exchange and avoid isolated clothes like nylons.

- Temperature in closed car
    A. Increases by 11°c after 10 minutes under sun in hot weather
    B. Inside the car temperature will be double the outside after one hour under sun.
    C. Children bodies cannot withstand the high temperatures and lead to rapid increase in body temperature and heat stroke leading to death.
        I. Never leave children inside a car alone even for few minutes
        II. Never leave children inside a car even if outside temperate was cool

Appendix II Physical Fitness Tests

Physical Fitness Tests

The tests were adapted from EuroFit test battery.

Oja P and Tuxworth B. Eurofit for Adults – Assessment of Health-related fitness. Finland: Council of Europe Publishing; 1995.

1. Endurance Shuttle Run test (20-m beep test)

Aim of the test:

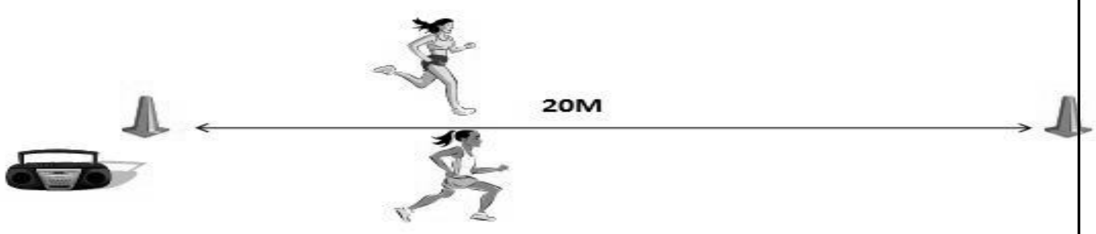
Evaluate the cardiovascular fitness and estimate the maximal aerobic power (VO_2max)

Equipment and material:

- Audio material with recorded beep test (recorded tape – CD – Flash drive)
- Audio player with loud and clear tone
- 2 lines one for the start and the end of the 20m
- A measuring tape
- Indoor space of 20 meter with at least 1 meter before the start line and one after the end line. (Space > 22 meters)
- Flat, firm and non-slippery surface.

Procedures:

1. On hearing the initial starting bleep, run from the start line to the end line arriving before or on time with the subsequent bleep. On hearing this bleep (but not before) run back to the start line again arriving before or on time with the subsequent bleep.
2. One of the feet should touch the line on or before the sound of the beep.
3. The time between the beeps will be reduced which will require the speed of running to increase gradually.
4. The participant should stop when either:
    a. The participant is fatigued, out of breath or have pain in their legs
    b. The participant is unable to reach to either start or end lines from a 3 meters' distance with the sound of the beep on two consecutive times.
    c. When this occurs the participant should stop running and stay in lane until the whole test stops to avoid interrupting the tests or causing injuries.
5. The level and stage when the participant stops are recorded as the result of the test.



2. Flexibility test: Sit and Reach

Aim of the test:

Evaluate trunk flexibility and hamstring tightness

Equipment:

A Box of 32 cm height, 50 cm length and 45 cm width with a top plate length of 75 cm, where the first 25 cm is outside the box border.

A tape measurement fixed on the top plate.

A 30 cm ruler crossing the tape measurement.

Procedure:

1. The participant sits on the floor with knees fully extended.
2. The examiner sits beside the participant and put her hand on the knees to fix them straight.
3. The participant should try to extend her hand toward the box as far as possible with pushing the ruler over the measuring tape and hold the position without bouncing for 2- 3 seconds.
4. The knees should not be bent.
5. The test is done for 2 trials and the better score is recorded.

3. Muscles strength: Vertical Jump

Aim of the test:

Measure the maximal vertical jump which is related to maximal lower limb muscles strength, endurance and coordination.

Equipment:

Contact mat (Probotics, Inc.) which measures the jumping height by calculating the hang time of the body in the air off the mat until landing on the mat.

Assembling:

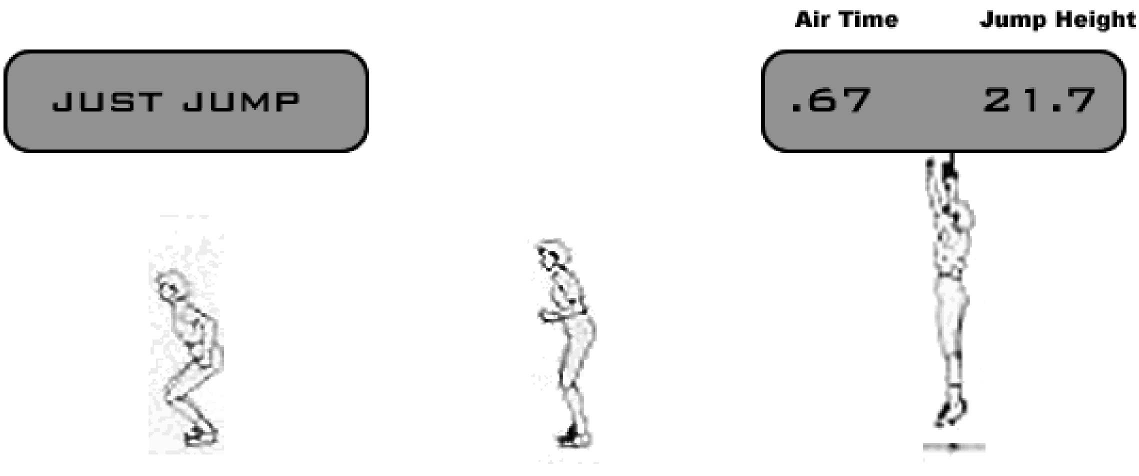
Place the mat on a hard level surface.

Connect the mat to the digital meter.

Switch on the meter and choose 1 jump mode.

Procedure:

1. The participant stands on the mat with extended knees and keeps them slightly apart.
2. The participant is asked to jump as high as possible and land on the mat.
3. The score will be displayed on the right side of the meter.



4. Dynamic sit-ups

Aim of the test:

Evaluate the trunk muscles strength and endurance

Equipment:

Exercise mat

Procedure:

1. The participant lye on the mat with knees bent to 90°.

2. The examiner stabilise the knees straight by hand.

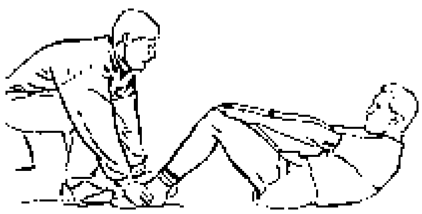
3. The examiner asks the participant to sit from lying 5 consecutive times in 3 positions:

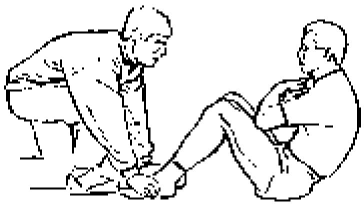
First position: The hands are extended with palms of the hands rested on the thighs – the fingertips of both hands should reach the knee caps (patella)

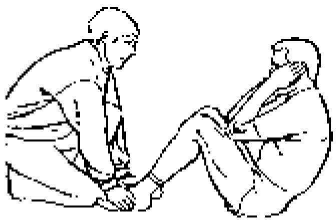
Second position: The hands are bended over the chest – the elbows should reach the thighs

Third position: Touching the earlobes with fingertips - the elbows should reach the thighs.

4. The score is taken from the number of repetitions performed out of 15.







5. Single Leg Balance:

Aim of the test:

Evaluate total body balance.

Equipment:

Stop watch

Procedure:

Balance on a flat and firm surface for 30 second with closed eyes.

1. The test is performed n barefoot or with stockings.
2. The test is done on the preferred foot by participant.
3. Two trials should be done before the actual test.
4. Movements of the hands and free foot are allowed.
5. Bouncing or shifting the tested foot are not allowed.
6. The test is started when participant is balanced.
7. The time stopped when the participant loses her balance.
8. The test is immediately and directly repeated until the 30 second time is completed.
9. The test is scored by the number of repetitions in 30 seconds.
10. If the participants lose her balance 15 times in the first 15 seconds or she is unable to balance on one leg the score will be 30.

Appendix III Information on Accelerometer

Information on accelerometer (activity monitor)

What is accelerometer (activity monitor)?

It is a device to monitor physical activity which provides objective measurements of human movement and used in many researches and clinical application. It includes a small electromechanical system and ambient light sensor.

How does it work?

Detect movement from three axes: vertical axis (standing), horizontal axis (lying) and perpendicular axis (sitting) in addition to the ambient light and then records the amount of energy consumed and save it in internal memory.

Is it safe?

Yes, it is safe and has no known harms as you can see from table below.

	Compliant with IEC (International Electrotechnical Commission) standards for "Type BF Applied Part" - meaning they comply with requirements for protection against electrical shock.
	Approved from US Food and Drug Administration (FDA) as a Class II medical device
	Compliant with part 15 of the FCC (Federal Communication Commission) Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
	Has been approved to be sold as medical devices according to the European Union's regulatory requirements
Ø	Does not produce any known physiological effects.
	Manufactured Lead-Free and comply with RoHS standards (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment)
	Water resistant in accordance with IEC 60529 and have the International Protection Rating: IPX7, or immersion in one (1) meter of water for up to 30 minutes.
	Do not dispose it in waste bins

http://www.actigraphcorp.com/

How and where it will be worn?

It will be attached by an elastic belt on lower waist as you can see in the picture. It can be worn on or below clothes as long as it fixed and does not flip.

How to know the stored information?

Information stored in the device will be retrieved by the researcher through attaching it to a computer which has a specialised software to extract and analyse the information.

Appendix IV Health Knowledge Questionnaires

Health Knowledge Questionnaire of Physical Activity

Please choose the correct answer from the given choices

Q1. Physical activity includes:

a. Sports
b. Exercises
c. Cleaning the house
d. All of the above

Q2. Duration of physical activity each day during adolescence should be at least:

a. 30 minutes
b. 45 minutes
c. 60 minutes
d. 90 minutes

Q3. Number of days of physical activity per week during adolescence should be:

a. One day
b. Three days
c. Five days
d. Seven days

Q4. Vigorous intensity activities which strengthen muscles and bone should be performed at least:

a. Once a week
b. Twice a week
c. Three times a week
d. Four times a week

Q5. Physical activity is important for:

a. All ages
b. Children and adolescents
c. Adults
d. Elderly

Q6. Benefits of physical activity for youth are:

a. Develop healthy bones, muscles, and joints
b. Develop coordination and movement control
c. Develop healthy heart and lungs
d. All of the above

Q7. Physical activity:

a. Is not needed for a thin person
b. Does not require a long time to show a benefit
c. Frequently leads to injuries
d. Causes an immediate increase in muscularity of the body

Q8. Physical activity contributes to:

a. Treatment of hypertension and diabetes
c. Maintain or reduce weight
b. Prevention of heart disease, breast and colon cancers
d. All of the above

Q9. Physical activity is not advisable for:

a. Thin people
c. Obese people
b. Overweight people
d. Those with major health problems

Q10. Physical activity is dangerous during:

a. Pregnancy
c. Hot weather
b. Menstrual period
d. All of the above

Q11. Main barrier for physical activity is:

a. Time available
c. Lack of motivation
b. Unsuitable weather
d. Activity changes the appearance

Q12. Physical activity should be stopped and consult the doctor in case of:

a. Heart and chest pain
c. Shortness of breath
b. Severe pain in bones, joints or muscles
d. All of the above

Q13. Which one of the following is most likely classed as a light physical activity?

a. Swimming
c. Walking
b. Fencing
d. Climbing stairs

Q14. Which one of the following is most likely classed as a moderate physical activity?

a. Cycling
c. Basketball
b. Aerobics
d. Tennis

Q15. Which one of the following is a vigorous intensity physical activity?

a. Bowling
c. Table tennis
b. Handball
d. Golf

Health Knowledge Questionnaire of Nutrition

Please choose the correct answer from the given choices

Q1. Number of main food groups is:

a. 3 c. 5

b. 4 d. 6

Q2. What is the primary source of energy in the food?

a. Proteins c. Fat

b. Carbohydrates d. Milk and dairy products

Q3. How many portions of fruits and vegetables should be consumed in a day?

a. 2 c. 4

b. 3 d. 5

Q4. How many glasses of fluids the body needs in a day?

a. 1 - 3 c. 6 - 8

b. 4 - 6 d. 10 – 8

Q5. If you often feel tired and exhausted, it is probably because of low:

a. Iron c. Calcium

b. Magnesium d. Potassium

Q6. The best way to make you feel full for longer is by eating:

a. Low-fibre foods c. Sugar-rich foods

b. High-fibre foods d. Fat-rich foods

Q7. Skipping breakfast may lead to:

a. Increased risk of heart diseases c. Weight gain

b. Less mental concentration d. All of the above

Q8. One of the following is NOT the result of excessive consumption of caffeinated beverages:

a. Dehydration c. Incontinence

b. Low blood pressure d. Indigestion

Q9. The best source of calcium is:

a. Low-fat yogurt c. Cheese

b. Low-fat milk d. Soya milk

Q10. What is the healthiest type of sugar?

a. White sugar c. Fruit sugar

b. Brown dark sugar d. Artificial sweetener

Q11. What is the highest cholesterol food of the following?

a. Lobster c. Cheeseburger

b. Liver d. Egg yolk

Q12. What is the highest containing salt food of the following?

a. Fish c. Pickles

b. Cheese d. Instant noodles

Q13. One of the following is a healthy diet:

a. Low-carb diet c. Low-fat diet

b. Low-protein diet d. Low-water diet

Q14. You most likely have an eating disorder, if you:

a. Worry to eat because of fear of weight gain c. Eat excessively until stage of discomfort or pain

b. Self-induced vomiting or frequent use of laxatives d. All of the above

Q15. One of the following is NOT a consequence of eating disorders:

a. Irregular heartbeat c. Dry skin, hair loss, and weak bones.

b. Diarrhoea d. Irregular menstruation or its loss

Health Knowledge Questionnaire of Bone Health

Please choose the correct answer from the given choices

Q1. Percentage of water in bones is:

a. 0% c. 30 – 40%

b. 10 – 20% d. 50 – 60%

Q2. The highest number of bones in the body is located in the:

a. Spine c. Hand

b. Foot d. Head

Q3. Which of the following is not a function of the bones?

a. Support the body c. Produce blood cells

b. Protect the internal organs d. Create movement

Q4. One of the following choices does not reduce bone strength in females:

a. Menstrual irregularity c. Sports

b. Thinness d. Obesity

Q5. Which of the following vitamins is essential for bone strength?

a. Vitamin A c. Vitamin C

b. Vitamin B d. Vitamin D

Q6. Bones are:

a. Totally rigid c. Filled from inside

b. Empty from inside d. None of the above

Q7. Bone characteristics include:

a. Renewal c. Flexibility

b. Rigidity d. All of the above

Q8. Bone maturation in girls is normally completed at the age of:

a. 17 c. 19

b. 18 d. 20

Q9. The body starts to lose the bone cells after the age:

a. 30 c. 50

b. 40 d. 60

Q10. Most dangerous type of bone fracture is:

a. Close c. Comminuted

b. Open d. Avulsion

Q11. One of the following does not cause bone fractures:

a. Carry loads c. Collision with a hard object

b. Falling on a hard surface d. Repetitive stress

Q12. Osteoporosis means:

a. Softness of the bones c. Cracking of the bones

b. Weakness of the bones d. Condensing the bones

Q13. The cause of osteoporosis is:

a. Lack of water c. Lack of calcium

b. Lack of salts d. Lack of platelets

Q14. Which of the following is a symptom of osteoporosis?

a. Pain in the bones c. Bone crackling

b. Swelling of the bones d. None of the above

Q15. Which is not a way of preventing osteoporosis?

a. Exercises c. Healthy nutrition

b. Avoid smoking d. Drinking water

Health Knowledge Questionnaire of Smoking

Please choose the correct answer from the given choices

Q1. Smoking can lead to:

a. Heart and lung disease
c. Premature death
b. Cancer
d. All of the above

Q2. Nicotine in cigarettes and shisha reaches the brain after:

a. 10 seconds of smoking
c. 10 hours of smoking
b. 10 minutes of smoking
d. 10 days of smoking

Q3. One of the following is NOT an ingredient in a cigarette?

a. Alcohol
c. Silicone
b. Benzene
d. Sugar

Q4. Which of the following is NOT a consequence of inhalation the smoke of smokers?

a. Miscarriage
c. Increased risk of cancer and heart diseases
b. Thalassemia
d. Shortness of breath and asthma

Q5. Children's inhalation of the smoke of smokers contributes to?

a. Respiratory tract infections
c. Ear infection
b. Sudden death
d. All of the above

Q6. Smoking shisha is:

a. Less harmful than cigarette
c. Equal to cigarette in harm
b. More harmful than cigarette
d. Has no harm

Q7. One of the following is NOT a consequence of shisha smoking:

a. Tuberculosis
c. Wrinkles of the skin
b. Spread infection
d. Burn of the lungs via inhalation

Q8. Which of the following is/are a result smoking during pregnancy?

a. Miscarriage c. Birth defects of the infant

b. Premature birth d. All of the above

Q9. Which of the following is not contained in the gases from cigarette smoke?

a. Cyanide gas c. Ammonia gas

b. Ozone gas d. Carbon monoxide

Q10. Cigarettes which are sold as 'light' type are:

a. Less dangerous than regular cigarette c. Equal in danger with regular cigarette

b. More dangerous than regular cigarette d. Not dangerous

Q11. Quitting smoking is difficult because of:

a. Addiction c. Getting used to smoking

b. Triggered feeling by smoking d. All of the above

Q12. Effect of quitting smoking on the body starts from:

a. 20 minutes of smoking cessation c. 12 hours of smoking cessation

b. 2 hours of smoking cessation d. 2 weeks of smoking cessation

Q13. One of the following is the immediate effect of quitting smoking:

a. Slowing heart beats c. Coldness of the tips of fingers and toes

b. Increased blood pressure d. Loss of appetite

Q14. Which of the following is the effect of a month of quitting smoking?

a. Reduced the risk of heart diseases to half c. Reduced risk of lung cancer to half

b. Lungs start self-repair d. Reduced risk of stroke same as non-smoker

Q15. How long does it take the body of a smoker to get back to his/her health before starting to smoke?

a. 5 years c. 15 years

b. 10 years d. Never gets back to his complete health

Health Knowledge Questionnaire of Harmful Substances

Please choose the correct answer from the given choices

Q1. Substance abuse means the harmful and hazardous use of psychoactive substances which include:

a. Prescription painkillers
c. Alcohol and tobacco

b. Illicit drugs
d. All of the above

Q2. The most common illicit drug in the world is:

a. Crystal meth
c. Cocaine

b. Cannabis
d. Heroin

Q3. Addiction means all BUT?

a. Strong urge to use the substance
c. Continue to use it despite the harmful consequences

b. Reduced substance's tolerance with time
d. Difficulty in controlling its use

Q4. Which does substance's tolerance mean?

a. Ability to withstand substances without any harm
c. Intense need to use the substances

b. Increase the dose to reach the desired result
d. Desire to use different substances

Q5. Continuous use of harmful and hazardous substances leads to:

a. Decreased mental skills
c. Severe depression

b. Psychosis
d. All of the above

Q6. Which of the following is NOT a result of drug abuse?

a. Distort person's perception
c. Increase concentration and thinking

b. Block all feelings
d. Death

Q7. Which of the following substances DOES NOT cause addiction but is dangerous?

a. Hallucinogens
c. Depressants

b. Stimulants
d. Opioids

Q8. Some of the harmful and hazardous substances remain in the body for a period which can last to:

a. A week c. 6 months

b. A month d. A year

Q9. Overdose occurs because of the excessive use of:

a. Illicit drugs c. Steroids

b. Medications d. All of the above

Q10. Medication abuse means:

a. Using prescribed medications without consulting a physician c. Using someone else's prescribed medications

b. Using medications against prescribed dose and duration d. All of the above

Q11. Which of the following prescription drugs DOES NOT lead to dependency?

a. Tranquilisers c. Antidepressants

b. Strong painkillers d. Stimulants

Q12. Which of the following non-prescription drugs DOES NOT leads to dependency?

a. Decongestant nasal spray c. Flu medications

b. Asthma inhaler d. Cough syrup

Q13. Which of the following is NOT an effect of the drug, Lyrica?

a. Suicidal thoughts c. Drowsiness and somnolence

b. Weight loss d. Hives

Q14. Which of the following is NOT a side effect of Tramadol containing drugs?

a. Addiction c. Hallucinations

b. Death d. Decreased body temperature

Q15. Which of the following is NOT a withdrawal symptom of addiction?

a. Seizures c. Slowing heart rate

b. Nausea and vomiting d. Difficulty in breathing

Health Knowledge Questionnaire of Sun and Heat

Please choose the correct answer from the given choices

Q1. The most harmful type of sun radiations which causes sunburn is:

a. Infrared radiations c. Visible light

b. Ultraviolet radiations d. Blue light

Q2. The most dangerous type of radiations which causes skin cancer is:

a. UVA c. UVC

b. UVB d. UVD

Q3. Sun radiation is essential for the production of:

a. Calcium c. Vitamin A

b. Potassium d. Vitamin D

Q4. Long exposure to the sun may leads to:

a. Skin ageing c. Skin cancer

b. Cataracts d. All of the above

Q5. Skin cancer affects?

a. Light skinned people c. Dark skinned people

b. Moderate skinned people d. All of the above

Q6. Sun protection factor 30 known as SPF30 in sun protection lotion or spray blocks:

a. 30% of UVB c. 97% of UVB

b. 70% of UVB d. 53% of UVB

Q7. Best method of sun protection is:

a. Sun protection lotion c. Using umbrella

b. Wearing hat d. Wearing light colour clothes

Q8. Sun bathing (sun exposure to get skin tan):

a. Less harmful than sunbed
c. Equal in harm to sunbed
b. More harmful than sunbed
d. Has no harm

Q9. Most heat exchange between the body and the environment is done through the mode:

a. Conduction
c. Radiation
b. Convection
d. Evaporation

Q10. Normal oral body temperature in females, ranges between:

a. 37°C – 37.1°C
c. 33.2°C – 38.1°C
b. 37°C – 38.5°C
d. 37.7°C – 39.3°C

Q11. Peak body temperature occurs during the:

a. Morning time
c. Afternoon time
b. Noon time
d. Evening time

Q12. Risk of heat stroke increases when the weather is:

a. Hot and dry
c. Hot and rainy
b. Hot and humid
d. Hot and dusty

Q13. The best type of clothes to prevent heat injuries is:

a. Cotton clothes
c. Wool clothes
b. Heat isolated clothes
d. Loose clothes

Q14. How much fluid does the body need in hot weather?

a. A litre
c. 4.5 litres
b. Two litres
d. 6.5 litres

Q15. Temperature inside a closed car after one hour under the sun equals?

a. Half of the outside temperature
c. Double the outside temperature
b. The outside temperature
d. Quarter of the outside temperature

Appendix V Piloted Physical Activity Questionnaire

Physical Activity Questionnaire for Adolescent Girls

Please tick √ the closest answer to your usual activity during the week from the following:

Sleep

How many hours you sleep at night?

Less than 4 hours ☐ 4 to 5 hours ☐ 6 to 7 hours ☐ 8 or more

Do you sleep during the day? (Afternoon)

No

Yes, how many hours?

☐ Less than 1 hour ☐ 1 hour ☐ 2 to 3 hours ☐ > 3 hours

School

How many physical education classes you have per week?

☐ None ☐ 1 per week ☐ 2 per week ☐ 3 per week ☐ 4 per week

How much time you spend physically active (run, jump, step, exercise…etc.) in PE class?

☐ 5 minutes or less ☐ 10 - 15 minutes ☐ 20 minutes 30 minutes ☐ 45 minutes or more

How do you spend your time during breaks?

☐ Sitting (eating, talking, reading, writing) ☐ Standing or walking around ☐ Run or play

Weekdays

How much time you spend sitting at home on weekdays? (i.e. study, watch TV, use PC, tablet, mobile)

☐ 1 – 2 hours ☐ 3 – 4 hours ☐ 5 – 6 hours ☐ 7 – 8 hours ☐ 9 hours or more

How much time you spend walking outside home during weekdays?

☐ Never ☐ 5 minutes or less ☐ 10 – 15 minutes ☐ 20 - 30 minutes ☐ 1 hour or more

Which one of the following you participate in during weekdays (not training)? (10 continues minutes or more)

☐ None ☐ Brisk walking ☐ Jogging ☐ Swimming ☐ Cycling

☐ Gym exercise, please specify ……………………………………………………………

How many times you participate in it during weekdays?

□ 1 day/week □ 2 days/week □ 3 days/week □ 4 days/week □ 5 days/week

How long you spend on it?

□ 10 - 15 minutes □ 20 minutes 30 minutes □ 40 - 50 minutes □ 1 hour or more

How many times you use each of the following during the weekdays?

Stairs: □ Never □ 1 time □ 2 – 3 times □ 4 – 5 times □ 6 times or more

Elevator/escalator: □ Never □ 1 time □ 2 – 3 times □ 4 – 5 times □ 6 times or more

Sports

Do you participate in competitive sports?

□ No

□ Yes, please specify

□ Basketball □ Volleyball □ Football □ Handball □ Taekwondo

□ Karate □ Athletics 100m/200m/400m/hurdles/high jump/long jump/

triple jump/discus/javelin/batons

How many days you practice in a week?

□ 2 days/week □ 3 days/week □ 4 days/week □ 5 days/week □ 6 days/week or more

How long you are very active (sweating, harder breath, higher heart beats) during the practice?

□ 10 – 15 minutes □ 20 – 30 minutes □ 40 – 50 minutes □ 1 hour or more

Weekends

How much time you spend sitting at home on weekends? (i.e. study, watch TV, use PC, tablet, mobile)

□ 1 – 2 hours □ 3 – 4 hours □ 5 – 6 hours □ 7 – 8 hours □ 9 hours or more

Which one of the following you participate in during weekends (not training)? (10 continues minutes or more)

□ None □ Brisk walking □ Jogging □ Swimming □ Cycling

□ Gym exercise, please specify ……………………………………………………………

How many times you participate in it during weekends?

□ 1 day in the weekend □ 2 days in the weekend

How long you spend on it?

□ 10 - 15 minutes □ 20 minutes 30 minutes □ 40 - 50 minutes □ 1 hour or more

How many times you use each of the following during the weekends?

Stairs: □ Never □ 1 time □ 2 – 3 times □ 4 – 5 times □ 6 times or more

Elevator/escalator: □ Never □ 1 time □ 2 – 3 times □ 4 – 5 times □ 6 times or more

How did you find the questionnaire?

Do you have any recommendation?

Appendix VI Health Behaviours Questionnaire

Health Related Behaviours and Attitudes Questionnaire

Dear Participant:

The purpose of the questionnaire is to identify the health knowledge of the girls and their health-related attitudes and behaviours to form a database for future investigations.

We would like to ensure confidentiality of the information giving when answering this questionnaire, which will be anonymous and the person who filled it will be unidentified and it will be given a random ID number for the research purpose as seen on the box at the top right corner of the questionnaire.

Please memorise the ID number for the upcoming questionnaires which will have the same ID number for each participant.

Only the researcher (Noor Alfailakawi) will have the right to view it who will not be able to identify the person who filled it.

The questionnaire is not a test and the answers will not be corrected or evaluated it is just for the collection of information for the research purpose. Therefore, do not worry whether your answer is correct or not.

It will help us to construct educational programmes for health promotion among adolescent females in the region.

Therefore, Please:

✍ Fill the entire questionnaire and make sure you have answered all the questions.

✓Fill the questionnaire to the best of your knowledge and ability.

? Ask for help if you did not understand any of the questions or answers.

Thank you for your help with the study

Please fill the blanks with the appropriate information and tick (✓) the true answer:

Social Information

Date of Birth: _____/___/______ Height:_________cm, Weight:______________Kg

Nationality: ___________________, Living Area:________________ __, School grade: 10th / 11th / 12th

I live with my parents □Both □ One □Other, please specify ....

How many family members living at home? □ 1 - 2 □ 3 – 5 □ 6 and more

Number of the employed members from the family living at home □None □ 1 - 2 □ 3 – 5 □ 6 and more

Number of domestic workers (i.e. maids, driver, cook, housekeeper...etc.) □None □ 1 - 2 □ 3 – 5 □ 6 and more

7. Type of Residence □A House, no. of floors □A floor in a house, floor no □Residential building, floor no

(Example: basement + ground + second floor + roof floor = 4)

8. Is there an elevator at the residence □ No □Yes, 9. If yes, how many times do you use it in a day: □Never □ Once □ Twice □ 3 times □4 and more

Personal Health Information

10. Is your period □ Regular □ Not regular? (Regular means it occurs monthly)

11. How old were you when you had your first period? _______years

12. Do you use drugs for regulating or delaying your period? □ No □ Yes, it's purpose....................

13. Do you take drugs to reduce period's symptoms? □ No □ Yes, please state them...................

Physical Activity

Physical activity is divided into four parts: physical activities during school, physical activities at home, activities to transport to and from places, and physical activities during leisure time like sports and exercises

PART 1: SCHOOL-RELATED PHYSICAL ACTIVITY

A. During Physical Education Classes

14. How many physical education (PE) classes did you have the last 7 days?

□ 1 class □ 2 classes □ 3 classes □ 4 classes □ 5 classes

15. How much time you spent in TOTAL during PE classes doing sports, exercises, running…etc., for at least 10 uninterrupted minutes?

□ 30 minutes □ 45 minutes □ One Hour □ One and a half hour □ Two hours and more

B. During Breaks

16. How many days during the last 7 days did you spend walking for at least 10 uninterrupted minutes during the breaks?

□ None □ 1 day □ 2 days □ 3 days □ 4 - 5 days

17. How long did you spend walking during one day?

□ 10 minutes □ 15 minutes □ 20 minutes □ 25 minutes □ 30 minutes and more

18. How many days during the last 7 days you spent sitting during the breaks?

□ None □ 1 day □ 2 days □ 3 days □ 4 - 5 days

19. How long did you spend sitting during one day?

□ 10 minutes □ 15 minutes □ 20 minutes □ 25 minutes □ 30 minutes and more

PART 2: HOUSEWORK AND GARDENING

20. How many days during the last 7 days did you spend doing physical activities in the garden or in home that makes you breathe slightly or much harder than normal for at least 10 uninterrupted minutes? (Like cleaning, vacuuming, carrying load…etc.)

□ None □ 1 day □ 2 – 3 days □ 4 -5 days □ 6 -7 days

21. How long did you spend on those activities in one day?

□ 10 minutes □ 15 minutes □ 20 minutes □ 25 minutes □ 30 minutes and more

PART 3: TRANSPORTATION

This part is about how you transfer from place to place, including places like school, malls, supermarket…etc.

22. How many days did you walk for at least 10 uninterrupted (without stopping) minutes to get from a place to another?

□ None □ 1 day □ 2 – 3 days □ 4 -5 days □ 6 -7 days

23. How long did you spend walking in a one day?

□ 10 minutes □ 15 minutes □ 20 minutes □ 25 minutes □ 30 minutes and more

24. How many days did you use car for at least 10 uninterrupted minutes to get from a place to another?

□ None □ 1 day □ 2 – 3 days □ 4 -5 days □ 6 -7 days

25. How long did you spend transferring by a car in a one day?

□ 10 minutes □ 15 minutes □ 20 minutes □ 25 minutes □ 30 minutes and more

PART 4: SPORTS AND LEISURE TIME PHYSICAL ACTIVITY

This part is about the sports and exercises you do on your leisure-time and NOT IN THE SCHOOL

26. How many days did you WALKING for at least 10 uninterrupted minutes in your leisure time and NOT FOR TRANSPORTATION?

□ None □ 1 day □ 2 – 3 days □ 4 -5 days □ 6 -7 days

27. How long did you spend walking for leisure time in a one day?

□ 10 minutes □ 15 minutes □ 30 minutes □ 45 minutes □ 60 minutes and more

28. How many days did you engaged in moderate physical activities for at least 10 uninterrupted minutes that make you breathe slightly harder than normal like swimming at regular pace, table tennis…etc. out of the school?

□ None □ 1 day □ 2 – 3 days □ 4 -5 days □ 6 -7 days

29. How long did you spend on those activities in a one day out of the school?

□ 10 minutes □ 15 minutes □ 30 minutes □ 45 minutes □ 60 minutes and more

30. How many days did you engaged in vigorous physical activities that make you breathe much harder than normal like aerobics, running, fast swimming, etc., out of the school?

□ None □ 1 day □ 2 – 3 days □ 4 -5 days □ 6 -7 days

31. How long did you spend on those activities in a one day out of the school?

□ 10 minutes □ 15 minutes □ 30 minutes □ 45 minutes □ 60 minutes and more

32. Does your father engage in physical activity? □ No □Yes

33. Does your mother engage in physical activity? □No □Yes

34. If you DO engage in regular physical activity, please state the MAIN reason:

- □ To maintain or lose weight
- □ To acquire physical fitness
- □ To maintain and strengthen the muscles
- □ To promote healthy living
- □ To enhance the social interaction

35. If you DO NOT engage in exercise, please answer the following:

Is it because it interferes with the study time? □ No □Yes

Is it due lack of time? □ No □Yes

Is it due to disrupting aesthetic appearance (avoid sweating, messing hair…etc)? □ No □ Yes

Do you avoid it because of embarrassment of being overweight? □ No □ Yes

Is it due to lack of motivation? □ No □ Yes

Is it due to lack of support from family? □ No □ Yes

Is it due to lack of support from friends? □ No □ Yes

Is it due to lack of interest in physical activity? □ No □ Yes

Is it because you are concerned about muscularity that would change your body frame? □ No □ Yes

Is it due to lack of facilities? □ No □ Yes

Is it because of difficulty reaching the place, a long distance of the place, or heavy traffic? □No □ Yes

Is it because of lack of safety and security? □ No □ Yes

Does it have to do with a challenge to with traditions and cultures? □ No □ Yes

Do you think that you do not need physical activity? □ No □ Yes

Is it because of unsuitable weather? □ No □ Yes

Is it because of medical reasons that restrict your engagement in physical activity/exercise? □ No □ Yes

If there are other reasons, please state them………………………………………………………..

Nutrition

Weight and Diet:

36. Do you consider your weight? □ Slim □ Overweight □ Normal weight

37. Do you feel embarrassed from your weight? □ Yes □ No

38. Are you currently following a diet? □ Yes □ No

39. Are you thinking of undergoing any surgical procedure for weight loss? □ Yes □ No

Eating Habits

A. Meals and major foods:

40. How often do you have breakfast? □ Never □ Sometimes □ On holidays only □ On schooldays only □ Daily

41. How often do you have lunch? □ Never □ Sometimes □ On holidays only □ On schooldays only □ Daily

42. How often do you have dinner? □ Never □ Sometimes □ On holidays only □ On schooldays only □ Daily

43. Do you consume dairy daily? □ No □ Yes, How many times? □ once □ twice □ 3 and more

44. Do you eat fruit or fresh juices daily? □ No □ Yes, How many? □ once □ twice □ 3 and more

45. Do you eat vegetables or a salad daily? □ No □ Yes, How many? □ once □ twice □ 3 and more

46. How many times do you eat meat, chicken, or seafood in a week? □ Never □ Once □ 2-3 □ 4-5 □ 6 and more

B. Snacks and minor food:

47. How many times do you eat dessert in a week? □ Never □ Once □ 2-3 □ 4-5 □ 6 and more (Examples: Chocolates, candies, cakes, biscuits, cookies, ice creams…etc.)

48. How many times do you eat fried foods in a week? □ Never □ Once □ 2-3 □ 4-5 □ 6 and more (Examples: fries, chicken, nuggets, burgers, shrimps…etc.)

49. Do you like the food □ little salted □ moderately salted □ highly salted

50. Do you eat snacks between meals? □ No □ Yes

51. What kind of snacks do you have? (you may choose more than one choice) □ Nuts/seeds □ chips/popcorns □ chocolates/candies □ biscuits/cookies □ Fruits/vegetables

52. How many times per week do you eat from restaurants? (Delivery – dine in)?
□ Never □ Once □ 2-3 □ 4 and more

C. Beverages:

53. How many glasses of water do you drink in a day? □ Never □ Once □ 2-3 □ 4 and more

54. How many glasses/cans of juice do you drink in a day? □ Never □ Once □ 2-3 □ 4 and more

55. How many glasses/cans of soda (coke, seven-up, Miranda…etc.) do you drink in a day?
□ Never □ Once □ 2-3 □ 4 and more

56. How many glasses/cans of energy drinks (red bull, power horse…etc.) do you drink in a day?
□ None □ 1 -2 □ 3 - 5 □ 6 and more

57. How many cups of coffee/tea do you drink in a day? □ None □ 1 -2 □ 3 - 5 □ 6 and more

Medications and drugs

58. Do you take any prescribed medications (drugs, injections, inhalant…etc.) □ No □ Yes, please state the reason…………………………………..

59. Do you take weight loss drugs? □ No □ Yes, please state the names…………………………………………….., Is this drug on prescription? □ No □ Yes

60. Do you take any supplements? □ No □ Yes, please specify ……………………………………………………………

61. Do you take tramadol containing drugs? □ No □ Yes, If the answer was yes, do you take it with prescription? □ No □ Yes, please state the reason…………………………………………………………

62. Do you take (Lyrica) drug? □ No □ Yes, If the answer was yes, do you take it with prescription? □ No □ Yes, please state the reason…………………………………………………………

Behaviours

63. Do you smoke? □ No □ Yes

64. If yes, what kind of tobacco smoking? □ Cigarettes □ Shisha/Pipe □ Both

65. If you do smoke, please fill the following table:

Type of Smoking	Quantity by number	Frequency by day/week/month
Cigarettes		
Shisha		

66. Are there any smokers in your home? □ No □ Yes, If yes, please state the number of smokers

67. Do you have female friends who smoke? □ No □ Yes

68. If you do not smoke, do you think of smoking? □ No □ Yes

69. Do you use sun protection when going out? □ No □ Yes,

If the answer was yes, please specify the type □ Ointment □ Spray □ Umbrella/Cap

70. Do you use sun bath (sun exposure) for tanning? □ No □ Yes,

If the answer was yes, what is the period: □ less than 15 mins □ 15-19 mins □ 20-30 mins □ 31 - 45 mins □ 46 mins and more

71. Do you use the sun bed for tanning? □ No □ Yes,

If the answer was yes, what is the period: □ 5 minutes □ 6 - 10 mins □ 11 - 15 mins □ 16 - 20 mins □ more than 20 mins

Thank you for completing this questionnaire

Appendix VII College Ethical Approval

University of Glasgow | College of Medical, Veterinary & Life Sciences

20 November 2014

Dr John MacLean
Honorary Clinical Senior Lecturer in Sport & Exercise Medicine
University of Glasgow

Dear Dr MacLean «Principal_Investigator»

MVLS College Ethics Committee

Project Title: Girls Life Enhancing Attitudes and Motives (GLEAMs) - A Health Educational Programme for Adolescent Females in Kuwait
Project No: 200140021

The College Ethics Committee has reviewed your application and has agreed that there is no objection on ethical grounds to the proposed study. It is happy therefore to approve the project, subject to the following conditions:

Project end date: 1st June 2015.

The research should be carried out only on the sites, and/or with the groups defined in the application.

Any proposed changes in the protocol should be submitted for reassessment, except when it is necessary to change the protocol to eliminate hazard to the subjects or where the change involves only the administrative aspects of the project. The Ethics Committee should be informed of any such changes.

You should submit a short end of study report to the Ethics Committee within 3 months of completion.

Yours sincerely

Willie Martin

Professor William Martin
College Ethics Officer

Professor William Martin

Professor of Cardiovascular Pharmacology

R507B Level 5
School of Life Sciences
West Medical Building
Glasgow G12 8QQ Tel: 0141 330 4489

E-mail: William.Martin@glasgow.ac.uk

Appendix VIII Participants' Information Sheet

University of Glasgow | College of Medical, Veterinary & Life Sciences

PARTICIPANT'S INFORMATION SHEET

1. **Study title**

GLEAMs project: An Educational Programme to Enhance Healthy Behaviours among Adolescent Females in Kuwait.

2. **Invitation paragraph**

You are being invited to take part in a research study. Before you decide it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

3. **Supervised Parties:**

University of Glasgow/ Institute of cardiovascular and medical sciences

Kuwait University/ Health Science Centre/ Physiology department

4. **What is the purpose of the study?**

Females undergo many health-related behavioural changes during adolescence such as decrease physical activity and unhealthy nutrition which lead to harmful results like malnutrition or obesity, decrease bone growth, increase cholesterol level, increase blood sugar and pressure. Females in Kuwait are at higher risk of such behaviours which make them more susceptible to cardiovascular diseases, diabetes, chronic respiratory diseases and cancers. In addition, they are acquiring risky habits like sun overexposure for tanning, smoking and drugs misuse which might be for weight loss, improve cognitive function or sport performance. They are unaware of the risks associated with those behaviours on their health and safety.

World Health Organisation (WHO) stated that about one third of adulthood diseases are related to behaviours and conditions initiated in adolescence and it can be preventable. Therefore, we propose an educational programme to try to reverse such unhealthy behaviour among adolescent females in Kuwait by increasing health knowledge of adverse health-related behaviours and to motivate them to improve and maintain the healthy ones. The aim of the programme is to induce positive health-related behavioural changes with regard to physical activity, nutrition, prevention of drug use, smoking, and heat and sun protection.

The programme will comprise 6 in-school educational sessions for high school girls between the age of 15 and 18 throughout the school year 2014/2015. Two classes will be randomly selected from each of 3 school year groups with a total targeted number of 120 girls. In each of the 3 year groups the 2 classes will be randomly allocated to either intervention or control groups. The sessions will be held in the school at PE class for a total of 50 minutes: 40 minutes for interactive presentation and 10 minutes for discussion. The times of assessments and educational sessions are planned to be out of times of exams and holidays and will not disrupt the time of your study.

Participation in the programme will provide better health knowledge in the above mentioned topics. In addition, it will advise you to refrain from unhealthy behaviours and motivate you to change it into healthier ones and maintain it throughout your lifetime. Finally, it will help us to evaluate the effectiveness of implementing this programme for adolescent girls and to develop it for future implementation on a broader base. More details on the programme and the proposed dates are attached.

4. **Why have I been chosen?**

As previously mentioned, some behaviours in adolescence contribute to about one-third of adulthood diseases. Therefore, it is crucial to increase the awareness of the risks of those behaviours among adolescent females in Kuwait whose health and safety are at future risk.

We decided to include 120 adolescent girls living in Kuwait between the ages of 15 and 18 from Adan high school for girls.

5. **Do I have to take part?**

It is up to you to decide whether or not to take part. If you do decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. Moreover, you are still free to withdraw at any time and without giving a reason if you decide to participate.

6. **What will happen to me if I take part?**

You will be given some questionnaires and a possibility of having a small device attached by belt on your waist monitoring your activity and non-activity time for 7-days, fitness tests including 20m running back and forth, sit-and-reach, single leg stand, high jump, and sit-ups. In addition, your height, weight, percentage of body fat, and fat distribution will be measured. These assessments will be taken at the beginning of the study, at the middle of the study and at the end of the study. This will help us to evaluate the effectiveness of the programme by identifying any changes of the assessments at the timescale. More details are outlined in the following table.

Sometimes because we do not know which way of treating participants is best, we need to make comparisons. People will be put into groups and then compared. The groups are selected by a computer which has no information about the individual - i.e., by 50:50 chance. Participants in each group then have a different treatment, and these are compared.

Timetable of the Study 2014/2015

	1st week	2nd week	3rd week	4th week	Extra days
Nov 2014	Sun 02/11/2014 – Thurs 06/11/2014	Sun 09/11/2014 – Thurs 13/11/2014	Sun 16/11/2014 – Thurs 20/11/2014	Sun 23/11/2014 – Thurs 27/11/2014	Sunday 30/11/2014
				Health behaviours Q Body measurements	
Dec 2014	Mon 01/12/2014 – Thurs 04/12/2014	Sun 07/12/2014 – Thurs 11/12/2014	Sun 14/12/2014 – Thurs 18/12/2014	Sun 21/12/2014– Thurs 25/12/2014	Sun 28/12/2014 – Weds 31/12/2014
	Physical fitness testing	PA knowledge Q Physical Activity Lecture	PA knowledge Q Accelerometer	Sun 21/12/2014 – Weds 31/12/2014 Second Term Exams (Finals)	
Jan 2015	Thurs 01/01/2015	Sun 04/01/2015 – Thurs 08/01/2015	Sun 11/01/2015 – Thurs 15/01/2015	Sun 18/01/2015 – Thurs 22/01/2015	Sun 25/01/2015 – Thurs 29/01/2015
	Thursday 01/01/2015 Sun 04/01/2015 and Mon 05/01/2015 Continue Second Term Exams (Finals)		Sun 11/01/2015 – Thurs 22/01/2015 Midterm Break		Nutrition knowledge Q Healthy Nutrition
Feb 2015	Sun 01/02/2015 – Thurs 05/02/2015	Sun 08/02/2015 – Thurs 12/02/2015	Sun 15/02/2015 – Thurs 19/02/2015	Sun 22/02/2015 – Thurs 26/02/2015	None
	Nutrition knowledge Q	Smoking knowledge Q Lecture Smoking Lecture	Smoking Knowledge Q	Wed 25/2/2015 – Thurs 26/2/2015	
Mar 2015	Sun 1/3/2015 – Thurs 5/3/2015	Sun 10/3/2015 – Thurs 12/3/2015	Sun 15/3/2015 – Thurs 19/3/2015	Sun 22/3/2015 – Thurs 26/3/2015	Sun 29/3/2015 and Tues 31/3/2015
	Substance abuse Knowledge Q Substance abuse Lecture	Substance abuse Knowledge Q		Bone Knowledge Q Bone Health Lecture	Bone Knowledge Q
April 2015	Weds 01/04/2015 – Thurs 02/04/2015	Sun 05/04/2015 – Thurs 09/04/2015	Sun 12/04/2015 – Thurs 16/04/2015	Sun 19/04/2015 – Thurs 23/04/2015	Sun 26/04/2015 – Thurs 30/04/2015
	Sun protection Knowledge Q Sun Protection Lecture	Sun protection Knowledge Q	Health behaviours Q Body measurements Fitness testing		
May 2015	Sun 3/05/2015 –Thurs 7/05/2015	Sun 10/05/2014 –Thurs 14/05/2015	Sun 17/05/2015 – Thurs 21/05/2015	Sun 24/05/2015 – Thurs 28/05/2015	Sunday 31/05/2015
	Accelerometers		Wed 20/05/2015 – Sun 31/05/2015 Fourth Term Exams (Finals)		
June 2015	Mon 02/06/2015 – Thurs 04/06/2015	Sun 07/06/2015 – Thurs 11/06/2015	Sun 14/06/2015 – Thurs 18/06/2015	Sun 21/06/2015 - Thurs 25/06/2015	Sunday 28/06/2015 – Tues 30/06/2015
	Continue Fourth Term Exams (Finals)	Summer Holiday			

- Official Holidays
- School's Exams and Holidays
- Educational sessions
- Assessment

7. **What do I have to do?**

You will have to attend the PE class to take your physical assessments and fitness test. In addition, you have to answer all questionnaires which will be given at the class. Finally, you may have to wear a very small device around your waist for 7 consecutive days to measure your physical activity.

8. **What are the possible disadvantages and risks of taking part?**

Taking part of this programme will include fitness tests which may result in fatigue and some mild discomfort such as muscle spasm. However, we will have a nearby first aid kit with trained staff in case of an emergency.

Please tick the box if you have any chronic medical condition, which restricts performing a high physical effort like running and jumping, such as:

- ☐ Blood conditions (anaemia, thalassemia... etc.)
- ☐ Asthma
- ☐ Diabetes
- ☐ Cardiac disease

9. **What are the possible benefits of taking part?**

You will receive no direct benefit from taking part in this study. The information that is collected during this study will give us a better understanding of unhealthy habits and behaviours and the effectiveness of our programme in improving them into healthy ones. Consequently, it will help us to provide more comprehensive programme to be applied to your colleagues in the future.

10. **Will my taking part in this study be kept confidential?**

All information which is collected about you during the course of the research will be kept strictly confidential. You will be identified by an ID number, and any information about you will have your name and address removed so that you cannot be recognised from it.

11. **What will happen to the results of the research study?**

The results of this study will be published in medical journals and at medical conferences BUT you will not be mentioned or identified in any report or publication as mentioned before.

12. **Who is organising and funding the research?**

This study is supervised by University of Glasgow in the United Kingdom and Kuwait University.

13. **Who has reviewed the study?**

The study has been reviewed by the College Ethics Committee.

14. **Contact for Further Information**

- For further information, please contact Noor Alfailakawi, the researcher.

  E-mail: has been removed in this version

  Telephone: has been removed in this version

You will be given a copy of the information sheet and a signed consent form to keep.

We would like to thank you for taking time to read the above information and welcome you if you decided to participate in the study

Appendix IX Consent Form

University of Glasgow | College of Medical, Veterinary & Life Sciences

Centre Number: 1

Project Number: 1

Subject Identification Number for this trial:

CONSENT FORM

Title of Project:

Girls Lifestyle Enhancing Attitudes and Motives (GLEAMs) A Health Educational Programme for Adolescent Females in Kuwait

Name of Researcher(s):

Dr. John MacLean

Noor Alfailakawi

Please initial box

I confirm that I have read and understand the information sheet dated 14/11/2014 (version 1) for the above study and have had the opportunity to ask questions. ☐

I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, without my legal rights being affected. ☐

I agree to take part in the above study. ☐

Name of subject Date Signature

Name of parent/legal guardian Date Signature

Noor Kh. Alfailakawi

Researcher Date Signature

(1 copy for subject; 1 copy for researcher)

Appendix X Health Screening Form

Health Screening Form

Dear Participants,

We would like to make sure that you are eligible to be included in the study and to ensure your safety. The study involves a 20m fitness test which requires a vigorous physical effort and 3 sets of 5 sit-ups which requires a moderate physical effort.

Please let us know if you have any medical restriction to vigorous intensity physical effort like running and jumping in the following list by ticking the adjacent box:

- ☐ Severe blood conditions (i.e. anaemia, thalassemia, etc.)
- ☐ Heart disease
- ☐ Insulin dependent diabetes mellitus
- ☐ Severe Asthma
- ☐ Inflammation in joints or tendons of the knee(s) or the ankle(s)
- ☐ Recent lower extremity injury (i.e. ankle sprain)
- ☐ Other, please specify________________________________

Have you been advised by a physician to not to engage in vigorous physical effort?

☐No ☐Yes, Please state the reason_________________________________

Thank you

Appendix XI Kuwait Metrological Report

			Temp (Cº)		
Station Name	**Station No.**	**Date**	**MAX**	**MIN**	**AVE**
KUWAIT AIRPORT	40582	01/09/2014	45.1	30.7	37.8
KUWAIT AIRPORT	40582	02/09/2014	45.7	27.1	36.5
KUWAIT AIRPORT	40582	03/09/2014	47	27.3	36.7
KUWAIT AIRPORT	40582	04/09/2014	47.7	28	37.9
KUWAIT AIRPORT	40582	05/09/2014	45.8	34.1	39.8
KUWAIT AIRPORT	40582	06/09/2014	45.3	28.5	38.2
KUWAIT AIRPORT	40582	07/09/2014	46.7	28.3	37.8
KUWAIT AIRPORT	40582	08/09/2014	46	28.4	37.2
KUWAIT AIRPORT	40582	09/09/2014	43.9	28	37.2
KUWAIT AIRPORT	40582	10/09/2014	43.5	32.4	37.7
KUWAIT AIRPORT	40582	11/09/2014	44.3	32.9	37.8
KUWAIT AIRPORT	40582	12/09/2014	43.5	31.7	37.6
KUWAIT AIRPORT	40582	13/09/2014	43.1	31.3	37.2
KUWAIT AIRPORT	40582	14/09/2014	43.3	26	35.9
KUWAIT AIRPORT	40582	15/09/2014	44.5	24.5	35.8
KUWAIT AIRPORT	40582	16/09/2014	44.7	27	34.8
KUWAIT AIRPORT	40582	17/09/2014	42.7	26.9	35.4
KUWAIT AIRPORT	40582	18/09/2014	41.5	27	35.4
KUWAIT AIRPORT	40582	19/09/2014	41.6	24.9	34.8
KUWAIT AIRPORT	40582	20/09/2014	42.9	24.1	34.4
KUWAIT AIRPORT	40582	21/09/2014	44.1	22.7	33.4
KUWAIT AIRPORT	40582	22/09/2014	41.8	26.4	35.1
KUWAIT AIRPORT	40582	23/09/2014	42.1	29.4	35.9
KUWAIT AIRPORT	40582	24/09/2014	41.2	24.7	34
KUWAIT AIRPORT	40582	25/09/2014	41.4	23.6	33.8
KUWAIT AIRPORT	40582	26/09/2014	43.8	23.4	33.1
KUWAIT AIRPORT	40582	27/09/2014	40.8	25.1	33
KUWAIT AIRPORT	40582	28/09/2014	39	23.2	31.5
KUWAIT AIRPORT	40582	29/09/2014	41.4	23.6	31.8
KUWAIT AIRPORT	40582	30/09/2014	41.5	22.2	31.4
KUWAIT AIRPORT	40582	01/10/2014	39.2	23.1	31
KUWAIT AIRPORT	40582	02/10/2014	41.2	24.9	31.8
KUWAIT AIRPORT	40582	03/10/2014	40.7	26.7	32.1
KUWAIT AIRPORT	40582	04/10/2014	39.9	26.4	33.6
KUWAIT AIRPORT	40582	05/10/2014	40.1	22.7	31.6
KUWAIT AIRPORT	40582	06/10/2014	41.9	22.2	32

KUWAIT AIRPORT	40582	07/10/2014	40.3	25.7	33.7
KUWAIT AIRPORT	40582	08/10/2014	39.1	25	32.3
KUWAIT AIRPORT	40582	09/10/2014	38.8	18.5	29.4
KUWAIT AIRPORT	40582	10/10/2014	39.3	20	29.7
KUWAIT AIRPORT	40582	11/10/2014	39.3	20.4	30.2
KUWAIT AIRPORT	40582	12/10/2014	40.2	22.2	31.2
KUWAIT AIRPORT	40582	13/10/2014	37.6	23.3	31.1
KUWAIT AIRPORT	40582	14/10/2014	38.1	22	30.3
KUWAIT AIRPORT	40582	15/10/2014	35.9	21.9	30
KUWAIT AIRPORT	40582	16/10/2014	34.6	22.1	29.6
KUWAIT AIRPORT	40582	17/10/2014	31.8	27.1	29
KUWAIT AIRPORT	40582	18/10/2014	33.5	22.7	28.5
KUWAIT AIRPORT	40582	19/10/2014	35.2	18.2	27.3
KUWAIT AIRPORT	40582	20/10/2014	39.5	26	32.3
KUWAIT AIRPORT	40582	21/10/2014	30.5	21.9	26.3
KUWAIT AIRPORT	40582	22/10/2014	29.5	21.7	25.3
KUWAIT AIRPORT	40582	23/10/2014	30.9	14.8	23.7
KUWAIT AIRPORT	40582	24/10/2014	31.9	15.4	23.8
KUWAIT AIRPORT	40582	25/10/2014	34.7	17.5	27.4
KUWAIT AIRPORT	40582	26/10/2014	33.7	21	27.5
KUWAIT AIRPORT	40582	27/10/2014	35	17.8	26.4
KUWAIT AIRPORT	40582	28/10/2014	34.2	19.9	26.8
KUWAIT AIRPORT	40582	29/10/2014	31.7	22.6	27.2
KUWAIT AIRPORT	40582	30/10/2014	31.6	23.1	27
KUWAIT AIRPORT	40582	31/10/2014	37.5	23.3	29.3
KUWAIT AIRPORT	40582	01/11/2014	31.8	17.5	25.9
KUWAIT AIRPORT	40582	02/11/2014	30	15.7	23.1
KUWAIT AIRPORT	40582	03/11/2014	33.2	15.1	24.2
KUWAIT AIRPORT	40582	04/11/2014	31.8	20.7	25.7
KUWAIT AIRPORT	40582	05/11/2014	24.3	14.9	20.9
KUWAIT AIRPORT	40582	06/11/2014	22.9	10.6	17.7
KUWAIT AIRPORT	40582	07/11/2014	23.7	7.9	16.1
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KUWAIT AIRPORT	40582	09/11/2014	27.8	7.5	17.5
KUWAIT AIRPORT	40582	10/11/2014	26.5	7.4	17.1
KUWAIT AIRPORT	40582	11/11/2014	25.8	6.8	16.4
KUWAIT AIRPORT	40582	12/11/2014	25.6	7.1	16.1
KUWAIT AIRPORT	40582	13/11/2014	25.8	6.7	16.3
KUWAIT AIRPORT	40582	14/11/2014	27.2	7.3	18.1
KUWAIT AIRPORT	40582	15/11/2014	28.2	11.1	20
KUWAIT AIRPORT	40582	16/11/2014	27.5	13.1	20.8

KUWAIT AIRPORT	40582	17/11/2014	28	17.6	23
KUWAIT AIRPORT	40582	18/11/2014	27.5	19.3	22.8
KUWAIT AIRPORT	40582	19/11/2014	26.4	13	20.4
KUWAIT AIRPORT	40582	20/11/2014	25.2	10.6	18.4
KUWAIT AIRPORT	40582	21/11/2014	21.2	12.4	17.9
KUWAIT AIRPORT	40582	22/11/2014	31	16.5	23
KUWAIT AIRPORT	40582	23/11/2014	27.4	18.9	22.9
KUWAIT AIRPORT	40582	24/11/2014	27.2	18.7	21.9
KUWAIT AIRPORT	40582	25/11/2014	27.1	15.7	20.6
KUWAIT AIRPORT	40582	26/11/2014	20.6	10.8	15.6
KUWAIT AIRPORT	40582	27/11/2014	24.3	8.1	16.2
KUWAIT AIRPORT	40582	28/11/2014	23.7	11.9	18.7
KUWAIT AIRPORT	40582	29/11/2014	20.9	12.1	17.2
KUWAIT AIRPORT	40582	30/11/2014	19.7	6.1	13.8
KUWAIT AIRPORT	40582	01/12/2014	19.3	5.3	12.2
KUWAIT AIRPORT	40582	02/12/2014	21.4	4	12.8
KUWAIT AIRPORT	40582	03/12/2014	24.3	6.4	16
KUWAIT AIRPORT	40582	04/12/2014	24.8	9.6	17.3
KUWAIT AIRPORT	40582	05/12/2014	24.5	8.8	16.4
KUWAIT AIRPORT	40582	06/12/2014	24.8	7.4	16.2
KUWAIT AIRPORT	40582	07/12/2014	25.5	7.7	16.3
KUWAIT AIRPORT	40582	08/12/2014	26.2	7.8	16.2
KUWAIT AIRPORT	40582	09/12/2014	25.8	7.9	16.7
KUWAIT AIRPORT	40582	10/12/2014	26.3	10.3	17.4
KUWAIT AIRPORT	40582	11/12/2014	24	9.9	17.9
KUWAIT AIRPORT	40582	12/12/2014	25.1	10	17.1
KUWAIT AIRPORT	40582	13/12/2014	25.8	5.5	15
KUWAIT AIRPORT	40582	14/12/2014	26	10.4	18.3
KUWAIT AIRPORT	40582	15/12/2014	26.1	14.8	20.1
KUWAIT AIRPORT	40582	16/12/2014	20.3	16	18.3
KUWAIT AIRPORT	40582	17/12/2014	19.5	9.3	15.5
KUWAIT AIRPORT	40582	18/12/2014	20.2	7.1	13
KUWAIT AIRPORT	40582	19/12/2014	21.6	6	13.9
KUWAIT AIRPORT	40582	20/12/2014	26.4	11.6	18.6
KUWAIT AIRPORT	40582	21/12/2014	20.4	15.1	17.6
KUWAIT AIRPORT	40582	22/12/2014	20.3	9.3	14.9
KUWAIT AIRPORT	40582	23/12/2014	21.1	4.4	12.8
KUWAIT AIRPORT	40582	24/12/2014	19.1	6.5	13.4
KUWAIT AIRPORT	40582	25/12/2014	17.9	4.2	11.6
KUWAIT AIRPORT	40582	26/12/2014	19.7	2.3	11.1
KUWAIT AIRPORT	40582	27/12/2014	22	6	13.6

KUWAIT AIRPORT	40582	28/12/2014	28	8.5	17.6
KUWAIT AIRPORT	40582	29/12/2014	25.6	13.1	19.4
KUWAIT AIRPORT	40582	30/12/2014	23.9	9.4	17
KUWAIT AIRPORT	40582	31/12/2014	23	6.1	14.2
KUWAIT AIRPORT	40582	01/01/2015	22.9	6.1	13.9
KUWAIT AIRPORT	40582	02/01/2015	23.6	5.4	13.9
KUWAIT AIRPORT	40582	03/01/2015	24	7.9	15
KUWAIT AIRPORT	40582	04/01/2015	23.2	9.8	16.3
KUWAIT AIRPORT	40582	05/01/2015	21	9	15.8
KUWAIT AIRPORT	40582	06/01/2015	21.4	5.1	14.2
KUWAIT AIRPORT	40582	07/01/2015	25	10	18.2
KUWAIT AIRPORT	40582	08/01/2015	17.5	7.3	13
KUWAIT AIRPORT	40582	09/01/2015	16.6	5.2	10.9
KUWAIT AIRPORT	40582	10/01/2015	18.8	5.1	11.5
KUWAIT AIRPORT	40582	11/01/2015	14.6	3.3	9.3
KUWAIT AIRPORT	40582	12/01/2015	15.3	3	9.6
KUWAIT AIRPORT	40582	13/01/2015	17.6	2	9.6
KUWAIT AIRPORT	40582	14/01/2015	19.1	1.4	9.6
KUWAIT AIRPORT	40582	15/01/2015	20.2	2.3	11.8
KUWAIT AIRPORT	40582	16/01/2015	20.8	7.6	14.3
KUWAIT AIRPORT	40582	17/01/2015	19.5	6	13.8
KUWAIT AIRPORT	40582	18/01/2015	15.7	8.2	12.4
KUWAIT AIRPORT	40582	19/01/2015	18.6	4.5	11.6
KUWAIT AIRPORT	40582	20/01/2015	19.2	4.1	10.7
KUWAIT AIRPORT	40582	21/01/2015	19.5	1.4	10.1
KUWAIT AIRPORT	40582	22/01/2015	21.8	1	10.7
KUWAIT AIRPORT	40582	23/01/2015	22.5	2.7	12.9
KUWAIT AIRPORT	40582	24/01/2015	21.9	2.8	12.1
KUWAIT AIRPORT	40582	25/01/2015	23	2.5	12.4
KUWAIT AIRPORT	40582	26/01/2015	21.7	5.5	14.6
KUWAIT AIRPORT	40582	27/01/2015	27.3	13.2	18.3
KUWAIT AIRPORT	40582	28/01/2015	23.3	11.6	17.6
KUWAIT AIRPORT	40582	29/01/2015	28.3	14.9	19.8
KUWAIT AIRPORT	40582	30/01/2015	30	11.8	19.6
KUWAIT AIRPORT	40582	31/01/2015	24.5	14.9	19.6
KUWAIT AIRPORT	40582	01/02/2015	22.8	10.1	17
KUWAIT AIRPORT	40582	02/02/2015	23.8	8.1	15.5
KUWAIT AIRPORT	40582	03/02/2015	25.2	5.9	16.4
KUWAIT AIRPORT	40582	04/02/2015	27.5	12.9	18.7
KUWAIT AIRPORT	40582	05/02/2015	24.7	10.8	18.3
KUWAIT AIRPORT	40582	06/02/2015	24.1	8.5	16.8

KUWAIT AIRPORT	40582	07/02/2015	23.4	5.1	14.9
KUWAIT AIRPORT	40582	08/02/2015	25.6	16.3	20.4
KUWAIT AIRPORT	40582	09/02/2015	24.9	10.9	18.4
KUWAIT AIRPORT	40582	10/02/2015	33	17.2	21.5
KUWAIT AIRPORT	40582	11/02/2015	32.2	19.5	22.8
KUWAIT AIRPORT	40582	12/02/2015	24.7	15.2	20.4
KUWAIT AIRPORT	40582	13/02/2015	21	11.7	16.6
KUWAIT AIRPORT	40582	14/02/2015	23.1	8.5	16.9
KUWAIT AIRPORT	40582	15/02/2015	23.5	8.7	16.4
KUWAIT AIRPORT	40582	16/02/2015	23.6	10.3	17.3
KUWAIT AIRPORT	40582	17/02/2015	25.6	11.9	19.3
KUWAIT AIRPORT	40582	18/02/2015	22.5	15.9	18.3
KUWAIT AIRPORT	40582	19/02/2015	20.6	15.6	17.4
KUWAIT AIRPORT	40582	20/02/2015	25.3	12.4	17.2
KUWAIT AIRPORT	40582	21/02/2015	18.3	10.7	14
KUWAIT AIRPORT	40582	22/02/2015	15.4	8.2	11.8
KUWAIT AIRPORT	40582	23/02/2015	18.6	4.5	12.3
KUWAIT AIRPORT	40582	24/02/2015	20	2.4	12.7
KUWAIT AIRPORT	40582	25/02/2015	20.3	9.4	15.7
KUWAIT AIRPORT	40582	26/02/2015	24.1	11.2	17.8
KUWAIT AIRPORT	40582	27/02/2015	25	11.4	18
KUWAIT AIRPORT	40582	28/02/2015	26	7.3	16.8
KUWAIT AIRPORT	40582	01/03/2015	27	8.6	17.6
KUWAIT AIRPORT	40582	02/03/2015	27.3	8.6	18
KUWAIT AIRPORT	40582	03/03/2015	25.6	7.9	18.2
KUWAIT AIRPORT	40582	04/03/2015	27.1	10.5	19.9
KUWAIT AIRPORT	40582	05/03/2015	25.5	11.1	20.3
KUWAIT AIRPORT	40582	06/03/2015	26	11.1	19.1
KUWAIT AIRPORT	40582	07/03/2015	29.2	8.6	18.8
KUWAIT AIRPORT	40582	08/03/2015	27.8	7.2	18.2
KUWAIT AIRPORT	40582	09/03/2015	26.5	12.4	19.5
KUWAIT AIRPORT	40582	10/03/2015	29.9	14.3	22.4
KUWAIT AIRPORT	40582	11/03/2015	28.4	11.5	20.8
KUWAIT AIRPORT	40582	12/03/2015	26	6.6	18.2
KUWAIT AIRPORT	40582	13/03/2015	25.1	18	20.4
KUWAIT AIRPORT	40582	14/03/2015	26.5	13.5	20.3
KUWAIT AIRPORT	40582	15/03/2015	27	17	21.8
KUWAIT AIRPORT	40582	16/03/2015	29.1	15.1	21.5
KUWAIT AIRPORT	40582	17/03/2015	23.2	16.9	20.3
KUWAIT AIRPORT	40582	18/03/2015	23.9	18.7	20.7
KUWAIT AIRPORT	40582	19/03/2015	25.5	17.9	21.8

KUWAIT AIRPORT	40582	20/03/2015	31.7	18.4	24.8
KUWAIT AIRPORT	40582	21/03/2015	26.6	19.6	22.5
KUWAIT AIRPORT	40582	22/03/2015	26.3	16.6	21.3
KUWAIT AIRPORT	40582	23/03/2015	23.5	9.2	17.5
KUWAIT AIRPORT	40582	24/03/2015	24.3	8.1	17.2
KUWAIT AIRPORT	40582	25/03/2015	24.7	11.6	19.8
KUWAIT AIRPORT	40582	26/03/2015	28.3	16.4	21.5
KUWAIT AIRPORT	40582	27/03/2015	29	16.9	22.6
KUWAIT AIRPORT	40582	28/03/2015	29.9	11.7	21
KUWAIT AIRPORT	40582	29/03/2015	30.3	14.3	22.7
KUWAIT AIRPORT	40582	30/03/2015	33.5	22.6	26.8
KUWAIT AIRPORT	40582	31/03/2015	31.2	21.9	25.9
KUWAIT AIRPORT	40582	01/04/2015	29.2	21.3	25
KUWAIT AIRPORT	40582	02/04/2015	28.9	17.6	23.4
KUWAIT AIRPORT	40582	03/04/2015	31.1	14.2	24.1
KUWAIT AIRPORT	40582	04/04/2015	30.6	17.6	24.1
KUWAIT AIRPORT	40582	05/04/2015	35.3	15.7	26.7
KUWAIT AIRPORT	40582	06/04/2015	34.1	19.7	26.6
KUWAIT AIRPORT	40582	07/04/2015	34.7	19.3	27.8
KUWAIT AIRPORT	40582	08/04/2015	36.1	21.9	29
KUWAIT AIRPORT	40582	09/04/2015	36.1	19	28.8
KUWAIT AIRPORT	40582	10/04/2015	34.3	26	29.4
KUWAIT AIRPORT	40582	11/04/2015	38.3	25.5	29
KUWAIT AIRPORT	40582	12/04/2015	34.6	23.3	28.6
KUWAIT AIRPORT	40582	13/04/2015	27.3	19.7	23.1
KUWAIT AIRPORT	40582	14/04/2015	28.1	10.4	22
KUWAIT AIRPORT	40582	15/04/2015	28.5	21	24.4
KUWAIT AIRPORT	40582	16/04/2015	36.5	21.9	28.3
KUWAIT AIRPORT	40582	17/04/2015	33.7	25.1	28.2
KUWAIT AIRPORT	40582	18/04/2015	32	20.9	26.6
KUWAIT AIRPORT	40582	19/04/2015	34	17.3	27
KUWAIT AIRPORT	40582	20/04/2015	35.5	15.2	27
KUWAIT AIRPORT	40582	21/04/2015	38.3	16.8	28.3
KUWAIT AIRPORT	40582	22/04/2015	39.4	26.4	32.5
KUWAIT AIRPORT	40582	23/04/2015	36.9	24.7	30.5
KUWAIT AIRPORT	40582	24/04/2015	30.7	22.3	26.6
KUWAIT AIRPORT	40582	25/04/2015	29.4	18.2	23.6
KUWAIT AIRPORT	40582	26/04/2015	32.7	19.1	25.6
KUWAIT AIRPORT	40582	27/04/2015	34.6	21.6	28.3
KUWAIT AIRPORT	40582	28/04/2015	39	24.2	31.2
KUWAIT AIRPORT	40582	29/04/2015	39.8	20.5	31.1

KUWAIT AIRPORT	40582	30/04/2015	41.4	19.6	30.9
KUWAIT AIRPORT	40582	01/05/2015	42.1	21.7	31.8
KUWAIT AIRPORT	40582	02/05/2015	38.1	24.1	31.5
KUWAIT AIRPORT	40582	03/05/2015	40.7	25.1	33.4
KUWAIT AIRPORT	40582	04/05/2015	37.1	26.3	31.7
KUWAIT AIRPORT	40582	05/05/2015	34.7	22.9	29.6
KUWAIT AIRPORT	40582	06/05/2015	32	25.8	28.7
KUWAIT AIRPORT	40582	07/05/2015	39.1	25.5	30.6
KUWAIT AIRPORT	40582	08/05/2015	34.7	24.4	30.1
KUWAIT AIRPORT	40582	09/05/2015	36.5	24	30.2
KUWAIT AIRPORT	40582	10/05/2015	36.9	22.2	29.8
KUWAIT AIRPORT	40582	11/05/2015	39.1	23.3	31.4
KUWAIT AIRPORT	40582	12/05/2015	40.1	25.4	33.9
KUWAIT AIRPORT	40582	13/05/2015	42.2	25.8	34
KUWAIT AIRPORT	40582	14/05/2015	44.6	29.1	36.2
KUWAIT AIRPORT	40582	15/05/2015	37.4	29.6	33.5
KUWAIT AIRPORT	40582	16/05/2015	36.7	28.2	32.4
KUWAIT AIRPORT	40582	17/05/2015	39.1	24	32.8
KUWAIT AIRPORT	40582	18/05/2015	40.9	23.9	32.7
KUWAIT AIRPORT	40582	19/05/2015	42.1	25.2	34.5
KUWAIT AIRPORT	40582	20/05/2015	44.2	23.9	34.5
KUWAIT AIRPORT	40582	21/05/2015	45.2	25.5	35.9
KUWAIT AIRPORT	40582	22/05/2015	44.4	26.6	35.3
KUWAIT AIRPORT	40582	23/05/2015	41.8	31.7	37.1
KUWAIT AIRPORT	40582	24/05/2015	41.8	29.4	35.8
KUWAIT AIRPORT	40582	25/05/2015	42.1	30.8	35.8
KUWAIT AIRPORT	40582	26/05/2015	42.9	27.4	36.1
KUWAIT AIRPORT	40582	27/05/2015	45.4	25.6	37.2
KUWAIT AIRPORT	40582	28/05/2015	44.3	28	37.6
KUWAIT AIRPORT	40582	29/05/2015	46.5	28	37.8
KUWAIT AIRPORT	40582	30/05/2015	46.8	28.9	38
KUWAIT AIRPORT	40582	31/05/2015	45.3	30.3	37.6
		MAX	47.7	34.1	39.8
		MIN	14.6	1.0	9.3
		AVE	30.8	16.3	23.7

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