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At Dietetics, Nutrition & Biological Sciences
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ASSESSING THE LIFESTYLE
(PHYSICAL ACTIVITY LEVELS,
SEDENTARY BEHAVIOUR AND EATING
HABITS) OF OMANI ADOLESCENT GIRLS:
A MIXED METHODS STUDY

ZUWAINA HUMAID AL-MAHROUQI

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List of abbreviations

Sr. No	Full Name	Abbreviation
1.	Active Schools	ASs
2.	Arab Teens Lifestyle study	ATLS
3.	Basal Metabolic Rate	BMR
4.	Body Mass Index	BMI
5.	British Heart Foundation	BHF
6.	Canadian Society for Exercise Physiology	CSEP
7.	Cardiovascular Disease	CVD
8.	Centres for Disease Control and Prevention	CDC
9.	Charts and Group of China Obesity Task Force	COTF
10.	Critical Appraisal Skill Programme	CASP
11.	Digital Video Disc	DVD
12.	Eastern Mediterranean Region	EMR
13.	Energy Intake	EI
14.	Food Frequency Questionnaire	FFQ
15.	Gulf Cooperation Council	GCC
16.	Hong Kong Growth Survey	HKGS
17.	International Obesity Taskforce	IOTF
18.	Interquartile Range	IQR
19.	Kingdom Saudi Arabia	KSA
20.	Metabolic Equivalents	METs
21.	Ministry of Education	MOE
22.	Ministry of Health	MOH
23.	Ministry of National Economy	MONE
24.	National Centre for Statistics and Information	NCSI
25.	National health and Nutrition Examination Survey	NHANES
26.	National health Services	NHS
27.	National Institute for Health and Care Excellence	NICE
28.	National Institute of Health	NIH
29.	National Sleep Foundation	NSF
30.	Non-Communicable Diseases	NCD
31.	Oman Medical College	OMC
32.	Organization for Economic Cooperation and Development	OECD
33.	Physical Activity Across the Curriculum	PAAC
34.	Physical Education	PE
35.	Queen Margaret University	QMU
36.	Randomized Control Trial	RCT
37.	Registered Nurses	RNs
38.	Television	TV
39.	Total Energy Expenditure	TEE
40.	United Kingdom	UK
41.	United States	US
42.	World Health Organization	WHO

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Declaration

Hereby I declare that this dissertation work is my own original work and all literature references were acknowledged.

Signed: *Zuwaina*

Date: 14.5.2019

Abstract

Background: Rising body mass index (BMI) in the world population is a serious global health issue of 21st century. Epidemiology and management of high BMI have been the themes of many studies. In the Arab world, including in Oman where this study is based, the prevalence of obesity and inactivity emerged late but is accelerating rapidly, particularly among the youth. The aim of this study is to bridge the research gap that exists regarding Omani adolescent girls' lifestyle and their association with body weight status by studying the diet and activity habits of this population using a mixed method approach. To date, this is the first study of its kind from Oman.

Methods: An explanatory sequential mixed methods study was conducted to assess the lifestyle characteristics (physical activity level, sedentary behaviour, and eating habits) among Omani girls aged 15–18 years, and to understand their perceptions related to this lifestyle. A total of 421 female students were randomly selected from two schools in Ibri, Oman, to participate in this study. A validated online ATLS questionnaire (N = 421), diet diary and pedometer (n = 59) and focus groups (n = 16) were used as data collection instruments. Ethical approvals were granted by the Queen Margaret University (QMU) ethics committee and Oman Ministry of Education (MOE). Informed consent was obtained from the participants and their parents and the confidentiality of the collected data maintained.

Results: The prevalence of overweight was 21% and obesity 14% among this sample of Omani female adolescents. The average footstep tally of the participants (n=59) was 5,755 footsteps per day against the recommended 10,000–11,700 with significant differences between BMI groups. The pedometer data indicated that normal weight participants scored mean footstep counts of 6,625 per day, while it was 6,094 in the overweight girls, falling further to 5,755 for their obese peers. The majority of the participants (56%) who maintained diet diaries were normal reporters, while misreporters were 44%. After excluding the misreporters, the energy intake (EI) of the diet diary cohort was lower than the recommended value of 2400 Kcal/day. The overweight participants were significantly more likely to consume French fries/ chips (82%) and cake/ doughnuts (74%) than the other BMI groups, while the obese participants consumed more sweets (61%) and fast food (42%).

The participants perceived environmental and sociocultural factors, rapid modernisation and acculturation of Omani society, lack of encouragement from family, friends, and teachers, as well as lack of self-motivation and role models as barriers to physical activity. Even though they perceived fast food as unhealthy, they were attracted to these due to the taste and advertisements. The study also found that increased digital screen-time, sleeping less, and missing breakfast were other factors that positively correlated with inactivity and increased the BMI among Omani female adolescents.

Conclusion: The current study establishes a positive correlation between the overweight and obesity in Omani teenage girls and their physical inactivity and nutritional habits. While the current results are similar to those from other parts of the world, there are also factors that are specific to the region such as the climate and culture that makes the problem complex. The trend for BMI to rise with age among teenagers raises apprehension that it may continue in

their adulthood. Urgent action needs to be taken by adolescent girls in Oman, their parents, and higher authorities at Oman ministries of education and health to improve the nutritional habits and physical activity of this age group. Specific culture-sensitive suggestions are provided in this thesis to meet these challenges.

Key words: adolescent girls, obesity, overweight, BMI, Arab, Oman, school children, lifestyle, physical activity, dietary habits, sedentary behaviour, fast food, sleep, Ibri

Structure of the Thesis

This thesis has six chapters:

Chapter One is the introduction which overviews the study topic.

Chapter Two is the literature review which discusses the previous studies conducted in the field of the studied topic.

Chapter Three is the material and methods which explains the methodology, sequential exploratory mixed method approach and the methods (quantitative and qualitative) adopted in this study.

Chapter Four presents the results (both quantitative and qualitative) in tabular and graphical formats supported by explanations and additional information where necessary.

Chapter Five is the discussion which integrates the quantitative and qualitative findings, support and contrasts these findings from the literature, and where possible, introduces occasional hypotheses and makes contextual and suggestions.

Chapter Six form the conclusion and recommendations which presents the overall summary of the study and suggests culturally sensitive recommendations to promote healthy lifestyle among Omani adolescent girls.

Chapter 1: Introduction

Human health is greatly affected by where and how we live, and by what and how we eat. The World Health Organisation (WHO) (1999) defines the healthy lifestyle as the way of living that reduces the risk of being extremely sick or dying early. An individual who practises a healthy lifestyle, eating a well-balanced diet, exercising daily, and living in a pollution-free environment, is less likely to develop health problems (Bunker 2001).

Healthy eating is referred to as consumption of adequate amount of food that comprises the main five food groups, namely, carbohydrates, proteins, fats, vitamins, and minerals (Rolfes et al. 2006). Evidence shows that living sedentarily on high sugar, high fat foods leads to increase in body weight (Gharib and Rasheed 2008). Adults with body mass index (BMI) above 25 and up to 29.9 kg/m² are classified overweight and those with BMI 30 kg/m² or above are classified as obese (WHO 2003b). Obesity increases the risk for many health problems such as hypertension, cardiovascular diseases and diabetes mellitus, (Badran and Laher 2011). Sedentary behaviour refers to physical inactiveness characterised by low level energy consuming activities (Rowlands 2017) and is referred to physical activity that takes place while sitting or lying down and which consumes minimal energy: typically, less than 1.5 Metabolic Equivalent (METs) a day (Tremblay 2012). Physical inactivity can be defined as doing inadequate amounts of physical activity or failing to achieve the minimum prescribed physical activity as per guidelines (British Heart Foundation (BHF) 2012).

World governments and international bodies such as WHO have been educating people about the need to maintain healthy lifestyles. Despite their efforts, a recent meta-analysis of 2,416 population-based measurement studies in 128.9 million children, adolescents, and adults has clearly demonstrated that overweight and obesity, a common precursor for non-communicable diseases (NCDs), is increasing among children and young people, particularly in the well-to-do emerging economies in the Middle East (Abarca-Gómez et al. 2017). The main reasons for this appear to be non-compliance with the principles of healthy eating and the rising propensity for sedentary behaviour. These habits may decrease the quality of life and increase the risk of developing of chronic diseases (Zhu and Owen 2018).

1.1 The Gulf Cooperation Council (GCC) region

Among the countries that are affected by the rising trend in unhealthy diet, sedentary behaviour and the consequent high BMI, are the prosperous GCC nations of the Arabian Gulf region: Kingdom of Saudi Arabia (KSA), Bahrain, Kuwait, Qatar, United Arab Emirates and Oman.

Across the GCC nations, by the year 2025 the demand for medical management of NCDs is expected to increase greatly, especially for cardiovascular diseases (by 419%) and diabetes (by 323%) (Mourshed et al. 2006). By 2025, cardiovascular diseases may consume nearly a quarter (24%) of the total healthcare budget of the region (Mourshed et al. 2006). This calls for urgent steps to understand the problem and be ready with region-and-culture specific action plans for the entire GCC region including Oman.

Unhealthy eating habits and sedentary lifestyles contribute to such problems, especially among women in the GCC region who tend to be more prone to overweight and obesity than men (Badran and Laher 2011). An additional generational risk of maternal obesity is that it provides a faulty role model for the girl child, in whom signs of future lifestyle aberrations can begin in childhood and adolescent.

According to WHO (2017a) an adolescent is an individual aged between 10 and 19 years. Sedentary behaviour among adolescent girls has been frequently reported in Middle Eastern countries such as Bahrain, Iraq, Saudi, Emirates, Pakistan, Syria and Oman (Al-Hazzaa et al. 2006; Al-Sabbah et al. 2007; Bin Zaal et al. 2009; Nasreddine et al. 2010; Musaiger et al. 2011; Kilani et al. 2013; Musaiger et al. 2014a). Habituation to comfort-oriented technology such as automobiles, domestic appliances, remote controls, mobile phones, computers, television, and electronic games may have contributed to the increasingly sedentary lifestyle of the adolescents (Atkin et al. 2008).

It was reported by Al-Hazzaa and Musaiger (2010) that in Arab countries the risk for NCDs begins with high BMI in adolescents. Lifestyle factors such as food and physical activity are key determinants of body weight status which may differ between genders. In Oman, there are insufficient studies that assess the lifestyle of adolescents in relation to food and physical activity (Kilani et al. 2013). Therefore, this study intended to fill the gap by assessing lifestyles of Omani adolescent girls.

1.2 Oman and Ibri

A member-nation of the GCC, Oman is situated along the eastern coast of Arabian Peninsula. Oman has a desert climate like its GCC peers except for the Dhofar region in the far south which has a tropical monsoon climate. Thus, the climate of most of Oman is hot and dry for much of the year—an additional region-specific disincentive for outdoor physical activities (Al-Nuaim et al. 2012).

Increasing sedentary behaviour has been identified among adolescent girls in Oman, where 55% of them devote much of their free time in front of televisions or computers, a tendency shared by young Omani adults as well (Kilani et al. 2012).

Ibri, the interior desert town from where the present data is obtained, is situated in the Wilayat (Governorate) of Al-Dhahira in northwest of Oman. The fact that Ibri is situated outside the highly urbanized national capital region of Muscat makes it a more representative sampling location for a study such as the present one.

Economic prosperity has brought modern comforts such as home air-conditioning and vehicles to interior Omani towns like Ibri and even to isolated townships deep in the desert. Thus, modern Omanis increasingly prefer to remain indoors except during the brief winter season from November to February. The boredom of indoor life is alleviated by digital communication and entertainment facilities and labour-saving devices, which has increased the tendency for sedentary behaviour. In urban and semi-urban areas, there is also rising consumption of fast food and sugary drinks. A study in Oman involving nearly 5,000 adults (>18 years) indicated high prevalence of NCDs: diabetes mellitus 12.3%, hypertension 40.3%, high total cholesterol 33.6%, and obesity 24.1% (Al Riyami et al. 2012).

According to the Annual Health Reports (2013–2016) published by MOH (2017), the prevalence of diabetes mellitus (both in terms of new cases and total cases) is increasing in the country. The total diabetes cases have increased at an average annual rate of >9,000 from 2012 to 2015 (MOH 2017) and is expected to continue to increase. In addition, newly reported cases are increasing each year—there were more than 13,000 new cases between the year 2014 to 2015. There must be greater efforts to strengthen the primary prevention services that emphasize lifestyle modification and behaviour change, otherwise there will be a great burden on future government and health services.

1.3 Background and rationale of this study

According to the National Centre for Statistics and Information (NCSI) (2016) in 2015, the total Omani population was 2.5 million (excluding expatriates) of which adolescents (10–19-year-olds) formed 18.2%. Recent literature suggests that rates of overweight and obesity among adolescents are increasing in Oman, warranting further exploration.

An earlier study found out that the prevalence of obesity and overweight among Omani college students was 28% and most had poor nutritional knowledge (Kilani et al. 2012). Prior to this, Al-Lawati and Jousilahti (2004) reviewed two earlier surveys conducted during 1991 and 2000 that assessed the prevalence of obesity among 11,486 Omani adults aged ≥ 20 years. The review revealed the prevalence of urban obesity, at 21%, to be higher than rural obesity (13%) in Oman. Recent data from prosperous countries of the world including Saudi Arabia and United States show that the rural urban obesity gap have diminished and have even begun to reverse due to prosperity and sedentariness encroaching into rural areas (Al-Nuaim et al. 2012; Johnson and Johnson 2015), detail of the findings see section (2.9).

Adolescence is the transition phase from childhood to adulthood, when many physiological and psychological changes take place (Beckett and Taylor 2010). Influence of parents diminishes while that of friends and peers grow (Byrne and La Puma 2007). While peer influence is essential for successful transition to adulthood, it may have positive or negative outcomes where lifestyle is concerned. A physical activity-oriented peer group is likely to promote to positive health choices leading towards normal BMI, while a peer group with a sedentary orientation promotes lifestyles that lead to higher BMI. Adolescents who grow up in families that follow unhealthy lifestyles may already have higher BMI which in turn might cause them from being excluded or bullied by their schoolmates which might cause them to further avoid outdoors physical activities (Salvy et al. 2012). Such overweight youngsters might then seek support from among others like them, further reinforcing their suboptimal lifestyle. In a study, overweight adolescents who were among their known friends consumed more fast food compared to being with unknown peers and those who were of normal weight (Salvy et al. 2009). A systematic review of 26 studies was conducted by Moore et al. (2017) to examine the effect of peer influence on the dietary behaviour among adults. Even though the review revealed positive and negative effects, the authors pointed out the need for further studies using objective methods among adults to confirm the nature and extent of peer influence on dietary behaviour. Such studies need to be conducted among adolescents as well. The above

was a reason for choosing Omani adolescent girls in the age group 15–18 as the target group of this study. The reason for not enrolling children below 15 years was that parental control is greater among younger teenagers, such as enforced bedtimes (Doheny et al. 2013; Buxton et al. 2015), eating habits (Birch et al. 2007) and physical activities (Willkie et al. 2018). Including the below-15-year age group might have skewed the results of this study.

According to the WHO (2003), being overweight during childhood and adolescence is a strong predictor of continuing that trend in adulthood. The likelihood of adolescent obesity (80%) continuing into adulthood has been found to be higher than that of childhood obesity (20%) (Krebs and Jacobson 2003). Therefore, efforts to prevent overweight and obesity from childhood itself may help avoid the problem continuing into adulthood.

Adolescent girls are at the crucial stage of their life that prepares them for motherhood. If they remain physically inactive, consume unhealthy food and become overweight, they run the risk of facing problems and complications during their maternal life, including becoming suboptimal role models for the next generation. This calls for proactive action, the data and justification of which are provided by research initiatives such as the present study. From my personal perspective, a man improving his lifestyle benefits him personally; when a woman improves hers, it benefits her entire family. Her healthy lifestyle will significantly enhance the health and success of her family, her community and ultimately the nation.

Overweight women carry serious health risks, which can particularly affect them and their offspring during pregnancy and motherhood. A retrospective study in the Al Dhahira governorate of Oman (Patel 2008) revealed that 58.8% of the mothers who delivered babies in the period from 2000 to 2004 were overweight, which may have contributed to foetal mortality rates, which was 9.1 per 1000 for that period. The need to prevent avoidable infant deaths is another reason why adolescent girl need to be encouraged to maintain their BMI at healthy levels.

Shaw et al. (2011) stated that involving children and adolescents in research gives them the chance to participate in the process, which may improve their community commitments. The present study has taken that role seriously by involving adolescent girls to participate actively in the research, to contribute in improving the general health of this age group and ultimately benefit the health of their peers as well. This highlights the importance of selecting this group as the main contributors to this study.

To the author's knowledge, no previous research has assessed the lifestyle of Omani adolescent girls using a mixed method approach. Hence, the present mixed method study was aimed at and designed to assess body weight status, lifestyle habits including physical activity levels, sedentary behaviour, and eating habits, and the subjective perceptions and opinions, of Omani girls aged from 15 to 18 years.

Prior to conducting this research, it was essential to appraise the existing literature to gain background data and possible guidance. Accordingly, a detailed literature review was conducted and is discussed in the next chapter.

Chapter 2: Literature Review

2.1 Introduction

A researcher who plans to conduct a study should first review previous studies related to one's proposed research topic. Reviewing and critiquing existing literature requires objectively and systematically examining existing evidence, conclusions, flaws, and limitations of the reviewed studies, whether positive or negative (LoBiondo-Wood and Haber 2014). With this understanding, the author of this study generated a critiquing framework as per the Critical Appraisal Skills Programme (CASP) (2013). A critiquing framework has several purposes Rees (2003), it helps the researchers to improve their knowledge about the studied topic (in the present case, the lifestyle of Omani adolescent girls), to understand what is known and unknown about the theme, in constructing the research questions and in selecting the appropriate research methodology (Polit and Beck 2014). The literature review provides researchers with the chance to scientifically integrate their research, with the existing literature, which makes their new contribution to the world of science easily accessible and comprehensible in a historical context. The literature review conducted for this study identified a gap in the current knowledge regarding the lifestyle of Omani adolescent girls. This has informed the main aims and objectives of the current study and this will help in contributing to the knowledge in the field of research.

2.2 Search Strategy for the Present Study

Before commencing the literature search and to retain focus on the research topic, the inclusion and exclusion criteria for this literature review were determined. The search was limited to material published from 2000 to 2018 and presented in the English language. The primary search for literature was not restricted to the exact topic of the study (for example, instead of 'adolescent girls', the search included other age groups and both genders). The collected literature was taken from different research designs: qualitative, quantitative, mixed methods, cross-sectional studies, and systematic reviews. The geographic source of the literature sought was international and included countries such as United Kingdom (UK), United State (US), Australia, Canada, and the Middle East.

The papers were mostly retrieved from electronic databases: PubMed, ProQuest, e.library, CINAHL, Google Scholar, ScienceDirect, and QMU library database. The following key words and phrases were combined during the search in the databases; adolescent girls, obesity, Oman, school children, lifestyle, physical activity, dietary habits, and sedentary behaviour.

Various search combinations such as ((obesity), (lifestyle), (obesity AND lifestyle), (obesity AND “lifestyle among adolescent girls”/ OR children) and (adolescents/ OR teenagers)) were considered and the same strategy was used to search each database. Using Boolean operators such as 'OR' or 'NOT' within the key words or 'AND' to combine the search terms (Moher et al. 2009) helped filter the results further.

The searches resulted in a longlist of 2,340 records out of which 103 articles (with different research designs) were confirmed to be relevant to the studied topic. Figure (2.1) illustrates the details of the literature search of this study using PRISMA guidelines (Moher et al. 2009).

Judging an article by its title could be misleading; therefore, preliminary selection involved reading the abstracts as well. Papers summarily rejected included those published before year 2000, those unrelated to the studied topic, reports (not studies or scholarly reviews) and papers whose full text were not available. The articles shortlisted were subjected to further filtering by reading their main content and subjecting them to the inclusion criteria of the study as per PRISMA guidelines. The search was updated at various stages of preparing this thesis (till July 2018), to replace older references with newer ones and to incorporate emerging research in the studied topic.

In addition, a manual search was done from different research and health sciences books and from different peer-reviewed journals from the QMU library catalogue and MOH holding libraries. Furthermore, some statistical information was obtained from the Omani government bodies such as MOE Statistics Office, MOH and Ministry of National Economy.

The reviewed literature is structured according to the research question and the studied topic.

It is presented in the following main headings:

- Causes of Obesity
- Prevalence of Obesity in the Developed Countries
- Prevalence of Obesity in the Developing Countries
- Complications from Obesity
- Physical activity and inactivity
- Nutritional Requirements for 15–18-year-old Girls
- Dietary habits

- Dietary Habits and Physical Activities of Children and Adolescents in Different BMI Groups
- Gender, Environmental and Cultural Aspects
- Adolescent Experiences of Dietary and Lifestyle Behaviour: Data from Qualitative Studies
- Conclusions

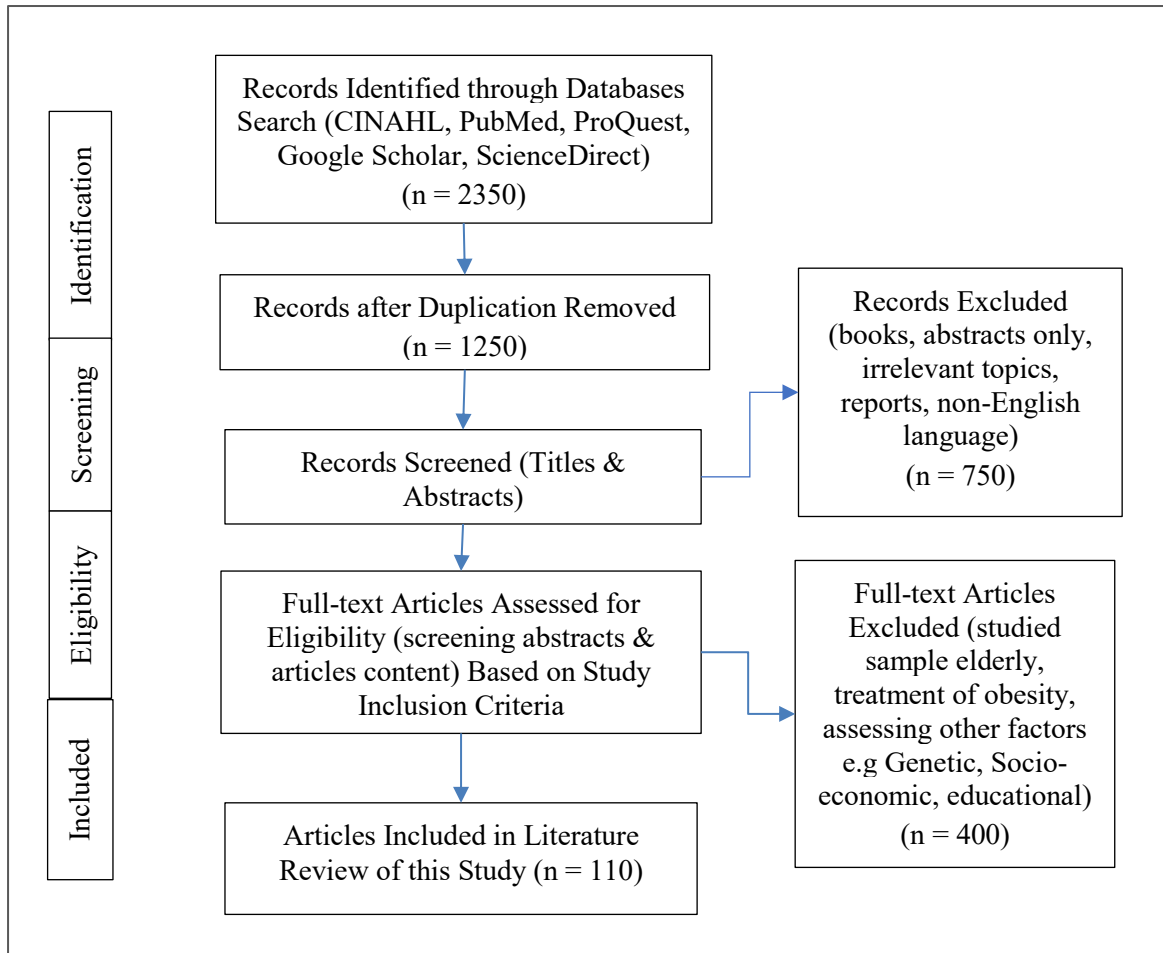


Figure (2.1) PRISMA Flowchart of Literature Search
Source: Moher et al. (2009)

2.1 Causes of Obesity

The factors contributing to the increase in obesity among children, adolescents, and adults are broadly classified as genetic and non-genetic (Han et al. 2010). The most common genetic condition that directly contributes to obesity in children and adolescents is a gene defect that inhibits the release of the post-meal appetite suppressant hormone Peptide YY that accounts for 5% to 6% of early childhood obesity (Karra et al. 2009). However, effective treatment of such genetic vulnerability may have to wait till gene therapy is available in the future.

Endocrine disease is another factor; for example, hypothyroidism decreases the energy metabolism. The consequent of imbalance between energy intake (EI) and expenditure translates to increased body weight (Clemens 2016). Verma et al. (2008) reported that among adults (aged 18–70) in India with primary hypothyroidism, 44% are obese or overweight.

The risk of childhood obesity can increase due to several reasons. Risks are higher for babies born to mothers who had gestational diabetes during pregnancy (Han et al. 2010), babies born with too high or too low birth weight (Ong and Loos 2006), those who received inadequate sleep during infancy (Al Mamun et al. 2007), and those who were regularly fed high calorie food during infancy (Owen et al. 2005)

Living in a city is also a risk factor for childhood obesity as suggested by Wang and Lobstein (2006). One reason could be the ready availability of unhealthy food choices such as fast food and energy rich snacks. In New York City, Thorpe et al. (2004) conducted a study in 69 primary schools with 3,069 boys and girls among whom 43% were overweight and obese. In the Arabian city of Makkah, 30% of a cohort of girls aged 8–11 years were overweight or obese (Al-Kutbe et al. 2017). This difference could be due to availability and easy accessibility of fast food. Black et al. (2010) found that in New York City, residents of localities with high density of fast food outlets are likely to have increased obesity.

Most studies have attributed obesity to a combination of excessive EI and sedentary lifestyles (WHO 2004a; Wright and Aronne 2012; Awadalla et al. 2014). In addition, diets worldwide have changed significantly since the 1980s when obesity was not a global problem. The current diets of many have more processed foods with high calories and fat content, which has been proposed to be directly responsible for the rise in obesity (Lifshitz and Lifshitz 2014; Schulte et al. 2015). The modern lifestyle also exposes many individuals to higher EI than their energy expenditure (Lifshitz and Lifshitz 2014). Economic globalization since the 1980s has brought the world the benefits and drawbacks of industrially produced and altered food, preservation and mass marketing of cheap, palatable, ready-to-eat foodstuffs (Pan et al. 2012). On the positive side the post-1980s production and distribution revolution reduced the world hunger despite a significant increase in population (Pavcnik 2009). On the other hand, inter-corporate competitions for market share have resulted in a very cheap low-nutrient, high calorie food (Lifshitz and Lifshitz 2014) with artificially enhanced flavour popularised using advanced marketing techniques. This revolutionised eating habits across the world and triggered the present obesity crisis.

With some of these foods being palatable, popular, and addictive, in addition to being cleverly marketed to children and adolescents, a worldwide culture that creates and sustains the perfect environment for obesity is in place. In the US, a cross-sectional study by Schulte et al. (2015) had 398 participants rank 35 food items on palatable eating behaviour Likert scale. An average score was given on a scale from 1-7 for each. '1' represented 'not palatable', whereas '7' stood for 'extremely palatable'. Pizza (4.01) was ranked at the top of the reported palatable scale, chocolate and chips (3.73) were the second and cookies (3.71) were rated the third. Cucumber (1.53) was rated the least palatable food. Most foods rated 'palatable' were processed and fat-dense or high in carbohydrate/sugar, or both. The researchers used terms such as 'addictive' or 'addiction' to describe the craving to fatty and sugary foods to encourage the reader's mind to associate such craving with craving to illegal drugs. Such association was technically correct as the attraction of both illegal drugs and fast food are related to the powerful dopaminergic reward system in the brain (Alonso-Alonso et al. 2015).

However, the palatability in one culture cannot be generalized to others as the availability and accessibility of fast food and cultural factors differ. If a similar study were to be conducted in Oman where fast food outlets are fewer than in the US, the people's ratings of food items may differ. In India where vegetarianism is a cultural ideal (Rammohan et al. 2011), the ratings might again vary. However, the growing popularity of fast food chains that offer similar products in countries as diverse as China, India, Africa, and the Arab world suggests that modern fast food may have the capability to bypass many cultural taboos and address the basic human psychophysiological cravings, making them potentially addictive (Sinha 2018). Recent research by DiFeliceantonio et al. (2018) further supports the notion of the addiction potential of foods high in both fat and carbohydrate because such foods appear to simultaneously trigger two separate reward circuits in the brain (one for fat and the other for energy).

In emerging economies, the prevalence of obesity has also been associated with increased spending power of people (Lifshitz and Lifshitz 2014). Instead of continuing with the sameness of traditional home food, people who move into cities seek new tastes and experiences, for example, out-of-reach colas and fast-food. Targeted advertisements give added incentives for gastronomic experimentations. Regulators have not until recently been keen on regulating advertisements and marketing of food (Lifshitz and Lifshitz 2014). Aitsi-Selmi et al. (2012) reported of a positive association between wealth and obesity among Egyptian women with low education levels, $p = <0.001$. In some parts of the Middle East overweight is still seen as

a sign of prosperity (Klautzer et al. 2014). It is possible that well-to-do people in such regions are at higher risk to develop obesity related health problems.

In a study which took the opinions of 2,000 medical students randomly selected from 50 medical colleges in the United States, 28% participants associated obesity with poor eating habits, inadequate exercise, and genetic factors (Phelan et al. 2015). Meanwhile, 27% linked obesity to physiological factors, while 24% attributed it to behavioural and social factors, and 22% linked it to energy balance. Most medical students related obesity to eating habits and inadequate physical activity, which parallel the consensus of experts as the primary causes of obesity (Phelan et al. 2015). Even though factors such as genetics and psychological wellbeing are also important, the primary factors are the most critical contributors to the development of obesity. The study's large sample size representing most of the US medical schools render its findings generalisable to American medical students. However, these may not be generalisable to non-western cultures, for example, Omani medical students.

2.1.1 Impact of advertisements

The physiological changes that occur during adolescence affect eating habits and food choices. The reasons include availability, cost, variety and choices of food, peer influence, parents' lifestyle, advertisements, and the taste of the food (Blanchette and Brugg 2005; Salvy et al. 2009; Oinam et al. 2018).

Many studies have opined that the major motivation for adolescents to consume fast food was provided by media advertisements, which consequently has been associated with rising adolescent obesity levels (Chapman et al. 2006; Utter et al. 2006; Wang et al. 2018). A cross-sectional study in New Zealand by Utter et al. (2006) enrolled 3,275 children in the 5–14-year age group to complete the Food Frequency Questionnaire (FFQ) and found a positive relationship between their age, the time they spent watching television (TV), and their consumption of advertised foods such as fruit drinks, sweets, soft drinks and fast food. However, the results were limited by inability of FFQ to measure the amount of food intake. In Australia, Chapman et al. (2006) measured the proportion between TV programme hours and the length of TV food advertisements included in the regular schedule. From 645 hours of total TV time the researchers isolated 3,287 food advertisements which occupied 81% of the total advertising time. An average of 5 fast food advertising segments had been inserted into most popular evening programmes. Weekend mornings had more than six advertisement segments per hour featuring fast food, sweets and artificial drinks (Chapman et al. 2006). This

trend is despite primetime advertising slots being very expensive. Showing food advertisements in the hours when large numbers of children and adolescents are likely to be watching TV, risks enticing them from early ages to turn into mass consumers of fast food, sweets, and artificial drinks.

The above apprehension was verified by a large international survey that examined the association between TV advertisements and prevalence of children's overweight and obesity in 10 countries—US, Australia and 8 European countries including the UK) (Lobstein and Dobb 2005). A significant negative association was seen between prevalence of overweight and the numbers of TV advertisements aired during children's programs that were designed to motivate children to eat unhealthy foods, $p = <0.01$.

Recently, Fleming-Milici and Harris (2018) recommended curtailing of food and beverage advertisements targeting children and adolescents to pre-empt future devastating lifestyle and health consequences. Vandevijvere et al. (2017) suggested that the WHO should provide guidelines to governments to regulate advertisements of unhealthy foods during the children's TV viewing peak times. In addition, Berry et al. (2017) presented data of 3,911 TV viewers aged 18 years and above, 86.4% of whom agreed it was desirable to stop airing unhealthy food advertisements on TV during the peak times typical for children's audience. Moreover, 87% of the participants agreed that the government must control children's food and beverage advertisements. Cancer Council Australia (2015) reported a recommendation to prevent unhealthy food advertising on primetime TV in the evenings till 9 PM to prevent children from watching those adverts. This suggestion also appears suitable for implementation in countries such as Oman, where governmental intervention may help reduce unhealthy food habits being learned in childhood.

However, a modern trend that make older children and teenagers vulnerable is that junk food and high-sugar beverage advertisements are moving from TV to the Internet (Freeman et al. 2014). Online fast food advertisers adopt psychological tactics that exploit the interactive nature of the Internet, such as making unexpected free offers for regular customers who download their apps, thus earning the food companies captive customer bases among the youth.

Lobstein et al. (2015) have recommended new regulations and public health initiatives to ensure healthy food for children and women in the United States. These include starting an obesity prevention programme from early childhood, promotion of breastfeeding and proper weaning diets. Regulations have also been implemented on food advertising to protect

consumers from misinformation (Lobstein et al. 2015). Similar regulations, if implemented in the emerging economies as well, might help in reducing the number of obesity and overweight cases, thus reducing the risk for NCDs.

2.2 Prevalence of Obesity in the Developed Countries

2.2.1 Prevalence of Adult Obesity

According to the WHO obesity is among the fastest rising global health epidemics which affect millions in the world today (WHO 2015). WHO (2017b) has classified BMI for adults above the age of 20 years as it is shown in the following table (2.1).

Table (2.1) Classification of Adult BMI according to WHO (2017b).

*BMI (kg/m²)	Classification
Under 18.5	Underweight
18.5–24.9	Normal weight
25–29.9	Pre-obesity
30–34.9	Obesity class I
35–39.9	Obesity class II
Larger than 40	Obesity class III

*(BMI= Body Mass Index, Kg=kilogram, m²= square meter)

According to a large international study, during 1975–2014, worldwide obesity increased from 3.2% to 10.8% (NCD Risk Factor Collaboration, 2016). The authors have predicted an even steeper rise till 2025—39% in obesity and 17% in severe obesity. These findings appear generalisable globally as they comprise data pertaining to 19.2 million men and women from different parts of the world.

Developed countries have the highest prevalence of obesity as shown by the data from the relatively prosperous 35-nation group that comprise the Organization for Economic Cooperation and Development (OECD, 2017). In 2015, the top ranks in adult (male and female) obesity in the OECD went to the United States (38.2%), Mexico (33.4%) and New Zealand (30.7%). At the other extreme were Japan and Korea with 3.7% and 5.3%, respectively (OECD, 2017). The low obesity in Japan and Korea despite their economic prosperity has been attributed to various reasons ranging from dietary habits to genetics.

In the US, the incidence of obesity during 2011–2014 was much higher among adults (36%) than among children and adolescents (17%) (Ogden et al. 2015). These findings were supported by a study among 2,638 adult American men and 2,817 women between 2013 and 2014 that

revealed an overall obesity prevalence of 37.7%, at 35% for men and 40.4% for women (Flegal et al. 2016). According to the Centre for Disease Control and prevention (CDC) in the United States, anthropometric measurements were performed for 9,120 participants aged 0–>60 years between 2003 and 2012. The results show a significant rise in obesity among women aged ≥ 60 years (from 31% to 38%, $p = 0.006$) (Ogden et al. 2014).

Peltzer et al. (2014) conducted an international cross-sectional survey among 15,746 college students of both genders aged from 16 to 30 years, randomly selected from twenty-two countries. Male students had a prevalence of obesity 6% and overweight 19%; while among female students, obesity was 5% and overweight 15% (Peltzer et al. 2014). The highest incidence of female obesity was reported in Barbados (18.7%), South Africa (15.6%) and Jamaica (10.7%) (Peltzer et al. 2014). The main strength of this study was its large sample size, but its results cannot be generalized to the young adult population of the studied countries because in each country the participants were selected from a single university located in one city.

Afshin et al. (2017) conducted a multi-centre study over a period of 25 years to 2015, presented obesity data using International Obesity Taskforce (IOTF) cut-off from a total of more than 68 million individuals spread over 195 countries, reported that global obesity among children to be nearly 5%, and among adults, 12%. Prevalence of obesity in women (11%) was higher than in men (6%) (Afshin et al. 2017). In 2015, more than 600 million adults and 107 million children were obese with the number doubling in more than 70 countries (Afshin et al. 2017). Adult obesity levels in Europe are among the highest globally. The UK leads with 26.9% prevalence followed by Belgium (18.6%), Spain (16.7%), Portugal (16.6%), France (15.3) and Sweden (12.3%) (OECD, 2017). In Scotland, adult obesity increased from 18% in 1998 to 29% in 2015 and overweight increased from 52% in 1998 to 62% in 2015 (The Scottish Government 2015).

2.2.2 Prevalence of obesity among Children and Adolescents

More alarming than the increase in obesity in adults is the sharply rising trend among children and adolescents. Among the indicators of rising childhood obesity in the last three decades is the increase in paediatric non-communicable health problems, mainly in OECD countries (OECD 2017). A study by Flynn and Falkner (2011) indicated a 20% incidence of obesity among American adolescents. In addition, a cross-sectional US study among 4,111 children

and adolescents during 2009–2010, showed 16.9% obesity prevalence (Ogden et al. 2012) with no significant differences between girls and boys ($p > 0.5$).

In a more recent US study among 432 students from eight rural high schools of North Carolina and Kentucky, found prevalence of obesity and overweight at 24% and 21%, respectively. (Gustafson et al. 2017) A limitation of that study was that its subjects were rural adolescents whose BMI is less generalizable to their urban peers, mainly because of the expected differences in the nature and extent of physical activity levels between rural and urban areas. A further limitation is that the authors have not explained the system they used for BMI measurements.

In Scotland, the prevalence of obesity and overweight was respectively 15% and 13% among children aged 2–15 years in the year 2015, according to the Scottish Health Survey (The Scottish Government 2015). In England, van Jaarsveld and Gulliford (2015) assessed the prevalence of obesity and overweight among children aged 2–15 from 370,544 electronic health records pertaining to the period 1994–2013 obtained from 375 medical establishments in England and found that more than 33% were obese or overweight. As of 2013, the prevalence of obesity and overweight (37.8%) was highest among 11–15-year-old boys (van Jaarsveld and Gulliford 2015). Interestingly, during first ten years of the study (1994–2003) the mean annual increase was very high at 8.1% but the subsequent ten years (2004–2013) showed a remarkable slowdown, showing only 0.4% yearly mean increase. Such tapering off in the rising trend of childhood obesity parallels the similarly flattening trend in adult obesity rise in wealthy countries. A caveat against the England study is that the anthropometric measurements may have been taken during their illnesses, as the study data were taken from the subjects' health records. If so, generalisability to healthy populations becomes questionable. This is because the subjects' weight losses could be partly attributed to illness related causes such as diabetes, persistent infection, hyperthyroidism, gastroenteritis, bowel diseases (Shiel 2015). Weight gains may sometimes be due to water retention in case of heart and renal diseases or prolonged use of medication such as corticosteroids (Pletcher 2017).

The rising obesity in children could also be attributed to 'modelling,' the way young children learn by imitating their elders. Children are more likely to assimilate parental non-verbal behaviour than their spoken guidance. Thus, societies with high obesity levels tend to have adults with poor eating habits and sedentary behaviour (Navia et al. 2017; Stephens et al 2017; Navarro et al. 2017), which are imbibed by children who model on them.

2.3 Prevalence of Obesity in the Developing Countries

In the past, obesity used to be associated with prosperity because only the rich could afford palatable food rich in refined sugar, animal proteins and fats. Industrial farming and food preservation technologies have brought such food within the reach of lower income classes in most parts of the world. Thus, possibly for the first time in human history, obesity is becoming endemic among low and middle-income earners (Lobstein et al. 2015), particularly in the developing countries. This is problematic in both adolescence and adults.

2.3.1 Prevalence of Adult Obesity

In the last decade the prevalence of obesity rose significantly among adults in GCC countries, (ALNohair 2014). While worldwide obesity is still rising, some developed countries have begun to report slowing rates of increases in adult obesity (WHO 2015). The opposite trend is shown by the economically developing countries such as India, as well as those which have recently become prosperous, such as the GCC countries including Oman. These countries, which previously had low levels of obesity, are reporting rapid increase in obesity. GCC countries have obesity in the range of 2%–55% among women and 1%–30% among men (AL Nohair 2014).

A cross-sectional study was conducted in Aseer district, KSA by Al Zahrani et al. (2016), to assess the prevalence of overweight and obesity among 255 resident physicians aged 26–30 years, of both genders. Participants' weight was measured by a valid electronic weighing scale and WHO cut-off point was used to calculate BMI. The prevalence of overweight and obesity was 36% and 23.2% respectively. Male obesity (31.9%) was much higher than female obesity (7.1%), $p \leq 0.001$. The figures are particularly of concern given that they are doctors who have had adequate lifestyle education. This suggests that cognitive motivators such as specialist knowledge, status, and responsibility as role models, or even an intellectual will to change, might not always be sufficient to consistently practice a healthy lifestyle. Despite the important questions elicited by this study, the small sample size prevents their generalisability. The study deserves to be replicated in all GCC universities across different specialities in order to obtain further understanding about the relationship between professional and intellectual understanding and lifestyle.

Female gender itself appears to be a predictor for obesity. An Iranian study conducted in Tehran province among 3,000 men and women (age ≥ 20 years) found women nearly twice as

likely to be obese as men (20.6% versus 11.7%) (Moghimi-Dehkordi et al. 2013). The researchers had used a random selection of participants with large sample size, and the participants were from both urban and semi-rural regions of the Teheran province which seem to render these results generalisable to the rest of Iran. However, the study was limited by the fact that BMI was estimated based on participants' self-reported weight and height. Many studies found that there was a strong relationship between measured and self-reported weight and height (Abalkhail et al. 2002; Brener et al. 2003; Field et al. 2007). On the other hand, it has also been observed that obese and overweight individuals tend to underreport their weight (Wang et al. 2002; Larsen et al. 2008).

2.3.2 Prevalence of obesity among Children and Adolescents

A systematic review of 42 studies was conducted in Nigeria on obesity in children and adolescents (between the ages of 2 and 15) for the period between 1983 and 2013. It became apparent that paediatric and early-adolescent obesity had almost doubled in that country from 2.8% in 1983 to 5.8% in 2013 (Ejike 2014). This systematic review was limited due to the suboptimal quality of reviewed papers with regards to issues such as sample size and research design. However, even with the limitations, a large rise in prevalence of obesity is evident in Nigeria, the most populated African country (Ejike 2014).

Regarding the African continent, De Onis et al. (2010) reported that the incidence of childhood overweight and obesity in 2010 was 8.5% and expected it to rise to 12.7% in 2020. The above finding was part of the researchers' mega analysis of 450 cross-sectional surveys from 144 countries which found 43 million pre-school children (under the age of 5) to be obese, with a further 92 million to be overweight. The researchers predicted the prevalence of childhood obesity to rise to above 60 million by the year 2020 worldwide and observed that obesity among adults is closely linked to child and adolescent obesity. Children are likely to learn behaviours that are predominant in their respective social groupings, such as families, communities, and friends. In this large analysis, overweight and obesity in preschool children were assessed by 'weight-for-length and -height' instead of 'BMI-for-age.' According to the researchers both methods produce very similar findings (De Onis et al. 2010).

Gupta et al. (2012) in their systematic review of 163 studies revealed that the obesity prevalence among children had increased in developing countries such as Mexico (41.8%), Brazil (22.1%), India (22%) and Argentina (19.3%). These countries are in a phase of development where obesity and its consequences are still given lower priority than in the developed countries

(Gupta et al. 2012). The fact that obesity among children and adolescents is growing fast in these countries indicates a need for their governments to urgently change their priorities. Being a systematic review of a large number of studies from different countries, its findings can be accepted as reliable (Clarke 2011). The rising per capita income in China and India is triggering epidemics of sedentary behaviour and unhealthy eating among their youth. Already the incidence of obesity among Indian children (5–19 years old) is reported to be 22% (Gupta et al. 2012). Schumkler and Didier (2014) warn that continuing increase in childhood and adolescent obesity in these two mega nations that account for more than 36% of world population may ultimately generate healthcare strains on a global scale.

The Arab region is also burdened by rising obesity among children and adolescents, which ranged from 5% to 18% in 2010 (Badran and Laher 2011) and is a fast-growing problem unlike in the Westernised countries where the trend appears to be stabilising. Al-Hazzaa et al. (2013) conducted a cross-sectional study to compare between the lifestyles of British (n = 1,158) and Kingdom of Saudi Arabian adolescents (n = 1,648). Participants aged 14–18 years were selected from high schools using stratified random-sampling technique. IOTF cut-off reference was used to identify participants' BMI in the age range 14–17 years and adult cut-off points for 18-year-olds. They found higher prevalence of overweight and obesity among adolescents in KSA (38.3%) than in the UK (24.1%). Summers in KSA are hot and dry and discourage outdoor activities, while the mild summers in UK are more outdoor-friendly. The cultures are also vastly different. Western girls and women are generally free to engage in outdoor physical activities wearing sportswear in presence of men, their Arabian counterparts face restrictions on both counts. Arab food habits are also different from those in Europe. Together these may contribute to the higher BMI among KSA adolescents.

In a Jordanian cross-sectional study conducted in Amman, 735 boys and girls aged 14–18 years participated. The prevalence of overweight and obesity among the girls (n = 349) was 12.6% and 4.3%, respectively (Tayyem et al. 2014). However, a recent Jordanian cross-sectional study among 787 teenaged girls indicated much higher prevalence of overweight (34.9%) and obesity (12.5%). The subjects had low-to-moderate awareness about the health hazards of obesity (Thaher et al. 2018). The higher levels of obesity in the more recent study seems to indicate a deteriorating trend in Jordanian teen lifestyle, which parallels that from other emerging economies. A large comparative study of 15–18-year-old boys and girls in five Arab countries found Kuwaitis to have the highest obesity levels (boys = 35.3% and girls = 23.6%) and overweight (boys = 26.2% and girls = 19.1%) (Musaiger et al. 2013). This is not unexpected, given

that Kuwaiti women have very high obesity levels (43.5%) as well (World Bank 2017), once again calling to attention the possibility of children modelling on parental behaviour. Jildeh et al. (2010) found the prevalence of overweight and obesity among Palestinian adolescents at 24% and 10%, respectively. Among Libyan teenagers aged 14–19 years, the corresponding figures were 18.3% and 12.1%, respectively (Omar et al. 2017).

In KSA a cross-sectional study by Al Nuaim et al. (2012) involved 1,270 high school adolescents of both sexes. Among the girls, obesity and overweight were prevalent at 17.7% and 18.8%, respectively. In a cross-sectional study in Iraq on 723 boys and girls, the rate of overweight and obesity among 15–18-year-old girls was 20.9% and 4.6%, respectively (Musaiger et al. 2014a).

In Oman, MOH (2016) reported that among seventh to tenth-grade boys and girls (aged 13–16 years), the percentage of newly diagnosed cases of overweight and obesity were 44% for students in grade 7 and 45% for those in grade 10. These percentages are disturbingly high, motivating the author of the current study to find out the causes behind this problem. Increasing numbers of obese children will negatively impact the physical, emotional (Sahoo et al. 2015) and social health of the individual, family, and the society, ultimately affecting the country as a whole.

To conclude, most of the reviewed literature indicate that obesity and overweight in children and teenagers is increasing globally. The consensus seems to be that obesity is the result of unhealthy lifestyle factors such as eating energy dense food and reduced physical activity (Gharib and Rasheed 2008). It is also clear that the problem will be potentially more disruptive in future in the economically developing regions of the world such as Africa, South Asia and parts of the Middle East, Central Asia and East Asia, Latin America. The list of problem areas also should include the prosperous economies of the Arabian Gulf region. However, there is a shortage of quality studies from most of these regions, many of whom seem ill-equipped to resist a future obesity epidemic. Even in the relatively well-to-do Arabian Gulf region, studies on childhood and adolescent obesity are insufficient; this could be because the nature of the topic (girls' obesity) is a sensitive issue in Omani community. This calls for comprehensive research initiatives in the region.

2.4 Complications from Obesity

Unlike in the past when obesity was a ‘first-world’ problem, it has now become a global health concern, particularly in the less affluent countries, due to its subsequent health complications (Ng et al. 2014). Obesity projections in different age groups worldwide, and particularly in the emerging economies, are showing rising trends. Along with obesity, associated health complications, untimely deaths, and the consequent socioeconomic costs are all set to increase. Lifestyle diseases such as diabetes, cardiovascular complications and hypertension are increasingly affecting younger generations including children (WHO 2004a). Most people in the world live in countries where mortalities from obesity and weight related complications are higher than those related to being underweight (WHO 2004b). Murray and Ng (2017) reported that, in 2015, nearly 30% of the entire world population were obese or overweight. According to Afshin et al. (2017) the statistics related to overweight and obesity are directly linked to that of NCDs such as heart diseases, stroke, and diabetes. Other risk factors of obesity are musculoskeletal disorders, osteoarthritis, as well as certain cancers such as breast cancer, ovarian cancer, liver and colon cancer (WHO 2004a). The worry is not only regarding the health of the current teenager group, but also the health of future generations and their societies.

Modern healthcare facilities enable obese people to live longer than ever. However, they are still at risk of contracting chronic diseases such as diabetes mellitus, heart disease and renal problems, which in turn generate further health complications and reduced quality of life (Gregg and Shaw 2017). Childhood obesity has major negative effects on all body systems (Raj and Kumar 2010). A large multi-centre study in the US among 11,245 children and adolescents (0–19 years), found the rates of increase of type 1 and 2 diabetes in children at 1.8% ($p < 0.001$) annually and in adolescents, at 7.1% annually ($p < 0.001$) (Mayer-Davis et al. 2017).

The rise of obesity and its associated health complications increases healthcare costs, exerting pressure on health resources. In the USA, the health care spends on obese individuals is 42% higher than that those with normal body weight (Finkelstein 2009). In the UK, the National health Services (NHS) spends every year about £16 billion to provide medical services to weight related medical conditions (Hughes 2016). In developed countries, obesity management accounts for 2–6% of the total healthcare costs (WHO 2003a). In 2008, in the US the yearly healthcare cost for an obese person was \$1,723 and for an overweight individual, \$266 (Tsai et al. 2011). By the year 2030, the predicted healthcare cost for obesity and overweight is estimated at \$ 956.9 billion, or about 16% to 18% of the aggregate health care budget of the

US (Wang et al. 2008). Globally, high BMI was linked to more than 4 million deaths in 2015, (Afshin et al. 2017). More than 34% of the deaths were due to cardiovascular diseases and 14% due to diabetes, which were directly weight related (Afshin et al. 2017).

As of 2013, the prevalence of overweight and obesity among children and adolescents in developed countries increased significantly to 23.8% in boys and 22.6% in girls. In developing countries, the corresponding figures were 12.9% for boys and 13.4% for girls (Ng et al. 2014). De Armas et al. (2012) reported that the incidence of metabolic syndrome (diabetes, hypertension and cardiovascular) among the obese younger generation was high (19.6%) and recommended early interventions to reduce childhood obesity, the principal cause of these diseases.

2.4.1. Abdominal obesity

Abdominal obesity (central obesity), it is defined as increased fat around abdominal region and is measured by waist circumference (Sigurdsson 2014). The waist circumference cut-off value of 111.5 cm for boys and 104.6 cm for girls was recommended by International Diabetes Federation criteria for children and adolescents and helps to detect metabolic syndrome (Zimmet et al. 2007). BMI and waist circumference should be interpreted together to determine nutritional status and cardiovascular disease (CVD) risk (National Institute for Health and Care Excellence (NICE) 2006).

A cross-sectional study was conducted by Landi Masquio et al. (2015) enrolled 195 obese adolescents aged 15–19 years. The findings revealed positive association between waist circumference and body weight, BMI, visceral fat, subcutaneous fat, body fat, Blood Pressure, insulin and liver enzymes ($p < 0.05$). The increase of these parameters among the Brazilian adolescents also represents an increased chance for this population to develop cardiovascular diseases, diabetes mellitus, and liver damage at younger ages (Arnaiz et al. 2013).

Evidence shows that visceral adiposity (central obesity) is a bigger risk for development of CVD and diabetes. Increasing abdominal obesity alters the body metabolism whereby the fat tissues begin to release free fatty acids into the blood stream, which increases the risk for reduced insulin sensitivity thereby raising blood sugar, ultimately resulting in diabetes mellitus (Mahmuda et al. 2017) (Figure 2.2).

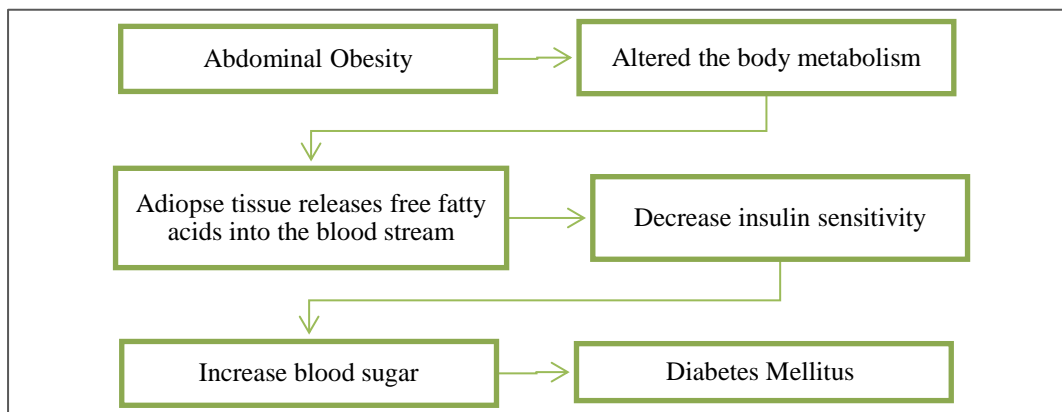


Figure (2.2) Relationship between obesity and Diabetes Mellitus

Abdominal obesity, caused by poor diet (excess intake of fat) accompanied by a sedentary lifestyle, lead to increased blood cholesterol level (Després et al. 2008). The excess cholesterol gets deposited on the inner walls of arteries reducing their elasticity causing aortic stiffness, which in turn increases the risk for blood pressure, coronary artery disease, and stroke (Safar et al. 2006; American Heart Association 2015) (Figure 2.3).

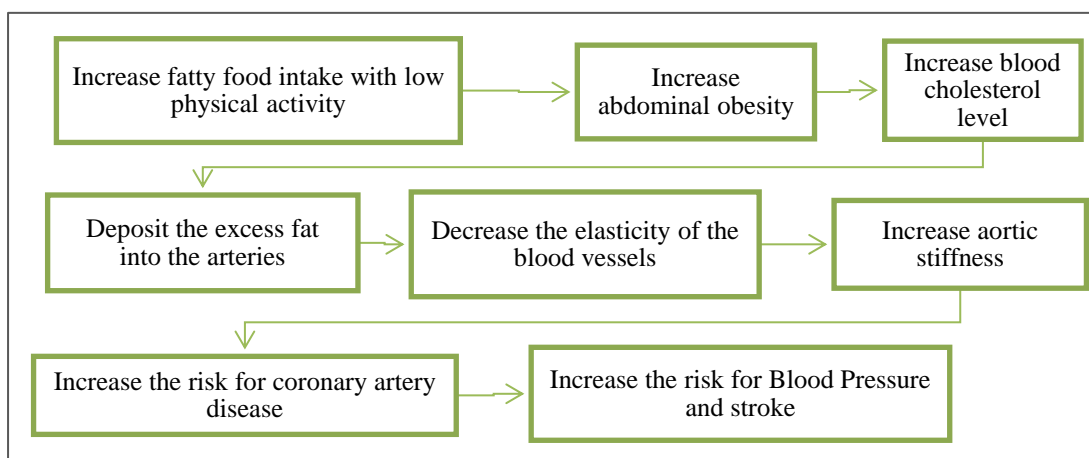


Figure (2.3) Relationship between obesity and cardiovascular diseases

Several studies have noted the positive relationship between obesity (whole body, including abdominal obesity) and arterial stiffness among the youth, as Hudson et al. (2017) found among British adolescents. In Australia, a randomised clinical trial study and longitudinal study over one-year intervention was conducted by Ho et al. (2014) who enrolled 59 obese adolescent boys and girls aged 10–17 years. The study performed objective measurements such as anthropometric data, percentage body fat, arterial elasticity, and oral glucose tolerance test on the participants. The findings revealed that participants who had lower body fat had

significantly lower systemic vascular resistance $p=0.001$. Additionally, there was a positive relationship between systemic vascular resistance and Blood Pressure, $p=<0.0001$. Rise in systemic vascular resistance cause the blood vessels to constrict, decreasing the blood flow to the vital organs (Siddiqui 2011). The study used dual-energy x-ray absorptiometry to measure body fat composition of the participants, which increased the accuracy and reliability of the measurements (McArdle et al. 2015).

WHO (2018a) has confirmed that obesity and overweight had a major contribution in causing lifestyle diseases and reducing the quality of life. In China, a large study conducted by Zou et al. (2017) on 214,354 boys and girls aged 7–18 years, showed blood pressure to be higher in obese participants, $p= <0.001$. There were also statistically significant differences in the incidence of raised blood pressure between participants in different BMI groups: underweight (3.2%), normal weight (4.9%), overweight (9.8%) and obese (17.5%). The researchers suggested to initiate a programme to control obesity and overweight among Chinese children and adolescents to minimize the risk hypertension in future.

Regarding Oman, WHO (2014a) reported that three-quarters of deaths in the country's population resulted from BMI related causes such as cardiovascular diseases, diabetes, and respiratory diseases. The number of newly diagnosed diabetes cases has increased from 5,167 in 2006 to 6,143 in 2016, and the national total diabetic cases increased from 54,599 cases in 2006 to 89,246 in 2016 (MOH 2007; MOH 2017). Significantly, the MOH (2017) Annual Health Report stated that the new cases of diabetes were more in the female population, with 3,184 new female diabetics, against 2,959 male diabetics, a finding that leads to the second major factor associated with high BMI and its related morbidities: physical inactivity in both genders, and more so in women than in men in the traditional Omani society. This finding makes it imperative to conduct studies such as the present one, to investigate Omani girls' lifestyles and the factors that predisposing many of them to higher BMI.

2.5 Physical activity and inactivity

Two lifestyle factors, food and physical activity, are considered the key determinants of body weight status of an individual (Fuglestad et al. 2012). Among the two physical activity factor shows more gender differences in traditional patriarchal cultures such as Oman.

Overweight and obese adolescents are less likely to meet the recommended one hour of moderate physical activity per day (NHS 2018b), and the imbalance between energy consumed and energy expended raises the BMI (Wiklund 2016). Physical activity is a major contributor to energy expenditure of the body prevents accumulation of excess calories and slows down weight gain (Westerterp 2013). To regulate body weight, the aim is to achieve energy balance, based on calories consumed and calories burned (NIH 2007), therefore increasing physical activity and reducing intake of energy complement each other in reduction of BMI (Swift et al. 2014). Here, the need for regular exercising is being particularly emphasized in the modern context due to reduced physical activity levels among most populations.

According to a statistical report presented by Health and Social Care Information Centre, UK (HSCIC) (2014) in 2012, the percentage inactivity in individuals in UK aged ≥ 16 years was higher in females (26%) than in males (19%), when benchmarked against the UK physical activity guideline of recommended daily 60 minutes. Among Saudi adolescents, 64% were physically inactive, much higher than the 25.5% inactivity level among their British counterparts (Al-Hazzaa et al. 2013). The findings this study has good external validity because the researchers used a large sample size (N=2,806) and recruited them randomly. However, to investigate the reasons for not engaging in physical activity further, qualitative data, such as that achieved through focus group discussions or individual interviews could be included. Despite the limitation the Al-Hazzaa et al (2013) study brings to focus the relationship between the lack of physical activity and obesity and opens opportunity for investigating the reasons behind the extremely high levels of sedentariness in the Arab world. As pointed out earlier, cultural differences between the two countries, such as climatic and cultural restrictions in Arabia, are the reasons readily pointed out. However, specific aspects of these need to be studied and region and culture specific remedies can be evolved, which will be attempted in this paper.

Physical activity can be defined as a mechanical movement of human muscular system that involves the consumption of energy (WHO 2015), such as walking, jogging, running, dancing, swimming, washing, vacuuming and gardening (NIH 2011). Exercise is a voluntary form of physical activity, such as playing football, tennis, working out in the gym, swimming and running (NIH 2011). Many exercises are culturally acceptable for adolescent girls in more secularized countries than in the Arab-Islamic region including Oman where grown up girls might be discouraged from participating in sporting activities in a mixed gender environment. On the other hand, there are only limited female-only sporting venues in Oman.

The following studies have reported physical activity and sedentary behaviour that the Omani population engages in, with some providing the reasons for such lifestyle. In a descriptive study that focused on investigating the participation of the Omani adolescents in physical activities, Al-Shamli (2017) found that, of the 511 adolescent boys surveyed, urban and rural respondents reported respectively 24 and 18 hours per week engaged in sedentary activities such as watching television, browsing the Internet and playing video games. Out of the surveyed populations, 51.5% participated in sports activities in the public areas, at home, and at clubs. Given the higher amount of involvement of adolescents in physical activities, the study recommended that the Ministry of Sports collaborate with Ministry of Education (MOE) to use the existing school facilities to host more sporting events in order to encourage student participation and interest in these. The authors also recommended establishing after-school clubs that promote physical activities among both boys and girls.

Hassan and Al-Kharusy (2000) suggested that simple field fitness tests be conducted on children. Their study demonstrated that such measurements are easy to perform and inexpensive. Though they conducted measurements only on male children, they recommended replicating the same on girls in same age group with larger sample sizes.

The other related study that provided the reasons for the Omani population's involvement in physical activity and sedentary behaviour was the one undertaken by Al-Shamli (2010a) measuring the physiological fitness and physical activity of the 10th grade male students in Oman. With a sample of 330 male adolescents and employing the physical activity survey, the study revealed that the body fat percentage ($M = 6.82\%$, $SD = 4.91$) as well as the muscle strength ($M = 38.15\text{kg}$, $SD = 7.60$) of the urban adolescents was higher as opposed to that of the rural adolescents, body fat percentage ($M = 5.79\%$, $SD = 4.29$) and muscle strength ($M = 37.81\text{kg}$, $SD = 6.93$). The finding that the rural adolescents had higher scores in flexibility and cardiovascular functioning indicated that the rural adolescents undertook more physical activity than the urban adolescents.

Al-Shamli (2010a) suggested that teachers, parents, school administrators, and the entire community should encourage physical fitness in boys. This recommendation has been supported by evidence from the study by Al-Shamli (2010b) which acknowledged the benefits of existing PE curriculum and recommended designing one with even more fitness-enhancing activities. Al-Sinani (2014) has supported this recommendation indicating that the physical education is a necessity in Oman in the present time. Studies have also indicated that other

beliefs held by the Omani population embracing the physically active lifestyle include the need to control or avoid the chronic illnesses (Mabry et al. 2014; Kilani et al. 2014).

According to Mabry et al. (2014) the increasing incidence of chronic illnesses in the Omani population is a major public health concern and thus an urgent inter-sectoral action to reduce physical inactivity is needed. In Oman, inactivity was ranked the fourth top risk factor for chronic illnesses. Several calls made to re-examine whether the rising trend in inactivity is a legacy that the older generation is passing to the children (Lakhtakia 2013). Adult inactivity is attributable to mechanisation of household chores, in addition to families hiring domestic labour (housemaids, drivers, farm-workers, cooks, and babysitters) so family members are relatively free from manual work. In Oman, there was an increase in the number of mostly expatriate domestic workers by 155% between 1993 and 2010 (NCSI 2013). There was a further increase of 25% from 2010 and 2012, resulting in 120 workers for every hundred families in Oman (NCSI 2013). The reduction in domestic work increase inactivity in Omani women most.

Higher inactivity among women compared to men is also a global trend as shown by a 2010 study where physical inactivity was recorded globally, where 20% men and 27% women were found to be inactive (WHO 2017c). A cross-sectional American survey by Flegal, et al. (2016) based on weight and height data from the National Health and Nutrition Examination Survey (NHANES), revealed higher obesity levels among women compared to men. Even where men were affected by obesity, they tended to be more physically active than women. Men exercise more than women, which may partly explain their lower obesity levels, and if so, it may translate to comparatively lower susceptibility to lifestyle diseases such as type II diabetes (Mikus et al. 2012).

2.6 Nutritional Requirement for 15–18-year-old Girls

Adolescence is a period of rapid physical growth as well as a phase of intellectual, emotional and overall personality changes (Rogol et al. 2002; Spear 2002). This complex and rapid development calls for additional proteins, carbohydrate and fat in the teenager's diet (Saxena and Saxena 2011) in addition to micronutrients such as vitamins and minerals.

Adolescents require additional energy to grow and maintain physical activity, according to the Omani Guide to Healthy Eating, which recommends EI for Omani adolescent girls aged 14–

18 years at 2,400 Kcal per day (MOH 2009). To achieve this, they should consume a variety of healthy foods that contain the essential three macronutrients, namely carbohydrate, proteins and fats. (Ozdemir 2016). Macronutrient requirements vary among genders and age groups. For Omani girls in the 14–18-year age group, MOH recommends carbohydrate 330–450g, proteins 48–60g and fats 70g (MOH 2009).

It is during the adolescence that about 50% of the adult body weight is gained (Karakoyun and Yagci 2013). Thus, the importance of monitoring and maintaining balanced nutrition during this period cannot be overemphasised. Imbalanced nutrition refers to consuming more than what the body requires for its metabolic needs, and contributes to higher BMI, while insufficient nutrition implies consumption of less than essential food which also leads to other health issues such as delayed and insufficient growth and general development (WHO 2002). To avoid these two extremes, adolescents' food intake patterns need to be closely monitored and have their BMI measured periodically (Bender 2014).

According to Ozdemir (2016), balanced-diet recommendation for adolescents consists of 50% carbohydrate, 30% fat and 20% protein. However, the constitution of balanced diet can vary between countries, regions and ethnicities of the world. For example, for girls aged 14–18 years, Omani Guide to Healthy Eating recommends a daily diet of carbohydrate, fat and protein at 61%, 26% and 9% respectively (MOH 2009). Meanwhile the corresponding recommendation for girls in the UK are 50%, 35% and 15%, respectively (NICE 2015).

Studies from different countries reported varying amounts of daily intakes of macronutrients, and many factors play roles on this variation. Carlsen et al. (2010) enrolled 59 Norwegian youth of ages 18 and above to participate in weighed 7-day diet diaries that used a digital food weighing scale. The energy gained from carbohydrate, fat and protein were 42%, 17% and 35% respectively. Norwegian participants reported lower percent of energy than reported by Matthys et al. (2003) who enrolled 341 Flemish adolescents aged 13–18 years of both genders, to participate in the completion of 7-day diet diaries. The reported energy gains from carbohydrate, fat and protein were 49%, 36% and 14.5%, respectively. More than 90% of Flemish adolescents had fat intake higher than the recommended value of 30% of the total daily energy intake. Taking an unbalanced diet might lead to increasing problems in adolescent's nutritional health problems. For example, excessive ingestion of dietary fats may increase the risk of developing cardiovascular diseases (American Heart Association 2015). However,

increased intake of fruits and vegetables reduces that risk (Woodside et al. 2013). As a result, the intake of micronutrients is expected to increase as well (Fulton et al. 2017).

Albar et al. (2014) took a representative sample from the National Diet and Nutrition Survey (NDNS) of 636 British teenagers in the age range of 11–18 years. The participants' un-weighed 4-day diet diaries revealed their total average daily EI to be 1798 kcal, in which the shares of carbohydrate, protein and fat were 241g (50.2%), 66g (14.7%), and 68g (34%), respectively. The portion sizes of high-energy-dense foods were associated positively with increased body weight in British adolescents (Albar et al. 2014). In comparison, Canadian adolescents aged 12 and above consumed higher daily EI as measured by 24-hours food recall (Garriguet 2008). In this group, the normal energy reporters had daily EI of 2,349 kcal, from proteins: 93 g (15.8%), carbohydrate: 291g (46.5%), and fats: 87g (33%). Using 24 hours food recall is a different method to the NDNS which used un-weighed diet diaries so the findings from 24 hours food recall may be less accurate than NDNS findings.

2.7 Dietary Habits

2.7.1. Fast-food industry which revolutionised world food habits

Until about forty years ago, people mostly ate fresh, locally produced food and had limited access to processed food (MOH 2009), particularly in the non-Western world. It was in the late 1980s to early 1990s when the fast-food culture began to spread to emerging economies. Western multinational food processing and distribution companies, ready with technology, workforce, and decades of marketing experience, had an overwhelming advantage over local competition, and they soon began to dominate the food industry in the developing world (Goryakin et al. 2015). In the subsequent decades, the global fast-food industry grows into a powerful, technology-driven power, and is projected to be worth over USD 690 billion by 2022 (Zion Market Research 2017). Having permeated the cities, fast-food industry is already encroaching into small towns and rural areas (Talwar 2004). At the end of 2012 there were 48,034 MacDonald's restaurants worldwide. These were distributed in 118 countries including Oman, selling burgers at a rate of 75 per second (Al-Adeel 2014). In China, 600 KFC restaurants were newly opened in 2016, while McDonald's plans to open one thousand fast food outlets by 2021 (Ng 2017).

Popularity of fast-food has grown to such an extent that across the world many rate these food products as their favourites (Talwar 2004). However, palatability is only one of the factors that

makes the modern fast-food so addictive. Companies cleverly use psychology and the power of behavioural economics to predict and control consumer behaviour at individual and group levels (Battye 2018). However, the consumer is also responsible for so readily succumbing to the temptation ready-to-eat hot food.

The typical fast-food company maintains a large database of its market, and carefully analyses the target consumers' tastes, desires and spending patterns and targets products and advertisements that takes advantage of those characteristics, generating a loyal consumer base—captivated not only by the food itself, its packaging, the environment, the memories it evokes, and above all, its standardized predictability, particularly its promise of almost instant gratification—all of which together overpowers individuals and gradually alters their lifestyle (Moss 2013). The uniformity and predictability of fast-food marketing also results in groups of people who think alike, favouring a particular brand of fast-food and the ambience its outlets generate, which is further reinforced by targeted advertising campaigns (Moss 2013). Individuals who identify themselves as part of a group increasingly find it difficult to think differently from the group (Cookson and Ilbury 2011).

There is also the suggestion that choosing fast-food over healthy food may be beyond individual free will, which might be why nutrition-education alone may not trigger behavioural change (Levitsky and Pacanowski 2012). This view is gaining support (Lean et al. 2018) and nutrition and health care professionals are increasingly favouring supplementing nutrition education with decisive governmental action such as Mexico's recent 'sugar tax' on soft drinks (The LANCET Diabetes and Endocrinology 2017). It may be recalled that almost a century ago, in 1922, Norway had imposed a sugar tax, as a result, the ratio of overweight children fell below than their counterparts in US and UK, (Harris 2018) The Norwegian experience could be adopted by other countries including Oman, and the resultant tax revenue might be utilized to promote healthy lifestyle in the population.

WHO (2016) recommended that media catering to children and young people watch must be free from advertisements for unhealthy foods and sweetened drinks. Recently, expert voices urging government controls have become strident enough for catching the attention of the mainstream media which has also begun to support the battle against unrestricted advertisement targeting young people.

The Food Foundation (2017) in the UK introduced new restrictions on advertisements of high fat food, sugar and salt products. Advertisements should not exploit the psychological

vulnerabilities of children or entice consumers buy the product. Marketers should follow European Union regulations for their fast food advertisements. Unhealthy lifestyle, such as eating more meals, eating before sleep, and missing meals should not be advertised. Nor should the fast food advertisements associate health, youth, and sporting performance with unhealthy food. The mainstream newspapers in UK played a positive role here by endorsing the government initiatives to restrict fast food advertising and promotions and asked for increasing such regulations (Boseley 2018).

2.7.2. Fast-food culture and obesity

As a plethora of literature have suggested, consumption of fast food may lead to obesity and eventually to chronic lifestyle diseases (Moreno and Rodriguez 2007). In four public high schools in the US, a randomized intervention trial study (obesity prevention programme) was conducted by Wang et al. (2006). The schools were randomly selected, and data collected from different sources such as the pupils, their families, school records, school staff, and other local residents. The findings revealed that obese adolescents consumed high-fat meals (55%) and soft drinks (70%) more than twice a day and ate smaller amounts of fruits and vegetables. The findings such studies provide strong evidence for health risks of fast-food.

Individuals in poor and middle-income countries have been reported as having healthier diets than their high-income counterparts; however, the major fast food and soft drink manufacturers are targeting the youth in these countries in order to expand their consumer base (McNeil 2015).

A worldwide report published by Imamura et al. (2015) with focus on obesity indicated that unhealthy food habits were increasing. This systematic review assessed 325 dietary studies from 187 countries, comparing the consumption of 10 healthy foods involving whole grains, fish, nuts, beans, milk, vegetables, and fruits with 7 unhealthy foods such as trans fats, sodium, meat (processed and unprocessed), and soft drinks. Some poor countries such as Mali, Chad, Guyana, Myanmar, and Laos reported the highest scores of fast food consumption. The Mediterranean nations of Greece and Turkey scored low. The worst performing countries included Argentina, Mongolia, and Kazakhstan. Among the developed countries, the United States performed below average, which placed it lower than Mexico and Canada (Imamura et al. 2015).

In the USA, children habitually consume more than 200 kcal per day in the form of unhealthy foods, and this habit might continue into their adulthood (Lobstein et al. 2015). Consequently, American children's average weight has increased by more than 5 kg in the last three decades

(Lobstein et al. 2015). On the other hand, poverty ridden regions of countries like Vietnam, South Africa, Brazil and India, where children consume starchy, protein-deficient food, may result in their remaining short in stature, yet obese (McNeil. 2015).

A review of three large dietary projects has been undertaken to assess the food habits of different populations across the globe supported the finding that the nutrition-related risk factors for chronic illnesses usually begins in early childhood and adolescence (Moreno et al. 2005).

The canteen ‘card payment’ system has been recently used to assess the food habits of adolescents. A study conducted in Northern Ireland by Logan et al. (2017) analysed six weeks’ data on the lunch purchased by 294 students using canteen cards in two high schools (urban and rural). The researchers were able to identify the most and least liked foods and rank them according to nutritive value (healthy and unhealthy). This new method is considered reliable as the consumption data is documented automatically. However, to generalize the findings, larger sample sizes across populations may be needed.

In a study that aimed to assess the differences in food habits among seven European countries within a ten-year interval, Trichopoulou et al. (2002) reported that the overall eating habits of both northern and southern Europeans depended upon the relative availability of various types of food. The availability of several food items such as vegetable fats, sugar products, as well as animal lipids had fallen over the decade under study. In addition, where the head of the family was highly educated, there was a positive shift towards healthier food choices such as low-fat milk, animal lipids, fresh fruits, (an unhealthy exception being soft drinks). (Trichopoulou et al. 2002).

The desire to live a healthy life has also been reported to influence the eating habits of several populations. In England, Lake et al. (2006) conducted a longitudinal dietary study to assess the dietary intakes of 198 participants (aged 12–33 years) of both genders, using 3-day diet diaries. The reported intake showed a decrease in the intake of foods that contain sugar, fat as well as dairy foods and milk, with $p < 0.05$. The intakes of vegetables and fruits have on the other hand been reported to increase with significant value $p < 0.05$.

Kilani et al. (2013) in their study among adolescents in Oman found that 50.2% of boys and 63.3% of girls consumed fast food. It was also found that 64.9% of the girls in the study skipped breakfast. Similar findings have emerged from different parts of the world including Bahrain, Saudi Arabia, Dubai, UK and USA (Rampersaud et al. 2005; Al-Hazzaa et al. 2006; Bin Zaal

et al. 2009; Musaiger et al. 2011; Corder et al. 2011). Malinauskas et al. (2006) found that female Americans tended skip breakfast in the hope of losing weight. However, evidence shows that skipping breakfast is less likely to help. Eating a healthy breakfast promotes the absorption of essential nutrients (Rampersaud 2009) leading to optimal body weight and alertness during school hours, and consequently academic performance (Levin and Kirby 2012).

2.8 Dietary Habits and Physical Activities of Children and Adolescents

Children and adolescents in different BMI groups have different habits and practices. D'Addesa et al. (2010) conducted a study to examine the lifestyles among adolescents of different BMI groups in Rome. The subjects were 756 adolescent boys and girls aged 10–17. They completed questionnaires about food and physical activity and 24-hour dietary recalls. Among the boys 28% were overweight and 9% were obese, while 24% of the girls were overweight and 9% were obese. It was also found that the average time spent watching TV was slightly higher among the overweight girls ($M = 2.7$ hours/ day) than the girls with normal weight ($M = 2.4$ hours/ day), ($p < 0.5$). Furthermore, overweight boys ($M = 3$ hours/day) spent less time practicing physical activities than normal-weight boys ($M = 4.2$ hours/day), $p < 0.5$. The self-reported EI, overweight participants reporting lower daily consumption of fats, carbohydrate and protein compared to normal weight participants ($p < 0.5$). Various studies suggest that obese and overweight people tend to underreport their food intake (Rodrigues et al. 2008), a caution for researchers who analyse self-reported data.

A further limitation of the 24-hour dietary recall method employed in the above study, even with the help of well-trained dieticians, is that an estimated dietary record for a single day need not give an adequate picture of the participants' eating habits. This method depends exclusively on the participants' memory of the food and drinks consumed the previous day (Thompson et al. 2015). More reliable is the weighed 7-day diet diary where participants record their pattern of eating for a week, including the weekends. Lentjes et al. (2014) state that a period of 7-day is considered optimal to assess nutritional patterns of their participants. However, this method can be tedious for the participants to record and for the researcher to analyse (Livingstone et al. 2004). This may require reducing the sample size and training the participants before starting the data collection. Another source of misreporting is dieting participants. For example,

D'Addesa et al. (2010) studied the EI of boys and girls aged 11–17 years and majority of overweight participants were who on a diet (the reason for dieting was not mentioned in the study). As a result, overweight adolescents reported lower EI (boys: 2,412 kcal; girls: 2,067 kcal) than their normal weight peers did (boys: 2,773 kcal; girls: 2,244 kcal).

A study was conducted in Spain by Garaulet et al. (2000) among 331 14–18-year-old boys and girls to assess the prevalence of being overweight and obese, and to examine the relationship between eating habits and physical activities in different BMI groups. More boys (48.2%) than girls (30.8%) were overweight or obese. Additionally, overweight and obese teenagers of both genders reported lower daily intake of energy and carbohydrate (to $p < 0.05$), but higher intake of fats compared to normal weight boys (to $p < 0.05$). Overweight and obese boys spent less time on physically activities than did boys of normal weight. ($p = 0.033$). Similar findings emerged in a Jordanian study among 14–20-year-olds living in Amman where the tendency to be overweight and obese was higher among males (25.7%) than females (16.9%) (Abu-Mweis et al. 2014). Thus, the two studies (Jordanian and Spanish) gave against-the-norm results by reporting more obesity among boys than girls. This calls for further investigation as to the reason for such an unusual rise in obesity among Spanish and Jordanian boys. To study the cause in-depth, a qualitative study should also be conducted to record the opinions of the participants and their parents or caregivers.

A recent cross-sectional study conducted in Makkah, KSA by Al-Kutbe et al. (2017) examined the difference between eating habits and physical activity of participants in different BMI groups by enrolling 266 participants from seven female primary schools in the city. To have a clear picture about children's eating habits and physical activity, the authors used a variety of data collection instruments, including a 4-day un-weighed diet and accelerometer (2 weekdays and 2 weekends). The results show that 30% of the total participants were obese or overweight. In addition, there were significant differences between the dietary habits of participants of different BMI levels. The total daily EI was higher among obese girls ($M = 2,677$ Kcal/ day) compared to those of healthy weight ($M = 1,806$ Kcal/ day), $p < 0.001$. Obese girls also had a higher intake of fat, protein, carbohydrate, sweets and sugary drinks compared to girls of normal weight ($p < 0.001$). Most participants did not meet the recommended daily footsteps for their age. The data of under-reporters were excluded from the study. The researchers identified under-reporters by using The Henry equation for Basal Metabolic Rate (BMR) reported by UK, Scientific Advisory Committee on Nutrition (SACN) (2011). The results showed the obese children had poor eating habits and prone to inactivity. Even though the

sample was too small and non-diverse to be used to generalize the findings to the national population of KSA, it was adequate to generalize about children living in Makkah city. The causes of such lifestyle deterioration need to be identified by conducting a Mixed Methods Study that also includes interviews with parents. Such a study should help evolve effective strategies that help the children and their parents—particularly the mothers—to make optimum use of lifestyle-enhancing facilities available to girls living in affluent Arab Muslim cities such as Makkah.

Another study, conducted in Switzerland by Aeberli et al. (2007), employed 142 boys and girls aged 6–14 years using convenience sample selection. The study aimed to examine the difference between the food habits and physical activity among normal weight ($n = 74$) and overweight ($n = 68$) Swiss children. The overweight children consumed 27.9 g/day more of meat products than children of normal weight ($p < 0.001$). The overweight children also spent extra 100.5 minutes/ week watching TV and playing games than normal weight children did ($p = 0.035$). There were no significant differences between the groups in terms of their intakes of fat and saturated fat, but Swiss children generally were seen to be consuming more than the recommended values. The childhood obesity shown in this study could be because of excess protein and fat intakes from meat and meat products, so health education should emphasise a reduction in intake of meat and meat products among Swiss children.

Abu-Mweis et al. (2014) examined the lifestyle of 735 Jordanian high school students (14–20 years) by completing a self-reported questionnaire. They found that, more boys were overweight (16.1%) and obese (9.6%), than girls among whom only 12.6% were overweight and 4.3% obese. There were significant gender and lifestyle differences. 79.7% of the boys consumed sugary drinks more thrice a week compared to 66.3% of the girls ($p < 0.05$). In addition, the boys (27.7%) consumed more fast food than the girls (15.6%), $p < 0.05$. Meanwhile, the girls consumed more French fries (56.4%) and chocolate (66.1%) than the boys did (46.2% and 55.1%, respectively), $p < 0.05$. Most subjects admitted to skipping breakfast, but among those who did eat daily breakfast, the boys dominated (29.4%) the girls (17.5%), $p < 0.05$. (Abu-Mweis et al. 2014). Thus, both boys and girls had propensity towards unhealthy dietary habits but there was gender-specific differences in habits. The study sample being large, its findings can be generalized to the Jordanian adolescent population.

In Australia, a longitudinal study was conducted starting 2008 by enrolling 2,280 boys and girls aged 8–9 years of whom 2,037 were breakfast eaters (89%) and 243 were breakfast

skippers (11%). Participants were selected by systematic random sample according to their date of birth. The data regarding children's breakfast consumption was collected through interviewing parents or guardians who were asked to fill out two questionnaires. Two years later, in 2010, a teacher responsible for a class of 10–11 years old children were asked to complete questionnaires regarding the children's academic performance and behaviours. The children who had skipped their breakfast according to 2008 data, now demonstrated poorer performance in Maths, reading and general academic abilities, compared to the children who consumed regular breakfast. No other significant behavioural differences were noted between breakfast eaters and skippers. (Smith et al. 2017). A caveat here is that the link between daily breakfast and academic performance may be part of a bigger trend. It is conceivable that the families of breakfast-eating children are fundamentally more disciplined and had established regular home work hours.

In the USA, a longitudinal study lasting over 3 years was conducted by Berkey et al. (2003) to examine the effects of missing breakfast on body weight. The findings compiled from the data provided by 14,586 participants aged 9–14 years, showed that overweight participants who did not consume breakfast lost weight (boys: -0.66 kg/m^2 ; girls: -0.50 kg/m^2). Normal weight participants who did not consume breakfast increased weight (boys: $+0.21 \text{ kg/m}^2$; girls: $+0.08 \text{ kg/m}^2$). The findings show that, participants who reported missing breakfast have reported lower daily EI so, this could be one the contributing factors for the overweight adolescents to reduce body weight.

In the above study observing participants for the duration of 3 years allowed the researchers to study the long-term trend of breakfast consumption study the changes in the body weight among studied subjects (Berkey et al. 2003). Due to the duration and sample size this finding can be generalized to a larger population of North American children. In general, despite their long gestation and logistic challenges, longitudinal studies of lifestyle patterns seem more reliable than their cross-sectional counterparts.

The following studies highlighted the differences between physical activities among Canadian adolescents in different BMI groups and between genders. Girls were generally reported to have less physical activity compared to boys. The boys reported higher mean footstep counts (11,267 steps/ day) than girls did (9,204 steps/ day) (Colley et al. 2011). A study conducted in Palestine by Jildeh et al. (2010) found that adolescent boys participated more often in the physical activities over a period of 5 days (29%), than girls did 16%. Harahap et al. (2018)

enrolled 1,143 Indonesian school age children to measure physical activity by pedometer for two days. The boys had higher mean footstep counts (13,329 steps/ day) than the girls (11,999 steps/ day), $p < 0.05$. Arab culture requires girls to do indoor house work whereas boys engage in more strenuous outdoor physical activities (Jildeh et al. 2010).

Other studies also reported that normal weight children and adolescents were more active than obese peers. Colley et al. (2011) enrolled 1,031 Canadian children and adolescents aged 6 to 19 years to measure daily footstep counts. The study was conducted over 7-days using Actical Accelerometers. It was reported that obese adolescents walked fewer daily footsteps (10,224 steps/ day), compared to their normal weight counterparts who clocked 11,159 steps. The trend was similar but inter-BMI difference in footsteps was lower in a study on Indonesian children. Normal weight children had footstep counts of 12,848 steps/ day, closely followed by their overweight peers who managed 12,207 steps, $p = < 0.05$ (Harahap et al. 2018).

An interesting study was conducted among Navajo Native American high school students by Jones et al. (2017) who used pedometers to measure footstep counts. Native American youth have high levels of obesity, nearly 50% which makes them more prone to lifestyle diseases. The boys' achieved more footstep counts during weekdays (11,078 steps/ day) than during weekends (6,493 steps/ day), $p = < 0.05$. The higher weekday-tally was partly due to participation in physical education classes. Interestingly, the girls in the study clocked almost the same mean footstep counts during weekdays (7,567 steps) and weekends (7,589 steps). In the traditional culture of Navajo Indians, girls have weekend household responsibilities including feeding animals and chopping wood. This also explains why their weekend footstep count exceeded that of the boys. Additionally, this throws attention to the differences and similarities in the demands on female physical activity in two vastly different traditional societies—the Navajo Indians and the Middle Eastern Arabs.

There are different factors hindering individuals from practicing physical activity. Awadalla et al. (2014) reported that among the 1,257 Saudi students of both genders studying in health colleges in King Khalid University, 58% were physically inactive, 'time constraints' being the primary self-reported reason. The large sample size made it possible to identify the differences between male and female physical activities, and these findings can be generalized to most Saudi youth (LoBiondo-Wood and Haber 2014). The prevalence of vigorous physical activities (≥ 75 min/week) among the male students (20%) was statistically higher than that of the female students (10%), $p = < 0.001$ (Awadalla et al. 2014). To avoid sample-selection bias, the

researchers selected their sample randomly and provided a detailed description of their sampling strategy as prescribed by Gray and Rodney (2004). To reduce measurement errors, the ATLS questionnaire used for the King Khalid University study had been prior-tested for internal consistency, reliability and validity in twelve Arab countries (LoBiondo-Wood and Haber 2014).

2.9 Socio-cultural and Lifestyle Factors in GCC Region

In 2016, according to WHO (2018a) the global prevalence of obesity and overweight among women (15% and 40%, respectively) was higher than men (11% and 39%, respectively). In Arab countries, the trend is similar. Improvement of living conditions encourages sedentary lifestyle, facilitated by more cars, better road conditions, cheaper and faster broadband Internet, smartphones and the addictive nature of social media. Therefore, consumption of unhealthy food increased, accompanied by decreased physical activity, which predictably resulted in increased obesity among children, teenage and adults (Badran and Laher 2011).

Between rural and urban regions in the GCC countries there is an interesting relationship. An early study from Saudi Arabia by El-Hazmi and Warsy (2002) among a sample of 12,701 children and adolescents in Saudi Arabia, reported lower obesity among rural Saudi children (4%) compared to city children (10%). Al-Othaimen et al. (2007) suggested that this could be because rural life demanded more physical activity than in cities. However, this difference is narrowing and even reversing as shown by later studies. In the mixed (urban, agricultural-rural and desert-rural) region of Al-Ahsa in Saudi Arabia, a study on 15–19-year-olds (607 girls, N= 1,270) found that both girls and boys residing in desert-rural areas were more sedentary and obese than their peers in the neighbouring urban and agricultural-rural regions (Al-Nuaim et al. 2012). Both Al-Ahsa's desert-rural environment and Oman's Ibri region are similarly dry, and largely rural. Thus, everything else being equal, a rural desert climate might encourage an inactive indoor lifestyle contributing to higher BMI. The other affluent regions of the world are also showing signs that rural obesity may have begun to overtake urban obesity (Johnson and Johnson 2015). Additional reasons for the rising obesity in rural areas in relatively affluent countries might be due to: the spread of affluence to rural areas, mechanization of farming requiring less and less manual labour, the urban "exercise-for-fitness" culture still being alien to rural culture, freedom from competitive stresses that occupy

urban lives, availability of digital entertainment and social media, as well as easier availability of processed foods and the spread of fast food culture.

A region-specific obesity inducing factor in the GCC countries including Oman is that most families here employ expatriate domestic labour. Additionally, cultural restrictions limit females from performing physical activities in public. Boredom is readily alleviated by TV and digital entertainment. All these factors together seem to explain the rising obesity among GCC women.

It was found that GCC countries had higher consumption of carbohydrate, fat and sugar. According to GCC Food Industry report for the period 2014–2019, Qatar (5.5%) had the highest growth in food consumption, followed by UAE (4.8%) and Oman (3.2%) ranked the third (Bureau 2015). Annual GCC investments in processing and preserving of fish and meat have increased from \$1,492 million in 2012 to \$2,218 million in 2014 (Geilenkirchen 2016). High food consumption happens during social gatherings as well as daily meals. For instance, in Saudi Arabia and Kuwait celebratory feasts consist of traditional heavy meal with rice (carbohydrate), meat (protein and fat) and sweetmeats such as halwa (sugar, starch, and fat) (Al-Kandari 2006; Al-Othaimen et al. 2007). The ingredients are similar in other GCC countries including Oman. Such cultural occasions—which are held frequently—also contribute to the rising BMI in the GCC population. Findings of a cross-sectional study of 304 of university students in the UAE by Al Dhaheri, et al. (2014) shows that the majority (boys =64.9% and girls=52%) indicated that they liked such traditional food due to its taste. Even though GCC residents do share a similar gastronomic culture, generalising the UAE study findings to the entire region is not recommended because of the small sample size that too limited to university students.

The above studies reveal the influence of culture in developing food habits observing and imitating parents and elders' behaviour in festive occasions, and how these ingrained preferences contribute in determining the BMI of a person.

2.10 Gender, Environmental and Cultural Aspects

Energy requirements are higher for boys than girls and this is reflected in many studies reporting that females consume less energy than males. Matthys et al. (2003) reported that Flemish adolescent boys had a higher daily mean EI (2,653 kcal/ day) than girls (1,970 kcal/

day). Recently 1,143 Indonesian school boys and girls were enrolled to complete a 24-hour food recall with the help of their parents or caregivers (Harahap et al. 2018). The boys reported higher mean daily EI (1,209 kcal/ day) compared to the girls (1,181 kcal/ day), $p < 0.05$. Male body being larger and more muscular than female body generally requires more EI (Muth 2012).

In some traditional societies the natural requirement of marginally additional nutrition for boys is accentuated due to a traditional preference for boys over girls, resulting in nutrition deprivation for girls. It is common in Arab communities to prefer boys to girls. According to Jildeh et al. (2010), Palestinian boys in East Jerusalem reported themselves to be 'healthier' than girls. Palestinian adolescent girls had daily EI of 1,651 kcal/ day compared to boys who consumed 2,158 kcal/ day). There were also qualitative differences in the food consumed between genders. Girls consumed much less protein (10%), carbohydrate (48%) and fat (30%) than the boys for whom the corresponding figures were 15%, 59% and 40%, respectively (Jildeh et al. 2010). This is also the norm in India, another male preferring culture, where mothers have been noted to give markedly preferential treatment to male infants while breast feeding and consequently girls in poor families in India tend to grow up more malnourished than boys from infancy (Fledderjohann et al. 2014).

A curious reason for obesity in children has been reported from China: the grandparent effect. Chinese grandparents who grew up during the Great Famine of the early 1960s, seem to express their unconscious fear of starvation by overfeeding their grandchildren which is noted as a cause of childhood obesity in China (Li et al. 2015)

The geographical location of residence is also likely to make a difference in the levels of adolescent obesity. An adolescent who is habitually involved in high physical activity or living in a hilly region, needs higher calories than an inactive one (Crespo et al. 2001). Living in hilly regions reduces the chances of obesity, perhaps due to hypoxia in higher altitudes, as a recent study among Spanish youth suggest (Díaz-Gutiérrez et al. 2016). Living in hilly area people's BMR and leptin level increase so this leads to decrease appetite and ultimately leads to decrease EI which leads to decrease body weight (Díaz-Gutiérrez et al. 2016).

The differences between the energy intakes between adolescents in different countries could be availability, cost, and accessibility of food and differences in physical activity levels. Caspi et al. (2012) reported that, easy access to ready-to-eat food from malls, drive-in, supermarkets,

fast food restaurants and mobile trucks, ice cream stores and convenience stores attracts the consumers to try different types of food, contributing to excess 'empty-calorie' intake.

As it was discussed above the reasons for obesity are wide ranging and multifactorial and differ between countries, cultures and genders.

2.11 Adolescent Experiences of Dietary and Lifestyle Behaviour: Data from Qualitative Studies

Qualitative researchers encourage their study participants to ventilate their perceptions, thoughts, and opinions of the studied problem. This 'insider information' is used to identify patterns in perception and behaviour. The following paragraphs explore the work of qualitative researchers from different countries who were able to elicit adolescents' perceptions regarding their dietary lifestyle.

A qualitative study was conducted by Banna et al. (2016) to assess the effect of socio-cultural factors in eating behaviour among Peruvian boys and girls aged 15–17 years. Fourteen adolescents were interviewed at their homes by a trained researcher. The home interviews helped the researcher gain first-hand information on the food consumption patterns and preferences of the participants. The participants revealed how individual, physical and social environment and social media influenced their food habits.

In a recent qualitative study in Bangladesh by Kabir et al. (2018), 25 university students participated in one to one interview and another 26 participated in focus group discussions to explore the factors that affected the students' eating habits and dietary intake. The interviews and focus group discussions were conducted by trained researchers in qualitative research. The researchers reported different factors influencing their food choices such as personal factors (taste, cooking skills, knowledge about the food), social factors (peer influence), factors related to university life (campus culture and examination pressure), and environmental factors (food prices, availability of cooking resources). These identified factors could be applied to the educated youth of Bangladesh and cannot be generalized internationally. The cultural, environmental differences and the small sample size prevent that. In addition, female sample size was smaller (37%) than males (63%), probably because the researchers were male. Yusof and Omar-Fauzee (2003) reported that if the interviewer was from the opposite sex, participants might be hesitant to participate. The researcher gender issue can thus be considered a limitation of the study.

Fitzgerald et al. (2010) conducted a qualitative study to examine the factors influencing the food choices among 29 Irish children and adolescents aged 9–18 years. Participants were involved in six focus group discussions, divided according to their age and gender. The Findings show that in higher ages parental control started to lessen, and adolescents perceived that they had more independence over their food choices compared with children. The study's small sample size may limit its generalisability to similarly placed Irish youth.

Watts et al. (2015) invited 22 Canadian participants aged from 11-16 years to explore the factors affecting or facilitating healthy eating habits among overweight and obese adolescents within the home environment. In general, homes with less availability of healthful foods, where family members preferred less healthful foods and living in places where healthier foods were unavailable or inaccessible are described as barriers to healthful eating. Special occasions and time spent studying or in front of the screen were also conducive to less healthful food choices. Home cooked meals supported adolescents in making healthier food choices, while specific parenting strategies such as encouragement and restriction were helpful for some adolescents.

Amiri et al. (2011) conducted a qualitative study in Tehran city to explore factors that affecting the healthy lifestyle among adolescents aged 15–17 years. Fifty-one obese and overweight boys and girls belonging to both genders were enrolled to participate in seven focus group discussions and 15 one to one interview. Iranian adolescents perceived that personal and environmental factors were the main barriers for not practicing a healthy lifestyle. Participants were selected purposefully from different socioeconomic levels (low and high) in Tehran.

However, the study was conducted in Tehran city so, the perceived barriers may not reflect the healthy lifestyle by the village's adolescents in Iran. To improve the validity and accuracy of the Iranian study results, the probability of the study was measured by different means member's check, respondents' validation and by researchers had spent more time in studied area.

2.11 Conclusions

The reviewed literature confirms that obesity is a rising global epidemic that requires urgent attention and intervention. Globally, obesity prevalence among adults is higher than among children and adolescents but the prevalence among the younger age groups is accelerating more. This increase has is reflected in cardiovascular and NCD such as diabetes increasing in

the youth. Any genetic proneness to obesity is greatly accentuated by the culture of poor eating habits and sedentary lifestyles. More children and adolescents are suffering from obesity and weight related complications. This makes it vital to assess the lifestyle practices of teenagers in the less studied populations. The less urbanised regions of Oman such as Ibri Wilayat would fit with this population/goal.

Gaps in the Literature

A few studies published in Oman discuss lifestyle habits and their relation to the physical health and wellbeing of adolescents and adults. However, most of these studies (Al-Kilani et al. 2012; Al-Kilani et al. 2013) were conducted using data collected from the capital region of Muscat, which revealed that the prevalence of physical inactivity and sedentary lifestyle among adolescents aged 15–18 years was more in girls than in boys, as was the consumption of fast food (Kilani et al. 2013). Despite the urban bias, that study's findings are among the best available for this age group in Oman and due to its moderately large sample size ($n = 802$) and the randomisation of the sample recruitment strategy (LoBiondo-Wood and Haber 2014). Lack of similar studies in the country's less urbanised regions is the reason that the current study focuses on a semi-rural district (Al Dhahira governorate) of Oman. Additionally, in Oman, there is a lack of updated evidence on adolescent lifestyle.

Previous studies among adolescents in Oman point to the urgent necessity to target Omani girls at the stage of their life that primarily prepares them for the role as potential mothers and encourage them to enter pregnancy at a healthy body weight. Most reviewed studies have been quantitative (cross-sectional), where the participants' responses are restricted by mostly close ended questions (LoBiondo-Wood and Haber 2014). Therefore, the current study attempts to fill in that information gap by assessing nutrition and physical activity aspects of Omani adolescent girls' lifestyle by using a sequential exploratory mixed method approach that seeks to identify the scope of the problem by using a quantitative approach followed by a qualitative one to explore in-depth understanding about the studied problem. In addition, results from the study would allow the development of effective targeted recommendation for the immediate and long-term future.

2.12 Research Questions

This study aimed to provide valid answers for the following questions:

1. What are the prevalence and levels of overweight and obesity in Omani adolescent girls?
2. What are the dietary habits of Omani adolescent girls?
3. What are the levels of physical activity and sedentary behaviours among Omani adolescent girls?
4. What is the relationship between adolescents' lifestyle and their body weight?
5. Are there any differences between the lifestyles of obese or overweight Omani adolescent girls and those of normal weight?
6. What are the subjective perceptions of Omani adolescent girls regarding their dietary habits and exercise?

2.13 The Aim and Objectives of the Study

2.13.1 Main aim of the study

The aim of this study is to assess the lifestyle characteristics (physical activity level, sedentary behaviours and dietary habits) and the reasons for such lifestyle among adolescent girls aged 15–18 years in Ibri, Oman.

2.13.2 Objectives:

- To assess the BMI of adolescent girls by measuring their weight and height using the WHO z-score chart for girls aged 5–19 years.
- To assess the level of physical activity of the participants by:
 - Measuring the number of footsteps and energy expended using a pedometer,
 - Recording the types of physical activities and frequency of practicing such activities using ATLS questionnaire.
- To assess dietary habits by:
 - Completion of an online questionnaire,
 - Completion of un-weighed 7- day diet diary to record the type and of food eaten, how often and the portion size.
- To assess sedentary behaviour based on self-reported data (elicited by ATLS questionnaire) on sleeping time and screen-time.

- To compare the participants' daily intake of calories, carbohydrate, protein, and fats against the Omani Guide of Healthy Eating.
- To estimate the total energy intake, BMR and Total Energy Expenditure (TEE) of the participants and identify the differences between the BMI categories.
- To analyse the data from the ATLS questionnaires, pedometers and un-weighed diet diaries and to identify the differences and similarities in the dietary habits, physical activities and sedentary behaviours between normal weight, obese and overweight adolescents.
- To explore the rationale for adolescent Omani girls for choosing a lifestyle pertaining to dietary habits and physical activity using focus group discussion.

Chapter 3: Material and Methods

3.1 Introduction

The aim of this study is to assess the lifestyle characteristics among adolescent girls in Oman (physical activity, sedentary behaviour, and eating habits) and to explore their personal perceptions regarding their lifestyle choices. This chapter provides a detailed description of methodologies adopted to achieve this aim.

3.2 Research Paradigm

A pragmatic researcher understands the importance of focusing the study design to its objectives—to find answers to the research question. To maintain such focus, a research paradigm (the philosophical basis of research) helps guide the direction and methodology of the research so that the objectives are always kept in view (Houghton et al. 2012). This also helps in choosing an appropriate research methodology that is linked to one's ontological stance. According to Saunders et al. (2016), a research paradigm is a belief on how data should be gathered, analysed, and used in providing essential information in a given study. A robust research paradigm should incorporate elements of epistemology and ontology (Saunders et al. 2016). A researcher's epistemology refers to what is known (understood) by the researcher to be true. Ontology refers to the nature of reality as believed by the researcher (Saunders et al. 2016).

The following paragraphs present this researcher's ontology and her belief in how to approach the studied problem:

Twenty years ago, teenagers in my community in Ibri consumed home-cooked food, were more active at home doing house work and did not have internet or smartphones. They were physically active and overweight girls were rare. In recent years I could not help noticing how the new generation of schoolgirls of Ibri were becoming obviously overweight and much less active than their counterparts 20 years ago. This deeply worried me. As a community nurse I had the opportunity to enquire into this matter and it became clear that not only the girls but entire families were becoming overweight and inactive. Due to my nursing experience I knew the consequence of overweight and obesity and how it can negatively affect the health of the

present and the next generation. So, I made up my mind to help in managing this problem from my home town and from my country as a whole. I read the Omani and WHO health reports and articles on this and which warned that the country was likely have an epidemic of obesity, and related health problems unless checked proactively. I came to believe that it was my duty to understand the problem well and work towards finding a solution to it in a culturally relevant manner—because methods that might work in western countries need not always work in an Arab Muslim country like Oman. I also believed that teenage girls were most vulnerable (because they would become mothers in a few years), and their lifestyles need to be studied in detail first. So, that the generation of mothers would become less overweight and more active and thus become role models for their children.

My curiosity made me understand the problem in depth and I decided to investigate deeper to unearth the underlying reasons with a view to fundamentally improving the lifestyle of Omani girls. So, my epistemology started here where, acquiring adequate knowledge about the problem was the key. I used multiple measures to examine the problem. First, reading and understanding what others have done to manage this problem. This gave me an idea about the appropriate research paradigm used particularly for this problem, number of subjects recruited, procedures and the research setting (Morgan 2014). After having an extensive literature review and I saw many researchers have succeeded in their studies before me, I developed a belief — ‘this going to work with me as well’.

The ontology of the research is always modified and changed by researcher beliefs. My ontology changed over the time, so my epistemology changed also. This means that my ontology about ‘lifestyle of Omani teenager girls’ in 2014 was no longer the same, which made me move from quantitative to mixed methods. I had a belief that a pragmatic paradigm is going to satisfy my ontology and gain me comprehensive information about the topic. Therefore, this paradigm was adopted to answer the research question. Charles Sanders Peirce often thought of as the father of pragmatism (Plowright 2016) believed that, the principle of pragmatism is getting a clear answer to a problem by looking at the problem pragmatically (Plowright 2016). This means, looking at the problem or the issue from different sides, right, left, front and back (looking around the problem).

Research paradigms are categorized as *positivism*, *interpretivism* and *pragmatism* (Houghton et al. 2012). Positivism and interpretivism are the two extreme research philosophies with the positivism research philosophy being based on the belief that reality is stable and can therefore

be observed and described from an objective point of view (Saunders et al. 2016). However, an interpretive research paradigm is based on the belief that reality is too complex and ever changing with multiple variables interacting with each other in myriad different ways. Thus, reality can therefore only be understood at subjective, intuitive, levels (Saunders et al. 2016).

These two opposing philosophies have given rise to a middle-way — the *pragmatic* research paradigm, which incorporates elements from both positivism and interpretivism. A pragmatic paradigm is based on the belief that even though useful information may indeed be gained from the objective, subjective and intersubjective approaches, each can generate only partial models of the studied reality, and that no single point of view is able to provide a truly integrated picture of the world (Morgan 2014). Thus, each paradigm is accompanied by its own limitations.

A pragmatic research paradigm has ideally no bias towards any belief systems about the nature and measurability of reality (Houghton et al. 2012). The researcher of the present study believes that there are multiple realities that are individually true of Omani female adolescents' lifestyle, but no single point of view can provide its entire picture. Thus, a pragmatic research paradigm was chosen for the current research. A pragmatic research paradigm calls for, the researcher to be both objective and subjective when conducting the study (Ihuah and Eaton 2013). Therefore, the objective (quantitative, measurable) data such as weight, BMI, calorific intake, footstep counts, are measurable, using measuring tapes, weighing machines, questionnaire, diet diary, and pedometer readings (Digi-walker SW 701) (Schneider et al. 2003). Whereas, the subjective data (qualitative) were obtained from focus group discussions which were based on interpersonal interactions which enabled exploration of the participants' self-perceptions and opinions regarding their exercise and dietary habits. The opinion of the researcher of this study is that this mixed-methods approach has indeed provided an integrated picture of the situation under study.

Moreover, the undertaken research needs to be both deductive and inductive when pragmatic research paradigm is adapted (Morgan 2014). The current study therefore needed to be undertaken using an appropriate research design to include both objective and subjective elements so that the study is both deductive and inductive, as expected of a pragmatic research paradigm. Table (3.1) shows the description of research philosophy and methodology of the current study.

Several reasons make the pragmatic research philosophy appropriate for this research study. It allows different ways of interpreting the world and including beliefs on multiple models of reality. This free the researcher to investigate the phenomenon of interest from various perspectives (Saunders et al. 2016). In the present study, the researcher could assess the lifestyle of adolescent girls and its impact on their body weight from various perspectives because of the adoption of the pragmatic research paradigm. The explanatory sequence design has some elements of pragmatic philosophy and quantitative and qualitative approaches are carried out sequentially. This helps to triangulate and provide a deeper understanding of lifestyle factors and what underpins them. This is likely to have enhanced the understanding of the issues investigated in the study, which were the effects of lifestyle characteristics such as physical activity level, sedentary behaviours and eating habits on the body weight of Omani adolescent girls.

Table (3.1) Research Philosophy and Methodology

Research philosophy	Pragmatism Paradigm
Ontology	Researcher believes that this method is the best to answer the research questions. Their understanding of reality is based on multiple (objective, subjective and intersubjective) realities and they select the appropriate one to solve the studied problem.
Epistemology	Understanding the reality or gaining knowledge by getting objective answers for the research questions from quantitative data (ATLS Questionnaire, Diet Diaries and Pedometers) and subjective answers from qualitative data (semi-structured Focus Group Discussion) and merging both the views.
Methodology	Mixed Method (sequential explanatory approach, (quantitative followed by qualitative).

3.3 Methodological Design

Matching the methodology to the research question is integral to any research. There are three main types of research design: qualitative, quantitative, and mixed-methods (Gray 2009). Quantitative design deals with numbers and is analysed through statistical methods. The major advantage of this approach is that it produces reliable results that can be generalized to a larger population because of the large size of the studied sample (Rees 2003). However, the quantitative method has a weakness in that it cannot identify the reason behind certain behaviours or actions. For instance, quantitative methods can clearly indicate the percentage of

participants who were not engaging in physical activity but may not explain why this was the case. Where quantitative methods fail, qualitative methods become applicable. Qualitative research is defined by Creswell (2014 p.4) as ‘an approach for exploring and understanding the meaning individual or groups ascribe to a social or human problem’. Qualitative research deals with words and phrases and converts them into the narrative analysis (Rees 2003). Here, emotional intelligence, self-awareness, mindfulness and verbal and nonverbal communication skills become the researcher’s tools (Collins and Cooper 2014). A popular qualitative methodology involves collecting face to face data from the participants via semi-structured focus group discussion. The advantage of using qualitative research is that it gives rich information about participants’ personal experiences and their own reasons behind such experiences (Saunders et al. 2016). However, it is often difficult to generalize qualitative findings because this method is time consuming and hence the sample size must be kept small (Rees 2003). The researcher must be vigilant against her personal and cultural value systems causing perceptual biases (Collins and Cooper 2014).

It can be seen from the above that both quantitative and qualitative approaches have their strengths and drawbacks which call for both approaches to be used in the same study. This potentially balances the weakness of one method with the strength of the other. In the current study, most questions and all measurements are quantitative in nature, and seeks to find out what and how aspects of Omani teenage girls’ lifestyle. The qualitative aspect of the study enquires why the girls think and feel about their lifestyle. Thus, the quantitative and qualitative aspects of the study complement each other.

3.3.1 The Mixed-methods Approach

The use of a combination of qualitative and quantitative methods to collect and analyse the required data in one study is known as a mixed-methods approach (Halcomb et al. 2009), which is more comprehensive than a single approach, it allows tackling the research problem from using more than one method. If the findings of both approaches match each other, it would be a confirmation of the accuracy of the final solution. The mixed-methods approach has been successfully used in disciplines as different as midwifery (Kathrin 2010), social sciences (Karmo 2012), business (Matthias et al. 2012), nephrology (Hayes et al. 2013), economics (Paola and Georgia 2014), psychology (Nikolaou et al. 2015) and nursing (Lamont et al. 2015). An example of the success of the mixed-methods approach was the study conducted by Lamont et al. (2015) at a tertiary hospital in Australia. They used a sequential explanatory mixed-

methods approach to determine intra-professional collaborative relationships between groups of nursing leaders. They enrolled 71 nursing leaders to complete the questionnaire, followed by two focus group discussions with 17 of the participants asking semi-structured questions to explore the collaborative relationships in greater depth. The data from both the questionnaire and the focus groups led the authors to report that there existed a high degree of collaboration between the studied groups which had created a supportive working environment in the hospital that helped provide optimum patient care. The report concludes that it is very important to promote and maintain the collaborative behaviours of nursing leaders within an organization. The mixed-methods approach evidenced the importance of promoting such behaviours.

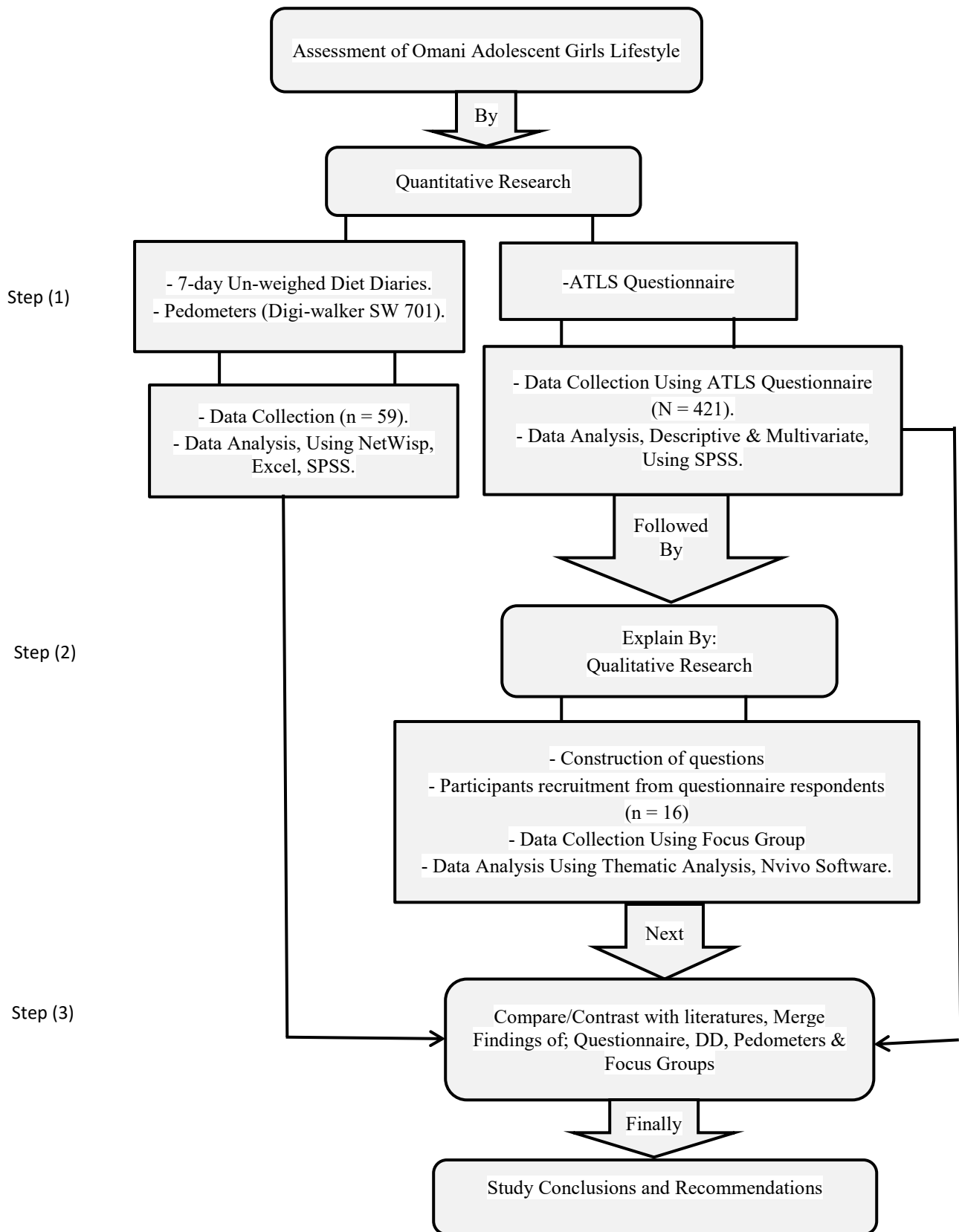


Figure (3.1) Model of Explanatory Sequential Mixed-methods Design

Therefore, a sequential exploratory mixed-methods approach will serve the purpose of this study, since the researcher aims to explore in-depth subjective issues in relation to lifestyle by using the qualitative approach, and by using the quantitative approach to explore the size of the problem and any relationships between the factors. An additional reason for this design is a recommendation by NICE (2015) who recommend mixed-methods approach in studies on prevention and management of overweight and obesity.

In the current study, a single method was not deemed sufficient to answer the research questions, as the opinions, attitudes and beliefs of the participants about their lifestyle cannot be fully answered by closed questions. The mixed-methods approach rectifies this deficiency by facilitating a comprehensive and in-depth insight into the research questions and utilising the benefits of both quantitative and qualitative approaches (Creswell 2014).

Specifically, this study used the ‘explanatory sequential mixed method’, as the quantitative data was collected and analysed first, and this part informed the subsequent qualitative research (Creswell 2014). The findings from the quantitative data are presented numerically. The qualitative discussion then explored in-depth the subjective reasons and opinions that gave rise to the quantitative data. For example, regarding physical activity, the questionnaire quantified the participants’ physical activities, while the focus group discussion sought to discover why they did or did not participate in exercise.

Thus, the quantitative data also served as a guide to inform collection of the qualitative data. At the same time, the statistical findings obtained from the quantitative research were explained by the qualitative research. The procedures for explanatory sequential mixed-methods design are presented in Figure (3.1).

This method has helped the researcher to decide what type of questions to ask the participants in the focus group discussion (Creswell 2014). Therefore, the mixed-methods approach has led to more comprehensive findings and richer data than using one method only. Following explanatory sequence design, it helped to get an in-depth understanding about how and why the Omani adolescent girls practiced different healthy and unhealthy lifestyles. The two phases of the study (quantitative and qualitative) were carried out separately and this made the research more manageable and the researcher was able to merge the findings within the interpretation phase. Additionally, a mixed-methods is useful to utilize the benefits of both quantitative and qualitative approaches and to capture the reality behind the findings (Creswell 2014; Poilt and Beck 2014).

The limitation of this approach is that it requires more time, effort, funding, human and technical resources, and technical and communication skills (Gray 2009; Kumar 2014). Following explanatory sequence design is time consuming because the two steps of researches are carried out at two different times. In addition, analysis and transcription of qualitative data, must be carried out for both types of research. For this study, the cost is considered worthwhile, as a mixed-methods explanatory sequence design procures valuable statistics and in-depth descriptive information on the studied topic (adolescents' lifestyle).

3.4 The procedure of the study

After getting the approval from ethical committees at QMU and MOE to commence the study, the researcher met the principals of the selected schools and thereafter the School Health Nurses to discuss the aim and the procedure of the study. The nurses became the researcher's assistants. They acted as facilitators between the researcher and the school administration, teachers, and students. They prepared list of students with medical problems to be excluded from the study and helped with the distribution and collection of consent and assent forms. They also actively participated in taking anthropometric data of participants. The nurses also assisted the researcher during the preparation for data collection for the online questionnaire and the assisted with the coordination of focus group discussions.

After preliminary discussions with the Principal and the nurses, the researcher requested the school secretary for a list of names and dates of birth of all 10th to 12th grade students in the school. After excluding students who were unsuitable as per the selection criteria, the list was subjected to Simple Random Sampling to select the study participants. The detailed process is explained under the section (3.5.1) and figure (3.2).

For the random selection of the selected participants for the quantitative study, the students' name list (the sampling frame) was used by the software programme to output the required numbers, and thereafter match the selected numbers with the students' names (Gray 2009). To limit the sampling error and bias, simple random sampling was followed to select the schools and participants (LoBiondo-Wood and Haber 2014). Students' names list was prepared according to the study selection criteria.

The final selection list had 270 participants from School-1 and 172 participants from School-2 which totalled to N = 442 participants for the study. The selection procedure was done by

opening the Research Randomizer programme page, filling in the required fields and clicking ‘randomize’ to get the required number for the selected school. Random method of sample selection gave all the students equal chance of participating in the study (Rees 2003).

An adequate sample size is required to identify the differences between obesity or overweight and normal weight adolescents’ lifestyles and differentiate between the active and inactive participants. Moreover, the sample size should be sufficiently large to yield reliable correlations between the study variables (LoBiondo-Wood and Haber 2014). At 442 participants, the sample size of the current study was 15% larger than optimum. The larger size was a precaution against potential refusals, drop outs, and absences on data collection days. The detailed procedure and justification of sample size calculations are at section (3.5.3).

3.5 Schools’ and Participants’ Selection

3.5.1 School Sample Selection

More than 18% of Omani population are of school age and the country has 1,040 government schools with a total of 517,053 students of both genders distributed across nine Governorates (NCSI 2017). As the most Omani children and teenagers go to school, the country’s schools well-represent its youth demography (NCSI 2017). Thus, schools were chosen as the data sources for the current study.

Al Dhahira Governorate has three Wilayats (districts): Ibri, Yanqul and Dhank. Ibri was chosen because it had the largest number of girls (2,771) in the tenth to twelfth grades (MOE 2015). Ibri Wilayat has 53 governmental schools for both genders (MOE 2015) of which eight matched the study’s selection criteria. From these, two schools were randomly selected for the study. The selected schools were Al Galya Bint Nasser School with a total of 513 students in grades 10–12, and Fatima Bint Assad School with 266 students (MOE 2015) (Table 3.2). The schools’ selection procedure was done online by using the Research Randomizer programme page (Social Psychology Network 2014). A similar randomisation procedure was employed to select the participants as well.

Table (3.2) Total Number of Students in the Studied Schools during the Academic Year 2015-2016.

	Grade, 10th.	Grade, 11th.	Grade, 12th.	Total
Al Galya Bint Nasser	198	155	160	513
Fatima Bint Assad	94	79	93	266
Total	292	234	253	779

Source MOE (2015)

3.5.2 Reasons for Participants' Selection

Before undertaking this study, the researcher was engaged in community health practice in different girls' high schools in the Ibri district. She had noticed then that many students seemed obviously overweight. Their health records showed that many of them had reached weight levels between overweight and obese. Subsequent literature search gave a clearer picture of adolescents' body weight and the contributing factors for its increase in this population group. Derivation of the research from observation in practice, and then by literature review, could help in enlightening the quality of health services provided to school children in Oman. Ultimately, this stimulated the researcher to focus on what to observe and how to define her observation to gain useful information about the studied topic (Mansell 2011).

Detailed discussion about the rational for participants' selection has been presented at section (1.3).

3.5.3 Participants Sample Selection (Lifestyle Questionnaire)

In 2015, Oman had a total of 218,031 adolescents aged 15–19 years of both genders, of whom 106,727 were girls (NCSI 2016). A total of 19,292 students was studying in the tenth to twelfth grades and 42.5% of them were girls (NCSI 2016).

In Ibri, the total number of girls studying in all schools in the tenth to twelfth grades was 2,771 (MOE 2015). In any research, optimal sample size is important for the findings to be accurate and generalisable (Kumar 2014). According to Charan and Biswas (2013) sample size and its calculation can differ from one research design to another. Too small samples can cause type-two error and might not be sensitive enough to detect the statistical differences across the studied groups (Heavey 2015). For ascertaining an optimally representative sample size, the researcher employed the following formula (Lewis 2001):

$$n = [z^2 \times p \times (1-p)] / d^2$$

n = required sample size

$z =$ Confidence level, at 95% = 1.960

$p =$ proportion of the population assumed to be at 0.50 (yielding the maximum possible sample size)

$d = 0.05$ (the degree of accuracy as reflected by the amount of error that can be tolerated= 5%)

$$n = (1.960)^2 \times 0.50 \times 0.50 / 0.05^2$$

$$n = 3.8416 \times 0.25 / 0.0025 = 384.16 = 384$$

Add 15% as precaution against missing or incomplete data (= 58)

$$n = 384 + 58 = 442$$

Therefore, the required sample size for this study is 442.

Accordingly, 442 students were recruited. Evidence shows that the higher the analytical power, the more robust the data will be (LoBiondo-Wood and Haber 2014). A sample size that is not optimal will limit the generalisability of the study findings (Poilt and Beck 2014).

Figure (3.2) illustrates the sample size and sampling technique for the different data collection tools used in the current study.

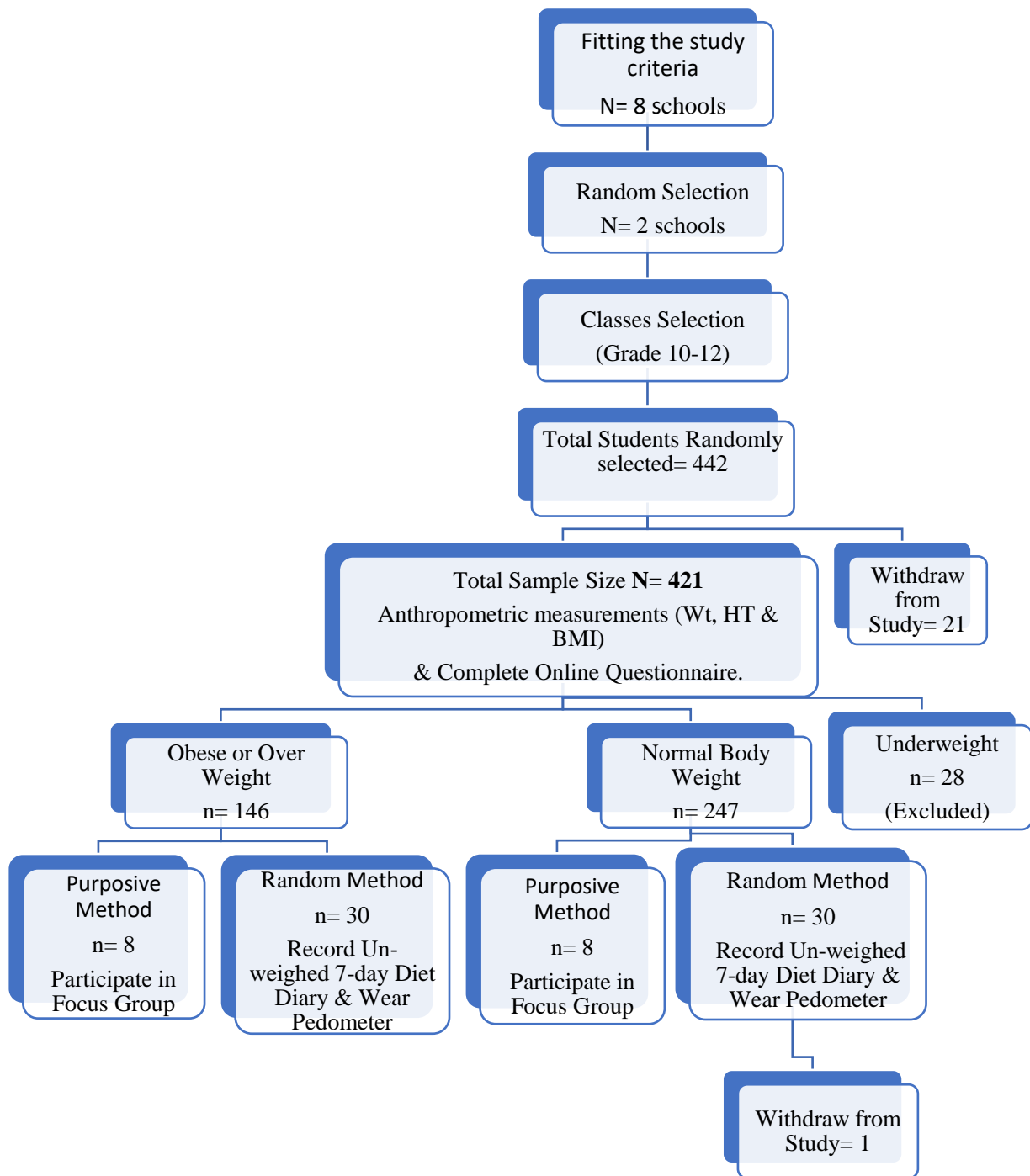


Figure (3.2) Flow Chart of Participants Recruitment

3.5.4 Dietary Intake and Physical Activity Sample size

The calculation to arrive at an appropriate sample size to allow comparison between Omani girls who were overweight/ obese and normal weight as per their dietary intake and physical activity, was based on the main outcome variables of their energy intake, as well as from the

findings of Elliott et al. (2011). It was thus determined that 24 subjects should be included in each group (for example, Group 1 might comprise 24 normal-weight subjects, and Group 2, 24 overweight/ obese subjects). Hence a sample size of 48 will have 80% power to detect a difference in mean EI of 1,060 kJ (250 kcal) per day between Group 1 and Group 2 using a two-group Satterthwaite t-test with a 0.05 two-sided significance level. This was calculated using the mean and standard deviation data from Elliott et al. (2011) who investigated dietary intakes between normal and overweight adolescent girls.

To this was added the previously estimated attrition rate of 15% (here, $n = 8$) (due non-completion of the diet diary, malfunctioning pedometer or the subject's absence on the day of data collection). This raised the group strength to 28 each, a total of 56 participants. They were purposively recruited from the total sample. They were selected from the main subjects who participated in the online questionnaire.

3.5.5 Focus Group Selection

In a qualitative study design, the sample size would be smaller than in a quantitative one (Rees 2003) as the aim is not to generalise but to gain a rich descriptive understanding of the area under investigation. The smaller the sample size, the easier to capture the experience and opinions of the subjects (Rees 2003). Thus, in this study the qualitative sample size was kept smaller than the quantitative one. Krueger (2014) suggested that the size of the focus group for qualitative study shouldn't exceed ten adult members. However, Shaw et al. (2011) recommended six to eight as the ideal strength of a focus group comprising children and adolescents, and where the age differences between the members are smaller (two to three years). Smaller groups enable all the group members to participate in the discussion (Goodman and Evan 2013). In an American study (Kelly 2012) 21 adolescents with diabetes (divided into two groups) attended focus group discussion sessions about self-care. Focus group was the only instrument used and the researcher was able to achieve the research objectives.

In the present study, from the total of 421 participants who completed the online ATLS questionnaire, 16 participants from each school ($n = 8$ normal weight and $n = 8$ overweight and obese) (figure 3.2) were purposively selected and subsequently invited to participate in two semi-structured focus group discussions, one group in each school and the size was adequate to answer the research questions of the present study. Purposive method was used to fit the purpose of the study. The researcher selected the participants based on her research interests

and the students' presumed openness to share their perceptions, barriers and experiences (Bernard 2017).

All the subjects who were invited to attend the focus group agreed to join it. Parental and Participant Information Sheets (appendix 4) were given to each, which included one signed consent being applicable for the completion of the questionnaires and the focus group discussion. The details of obtaining informed consent were discussed under section (3.7.3).

3.6 Data Collection Instruments

This study was conducted in two schools of Al Dhahira Governorate, started in the mid of December 2015 and completed in May 2016 of the academic year 2015/2016. The data were collected using four methods: an online self-administered questionnaire (N = 421); 7-day diet diary & pedometer (Digi-walker SW 701) (n = 59) and semi-structured focus group discussions (n = 16), see figure (3.2). The triangulation of the collection of data helps to enhance the transparency of the study findings (Creswell 2014) and strengthens the evidence of the findings (Rees 2003). This triangulation helps in improving the parallel forms reliability of the study findings.

3.6.1 Anthropometric Measurements

Different methods to measure body composition are available, including measuring skinfold thickness to estimate the percentage of total body fat, waist circumference, and BMI (McArdle et al. 2015). The skinfold thickness measurement needs highly trained personnel to measure and gives poor results when measuring obesity in children (Wells and Fewtrell 2006). Children and adolescents generally dislike the pinching of the clipper and might move during the procedure, which will affect the reading. It is used rarely in research studies involving children.

Another anthropometric method, the waist measurement, has a limitation in that it measures only abdominal adiposity (McArdle et al. 2015). Sometimes, people with a central obesity might have a normal body weight, yet at risk of developing diseases such as metabolic syndrome, diabetes and heart disease (Sahakyan et al. 2015). Additionally, from an Omani cultural point of view, these more invasive methodologies would not be acceptable for girls or their parents, who would not agree to their daughter's body to be exposed in front of others including the researcher. This might also cause a detrimental psychological impact on body image especially in the obese participants. These also might increase the withdrawal rate from

the study. However, Alberti et al. (2009) suggested using the waist measurement as a valuable assessment tool in different primary care conditions.

A third option is Bio-electrical impedance analysis, a technique of measuring body structure, the amount of body fat in relation to lean body figure/ mass (Doan et al. 2008).

In addition to the most common and traditional measurement methods described above, other more technologically advanced methods are used to assess body composition. These include dual energy x-ray absorptiometry, densitometry, isotope dilution (hydrometry) and magnetic resonance imaging (McArdle et al. 2015). These methods either all have a high accuracy rate (McArdle et al. 2015) or measure specific body compositions that cannot be measured using the traditional methods. On the downside, these equipment's are expensive, their operation time-consuming, and they require technically trained operators. In addition to all these is the likelihood of cultural resistance. In any case, these methods were not available in Oman at the time of this study.

The fourth option—which was eventually selected—was to adopt the WHO BMI categories. It is simple to administer, is relatively non-invasive, internationally used in populations where cost or modesty prevented the first three options. Ko et al. (2008) measured the prevalence of obesity and overweight among Chinese adolescents aged 11 to 18 years using 4 obesity criteria measurements for children, such as the Centres for Disease Control and Prevention (CDC), International Obesity Taskforce (IOTF), Hong Kong Growth Survey (HKGS) charts and Group of China Obesity Task Force (COTF). The findings revealed that, CDC, COTF and IOTF criteria displayed parallel rates of obesity and overweight among Chinese adolescents, however, the rates of obesity according to HKGS criteria were showing high results. However, till today, no specified BMI cut-off values obesity and overweight have been recognised for an Arab or Asian population independently, therefore, WHO BMI cut-off value should remain as an international category (WHO 2004b). Therefore, it was decided to use WHO BMI categorisation to measure the participants' obesity and overweight in the current study. BMI is an appropriate and practicable body weight measuring tool for children and adolescents (Kuczmarski et al. 2002)

BMI measures the ratio of weight to the height and is the most common method used to assess overweight and obesity (McArdle et al. 2015). Its simplicity and low-invasive nature make it particularly suitable for use in children and adolescents (Kuczmarski et al. 2002). BMI for age growth graph for males and females from 5 to 19 years of age provides a measuring tool for

checking the weight in relation to the height (Kuczmarski et al. 2002; WHO 2014b). Furthermore, BMI is used by the NICE (2015) guidelines to measure and display different weight status in different age groups. BMI is a universal guide to nutritional status and is the most popular method used by practitioners and researchers with different age groups. BMI has been used extensively and effectively to categorise body weight status in both small and large studies. For example, Purcell et al. (2015) calculated the BMI of 55 adult patients with knee diseases and group them into two levels, overweight and obese. They were then able to compare the two levels with the severity of knee problems. BMI was used in a large-scale study of more than nineteen million participants and the participants were categorized from underweight to morbidly obese (NCD Collaboration 2016). BMI is useful to classify both overweight and obesity (Cole et al. 2000).

D'Addesa et al. (2010) used BMI to identify the weight status of their 756 adolescents to assess the relationship between the participants' weight and their dietary habits. After considering all these factors, BMI, was used in the current study, and was calculated as follows: body weight in kg, divided by height squared in meters (McArdle et al. 2015).

As it is well known, the growth patterns for girls and boys are different. However, the BMI cut-off points in children and adolescents are associated with age and gender, so their BMI cut-off points differ from adults (Must and Anderson 2006). For instance, according to the WHO z-score, a BMI of 22 kg/m² is obese for a child of 10, overweight for a child of 12 and a normal weight for a child of 14. For a child, the BMI z-score depends on the weight, height, sex, and age, rather than merely depend on weight and height (Must and Anderson 2006). Consequently, in this study, the WHO z-score chart for girls aged from 5–19 years was used to plot the BMI of the participants (WHO 2014b), see appendix (5). In fact, this chart is used by school health nurses in Oman to record the BMI of school children as it is well known that the ideal BMI differs from country to county. For instance, in the US, Centers for Disease Control (CDC) published children's growth charts for boys and girls aged from 2 to 20 years old, in 2000 to assess the BMI level (CDC 2000). Additionally, in Scotland the new growth chart for children aged from 2 to 18 years of age for both genders has been implemented since 2013 (The Scottish Government 2012).

In this study, the WHO BMI interpretation was used (WHO 2014b). According to the WHO (2014b), the z-score cut-off point for being overweight is, >1 standard deviation (equal to BMI 25 kg/m²) and that for obesity is >2 standard deviation (equal to BMI 30 kg/m²). In an

international study, conducted by Cole et al. (2000) across six countries, (including the UK with a large sample size of 192,727 participants from age 0 to 25 years), BMI z-score charts were used to classify both overweight and obese subjects.

Therefore, in the current study, anthropometric measurements (body weight and height) were carried out by the researcher using standardized procedures, assisted by the school nurses. School nurses in Oman are qualified registered nurses (RNs) experienced in working with children and adolescents and in performing physical assessments including anthropometric measurements.

Body weight was measured to the nearest 100 grams using an electronic Seca weighing scale, whose attached meter measured the height as well. To minimise measurement errors the participants were asked to remove heavy clothing including headscarves, as well as jewellery, and shoes. The scale was calibrated daily to maintain accuracy, reliability and validity of the measurements (Boswell and Cannon 2011). Height was measured to the nearest 0.1 cm with the participant in a standing position. The participant was asked to stand straight and look straight ahead, whereupon the headboard was lowered to the top of her head and the reading recorded.

To maintain privacy during anthropometric measurements, the school health room was used, only one participant was taken in at a time, and an all-women team conducted the procedure after locking the door. The researcher and school health nurses maintained anthropometric measurement lists. After that, the participants were grouped according to their BMI levels and kept ready to start completing the online questionnaire.

Measurement error:

Measurement errors could be systematic or random (Viswanathan 2005). Systematic measurement error occurs if the measuring instrument is defective (Viswanathan 2005), for instance a weighing machine that gives too high or too low reading. In this study, this type of error was minimized during anthropometric measurements by using a calibrated electronic Seca scale with attached stadiometer to measure both the weight and the height of the participants. However, systematic error was unavoidable in the unweighted 7-day diet diary due to employing crude household measures such as spoons, cups and bowls the sizes of which might vary in different homes. Regarding random measurement error, this was inevitable in the ATLS tests due to imperfect nature of the participants' knowledge about their lifestyle and

perceptions of barriers. Random measurement error was also likely to occur in focus group discussions.

3.6.2 Online Arab Teens Lifestyle Study Questionnaire (ATLS)

This study has adopted the revised ATLS physical activity questionnaire (Al-Hazza 2013). Permission to use the questionnaire was obtained from its designer (appendix 6). This questionnaire aims to assess the levels of physical activity and the dietary intakes of Arab teenagers. In a study conducted by Al-Hazza et al. (2011b), randomly selected 75 participants of both genders from high school participated in testing the convergent validity of the ATLS questionnaire with an electronic pedometer. The results showed strong relationship between the footsteps counts (pedometer) and total time spent on all physical activities (as per their responses to the questionnaire) was $r = 0.37$; $p = 0.001$. Additionally, the validity of the nutritional part of the questionnaire had previously been examined by different experts in the field of nutrition and the stability of the questionnaire was tested by test-retest reliability (Musaiger et al. 2011).

Thus, the ATLS questionnaire, having undergone several practical tests and administrations, is generally accepted as a reliable and effective tool for measuring the regular physical activity and nutritional habits of Arab adolescent boys and girls, including Omanis, across BMI levels. However, it might better if ATLS questionnaire could be validated against other dietary assessment tools such as weighed/un-weighed diet diaries or FFQ.

The ATLS aims to assess total food intake for Arab teenagers in addition to assessing physical activity, and sedentary behaviours. It is very important to select the collection tool that matches the research question (s). The ATLS questionnaire has been used by many researchers in different Arab countries, including Oman (Al-Hazzaa et al. 2011a; Khalaf et al. 2013; Kilani et al. 2013; Awadalla et al. 2014; Tayyem et al. 2014). This questionnaire is divided into three sections. The sections contain questions on the physical activity/inactivity, and sedentary behaviour and dietary habits. The details of each section are discussed in the following paragraphs.

3.6.2.1 ATLS questionnaire (Physical Activity/ Inactivity)

The physical activity question section originally had 27 items. Two questions (about dance) were excluded in this study as requested from ethical committee of MOE. The term dance is linked to the western dance which is not accepted by Omani culture.

ATLS questionnaire is designed to examine the frequency, intensity and the duration of different physical activities performed by the participant. Moderate-intensity physical activities include normal paced walking, brisk walking, recreational swimming, household activities, and recreational sports such as volleyball, badminton and table tennis (Kilani et al 2013, p.512). Vigorous-intensity physical activities and sports include stair climbing, jogging, running, cycling, self-defence, weight training, soccer, basketball, handball, and singles tennis (Kilani et al 2013, p.512). It measures the time spent on such activities, the place, and with whom the activities are performed. This section aims to evaluate the participant's level of activity as either active or inactive. According to the UK physical activity guidelines for children and adolescents, a minimum requirement of one hour daily or seven hours weekly of physical activity has to be performed at moderate to vigorous intensity, to be considered an active individual (NICE 2015), below which one is considered to be inactive individual. In this study, the one-hour period was used as the cut-off value; participants who spent less than one hour a day in moderate to vigorous intensity physical activity were considered to lead sedentary lives.

3.6.2.2 ATLS questionnaire (Sedentary Behaviour)

The ATLS questionnaire also measures sedentary behaviour of the participants by asking them the amount of time spent on screen activities — watching TV, playing computer games etc. The daily hours spent sleeping was also sought (Kilani et al. 2013). The permitted total screen time in a day for a child or an adolescent is two hours (NICE 2015). For this study, 2 hours was used as the cut-off value and participants who exceeded that limit were considered to lead a sedentary life. Additionally, an average of daily nine hours of sleep for 15–17-year-olds and eight hours for 18-year-olds was used as a cut-off value as recommended by the National Sleep Foundation (NSF) in US (NSF 2015a). These cut-off values were used because during the time of research there were no recommended values specific for Oman related to screen time, sleep duration and physical activity.

3.6.2.3 ATLS questionnaire (Dietary Habits)

There are different types of questionnaire used in nutritional research, but most were not suitable for this study. Among those found unsuitable is the FFQ, the most popular instrument worldwide to assess food intake across long periods of time (Heald et al. 2005; Macdonald et al. 2005; Bel-Serrat et al. 2013; Kolahtooz et al.2014). Furthermore, in the UK, the Scottish Collaborative Group-MRC FFQ has been used by Scottish and English researchers to examine the daily food intake up to three months (Wrieden et al. 2003). The Pre-School FFQ was

designed to determine the food intake of small children of four and five years (Wrieden et al. 2003), while the Calcium and Vitamin D FFQ was developed to measure the intake of calcium and vitamin D for old people aged ≥ 70 years (Wrieden et al. 2003). Nutritional questionnaires have the advantage that they can be used in large sample studies, can provide important information about the nutritional habits of the participants, are cheap and are self-reported (Oliver et al. 2007). However, the self-reporting method has the tendency for misreporting of the required data (Prince et al. 2008).

The above-mentioned international questionnaires exclude several foods common in the Omani diet, and several of them aim to assess only one or two specific nutrients such as calcium or vitamins. On the other hand, the ATLS is customized and validated for Arab teenagers who consume regional diets. ATLS also seeks to assess the participants' total food intake in addition to their physical activity and sedentary behaviours. As a result, ATLS questionnaire was selected as the appropriate instrument for this study.

The ATLS questionnaire consists of eight items that are designed to assess the frequency, intensity, and duration of healthy and unhealthy food habits. It enquires about breakfast habits, consumption of 'healthy' food (such as fruit and vegetables and dairy products), consumption of 'unhealthy' food such as soft drinks, energy drinks, fast-food (pizzas, burgers, French fries, Arabic shawarma, doughnuts, cakes, sweets, chocolates, etc). The participant has to select from a multiple-choice list.

The ATLS questionnaire was converted to a softcopy of both versions (Arabic and English), the English copy is in the appendix (7). An online self-administered ATLS questionnaire is a suitable and fast method for gathering research data (Hunter 2012). Online ATLS questionnaires allow the final data analysis to be easy and quick. Our Omani participants had the necessary computer literacy to answer the questionnaire during school hours on school computers.

All participants answered the online questionnaire, which included revelations of their own perceptions and understanding about their physical activities and dietary habits. Compared to paper questionnaires, the online method better preserved privacy, was cost-effective, labour saving, and avoided clerical/ transcription errors. Each of the studied schools had 30 to 40 computers in its Learning Resources Centre. The questionnaire was downloaded on all computers by Information Technology teacher of each school. The participants were invited in batches to enter and randomly occupy vacant terminals. As they were answering the online

questionnaire, the researcher was present to monitor the situation. The participants were respectively reminded that most questions are multiple choice and they were invited to answer all questions by selecting their choice by clicking on the radio button that appeared their best answer. After completing all questions, they had to click on the submit button. The time taken to complete the questionnaire was approximately 10–15 minutes. The fact that the questions were in a clear and simple Arabic language (the students' mother tongue) helped.

Additionally, to make it more attractive the background of the online questionnaire template had colour illustrations. To acknowledge the participants' participation, remunerations (gifts) were given to all upon completion of the ATLS questionnaire.

3.6.3 Physical Activity Measurements by Pedometer (Digi-walker SW 701)

Physical activity assessment methods are classifiable as being subjective and objective. The subjective methods include self-reporting instruments such as questionnaires and physical activity diary (Prince et al. 2008; Reiser and Schlenk 2009; Mackay et al. 2011). Subjective measures (self-reported methods) are popular in behavioural research because they are easy to facilitate, are inexpensive, and they tend to be well accepted by the participants (Dishman et al. 2001; Reiser and Schlenk 2009). Ideally, self-reported methods can provide rich and complete picture about participants' physical activity levels. But in practice it is often seen that participants might over-report or under-report their actual physical activities, energy expenditure, and level of activity (Prince et al. 2008). There are also the problem adherence rates to the physical activity diary, which have been found variously at 29% (Broderick et al. 2003) or even 11% (Stone et al. 2003). This study excluded the physical activity diary so as not to overburden the participants were assigned to maintain another one—the diet diary.

In addition to the above-mentioned physical activity measurements, direct observation is largely an objective method, and is considered ideal for assessing children's physical activity as it can clearly describe these in detail (Loprinzi and Cardinal 2011). This method is possible when the participants remain in one place. On the downside, this method needs a great deal of time and sustained attention from the researcher, though video recording lightens the burden. This method is impractical with groups of adolescents, especially when the activities need to be monitored round the clock over seven days at a stretch, with a single researcher (Rachele et al. 2012).

Thus, the current study needed an objective instrument that is also self-recording. There were three options: the heart-rate monitor, the pedometer, and its upgraded version, the accelerometer (Mackay et al. 2011). The heart (or pulse) monitor measures heart rate which varies with physical activity. However, the heart rate can also vary widely even when the person is at rest due to psychological stressors, especially emotions (fear, anger and joy), physical illnesses, consumption of CNS stimulants (such as caffeine and tobacco), or CNS depressants (such as alcohol), and some medications (Reiser and Schlenk 2009).

The second option was the accelerometer which measures the speed of walking in addition to the distance covered. However, the accelerometer is much more expensive than its simpler and still-popular predecessor, the pedometer (Reiser and Schlenk 2009). If the higher initial cost can be borne, accelerometers are ideal for large sample studies to measure physical activity, energy expenditure and sedentary behaviour (Strath et al. 2012). A big advantage of an accelerometer is that it can be worn in different parts of the body, such as the hip, thigh, or waist, thus activities generated from different parts of the body (arm, leg, waist) become quantifiable (Sylvia et al. 2014). However, new accelerometer users may encounter a mild learning curve compared to the wear-and-forget simplicity of pedometers (Reiser and Schlenk 2009).

Pedometers are ‘simple and inexpensive body-worn motion sensors used for objective assessment of physical activity behaviours’ (Al-Hazzaa 2007, p. 460). There are different models of a pedometer, but not all are suited for research purposes. Pedometer records footsteps, distance walked, and estimate calories expended during exercise. However, the estimate of calories is not accurate enough for research purposes. The reason is that pedometer captures horizontal locomotor activity, (Crouter et al. 2005), and Yamax Digi-Walker SW-701, is not sensitive to body movement during the isometric type activity and upper body exercise (Carron et al. 2003). Therefore, in the current study, the energy expenditure data from the pedometer was not used. According to Schneider et al. (2003), it is very important for the researchers who use pedometers in the assessment of physical activity to identify the accuracy and dependability of these devices. So, for this study the Yamax Digi-Walker SW-701, pedometer was used because it is found to have high accuracy and reliability in its measurement of footsteps and the distance walked (Schneider et al. 2003). This type of pedometer was used by Al-Hazzaa (2007) to assess the physical activity of 95 male schoolchildren for three days, and it was able to differentiate between the active and inactive child by recording the step count per day. The study revealed that, there were significant differences ($p = 0.004$) between the

mean count of steps walked by obese less than the normal weight boys which are ($M = 10,602$; $SD = 4,800$) steps/day and ($M = 14,271$, $SD = 5,576$) steps/day respectively (Al-Hazzaa 2007).

After comparing the various activity measurement methods and tools as discussed above, a combination of subjective estimates of physical activity (ATLS questionnaire) and objective footstep counts recorded by pedometers was deemed appropriate to estimate the physical activities of the participants of the current study. Objective ways of measuring physical activity usually depend on solid data recorded by the used monitors/ devices. This method used to overcome the disadvantages of self-reporting such as bias (Shephard 2003) and exaggeration of responses by the participants (Brener et al. 2003). Objective method was used to increase accuracy and precision of the collected data (Prince et al. 2008). Objective measures are believed to provide more precise findings and eliminate many of the issues with participants' memory and response bias (Prince et al. 2008).

3.6.3.1 Calibration of Pedometer (Digi-walker SW 701)

All pedometers were tested by the researcher by walking and counting 10 steps and checking the recording. Calibration was done by entering the participants' body weight in the pound (lbs). This was done by multiplying the participant's weight (Kg) x 2.2 (lbs). The batteries of all pedometers were checked and replaced if indicated. All pedometers were kept ready to be used by the participants, and they were instructed to clip their pedometer to either a belt or waistband on the anterior midline of their right or left thigh and to wear them for seven days continuously and removing them only during sleep or while taking bath. They were shown how to wear and remove the pedometer. Additionally, the participants were asked not to manipulate the readings. They were also told that if they have any problems with the device to contact the researcher immediately and to return them to the researcher after completion of the seventh day, for analysis. The total footsteps and distance walked were calculated and compared with the reported EI from the diet diaries.

Studies by Tudor-Locke et al. (2005), Kubota et al. (2009) reported that intra-class correlation coefficient test revealed a minimum of 3 days wearing a pedometer to achieve a reliability of 0.80 to estimate of the daily footstep count. Penpraze et al. (2006) conducted a longitudinal study by enrolling 76 pre-school children of both genders to assess the reliability of the accelerometer. The parents were instructed to help their children to wear the device from morning till bedtime for seven days and recorded in the diary the timing of wearing and removing. It has been found that the accelerometer reliability increases by the number of days

worn, for example, using it for seven days increases the reliability of 80% in comparison to 62% when used for 3 days (Penpraze et al. 2006). The procedures of physical activity measurement and recording time information provided in the above studies were adopted in the current study.

Pedometers cannot measure activities that do not depend on footsteps such as cycling, upper body workouts and swimming. Therefore, to give more accurate physical activity measure and avoid underestimation, participants were invited to complete ATLS questionnaire which included a physical activity section which asked about their activities that cannot be measured by a pedometer. To have an accurate data, footstep was recorded for 7 days including the weekends because evidence reported that children and adolescents walked less during the weekends (Duncan et al. 2008).

3.6.4 Dietary Intake Measurements

The different nutritional assessment methods available and can to be used for children and adolescents such as FFQ, diet history, brief instruments, 24-hour recalls, weighed and un-weighed diet diaries (Dennison et al 2000). FFQ and 24-hour recall were found to yield less accurate data than weighed and un-weighed diet diaries (Day et al. 2001). Additionally, the weighed diet diary was found to be the most accurate method to assess the nutritional intake and it gives an exact portion size rather than an estimated one (Bandini et al. 2003). Despite this, the weighed diet diary was not suitable for this study. The weighing of each food item would take time, and participants would need weighing facilities at home. Even if these were provided, they might affect the togetherness and shared nature of Arab family dining, pushing down compliance rates. As a result, more mistakes in reporting would take place (Bandini et al. 2003).

The fact that five (71%) of the total seven days of the study were school days also created logistic difficulties. Therefore, it was decided not to adopt the weighed diet diary approach in the current study. In this study, it was decided that an un-weighed or estimated handwritten diet diary would be used for many reasons; to make things easier for the participants, to increase participation, to reduce participants' frustration and to promote comfort for the participants.

It was noted that different researchers have used different lengths of nutritional assessment period using the diet diary with different age groups. They varied between twelve hours (Briggs et al. 2015), one day (Bazelmans et al. 2007), three days (dos Santos et al. 2010) and seven days (Welch et al. 2001; Lentjes et al. 2014). For this study, an assessment period of seven

days was adopted. Recording of the intake across seven days, including the weekends, were thought to reduce the bias toward certain days and help in assessing the most regular and irregular foods consumed. In the Omani community, the weekend meals are usually heavy with high fat and energy rich, deliciously prepared because traditionally all the family members gather at their grandparents' home.

Thus, researchers should not build their findings on one day intake because individual dietary intake is varied from day to day. Therefore, in the current study daily dietary habits were assessed for seven days, including two weekends' days using the 7-day un-weighed diet diary.

Alaszewski (2006, p. 1) defines a diary 'as a document created by an individual who has maintained a regular, personal and contemporaneous record'. In the diet diary the participant records the type and the amount of food and drinks consumed each time during the study period (Garaulet et al. 2000; Thompson and Subar 2013). In this study, using objective method to record the daily dietary intake has been found to be a useful method to measure adolescents' nutrient intake and dietary pattern (Bandini et al. 2003) in addition to an online questionnaire. The reasons for including objective method to collect the data in the current study were discussed in detailed in this chapter under the section (3.6.3).

Livingstone and Black (2003) argue that teenagers can be un-motivated to record their food intake, so there is the chance of inaccurate information being given. Moreover, diet diaries are often reported to be time-consuming, difficult to maintain, and boring to fill in (Livingstone et al. 2004).

Despite the above disadvantages, Morrison (2002) stated that a diary can be used to get information which cannot be obtained by using, for example, face to face interviews. Thompson and Subar (2013) considered the food records as the gold standard to study dietary intake, particularly among youngsters, as it can give a relatively accurate account of portion size and the total amount of food consumed. This may be because of the record commonly being made out at the time of food consumption. However, Godwin et al. (2004) stated that, the selection of the appropriate dietary assessment method depends on the objectives and the approach of the study.

The printed copy of 7-day food and drink diary was developed by the researcher of the current study and translated to Arabic language, English copy with detailed instructions is attached in appendix (8). It is a booklet with 17 A4 sized pages. The cover was designed attractively, and the diary contained the participant's profile such as date of birth, weight, height, BMI and the

date of starting and finishing the recording. The first page had detail instructions on how to complete the diary. The second page had examples of foods and beverages and their descriptions and the third page featured a sample of a full day's completed record. The remaining pages consisted of forms to record the participants' food and drink intake, two pages for each day for seven days. Extra space was given under each day's record to give the participant the opportunity to be more descriptive. Clear instructions were given to the participants that, the recording must start from the waking up in the morning till retiring at night on all the seven days. These instructions were included in the initial orientation session conducted by the researcher to explain the purpose of diary keeping, and how to maintain the diary and the opportunity was given to ask any questions. These instructions were printed in the diary. The participants asked about what things to be recorded and how to measure the intake, they were directed to record whatever food and drinks that they take, at what time, the quantity, how food was prepared and brand name of the packed food items. They were instructed to measure the quantity by household measures such as tablespoons, teaspoons, bowl and cups. In addition, there were encouraged to keep their diary with them all the time and try to record any intakes as early as possible after consumption to avoid forgetting. Researcher reminded the participants to eat normally as they are eating every day and not to change their food habits.

The completed handwritten diet diaries were handed over to the researcher and school health nurse. Initially, the diaries were checked for completeness of seven-day records and clarification of an unfamiliar food item (s) and when needed the diet diaries were returned to the participant, for example, to write missing portion size (Kerr et al. 2013).

3.6.4.1 Assessment of Misreporting

According to the literature, some participants may not accurately report their habitual food intake, particularly the foods which are commonly perceived as unhealthy, such as 'fast foods', so inaccurate or incomplete information might be presented in their diaries. Livingstone and Black (2003), Meng et al. (2013), Shaneshin et al. (2014) reported that people with a high BMI tend to under-report their food intake. However, this does not mean that people with a normal BMI are entirely accurate in reporting their dietary intake.

An instance of significant misreporting occurred in a study by Prentice et al. (1986) which compared between obese (n = 9) and normal weight women (n = 13). A self-reported diet diary was used to collect daily dietary intake. It was discovered that obese subjects had energy

expenditures higher than their reported energy intakes indicating large under-reporting of food intake (Carneiro et al. 2016). However, this was a very small study with unequal sample sizes in each group which might have affected its main findings, limiting its generalization potential (Polit and Beck 2014). The caution that these studies raises is the possibility that diet diaries may contain underreported and incomplete information.

In such circumstances, observational method, despite its tediousness, might have to be considered as a supplementary tool (Polit and Beck 2014). Observational method refers to direct personal observation by an observer during meal time and record the details of each food item on the participant's plate. In addition, recorded the amount of food consumed, left over, fallen and spilled by the participant (Krehbiel et al. 2017).

Therefore, according to literature, to minimize under-reporting, the researchers should ensure that their diary format follows the principles of clarity, ease of completion, flexibility, purpose and format (Morrison 2002), and in the current study, these points were taken into consideration. The researcher ensured that the food diary was culturally appropriate, and the entire food-diary was prepared in Arabic, the mother tongue of the students, Detailed instructions were given to the users on how to maintain it. Before being given the diary, an orientation session was given to the selected participants to explain the purpose of diary keeping, and how to maintain the diary, and the opportunity was given to have any questions answered, diet diary details were under section (3.6.4). Additionally, the participants were assured that anonymity and confidentiality of the collected information would be maintained. All these precautions assisted in producing a reliable data set.

In this study, the self-reported 59 un-weighed 7-day diet diaries were scrutinized for possible misreporting. Detailed assessment procedure is given in the following paragraphs. After computing the total daily intake of carbohydrate, protein, fats and total daily calorie, diet diaries for all participants were examined for indications of misreporting such as underreporting and over reporting.

Underreporting is defined as the participant reporting EI lower than the required energy while, over reporting is reporting the EI more than energy expenditure (Kerr et al. 2013). Identification of under reporters helps improve the study findings (Livingstone and Black 2003). Many researchers have used the doubly-labelled water method, considered the gold standard for assessing the accuracy of EI self-reports (Butler et al. 2004; Buchowski 2014). However, this method is too prohibitively expensive (Bailey et al. 2007) to be used in this

study. Therefore, in this study to identify the misreporters the Henry equation (SACN 2011) to estimate energy requirements and Goldberg cut-off (Black 2000) for acceptable ratio between the reported energy intake and estimated TEE, were used.

TEE consists of three different elements such as BMR, which constitutes 40–70% of TEE, food intake which constitutes 10% of energy intake and physical activity which constitutes 25–50% of TEE in an individual adult (SACN 2011).

In this study, to assess misreporting, the estimation of the BMR, TEE and physical activity level were assessed for each participant. So, the following calculation was done to get these values.

BMR was calculated from the participants' body weight and height, using female aged between ten to eighteen data, BMR was calculated using Henry equation, $BMR = (9.4 \times \text{weight}) + (249 \times \text{height}) + 462$ (SACN 2011). Then, to assess underreporting, an estimate of energy requirement was calculated by estimating the TEE for each participant.

This was estimated by multiplying, BMR by a physical activity level (PAL) factor of 1.2 (SACN 2011). In this study, the minimum level of the PAL (1.2) was used because, PAL of all participants of the current was measured by pedometer (daily footstep counts) and revealed that most participants (98%) had daily footstep counts that were less than the recommended value of 10,000 to 11,700 steps/ day for adolescents (Tudoe-Locke et al 2011), considering that most participants were inactive (see section 4.1.17.2). Kerr et al. (2013) stated that, to improve the classification of dietary reporting (normal, under and over reporting) of each participant, information about habitual physical activity should be available.

Finally, to assess the accuracy of the reported EI from the diet diaries, divide the reported EI by the estimated TEE (Mirmiran et al. 2006). According to Black (2000) the definition of different categories of dietary reporters by using the following Goldberg cutoff; normal reporters were defined as having the EI: TEE in the range of 0.76 to 1.24, under reporters as EI: TEE <0.76 and over reporters as EI: TEE >1.24. The data of misreporters were excluded from the findings of this study.

3.6.5 Focus Group Discussion

To collect depth information on the research topic, focus group discussions with 16 participants were conducted. The use of ATLS questionnaires, pedometers and diary methods alone may not give in-depth information to answer the research question. Therefore, face to face

discussion was used to allow adolescents to offer their perceptions/ views on lifestyle issues. A focus group aims to gather data or information on a specific topic based on the group members' interactions (Krueger 2014). Additionally, the focus group discussion was used to explore views, perceptions and to deepen the understanding of the specified issue (Goodman and Evan 2013). The focus group was helpful to understand why adolescents are choosing such a lifestyle by sharing their personal experiences.

Using focus groups as a tool for data collection on physical activity and food habits are a first in Oman, where female Omani adolescents have the chance to contribute their own views and to listen to those of others. The semi-structured focus group discussion took place after analysing the online ATLS questionnaire. According to the findings from ATLS questionnaire, the focus group guide questions were prepared (appendix 9). According to Creswell (2014) open-ended questions give the participants a valuable opportunity to speak and give the researcher more time to listen. The content validity of the prepared questions was evaluated by an expert qualitative researcher (Polit and Beck 2014). For each group discussion, a list of participants' names (10 names) with a code number was prepared prior to the discussion. Two extra names were kept as standby in case of absenteeism or unwillingness to participate.

3.6.5.1 Focus Group Discussion Procedure

The participants met in a private room at their school, with the researcher acting as the facilitator, with a staff nurse from Ibri hospital (who holds a master's degree and has research experience) acting as moderator. In order to maintain the privacy and confidentiality of the participants, no one else was allowed into the room (Oliver 2003). The room was arranged one day before the meeting, and was kept clean and comfortable for the participants, with enough chairs for all. The chairs were arranged in a circle to promote fraternity (sisterhood) among the participants and help them shed their inhibitions and freely share their views

At the beginning of the meeting, both the facilitator and moderator introduced themselves and requested the participants to introduce themselves to the group, to make the environment comfortable and friendly. They were reminded if they are not willing to participate in this discussion, they have the right to withdraw at any time. These were intended as ice breaking exercises, although the eight participants were from the same school.

Yusof and Omar-Fauzee (2003) warned that if the facilitator and moderator were from different cultures and of the opposite sex, participants might show inhibition and caution in their responses. In the present study these problems did not exist. The researcher being a woman

from the same religious and cultural background as the students, found it easy to communicate with the adolescent Omani girls during qualitative data collection which involved her meeting the girls face to face. In addition, all the participants already knew the researcher, as she was frequently present in the two schools for more than 6 months prior to focus group discussion sessions. Similar practice was followed in a study conducted in Costa Rica by Monge-Rojas et al. (2005) who invited 108 high school students to attend 36 focus group discussion sessions by assigning male moderator for boys and female moderator for girls. There are also religious and cultural restrictions to consider. In a study in Kenya, 67% of Muslim college students cited religious reasons against their participating in a gender-mixed sports training programme (Wabuyabo et al. 2015). From Malaysia, Yusof and Omar-Fauzee (2003) reported that 45% of Muslim college students of both genders refused to be trained by a coach from the opposite sex.

During the introduction session, the recording was off to maintain the anonymity of the participants. After that, the actual discussion was started, and participants were reminded about the purpose of the study, their role in the discussion and they were asked not to state their names or other identifiers. Instead, a code number was stuck on the desk in front of each participant. They were identified by their numbers and no names were mentioned. They were also requested to call each other by numbers while the discussion was being audio-taped.

Details of the focus group discussion guideline is in the appendix (10). Moreover, they were informed that the full discussion will be audio recorded by MP3. This was to enhance the participants' motivation to speak and disclose more information and allow the moderator to focus on the discussion. Using the digital portable MP3 player with a storage capacity of 5GB allowed the facilitator to concentrate on the discussion (Fernandez and Griffiths 2007). A standby telephone recorder remained ready to use in case of the MP3 recorder failed. The audio recording was used to avoid missing any important verbal information (Goodman and Evan 2013). However, the disadvantages of audio-recording are that it misses non-verbal cues such as facial expressions, eye-contact and posture, which are integral to group interactions. According to Foley and Gentile (2010), about 60–65% of interpersonal communication is nonverbal. Kohler et al. (2004) indicated that facial expressions should be noted to ascertain their congruence with the spoken responses.

Non-verbal clues were recorded by the moderator manually. In addition to the audio recording, a flip chart was used to list the participants' thoughts (Puchta and Potter 2004). This way everyone could see everyone's ideas and repetition was avoided.

The focus group discussion took place by asking semi-structured, open-ended questions. The focus group questions were set in two languages (English and Arabic). Arabic is the native language of the invited participants.

Opportunities were given to the participants to expand their answer, using probing and prompting questions such as; 'please expand your idea; tell me more about your opinion; can you clarify your suggestion and give me an example?'. All members were encouraged to contribute actively to the discussion. Each discussion took about one hour and with the second discussion the data saturation was gained. After completing the discussion, a small refreshment party and gifts were given to all participants. All girls were acknowledged for their valuable contribution.

Immediately after the discussion, the information from the audio recording was transcribed and translated into English language.

3.7 Ethical Approval

Research projects that require personal involvement from the participants should respect their autonomy and privacy, protect them from hazards, prevent the study procedure from causing undue emotional or physical discomfort, and to the extent possible ensure that the procedure be beneficial to them (Stommel and Wills 2004; Woods and Schneider 2013). These principles were adhered to during the design and implementation of this study.

The ethical approval for this research was obtained on the 12th. December 2015 from the Research Ethics Panel of Queen Margaret University (QMU) in the UK (appendix 1), following the ethical approval received on 13th October 2015 from Oman, MOE, (appendix 2). Thereafter, the researcher requested the Directorate General of Education of Al-Dhahira Governorate, Oman, to notify the schools chosen for the study. Thereafter, researcher visited the principals and the School Health Nurses of the selected two schools in the town of Ibri to discuss the aims and details of the study.

3.7.1 Inclusion criteria

It is important to define the study population and their characteristics correctly prior to the selection of samples (Saunders et al. 2016). Criteria must be set to ensure that the study population is indeed representative of the target demographic (Polit and Beck 2017). In the present study the inclusion criteria were: the participants should be girls, Omani nationals, aged 15–18 years, enrolled in 10th, 11th or 12th grade in a government-run girls' school in Ibri, large enough to have >200 students in grades 10–12 in total. The participants should be free from physical disabilities, in good health, neither pregnant nor lactating, and free from medical conditions that restricted their diet or physical activity.

3.7.2 Exclusion criteria

This study excluded boys, expatriates, private school students (there were no private schools in the studied area), girls younger than 15 and older than 18 years, those enrolled in grades lower than 10th, and those who, or whose parents had refused to sign the informed consent.

3.7.3 Participants Consent

After the final participant's list had been composed (see section 3.4) the researcher met the selected participants in groups in their classrooms and explained to them that they had been randomly selected and invited them to participate in the study. The purpose of the study was explained, and acknowledgment of their participation noted. The participants were given the opportunity to raise any questions and doubts and were assured that they had the right to withdraw from the study at any time without penalisation (Houser 2008). They were also assured that their information would remain confidential and used for research purpose only.

The consent form was required to be easily understandable by the participants, their parents or guardians, teachers, and other relevant professionals (Oliver 2003). Therefore, the consent form and all information sheets (detailing the purpose, procedure, and timetable of the study) were translated to Arabic language, universally understood in Oman. See the English version of the parental and participant consent forms in appendix (3).

In the UK, children under 16 are required to obtain parental consent to participate in such studies (Shaw et al. 2011). Omani personal status law stipulates the age of 18 years for one to be deemed competent enough to make such decisions for oneself (Oman Legal Network 2015). As current participants were not over 18, parental/caregiver consent was sought from all, in addition to their personal consent.

Finally, from the researcher's point of view, the young participants deserved a token of appreciation for their contribution to the research, so a remuneration was given to all upon the completion of each phase of the study. The remuneration was distributed only at the end of each phase in accordance with the principle that incentives given at the beginning could affect the participants' motivations and this could, in turn, reflect on their answers and opinions, and thus affect the reliability of the study (Kumar 2014).

3.7.4 Data Security and Storage

Each Participant was allocated a code number and assured that her anonymity would be maintained (Rees 2003; QMU 2011). All quantitative and qualitative digital data were saved in an encrypted file secured with a password known to the researcher only (Tod 2013). All paper documents were stored separately from the research dataset in a locked filing cupboard under the personal custody of the researcher. Participant identifiable information sheet (personal profile) was not shared with anyone and not presented in the report of the study. It was saved separately from the research data set in an encrypted file secured with a password.

The QMU ethical policy requires the primary data of all research to be stored for five years from completion of the study (QMU 2011). Accordingly, the handwritten diaries and focus group tape scripts have been securely stored at the University for the stipulated five-year period, the responsibility for which is with the researcher of this study.

3.7.5 Focus Group Discussion Confidentiality

In accordance with the research ethical policy, the privacy and confidentiality of the collected data for the focus group were maintained (Johnson and Long 2013). The researcher met the focus group participants in a private room at their school. Their identities were protected by assigning them code numbers (p1, p2, p3, etc.) instead of using their names, or roll numbers (Johnson and Long 2013; Kumar 2014). Their voices were recorded but were kept individually unidentifiable by tagging the recordings and transcripts with code numbers and other identifiable data were removed which were part of the conversations in the focus groups, such as place and people's names.

3.8 Statistical Analysis of Quantitative Data

3.8.1 Validation of ATLS questionnaire

Arab Teens Lifestyle Study (ATLS) Questionnaire, the most important quantitative instrument for the current study, has been shown to be highly reliable for its target population, with an intra-class correlation (ICC) of 0.85 (Al-Hazzaa and Al-Ahmadi 2003). Prior to data analysis, the ATLS questionnaire was subjected to Cronbach Alpha test, popular tool for assessing the internal consistency reliability of a set of test items (Huck 2008), and outputs its results in a 0–1 scale where represents maximum reliability (Gray 2015; Heavey 2015;). The internal consistency reliability to the Cronbach Alpha test rises as the number of items in a questionnaire increases beyond 10 (Pallant 2016). The 42-item ATLS questionnaire yielded an acceptable Cronbach Alpha value of 0.7 (Pallant 2016). This enabled the ATLS questionnaire data to be used to analyse the relationship between the BMI of the Omani female adolescents and their lifestyles.

3.8.2 Physical Activity Level, Sedentary Behaviours and Eating Habits (Online ATLS Questionnaire)

The quantitative data on the physical activity levels, sedentary behaviours and eating habits from the online ATLS questionnaire were analysed using ‘Statistical Package for The Social Sciences’ (SPSS Version 23, IBM). SPSS, being a dedicated statistical software, can execute computations rapidly and accurately regardless of the size of the data (Rizvi 2014). The current study used Cronbach’s alpha coefficient to measure the internal consistency reliability of the questionnaire items (Pallant 2016). Cronbach's alpha coefficients were evaluated using the guidelines recommended by George and Mallery (2003, p.231) where ‘>0.9 is excellent, >0.8 good, >0.7 acceptable, >0.6 questionable, >0.5 poor, and ≤0.5 unacceptable’.

BMI (normal weight, underweight, overweight, and obese) of all participants was calculated and plotted in the WHO z-score chart for girls aged from 5–19 years (WHO 2014b).

Data of duration of physical activity were normally distributed, which made it possible to use means and standard deviations or proportions, and percentages to describe the duration of physical activities. The relationship between participants in different BMI groups and their duration of physical activities were subjected to Pearson Chi-Square test. The cross-tabulation analysis accompanied by chi-square tests for independency was performed to examine the differences between participants in different BMI groups and different physical activity variables. Additionally, one-way ANOVA was used to assess variations in a dependent variable

(BMI) to a given (duration of physical activity) independent variables. The effect size was calculated using eta squared, by dividing the sum of squares between the groups by the total sum of squares, taken from the one-way ANOVA table (Pallant 2016). Cohen classification was used to evaluate the strength of the relationships—small effect = 0.2, medium effect = 0.5 and large effect = 0.8 (Pallant 2016, p. 212).

Pearson correlation analysis was conducted between BMI and different physical activities. Additionally, one sample *t*-test was conducted to examine the differences in the daily recommended duration of moderate-to-vigorous sports between Omani adolescent girls in different BMI groups.

On the other hand, data of physical activity (times/ week), sedentary behaviour and dietary habits were skewed so, percentage, median and Interquartile Range (IQR) to describe the average of different lifestyle characteristics (physical activities (frequency), food habits and sedentary behaviours) and Chi-square test. Wilcoxon Signed Ranks was conducted to examine the difference between watching TV & Digital Video Disc (DVD) Hours, using computer and internet, and sleeping hours during week days and weekends.

A paired samples *t*-test was conducted to examine whether the difference between the means of reported screen time and the reported sleep duration during weekdays and weekends were significantly different from zero. Statistical significance (alpha) was assumed at $p \leq 0.05$.

During the analysis, frequency of food consumption was analysed according to number of times consumed by the participants—for example, more than 3 times per week was considered to be undesirable cut-offs for consumption of sugar-sweetened drinks, fast food, french fries/potato chips, cake/doughnut/biscuit, sweets/chocolates and energy drinks (Musaiger et al. 2014a). However, daily consumption of breakfast, vegetable consumption, fruit consumption and milk considered to be desirable cut-offs (Musaiger et al. 2014a). For example, the frequency of the intake of fruits and vegetables cut-offs was 7 times a week. In this study, the intake quantity was not considered. The daily recommended intake of fruits and vegetables is 400g (NHS 2016).

Finally, multivariate logistic regressions were conducted to investigate the association between lifestyle factors and adolescents in different BMI groups.

3.8.3 Dietary Intake (Diet Diary)

The nutritional analysis of the un-weighed 7-day Diet Diary for total energy intake (fat, protein, and carbohydrate) were calculated using NetWisp 4 (Tinuviel Software) programme and Microsoft Excel 2010. Most foods and drinks displayed in the NetWisp programme are European which are quite different from Omani traditional foods, in terms of type, ingredients, nutrient and energy content. So, the researcher found she could not use NetWisp without determining the energy and nutrient equivalents of Omani food. The problem was solved by Sultan Qaboos University (SQU) Department of Food Science and Nutrition, Oman, where a co-author of a nutrition study kindly lent her their in-house template, created using Microsoft Excel 2010 which incorporated nutritional equivalents of more than 100 foods commonly consumed in Oman. The Excel template provided pre-calculated nutritional data not only about traditional Omani food, but also about the fruits, vegetables, drinks, breads, desserts, meats, fish, milk and milk products popular in Oman. For each food item portion size was specified in terms of household serving utensils such as teaspoon, table spoon, cup 240ml, cup 180ml etc. (Ali et al. 2013).

Therefore, Microsoft Excel 2010 was used to calculate the daily EI, intakes of fats, protein, and carbohydrate for the Omani food items (Ali et al. 2013) that were not listed in the Netwisp 4 software. This Excel template helped improve the accuracy and regional relevance of the nutritional data. Thereafter, all data were further analysed by SPSS version 23. Comparison of different nutrients taken from the un-weighed 7-day diet diaries data was performed according to the recommended dietary intake with The Omani Guide of Healthy Eating for girls aged 15–18 years (MOH 2009).

After that, all data were exported to SPSS software. Descriptive analysis was used to describe the characteristics of the participants. Means and standard deviations or proportions, and percentages were used to describe the food intake, such as energy intake, fats, CHO, and protein intake, estimated BMR, estimated TEE and the difference between estimated TEE and reported energy intake. Shapiro-Wilk test were carried out to assess for normality of distribution of the data. The data that were found to be normally distributed were run through a parametric test such as the univariate analysis of variance or a one-way ANOVA, to test the differences of mean across the three BMI groups.

The relationship between participants' BMI and total daily energy intake, daily protein intake, daily carbohydrate intake, daily fats intake, BMR, energy expenditure and difference between

energy expenditure and energy intake were tested by calculating the two-tailed Pearson's correlation coefficient analysis in simple bivariate correlation. A paired-samples *t*-test was conducted to examine whether the difference between TEE and EI was significantly different from zero. One-sample *t*-tests were conducted between reported nutrient intakes and recommended intakes for this population group. The cross-tabulation analysis accompanied by chi-square tests for independency was performed to examine the differences between BMI group and food intake variables. Independent sample *t*-test was run to examine the differences between BMI, age and the normal reporters/ under-reporters.

In the results of this study, statistical significance was assumed at $p < 0.05$.

3.8.4 Physical Activity (Pedometer, Digi-walker SW 701)

All data (daily footstep count, and distance walked) recorded by the pedometers were analysed using SPSS Version 23, IBM. Descriptive analysis was performed to describe the characteristics of the participants. Means and standard deviations or proportions, and percentages were conducted to describe the daily footstep count and distance walked, participants' age, weight, and height. Pearson correlation was used to determine the relationship between the BMI of a participants with her age, weight, height, daily step count and daily distance walked. One-way ANOVA tested the differences of the mean of daily step counts across the three BMI groups. A one sample *t*-test was conducted between daily recorded step counts and the mean of the daily recommended step counts for adolescents by Tudor-Locke et al. (2011). An independent samples *t*-test was conducted to examine the differences between the mean of daily step counts of normal weight and overweight/obese participants. A paired samples *t*-test was conducted to examine whether the difference between the means of diet diaries report of daily total energy intake was significantly different from zero. In this result, statistical significance was assumed at $p < 0.05$.

3.9 Qualitative Study

3.9.1 Focus Group Discussion procedure

The aim of the current study was to assess the lifestyle characteristics (physical activity level, sedentary behaviours and eating habits) of Omani adolescent girls also to gain in-depth understanding about how and why they practised that lifestyle. Pragmatic paradigm was used in this study because it has similar approach of finding out what, how and why of a specific

issue. This was achieved by inviting purposively selected 16 high school students from different BMI groups to participate in focus group discussions. Before starting the focus group discussions to collect the qualitative data, the anthropometric measurements and quantitative data from ATLS questionnaire were analysed to identify significant findings that required justification and reasoning. Based on preliminary results, the following headings were found essential for the focus group discussion: physical exercise, food habits and school snacks. The next step was the construction of guide questions for focus group discussion. These questions were developed in line with the preliminary results of the ATLS questionnaire. The questions were reviewed and validated by a qualitative researcher. According to the feedback from the qualitative researcher, modifications were done in the construction of the questions. After finalizing the questions in English, a professional translator prepared an Arabic equivalent, which was further verified and edited by the researcher for accuracy, details are in section (3.6.5.1). The final version of the guide questions is at appendix (9). In addition to this, guidelines for administering and conducting the semi-structured focus group discussion were also developed (Appendix 10).

Prior to the actual focus group discussion, a pilot focus group discussion was conducted with four eligible students who were not included in the actual study. The aim was to examine the clarity of the questions and the length of the discussion. The pilot discussion went well, and the participants reported that all questions were clear. It was completed in approximately 35 minutes because the strength of the pilot group was also half of that of the main discussion group, whose sessions were allotted one hour each.

After the successful completion of the pilot, the actual participants of the focus group discussion were selected (as discussed in section 3.6.5).

Data saturation was accomplished with the second session of focus group discussions. After the completion of both the sessions of the semi-structured focus group discussions, the accumulated information was subjected to thematic analysis.

3.9.2 Testing the Credibility

Subsequently, the researcher, supported by her supervisor, analysed and interpreted the qualitative data. Cognizance was taken for the possibility that qualitative studies, being subjective, are liable to be influenced by the researcher's opinions, beliefs, and personal experiences (Thomas 2006). In the current study such biases were mitigated using field notes, reflexivity (see sections 3.9.3, 3.9.4) and supervisor support.

In qualitative research, data analysis and interpretation of data might be done differently by different researchers, which necessitates evaluation of the trustworthiness of the results (Thomas 2006). In this study the trustworthiness of the findings was evaluated by the researcher's supervisor, who has experience in qualitative research. Upon request of the researcher, the supervisor reviewed and gave feedback on the coding list and themes/categories. The feedback was also given regarding changing the term (s) or reconstruction of certain codes and themes. For example, 'female exercise' to 'exercise as gendered', 'perception of food habits' to 'perception of eating habits', and 'suggestions' to 'enablers'. In addition, 'westernisation' and 'modernisation' were separated to two different sub-themes. These resulted in clearer and more precise coding and theme lists. Confirmability was recognised by checking the transcripts for reliability and generating descriptions for the identified themes (Gibbs 2007), (see section, 3.6.5).

According to Creswell (2014), the more time the researcher spends with his/ her participants in their setting the more and in-depth understanding about the studied problem, so the more accurate and valid results will be. The researcher of this study had spent more than six months in the field (Ibri, Oman) where she is conducting her study therefore, which allowed her to observe the schools' settings and frequently interact with students and staff, and develop rapport and mutual trust with the students, administrative staff and teachers. As a result, it seemed that the participants felt comfortable enough to share the required information with the researcher. Additionally, being a woman and an Omani herself, the researcher encountered no issues during face to face interactions with the girls.

To strengthen the credibility and improve the rigour of the study finding, the following techniques are suggested: triangulation, respondents' validation, and peer review (Creswell and Miller 2000).

Triangulation occurs where multiple methods are used in a study, which then mutually validate each other's results, and when successful, enhances the reliability and credibility of the study (Saunders et al. 2016). Triangulation is an integral feature of all stages of the current study. First, the data on the same phenomenon were collected using contrasting methods, namely, quantitative and qualitative. Thereafter the collected data were run through multiple methods of verification and data analysis that cross-validated the integrity of data and the validity and correctness of analysis.

Respondent validation seeks feedback from the participants of the study. The summary of the research findings is given back to the participants who give their feedback on the accuracy of the interpretations and conclusions (Creswell 2014). Respondent validation also allows the investigators to address the participants' specific individual concerns. In the respondent validation, different participants may have different opinions of the same data. However, after listening to an audio-recording taken immediately after the completion of the focus group discussion, clarification was carried out for unclear information. In this study, sending for respondent validation for all participants was difficult. In the current study, the time between the completion of data collection and qualitative analysis was long. At that time, schools were closed, and it was difficult to reach the participants. It was difficult to communicate with the participants because the researcher had no access to their personal addresses. It was decided not to send the transcript and analysis via the school email IDs of the participants due to the risk of third-party viewing. Long and Johnson (2000) recommends that respondent validation must take place as soon as data collection and analysis, otherwise participants might change their views due to any reason such as health problems, peer influence, or even because of participation in the study. Additionally, participants in this study were non-English speakers and the qualitative report was written in English, so its translation to Arabic and the subsequent back-translation to English could cause distortions in meanings. Furthermore, adolescents cannot be expected to have knowledge about research issues (Kirby 2004). Due to these reasons, respondent validation was not used in the present study.

Peer review involves an experienced qualitative researcher reviewing the study, including the focus group discussion transcripts, data analysis and the identified themes (Burnard et al. 2008). This method helps reducing the single-researcher bias and can offer different perspectives, interpretations and possibilities (Barbour 2001). Some reviewers might interpret the research data in different ways (Silverman 2013). To reduce the discrepancy in the interpretation of the study data, the reviewer was provided with clear aims and objectives, detailed explanation of how data were collected and analysed. Therefore, peer review was used in this study. Peer reviewer report is at appendix (11). Therefore, at the end, the researcher has conducted a study that was carefully planned, well-implemented and was able to generate well-evidenced findings (Ormston et al. 2014) with practical suggestions for improvement.

3.9.3 Field notes

The focus group discussion sessions were audio-recorded. To maintain privacy of participants, video recording was avoided. However, important non-verbal cues were recorded in the form of handwritten field notes (Miles et al. 2013). Here the term ‘field notes’ refers to notes of events, activities and behaviours taken by a qualitative researcher during the data collection phase of field research. Field notes offer deeper meaning and understanding about the studied topic during the analysis phase (Labaree 2016). There are two types of observational notes: structured and unstructured (Arthur et al. 2014). Structured observation is used by educators, while unstructured observation is mostly used by qualitative researchers. There are three steps to unstructured notes: inscription, description, and transcription (Arthur et al. 2014). Notes can be recorded in a notebook, a mobile phone or a laptop. The qualitative researchers should know when and why to write these notes and keep them very brief. Note-taking depends on the research question and on the nature of the research topic. In this study, during the semi-structured focus group interviews, non-verbal communications were manually recorded by the moderator (see section 3.6.5.1) and were integrated into the transcripts of the focus group discussion. For example, speaking with a loud voice and angry tone about school meal conveys that, the practice of the school was not good, and the participant felt strongly against it. An emphatic verbal statement accompanied by congruent non-verbal cues increases the likelihood of the given information being correct (Denham and Onwuegbuzie 2013).

3.9.4 Reflexivity

Reflexivity is the term used to describe the relationship between the researcher, participants, data and knowledge gained (Rayan 2005). Personal reflexivity can be achieved by constant self-evaluation, the aim of which is to reduce the subjectivity during the qualitative research process and avoid researcher’s bias (Mruck and Breuer 2003). The researcher aims to avoid conscious or unconscious bias that influences their opinions and thoughts and beliefs during the research process (Ormston et al. 2014). In qualitative research, bias might reduce the reliability and validity of the research outcome (Green and Thorogood 2014). Peer review is used to aim to reduce bias of the qualitative findings (Creswell 2014). However, this is difficult to achieve in qualitative research, as we all come with different assumptions and values.

Reflection can be considered the researcher’s ability to deal with different situations faced during the research process (Saunders et al. 2016). When reflecting on the research method, the researcher must be transparent in writing down the steps, the procedure of his/ her research,

and the reason behind each action taken. In addition, the researcher can reflect about the aim of being in the research field, and how to deal with the participants and other people involved in the study. This can be achieved using a reflective diary (Saunders et al. 2016). In this study, the researcher took notes to be used during data analysis and data interpretation and referred to field notes, as discussed in the previous (section 3.9.3). Additionally, the researcher's director of studies was kept informed about the progress of the research process in writing and photos.

To develop knowledge and skill in conducting qualitative study, the researcher has attended different conferences, carried out an extensive reading of books and articles on research methodologies, and watched videos on the same. The researcher undertook all efforts to be objective so that her personal feelings, views and opinions did not influence the research findings.

3.9.5 Focus group Analysis

The aim of using a sequential explanatory mixed-methods explanatory design was to use qualitative findings from the focus group to help in explaining and interpreting the quantitative results from the ATLS questionnaire. The qualitative data from the focus group discussions were analysed using thematic analysis. Braun and Clarke (2006, p. 6) describe thematic analysis as 'a method for identifying, analysing, and reporting patterns (themes) within'. In this study, thematic analysis was used to explore the perception and opinions of Omani adolescent girls in relation to the factors affecting their lifestyle choices (diet and exercise) through focus group discussion.

Creswell's (2014) six steps of qualitative analysis were used to analyse the qualitative data of this study (Figure 3.2). These steps are outlined below, and application of this process can be found in section (4.2.2).

Step (1) data organization and transcribing of the collected data. Immediately after finishing each focus group discussion, more than one copy of the audio file was saved in different data disks to prevent loss or corruption of data (Corti et al. 2014). After that, the researcher and the facilitator played the audio recording several times and started transcribing the raw data 'verbatim' (Parahoo 2014, p. 367).

Step (2) reading and listening to the record. After that, the transcribed work was checked against the audio tapes several times for accuracy, the research questions and objectives of the study were re-assessed to identify if there were any gaps between the transcripts and audio

tapes (Spencer et al. 2014b). To confirm the inter-rater or inter-observer reliability of the transcription, it was checked by a second party (Parahoo 2014). To reduce the translation error and improve the quality of the translated data, translation of the transcribed data to English language was carried out by the researcher (Regmi et al. 2010). In this study, the inter-rater reliability of the transcription/ translation was checked by a professional Omani translator who speaks Arabic and English languages. To gather enriched information about the researched topic field notes were maintained as discussed previously (section 3.3.9).

Step (3) involved coding and labelling the collected data with the help of qualitative data analysis software. The raw data were imported to ‘NVivo: version 10,’ a qualitative analysis software programme that was required to code, sort and store data (QSR 2014). By using a software programme time was saved and it was easy to manage and access a large amount of data (Corti et al. 2014). Coding was created after importing the transcribed/ translated data of the two semi-structured focus groups into NVivo programme by noting the repeated text and text that appeared to be of significance to the questions. These codes were developed further by selecting and adding text/ quote to the parent nodes or child nodes. Every time a similar quote was read, it was highlighted and added to the existing node or a new node was created if the text/ quote was new. A long coding list was produced (see code tree version 1 & 2, Appendix 12 & 13).

Step (4) developing categories or themes from the codes. The obtained codes were clustered, categorized, classified, and analysed to give possible explanations for the issues which were raised. Finally, four main themes were identified. These themes were used as headings for the qualitative data in the result (section 4.2.3).

Step (5) representation of the findings. Detailed description was given about the developed main themes (table 4.51, p. 135–136) and presented in a narrative form. Participants’ quotes were used as an evidence to support the identified themes and display the qualitative findings.

Step (6) interpretation. The interpretations of the findings were carried out by comparing with literature/ previous studies and giving possible explanations for the findings, see chapter 4.

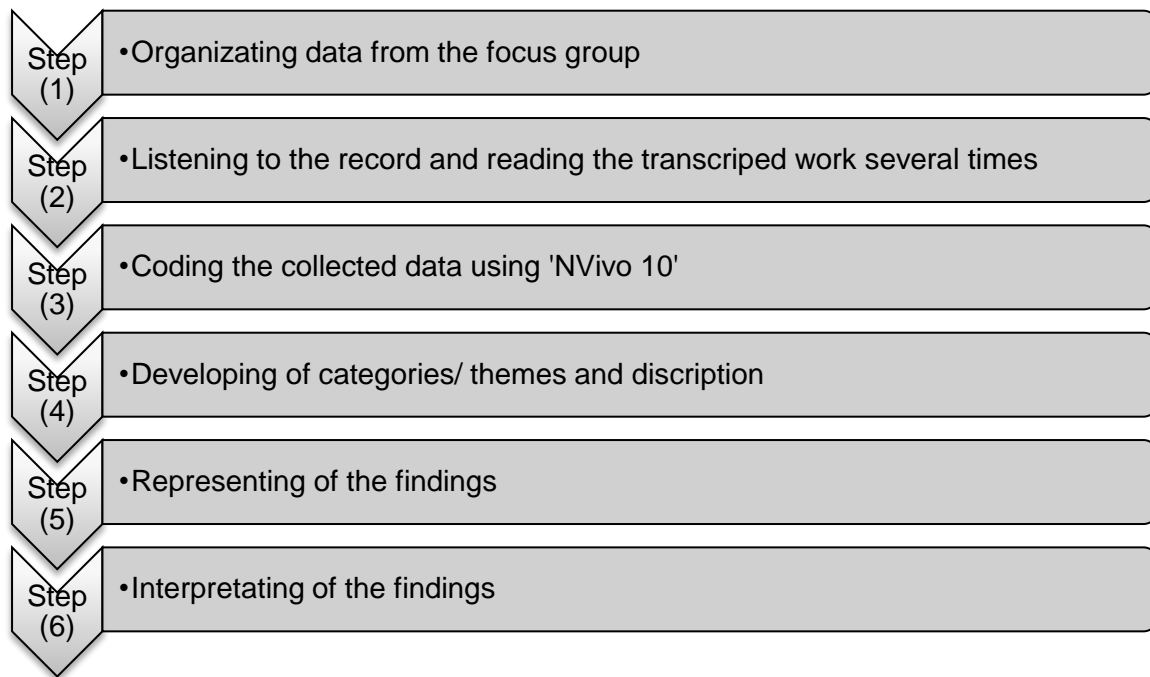


Figure (3.3) Steps of Focus Group Data Analysis
(Adopted from Creswell 2014, p.197)

Chapter 4: Results

4.1 Results of the Quantitative Study

4.1.1 Reliability Test using Cronbach's Alpha

The participants of this study were 421 Omani adolescent schoolgirls aged 15–18 years. A questionnaire asking about different aspects of the objective of the study was distributed among them. The responses of the participants were collected through online means. To test the internal consistency and reliability of the data set, Cronbach Alpha was applied, and the results are presented in the table (4.1) below. In this study, the Alpha value is 0.764 and represents an acceptable internal consistency between the responses, and therefore, the scale used to collect the data is considered reliable.

Table (4.1) Cronbach's Alpha Reliability Results

No. of items in Questionnaire	Cronbach's Alpha	Cronbach's Alpha based on Standardized Items
42	0.764	0.773

4.1.2 Recruitment of Participants

The aim of this study is to assess female Omani adolescent lifestyle characteristics. The participants were recruited randomly from two girls' high schools in Ibri. Their selection was according to the study inclusion criteria. Initially a total of 442 participants (270 from School-1 and 172 from School-2) were selected. Orientation about the aim and objectives of the study, and detailed consent forms and information sheets, were provided to all those were invited to participate. After 21 (5%) invitees withdrew from the study (due to their own or parental refusal to sign the consent form), the number of participants who completed the study was 421 (response rate 95%). Table (4.2) shows the participants from each of the two selected schools: 62% were from Al Galya Bint Nasser School and 38% from Fatima Bint Assad School. They are the largest girls' schools in the Ibri Wilayat.

Table (4.2) Distribution of Participants by School

School	Number	%
Al Galya Bint Nasser School (1)	259	62
Fatima Bint Assad School (2)	162	38
Total	421	100

4.1.3 Participants' Demographics Data

The study was conducted on Omani girls aged 15 to 18 years ($M = 16.4$ years, $SD = 1.0$). Age range was 4 years (15–18 years) and 60% of the participants were in the 16 and 17year old group. Lowest number of participants (16%) were from the 18-year-old group.

4.1.4 Anthropometric Measurements

The objective of these measurements was to categorise the participants according to their BMI. Weight and height were measured, and BMI was calculated and plotted in the WHO z-score chart for all the participating 421 girls. According to the BMI WHO z-score chart, the adolescent BMI cut-offs are: normal weight: $<1SD$, over weight: $>1SD$, obese: $>2SD$, and underweight: $< -2SD$ (WHO 2014b). Table (4.3) indicates the mean anthropometric characteristics of all the participants.

Table (4.3) Anthropometric Summary of the 421 Participants

Variable	Mean	*SD
Age/ year	16.4	1.0
**BMI (Kg/m ²)	23.4	6.3
Weight (Kg)	57.8	16.0
***Height (cm)	160	50

*SD= Standard Deviation, **(BMI= Body Mass Index, Kg=kilogram, m²= square meter), ***cm=centimetre

The participants were categorized by BMI into four groups: underweight (7%), normal weight (59%), overweight (21%) and obese (14%) (Figure 4.1). Table (4.4) gives the age wise and BMI wise breakup. It is seen that the prevalence of obesity is sharply reduced among 18-year-olds who are less than half as less likely to be obese (14% versus 32%) and overweight (11% versus 33%) and more likely to be underweight (25% versus 18%) than 17-year-olds.

Table (4.4) Distribution of BMI among participants of various age groups.

Age	Under-weight	Normal	Overweight	Obese	Age-wise total
15 years	6 (21%)	61(25%)	24 (28%)	14 (24%)	105
16 years	10 (36%)	73 (30%)	24 (28%)	18 (30%)	125
17 years	5 (18%)	72 (29%)	29 (33%)	19 (32%)	125
18 years	7 (25%)	41 (17%)	10 (11%)	8 (14%)	66
BMI-wise totals	28	247	87	59	421

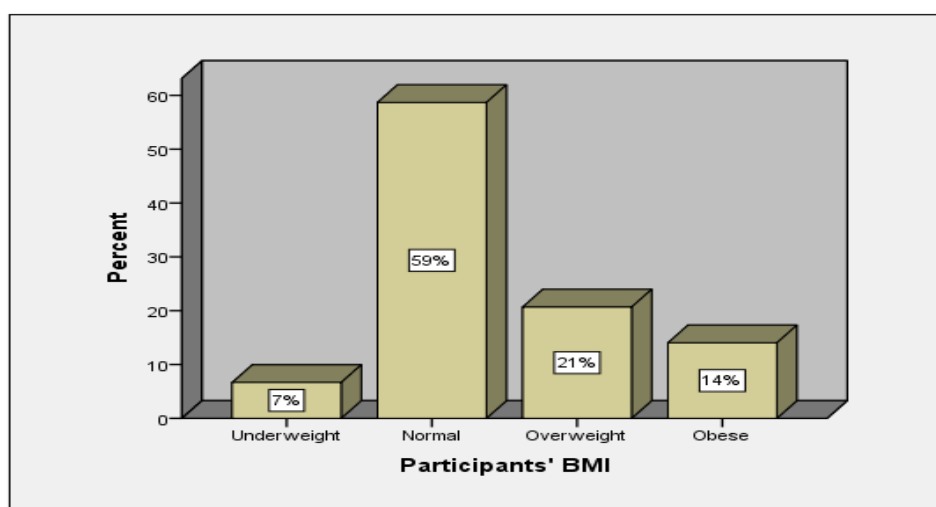


Figure (4.1) Distribution of BMI of Omani Adolescent Girls

4.1.5 Online ATLS Questionnaire Analysis

All 421 participants aged from 15 to 18 years completed the online ATLS questionnaire, an important tool to assess the lifestyle characteristics (physical activity level, sedentary behaviours, and eating habits) of the Omani adolescent girls. ATLS provided voluntary data regarding the details of the participants' physical activity, sedentary life (sitting, sleeping, and screen time), and food habits — the types and frequency of food and drink they habitually consumed. The ATLS data also helped determine the lifestyle characteristics and differences and similarities between the lifestyles of different BMI groups ranging from underweight to obesity.

The online ATLS questionnaire includes a variety of questions including Likert scale responses and general open-ended questions (for the duration of physical activity). The questionnaire is

divided into 3 parts. The analysis was also developed that way and focused on assessing the variety of lifestyles associated with BMI of the Omani adolescent girls.

4.1.6 Descriptive analysis – Physical Activity/Inactivity

This part of the study sought to identify the trends in activities or sedentary lifestyle that contributed to the weight increase of Omani adolescent girls. The ATLS questionnaire had several questions regarding the physical activity behaviour of the Omani adolescent girls. Although the internal consistency has already been tested, descriptive statistical analysis explains the data more clearly. Moreover, the measurement of Kurtosis and Skewness shows whether the data was normally distributed or not.

The data variables of the frequency (times/ week) of physical activities among participants were positively skewed. This means that the difference between the skewness value and standard error was >1.96 , and the data were right-tailed (Heavey 2015). However, the frequency of these activities among participants was described as percentage to better measure the data and these findings are displayed in the following tables. As variables of the duration (in minutes) of these physical activities were perfect normally distributed, the data were presented in mean. Table (4.5) shows that the most frequent moderate physical activity performed weekly 5 times, or more was household work (63%), where Omani adolescent girls spent ($M = 8$ minutes/day, $SD = 12$ minutes daily). The least frequent activity was swimming (13%) with an average of ($M = 0.5$ minutes/day, $SD = 2$ minutes daily).

Table (4.5) Moderate Intensive Physical Activity

Variables	Number (%) ≥ 5 times/ week	Mean *(SD) (minutes/ day)
Walking	88 (21%)	14 (19)
Swimming	51 (13%)	0.5 (2)
Moderate intensity sports (volleyball, table tennis, bowling)	198 (47%)	5 (9)
Household work	267 (63%)	8 (12)

*SD= Standard Deviation

Walking was the most popular moderate sport among the participants and 73% of the walkers preferred a moderate pace. (Table 4.6)

Table (4.6) Proportions of Walking Pace

Variable	Frequency	%
Fast	29	8
Moderate	309	73
Slow	38	9
Total	375	100

Table (4.7) indicates the prevalence and the duration and the time spent on vigorous intensive physical activities. The most practised vigorous intensive activity was running at mean 6 minutes/day. Cycling was the least practised vigorous sport.

Table (4.7) Vigorous Intensive Physical Activity

Variables	Number (%) ≥ 5 times/ week	Mean (*SD) (Minutes/day)
Jogging/running	51 (13%)	6 (10)
High intensity sports (basketball, handball, netball)	11 (3%)	3 (6)
Cycling	2 (0.5%)	0.5 (1)

*SD= Standard Deviation

4.1.7 Differences in Physical Activities between Adolescent Girls in Different BMI Groups

One-way ANOVA results at Table (4.8) show no significant differences in frequency of moderate intensity sports performed by the girls in different BMI groups.

Table (4.8) Moderate Intensity Sports: Comparison between BMI Groups

BMI	n	Mean (minutes/day)	*SD	<i>p</i>
Underweight	27	30.0	23.2	0.92
Normal	235	27.4	28.2	
Overweight	86	27.2	25.4	
Obese	56	29.4	23.6	

*SD= Standard Deviation

Table (4.9) shows that 88% of the participants reported spending less than the recommended daily one hour in moderate intensity sports, but the differences between BMIs were not statistically significant.

Table (4.9) Moderate Intensity Sports Compared with Recommended 60 Minutes by NICE (2015)

BMI	Moderate Intensity Sport		Total	<i>p</i>
	< 60 Minutes/ day	≥ 60 Minutes/ day		
Underweight	23 (85%)	4 (15%)	27	0.81
Normal	204 (87%)	31 (13%)	235	
Overweight	76 (88%)	10 (12%)	826	
Obese	51 (91%)	5 (9%)	56	
Total	354 (88%)	50 (12%)	404	

The sample *t*-test (Table 4.10) indicated that the true daily mean time spent by the participants in moderately intensive sports was 27.8 minutes/day.

Table (4.10) One Sample *t*-Test for Moderately Intensive Sports

Variable	Mean (Mins)/ Day	*SD	Recommended minutes/ day (NICE 2015)	<i>t</i>	<i>p</i>
Moderate Intensity Sports	27.8	26.7	60	-24.25	< 0.001

*SD= Standard Deviation

One-way ANOVA of vigorous intensity sports at the levels of BMI (Table 4.11) shows no significant differences in the main effect, BMI. It also indicates that participation in vigorous intensity sports was extremely low among the participants across all BMI groups.

Table (4.11) Comparison: Vigorous Intensity Sports

BMI	N	Mean (Minutes/day)	*SD	<i>p</i>
Underweight	27	11.6	13.2	0.83
Normal	230	11.5	16.4	
Overweight	79	11.6	16.1	
Obese	55	9.5	12.0	

*SD= Standard Deviation

The extremely low participation in vigorous physical activity is reiterated by crosstab analysis (Table 4.12) which reveals that 95% of the participants across all BMI groups were working out less than <2,520 METs/ week.

Table (4.12) Participation in Vigorous Physical Activity

BMI	Vigorous Intensity Activity MET		Total	<i>p</i>
	<2520 METs	≥ 2520 METs		
Underweight	27 (100%)	0 (0%)	27 (100%)	0.40
Normal	215 (94%)	15 (6%)	230(100%)	
Overweight	76 (96%)	3 (4%)	79(100%)	
Obese	53 (96%)	2 (4%)	55 (100%)	
Total	354 (95%)	20 (5%)	391 (100%)	

The true mean of vigorous intensity physical activity was very low, at 11.3 minutes/day as revealed by One sample *t*-test (Table 4.13).

Table (4.13) One Sample *t*-Test for Vigorous Intensity Sports

Variable	Mean (Mins)/Day	*SD	Recommended minutes/ day (NICE 2015)	<i>t</i>	<i>p</i>
Vigorous Intensity Sports	11	15.6	60	-61.87	< 0.001

*SD= Standard Deviation

Table (4.14) explores the preferred venues for physical activity. Most girls (59%) preferred to exercise at home while 33% opted for school. Public areas like parks and sports centres had the lowest priority. Among the BMI groups underweight girls overwhelmingly preferred home (71%). One significant About 11% of the overweight girls preferred parks or public areas which was significantly higher than among all other age groups.

Table (4.14) Place for Physical Activity or Sports

BMI	Home	School	Park or Public Area	Sports or Recreation Center	Other
Underweight	20(71%)	7(25%)	1(4%)	0(0%)	0(0%)
Normal	147(59%)	88(36%)	11(4%)	1(0.4%)	0(0%)
Overweight	46(53%)	29(33%)	10(11%)	0(0%)	2(2%)
Obese	36(61%)	16(27%)	3(5%)	3(5%)	1(2%)
Total	249(59%)	140(33%)	25(6%)	4(1%)	3(1%)

Approximately 36% of the study participants reported that they did not have a timetable or preferred time in the day for physical activities (Figure 4.2). However, 25% girls indicated their preference for mornings, while 16% preferred afternoons. The least preferred was evenings, at 5%.

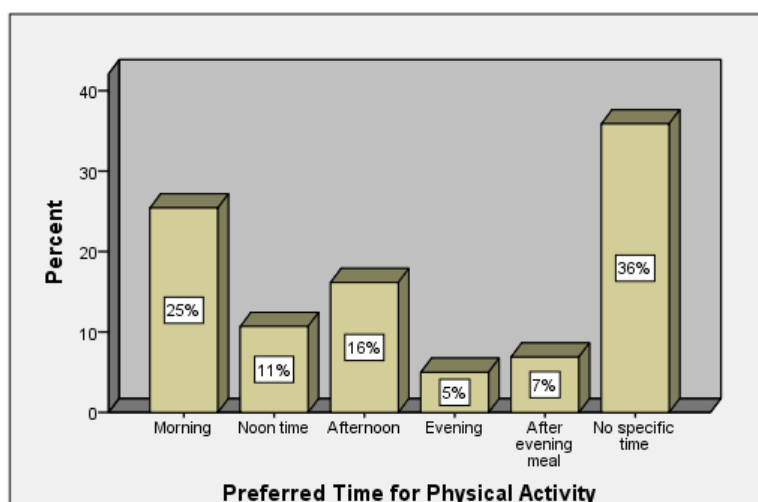


Figure (4.2) Preferred Time for Physical Activities

As Figure (4.3) suggests, the most popular option (33%) was to exercise alone. The next in preference was with relatives (26%), while 23% girls preferred to exercise with friends. Parents were the least preferred company (5%) while being physically active.

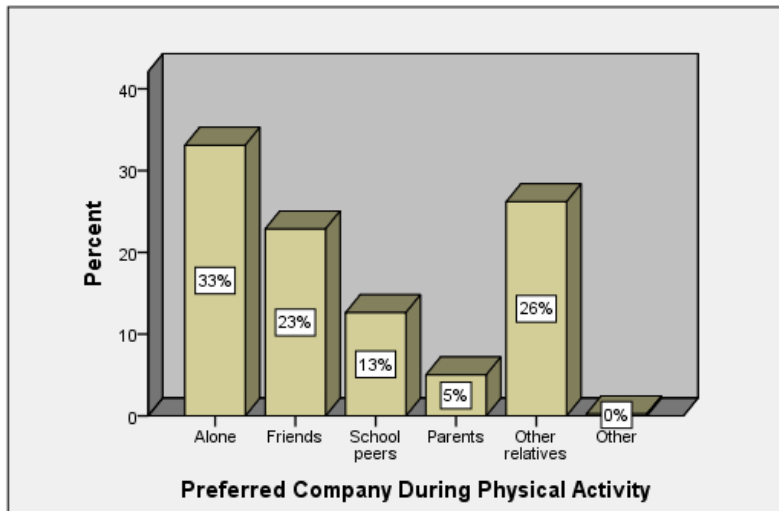


Figure (4.3) Participants’ social preferences during physical activities

Adolescents undertake physical activities for different purposes, which in turn might have a significant impact on the overall effect of such activities. Around 50% of the Omani adolescent girls revealed that they were engaging in physical activities only for the purpose of staying in good health (Figure 4.4). Another 34% wanted to lose weight. Social factors and sports competitions, at 2% each, were the least chosen purposes for engaging into physical activities.

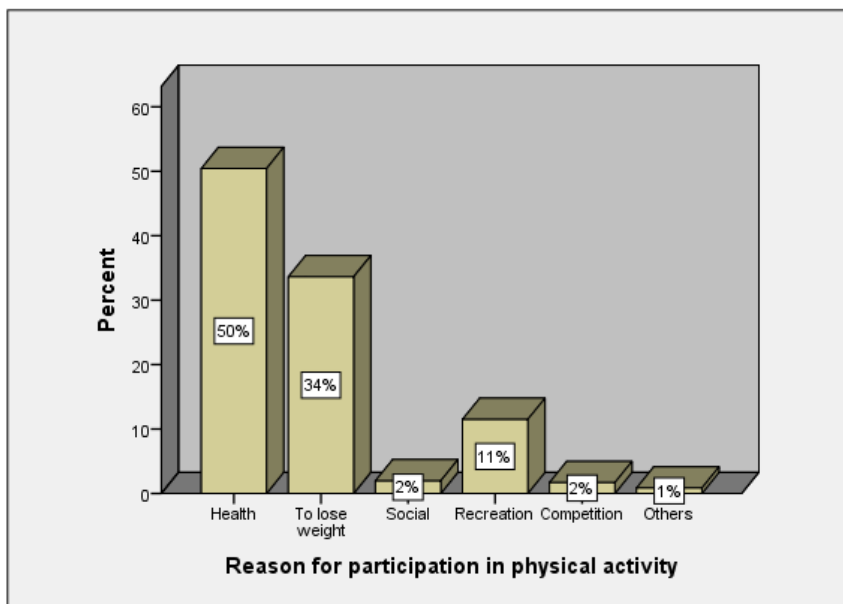


Figure (4.4) Reasons for Participating in Physical Activities

The analysis regarding the reasons for not engaging in physical activities are presented in figure (4.5). Although the importance of engaging in physical activities was well-recognised among participants, many were not engaging in them. The majority (67%) felt that they did not have

sufficient time. Other reasons advanced included inadequate facilities, and personal lack of interest.

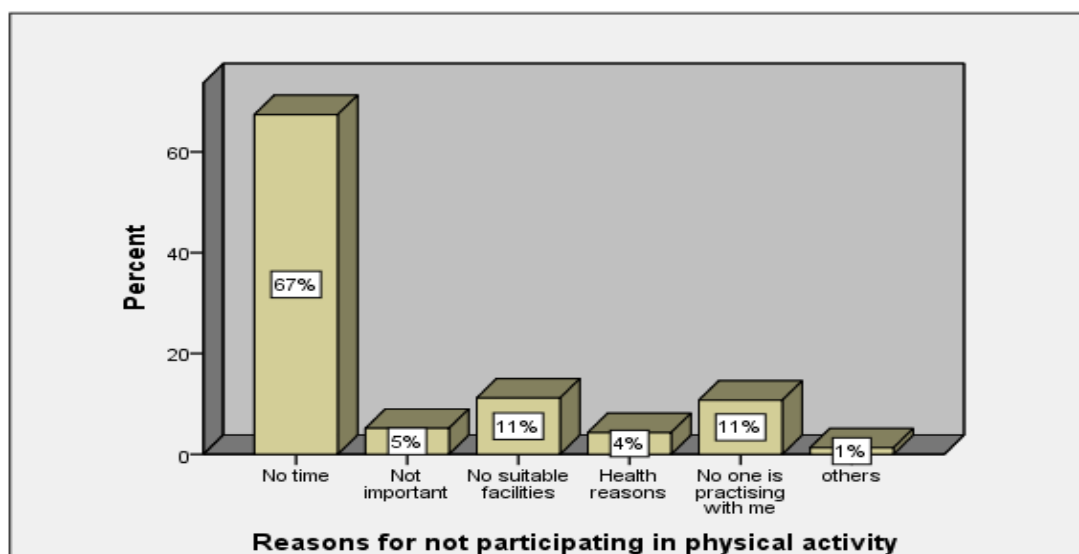


Figure (4.5) Participants’ reasons for not participating in physical activities

4.1.8 Descriptive analysis: Sedentary Behaviours

As the study was concerned with assessing the lifestyle of the Omani adolescent girls, it was important to identify and analyse their sedentary behaviours and compare between sedentary behaviours between BMI groups. The participant responses to questions in the ATLS that sought information on time they spent on sedentary behaviour were compiled and analysed. These included times they spent sitting in front of various electronic screens (TV, DVD, video, computer and Internet) as well their daily sleeping hours. The data of most of the sedentary behaviour variables were found to be not normally distributed. Table (4.15) shows the girls’ screen time during weekdays and weekends was about 2–3 hours per day. The average sleeping time was about 6 hours during weekdays and 8 hours during weekends.

Table (4.15) Average Sedentary Behaviour

	Median (*IQR) (Times/ week)
Watching **TV, ***DVD/Video week days	2.4 (1–4)
Watching TV, DVD/Video weekends	2 (0.5–4)
Using computer, internet/ week days	2.8 (2–5)
Using computer, internet/Weekends	3 (1–5)
Sleeping/ week days	6 (5–7)
Sleeping/ weekends	8 (7–9)

*IQR= Interquartile Range, **TV= Television, ***DVD= Digital Video Disc

4.1.9 Differences in Lifestyle (sedentary behaviour) between Omani Adolescent Girls in Different BMI Groups

Table (4.16) reveals that the vast majority (97%) of participant in all BMI groups had more than the recommended daily two hours of screen time during weekdays. All overweight participants had more than 2 hours screen time during the weekdays.

Table (4.16) Reported Screen Time during Weekdays Compared with Recommended Two Hours by NICE (2015)

BMI	No of participants using screens (Weekdays)			<i>p</i>
	≤2 (Hours/Day)	>2 (Hours/Day)	Total	
Underweight	3 (11%)	25 (89%)	28	0.041
Normal	8 (3%)	239 (97%)	247	
Overweight	0 (0%)	87 (100%)	87	
Obese	2 (3%)	57 (97%)	59	
Total	13 (3%)	408 (97%)	421	

During weekends, there was (Table 4.17) no significant difference between BMI groups regarding, the time they spent in front of screens.

Table (4.17) Reported Screen Time during Weekends Compared with Recommended Two Hours by NICE (2015)

BMI	No of participants using screens (Weekends)			<i>p</i>
	≤ 2 (Hours/Day)	>2 (Hours/Day)	Total	
Underweight	13 (46%)	15 (54%)	28	>0.5
Normal	139 (56%)	108 (44%)	247	
Overweight	36 (41%)	51 (59%)	87	
Obese	32 (54%)	27 (46%)	59	
Total	220 (52%)	201 (48%)	421	

Wilcoxon Signed Ranks test indicated the median of TV and DVD watching hours among Omani girls during weekdays was significantly higher than during weekends (Table 4.18).

Table (4.18) TV & DVD Hours on Weekdays and Weekends

Watching *TV & **DVD Weekends (Hours/ day)		Watching TV & DVD Weekdays (Hours/ day)		<i>Z</i>	<i>p</i>
Median	IQR	Median	***IQR		
2	0.5–3	2.4	0.5–3	-2.883	0.004

*TV= Television, **DVD= Digital Video Disc, ***IQR= Interquartile Range

Wilcoxon Signed Ranks test showed the median of using computer and internet among Omani girls during weekends was significantly higher than the median of the weekdays (Table 4.19).

Table (4.19) Computer & Internet Hours on Weekends and Weekdays

Weekends (Hours/ day)		Weekdays (Hours/ day)		<i>Z</i>	<i>p</i>
Median	*IQR	Median	*IQR		
3	2–5	2.8	1–5	-2.556	0.011

*IQR= Interquartile Range

4.1.10 Differences in Duration of Sleep between 18-year-old Omani Girls in Different BMI Groups

The National Sleep Foundation (NSF) for the adolescent aged 18-25 years old, has recommended an average of eight hours a day of sleep and nine hours for 14-17 years old (NSF 2015a).

During weekdays the majority (79%) of the 18-year-olds slept less than the recommended 8 hours. The Pearson Chi-Square test found significant differences between different BMI groups and their mean sleeping hours. (Table 4.20)

Table (4.20) 18-year-old Girls Reported Sleeping Duration during Weekdays Compared with Recommended 8 hours by NSF (2015a)

BMI	Sleeping Hours/ weekdays		Total	<i>p</i>
	<8 (Hour/Day)	≥ 8 (Hour/Day)		
Underweight	6 (86%)	1 (14%)	7	0.010
Normal	36 (88%)	5 (12%)	41	
Overweight	4 (40%)	6 (60%)	10	
Obese	6 (75%)	2 (25%)	8	
Total	52 (79%)	14 (21%)	66	

During weekends, half of the 18-year-olds reported sleeping less than 8 hours. Sleep deficit was most prevalent among the underweight girls (86%) (Table 4.21).

Table (4.21) 18-year-old Girls Reported Sleeping Duration during weekends Compared with Recommended 8 hours by NSF (2015a)

BMI	Sleeping Hours/ weekends		Total	<i>p</i>
	<8 (Hour/Day)	≥ 8 (Hour/Day)		
Underweight	6 (86%)	1 (14%)	7	0.012
Normal	23 (56%)	18 (44%)	41	
Overweight	1 (10%)	9 (90%)	10	
Obese	5 (62%)	3 (37%)	8	
Total	35 (53%)	31(47%)	66	

4.1.11 Differences in Sleeping Hours between Omani Adolescent Girls aged 15–17 years in Different BMI Groups

Table (4.22) indicates that 58% of the 15–17-year-old subjects responded that they slept less than the recommended 9 hours during the weekends. Tabular analysis revealed that most obese 15–17-year-olds (65%) slept less than their counterparts in other BMI groups (Table 4.20). With the Pearson Chi-Square significance at $p = 0.025$, there was a statistically significant difference between the percentages of participants in different BMI groups in the 15–17 age group, between their actual hours of weekend sleep and the recommended hours.

Table (4.22) 15–17-year-old Girls Reported Sleeping Duration during Weekdays Versus the Recommended 9 hours by NSF (2015a)

BMI	Sleeping Hours/ weekends		Total	<i>p</i>
	<9 (Hour/Day)	≥ 9 (Hour/Day)		
Underweight	7 (33%)	14 (67%)	21	0.025
Normal	128 (62%)	78 (38%)	206	
Overweight	39 (51%)	38 (49%)	77	
Obese	33 (65%)	18 (35%)	51	
Total	207 (58%)	148 (42%)	355	

During the weekends the 15–17-year-old girls received even less sleep than during week days, 92% sleeping less than the recommended 9 hours. Overweight girls (97%) slept less than those in other BMI groups (Table 4.23).

Table (4.23) 15–17-year-old Girls Reported Sleeping Duration during Weekends Versus the Recommended 9 hours by NSF (2015a)

BMI	Sleeping Hours/ weekdays		Total	<i>p</i>
	<9 (Hour/Day)	≥9 (Hour/Day)		
Underweight	17 (81%)	4 (19%)	21 (100%)	>0.05
Normal	190 (92%)	16 (8%)	206 (100%)	
Overweight	75 (97%)	2 (3%)	77 (100%)	
Obese	46 (90%)	5 (10%)	51 (100%)	
Total	328 (92%)	27 (8%)	355 (100%)	

Wilcoxon Signed Ranks test revealed the median of sleep among Omani girls during weekends was significantly higher than the median during the weekdays (Table 4.24).

Table (4.24) Difference between Sleeping Hours

Weekends Sleep (Hour/ day)		Weekdays Sleep (Hour/ day)		<i>Z</i>	<i>p</i>
Median	*IQR	Median	*IQR		
8	7-9	6	5-7	-12.129	< 0.001

*IQR= Interquartile Range

4.1.12 Descriptive Statistics: Dietary Habits

The objective of this study was to assess eating habits that might contribute to an increase in Omani female adolescent body weight. Dietary habits refer to foods and beverages consumed on a regular basis. They are among the most important and influential factors that determine an individual's BMI. An additional objective of this study was to record the different categories (types) of foods consumed, including fruits, vegetables, dairy products, cakes, fast food, soft and energy drinks, and how often these were consumed, as well as to identify and quantify the differences and similarities between the dietary habits of the obese, overweight, normal weight and underweight Omani adolescent girls. To achieve these objectives, the ATLS questionnaire had several questions regarding their food habits and the kinds of foods they prefer and usually consume, as well as the frequency of eating those foods. According to the normality test, all the data had positive skewness, and thus right tailed.

Table (4.25) indicates descriptive analysis regarding the dietary food habits of Omani adolescent girls. The average value of most of the dietary food intake was between 3–6 times per week. However, in case of fast food and energy drinks, the median responses were 2 times per week, respectively.

Table (4.25) Average of Consumption Different Food Intakes per Week

	Median (*IQR) (times/ week)
Breakfast consumption	5 (3–7)
Soft drinks	3 (2–6)
Vegetable consumption	6 (3–7)
Fruit consumption	5 (3–7)
Dairy products & milk	4 (2–7)
Fast food	2 (1–3)
French fries /potato chips	4 (2–6)
Cakes & biscuits	4 (2–5)
Sweets and & chocolates	3 (2–6)
Energy drinks	2 (1–4)

*IQR= Interquartile Range

4.1.13 Differences in Food Habits between Omani Adolescent Girls in Different BMI Groups

Table (4.26) displays the proportion of Omani adolescent girls in different BMI groups who exceeded the normal cut-off values of the consumption of different foods. Daily breakfast consumption was higher among the adolescents of normal BMI (at 39%) than the other BMI groups.

Daily consumption of vegetables was almost equal among adolescents in the normal weight, overweight and obese groups. The proportion of milk and other dairy products consumed more than three times a week was high among the underweight adolescents (57%), while normal weight and overweight adolescents, consumed these less, at 44%, 53% and 54% respectively, however, the statistical significance of these variations was low. $p = 0.57$. Regarding fruit, obese female participants (31%) consumed more than their normal weight, overweight and underweight schoolmates did (the latter were 29%, 26% and 29% respectively), $p = 0.002$.

Obese participants were significantly more likely to consume fast foods (42%) and sweets (61%) more than thrice weekly than those in the other BMI groups. Overweight participants consumed significantly more cakes and french-fries compared to those in the other BMI groups.

Table (4.26) Proportion of Omani Adolescent Girls Exceeding the Cut-off Values for Food Intake

Variables	Under-weight	Normal weight	Over weight	Obese	<i>p</i>
Daily Consumption of Breakfast	8 (29%)	97 (39%)	13 (15%)	9 (15%)	<0.001
Daily Consumption of Vegetables	11 (39%)	110 (45%)	39 (45%)	26 (44%)	0.96
Daily Consumption of Fruits	8 (29%)	71 (29%)	23 (26%)	18 (31%)	0.002
Soft Drinks >3 times/week	15 (54%)	116 (47%)	30 (35%)	23 (39%)	0.12
Dairy Products >3 times/week	16 (57%)	130 (53%)	47 (54%)	26 (44%)	0.57
Fast Food (Pizza) >3 times/week	1 (4%)	38 (15%)	26 (30%)	25 (42%)	<0.001
French Fries & Crisps >3 times/week	17 (61%)	118 (48%)	71 (82%)	43 (73%)	<0.001
Sweets >3 times/week	14 (50%)	105 (43%)	47 (54%)	36 (61%)	0.04
Cake/ Doughnuts >3 times/week	12 (43%)	103 (42%)	64 (74%)	42 (71%)	<0.001
Energy Drinks >3 times/week	1 (4%)	13 (5%)	3 (3%)	2 (3%)	0.85

Note: *p* value tested by Chi-square test

4.1.14 Part (1) Dietary Intake Analysis from 7-day Unweighed Diet Diary

In this study, the analysis for whole food intake reporters (normal reporters, under reporters and over reporters) was performed first, and then the misreports were removed. Further analysis was carried out for normal reporters only. This procedure was similar to the work of Munoz et al. (1997). Data were collected from 59 participants aged between 15 and 18 years who had completed the unweighed 7-day diet diary (Table 4.25). The BMI of these participants ranged from normal weight to obese (17.7–45.5 kg/m²). Nearly half (44%) of who were part of the diet-diary cohort were 16 years old, while 18-year-old participants comprised only 7% (Table 4.27). The WHO z-score chart was used to classify the BMI of each participant. BMI-wise, half (49%) were of normal weight while the others were either overweight (22%) or obese

(29%) in terms of BMI (Table 4.27). There was no underweight participant in the diet-diary cohort.

Table (4.27) Participants' Characteristics

Variables	Categories	Number	%	Mean (*SD)
Age	15 years	13	22	16 (0.84)
	16 years	26	44	
	17 years	16	27	
	18 years	4	7	
Total		59	100	
**BMI (kg/m²)	Normal Weight	29	49	27 (7)
	Overweight	13	22	
	Obese	17	29	
Total		59	100	

*SD= Standard Deviation, **(BMI= Body Mass Index, Kg=kilogram, m²= square meter)

The one-way ANOVA (Table 4.28) was performed to determine how age, weight and height varied among the participants in different BMI groups. Participants in different BMI groups did not differ significantly in terms of age ($p = 0.332$) with normal weight participants ($M = 16$ years, $SD = 0.87$) when compared to overweight participants ($M = 16$ years, $SD = 0.86$) and obese participants ($M = 16$ years, $SD = 0.77$) (Table 4.26). The weight of the participants, however, differed significantly across BMI groups ($p < .001$), with obese participants weighing more ($M = 90$ Kg, $SD = 15$) than overweight participants ($M = 67$ Kg, $SD = 6$) who weighed more than the normal weight participants ($M = 52$ Kg, $SD = 6$) (Table 4.26). Height of the participants did not differ significantly across BMI groups ($p = 0.750$), but obese participants were slightly taller ($M = 156.4$ cm, $SD = 5.4$) than the normal weight participants ($M = 155.4$ cm, $SD = 4$) who were marginally taller than the overweight participants ($M = 155.3$ cm, $SD = 5$) (Table 4.28).

Table (4.28) Differences between BMI Groups and Participants' Characteristics

Age/ year	Normal weight (N = 29) Mean (*SD)	Overweight (N = 17) Mean (*SD)	Obese (N = 13) Mean (*SD)	Total (N = 59) Mean (*SD)	<i>p</i>
Weight/ **kg	16 (0.87)	16 (0.86)	16 (0.77)	16 (0.84)	0.332
Height/ ***cm	52 (6)	67 (6)	90 (15)	66 (19)	<0.001
Age/ year	155.4 (4)	155.3 (5)	156.4 (5)	156 (5)	0.750

*SD= Standard Deviation, **Kg=kilogram, ***cm=centimetre

On average, the participants reported consuming 1,518 Kcal/ day ($SD = 404$), comprising 51.2g protein ($SD = 12.1$), 215.2g carbohydrate ($SD = 66.6$), and 54.7g of fats ($SD = 16.7$) representing 13.5%, 53%, 32% of the total energy intake (EI) per day, respectively (Table 4.29).

Table (4.29) Means of Food Intakes from the Un-Weighed 7-Day Diet Diaries

Variables	Number	(Min/ Max)	Mean (*SD)	% Energy
Energy Intake (**Kcal/day)	59	(775/ 2,391)	1,518 (404)	-
Protein Intake (**g/day)	59	(23.2/ 71.2)	51.2 (12.1)	13.5
Carbohydrate Intake (g/day)	59	(92.0/ 371.7)	215.2 (66.6)	53
Fat Intake (g/day)	59	(21.3/ 113.3)	54.7 (16.7)	32

*SD= Standard Deviation, **Kcal= kilocalorie, ***g= gram,

The participants' dietary intakes were compared to The Omani Guide to Healthy Eating (MOH 2009), which recommended nutrient intakes of carbohydrate (330–450g), protein (48–60g), fats (70g) and energy intake (EI) (2,400 Kcal) for female Omani adolescents of 14–18 years of age (MOH 2009).

On a daily basis, all the participants who completed the 7-Day Diet Diary had energy intakes less than the recommended 2,400 Kcal/day. Regarding CHO, only three participants (5%) consumed the recommended amount while all the others (95%) consumed less than the recommended amount (Table 4.30). As regards protein, 16 (27%) participants who completed the 7-Day Diet Diary daily consumed the recommended amount of protein while 25 (42%) consumed less and 18 (31%) consumed more than the recommended amounts (Table 4.30). Lower-than-recommended fat consumption was reported by most (85%) participants who completed the 7-Day Diet Diary, while 15% reported consuming more fat than recommended (Table 4.30). Therefore, none of the participants who completed the 7-Day Diet Diary reported consuming more than the total recommended energy intake.

Table (4.30) Frequencies and Percentages of Reported Dietary Intakes

Variables	Recommended Intakes (MOH 2009)	Number	%
Energy Intake (*Kcal/day)	<2,400	59	100
Protein Intake (**g/ day)	<48g	25	42
	48g – 60g	16	27
	> 60g	18	31
carbohydrate Intake (g/day)	<330g	56	95
	330g – 450g	3	5
Fats Intake (g/day)	<70g	50	85
	>70g	9	15

*Kcal= kilocalorie, **g= gram,

One-way ANOVA (Table 4.31) indicated no significant differences between the three levels of BMI groups. The percentage of energy gained from protein intake was 13% in normal weight participants, and 14% each in overweight and obese participants (Table 4.31). In addition, the percentage of energy gained from carbohydrate intake was 54% in the normal weight, 52% in the overweight, and 53% in the obese participants (Table 4.31). The percentage of energy gained from fat normal weight was 32%, overweight 33% and obese 32%.

Table (4.31) Differences between BMI Groups and Reported Dietary Intakes

Variables	Normal weight (N = 29) Mean (*SD)	% Energy	Overweight (N = 13) Mean (*SD)	% Energy	Obese (N = 17) Mean (*SD)	% Energy	<i>p</i>
Energy Intake (*Kcal/day)	1,602 (426)	-	1,447 (389)	-	1,427 (366)	-	>0.05
Protein Intake (*g/day)	51.1 (13.8)	13	50.9 (9.4)	14	51.5 (11.2)	14	>0.05
Carbohydrate Intake (g/day)	230.6 (68.3)	54	199.8 (70.4)	52	201.3 (58.2)	53	>0.05
Fat Intake(g/day)	57.4 (17.9)	32	53.4 (13.7)	33	51 (16.6)	32	>0.05

*SD= Standard Deviation, **Kcal= kilocalorie, ***g= gram

Paired samples *t*-test suggested that the mean of the estimated TEE was significantly higher than the mean of the reported EI. (Table 4.32).

Table (4.32) Paired Samples t-Test for the Difference Between Estimated TEE and Reported EI

*TEE (**Kcal/day)		***EI (Kcal /day)		<i>t</i>	<i>p</i>
Mean	*SD	Mean	****SD		
1,765	215	1,518	403	3.81	< 0.001

Note. Degrees of Freedom for the *t*-statistic = 58.

*TEE= Total Energy Expenditure, **Kcal= kilocalorie, ***EI= Energy Intake, ****SD= Standard Deviation

Pearson correlation analysis, among BMI, daily reported EI, daily protein intake, daily carbohydrate intake and daily fat intake showed no significant association between BMI of all diet diary samples, including the misreporters and the reported EI and macronutrients.

4.1.15 Identifying Mis-reported Diet Diaries

In this study, the data of daily EI collected from 59 participants' un-weighed 7-day diet diaries was assessed for underreporting. This was carried out using the Henry Equations to estimate the BMR for each participant (SACN 2011); see the detailed calculation in section (3.6.4.1).

According to Black (2000, p. 396), different categories of dietary reporters defined according to their ratio between EI and EE, as follows:

Normal reporters EI:EE=0.76–1.24,

Under-reporters EI:EE=<0.76,

Over-reporters EI: EE=> 1.24.

In this study, 33 (56%) participants were classified normal reporters, 22 (37%) as under-reporters and 4 (7%) as over reporters. The table (4.33) shows the different categories of Omani female adolescent dietary reporters; of the total 59 participants, 33 (56%) were classified normal reporters, 22 (37%) under-reporters and 4 (7%) over-reporters. Among the normal weight participants, the most frequently observed category was normal reporter, 19 (32%). among obese participants, it was under-reporter, 10 (17%) and for the overweight, the most frequently observed category was normal reporter, 7 (12%). The under reporters and over reporters were excluded from the analysis of the current study. Dietary data of the remaining 33 participants (valid/ normal reporters) were analysed.

Table (4.33) Frequencies and Percentages of Food Reporters

Variable	Number	Normal weight	Obese	Overweight
Normal Reporter (0.76–1.24)	33 (56%)	19 (32%)	7 (12%)	7 (12%)
Under-Reporter (<0.76)	22 (37%)	6 (10%)	10 (17%)	6 (10%)
Over-Reporter (>1.24)	4 (7%)	4 (7%)	0 (0%)	0 (0%)
Total	59 (100%)	29 (49%)	17 (29%)	13 (22%)

4.1.16 Part (2) Diet Diary

4.1.16.1 Analysing the Normal Reporters Food Intakes from the Un-Weighed 7-Day Diet Diaries

On average, the participants reported consuming daily 1,681 Kcal, protein 55 g, carbohydrate 240g, and fat 61 g (Table 4.34).

Table (4.34) Means of Food Intakes of Normal Reporters

Variable	Number	Mean	*SD	Calories	% Energy
Energy Intake (**Kcal/day)	33	1,681	262	-	-
Protein Intake (***g/day)	33	55	10	220	13%
carbohydrate Intake (g/day)	33	240	45	900	54%
Fat Intake (g/day)	33	61	13	549	33%

*SD= Standard Deviation, **Kcal= kilocalorie, ***g= gram

Table (4.35) illustrates that the normal reporter participants who completed the 7-Day Diet Diaries had a mean energy intake lower than the recommended 2,400 Kcal/day. They were also eating less than the recommended amount of daily carbohydrate and fat. Twelve participants (36%) consumed the recommended amount of protein daily while the remaining 10 participants (30%) consumed less than the required 48 g.

Thus, none of the participants who completed the 7-Day Diet Diary reported consuming more than the recommended amount of calories and carbohydrate on a daily basis. (Table 4.35).

Table (4.35) Frequencies and Percentages of Reported Dietary Intakes of Normal Reporter

Variable	Recommended (MOH 2009)	Number	%
Energy Intake (*Kcal/day)	<2,400	33	100
Protein Intake (**g/ day)	48–60 g	12	36
	<48 g	10	30
	>60 g	11	33
carbohydrate Intake (g/day)	<330 g	33	100
Fat Intake (g/day)	<70 g	26	79
	>70 g	7	21

*Kcal= kilocalorie, **g= gram

4.1.16.2 Estimation of energy requirements

To assess dietary misreporting the estimation of the BMR, TEE and the difference between estimated energy expenditure and the reported energy intake were assessed for each participant. The detailed calculation is found in section (3.6.4.1). On average, participants reached the estimated BMR of about 1,425 Kcal/day ($M = 1,425$ Kcal/day, $SD = 154$), the estimated TEE of 1,710 Kcal/ day ($M = 1,710$ Kcal/day, $SD = 184$), the average of reported EI was ($M = 1,681$ Kcal/ day, $SD = 262$) (Table 4.34). On average, the participants showed the difference between the estimated TEE and the reported EI of 29 kcal/ day, $SD = 290$ (Table 4.36).

Table (4.36) Mean of Estimated BMR & TEE, TEE – EI and Reported EI

Variable	Number	Min–Max	Mean	*SD
BMR (Kcal/day)	33	1,222/1,949	1,425	154
****TEE (Kcal/day)	33	1,466/2,339	1,710	184
Energy Intake (Kcal/day)	33	1,247/2,184	1,681	262
TEE – EI (kcal/day)	33	–448/ 517	29	290

*SD= Standard Deviation, **BMR= Basal Metabolic Rate, ***Kcal= kilocalorie, ****TEE= Total Energy Expenditure

A paired samples *t*-test (Table 4.37) was conducted to examine whether the difference between the estimated TEE and the reported EI was significantly different from zero. The result of the paired samples *t*-test was not significant, $p = >0.5$.

Table (4.37) Paired Samples *t*-Test for the Difference Between Estimated TEE and Reported EI

Energy Intake (*Kcal /day)		**TEE (Kcal/day)		<i>t</i>	<i>p</i>
Mean	***SD	Mean	SD		
1,681	262	1,710	184	-0.58	0.563

Note. Degrees of Freedom for the *t*-statistic = 32.

*Kcal= kilocalorie **TEE= Total Energy Expenditure, ***SD= Standard Deviation

A one sample *t*-test (Table 4.38) was conducted to examine whether the reported EI, carbohydrate, protein and fat could have been created by a probability distribution with a mean of the daily recommended 2,400 kcal (390 g, 54 g and 70 g, respectively). The result of the one sample *t*-test was significant for EI, carbohydrate and fat, $p < 0.001$. The reported EI, carbohydrate, and fat of the normal reporters are unlikely to have been created by a distribution with the mean of the recommended intakes. The true mean ($M = 1,681$ Kcal/day, $SD = 262$) of the distribution of the reported EI is most likely lower than the recommended 2,400 Kcal/ day. In addition, the true mean ($M = 240$ g/day, $SD = 45$) of the distribution of daily carbohydrate intake is most likely lower than the recommended 390 g/day. Moreover, the true mean ($M = 61$ g/day, $SD = 13$) of the distribution of daily fat intake is most likely lower than the recommended 70 g/day. However, the result of the one sample *t*-test for the protein intake was not significant, $p = 0.496$

Table (4.38) One Sample *t*-Test for reported Dietary Intake

Variable	Mean	*SD	mu	<i>t</i>	<i>p</i>
Energy Intake (**Kcal/day)	1,681	262	2,400	-15.77	< 0.001
Carbohydrate ***g/day	240	45	390	-18.92	< 0.001
Protein g/ day	55	10	54	0.69	0.496
Fat g/day	61	13	70	-4.20	< 0.001

Note. Degrees of Freedom for the *t*-statistic = 32.

*SD= Standard Deviation, **Kcal= kilocalorie, ***g= gram

4.1.16.3 Differences in Food Intake between Adolescent Girls of Overweight or Obese and Normal Weight

Shapiro-Wilk test result shows the reported daily food intake by the normal reporter participants to be normally distributed ($p \Rightarrow 0.05$). One-way ANOVA was therefore used to investigate how the average obtained for daily energy intake, daily protein intake, daily carbohydrate intake, and daily fat intake, BMR, TEE and EI: TEE varied across different BMI groups.

The one-way ANOVA (Table 4.39) indicated no significant differences between the three BMI groups. The percentage of the energy gained from protein, in normal weight and overweight participants was 13% each, and among the obese it was 13.5%. In addition, the percentage of the energy gained from carbohydrate intake was among the normal weight participants (53%), overweight and obese (54% each). Moreover, the percentage of the energy gained from fat was, in normal weight girls at 33%, and for overweight and obese at 32% each (Table 4.39).

Table (4.39) Differences between BMI Groups and Reported Dietary Intakes

Variables	Normal weight (N = 19) M (*SD)	% Energy	Overweight (N = 7) M (*SD)	% Energy	Obese (N = 7) M (*SD)	% Energy	<i>p</i>
Energy Intake (**Kcal/day)	1,638 (235)	-	1,702 (334)	-	1,778 (268)	-	>0.05
Protein Intake (***g/day)	53 (11)	13	57 (7)	13	60 (9)	13.5	>0.05
Carbohydrate Intake (g/day)	233 (38)	53	244 (65)	54	257 (43)	54	>0.05
Fat Intake(g/day)	60 (12)	33	61 (15)	32	64 (15)	32	>0.05

*SD= Standard Deviation, **Kcal= kilocalorie, ***g= gram

The results from the one-way ANOVA (Table 4.40) indicated that specific variables with averages that differed significantly across different BMI groups were estimated BMR and TEE ($p < 0.001$). However, there was no significant difference between the three levels of BMI groups in terms of the ratio between EI and estimated TEE ($p \geq 0.5$).

Moreover, obese girls had a significantly higher average of estimated TEE when compared to overweight girls who had a significantly higher average TEE when compared to girls of normal weight.

Although, there was an energy balance between reported EI and estimated TEE across all group, (hence these subjects were deemed to be normal reporters there may be a trend for the obese subjects to report slightly lower energy intakes in relation to their TEE (0.90) than overweight (0.97) and normal weight (1.02).

Table (4.40) shows further Tukey pairwise comparisons were conducted for all significant effects. For the main effect of BMI, the mean of BMR for normal weight ($M = 1,328$, $SD = 53$) was significantly smaller than obese ($M = 1,654$ kcal/day, $SD = 152$), $p < 0.001$. For the main effect of BMI, the mean of BMR for normal weight ($M = 1,328$ kcal/day, $SD = 53$) was significantly smaller than overweight ($M = 1,461$ kcal/day, $SD = 46$), $p = 0.003$. For the main effect of BMI, the mean of BMR for obese ($M = 1,654$ kcal/day, $SD = 152$) was significantly larger than overweight ($M = 1,461$ kcal/day, $SD = 46$), $p < .001$.

Table (4.40) displays the main effect of BMI, the mean of TEE for normal weight ($M = 1,593.59$, $SD = 63.91$) was significantly smaller than obese ($M = 1,984$ kcal/day, $SD = 182$), $p < 0.001$. For the main effect of BMI, the mean of TEE for normal weight ($M = 1,594$ kcal/day, $SD = 64$) was significantly smaller than overweight ($M = 1,754$ kcal/day, $SD = 55$), $p = 0.003$. For the main effect of BMI, the mean of TEE for obese ($M = 1,984$ kcal/day, $SD = 182$) was significantly larger than overweight ($M = 1,754$ kcal/day, $SD = 55$), $p < 0.001$.

Table (4.40) Differences between BMI Groups and Estimated Daily BMR, TEE & EI: TEE

Variables	Normal weight ($N = 19$) Mean (*SD)	Overweight ($N = 7$) Mean (SD)	Obese ($N = 7$) Mean (SD)	F	p
BMR(Kcal/day)	1,328 (53)	1,461 (46)	1,654 (152)	41	< 0.001
****TEE (Kcal/day)	1,594 (64)	1,754 (55)	1,984 (182)	41	< 0.001
*****EI: TEE (Kcal/day)	1.02 (.01)	0.97 (.18)	0.90 (.16)	1.5	0.23

*SD= Standard Deviation, **BMR= Basal Metabolic Rate, ***Kcal= kilocalorie, ****TEE= Total Energy Expenditure, *****EI= Energy intake

For all reporters—normal reporters, under reporters and over-reporters—there were significant negative relationships between participants' BMI and the ratio of total estimated energy expenditure and the reported total daily energy intake, $p = <0.001$, $p = 0.018$, $p = .045$ and $p = 0.006$, respectively (Table 4.41).

Table (4.41) Association between BMI (kg/m²) and TEE: EI

Variables	Number	*BMI and **TEE: ***EI Pearson's correlation coefficient
All Reporters	59	$r = 0.513, p = <0.001$
Normal Reporters	33	$r = 0.410, p = 0.018$
Under Reporters	22	$r = 0.432, p = 0.045$
Over-reporters	4	$r = 0.521, p = 0.006$

*BMR= Basal Metabolic Rate, **TEE= Total Energy Expenditure, ***EI= Energy intake

The normal reporter participants reportedly had mean daily energy intake ($M = 1,681$ kcal/ day, $SD = 262$), carbohydrate ($M = 240$ g/day, $SD = 45$), protein ($M = 55$ g/day, $SD = 10$), and fat ($M = 61$ g/day, $SD = 13$ g/day) (Table 4.41). Meanwhile under-reporter participants reported to have consumed much less: ($M = 1,131$ kcal/ day, $SD = 176$), carbohydrate ($M = 154$ g/day, $SD = 24.5$), protein ($M = 42.2$ g/day, $SD = 9.3$), and fat ($M = 41.5$ g/day, $SD = 9.7$) (Table 4.42).

Table (4.42) Mean of Dietary Intake Normal Reporters and Underreports

	Normal Reporters, n = 33 Mean (***SD)	Under-Reporters, n = 22 Mean (SD)
Energy Intake (*kcal/day)	1,681 (262)	1,131 (176)
Carbohydrate Intake (**g/day)	240 (45)	154 (24.5)
Protein Intake (g/day)	55 (10)	42.2 (9.3)
Fat Intake (g/day)	61 (13)	41.5 (9.7)

*Kcal= kilocalorie, **g= gram, ***SD= Standard Deviation

An independent samples *t*-test (Table 4.43) was conducted to examine whether the means of daily EI and macronutrients were significantly different between the normal reporters and underreports participants. The result of the independent samples *t*-test was significant, $p = <0.001$ for the tested variables, suggesting that the means of daily EI and macronutrients were significantly different between the normal reporters and underreports participants. The mean of daily EI in the normal reporters ($M = 1,681$ kcal/ day, $SD = 13$) was significantly higher than the mean of daily EI in the underreports participants ($M = 1,131$ kcal/ day, $SD = 176$). The mean of daily carbohydrate intake in the normal reporters ($M = 240$ g/ day, $SD = 45$) was significantly higher than the mean of daily carbohydrate intake in the underreports participants ($M = 154$ g/ day, $SD = 24.5$). The mean of daily protein intake in the normal reporters ($M = 55$ g/ day, $SD = 10$) was significantly higher than the mean of daily protein intake in the underreports

participants ($M = 42.2/$ day, $SD = 9.3$). The mean of daily fat intake in the normal reporters ($M = 61g/$ day, $SD = 13$) was significantly higher than the mean of daily fat Intake in the underreports participants ($M = 41.5 g/$ day, $SD = 9.7$) (Table 4.43).

Table (4.43) Independent Samples *t*-Test for the Difference between Mean of Dietary Intake Normal Reporters and Underreports

	Normal Reporters n = 33		Under-Reporters n = 22		<i>t</i>	<i>p</i>
	M	SD	M	SD		
Energy Intake (*kcal/day)	1,681	262	1,131	176	8.62	<0.001
Carbohydrate Intake (**g/day)	240	45	154	24.5	9.11	<0.001
Protein Intake (g/day)	55	10	42.2	9.3	4.74	<0.001
Fat Intake (g/day)	61	13	41.5	9.7	5.94	<0.001

*Kcal= kilocalorie, **g= gram

4.1.18.4 The Association between Omani Adolescent Girls BMI And Reported Food Intake

The Shapiro-Wilk test—considered the best test for the normality of data, and applicable in sample sizes smaller than 50 (Ghasemi and Zahediasl 2012)—was used in the current study to investigate whether the data collected for daily energy EI, daily protein intake, daily carbohydrate intake and daily fat intake were adequate. The data was found to be normally distributed, $P > 0.5$. Therefore, a parametric test (the Pearson correlation coefficient) was used to investigate the relationship between the investigated food intake variables and the body weight of the normal reporters who completed the un-weighed 7-day Diet Diaries (Huck 2008).

The result of Pearson correlation analysis included the BMI, daily reported EI, daily protein intake, daily carbohydrate intake, and daily fat intake. However, there was no significant correlation between BMI of normal reporters and their reported EI and macronutrients.

There was a significant positive correlation between daily energy intake and fat ($r_p = 0.72, p < 0.001$). The correlation coefficient between daily energy intake and fat was 0.72, indicating a large effect size. Figure A (4.6) shows the positive correlation between the daily energy intake and consumption of fat. This indicates that as daily intake of EI increases, fat tends to increase.

There was a significant positive correlation between daily energy intake and carbohydrate ($r_p = 0.86, p < 0.001$). The correlation coefficient between daily energy intake and carbohydrate was 0.86, indicating a large effect size. Figure B (4.7) shows the positive correlation between the daily energy intake and consumption of carbohydrate. This indicates that as daily intake of EI increases, carbohydrate tends to increase. There was a significant positive correlation between daily energy intake and protein ($r_p = 0.80, p < .001$). The correlation coefficient between daily energy intake and protein was 0.80, indicating a large effect size. Figure C (4.8) shows the positive correlation between the daily energy intake and consumption of protein. This indicates that as intake of EI increases, protein tends to increase.

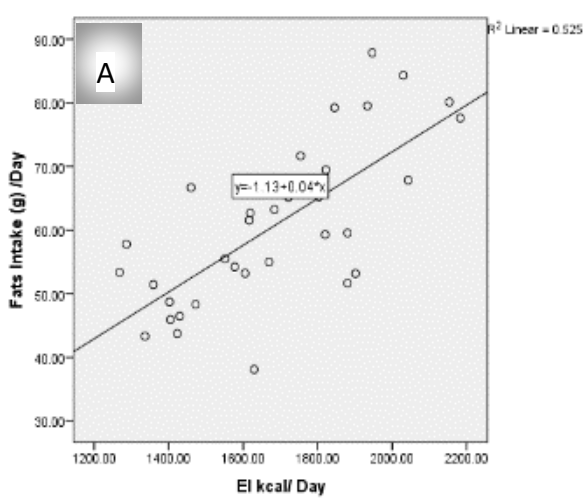


Figure A (4.6) Correlation between Daily EI and Fat Intake

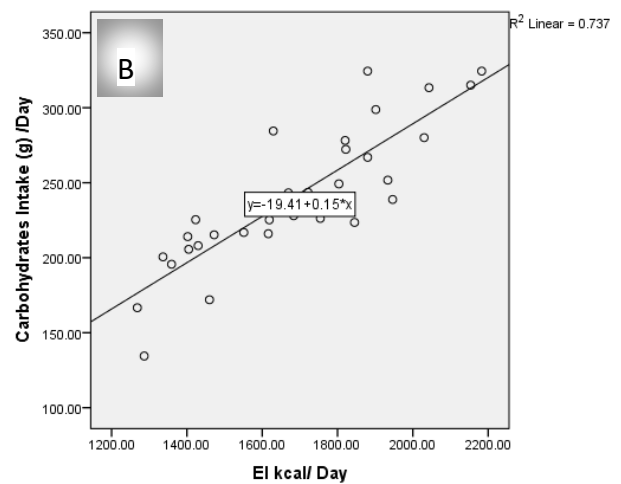


Figure B (4.7) Correlation between Daily EI and carbohydrate Intake

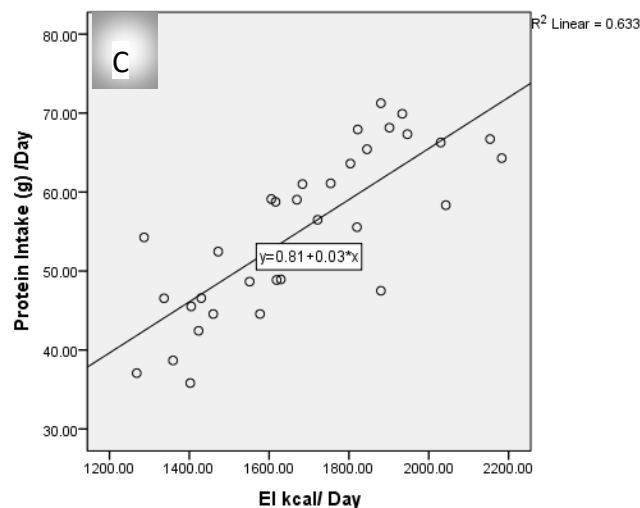


Figure C (4.8) Correlation between Daily EI and Protein Intake

4.1.17 Physical Activity Analysis (Pedometer Analysis)

4.1.17.1 Participants' Characteristics

In this analysis, data was collected from the same 59 participants who completed the unweighed 7-day diet diary. Data from 7-day diet diary were normally distributed. All participants who had completed 7-day diet diary had also the pedometer record of seven days. In this analysis, data were collected from 59 participants' pedometers, foot step count ranged from 1,250 to 13,992 steps ($M = 5,755$ steps/ day, $SD = 2,262$), daily distance walked ranged from 0.2 to 3.3 Miles ($M = 1.1$ mile/ day, $SD = 0.513$) (Table 4.44).

Table (4.44) Pedometer Data: Mean of the Daily Step Count and Distance Walked from

Variables	(Min/ Max)	Mean (*SD)
Foot Step Counts/day	(1,250/13,992)	5,755 (2,262)
Distance (Mile/ day)	(0.2/ 3.3)	1.1 (0.513)

*SD= Standard Deviation

Participants in different BMI groups differed significantly in terms of daily step counts ($F(2, 56) = 9.49, p < 0.001$) with normal weight participants having higher daily step count ($M = 6,625$ steps/ day, $SD = 2,170$) than overweight participants ($M = 6,094$ steps/ day, $SD = 1,841$) who in turn had a mean higher daily step count than the obese participants ($M = 4,011$ steps/ day, $SD = 1,753$). Moreover, daily distance of the participants differed significantly among the participants in different BMI groups ($F(2, 56) = 8.189, p = 0.001$) with normal weight participants walking longer distance daily ($M = 1.3$ Mile/ day, $SD = 0.54$) when compared to overweight participants ($M = 1.2$ Mile/ day, $SD = 0.33$) who covered mean longer distance than obese participants ($M = 0.8$ Mile/ day, $SD = 0.38$). Figure (4.9) illustrates these differences.

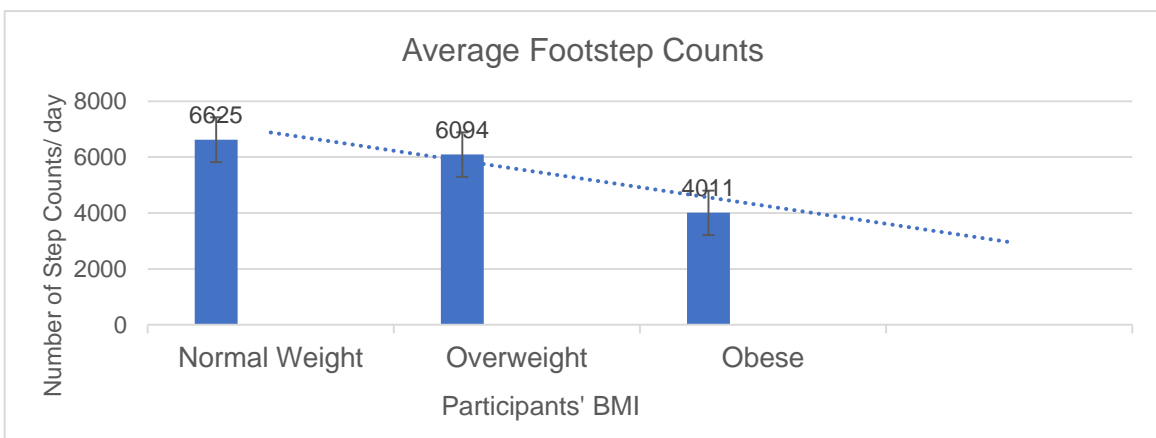


Figure (4.9) Average of Footstep Counts in different BMI Groups

An independent samples *t*-test (Table 4.45) was conducted to examine whether the mean of daily step counts was significantly different between the normal weight and overweight/obese participants. The result of the independent samples *t*-test was significant, $p = 0.003$, suggesting that the mean of daily step counts was significantly different between the normal weight and overweight/obese participants. The mean of daily step counts in the normal weight ($M = 6,625$ steps/ day, $SD = 2,170$) was significantly higher than the mean of daily step counts in the overweight/obese ($M = 4,914$ steps/ day, $SD = 2,049$) participants (Table 4.45).

Table (4.45) Independent Samples *t*-Test for the Difference between Daily Step Counts and BMI Groups

Variable	Normal Weight		Overweight/ Obese		<i>t</i>	<i>p</i>
	Mean	*SD	Mean	*SD		
Daily Step Counts/ day	6,625	2,170	4,914	2,049	3.12	0.003

Note. Degrees of Freedom for the *t*-statistic = 58.

*SD= Standard Deviation

4.1.17.2 Comparison between Daily Step Counts and BMI

Cross-tabulation accompanied by chi-square test of significance was conducted to investigate the difference between participants' daily step counts and their BMI level (Table 4.46).

Daily foot step count of most of the obese participants was $> 5,000$ step while the daily step count of most of the participants with normal weight was at $\geq 5,000$ steps. Most of the participants (98%) who worn the pedometers had daily step count that was lower than the recommended value for adolescent (10,000 to 11,700 steps/ day) (Tudor-Locke et al. 2011). The chi-square test indicated a significant difference between the daily step counts and participants' BMI ($p = 0.007$) (Table 4.46).

Table (4.46) Daily Step Counts: Comparison between Different BMI Groups

BMI	Footstep Counts/ day					Total	<i>p</i>
	<2,500	2,500–4,999	5,000–7,500	7,501–10,000	> 10,000		
Normal weight	0(0%)	5 (17%)	16 (55%)	7(24%)	1(4%)	29 (100%)	0.007
Overweight	0(0%)	4 (31%)	7 (54%)	2(15%)	0(0%)	13 (100%)	
Obese	3(18%)	10 (59%)	4 (23%)	0(0%)	0(0%)	17 (100%)	
Total	3(5%)	19 (32%)	27 (46%)	9(15%)	1(2%)	59 (100%)	

A one sample *t*-test (Table 4.47) was conducted to examine whether the daily recorded step counts could have been produced by a probability distribution with a mean of the recommended 10,900 steps per day and found the true mean steps a day to be much lower, at 5,755 (Table 4.47).

Table (4.47) One Sample *t*-Test for the Difference between Daily Recorded Step Counts and Recommended 10,900 Steps/ day

Variable	Mean	*SD	mu	<i>t</i>	<i>p</i>
Step Counts/ day	5,755	2,262	10,900	-17.47	< 0.001

*SD= Standard Deviation

Table (4.48) shows the cross-tabulation of the daily foot step counts and the participants' age group. The chi-square test indicated no significant relationship between the daily step counts and participants' ages.

Table (4.48) Daily Step Counts: Comparison between Age Groups

Age/ Year	Footstep Counts					Total	<i>P</i>
	<2,500	2,500– 4,999	5,000– 7,500	7,501– 10,000	> 10,000		
15	0(0%)	5(39%)	6(46%)	2(15%)	0(0%)	13(100%)	0.070
16	1(4%)	11(42%)	10(39%)	4(15%)	0(0%)	26(100%)	
17	2(12%)	2(13%)	8(50%)	3(19%)	1(6%)	16(100%)	
18	0(0%)	1(25%)	3(75%)	0(0%)	0(0%)	4(100%)	
Total	3(5%)	19(32%)	27(46%)	9(15%)	1(2%)	59(100%)	

4.1.18.6 The Association between Omani Adolescent Girls BMI and their Weight and Daily Step Count

Pearson correlation was performed to determine the relationship between the BMI of a participants' weight, and daily foot step counts. BMI was significantly negatively correlated to participants' daily step counts ($r = -0.44$, $p = 0.001$) (figure 4.10). Therefore, participants with higher BMI were likely to have lower daily step counts per day. The daily step counts were negatively associated with participants' weight ($r = -0.40$, $p = <0.001$). There was no significant association between recorded footstep counts reported of nutritional intake, $p \geq 0.05$.

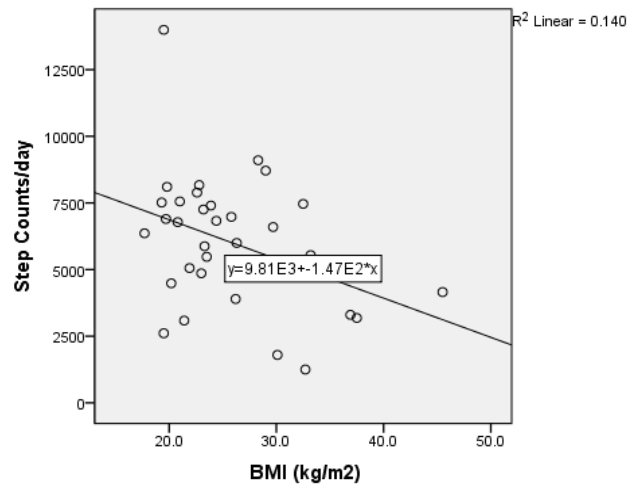


Figure (4.10) Correlation between BMI and foot step counts/ day

4.1.18 Association between Lifestyle factors and Adolescents in Different BMI Groups

A series of three multivariate logistic regressions were conducted to investigate the association between lifestyle factors (independent variables) such as physical activity, sedentary behaviour and dietary habits among Omani adolescent girls in different BMI groups (binary dependent variable). This association analysis gave a comprehensive picture about their lifestyle factors. For regression model, “normal weight” was selected as the reference class for the following reason: Normal weight is the ideal weight for a person compared to the other weight categories. The rationale for undertaking a series of three multivariate logistic regressions was; having more than one dependent variables.

The multivariate logistic regressions modelling is based on a backward stepwise approach to address the issue of multicollinearity among the variables, and ‘enter’ method for the initial modelling of all lifestyle variables (Table 4.49). (correlation matrix was also undertaken of all variables to investigate the level of association, which revealed that no correlation exceeded 0.6. This matrix is not reported due to its size). The factors were entered in separate models initially for each BMI grouping and then a final model unites those variables across these factors which were found to be significant, $p < 0.1$. For each model the odds ratio and its associated 95% CI is reported along with model statistics (Nagelkerke Rsq,).

Note that the sample size in each analysis varies dependent on the number of participants in the BMI groups involved but reflect the sample size achieved. Therefore, for the smaller group numbers the results may just be indicative.

Table (4.49) Association Between Lifestyle Factors and Participants' BMI

Variables	Underweight		Overweight		Obese	
	Odds Ratio (95%CI)	Sig.	Odds Ratio (95%CI)	Sig.	Odds Ratio (95%CI)	Sig.
Physical Activity (Frequency/ week)						
Walking	1.163 (0.985, 1.372)	0.074	1.016 (0.913, 1.131)	0.774	1.119 (0.993, 1.26)	0.064
Running	0.827 (0.661, 1.034)	0.095	0.907 (0.789, 1.042)	0.167	0.836 (0.706, 0.991)	0.039
Cycling	0.828 (0.309, 2.216)	0.707	0.951 (0.677, 1.335)	0.772	0.911 (0.45, 1.843)	0.794
Swimming	1.603 (0.896, 2.868)	0.112	1.217 (0.839, 1.763)	0.301	1.087 (0.629, 1.879)	0.766
Mod. sports	1.025 (0.789, 1.333)	0.851	1.051 (0.893, 1.237)	0.548	0.989 (0.796, 1.228)	0.918
High intensity ports	1.159 (0.886, 1.515)	0.281	1.109 (0.93, 1.322)	0.248	1.097 (0.866, 1.388)	0.444
Self-defence	0.617 (0.332, 1.144)	0.125	1.002 (0.827, 1.215)	0.981	0.415 (0.197, 0.877)	0.021
Training	1.099 (0.807, 1.496)	0.550	0.975 (0.776, 1.225)	0.830	1.015 (0.749, 1.375)	0.923
Household	0.925 (0.782, 1.094)	0.361	0.995 (0.899, 1.102)	0.928	1.143 (1.012, 1.291)	0.032
Sedentary Behaviour (Hour/ week)						
Watching TV week day	1.51 (1.138, 2.005)	0.004	1.088 (0.918, 1.29)	0.331	0.984 (0.802, 1.207)	0.875
Watching TV weekends	0.888 (0.679, 1.162)	0.388	0.868 (0.739, 1.018)	0.082	0.787 (0.637, 0.973)	0.027
Using computer weekday	0.907 (0.707, 1.162)	0.438	1.153 (0.993, 1.34)	0.062	1.32 (1.099, 1.586)	0.003
Using Computer weekends	1.07 (0.808, 1.416)	0.637	1.159 (0.978, 1.374)	0.088	1.081 (0.884, 1.323)	0.446
Sleeping weekday	1.194 (0.907, 1.57)	0.206	0.75 (0.63, 0.893)	0.001	0.909 (0.752, 1.1)	0.326
Sleeping weekends	1.081 (0.825, 1.417)	0.570	1.391 (1.162, 1.666)	0.000	1.011 (0.847, 1.206)	0.903
Diet Habits (Frequency/ week)						
Eating breakfast	0.903 (0.754, 1.082)	0.269	0.823 (0.732, 0.925)	0.001	0.813 (0.712, 0.929)	0.002
Drinking soft drinks	1.15 (0.949, 1.393)	0.154	0.766 (0.668, 0.877)	0.000	0.813 (0.705, 0.939)	0.005
Eating veg	1.096 (0.906, 1.325)	0.344	1.181 (1.035, 1.348)	0.014	1.127 (0.97, 1.311)	0.119
Eating fruits	0.73 (0.599, 0.89)	0.002	0.811 (0.713, 0.921)	0.001	0.928 (0.8, 1.076)	0.320
Drinking milk	1.133 (0.945, 1.359)	0.178	1.048 (0.92, 1.194)	0.482	0.959 (0.826, 1.114)	0.585
Eating (fast food) pizza	0.687 (0.485, 0.974)	0.035	1.126 (0.946, 1.34)	0.182	1.32 (1.095, 1.592)	0.004
Eating fries	1.004 (0.804, 1.253)	0.972	1.264 (1.072, 1.49)	0.005	1.205 (1.008, 1.442)	0.041
Eating cakes	1.052 (0.842, 1.315)	0.657	1.369 (1.167, 1.607)	0.000	1.36 (1.129, 1.637)	0.001
Eating sweets	1.045(0.856, 1.275)	0.668	0.957 (0.835, 1.097)	0.527	1.055 (0.907, 1.227)	0.489
Drinking energy drink	1.107 (0.726, 1.687)	0.637	1.196 (0.913, 1.567)	0.193	0.849 (0.597, 1.209)	0.365

Note: Reference is Normal weight

The logistic regression stepwise procedure results below for each factor shows those variables which remain significantly associated (also here includes those variables $p < 0.1$):

4.1.18.1 Association between Physical Activity and BMI

Table (4.50) illustrates multivariate logistic regression analysis, all non-significant values were excluded from the analysis table. The analysis of the model reveals that, none of the physical activities are related to Omani adolescents in underweight or overweight groups. Even though obesity appeared to be positively associated with running, self-defence sports and household tasks ($p < 0.05$), this relationship was mixed. However, increasing running and increasing self-defence reducing seem to be associated with likelihood of obesity, OR (95% CI), 0.836 (0.706, 0.991) and 0.415 (0.197, 0.877), respectively, so slightly reduced odds of running of being obese but less than half the odds for self-defence sports. Whereas, household tasks increased the odds by 14% that the participant was likely to be obese.

4.1.18.2 Association between Sedentary Behaviour and BMI

Table (4.50) reveals that, for those underweight adolescents increasing, watching TV and DVD during weekdays showed a 41% increase in odds of being underweight, while sleeping more during weekdays was negatively associated with being overweight by 25%, while sleeping more during weekends was associated positively (40% increase in these odds) of being overweight. Similarly, more hours spent in watching TV and DVD during weekends and in using the computer during weekdays were associated with increased chances of being obese, by 20% and 31%, respectively. Regarding physical activity, obese girls involved were likely to be participating in self-defense and running by 58% and 14%, respectively.

4.1.18.3 Association between Diet Habits and BMI

Table (4.50) shows that eating more fruit and fast food per week were associated with lower odds of being underweight by 24% and 29%, respectively. Many dietary variables were associated with being overweight compared to those girls within the normal weight group; eating breakfast, drinking soft drinks, eating fruits, on more days during the week implied that girls were associated with significantly less likely to be overweight (approximately 20%), while eating vegetable, fries, and cakes were associated with significantly increased those odds (20% to 38%). For the obese girls increasing frequency of eating breakfast, drinking soft drinks on many times a week were associated with significantly decreased the odds by 19% but perhaps unsurprisingly pizza, fries and cakes being eaten many times a week were associated with significantly increased odds (19% to 39%).

Table (4.50) Significant Results of Association of Binominal Regression Model

	Underweight		Overweight		Obese	
	Odds Ratio (95%CI)	Sig.	Odds Ratio (95%CI)	Sig.	Odds Ratio (95%CI)	Sig.
Physical Activity (Frequency/ week)						
Running	-	-	-	-	0.859 (0.739, 0.999)	0.049
Self-defence	-	-	-	-	0.418(0.203, 0.864)	0.018
Household	-	-	-	-	1.144 (1.015, 1.289)	0.028
Sedentary Behaviour (Hour/ week)						
Watching TV week day	1.411(1.118, 1.78)	0.004	-	-	-	-
Watching TV weekends	-	-	0.869 (0.741, 1.02)	0.085	0.818 (0.685, 0.978)	0.027
Using computer weekday	-	-	1.18 (1.023,1.361)	0.023	1.311 (1.116, 1.54)	0.001
Sleeping weekday	-	-	0.754 (0.634,0.897)	0.001	-	-
Sleep weekends	-	-	1.393 (1.164,1.668)	0.000	-	-
Diet Habits (Frequency/ week)						
Eating breakfast	-	-	0.816 (0.728,0.915)	0.001	0.823 (0.725, 0.935)	0.003
Drinking soft drinks	1.198 (1.007, 1.424)	0.041	0.78 (0.684,0.888)	0.000	0.803 (0.699, 0.924)	0.002
Eating vegetable	-	-	1.18 (1.042,1.336)	0.009	-	-
Eating fruits	0.761 (0.644, 0.9)	0.001	0.823 (0.729,0.929)	0.002	-	-
Eating (fast food) pizza	0.707 (0.507, 0.985)	0.041	-	-	1.336 (1.117, 1.599)	0.002
Eating fries	-	-	1.279 (1.095,1.495)	0.002	1.19 (1.004, 1.411)	0.044
Eating cake	-	-	1.38 (1.18, 1.615)	0.000	1.39 (1.161, 1.663)	0.000

Note: Reference is Normal weight

Finally, the variables in the lifestyle factors above were used to generate a final logistic regression model (backward stepwise procedure) for each BMI category, with the results presented in table (4.51). The analysis of the model reveals that increasing number of hours spent on watching TV and DVD during weekdays were associated with significantly increased odds by 43% among underweight girls whereas eating more fruits and fast food many times a week significantly decreased these odds by 22% and 29%, respectively. Overweight girls were more likely to be many times using the computer during week days (26%), sleeping more during weekends (49%), eating vegetables (19%), fries (23%) and cakes (46%), and was less likely to be sleeping less during week days (30%), eating breakfast (23%), and drinking soft drinks (27%). In addition, the girls who used the computer during weekdays (26%), performed household tasks (18%), and ate fast food (30%) and cakes (40%) showed a greater probability of being obese, while increase frequency of running, eating breakfast on many times per week and watching TV and DVD during weekends were associated with significantly decreased these odds by about 20%.

Table (4.51) Significant Results of Final Association Regression Model

Variables	Underweight		Overweight		Obese	
	Odds Ratio (95%CI)	Sig.	Odds Ratio (95%CI)	Sig.	Odds Ratio (95%CI)	Sig.
Physical Activity (Frequency/ week)						
Running	-	-	-	-	0.839 (0.722, 0.0975)	0.022
Household	-	-	-	-	1.175 (1.031, 1.338)	0.015
Sedentary Behavior (Hour/ week)						
Watching TV week day	1.432 (1.134,1.809)	0.003	-	-	-	-
Watching TV weekends	-	-	-	-	0.776 (0.638, 0.945)	0.011
Using computer weekday	-	-	1.261 (1.069, 1.487)	0.006	1.262 (1.058, 1.506)	0.010
Sleeping weekday	-	-	0.705 (0.574,0.865)	0.001	-	-
Sleep weekends	-	-	1.486 (1.218, 1.813)	0.000	-	-
Dietary Habits (Frequency/ week)						
Eating breakfast	-	-	0.775 (0.684, 0.879)	0.000	0.813 (0.714, 0.926)	0.002
Drinking soft drinks	-	-	0.727 (0.628, 0.841)	0.000	-	-
Eating vegetable	-	-	1.187 (1.041, 1.354)	0.010	-	-
Eating fruits	0.784 (0.662, 0.928)	0.005	0.828 (0.728, 0.943)	0.004	-	-
Eating (fast food) pizza	0.710 (0.515, 0.980)	0.037	-	-	1.293(1.075, 1.557)	0.006
Eating fries	-	-	1.225 (1.035, 1.450)	0.018	-	-
Eating cake	-	-	1.458 (1.228, 1.732)	0.000	1.393 (1.165, 1.664)	0.000

Note: Reference is Normal weight

4.1.19 Comparison of the Findings of Lifestyle Factors from Different Instruments

Table (4.52) illustrates the comparison of findings of physical activities measured by from different instruments used in the current study. The findings show that few participants (2%) had achieved the desired foot step counts. In addition, walking (21%) five times and more a week gives the double result of five times running per week and the number of minutes spent during the day.

Table (4.52) Percentage of desirable cut-off values for physical activity

Variables	Source of Data	%
Footsteps \geq 10,900 steps/ day	Pedometers	2%
\geq 5 times/ week walking	ATLS questionnaire	21%
\geq 5 times/ week running	ATLS questionnaire	13%
Moderate PA $>$ 60minutes/ day	ATLS questionnaire	12%

Table (4.53) shows the comparison between undesirable cut-off values of physical activities (inactivity) reveal similar proportion from pedometer (step counts) and questionnaire (screen time).

Table (4.53) % of undesirable cut-off values for physical activity and screen time

Variables	Source of Data	%
Footsteps <10,900 steps/ day	Pedometers	98%
PA <60minutes/ day	ATLS questionnaire	88%
Screen time >2 Hour/day	ATLS questionnaire	98%

Table (4.54) gives the comparison between of dietary assessment of fat got a similar proportion (21%) from both tools (diet diary and questionnaire).

Table (4.54) % of Omani Girls Who achieved undesirable cut-off values for dietary habits

Variables	Source of Data	%
Fat Intake (>70 g/day)	Diet Diaries	21%
Fast Food (>3 time/week)	ATLS questionnaire	21%

4.2 Results of Qualitative Study

4.2.1 Participants' Characteristics

Two semi-structured focus group discussions were conducted with 16 participants, 8 participants in each group (n = 4 participants with normal weight and n = 4 overweight/ obese participants). They were aged 16 (n = 3), 17 (n = 8), and 18 (n = 5) years, and students of tenth, eleventh or twelfth grade. The discussion sessions were conducted in the participants' own schools. They revealed their perceptions and views regarding their lifestyles including food habits, physical activities and barriers they faced. Each session took about one hour and was audiotaped.

The findings of the discussion are presented to reveal the responses to each question.

4.2.2 Thematic Analysis

Coding was created after importing the transcribed/ translated data of the two focus groups into 'NVivo programme version 10', by noting the repeated text such as perception about physical exercise, culture, hot weather, environment, unavailability of resources, etc. These codes were developed by selecting and adding text/ quote to the parent nodes or child nodes. Every time a similar quote was read, it was highlighted and added to the existing node or creating a new node if the text/ quote was new. A long coding list was produced (Appendix 12). Similar nodes were grouped together and become code and then refine to become subtheme. For example, 'limited resources for girls to exercise' was categorised as 'exercise as a gendered activity' and became sub themed under the main theme of 'barriers to exercise'.

4.2.3 Thematic Mapping

The following section presents the themes merged from qualitative data. These themes are used as the main headings and the sub-themes as the sub-headings in this section. These themes and sub-themes are discussed sequentially.

1. Perception of physical exercises
 - 1.1. Exercise as a positive activity
 - 1.2. Enablers to be active
2. Barriers to perform exercise
 - 2.1. Environmental factors
 - 2.2. Sociocultural factors
 - 2.3. Exercise as gendered
 - 2.4. Modernisation of Omani Society
 - 2.4.1. Automobile
 - 2.4.2. Technology
 - 2.4.3. Housemaids
 - 2.5. Lack of Motivation/ role models
 - 2.6. Perceived lack of time to perform physical exercise
3. Perception of food habits
 - 3.1. Fast Food is harmful
 - 3.2. Fast Food is popular
 - 3.3. Influences that promote eating fast food
 - 3.3.1. Media
 - 3.3.2. Westernisation
 - 3.4. Availability and resources
 - 3.5. Lack of time is perceived as a constraint to eat breakfast
4. Enablers to enhance the dining experience at school
 - 4.1. Food types and availability
 - 4.2. Physical environment
 - 4.3. Allocating additional time for meals/snacks within the curriculum
 - 4.4. Engaging students in decision making of food choices and implementing change in partnership

To give a clear visual representation of the codes and themes, table (4.54) was used to present the codes derived from the focus group discussion transcripts and from these codes were merged together to form thematic categories. In addition, two versions of mind maps were constructed to illustrate the data in a clear graphical fashion and to show the linkage between different codes and themes with examples (Vaismoradi et al. 2013; Daley 2014). Moreover, a mind map was designed to give a comprehensive picture about the study findings (Daley 2014), see version one of detailed thematic mind map illustrated in appendix (14). To reduce the large amount of the displayed data in mind map, a refined thematic map was developed, and it is presented in Figure (4.11), version (2).

Four major themes emerged from the data, these were; perception of physical exercises, barriers to exercise, perception of food habits and Enablers to enhance the school dining experience at school (Table 4.54) and themes brief description presented in table (4.56).

Table (4.55) From Codes via Sub-Themes to Main Themes

Initial Codes	Quotation from the Raw Text	Sub-themes	Main themes
Perception about Physical exercise	<i>Activate body cells ... Burn calories ... Improve the blood circulation ... Enhance muscle movement ...</i>	Exercise as a positive activity	Perception of physical exercises
Suggestions to maintain physical health	<i>... increasing number of periods per week. Time management and ... Helping in doing housework regularly. Walking is best for girls ... 'Doing House work and ...</i>	Enablers to be active	
Limited resources for girls to exercise. Hot Climate	<i>Unavailability of resources ... Limited sport halls for ladies ... We do not have gym machines very hot</i>	Lack of resources Environmental Factors	Barriers to exercise
Culture Gender stereotypes Time constraints	<i>Community beliefs ... Girls should not cycle this activity is for boys ... for small children ... More school homework ...</i>	Sociocultural factors Exercise as gendered Time constraints	
Lack of Motivation and Encouragement	<i>No motivation ... Self-motivation Motivation from parent, friends, teachers, curriculum, and relatives</i>	Lack of motivation/ Lack of encouragement / Lack of role models	

	<i>Less PE sessions in school ...</i>		
Technology	<i>Not walking using cars ... Electronic devices ... We have a housemaid at home ...</i>	Modernisation: Automobile Screen time/ technology Availability of housemaids	
Perception about fast food	<i>Fast food Leads to increase body weight ...</i>	Fast food is harmful to the body	Perception of food habits
	<i>... Quickly prepared ... Delicious ... Easy accessible ... Fried chips and burger I like, chips and pizza, home baked ...</i>	Fast food is popular Westernisation: Availability of fast food	
Reasons for preferring fast food	<i>... Delicious ... Attraction Advertisement ...</i>	Influence of media	
Reasons for not eating breakfast (BF)	<i>Not hungry early morning ... No time school bus is coming too early at 6am ...</i>	Time is perceived as constraint to eat breakfast	
Suggestions to improve school canteen	<i>Provision of fruits and vegetables and ensure more cleanness of the canteen ... Provision of fruits and vegetables and serve in an attractive way so the students will be motivated to get it. Provision of healthy food ... low fat milk. Provision of variety of healthy food like fruits, vegetables, fresh juice and milk. we need a dining hall ... should practice with us 5 minutes time given to students to eat a snack in the first period like the practice followed in the primary schools. Taking opinion of students through questionnaires and give them according to their needs ...</i>	Food types and availability Physical environment Allocating extra time for meals/snacks within the curriculum Engaging students in decision making of food choices and implementing change in partnership	Enablers to enhance the dining experience at school

Table (4.56) List of the Main Themes and Their Descriptions

Sr.	Main Themes	Descriptions
1.	Perception of physical exercises	Positive perceptions about physical activity and the wish for enablers to enhance these activities.
2.	Barriers to exercise	Factors perceived by the participants as constraints to perform physical exercises: environment, sociocultural factors, time constraints, gender, lack of motivation, modernisation of society.
3.	Perception of food habits	Negative views about fast food and eating habits at home or school, influence of media (commercial advertisements on TV, posters, etc.), time constraints for eating breakfast, 'westernisation.'
4.	Enablers to enhance the dining experience at school	Student suggestions: provide variety of healthy snacks, provision of dining hall, allocating additional time for meals/snacks within the curriculum and engaging students in decision making.

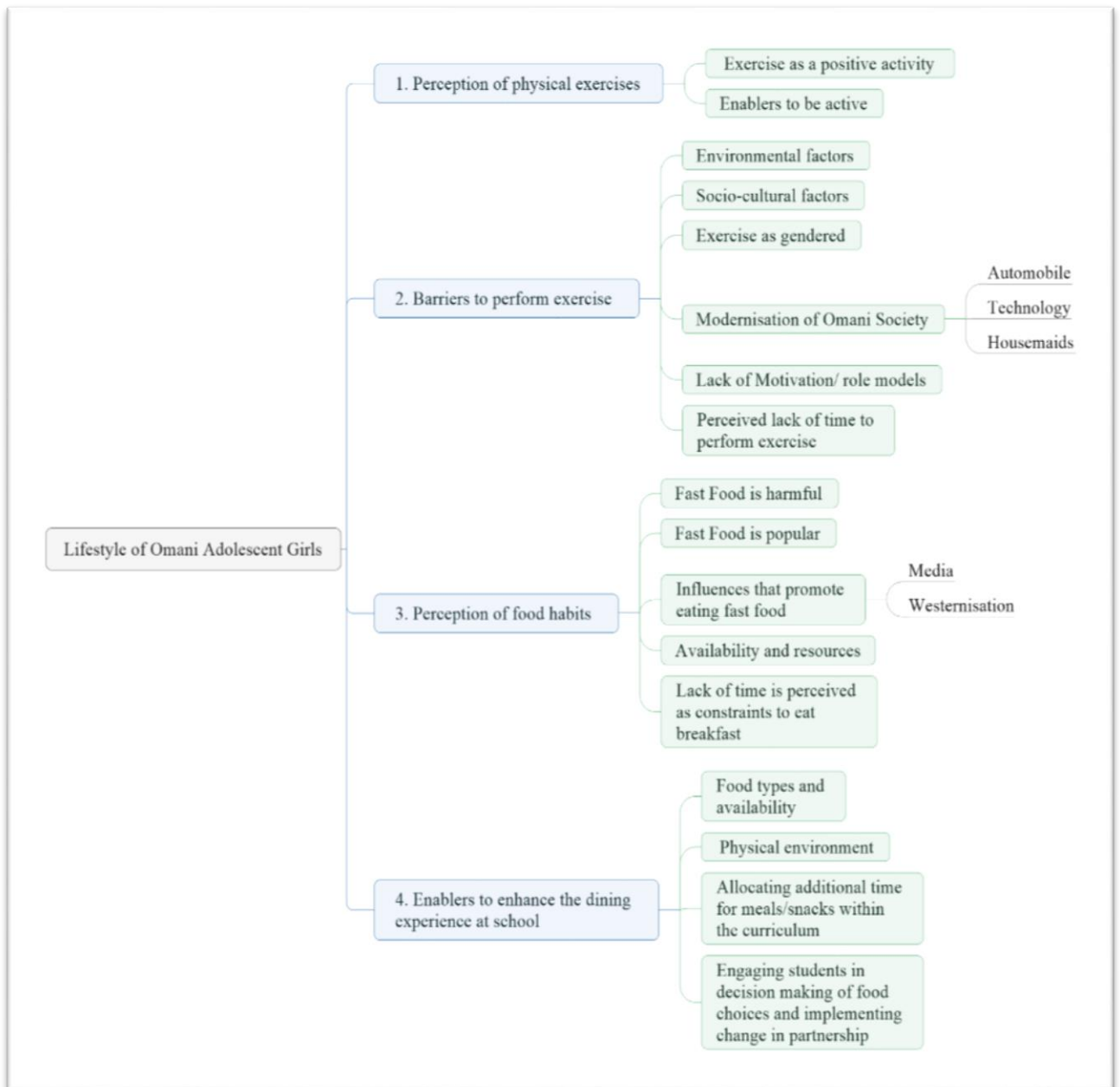


Figure (4.11) Thematic Mind Map with Four Key Themes (version 2)

1. Theme (1) Perception of physical exercises

Omani adolescent girls had a positive perception about physical activities (Physical exercise is good for the body) and they gave some suggestions that might assist them to promote their physical activities.

1.1. Exercise as a positive activity

All participants expressed their positive perceptions regarding physical exercise. They perceived that physical exercise helps in reducing the body weight by burning their intake calories, improves blood circulation, helps muscular movement, and good for the brain and keeps their body strong and healthy.

'Body movement that enhances muscle movement, such as doing physical exercises in and outside the house [with low tone]' (p.6 Normal Weight).

'I can say; doing physical exercise that improves physical health and have a strong body that helps the body to do daily routine work.' (p.8 Normal Weight).

'Improve the blood circulation and good body health, I mean healthy body free from diseases.' (p.4 Overweight).

'Doing body exercises, I mean [a.a.a ...] moving the body and protect it from the health problems like heart disease and diabetes'. (p.2 Obese).

Omani girls provided suggestions to maintain their physical health and to be active. Participants discussed their suggestions to improve physical exercise among adolescent girls in general. They suggested to increase the number of physical education classes in the school and initiate other practices to follow to increase physical activities.

'... increasing number of periods [PE sessions] per week.' (p.9 Normal Weight).

'Time management and ...' (p.12 Normal Weight).

'Helping in doing housework regularly.' (p.12 Normal Weight).

'Walking is the best for the girls.' (p.15 Obese).

1.2. Enablers to be active

Omani adolescent girls gave suggestions to help them to perform their physical exercises effectively. They wanted their own club to practice physical exercises.

'... to have sport club for ladies ...' (p.1 Obese).

Furthermore, participants discussed about having knowledge about their physical activities.

'Increase self-awareness about PE by reading about the importance of PE.' (p.7 Normal Weight).

'Valuing the importance of PE, after school PE classes or during holidays.' (p.14 Overweight).

Participants need to be motivated to perform physical exercises from the people surrounded them such as family members and friends.

'Follow the proper role model (I mean people who are practicing PE and benefiting from PE) and have a plan. For example, to reduce weight, we have to set a goal and work hard to achieve the goal.' (p.8 Normal Weight).

'Self-motivation and ...' (p.5 Normal Weight).

'... motivation from family members and friends ...' (p.1 Obese).

'... and motivation from others.' (p.12 Normal Weight).

2. Theme (2) Barriers to exercise

Omani girls indicated that it was difficult for them to practice physical exercises even though they acknowledged the benefits such better general health and protection from chronic diseases, as had been previously discussed in the theme (1). Adolescents in different BMI groups identified various barriers to perform physical exercises. These barriers were environmental factors, seeing exercise as gendered, sociocultural factors, lack of resources, lack of encouragement from family and friends and lack of role models. These barriers are discussed consecutively below.

2.1. Environmental Factors

Environmental factors were barrier to physical exercise. Young women were not able to perform physical exercises outdoor due to hot weather and lack of resources.

'I cannot do physical activities outside; weather is too hot'. (p.3 Overweight).

'... unavailability of resources, places, hot weather...' (p.6 Normal Weight).

'We do not have a suitable place where we can do some physical activities. At school PE is an elective subject and most of the student did not select PE.' (p.5 Normal Weight).

2.2. Socio-cultural factors

A further factor which effected Omani adolescent girl's physical activity was sociocultural. Omani adolescent girls in different BMI groups indicated that sociocultural factors such as community beliefs, culture, value, use of modern technology and family systems do have some influence on their physical activity.

'No. due to cultural restriction, we are big to ride a bike, small girls can do cycling.' (p.12 Normal Weight).

'When I was a child, I used it, but, now not using it due to community beliefs, we girls should not cycle, shame.' (p.4 Overweight).

'I am riding [bike] at home only.' (p.6 Normal Weight).

2.3 Exercise as Gendered

Girls were having difficulties performing physical exercises due to different issues such as unavailability of a suitable place to practice physical exercises and limited resources. This was linked to their gender.

'... football, cycling, running outside the house ... are for boys mostly.' (p.6 Normal Weight).

'Limited gym halls for ladies, 1 or 2 in my place.' (p.2 Obese).

'Unavailability of resources, suitable place for girls with suitable equipment ...' (p.2 Obese).

'... Gym machine at school, but still not yet activated and the other Gym machine at school, but not working.' (p.7 Normal Weight).

Participants revealed that, physical education lessons are not same for boys and girls of the same grade (p.10 Normal Weight).

'... PE curriculum, however, it discriminates between male and female students, e.g. football session is allocated for boys only.' (p.16 Overweight).

The participants opined that cycling was for small girls and in Omani culture would not accept older girls and women cycling publicly.

'... not allowing the girls to ride a bike.' (p.10 Normal Weight).

'... we are big to ride a bike [smiling]; small girls can do cycling.' (p.12 Normal Weight).

2.4 Modernisation of Omani Society

The focus group participants acknowledged that they lived a modern lifestyle characterised by cars, electronic devices etc. With housemaids doing most of their housework, they engaged in minimal physical activity.

2.4.1 Automobiles

Participants stated that people are using cars instead of walking.

'All the time we are using cars to move from one place to another, even going for short distances.' (p.9 Normal Weight).

'Yes, you are right [...] now we can see in every house more than two cars.' (p.10 Normal Weight).

2.4.2 Technology

All participants agreed that people are spending more time sitting in front of TV, computers, and mobile phones.

'I agreed with all what my friends had said, but they forget the use of electronic devices such as mobile phones or iPad. I have seen people are sitting more than 3-4 hours chatting using WhatsApp, Facebook or Twitter.' (p.15 Obese).

'... you are correct, my friend, people nowadays are using the remote control for everything, for the car, TV, gates, curtains and using elevators instead of stairs.' (p.16 Overweight).

2.4.3 Housemaids

Participants had expressed that housemaids are doing most of the housework so there was limited chance for them to practice their physical activities at home.

'... we have a housemaid.' (p.16 Overweight).

'... most of my time is for my study and we have a Housemaid.' (p.4 Overweight).

'... due to availability of housemaid.' (p.15 Obese).

2.5 Lack of Motivation/ role models

Furthermore, Omani adolescent girls perceived lack of self-motivation. Physical activities were also not being encouraged by their family members, friends, and teachers. The absence of role models to practice physical activities also seemed to be perceived as a barrier.

'... no motivation from others.' (p.5 Normal Weight).

'We need encouragement from friends and relatives.' (p.6 Normal Weight).

'...need motivation from home, my parents are encouraging us to study all the time, but not to exercise.' (p.10 Normal Weight).

'Lack of time and no self-motivation.' (p.10 Normal Weight).

2.6. Perceived lack of time to exercise

Female adolescents perceived lack of time as a barrier for not engaging in physical exercises regularly. Participants perceived that heavy homework was a factor, especially for senior students who were in their final year (12th grade).

'Busy studying, I am in 12th. grade and most of my time is spent studying.' (p.7 Normal Weight).

'yes, teachers are giving us more homework to do. Till midnight, I am doing my homework and studying so I am not getting time to walk outside and have a fresh air.' (p.13 Obese).

'yes, you are correct p2 [pointing to her friend], No proper place and time to practice PA also, much homework from school.' (p.3 Overweight).

'No. No time to do the house work, I need to do my homework [in a loud voice].' (p.2 Obese).

3. Theme (3) Perception of eating habits

Omani adolescent girls perceived that fast food is harmful to the body, however, fast food is popular among many students and they perceived that the media has an influence on consumption of fast food. Food availability at home or in the school is also perceived to influence their eating habits.

3.1. Fast Food is Harmful

Participants perceived that fast food is not good for the body and lead to increase body weight.

'It is a poison that affects the body of an individual and it has a late effect such as obesity as it has more fats [loud voice].' (p.9 Normal Weight).

'We know that it's harmful to us, but we still eat it.' (p.13 Obese).

'Easily prepared and have a lot of fats and many people don't recognize its negative effect on their body and it has high calorie, it one meal might have 1000 kcal.' (p.12 Normal Weight).

3.2. Fast Food is Popular

Female participants' perception regarding fast food as it is liked by most of the people, especially children and young people because it is tasty.

'The best meal for the youth and children, but people ignore its negative effect on the body.' (p.15 Obese).

'A meal that it cannot be avoided because it is widely used, easily prepared and delicious.' (p.16 Overweight).

3.3. Influences that promote eating fast food

Participants perceived that there are different factors that stimulate them to consume fast food such as advertisements, adopting western culture and availability of unhealthy food at school canteen.

3.3.1. Media

Omani adolescent girls revealed that media have a role in motivation adolescents to eat fast food by the attractive way of serving and displaying colourful pictures.

'Tasty and due to commercial advertisement (displaying nice pictures with attractive colours).' (p.11 Normal Weight).

'... serving (attractive way) and sometimes we are full but because of the way how they serve the snack, we eat more and more.' (p.14 Overweight).

'Attractive, advertising it in a beautiful picture.' (p.3 Overweight).

3.3.2. Westernisation

Some participants pointed out that they were following the trend of Western culture in their eating habits by eating fast food and other unhealthy foods at home and at food outlets.

Female adolescents indicated that sometimes they are eating fast food (homemade or takeaway) and bringing them from home

'... 'Max Sandwiches' [double-sandwiches], from shop.' (p.7 Normal Weight).

'... Fried chips and burger.' (p.16 Overweight).

'I like chips and pizza, home baked.' (p.3 Overweight).

'... Now, the problem is not in the canteen, the problem is in the students themselves. Sometime, students are bringing unhealthy food from home e.g. Crisps or chocolate, sweets. Crisps are not sold in the school, but sometimes students bring them from home.' (p. 10 Normal Weight).

3.4. Availability and resources

The availability of different kinds of food at school canteen. Participants stated that most school canteen food was unhealthy.

'Most of them are not healthy and lead to obesity, but we don't have a choice, no fruits or vegetables. Milk available and it is healthy.' (p.1 Obese).

'Juice, cheese pastry, cheese and white bread.' (p.6 Normal Weight).

'... sometime, I am buying croissant, Falafel sandwich, juice, water, biscuits, Break [Brand Name] chocolate bar.' (p.3 Overweight).

'Falafel sandwich, Cheese pastry, biscuits, juice.' (p.11 Normal Weight).

They also commented that cleanliness of the school canteen has to improve.

'More unhealthy food and canteen is not clean, files are there, open place, sometime, if the weather is windy the canteen is full of dust.' (p.6 Normal Weight).

One overweight adolescent mentioned that, her mother was not allowing them to eat fast food.

'I don't eat fast food because my mother doesn't like it and not allowing us to eat it.' (p.4 Overweight).

3.5. Lack of time is perceived as constraints to eat breakfast

Participants had also limited time to eat their morning breakfast, especially during school days because of school starts early in the morning at 7 am and they have to leave their houses between 6 am to 6.15 am and do not have any time to eat their breakfast. They stated also, at

that time they do not have an appetite to eat in the early morning. This was perceived as a barrier to adopt a healthy eating habit.

'No, because no time to eat, I have to reach school before 7 am.' (p.3 Overweight).

'Not eating [breakfast], especially on school days, No time bus is coming very early in the morning.' (p.8 Normal Weight).

'Not hungry, I don't like to eat in the early morning.' (p.16 Overweight).

'... bus is coming very early at 6 am.' (p.9 Normal Weight).

4. Theme (4) Enablers to enhance the dining experience at school

Omani adolescent girls had given suggestions that can assist their school canteen to provide clean and healthy meals to school children.

4.1. Food types and availability

Most participants asked for healthy foods such as fresh milk and milk products, fruits and vegetables in their school canteen.

'Provide fresh milk and milk products with different flavours.' (p.2 Obese).

'Provide fruits and vegetables and serve in an attractive way so the students will want to get it.' (p. 4 Overweight).

'Provide fruit salad that is clean and ...' (p. 8 Normal Weight).

'Provide fruits, vegetables and milk and milk products, provide different types of juice not only Mango and Oranges. Some students prefer to drink another type of juice like kiwi and Apple.' (p. 12 Normal Weight).

'Serve fruits in an attractive way, such as fruit salad and ...' (p. 7 Normal Weight).

The students wanted less salt in the canteen cheese pastries.

'Change the menu of pastries and make it more attractive. The available pastry has very salty cheese (this must be stopped because salt increases blood pressure). This type of pastry should be stopped.' (p.14 Overweight).

They suggested that school canteen should serve homemade quality healthy food rather than restaurant-like food and gave reasons.

'Prepare healthy meals liked by the students like homemade food.' (p.13 Overweight).

'... and traditional dishes like Harees [Ingredient: whole wheat, chicken or lamb, black pepper, clarified butter], different types of beans, fresh juice.' (p.7 Normal Weight).

'Because homemade food is more healthy and clean rather than restaurant prepared. Some restaurants are using the cooking oil more than one time.' (p.13 Overweight).

4.2. Physical environment

Participants wanted a well-equipped dining hall in their school.

'No place where we can sit and eat, now sitting under the trees, but sometimes the weather is not good, 'we need a dining hall.' (p. 4 Overweight).

'We need a suitable place with adequate chairs and tables, where we can sit and eat. Now, sitting under the trees and it is too hot.' (p. 16 Overweight).

4.3. Allocating additional time for meals/snacks within the curriculum

The girls suggested being allowed to have a short time at the beginning of the academic day to eat a snack.

'They [school administration] should give us 5 minutes to eat a snack in the first period like in primary schools. The students can bring their own snacks from home. This could be a piece of cucumber, carrot or a fruit. This will help the students who are not able to take their breakfast at home due to any reason.' (p.15 Overweight).

4.4. Engaging students in decision making of food choices and implementing change in partnership

Omani adolescent girls stated their suggestions to school administration: to take the students' opinion about school canteen and the food that they liked to be served by the canteen via survey. Additionally, allotting time to eat a snack at the starts of the first period.

'Taking opinion of students through questionnaires and give [healthy food] them according to their needs.' (p.9 Normal Weight).

'Taking opinion of students through questionnaire is very important, [for example] what type of food the students like, introduce different type of juices and milk products e.g. yogurt. Now selling only milk.' (p.11 Normal Weight).

Chapter (5) Discussion of the Study Results

5.1 Introduction

Seeking comprehensive answers to the research questions (section 2.12) to assess Omani adolescent girls' lifestyle, this study used the triangulation method within a mixed-methods research paradigm. In accordance with the sequential explanatory mixed methods approach, quantitative and qualitative data were analysed separately and prepared for the comprehensive discussion in this chapter which integrates the two.

In pragmatic research, it takes critical thinking and analytical skills to merge the numbers from the quantitative study with the words from the qualitative study, so that together they provide a satisfactory resolution to the studied problem. It is a dynamic puzzle, where individual parts when fitted together become a comprehensive picture that is more than the sum of its parts. This chapter demonstrates how the quantitative and qualitative findings in the present study complemented each other (Amaratunga et al. 2002) to answer the research questions. Mixing data from qualitative and quantitative approaches allowed taking advantage of the strengths of each method and thus increased the validity of the study findings (Bazeley 2004).

In this chapter the quantitative results (from the ATLS questionnaire, 7-day diet diary, and the pedometer data) are being integrated with the qualitative findings from the focus group discussions. The integrated results are then critically assessed by comparing them with those in literature. This has helped further validate the findings and form a clear understanding of the health-related lifestyle of Omani girls aged 15–18. From this understanding the researcher has generated several recommendations specific to the geo-cultural realities of Oman its neighbouring Arab countries.

This chapter presents the discussion of the study results presented in chapter (4). Listed below are the main headings presented in order, according to the research questions of this study:

- Overweight and Obesity Among Omani Adolescent Girls
- Physical Activity Among Omani Adolescent Girls
- Sedentary Behaviour Among Omani Adolescent Girls
- Dietary Habits Among Omani Adolescent Girls
- The Un-weighed 7-day Diet diary, Reporting of EI and Macronutrients

5.2 Overweight and obesity among Omani adolescent girls

This study aimed to examine the prevalence of obesity and overweight among its participants. The results show high prevalence of obesity and overweight among 421 Omani teenage girls aged 15–18 years, who were students of two all-girls schools in the town of Ibri in Oman. The WHO BMI z-score cut-off point for overweight was taken as >1 SD, and for obesity, >2 SD (WHO 2014b). The mean body weight of the participants was 57.8 kg, and 21% (87) were overweight and 14% (59) were obese. It is useful to compare these data with an earlier study conducted in 2010 on 442 Omani girls aged 15–18 years who were studying in the schools in the highly urbanised Muscat capital region. (Kilani et al. 2013). That study found the average weight of the girls to be 5 kg lower, and with much lower prevalence of overweight (12%) and obesity (9.2%) (Kilani et al. 2013). The Muscat girls were also shorter by 1.7 cm (160 cm versus 158.3 cm in the present cohort). This difference may partly be due to differences in cut-off levels for overweight and obesity. The Muscat study researchers used IOTF cut-off value to measure BMI. The present study adopted, the WHO BMI z-score cut-off point.

Another possibility is that the Kilani study was conducted in Muscat capital region where physical activity in public is common. Muscat is a tourist centre and has extensive public parks, road-sidewalks suitable for jogging, swimming pools, gyms and popular beaches where public swimming is encouraged. The current study was conducted in the far less urbanized Ibri, with its traditional outlook which does not encourage female physical activity. A new study simultaneously conducted among Omani 15–18-year-olds living in Muscat and Ibri (and other regions of Oman) is recommended to further investigate rural-urban divide in BMI.

Another explanation of the differences between the findings of the Muscat study and the present one is the five-year time gap between them. The substantial increase in average body weight and obesity in Omani girls during the five-year period from 2010 to 2015 may be reflecting such a general increase in rural teenage obesity during this period. In addition, global rural obesity, which used to be lower, appears to be rising faster than urban obesity—particularly in affluent regions of the world. Johnson and Johnson (2015) reviewed five large American studies which together had 74,168 participants aged 2–19 years and reported that rural American children and teenagers were 26% likely to be obese than their urban counterparts. Perhaps in high income countries such as Oman and the US, physical work is mechanised even in rural areas and the traditional physical activity organiser in rural areas, the large walkable distances, has been nullified by car ownership.

A study conducted by Al-Nuaim et al. (2012) in the mixed (urban, agricultural-rural and desert-rural) region of Al-Ahsa in Saudi Arabia on 15–19-year-olds (607 girls, N= 1,270) found that both girls and boys residing in desert-rural areas were less physically active and prone to obesity than their peers in A-Ahsa's urban and agricultural-rural regions. Both Al-Ahsa's desert-rural environment and the Ibri region are similarly dry, and largely rural. Thus, everything else being equal, a rural desert climate might encourage an inactive indoor lifestyle contributing to higher BMI.

The trend for rural obesity increase is less apparent in regions with low per capita income such as South Asia because of the lack of mechanisation in rural areas, which require rural South Asian women to be more physically active than their urban peers, though the gap is narrowing as the region's rural economy improves (Tripathy et al. 2016).

Omani girls in the current study had lower mean weight (57.8kg) than a group of 14–19-year-old Kuwaiti girls (62.2 kg) (Allafi et al. 2014) and matched the mean weight of Saudi girls aged 14–19 years (Al-Hazzaa et al. 2012). Despite the Omani girls' lower weight, they were, at 160 cm, 2–4 cm taller than the 14–19-year-old girls from Kuwait, Iraq, and Saudi Arabia (Al-Hazzaa et al. 2012; Allafi et al. 2014; Musaiger et al. 2014a). The reason for the Omani girls being taller despite weighing less than their Arab peers not clear. As mentioned earlier, the time-gap between various studies also should be kept in mind while comparing them, as Arab adolescent obesity is a recent and very dynamic phenomenon.

The above discussion shows that the prevalence of obesity and overweight among female adolescents is a global phenomenon and is a rising health threat in the GCC region including Oman. This calls for pro-active measures to facilitate behavioural changes in parents and adolescents by educating them, preventing miseducation by popular media, and making physical activity more socially and culturally desirable, and inactivity undesirable.

5.2.1 Obesity trend continues from adolescence into young adulthood

The trend of rising BMI in Omani girls is likely to continue as they grow into young women and mothers, as per the study by Al-Habsi and Kilani (2015) that showed that young women of Oman above the age 18 have high prevalence of obesity and overweight at 23.1% and 29.7%, respectively—even higher than among the teenagers in the present study. This suggests the trend towards increasing BMI may eventually place Omani young women and new mothers at high risk of developing related health complications (WHO 2014a).

An interesting finding was observed among the 18-year-old participants in the present study. The prevalence of obesity, was seen to be gradually rising among participants aged 15 to 17, yet this sharply reversed among 18-year-olds who were less than half as likely to be obese (14% versus 32%) and overweight (11% versus 33%) and more likely to be underweight (25% versus 18%) than among 17-year-olds. The reason for this is not known. Various hypotheses can be raised for this. For example, academic stress may have impacted the appetite among the senior most students who were facing their final (Year 12th.) board examinations in a few months. This was indeed reported by the 18-year-old focus group members. Another possibility is that data were skewed due to the fact that only 66 18-year-olds were participating compared to 125 17-year-olds. Future studies on the BMI variations among Omani teenagers may note the break in pattern as suggested in the current study and watch out for any similar findings in their data.

It needs to be stressed here that maternal obesity may have greater long-term repercussions on Omani society than paternal obesity. Young children, particularly girls, tend to model on their mothers, thus perpetuating generational cycles of inactivity, unhealthy eating, and related lifestyle diseases. Evidence for this comes from a recently concluded long-term study (Gray et al. 2018) which shows that the family lifestyle—particularly the mother's—contributes to as much as 11.3% of childhood obesity by the age of seven. According to psychologists, when children receive conflicting messages from their parents (for example, an obese and sedentary mother asking her young daughter to exercise and eat healthy foods) the child may ignore her words and imitate her physical behaviour (Maccoby 2000). Thus, the present study's correlation between Omani girls' BMI gains that is seen to continue into their twenties predict lifestyle risks for the next generation Omanis.

The present findings among Omani teenage girls differ from those of an earlier UAE study among 12–17-year-old girls in relation to prevalence in overweight (21% in Oman, vs 13.1% in UAE) and obesity (14% vs 20.5%) (Bin Zaal et al. 2009). In a variation, Iraqi female teenagers (15–18 years) had similar overweight percentages as the present participants (21%), but much lower obesity of 5% (Musaiger et al. 2014a). Furthermore, among Jordanian girls (14–18 years) both overweight (13%) and obesity (4%) were less than among the girls in the current study (Tayyem et al. 2014). A study conducted in Al Ahsa, Saudi Arabia by Al Nuaim et al. (2012) found that the proportion of overweight Saudi female adolescents (15–19 years) was lower (19%) than in the current study while that of obesity was higher (18%). Considering further regional comparisons, Kuwaiti girls (14–19 years) had higher incidence of overweight

and obesity (Allafi et al. 2014). This trend towards higher BMI among Kuwaiti was also reported by a large pan-Arab-region study conducted by Musaiger et al. (2013) who found that Kuwaiti adolescents (male and female) aged 15–18 years presented with the highest percentage of obesity (59%) and overweight (23%) among five Arab countries. Kuwaiti's tendency for female obesity continues among its adult women as well. The very high prevalence of obesity among Kuwaiti women (43.5%) in 2014, caused that country to be ranked 10th among 188 countries for adult female obesity (World Bank 2017). Thus, Kuwaiti girls tend to be heavier, and Omani girls tend to be taller than the rest of the GCC region, further studies could be conducted to identify the reason behind this difference.

As pointed out earlier, the time gap between the above studies must be given cognisance when drawing comparisons between them. For instance, it could be argued that the UAE study by Bin Zaal et al. (2009) reflected the then prevailing pan-GCC lifestyle patterns which were different than those prevailing in 2015, the year of the present study's data collection. An effective way to eliminate such time-gap problem would be to conduct a concurrent mega study that covers the entire world. World Health Organisation needs to be encouraged to undertake this exercise and repeat it periodically, say every five years. Such a database will then serve as a reliable benchmark for future lifestyle studies and regional and ethnicity comparisons.

Compared to the Omani girls in the present study, Scottish girls appear to have higher prevalence of overweight and obesity. The prevalence of combined overweight and obesity is 38% among Scottish girls and young women (16–24 years) (The Scottish Government 2017). American female adolescents' obesity (21%) is also higher than among the Omani girls in the present study (Hales et al. 2017). Ogden et al. (2002) suggested that larger food portion sizes may contribute to overweight American adolescents. Their body weight was also significantly related to their high consumption of fast food (Poti et al. 2014).

However, being marginally less obese than the Western teenagers is no reason for Omani girls to relax because the obesity in Oman (and its GCC peers) is rising much faster than in the western world. One reported cause of increasing obesity levels in the Arab countries is their increasing affluence and consequent changes in nutrition and activity patterns (Musaiger 2004). However, the real reason appears to be complex and specific to the region.

5.3 Physical activity among Omani Adolescent Girls

In the current study, each participant's physical activity was assessed by both self-reported and objective measurements. Many studies have revealed that the main contributors to obesity and overweight prevalence was physical inactivity in addition to poor eating habits (Hassan and Al-Karusay 2000; Prentice-Dunn and Prentice-Dunn 2012; Wright and Aronne 2012; Kilani et al. 2013; Awadalla et al. 2014; WHO 2018a). This trend is also observed in the results of the current study. Based on the findings, to successfully maintain healthy body weight, one's daily lifestyle should include increased physical activity and decreased sedentary behaviour (Stamatakis et al. 2009), in addition to consumption of a healthy portion-controlled diet. An encouraging trend was that 34% of current participants stated maintaining healthy body weight as the main reason for their engaging in physical activities, a proportion similar to those who were obese and overweight (35%).

5.3.1 Pedometer

The participants' physical activity levels were measured objectively using pedometers (model SW-701 was used for all participants) for 7 consecutive days and the data were presented as the mean of the number of footsteps per day. Most participants (98%) took average 5,755 steps per day against the recommended 10,000–11,700 steps for 10–18-year-olds (Tudor-Locke et al. 2011). Within that, the daily footstep counts of most obese participants were <5,000, while the normal weight participants achieved $\geq 5,000$. As there was no guideline related to the optimum daily footsteps for Omanis, the recommended value by Tudor-Locke et al. (2011) for girls between 10–18 years of age was used. Gordia et al. (2017) indicated that a universal footstep count reference may not be applicable for adolescents in all countries or regions, therefore guidelines for adolescents recommended footstep counts may be needed to be tailor made for individual countries and climates.

In the current study, the pedometer data indicated that normal weight participants clocked the highest mean footstep counts of 6,625 per day, which fell to 6,094 in the overweight girls, falling further to 5,755 for their obese peers. Such inverse relationship between footstep counts and BMI is reported by several international studies in various age groups. A large Saudi Arabian study on 2,908 participants aged 14–19-years (1,507 girls) studying in city schools revealed an average 6,866 step counts/ day (Al-Hazza et al. 2011a) against the current mean of 5,755 steps. Saudi adolescents clocked 16% more steps than their Omani peers. The better performance by Saudi teens may be attributed to their living in large, cosmopolitan cities (Al-

Khobar, Jeddah, and Riyadh). In addition, the Saudi study population comprised private and government school students (expensive and cosmopolitan) while the present participants were government-school students in the semi-rural Omani town of Ibri. Thus, the differences between facilities and attitudes might account for the 16% higher pedometer step counts by Saudi girls.

The performance gap between Omani and Western girls is even wider. A large Canadian study that used accelerometers found girls aged 15–19 manage 9,204 steps/ day (Colley et al. 2011). A large one-third performance gap stands out between the Canadian and Omani girls, although even the Canadian girls fell short of the recommended number of daily steps of 10,000–11,700 (Tudor-Locke et al. 2011). It must also be recalled that the current study was conducted during Spring when the outside day temperature was in the low 30 Celsius range. The reasons for the relatively fewer steps taken by Omani teenagers of all BMI levels, need to be investigated. This difference may be due to the Canadian study using different physical activity measurement tools (accelerometers) and this made it difficult to compare it with the current study.

5.4 Geo-cultural Influences

In the Arab world, geo-cultural factors — desert climate, traditional culture—interact with rising income levels and its inevitable technological and gastronomic consequences to create a region-specific situation. These region-specific factors need to be identified and studied before solutions can be found to the rising obesity in the Arab world. This means that interventions developed for the Western world need not work in the Arab world including Oman. The forthcoming part of the discussion, *inter-alia*, attempts to understand the interaction between the geo-cultural traditions and the recent affluence and its impact on the adolescence lifestyle.

5.4.1 Gender Differences in Physical Activity: Biology and Culture

According to the perception of focus group adolescent girls in the current study, female physical activity is not encouraged in Omani tradition. Active public sports such as football and cycling are restricted to boys. Only 0.5% of the girls in the current study practised cycling ≥ 5 times per week. In comparison, as early as 2006, 9% of Welsh high school girls were cycling (Sport Council for Wales 2009). Here it is essential to point out that the very notion of equality of opportunity in sports between genders is a quite modern phenomenon. Equal rights in sports was incorporated as a universal human right in the United Nations charter only by 1978 (United

Nations 2007). However, such equality of opportunity is underutilised by girls and women even in the Western world. For example, according to the Sport Council for Wales (2009), boys are more likely to be members of sports clubs than girls and the gender gap rises with age. The male: female membership ratio in sports clubs in year 7 was 65%: 50% and by year 11 it was 55%: 35%.

Multiple studies have endorsed that adolescent girls tend to be less physically active compared to their male peers. Canadian boys aged 15–19 registered 22% more mean footstep counts than girls (11,267 versus 9,204 steps/ day) (Colley et al. 2011). A study in Palestine by Jildeh et al. (2010) found that adolescent boys (11–16 years) participated more often in physical activities over a period of 5 days, 29%, higher activity level in comparison to the girls who scored 16% on the level of participation in the physical activities, over the same period. Significant difference in activities between teenaged boys and girls have been observed in studies worldwide and can be considered as biologically determined, beyond cultural and geographical divides. Unfortunately, this natural gender difference is exaggerated and canonised in traditional male dominated societies such as in the Middle East and South Asia.

The findings of this study on physical activity from ATLS questionnaire were compared to the recommended physical activity guideline of UK National Institute for Health and Care Excellence (NICE 2015) which recommended daily minimum of 60 minutes of moderate physical activity for young people and classified those who were active ≥ 60 minutes per day as *physically active* and those active ≤ 60 minutes per day as *physically inactive* (Youssef et al. 2013). These standards are also accepted by the Canadian Society for Exercise Physiology (CSEP) (2018) who recommend daily 60 minutes of physical activity for children and adolescents to gain physical, intellectual, social, and emotional benefits.

In the current study, Omani teenage girls were asked about the time they spent on moderately intense physical activities, using a self-administered ATLS questionnaire. The participants reported as spending average 27.8 minutes/day on moderate intensity sports. This showed that most participants were not able to achieve the recommended guideline of 60 minutes of moderate physical activity per day. Thus, 88% of the Omani participants were categorised physically inactive. The findings also showed that there was no statistically significant difference between the proportions of participants in different BMI groups and the recommended time spent engaged in moderate physical activities. According to the qualitative findings of the current study the barriers to exercise included: limited resources to exercise, hot

weather, time constraints due to excessive school homework. The Omani girls in this study also perceived that lack of encouragement from parents, teachers, friends and relatives formed an important barrier against physical activity. The present study's focus group data supports the evidence from the above Omani study and strongly recommends early introduction of culturally acceptable physical activity interventions for Omani female adolescents. A previous Omani study on physical activities conducted by Youssef et al. (2013) had shown 90.2% of Omani adolescent girls to be physically inactive. The findings of the current and previous Omani studies indicate that Omani girls are significantly less physically active than their peers in Saudi Arabia (Al-Ahsa) (81.5% physical inactivity), Iraq (69% inactivity) and Kuwait (76% inactivity) These studies had studied similar age groups under similar weather conditions, and had similar sample sizes (Al Nuaim et al. 2012; Allafi et al. 2014; Musaiger et al. 2014a). One reason for the relatively high inactivity among Omani girls could be that Omani community is more conservative regarding girls exercising outside in a mixed gender environment.

5.4.2 Perceived Barriers to Physical Activity

Traditional cultures tend to accentuate biological differences between males and females thus making it even more of a challenge for females to be physically active. Such gender gap is expected to be even wider in South Asian and Middle Eastern cultures which tend to be tradition-bound and patriarchal. Previous Omani studies have pointed out that the prevalence of physical inactivity was significantly higher among female than male teenagers (Al Barwani et al. 2001; Kilani 2013). The reason for this could be that Omani teenage girls perceive significant sociocultural barriers against their engaging in physical activities (Youssef et al. 2013),

... Internal barriers were listed according to priority; recreational activities (watching TV and using the computer) and were seen as more entertaining than exercising, having limited energy to exercise and thinking that exercise was difficult and too tiring ... students agreed that parents give priority to academic success, they lacked the leisure time due to academic responsibilities and lacked exercise equipment. (Youssef et al. 2013, p.763).

Conclusions from these earlier studies are supported by the qualitative findings of the present study, participants perceived the major barriers against physical activity to be; hot climate, lack of resources and lack of time to exercise. The Omani climate can indeed be a barrier against outdoor activities for most of the year. In fact, the present study data was collected in the spring

season where the outside daytime temperature was pleasant, 30–33 Celsius. Had the data been collected in summer where the daytime outside temperature varies between 40 and 50 Celsius, the activity levels might have been lower. It is possible that the habit of physical inactivity during the eight-month-long summer could be reaching into to the pleasant winter months from November to February as well. Climatic hindrance can thus be considered to be an important region-specific barrier to physical activity in the GCC countries including Oman. A systematic review of literature on the physical activity of Arab adults in the Arab region also suggested that hot weather in the region weather was perceived as a barrier (Benjamin and Donnelly 2013). Furthermore, weather as a barrier to perform physical activity was reported by Australian adult participants, presented by Salmon et al. (2003) in a cross-sectional study with 1,332 subjects.

Lack of time was reported as barrier to physical activity by participants in the current study. Literature reveal this is a common reason given by adults as well. Time shortage was perceived as a barrier by Arab adults in GCC regional studies reviewed by Benjamin and Donnelly (2013), as well as in the Australian study by Salmon et al. (2003). Hoare et al. (2017) founded that 50% of inactive adults in a study comprising 894 participants had reported lack of time as a barrier to performing physical activity. The study, despite its large number of participants, adopted self-administered method for data collection. A mixed methods approach was likely to have yielded practical results such as participant feedback for overcoming such perceived barriers. Women in different countries also saw lack of time as barrier: for example, Arab women (56%) (Qahoush et al. 2010), Saudi Arabia (45%) (Amin et al 2011), Turkey (44%) (Cocak et al. 2005), Kuwait (39%) (Serour et al. 2007). The perception of lack of time as a barrier to physical activities thus appears to be a universal phenomenon among all age groups and both genders. An exception to these universal trends were Welsh girls whose main barrier was shortage of companions while going to sport clubs (Sport Council for Wales 2009).

5.4.3 Domestic workers and housemaids

In Arab culture the household is the female domain and has traditionally provided plenty of task based physical exercise for girls and women. However, this assured source of exercise has been taken away by the new phenomenon of live-in expatriate housemaids and other domestic workers—a feature of modern middle-class Omani homes. During our focus group discussion, the girls of Ibri explained how housemaids performed most of their domestic work. In Oman, between 1993 and 2010 there was a 155% increase in the number of expatriate housemaids

(NCSI 2013) who are willing to work for comparatively low wages. Between 2010 and 2012 population of expatriate housemaids in Oman rose by another 25%. In the West, importing cheap expatriate household help is nearly impossible due to strict immigration controls and high minimum wage regulations. Thus, ready availability of cheap expatriate household labour has become another region-specific cause of lack of exercise and growth in obesity among the GCC women. Several qualitative studies from other Middle Eastern countries such as UAE, Qatar and Israel support the perception that women in these countries perceive employment of housemaids as barrier to physical activities (Shuval et al. 2008; Ali et al. 2010; Donnelly et al. 2012).

5.4.4 Cheaper cars and petrol

The third region-specific risk factor for obesity might be the cheapness of transportation. Most of Omani families own cars. Petrol is 65% cheaper in Oman than in UK (as on May 2018) (Trading Economics 2018). Negligible import duties and taxes keep prices of cars and spare parts low. Not surprisingly, the girls in our focus group discussion pointed out that nowadays Omanis prefer travelling even walkable distances by cars. Similar tendency was reported among Omani adolescents living in the Capital city, Muscat (Kilani et al. 2013). According to the Ministry of National Economy (MONE) household survey, car ownership among Omanis in 1999 was 69% (MONE 2001), and by 2011 it had jumped to 90% (NCSI 2012) and now in 2019 is even higher. In most other parts of the world private vehicle ownership and maintenance costs are much higher which may, at least theoretically, encourages walking short distances. To encourage moderate walking this aspect needs to be considered by policymakers in Oman and its GCC peers, whether a small ‘inactivity tax’ could be levied on petrol, imported private cars, and spare parts, with the proceeds going into creating public infrastructure that promote physical activity.

5.4.5 Lack of female-only sports facilities

Joining organized youth sports during childhood and continuing through adolescence is likely to ensure continued physical activity into early adulthood as well. This was shown by Kjønnsen et al. (2009) based on a ten-year longitudinal study of 630 Scandinavian adolescents.

Omani girls have limited opportunities for such continuous facilities for organized physical activity in their formative ages. This was one of the barriers that featured in our focus group discussions with Ibri schoolgirls. They pointed out the lack of female-only sports facilities were

hindering them from physical activities that could be engaged away from male attention. Among our focus participants only 1% girls were using sports or fitness clubs, with the majority exercising at home. Pointing out the paucity of culture-appropriate facilities suitable for the socially and culturally sensitive Omani females, the girls revealed they had limited opportunity to engage in physical activities. Omani adolescent girls participating in this study's focus group discussion expressed their wish for having 'female-only' sports and fitness clubs. In contrast, online surveys of 910 Dutch adults (≥ 18 years) show a high 51% female participation in sport club settings (Deelen et al. 2018). Apart from cultural differences between Netherlands and Oman, mixed-gender sports clubs also enable maximum utilisation of the facilities and makes better business sense.

Oman has 44 sports clubs, where the vast majority of users are male (Purohit 2016). Despite the country's high per capita income levels, it lacks female-friendly physical activity facilities. This is the situation in most of the Arab world. In Syria in 2007 there were a total of 380 Sports Clubs with 225,904 registered members, only 9.6% of whom were female (Pfister 2010).

Another important factor identified by the participants in this study was a sociocultural barrier that prevented Omani teenaged girls from participating in sports and other physical activities. In Oman, as in many other Arab countries, females are under more sociocultural constraints pertaining to their sport related physical activities and exercises than males. While men enjoy the freedom and can use venues to engage in their physical activities and exercise, woman are restricted by access and sociocultural values governing the society (Musaiger et al. 2014c). These restrictions are often erroneously attributed to the religion of Islam. Islam encourages physical activities irrespective of gender (Benn et al. 2010). It is likely that various Middle Eastern cultural taboos are being misinterpreted as being Islamic. The importance Islam gives to physical activity is evident even in the daily five-times prayer (*salah*) mandatory for all male and female believers. The physical component of the prayer consists of several distinct physical actions that promote flexibility and strengthening the body. However, these realities are too often ignored by traditional male-controlled societies in the Middle East which cause many Muslim women to abandon physical exercises. However, cultural norms are sensitive matters. Thus, any efforts to promote female physical activity culture in the Arab Islamic world must cognisant of the sociocultural restrictions. Young females cannot play in a mixed gender environment and they are required to wear sport outfit that covers the entire body, including head (Benn et al. 2010).

If gender specific sports clubs in Oman are to be built and run, generous public funding may be necessary, which could be partly generated from imposing ‘inactivity taxes’ suggested earlier. In smaller towns such as Ibri, these public-funded facilities might be expanded versions of school/college infrastructure, dedicated to students during working hours and thrown open to the entire local female population after working hours and on holidays.

5.4.6 Gender gaps in PE curricula and lack of encouragement from elders

Omani girls participating in our group discussion revealed that school physical education (PE) curricula were different for girls and boys of the same age and grade. For example, football and gymnastic sessions are excluded from the PE curricula for grades 10–12 girls and replaced with Rhythmic and Technicality Exercises (MOE 2012a; MOE 2012b). The allocation of selective physical education sessions (Both boys and girls) is four classes per week, a total of 180 minutes for grade, 11 and 12, respectively. In grade 10 (for both genders) physical education is reduced to one 45-minute class per week, despite remaining a compulsory subject. The school hours allotted for physical education and sport are much less than the hour recommended by NICE (UK) guidelines for teenagers. Al-Shamli (2010b) suggested that higher authorities in MOE, Oman, should increase grade 10 physical education classes to two or more sessions per week. However, it is not clear why even in this recommendation, PE sessions Grade 10th, currently at one session, are being requested to be raised to only two sessions, while four hours per week already are allotted to Grade 11th. and 12th. which have heavier academic loads. Even four sessions a week (180 minutes in all) will fall short of the recommended one hour a day of moderate to vigorous physical activity for adolescents. Thus, the number of PE sessions per week should comprise minimum five sessions of 45 minutes each and should not be curtailed for any grade. Considering the shortage of dedicated fitness centres, these school PE sessions have to take over the responsibility to spark and keep alive the culture of physical exercise among Omani girls so that it sustains into adulthood as shown by Kjønnsniksen et al. (2009).

Several cultural, motivational, and climatic factors seem to cause the differences in sports facilities between girls and boys. For example, bringing rigorous field games such as football into Omani girls’ curriculum might be resisted by conservatives. The girls themselves may be reluctant to bear the sweaty and dusty exertion wearing restrictive clothing in the hot and dusty outdoors. Many girls’ schools also may not have the funds for very large covered and air-conditioned gymnasia/ sport hall.

During the focus group discussions, the Omani girls revealed that they did not receive encouragement for exercising from their parents, friends and even some teachers. This shows the importance of community support for the successful implementation of even minor social improvements in the Arab culture. The lack of female role models also appeared to be a barrier in engaging in physical exercises. These perceptions were also supported by the quantitative findings of this study.

To build strong support for increasing physical activity, there should be a close relationship between adolescents and their families. Families should ideally exercise together, adults along with children. Kubayi et al. (2014) reported that rural South African parents hardly spent time with their children, as a reason rural youth in the study did not get support for physical activities from home. However, Omani rural families tend to be so close-knit that the reason parents do not encourage girls' physical activities might be due to reasons opposite to that of South African parents—heightened attachment and concern for their daughters' welfare. Like the rest of the Arab-Islamic world, rural Omani families tend to be close-knit, which then widens to include the entire community as well.

Evidence revealed that parental support is important in improving the frequency and involvement in physical activity of their children. A more recent cross-sectional study conducted in England by Willkie et al. (2018) enrolled 425 children aged 9–11 years to participate in the study. An accelerometer was worn for seven days, including weekends. The study findings showed a positive correlation between parental support and the frequency in physical activity of the children.

In this study, it was noticed that Omani girls rarely engaged in physical exercises in the presence of their parents. They preferred to exercise alone and occasionally with friends. One of the unanticipated revelations by focus group participants of this study was that some parents would not allow their daughters to ride bicycles. There was a belief that such activities could tear a girl's hymen (Kalyani 2016). However, research shows that more concern should be towards boys and men, in whom badly shaped or incorrectly angled bicycle saddles could put pressure on the prostate gland and penile root with the risk of injury to urogenital system (Sommer et al. 2001; Munarriz et al. 2005). Risk to females appears to be limited to lessening of sensation in the genital area for women cyclists compared to women runners, $p = < 0.05$. A suboptimal saddle might compress the nerves and blood circulation of the genital area (Guess et al. 2006; Guess et al 2011). However, such concerns seem to have been largely addressed

by modern saddle manufacturers who have brought out women's saddles custom designed to suit individual thigh gaps. Meanwhile research also suggests that female cyclists should keep their handlebars high so as not to damage their pelvic floor, while males should keep them low (Partin et al. 2012). As the risk of the above types of injuries from cycling appear to have been largely resolved due to better designed bicycles, women need to be encouraged to pursue this enjoyable, energy consuming and environmentally friendly mode of exercise and transport. This calls for general community re-education and demonstration of the modern female friendly facilities among Omani women and girls. Stationary bikes can be an affordable and culture-appropriate option for families who insist on female privacy, albeit not as enjoyable as outdoor cycling.

Clearly, there are formidable geo-cultural barriers—enforced by Oman's geography, climate and culture—against physical activity among Omani girls and women. Consequently Oman (and its GCC peers) have been ranked way down in the Global Gender Gap Report (World Economic Forum 2015). Oman, with only 60% gender equality, was placed 135th among 145 countries. Among the GCC countries Kuwait scored 117/144 with 65% gender equality, UAE at 119 (65%), Qatar at 122 (65%), Bahrain at 123 (64%), Saudi Arabia at 134 (61%) (World Economic Forum 2015). The Global Gender Gap Index-2015 looks at the gap between males and females in four essential categories: “economic participation and opportunity, educational attainment, health and survival, and political empowerment” (World Economic Forum 2015, p.2).

It appears that the gender gap barrier to female physical activities is not merely an Arab-Islamic phenomenon. It seems endemic in the Eastern civilizations in general. India is a major example of how sociocultural rigidity prevents the country's female-empowering legislations and executive decisions from being implemented in practice resulting in non-improvement of gender gap (Ravi and Jayaraman 2017). In 2016 India ranked lower than most GCC countries (130 among 146 countries) in the UNDP Gender Inequality Index (Ravi and Jayaraman 2017).

To return to the question of enhancing Omani female adolescent physical activity, the opinion of the researcher of this study is that the barriers — particularly the cultural barriers — are too strong to be challenged. Changes to improve the physical activity levels among Omani girls must be incremental, always staying within the cultural limits. A practical suggestion that is immediately implementable is given below:

5.4.6.1 Classroom-based physical activity

All schoolrooms in Oman are air-conditioned, and class strength ranges between 30–35 students. It is suggested that classrooms are used for daily physical activity with no additional expense or disruption. Daily 20-minute-long physical education session—spot running, sit-ups, balancing, stretching, bending, back and abdominal muscles strengthening, and isometric strength-training (using gravity as resistance), could be incorporated into the curricula of all-girls schools. Space for movement can be gained by simply pushing chairs under the desks, or where practical, moving the desks and chairs to sides of the schoolroom. The act of putting the furniture back in place after the exercises can all be done by the girls themselves. No additional equipment will be necessary. Before starting the program, two relatively athletic girls from each class should be trained separately by the school PE instructor. One of these girls will be leading each classroom session. After a few weeks, the task may be allotted by rotation to other willing girls in the class.

Classroom-based physical activity will be new for Oman. However, this is a tested and proven concept in the United States where the project Physical Activity Across the Curriculum (PAAC) promotes moderate classroom PE sessions for primary school children. The effectiveness of PAAC has been verified by Donnelly and Lambourne (2011) by their 3-year cluster randomized, controlled trial of 24 American elementary schools, which demonstrated that as number of minutes of PAAC per week increases, the children's BMI tends to decrease. However, any study on the benefits of this method on older girls and teenagers could not be found in literature. If it is introduced in Omani schools, it may even be a first in the world among teenage girls. Therefore, pilot studies are suggested among older girls in the middle and high school levels in Oman, before their wider implementation.

The aim should be to ensure that Omani girls do receive most of the daily minimum physical activity within the school itself. This may require supplementing classroom based physical activity by increasing the frequency of the present weekly 45-minute dedicated PE sessions bi-weekly and conducted in air-conditioned school gymnasiums except in the winter months. Games such as basketball, volleyball, badminton, and squash, which take up less space despite being activity-intensive, should be prioritized. Even here, group games like basketball and volleyball, which accommodate more participants, might be given priority over badminton and squash. During the cool winter months sporting activities might be performed outdoors in the fresh air.

Regarding motivating Omani teenagers to exercise, smartphone technology might have a role. Toscos et al. (2008) revealed a common fact shared by 8 female adolescents (US). They all agreed that the use of the mobile phone to record their daily footstep counts results from the pedometers and share these results with the friends in the study group. This helped in the increase of the physical activity among their family members. Those who did not like to exercise began to enjoy it after using the footstep counts application on their smartphones. Participants had also begun to state that they would be taking more steps during the day even during breaks to increase their footstep scores (Toscos et al. 2008). Ten years since the above study, smartphone technology has evolved. Free customizable apps such as “Google Fit” give performance scores, track route taken, issue reminders and words of encouragement that motivate adolescents to be more physically active. The human tendency that seeks to collect, accumulate and earn could be exploited appropriately by setting targets and tallying scores that may help motivation to continue physical activity. However, most Omani parents, with good reasons, do not let their teenagers own smart phones. Therefore, the benefits of this technology may remain limited to a few.

An interesting revelation made by the focus group participants of this study was that maintaining healthy body weight was their main reason for engaging in physical activities. Among the participants 34% sought to lose weight (as indicated by their ALTS responses) and this proportion was similar to the proportion among those who were obese and overweight. This finding suggests that those participants were aware of their weight being above normal levels.

A large mixed method study in Nizwa city, Oman, used physical examinations and blood tests in addition to quantitative (questionnaire) and qualitative (focus group discussion and individual interview) methods of data collection (Al-Siyabi et al. 2010). A total of 1,976 participants of both genders aged twenty and above enrolled in that study, which sought to analyse the social, economic, behavioural and political determinants of NCDs to reduce their causative factors, as well as to deliver better healthcare to NCD sufferers (Al-Siyabi et al. 2010, p.6). Qualitative findings revealed that introduction of pedestrian walkways in the city had increased the residents’ physical activity levels. The participants wanted more infrastructure that promoted physical activity, including swimming pools and more walkways that extended to nearby villages. Because of the scale, findings from such large study can be generalized to other Omani cities such as Ibri where the current study was conducted. Ibri is a neighbouring

city to Nizwa and having similar culture. This could contribute to motivating people to perform physical exercises to improve their general health.

Furthermore, a recent systematic review from Australia conducted by MacMillan et al. (2018) produced evidence based on longitudinal studies which indicate that developing the neighbourhood environment to include walking trails, parks, cycling paths and strategically locating public service facilities such as supermarkets, railway stations etc. to promote physical activity, seems to marginally improve the residents' physical activity and diet choices. The authors pointed that studies on the impact of urban developments on activity and health are very scarce, and even those that exist are not confirmatory, and their concluded that;

... it may be that the impact of changing built environment on health outcomes and physical activity and diet is small, however, if the change affects large population numbers, even small changes in behaviour will have the potential to reduce disease risk and prevalence at a population level (Rose 2001, cited in MacMillan et al. 2018, p. 25).

This requirement needs to be kept in mind while reviewing the urban facilities in Oman, such as the new initiative in Nizwa. Systematic long-term studies on the activity and health impact of various urban and suburban developments will reveal the relative benefits of different types of planned layouts. With clear inputs, town planners could incorporate innovations that generate physical activity without causing inconvenience.

Scottish Outperformance: to put the current study results into an international perspective, it can be compared with data from Scotland as a representative of the Western world. The Scottish national data for 2016 indicated 68% of Scottish girls above 15 years of age to be physically active (The Scottish Government 2017), showing a vast difference from the 12% physically active Omani girls in the current study. The outperformance of Scottish girls appears to be partly attributable to the accumulated benefits from fourteen years of Scotland's Active Schools Programme (AS) (Sportscotland, 2016). Though AS is a state initiative, it is run mainly by volunteers who make up 86% of the 20,000 deliverers, of whom paid deliverers comprise only 14%. Participation is voluntary for schools, and currently almost half the schools in Scotland have adopted the programme. AS aims to offer high quality physical activity for children and adolescents. Sessions are conducted before school, during lunchtime and at after-school clubs. There is also collaboration between AS participant schools and community clubs (Sportscotland, 2016), which might help the clubs to identify talented youth at early ages and train them for competitions. The active collaboration between various organizations also seems

to have generated a low-cost, high-efficiency model which spends yearly GBP 12.5 million over 293,878 distinct participants (in 2016-2017 academic year) at a low cost of Great British Pound 42.53 (Omani Rial 21.500) per participant per year (Sportscotland, 2016).

Thus, the Scottish model of physical activity promotion among children and adolescents, with its high volunteer participation, low costs, and collaboration with sports clubs, deserves to be examined for viability with cultural adaptation—for countries with high youth obesity risk such as Oman and its GCC peers.

The evidence indicates that performing physical activity regularly could help school aged children and adolescents in reducing their body weight (Swift et al. 2014) and protecting them from different diseases such as NCD (Janssen and LeBlanc 2010). Therefore, using the data findings from the current study, it can be suggested that to address the reported low levels of physical activity in Omani female adolescents compared to their peers in other GCC, this could be positively managed by strengthening physical education curriculum in Omani schools.

5.5 Association between BMI and Physical Activity

Along with nutrition, physical activity is one of the key lifestyle characteristics with significant impact on BMI in all age groups including adolescents. However, physical activity needs to be understood in terms of the significance of other life factors and their association to BMI. In Lebanon, Nasreddine et al. (2014), based on multivariate logistic regressions, reported that adolescents aged 12–19 years who were physically active more than twice a week had 38% reduced odds of becoming overweight 57% less chance of becoming obese. The present study aimed to determine the relationship between the body composition, the level of physical activity, and dietary habits prevailing among Omani female adolescents. Multivariate logistic regressions analysis shows a significant association between obesity of the participants and the levels of their physical activity (running and household tasks) determined by a self-reported ATLS questionnaire. Surprisingly, the girls who reported themselves as performing more household tasks had 18% higher probability of being obese, while those who reported higher frequency of running had 16% less probability of being obese. This apparent contradiction might be resolved by the following hypothesis: running is relatively strenuous activity with no other purpose than physical exercise. Thus, a regular runner may already be physically fit, may come from a family whose members are also physically fit. It could even be argued that such a family may have a more benign attitude towards physical activity among their girls.

Therefore, when a girl with normal BMI reports that she runs regularly, her answer is likely to be nearer reality. On the other hand, energy consumption in household work is far more difficult to quantify. If we assume that girls with higher BMI enjoy eating, they may also love cooking. Thus, it is possible that much of the household activity they engage in involves cooking, which time is consuming but a relatively sedentary activity. It is also possible that those who cook more may taste foods while they cook, which may nullify the benefit of any exercise they get from the process. In Omani family's housemaids may be doing the hardest and most energy consuming physical activities such as scrubbing floors, cleaning, and performing any external work. Thus the "time spent in household activities" may not be a reliable predictor of physical activity. Future studies may add a slightly modified ATLS questionnaire which adds a question or two that seek to breakup of household tasks performed by the participants, especially on cooking, food preparation etc.

Pearson correlation revealed a significant negative relationship between participants' BMI, their daily footstep counts as objectively recorded by pedometer, and the self-reported distance walked. The obese and overweight participants recorded lower daily footstep counts; they also reported walking shorter distances. These two data were significantly lower among obese participants than among their overweight and normal weight peers.

Many studies reported results similar to the current study among different age groups and measured by different methodologies. In a study conducted among 541 Saudi children and adolescents aged 2–18 years, Al-Agha et al. (2016) found a significant negative relationship between higher BMI and time spent on physical activity. Moreover, in older individuals, Dwyer et al. (2007) showed a negative relationship between obesity and daily footstep counts (measured by pedometer for 14 days) among participants aged 25 years and above.

It is vital that children and adolescents develop a regular habit to perform physical exercises that will help in prevention of weight gain and the development of heart disease and diabetes (Telama et al. 2005). Kahan and McKenzie (2015) argue that schools are the best place to promote physical activity for young people.

5.6 Sedentary behaviour among Omani Adolescent Girls

The current study demonstrates that Omani teenage girls have high incidence of sedentary behaviour. This was measured using the ATLS questionnaire which comprised items related to

assessing sedentary activities such as the total number of hours spent on screen time, such as watching TV, playing electronic games, and using the computer and internet, as well as the number of sleeping hours per day.

5.6.1 Digital Screen Time

The quantitative results show that 97% of our total participants across all BMI groups were spending more than the time recommended by NICE (2015) guidelines of maximum of 2 hours per day of screen time (watching TV, DVD, video, and computer) during the weekdays. In addition, their week-days screen time was 48% higher than during the weekends. The longer screen hours during weekdays might be attributed to using computers for homework in addition to entertainment. This was supported by this study's qualitative data that emerged during the focus group discussions where the participants revealed that they had substantial homework assignments during school days.

A previous Omani study also showed a trend of high screen time among adolescents of both genders (Kilani et al. 2013). Similar findings were found in studies conducted in other countries in the Middle East such as: Fazah et al. (2010) (14–18 years), Al-Hazzaa et al. (2012) (14–19 years), Musaiger et al. (2014b) (15–18 years), Allafi et al. (2014) (14–19 years), and Kelishadi et al. (2003) among Iranian adolescents (11–18 years). From the western countries, confirmatory data regarding high screen-time usage by adolescents emerged from studies by Henry et al. (2004), Dollman et al. (2007), Vasques et al. (2012) and Huffman et al. (2012),

It has been noted that screen time has further increased among adolescents in many countries. The internet is increasingly occupying adolescents screen time, but the internet is also valuable as an educational, health-care providing, scientific, technological and business tool, and it needs to grow further, without compromising the health and well-being of the user. Further studies that seek to investigate the reasons in detail and suggest solutions are called for. There is a wide-ranging responsibility, for all—parents, family members, school teachers, higher authorities in MOE, Ministry of Sport and community leaders, and adolescents themselves—to seek ways to safeguard adolescents' future health.

5.6.2 Electronic media

The correlation between the proliferation of electronic media and inactivity is pronounced among the adolescent population of Oman. In the present study 97% participants exceeded the recommended 2 hours daily limit on screen time. Additionally, there were statistically

significant differences between the proportions of inactivity in different BMI groups. This suggests that the increased use of technology, cars and domestic devices is a contributing factor in increasing physical inactivity. A previous study conducted in Oman found screen time among both genders (Male, 45% and Female, 55%) to be lower than in the current study (Kilani et al. 2013). Brazilian study by Lucena et al. (2015) on 2,874 students aged 14–19 years also found lower prevalence of screen time (male, 84% and female, 76%) than in the present study. However, that study was based on data collected in 2009. Meanwhile the present study used 2015 data when computers and the Internet was much more prevalent and accessible worldwide including in Oman. Personal computer uses among Omanis rose to 58%, while that of other electronic entertainment and communication devices, especially television and mobile phones, jumped to 98% (NCSI 2012). These statistics show a correlation between the increasing ownership of cars and electronic devices and increasing levels of inactivity in the Omani population.

To conclude, the unique conditions in Oman—the hot desert climate that discourage staying outside, availability of cheap household labour that decrease the motivation for household work, and cheap personal transportation facilities that discourage even short walks—have together created a cocoon of comfort for Omani teenagers with plenty of spare time to remain in that comfort. The spare time—which earlier would have been filled by community activities—is being taken over by screen time. In fact, rising screen-time may be directly contributing to the rising BMI of adolescents—by impacting their sleep, which is discussed under (5.6.3).

5.6.3 Sleep Duration

Adequate sleep is vital for adolescents' healthy body weight status. Lack of sleep is highly correlated with increased BMI (Watanabe et al. 2010; Garaulet et al. 2011). According to US National Sleep Foundation (NSF), 8 hours of sleep per day is recommended for adolescents aged 18 years and 9 hours for 15–17-year-olds (NSF 2015a).

Among the participants in this study 79% of Omani girls aged 18 years and 92% of girls aged 15–17 years of age slept less than the recommended daily hours during the weekdays. There was a statistically significant difference in the percentage of participants in different BMI groups and their sleeping hours during weekdays and weekends. The obese adolescents aged 15–17 slept less (65% of recommended hours) than their peers across BMI groups during weekends. In addition, among the 18-year-old participants, those with normal weight slept less

(88%) than their heavier peers during weekdays. The underweight girls slept even less (86%) during weekends.

Across the BMI groups in current study, the participants' mean sleep duration was significantly lower during weekdays (school-days) than during weekends. The burden of homework was cited as the reason by the focus group participants. Screen time during weekdays was also higher than during weekends. The focus group participants also attributed the lower school-day sleep time to having to rise as early as 5 am to be at school when it starts at 7 am.

Effect of screen-lighting on circadian rhythm. there is evidence that, the light from electronic screens at night may disrupt the normal circadian rhythm of the body by decreasing sleepiness and increasing tiredness on the following day (Chang 2015). This is claimed to be countered partially by modern computers and smartphones with 'Night Light' feature that alters the screen spectrum from the normal daylight mode to a mild reddish yellow resembling that of the sunset or fireside. This feature is claimed to trigger a primeval tendency to retire at sunset. Similarly, using the yellowish 'warm' LED lighting in homes might help the normal sleep cycle (Skeldon et al. 2017), particularly in TV rooms and bedrooms. Homeowners need to be educated about which lighting to use where: for example, white lights for the exterior, kitchen and bathrooms, and warm lights for the rest of the home.

5.6.4 Adolescent sleeplessness

Despite significant sociocultural differences between adolescents in Arab countries and the rest of the world, the recommended 8 hours of sleep per day is considered beneficial to all adolescents irrespective of their gender or ethnicity. Quantitative data from the present study shows that Omani teenage girls are receiving insufficient sleep. Moreover, Musaiger et al. (2014a) reported that 48.8% Iraqi adolescent girls slept less than 8 hours a day—a lower prevalence than among the Omani girls in the current study. Furthermore, Huang et al. (2010b) reported that in Taiwan 54% adolescents of both genders were not able to obtain the (then) recommended 6 to 8 hours of sleep per day. American high school adolescents may have even more sleep deficit, as evidenced by 73% girls and 70% boys getting less than eight hours of sleep, with significant statistical differences between the genders (Wheaton et al. 2018).

The US, NSF reported that sleep deprivation is significantly associated with an increased risk for cardiovascular diseases (NSF 2015b). A cross-sectional study conducted in China among 15,364 participants of ages above 15 years found that those who slept less than 6 hours or more than 8 hours daily had higher risk of Myocardial Infarction and stroke (Hu et al. 2018).

Peuhkuri et al. (2012) reported that individuals with sleep deficit were also likely consume more energy dense foods and less healthy food such as vegetables. A study on 16 German male night-shift workers in the 23–24 age group found that lack of sleep appeared to increase their hunger and pleasure-seeking behaviour, indicated by their breakfast preference for snacks over normal food, and in larger portions (Hogenkamp et al. 2013).

Similar tendency had been reported earlier by Westerlund et al. (2009) among 1,256 Finnish children. The authors suggested that inadequate sleep triggers hormonal changes, which in turn increases perception of hunger. This causes overeating of energy rich foods and increases the risk of obesity. The above-mentioned link between childhood sleep deprivation, overeating, and later obesity was supported by an American long-term study by Martinez et al. (2014) on 229 Mexican American children. The study, which commenced when the subjects were 8–10-year-old, found that that children who had sleep deficit had, after two years, presented with higher BMI, waist-to-height ratio, and weight gain. A recent Swedish study on 1,260 10-year-old children found association between excessive screen-time, insufficient sleep and childhood obesity (Garmy et al. 2017). Evidence suggests that sufficient sleep has a positive significant association with increased consumption of healthy food among adults (Grandner et al. 2010), adolescents (Chen et al. 2006; Al-Disi et al. 2010) and children (Moreira et al. 2010). In addition, systematic and meta-analytical studies have found links between inadequate sleep, overeating, and a later risk of obesity among all age groups, whether children, adolescents, or adults (Cappuccio et al. 2008; Chen et al. 2008).

With so many studies from different parts of the world on most age groups arriving at very similar conclusions, the connection between lack of sleep, overeating and obesity is indeed strong.

This raises the question of the desirability of enforcing sleeping discipling on children and teenagers. Studies show that parental firmness and consistency in establishing bedtime discipline has a positive impact on children's BMI (Doheny et al. 2013; Buxton et al. 2015). Here, the Arab-Islamic world, where strong parental authority is part of cultural heritage, is likely to outperform. Omani community elders would welcome reforms that reduce the screen time and enforce bedtime discipline. If Omani parents are made aware of the nature and seriousness of the link between late sleeping and obesity and are given precise guidelines to enforce strict lights-off-screens-off policy at the same time every night so that children and teenagers get eight or more hours of uninterrupted sleeping time, they are likely to enforce that

discipline effectively. The 'I have too much homework' excuse can be dealt with by persuading the school to reduce homework burden to match the early bedtime requirement. Well-slept and well-breakfasted children are likely to be more alert in school and thus easier to teach. Teachers may also welcome the relief of being able to correct less homework. This recommendation is for the Ministry of Education to examine and decide.

The Siesta: Midday napping and its lifestyle impact. Midday or afternoon siesta and its impact on lifestyle is a grossly under-researched field despite its popularity in the Arab world and much of the Mediterranean region. Islamic religious and secular sources recommend midday naps as being beneficial. The siesta is so popular throughout the Middle East as observed by BaHammam (2011), Tumiran et al. (2015) that shops are shut between 1pm and 4 pm when the streets are empty with few potential customers.

The current study could not collect information on daily siesta, as the ATLS questionnaire does not have the provision for the same. Emerging studies from the Western world have touched upon the psychophysiological impact of afternoon nap, and so far, the findings appear positive (Studte et al. 2015). Thus, it is recommended that future studies in Oman and its GCC peers analyse the effect of midday/ afternoon siestas on sleep cycles, physical activity, food habits and BMI of teenagers of the region.

5.6.5 Association between BMI and the Sedentary Behaviours

In the current study, increasing screen time (computer and internet) during weekdays is associated with increased odds of being overweight and obese. A similar finding was reported in a longitudinal study conducted by Fuller-Tyszkiewicz et al. (2012) that showed that there was a positive relationship between the increased screen time and increased body weight on Australian young people. The evidence shows that the more the time spent on screen, the more the possibility for lifestyle related health problems. A cross sectional study reported that Australian girls aged from 11 to 15 years had a negative relationship between their small-screen time and cardiorespiratory endurance. Among the boys, the relationship was not consistent (Hardy et al. 2009).

A recent study in Italy by Marino et al. (2017) enrolled 23,941 students, aged 15 years on average. The results showed there was a significant positive relationship between the use of computers, developing various psychological symptoms and difficulties in getting enough sleep. According to the NSF, the light released by electronic devices such as TV, mobile phones and computers inhibits emission of melatonin hormone which causes difficulties with falling

asleep (NSF 2018). As a result, decreasing the screen time is the best solution to improve physical, body weight and psychological health of the adolescents.

Many studies reported that increased screen time has a positive association not only with obesity but also with different health problems such as blood cholesterol, blood sugar, social isolation, and sedentariness. It is also associated with lower academic performance (Kang et al. 2010; Sisson et al. 2010; Tremblay et al. 2011).

The last point—the link between sleep and academic performance—may be used as an effective campaigning tool to motivate students towards getting adequate sleep. This research hypothesises that “good health” may be too amorphous and long-term a concept to motivate young people, while school grades are tangible and feels more immediate. Secondly, this is also a potential theme for narrative posters to be displayed in schools. A typical poster might be a cartoon narrative where a student remains glued to a screen till very late at night, wakes up early, skips breakfast, and spends the school hours nodding off and ends up scoring low grades. Alerted, she changes her sleep pattern and eventually scores high. Short films based on this theme can also be inserted as compulsory advertisements in primetime TV. This has also the advantage of being totally free of body-shaming (unlike overweight or physical activity).

In the current study, the odds of being overweight was reduced by 30% among the girls who slept longer during weekdays, and by 49% among those who slept for longer hours during weekends. This finding is similar to that found in a study among British boys and girls aged 9–11 years of both genders where increased sleeping time was associated with 34% lower odds of being overweight or obese (Wilkie et al. 2016). Inadequate sleep has also been associated with higher risk of obesity and overweight among Saudi adolescents aged 15–19 years (Al-Hazzaa et al. 2011a; Al-Hazzaa et al. 2012).

On the other hand, an adequate sleep pattern has been associated with healthy lifestyle. In a large study conducted in China by Gong et al. (2017) among 10,726 students reported a positive relationship between increased sleeping hours and higher consumption of milk, fruit, vegetables and water, and participation in physical activities. Chinese adolescents who enjoyed recommended 8 hours of sleep per day were also less likely to engage in unhealthy lifestyle habits such as smoking, drinking, excessive consumption of sweets and fast food, and omitting breakfast.

It can be concluded that it is imperative that adolescents sleep adequately and regularly for maintaining a healthy lifestyle. It has been shown lack of sleep can trigger obesity-generating

behaviour such as breakfast skipping, tendency to overeat and eat the wrong types of food, and daytime tiredness that discourages physical activity. Fortunately, sleep—unlike unhealthy eating and sedentary behaviour—can easily be enforced. Omani parents must be advised to use their traditional parental authority to strictly limit their children’s screen time and enforce strict bed-time rules on all days of the week.

5.7 Dietary Habits among Omani Adolescent Girls

Participants in the current study showed both healthy and unhealthy dietary habits. The girls with healthy habits included those who regularly ate breakfast and consumed milk, fruits and vegetables daily. Girls considered to have unhealthy dietary habits included those who skipped breakfast and habitually consumed fast food, French fries, sweets, and soft drinks.

Due to the importance of dietary habits in determining body weight status, the current study required a close examination of prevailing dietary habits among Omani female adolescents and assessment of the differences of food consumption existing between the participants in different BMI groups. The consumption of food was assessed on frequency per week. Dietary habits findings are discussed sequentially.

5.7.1 Breakfast Consumption

Current study findings reveal that the participating Omani female adolescents in different BMI groups differed in the frequency of breakfast consumption. Daily breakfast consumption was significantly higher among the participants with normal body weight (39%) compared to overweight and obese participants, at 15% each.

In comparison, the daily breakfast consumption rates among Kuwaiti, Iraqi and Bahraini female adolescents (15–18 years old) were 18%, 36% and 43% respectively, lower than the findings presented here (Allafi et al. 2014; Musaiger et al. 2014a; Musaiger et al. 2014b). Italian and UAE normal weight girls aged 11–18 years reported much higher rates of daily breakfast consumption (85% and 77% respectively) compared their GCC peers (Bin Zaal et al. 2009; D’Addesa et al. 2010) including the Omani participants in this study. Additionally, 69.5% Lebanese boys and girls aged 12–19 years of different BMI groups consumed higher daily breakfast—more than the participants of this study (Nasreddine et al. 2014).

Several studies from the GCC region reported that daily consumption of breakfast was higher among boys than girls. This was the trend among Bahraini, Iraqi and Kuwaiti boys whose

likelihood of daily consumption of breakfast (57%, 48% and 28% respectively) was higher than that of the girls (43%, 36% and 18% respectively) (Musaiger et al. 2011; Allafi et al. 2014; Musaiger et al. 2014a).

However, these studies did not identify the reasons behind the patterns of consumption of daily breakfast, which is presumably because they did not have a qualitative component. A mixed method study such as the current one would have provided more practical insights into the behaviour of the subjects. During the focus group discussions of the current study, participants stated that the common reason for skipping breakfast was the early morning school. To arrive at school on time at 7 am, several participants reported having to leave home as early as 6 am to catch the school bus, which left them with little time for breakfast. The same reasons for skipping breakfast were given by Costa Rican 12–18-year-olds during a focus group discussion (Monge-Rojas et al. 2005). Terry-McElrath et al. (2009) reported that the earlier the school started, the less likely the breakfast. Barr et al. (2014) found that the prevalence of breakfast skipping among Canadian children and adolescents increased with age: 2% (4 to 8 years), 9% (9 to 13 years) and 18% (14 to 18 years).

The prevalence of daily breakfast intake seems to be high at childhood and drops significantly during adolescence. For example, the percentage of daily consumption of breakfast among 7 to 9 years old Swedish children was 95.4% (Nilsen et al. 2017). Earlier, the US National Health and Nutrition Examination Survey for the period 1999–2006 had found the tendency for breakfast skipping, rose from 20% among American children to 31.5% among adolescents (Deshmukh-Taskar et al. 2010). This is not unexpected because in childhood, parents influence eating behaviours by selecting, preparing, and serving healthy food and ensure breakfast consumption. During adolescence parental influence is reduced. It is also suggested that the parental non-verbal behaviour ('do as I do') tends to influence children's eating habits more than verbal instructions ('do as I say') (Birch et al. 2007). Based on this concept, parents who wish to improve the behaviour of their children will be more successful if they themselves behave the way they would like their children to do. In addition to promoting regular breakfast consumption among the young, the entire family may then engage in a healthy lifestyle.

Most studies found that normal weight participants belonging to both genders were more likely to be habitually eating breakfast, and while obese participants, particularly females, were more likely to miss breakfast. The preponderance of female obese participants' skipping breakfast appears to be a notion that skipping breakfast reduces weight. An American study found that

>30% of female college students aged ≥ 18 years habitually skip breakfast to achieve weight reduction (Malinauskas et al. 2006). However, the same study showed that doing so is counterproductive because the rising hunger may lead to eating an energy-rich lunch (Bin Zaal et al. 2009).

In addition, since the human brain needs adequate glucose to properly function (Warren and Frier 2005) skipping breakfast might lower blood sugar levels, negatively impacting the intellectual performance of students (Morris and Sarll 2001). A study in Tripura, India, also suggested that college students who skip breakfast may risk impacting their intellectual development (Ghosh et al. 2013). A recent cross-sectional study conducted in Oman by Jahan et al. (2018) assessed the relationship between nutritional status and cognitive performance among 80 third year students of Oman Medical College (OMC). Female students were more likely to miss their breakfast, and more than 11% were found to have a mild intellectual alteration, 32% had low haemoglobin and 29% had low blood glucose (Jahan et al. 2018). Despite being a relatively small study, and conducted among young adults rather than teenagers, this can be taken as a pointer to a likely connection between breakfast skipping and academic underperformance among all youth of Oman, including children and teenagers. Thus, the OMC study needs to be shared with parents, teachers, school administrators and community leaders in Oman to motivate them to promote regular breakfast consumption as an essential step towards healthy physical and intellectual development of Omani children and adolescents. Meanwhile the OMC breakfast study needs to be replicated with larger sample sizes across other age groups including adolescent girls of Oman.

During a group discussion session in the current study, the participants came up with a suggestion of allowing students a short time at the beginning of the first period to eat a snack. Some of the primary schools in Ibri are already allowing small children to bring from home a few dates as a morning snack. This facility needs to be extended to older students as well, who need to be encouraged to bring from home healthy snacks.

In Scotland, some schools—such as Liberton High School, Edinburgh—run *breakfast clubs* that provide morning nourishment for students who are not able to eat breakfast at home. The aim is to decrease the number of breakfast skippers and by doing so improve student's engagement in educational activities and contribute to the improvement of students' general health (Harrop and Palmer 2002).

The Breakfast Club at the Liberton High School runs from Monday to Friday 8am to 8.30am. All students (S1–S6) are eligible to attend it for free. The food served by the club are varied and include fruits, cereals, cereal bars, toasts, smoothies, milk shakes, spreads etc. The club is supervised by the Breakfast Club staff. The results of the programme and the impact it has on student's performance and general health are yet to be evaluated. The concept of breakfast club appears to be suitable for Omani schools, as they are likely to compensate for breakfast skipping, particularly by adolescent girls.

Breakfast Clubs have been running in England also for many years and evaluations have been carried out. According to the randomized control trial (RCT) study conducted in English schools by Shemilt et al. (2004) there was higher prevalence of fruit consumers among primary school children who attended the breakfast club compared to those who were not attending. Additionally, it was reported that school children attending breakfast clubs experienced noticeable improvement in mental concentration compared to the children who did not attend.

Participants of this study voiced their opinions regarding school meals and suggested that the school should take the students' opinions on canteen food seriously. In comparison, in Scotland, voices of the schoolchildren and youth are listened to in accordance with the 'You said we did' rule. Students' feedback and opinions are taken seriously (The Scottish Government 2014, p. 78). This ethos empowers and motivates students to express their concerns and views openly regarding school's food and catering services. It also motivates the staff and other concerned authorities and encourages them to be self-critical about the quality of the services provided to the youth. The positive outcome of a long-term public investment in students' nutrition and health includes increased consumption of healthy food and a better understanding of the benefits healthy food has on the student's body and mind. By spending now on healthy nutrition for children and imparting them nutrition education, the Scottish authorities seek to improve the long-term physical and mental health of the Scottish population. Lower diet-related health problems and chronic diseases such as overweight and obesity will also save future healthcare costs (The Scottish Government, 2014).

Warren et al. (2008) who conducted a qualitative study that involved 7–11year-old children from six primary schools in Wales, UK, warned against making food choices freely available to very young children. This was based on the finding that all children who participated in the study preferred unhealthy food items, even when acknowledging their health consequences. The authors have suggested educating caregivers to limit choices of food to young children to

a range of healthy options, while encouraging the children to make informed food choices. In Oman also, student empowerment over food choices might be restricted to teenagers and above.

5.7.2 Fast Food and French Fries

In the present study, 42% of the obese participants consumed fast food more than three times a week, against 30% among overweight and 15% among normal weight participants. Most focus group participants preferred fast food were chicken sandwiches, fried chips, burger and pizzas. They acknowledged that advertisements had an important role in attracting them to specific foods, in addition to their general liking for the taste of fast food. Attraction to fast food appears to be a common adolescent preference worldwide, irrespective of their degree of westernisation (Munmun and Shatabdi 2013). This universal liking towards an unhealthy class of food is linked to various health problems such as obesity and diabetes mellitus among adolescents (Poti et al. 2014) reveals the universal human susceptibility to foods that give instant gratification, and the lure of psychologically targeted marketing.

In comparison to the current study, fast food consumption more than three times a week was less prevalent among Syrian, and Iraqi adolescents of both genders, at 14% and 31%, respectively (Musaiger and Kalam 2014; Musaiger et al. 2014a). However, a 2009-study from UAE, found the prevalence of fast food consumption by obese adolescents to be lower (male=42% and female=52%) than their normal weight study participants (male=58% and female=75%) (Bin Zaal et al. 2009). However, food habits of adolescents were based on self-reporting given via responses to questionnaire. It is known that obese adolescents tend to under report their consumption of fast food (Schoch and Raynor 2012), which seems to explain the unusual results of that study. By contrast, the present study, which anticipated misreporting had mechanisms in place to identify and exclude the food consumption data provided by misreporters. Another difficulty with the UAE study is that the year of data collection is not mentioned. The change in adolescent lifestyles being a relatively new and fast changing phenomenon, studies on lifestyle related matters need to mention the year of data collection to enable effective comparisons.

The incidence of fast food intake among young children appears much lower than among adolescents. For example, the prevalence of fast food consumption more often than thrice a week among 7 to 9 years old Swedish children was only 1.6% (Nilsen et al. 2017). Adolescents are more likely to have access to fast food than children and are more subject to peer pressure. Oinam et al. (2018) found that 70% of adolescents took their fast food with friends.

In the present study, the highest prevalence of consumption of french fries and crisps (>3 times/week) was among the overweight participants (82%), with significant differences noted among the BMI groups. The Saudi and Italian study findings differed from the results of this study, where normal weight female adolescents consumed more french fries than female adolescents of other BMI groups (D'Addesa al. 2010; Al-Hazzaa et al. 2012).

A recent study in the city of Imphal, India, by Oinam et al. (2018) found that the prevalence of fast food consumption among obese and overweight adolescents was 49.3%, significantly higher than those of Omani participants of this study. The Imphal teenagers cited taste (78.5%) as the main reason for their preference for fast food (Oinam et al. 2018). Earlier, an interview-based qualitative study conducted among 108 American teenagers aged 11–18 years revealed that their food choice was mainly determined by taste expectations (Contento et al. 2006).

5.5.3 Fast food: the impact of advertisements

Many studies have reported that major reason adolescents were attracted to fast food was influence of media advertisements. This was supported by the participants of the focus group discussion of the present study. Utter et al. (2006) found that the more hours spent watching TV, the higher the consumption of the advertised food products. A possible reason for this was revealed by an Australian study, (Chapman et al. 2006) which found that advertisements that promoted unhealthy foods were specifically shown during 6pm to 9pm on weekdays, being the peak TV viewing hours of children and adolescents. Moreover, Lobstein and Dobb (2005) showed a significant positive association between prevalence of overweight and number of TV advertisements (per hour, of unhealthy fast food, sweets, food substitutes, artificial drinks) inserted into and aired during children's TV programs, $p = <0.005$. In summary, it can be concluded that fast food consumption is still greatly influenced by media advertisements, but this may be changing, particularly among teenagers, due to the advertisers of fast foods increasingly turning to Internet-based social media and mobile phone apps which enable them to target products to specific communities and age groups.

Parental control and broad general education form part of the strategy to reduce the impact of media advertisements that promote unhealthy food choices. As suggested earlier, enforcing strict bedtime, for example, at 9 pm on weekdays will reduce the TV watching and Internet hours as an additional benefit.

The focus group participants in this study understood that high consumption of fast food is not beneficial to health and because of the high energy content, can lead to increase in body weight and obesity. They also acknowledged that traditional Omani dishes prepared at home under sanitary conditions were healthier for them. Homemade food must be encouraged at home and students encouraged to bring them to school as well. Education and health authorities in Oman may consider instructing schools to request mothers to send their children to school carrying packed homemade food.

5.7.4 Energy Dense Snacks

Energy dense snacks include sweets, chocolates, biscuits, cakes, and doughnuts. In this study the prevalence of consumption of biscuits, cakes and doughnuts more than 3 times/week was higher among overweight participants (74%) than the obese (71%) and other participants across BMI group.

Several studies from different parts of the world reported findings different from that of the current study on the consumption of energy dense snacks by adolescents. In a study conducted in three Saudi cities by Al Hazzaa et al. (2012) among 1,506 girls and 1,400 boys aged 14–19 years, the normal weight girls consumed more sweets and chocolates than all girls across BMI groups. The authors have however, raised the possibility of under-reporting by overweight and obese participants. In an earlier cross-sectional study in Dubai, among 661 adolescents (337 girls) aged 12 to 17 years, 72% of normal weight girls reported consuming sweets and chocolates 4 or more times a week (Bin Zaal et al. 2009). The possibility of under-reporting by the higher BMI groups was been mentioned in that study. The current study, however, took precautions to minimize under-reporting by the obese and overweight participants, which may explain the apparent mismatch (Schoch and Raynor 2012).

5.7.5 Consumptions of Fruits and Vegetables among Omani Adolescent Girls

In the current study, fruits and vegetables portion sizes were not measured, daily consumption frequency was used. Normal, overweight, and obese participants consumed vegetables in nearly the same proportions (44%–45%). However, daily consumption of fruits was higher among the obese (31%) group. According to The Omani Food Guide the recommended serving of fruits and vegetables for female adolescents aged 14–18 year is four cups per each day (170g/day), 1 cup = 42.5 g (MOH 2009). However, this considered to be very low compared to the UK recommendation for fruits and vegetables (5 portions, 80 g/each) daily serving which is

400g/ day (NHS 2016). According to Woodside et al. (2013) increase intake of fruits and vegetables helps in protecting individuals against the development of cardiovascular diseases. Those who consume low quantities of fruits and vegetables consumers are at higher risk for cardiovascular diseases. Low intake of fruits and vegetable could be due to lack of knowledge about the nutritional guidelines (Rooney et al. 2017).

It must be pointed out that the tendency for lower consumption of fresh fruits by Omani youth goes contrary to Omani culture. In Oman fresh fruits have always been prized and have been part of Oman's culture of entertaining visitors. Fresh fruit have been traditionally served to everyday visitors and have featured prominently during all social and religious occasions such as Eid, weddings, birthdays, childbirths and Ramadan. Ramadan fasts are ideally ended with water accompanied by fresh fruit, the latter perceived as easier on the digestive system immediately after fast. To return the Omani youth to appreciating the cultural significance of fresh fruits (in addition to their nutritive values) re-education is called for. To improve public nutritional knowledge MOH has established a strategy; starting with completion of a nutrition survey to assess public knowledge regarding nutrition among different age groups and communities. This enables targeting essential knowledge where it is lacking. This is accompanied by development of regional and public nutrition database library (Al-Ghannami and Atwood 2014).

A Saudi cross-sectional study conducted by Al-Hazzaa et al. (2012) indicated that there was no significant difference in daily consumption of fruits and vegetables between the Saudi adolescents of different BMI groups, this trend was similar to Omani female adolescents in this study with respect to the intake of vegetables.

The normal weight adolescent girls in Dubai reported higher consumption of fruit (67%) and vegetables (68%) compared with normal weight boys, whose consumption was also higher than the that of the participants in the present study (Bin Zaal et al. 2009). In addition, the proportion of daily consumption of fruit and vegetables among Iraqi female adolescents was a significantly higher (46.3% and 62.3%, respectively) than Iraqi male adolescents who consumed 24% fruits and 46% vegetables (Musaiger et al. 2014a) which was higher than the findings pertaining to the Omani female adolescents in the present study. Epstein et al. (2001) indicated that increase of daily intake of fruit and vegetables is a vital sign of healthy nutrition which helps to lower the total calorie intake and decrease body weight.

On the other hand, the current study's findings on the fruit and vegetables consumption levels by Omani girls were higher than those of 2009 data pertaining to Kuwaiti female adolescents, 11% of whom consumed fruits and 22% consumed vegetables (Allafi et al. 2014).

The present study concluded that female adolescents consumed low amount of fruit and vegetable and this finding was consistent with the findings by a large study conducted among adolescents in 11 countries including Oman. Al Ani et al. (2016) conducted a multinational study among 26,328 (13–15 years) participants in 11 Eastern Mediterranean Region (EMR) nations to assess fruit and vegetable intake per day. Only 19% participants reported consuming fruit and vegetables five times or more times per day. The highest proportion of those reporting consuming fruit and vegetables 5 or more times was recorded among Djibouti adolescents' (40%) and the lowest among Pakistani adolescents (10%). Except for Oman, Libya and Djibouti, significantly more males than females ate fruit and vegetables ≥ 5 times/day. Omani boys in that study (n=97) reported higher intake of fruit and vegetables to be five times and more per day, more than female Omani adolescents' (n=93) consumptions. This large multi-centre study conducted across the EMR nations which represents global extremes (such as Djibouti and Qatar) in per capita income and standard of living provides strong evidence (Evans 2003) for significant differences between intakes across 11 countries.

Meanwhile experts are increasingly and urgently warning against the inadequate intake of vegetables and fruit as causative of serious risks, such as WHO's recent warning of possible rise in global risk of death from gastrointestinal cancer, heart disease and stroke by 14%, 11% and 9%, respectively (WHO 2018b). Buttriss (2016), stated that to improve adolescents' health status and prevent future health problems in the above eleven surveyed countries, urgent action must be taken to increase their daily intake of fruits and vegetables at least five portions per day. This could be done by increasing availability and accessibility of grocery shops both at school and in the neighbourhood. A study among 634 early adolescent (12-year-old) African American girls living in less privileged areas in Baltimore city reported that African American girls living near four or more grocery stores consumed approximately 4.5 servings of fruits and vegetables per day, compared to less than 3 servings daily by who lived far away from grocery stores (Hager et al. 2017). A systematic review conducted by Rasmussen et al. (2006) reviewed 98 quantitative studies which assess the daily intake of fruits and vegetables among 6–18-year-olds in the US and European countries. The findings indicated that increased accessibility and availability of fruits and vegetables at home and at school showed a significant positive association with increased consumption of fruits and vegetables among children and

adolescents. This appears to be an example of how strategic placement of healthy food outlets in accessible locations could increase consumption of fruit and vegetables.

The above examples could encourage school canteens in Oman, these being the main source of non-home food for students, particularly girls. In the current study, focus group participants suggested introducing fruits and vegetables to the school canteen's list of foods, and wanted these to be tastefully displayed. School administration could improve students' healthy dietary choices by increasing the availability and attractiveness of such healthy foods at the school's canteens and phasing out the unhealthy options currently sold. Recent research suggests that by improving the quality of food in school canteens, the overall nutritional intake of the adolescents might be improved as well (Sedibe et al. 2018). A close supervision must be conducted periodically and jointly by MOE and MOH.

The focus group members also wanted their school to take a major initiative in educating the children and youth of their region on healthy food choices and nutrition. Their suggestion echoes the opinion among many researchers that educating children, youth and parents about nutrition and healthy food choices contributes to higher consumption of fruits and vegetables (Blanchette and Brugg 2005). However, educational initiatives alone are nearly not enough in making people eat more fruits and vegetables and other healthy food, as the study below suggests:

In a study on health education and consumption of fruit and vegetables from Saudi Arabia, Hussein (2011) reported on the relative ineffectiveness of specialized nutrition education on consumption of fruit and vegetables among 18–21-year-old female students of various applied medical sciences courses at King Abdulaziz University. Among a total of 205 participants, 73 were students of clinical nutrition. The study found no statistically significant difference between the clinical nutrition students and others in their choice and consumption of fruits and vegetables. These results question the notion that knowledge about healthy foods and why they are important for health can increase the consumption of fruit and vegetables among the adolescents and young adults. The author of the Saudi study goes deeper into the problem and suggests that there may be a biologically determined aversion/ dislike in humans to low-energy food such as vegetables which are also characterised by very low-fat content, and sometimes bitter taste (Hussein 2011). Thus, vegetable consumption is likely to be a learned behaviour rather than a physiologically ingrained one.

It may be pertinent to add another finding that being a health care specialist need not promote a healthy lifestyle in general. Al Zahrani et al. (2016) found that among 211 resident male and female physicians, 36% were overweight and 23.2% were obese. These two studies suggest that cognitive motivators such as specialist knowledge, status, and responsibility as role models, or even an intellectual will to change, might not translate physically to a healthy lifestyle. This also could mean that unhealthy lifestyle is a product of strong unconscious impulses that override intellectual understanding.

In this study the consumption of fruits and vegetables was examined by using the self-reported traditional method (questionnaire) which has limitation of misreporting. However, a recent systematic review conducted by Woodside et al. (2017, p.2) describes the potential use of biomarkers to assess fruits and vegetables intake more accurately. The biomarkers for nutritional assessment can be identified and tallied by testing the urine, blood and saliva of the participants. However, the biomarker method to assess fruit and vegetable consumption among the youth appears to be a very new and under-tested concept, particularly during 2015 when the data collection for this study took place. However, such methods need to be explored for future use in Oman, once they become the norm for accurate assessment of consumption patterns of various nutrients.

5.7.6 Milk and Milk Products

In this study, the consumption of milk and milk products (>3 times/ week) was higher among underweight girls (57%) than their peers across BMI groups, with no significant differences between the groups. The daily consumption of milk and milk products among Kuwaiti (25%) and Iraqi (35%) female adolescents was lower than those of this study (Allafi et al. 2014; Musaiger et al. 2014a).

Previous studies have suggested that milk and milk products may not contribute in increasing body weight. However, this needs to be accepted with caveats. For example, a relatively small study was conducted on 81 (28 male, 53 female) American first year college students of mean age of 18.3 years to assess the effect of yogurt consumption on body weight. Among women, for each additional unit of yogurt consumed, body weight increased by 0.6 kg (1.2 lbs) but there was no weight change in men. However, these results cannot be generalized because of the small sample size (N= 81) of the study group and self-reporting of food intake. Under such circumstances the chance of mis-reporting is generally high. The result however provides an interesting insight and therefore the study needs to be replicated on larger sample size and using

a more objective measure such as diet diary Another study by Lappe et al. (2017) assessed the effect of low-fat dairy products on body weight. This RCT was conducted on female adolescents to assess their calcium intake and its effect on body fat. The intervention group was supplied daily with low fat milk and yogurt and the control group was educated to pay attention to a well-balanced diet. The study found that the intake of low-fat milk products did not increase body weight. Yet another study endorses the weight-related benefits of high-fat milk under certain conditions. This cross-sectional study conducted among 145 three-year-old Latin-American children (along with their mothers), determined children's food intake by 24-hour food recall and measured their BMI. Among the participants, 17% of the children were severely obese. Multivariate analysis showed that higher milk fat consumption was associated with lower odds of severe obesity in children. The authors concluded that high fat milk may have a protective effect against severe obesity. (Beck et al. 2017). A drawback of this study was it used 24-hour food recall method which may not always yield an accurate picture of children's dairy intake.

Given the evidence provided by the findings of various studies, increased consumption of milk and milk products seems to be a relatively safer option as far as weight gain is concerned. It could serve as a useful public health message for Omani adolescents as well.

On this topic, the focus group participants of the present study suggested introducing different flavours of milk and milk products to the school's canteens. Implementing this suggestion might help to increase the consumption of milk and milk products among school children in Oman.

During the visit to primary school in Scotland, it was observed that children are given milk to drink during the story telling time. The routine is called 'Milk and Story' during which children are motivated to drink milk while listening to a story is being read to them. To improve milk consumption, such healthy practice could easily be implemented in the Omani primary schools as well.

As discussed above, throughout this section the findings were compared with similar ones from other parts of the world, possible reasons were considered, and possible suggestions made.

The current section where the overall findings of the food consumption part of this study have been discussed, indicate that Omani female adolescents are not consuming adequate number of servings of fruits, vegetables, milk, and milk products, and instead prefer energy- and fat-

rich foods. However, useful recommendations emerged from the focus group discussions to modify these behavioural patterns towards healthy ones.

5.7.7 Association between BMI and Breakfast Consumption

In the current study, increased frequency of eating breakfast among Omani girls was associated with 23% lower odds of being overweight and 19% of being obese. Nasreddine et al. (2014) reported similar association among a cohort of 868 Lebanese children and adolescents (age range 6–9 years) in whom higher intake of daily breakfast decreased probability of being overweight and obese.

These findings are similar to those found in studies in the GCC countries including Oman. The latter studies are even more comparable with the present one, as they have used the same measuring instrument (ATLS questionnaire), had similar participants' age groups and their populations were culturally similar to that of the current study's participants. These studies found a significant negative relationship between the number of days per week of breakfast consumption and BMI among Omani, Saudi and Kuwaiti adolescents (Al-Hazzaa et al. 2011a; Kilani et al. 2013; Allafi et al. 2014). Studies among children, adolescents, and adults in different parts of the world have revealed that the breakfast skipping correlates with the increase in overweight and obesity, such as Dubois et al. (2009) finding on 2,103 Canadian children aged 4–5 years and the large Dutch study involving 35,000 13–16-year-old Dutch boys and girls (Croezen et al. 2009). Regarding adults, an American study on 641 male and female participants aged 20–70 years also showed a correlation between breakfast skipping and rising BMI (Ma et al. 2003).

Breakfast skipping also correlated with lack of sleep among Japanese adolescents (Kaneita et al. 2006) and hypertension among Greek adolescents (Kollias et al. 2009). In addition, breakfast skippers were also likely to have unhealthy behaviour such as smoking and drinking alcohol, as per a Taiwanese study among 15,340 young men and women aged ≥ 20 years (Huang et al. 2010a). From Finland, Keski-Rahkonen et al. (2003) reported based on their study on 5,448 16-year-old Finnish boys and girls and their parents, that breakfast-skippers tended to be less physically active than breakfast-eaters.

Based on such agreement in the literature regarding the negative correlation between breakfast skipping on adolescent health, could be assumed that breakfast skipping among Omani female adolescents may also be correlated with health problems. The breakfast-skipping related health problems other than high BMI also need to be investigated among Omani adolescents. Specific

recommendations to combat this problem among Omani girls are summarized in the list of recommendations (section 6.2).

5.7.8 Association between BMI and Fruit and Vegetable Consumption

In addition, the increased consumption of fruits among Omani girls was associated with 22% decreased odds of their being underweight and 17% of being overweight. In Lebanon, Nasreddine et al. (2014) also reported that higher consumption of fruits and vegetable reduced the risk of high BMI among adolescents. An important incentive for increasing intake of healthy food such as fruit among overweight and obese participants might be for weight reduction. In the current study, the increasing fruits intake per week was associated with a decrease in the odds of being underweight and overweight by 24% and 17%, respectively. In addition, the increasing vegetable intake per week was associated with an increase in the odds of being overweight by 19%. Regarding the relationship between fruit and vegetable consumption and BMI, the literature gives mixed results. A longitudinal study among 163 adolescent boys and girls aged 16–17 in North Carolina (Mellendick et al. 2018) found BMI to be negatively correlated with the participants' fruit and vegetable consumption. Similar findings were reported by Matthews et al. (2011) who found significant negative association between the increased consumption of vegetables and decreased risk of being overweight 6–19-year-olds in South California. These researchers suggested that children and adolescents should be encouraged to eat plant-based foods (vegetables) to prevent them from being overweight or obese. A supporting Norwegian study among 138 adults aged 21–72 found that consuming more fruit and vegetable and less fatty foods help reduce body weight (Svendsen et al. 2007).

However, other studies show different findings. A large study among 14,918 American girls aged 9–14 years found no significant association between the intake of fruits and vegetables and BMI (Field et al. 2003). This was also the finding of a previous study with the same demographics conducted in Oman by Kilani et al. (2013) in Muscat capital region. In view of the contradictory findings in literature and based on current and previous Omani studies, link between Omani teenaged girls' fruit and vegetable consumption and their BMI remains unclear.

5.7.9 Association between BMI and unhealthy Food Consumption

In the current study, the high frequency of consumption of energy dense snacks was associated with increased odds of being overweight and obese by 15% and 14%, respectively. The same associations were found in respect of fast food: eating pizza, burger and shawarma were associated with 29% higher probability of being obese.

The Literature supports these findings. Among Lebanese adolescents, high intake of fast food was associated with increased probability of being overweight or obese (Nasreddine et al. 2014). A recent study among 600 Indian boys and girls in the 13–18 age group found a positive significant relationship between BMI and consumption of sweets and fast food (Bhattacharjee et al. 2017). The relationship between fast-food and high BMI was also established in a study in Minnesota (US) that enrolled 367 adolescents aged 11–18 years (Marlatt et al. 2016).

In a study by Boutelle et al. (2007) conducted among 902 American adolescents and their parents/ carers (also 902), found a positive association between fast food purchased for family meals and the BMI of the adolescents and their parents. Study by Al-Hazzaa et al. (2011a) revealed a significant negative association between BMI and the consumption of fast food among Saudi female adolescents. Kilani et al. (2013) showed there was a significant negative relationship between BMI of Omani boys and girls and their consumption of sweets and chocolates, French fries and potatoes. These findings were not found to be consistent with this study's findings even though the Saudi, previous and current Omani studies had used similar dietary measurement tool. However, most participants of the current study were sedentary, and habitually consumed energy dense food. Their unhealthy lifestyle put them at risk of developing high BMI.

Noticeable among the focus group participants of the current study was a decidedly 'western' orientation in their food preferences. This is usually considered unremarkable and harmless provided the food is healthy. However, this assumption is being questioned by the emerging field of *human microbiome*. Human microbiome, which constitutes 90% of the cells in our body and 99% of our DNA, is the collective term to describe colonies of different types of bacteria that reside in and on our bodies. The constitution of human microbiome is believed to stabilise at 'near adult level' as early as the age of three. Our physical and psychological health depends greatly on the health of our microbiome, the bulk of which reside in our gut. More importantly, the gut has its own primitive "brain", which often overrides and decides the behaviour of the cognitive brain—a phenomenon referred to as the *human brain-gut-*

microbiome axis (Martin et al., 2018). Recent studies have revealed significant differences between microbiota of different ethnicities and places of residence.

New findings show microbiome-triggered consequences on the health of immigrants in a totally different geocultural environment and acquiring totally new food habits, which may together result in psychophysiological consequences. (Gupta et al., 2017). As such findings become better studied, new research questions are likely to emerge. For example, how far Western food habits are physiologically (or rather, ‘microbiotically’) altering the microbiota of ethnic Arabs residing in Arabian Peninsula? If so, how such changes are likely to impact their BMI in the long-term? Future lifestyle studies among the residents of the GCC countries including Oman may need to address such questions.

5.8 The Un-weighed 7-day Diet diary, reporting of EI and macronutrients

In the present study, the analysis of the diet diaries of all reporters was carried out first and then misreporters were excluded, and detailed analysis conducted for normal reporters. This strategy is often mentioned in the literature, including a study by Fialkowski et al. (2010) conducted in Washington among 518 young men and women aged ≥ 18 years. They found that when the analysis included the misreporters, there was no association between BMI and intakes, but after excluding misreporters, a strong positive significant relationship emerged between the reported daily energy intake and BMI of normal reporters. In the present study such association was not found.

In the current study, there was a significant negative relationship between BMI among all reporters, (normal-, under- and misreporters) and the ratio of total estimated energy expenditure reported energy intake from un-weighed diet diary. There were no significant differences between the daily consumption of energy intake, carbohydrate, protein, and fat among the participants including the misreporters. This differs from the results of Albar et al. (2014) who revealed a strong positive significant relationship between daily intake (of energy, carbohydrate, protein, fat) and BMI among normal reporters’ British adolescents, whose dietary intake had been quantified by un-weighed 4-day diet diary.

5.8.1 Misreporting Energy Intake

In this study some high BMI participants tended to overestimate their physical activity and underestimate their EI. These cases were identified, and their impact neutralised as explained in section (4.1.15). Many studies have pointed out this problem, particularly in national obesity and physical activity surveys. For example, the 2007 Australian Children's Survey data on 4,800 children aged 2–16 years were subjected to the direct comparison of EI to TEE, Goldberg cut-offs and linear regression (Rangan et al. 2011). Underreporting of energy intake was 5–6.7%, and over reporting was 1.6–3.0%. The researchers state: 'Characteristics associated with under-reporting among youth included older age, female, higher BMI, higher physical activity levels, living in an urban location, lower parental education level, and feeling unwell on the survey day' (Rangan et al. 2011). Some of these characteristics were shared by the under-reporting adolescent girls in the present study.

The present study filtered out 26 misreporters and ran statistical tests on the normal reporters. The latter showed no significant correlation between their self-reported daily energy and macronutrient intake and BMI. Furthermore, in the present study, after excluding the misreporters, a paired samples t-test was conducted to examine the difference between the mean of the reported energy intakes were compared to the mean of their estimated TEE. There was no significant difference between their consumed energy and spent energy. This confirmed these participants were indeed valid normal reporters. Similar results were reported among 64 Philadelphia female adolescents (11–15 years) whose total daily energy intake was measured by 24-hour food recalls (Gordon-Larsen 2001).

5.8.2 Dietary Reporting

In the present study, 59 Omani adolescent girls (49% normal weight and 51% overweight/obese) were enrolled to record their un-weighed diet diary regarding the daily food and drink consumption for seven consecutive days inclusive of schooldays and the weekends. The average reported daily energy intake was significantly lower (1,518 kcal) compared to the average TEE (1,765 kcal), which showed a negative energy balance between energy consumed and spent. To filter out misreporting the energy consumption the 7-day diet diaries were assessed using EI: TEE ratio (Black 2000) (see section 3.6.4.1).

Thus, from the current data, under-reported 7-day diet diaries were identified and excluded from subsequent statistical analysis. Nutrient-wise, significant under-reporting occurred in all categories: carbohydrate at 154 g (against 240 g by normal reporters), protein at 42 g (55 g),

and fat at 41.5 g (61 g). However, in several studies the under-reporters reported slightly higher consumption of carbohydrate and protein, and lower consumption of fat compared to normal reporters (Carlsen et al. 2010). It suggested that such participants may want to show they were consuming less fat (Goris et al. 2000).

In this study, the overweight—rather than the obese—participants accounted for most under-reporting (17%). This observation has the support of a large study conducted in Australia where overweight participants were more likely to underestimate their overweight status, while those who were obese had a more correct perception of their real weight (Hayward et al. 2014). It may be that the overweight group are unable to accept the reality of their higher BMI and are seeing themselves to be near normal weight. Meanwhile the obese group are so far removed from the ideal BMI that many of them may have accepted the reality of their obesity. This may perhaps explain why the overweight group had the greatest tendency to underreport their food consumption. Such under-reporting may be less deliberate than they seem, for they arise from complex psychosocial motivations including instances of unconscious denial (Maurer et al. 2006).

The validity and subsequent interpretation of dietary data could be affected by the number of days of food intake to be recoded (Kerr et al. 2013). For example, a 24-hour dietary-recall-based on a study conducted by Gillman et al. (1997) showed a negative relationship between intake of saturated fats and the risk of stroke. This exemplifies why researchers should not construct their findings based on a one-day report on food consumption mainly because diet types and quantities vary from day to day.

Livingstone and Black (2003) argued that teenagers may lack motivation to regularly record their daily food consumption and as a result, there is a chance of teenagers under-reporting or reporting incorrect details. This was an issue in many studies, including the current study, which revealed that 56% participants could be classified as normal reporters, 37% as under-reporters and 7% as over-reporters. In Vainik et al. (2016) study in Estonia, the self-reported dietary intake of 313 boys aged 14 years had a prevalence of under-reporting of 74%, against 37% in the current study, while over-reporting was 4%, lower than the current 7%. There was a similarly high prevalence of under reporting (73%) in a British study among 636 boys and girls aged 11–18 (Albar et al. 2014). Maffeis et al. (2017) reported the findings from 58 children and adolescent diabetes sufferers (8–16 years old) who participated in the completion of a 3-day weighed dietary record with the help of their parents. Their prevalence of under reporting

of 33% was comparable to that of the present study. Parental involvement brought down under-reporting to 5% among children and 26% among adolescents in a French study involving 1,455 participants aged 3–17 (Lioret et al. 2011) based on their 7-day food records, using the Goldberg criterion to screen out misreporting. Garriguet (2008) assessed dietary intake of 35,107 Canadian adolescents using the 24-hour food recall. Upon assessment by EI: EE ratio, under reporters were 33% while over reporters were 10%. Additionally, Carlsen et al. (2010) revealed the findings of 346 Norwegians aged ≥ 18 years using weighed 7-day diet diary aided by digital food weighing scale. Here the prevalence of under-reporters was marginally lower (32%) than in the present study. Using measured digital food scale could help provide more accurate information about the amount of consumed foods and drinks (Ortega et al. 2015).

All mentioned studies agree that under-reporting daily energy intake to be common among overweight and obese study participants (Mattisson et al. 2005; Rasmussen et al. 2007; Carlsen et al. 2010; Mendez et al. 2011; Toozee et al. 2012; Mullaney et al. 2014; Livingstone and McNaughton 2017; Nordkvist et al. 2018). Another possibility is that a participant during the recording period may change his/ her eating pattern or may start a weight reduction programme (Westerterp and Goris 2002). Rennie et al. (2007) suggested to weigh the participants before and after the dietary recording period.

In this present study, to improve dietary self-reporting accuracy, the participants were given detailed verbal and written instructions on how to maintain their self-reported diet diary (see section 3.6.4). To improve the accuracy of the daily food intake reporting and to create a ‘gold standard’ or objective measure to evaluate self-reported dietary intake, a study was conducted in Aberdeen, Scotland by Stubbs et al. (2014) which had both visible and hidden measurements of food consumption while the subjects had free access to different types of food. The daily food intake was objectively measured in a laboratory setting (laboratory weighed intakes) during the hidden phase and self-reported during the visible phase. The researchers found differences between the reported energy consumption and the actual consumption to be between 5–21% for both genders. This finding provides evidence that there is no ‘gold standard’ or a method which will avoid the instances of mis-reporting by research participants of their accurate dietary consumption habits. At the same time, the study concluded that measured laboratory setting can be used with adult and adolescent participants alike (Stubbs et al. 2014).

Assessing dietary intake of adolescents is challenging also because they may not give accurate portion sizes (Livingstone et al. 2004). It has been emphasised that teenagers have high interest to work with technology (Boushey et al. 2009) so, selecting the appropriate dietary assessment methods according to the need and interest of the studied participants will help in increasing the accuracy level of food records (Foster et al. 2009).

Young people's fascination for smartphones can help reduce misreporting, improve the accuracy of their dietary recall, and serve as a permanent assessment record for the researcher. In the USA, Six et al. (2010) gave the 78 adolescents aged 11–18 years mobile phones to wear around their neck throughout the study period asked them to capture the images of all the food and drinks they consumed, before and after eating. This helped the participants to remember and record in detail the foods and drinks they consumed. At the same time the quantity of each dietary intake was also documented, and the image taken helped increase the accuracy of daily food intake recording and relieve the remembrance burden. However, since the assessment deals with non-weighed method, a more reliable estimation becomes possible regarding the amount of food consumed. In the present study this method was unsuitable as adolescent mobile phone use—let alone photography—is discouraged in a traditional country like Oman.

5.8.3 Energy Intake of Valid Reporters

In the present study, despite the detailed instructions given to the study participants on how to maintain the diet diary, all normal reporter participants reported daily energy intakes (1,681kcal) less than the recommended 2,400 Kcal/day. This recommendation is based on a physically active person – your female subjects were not physically active; therefore, this study participants do not require 2,400 kcal a day.

Persistent insufficient energy intake might lead to malnutrition (Mahan and Escott-Stump 2004). However, among Palestinian adolescents, 53% of males and 68% of females reported less daily energy intake than the recommended values of 3,000 and 2,200 kcal/ day, respectively, which was lower than the amount reported in the present study (Jildeh et al. 2010). In a study by Harahap et al. (2018) reported that Indonesian school age children (6–11 years) consumed lower mean daily energy (1,195 kcal) in comparison to Omani female adolescents of the present study. Whereas, Ghanaian children (11–15 years), Canadian normal reporters (12–17 years) and British normal reporters (11–18 years) consumed higher daily energy (2,074 kcal, 1,954 kcal and 2,251 kcal, respectively) than the female adolescents of this study (Albar et al. 2014; Jessri et al. 2016; Annan-Asare et al. 2017). Garriguet (2008) indicated that the

daily energy intake of normal energy reporters of Canadian (≥ 12 years old) was higher (2,349 kcal) than those reported by Omani girls in the current study.

The findings of the present study of daily energy intake and macronutrients revealed no significant differences between the participants in different BMI groups. However, a study reported by Albar et al. (2014) found that normal weight British adolescents had significant higher daily energy intake (2,251 kcal) than overweight/ obese participants (1,633 kcal). Additionally, Harahap et al. (2018) reported that Indonesian school age, overweight children consumed a higher mean of daily energy intake (1,381 kcal) when compared to their normal weight peers (1,185 kcal). On the other hand, normal weight Palestinian adolescents of both genders consumed a significantly higher mean of daily energy intake (2,016 kcal) than obese participants (1,541 kcal) (Jildeh et al. 2010). Palestinian boys consumed significantly higher daily energy (2,158 kcal) compared to girls (1,651 kcal) (Jildeh et al. 2010). However, the incidence of obesity and overweight among Palestinian boys was lower (30%) than girls (39%), which might be because 29% Palestinian boys performed physical exercise five days or more weekly compared to 16% girls (Jildeh et al. 2010).

In the present study the results of energy intake of 33 participants who classified as normal reporters showed that calories, they gained from protein accounted for 13%, carbohydrate contributed 54%, and fat 37.5% of the total energy intake. This result is like that from a Turkish study on 970 girls aged 12–17 (Öner et al. 2005). The girls completed self-reported 3-day diet diary. Norwegian adolescents of both genders and Flemish boys reported higher levels of energy gained from protein (17% and 15%, respectively) and fat (35% and 36%, respectively), while energy gained from carbohydrate was lower (42% and 49%, respectively), in comparison to the Omani adolescents in this study (Matthys et al. 2003; Carlsen et al. 2010). This may be because of the colder climates increases the body's perceived need for more fat for insulation and as a more efficient source of energy than carbohydrate (Torgan 2014).

5.8.4 Carbohydrate intake

The present study participants' daily average carbohydrate intake was 240g. British adolescents reported almost the same intake of 243 g (Albar et al. 2014). However, significantly higher figures were reported by Ghanaian adolescents (294 g) and Canadian female adolescent normal energy reporters (291 g) (Garriguet 2008; Annan-Asare et al. 2017).

The present study reported the average energy gained from carbohydrates at 53.5%, which was higher than the 49% gain reported by Canadian female adolescent normal energy reporters and

by Danish adolescents of both genders (51%) (Garriguet 2008; Bjerregaard et al. 2018), but lower than the average energy gain of 56% from carbohydrates by Ghanaian adolescents (Annan-Asare et al. 2017)

5.8.5 Protein intake

In the current study, the average daily protein intake by the Omani adolescent girls was 55 g, higher than the recommended 48 g. However, 30% girls consumed less protein than recommended. Higher average daily protein intakes were reported by Canadian adolescent girls (93 g), British adolescents (67 g) and Ghanaian adolescents (76 g) (Garriguet 2008; Albar et al. 2014; Annan-Asare et al. 2017). Jildeh et al. (2010) revealed that 48% of the Palestinian adolescent girls consumed daily proteins less than the recommended value of 44 g of proteins per day, higher values compared to this study findings. Furthermore, the current study participants' average energy gained from protein, at 13%, was lower than that of Canadian adolescent girls (16%), British adolescents (15%) as well as that of 12–15-year-old Danish adolescents (15%). (Garriguet 2008; Albar et al. 2014; Bjerregaard et al. 2018). Adequate energy and protein intake during adolescence is vital for the normal growth and development (Bass and Inge 2006). Overall healthy nutrition during teenage years also helps prevent later chronic diseases (Wahl 1999).

Systematic reviews indicated significant association between increased consumption of protein during childhood with increased risk of obesity during adulthood (Martorell et al. 2001; Hörnell et al. 2013). A longitudinal study conducted by Skinner et al. (2004) revealed that there was a positive relationship between protein intake and BMI among children aged 2–8 years old. The sources of protein are animals and plants. Animals' protein contains high saturated fat and cholesterol (Xu and Xue 2016) and no fibre, whereas plant protein (found in legumes, seeds, nuts, cereals, and some vegetables) is accompanied by fibre (Adhikari et al. 2016). Thus, consumption of plant-based proteins has a significant association with lower body weight and blood pressure (Craig and Mangels 2009). A risk of mass-produced meat and poultry is that they contain residues of various hormones and drugs used by farmers to artificially accelerate animal's growth. Such residues are also attributed to the rise in pediatric obesity and precocious puberty in girls (Delatour et al. 2018, Wang et al. 2017). A largely plant-based diet with less meat and poultry may be a safer and healthier option to prevent obesity in children in Oman.

5.8.6 Fat intake

In this present study, 21% of the participants reported higher dietary fat intake than the recommended 70 g/ day. Whereas, Jildeh et al. (2010) reported a high prevalence of dietary fat consumption among male Palestinian adolescents (40%) and female (30%) higher than the recommended total dietary fat intake which is <30%, higher than reported in this study. Nicklas et al. (2002) indicated that the increased intake of high fat food is a leading factor associated with obesity in young people. The average daily fat intake was 61 g, in the present study, less than that of Canadian female adolescent normal energy reporters (87 g), British (69 g) and Ghanaian adolescents (71 g) (Garriguet 2008; Albar et al. 2014; Annan-Asare et al. 2017). However, in terms of contribution to overall energy intake this study reported the energy gained from fat was 33%, nearly matching that of Canadian adolescent girls (32%), British adolescents (34%) and Danish adolescents (34%) (Garriguet 2008; Albar et al. 2014; Bjerregaard et al. 2018).

In summary, this study showed increased levels of overweight and obesity among Omani female adolescents. Therefore, it could be expected to find high levels of daily energy intake. What was found reported was lower-than-recommended energy intake. However, they also reported low levels of physical activity, so the low energy intakes might have been appropriate to their low energy requirements. The diet diary of normal reporters showed no significant differences between the participants across BMI groups in daily intake energy, macronutrients and the percentage of energy gained from macronutrients.

Cooking programmes could be introduced among school teachers in Oman to inculcate practical and disseminable knowledge about healthy cooking. High school students (both boys and girls) can also be given practical workshops where they choose each ingredient according to its nutritive content and cook in a healthy way. This will also help Omani boys to shed their gender bias regarding cooking being a feminine occupation. High school science curriculum can also be expanded to include basic healthy cooking and schools could include similar initiatives that have been successful in Scotland such as; the Healthier Scotland Cooking Bus programme, where primary school teachers are invited to attend healthy cooking training sessions. The feedback from the participants revealed a significant increase in their understanding about the importance of healthy cooking education. Additionally, participants' confidence regarding cooking skill and health teaching had significantly increased (Grubb and Drummond 2017).

Additionally, the ideas of healthy eating habits paired up with education of children and youth have been promoted in schools in Scotland for at least a decade. The Healthier Scotland Cooking Bus, a mobile cooking and nutrition education initiative, has been visiting Scottish schools and societies since 2008. Its mission is to encourage healthy eating habits as a part of an obesity prevention project (NHS 2018a). The Cooking Bus offers practical cooking classes to school children and teachers. The classes are designed and planned to encourage the children, youth and the adults to learn about the social and health benefits and importance of following healthy diet at school, home and broader community at large (NHS 2018a). Additionally, adopting Liberton High School's, experience of introducing 'Food, Health and Textiles Technology' as part of the curriculum of S1–S3 grades might help inculcate the concepts of healthy cooking and eating habits among Omani adolescents.

In conclusion, the findings of the reported 7-day dietary intake of Omani girls are similar to other studies except that there was no significant difference in the dietary intakes between participants in different BMI groups. To ensure accuracy of dietary reporting, comprehensive verbal and written instructions and periodic reminders were given to the participants. Despite such precautions there were case of mis-reporting (mostly underreporting). The mis-reported food intake diaries were identified and excluded from assessment so that the final figures reflected the reality to the extent possible.

5.9 Findings of Lifestyle Factors from Different Instruments

The current study findings show similar findings have emerged from physical activity and dietary habits as measured by different instruments. Cut-off value for physical inactivity reveal similar proportions from pedometer (98%) and screen time. In addition, dietary assessment of fat got a similar proportion (21%) from the two tools (7-day diet diary and ATLS questionnaire). However, the sample sizes in the two instruments were different, the ATLS questionnaire was returned by 421 participants, while pedometer was used by 59, and diet diaries of 33 were used (after eliminating misreporters). However, no evidence was found to support such findings. The fact that the different instruments gave similar results supports the validity and reliability of the study. Both tools are deemed reliable when able to consistently generate the same results.

5.10 Adolescent Lifestyle and Model of Behaviour Change

In the current study, most Omani girls were found to have unhealthy habits such as inactivity and habitual consumption of unhealthy foods that placed them at risk for lifestyle diseases such as obesity, diabetes and cardiovascular problems (Mikus et al. 2012; Afshin et al. 2017). Unlearning unhealthy lifestyle habits and replacing them with healthy ones is a process that can sometimes take a long time. Attempts to change can encounter obstacles, both personal (self-control) and social (peer pressure to return to old habits). In terms of physical activity, obstacles can be particularly daunting for Omani girls who must overcome cultural and climatic barriers as well.

Changing individual behaviours take place in stages. There are several models of behaviour change. For the purpose of the current study, I am following the Six-stage behaviour modification model postulated by Prochaska et al. (2015). The six stages (or ‘six states of change’) are: *pre-contemplation*, *contemplation*, *preparation*, *action*, *maintenance* and *termination*.

Pre-contemplation. This is the ‘first state of change’. The individual’s lifestyle is driven by habits, has no motivation to change them, and is unaware of their consequences (Prochaska et al. 2015). The focus group participants in this study reported that they preferred fast food because of its taste, attractive presentation, as well as easy availability which enabled them to spend more time in front of screens. They appeared to be unaware of the negative health consequences of such lifestyle. Some of them may have been aware but peer pressure caused it to become the ‘new normal’ for them. At that stage they may have been in the pre-contemplation stage.

Contemplation, the second stage of change, is where the individual starts to think to change his/ her lifestyle to be healthy (Prochaska et al. 2015). The focus group participants of this study may have cognitively perceived that fast food was unhealthy for them and lack of physical exercise was likely to help become healthier. But they were not yet developed an action plan so there was no change yet, only a vague realisation that change was needed. Several participants of the present study’s focus group may have been at this stage, as suggested by their confession, ‘we know, but we don’t practice’.

Preparation, the third stage of change is where the individual decides to change, having thought about the advantages and disadvantages of the current situation and imagined the

changed situation and prepared a plan of action (Prochaska et al. 2015). It can be presumed that while participating in the current study Omani girls—particularly those in the diet diary group, pedometer group, and the focus discussion group—began to consciously pay attention to their eating patterns and may have been becoming convinced of the harm fast food and sedentary lifestyle were increasing their body weight.

Action represents the fourth stage of change. Here the individual is ready to implement the prepared plan for the change (Prochaska et al. 2015). At this stage, to implement the new change, Omani girls need to be motivated and have a role model to follow. Unfortunately, participants stated that lack of encouragement and motivation from their family, teachers, friends and public to perform physical activities and to be healthy.

Maintenance, the fifth stage of change is where the individual engages and continues following the new habit (Prochaska et al. 2015). Barriers keep presenting themselves, and they need to be negotiated with knowledge, discipline and determination to maintain the new behaviour or habits to make them habitual. By the fifth stage the person might be already experiencing the benefits of his new lifestyle, which itself may act as a self-motivator.

Termination, the sixth and the last stage of change, is where the new behaviour has become involuntary (Prochaska et al. 2015). A return to the erstwhile unhealthy lifestyle is increasingly unlikely. In this stage, the individual has developed self-efficacy without the need for external motivators or rewards. A study conducted by Scruggs et al. (2018) to determine whether a physical activity intervention affects transtheoretical behaviour model variables that facilitate exercise implementation in breast cancer women. The findings of randomized trials of 60 inactive breast cancer women (n=35 intervention group and n=25 standard care group) show that it is vital to use an approach based on the Stages-of-Change during interventions to increase physical activity in breast cancer women. The intervention group had significantly higher self-efficacy ($p = 0.003$) and perceived significantly fewer negative effects of exercise ($p = 0.025$) at 3 and 6 months than the standard care group.

In this section, I made hypothetical assumptions about my research participants as they passed through Stages 3–6. As only one focus group session per group was conducted, no time-wise changes could be recorded. In hindsight, future studies which want to test the theory of behavioural changes in lifestyle among their subjects may incorporate three focus group sessions—one at the beginning of the study (before assigning the diet diary/pedometer), the second one at the end of that period, and a third and final assessment one after one month, to

see whether the participants' behaviour have been impacted in any sustainable way due to their active involvement in the study, by keeping diet diaries and wearing pedometers. The third session may be supplemented by an anonymous online questionnaire and a final BMI test for more accurate comparisons.

5.11 Strengths of the Study

The various areas of strength found in the current study are discussed below:

1. The current study was designed as an explanatory sequential mixed methods model where the quantitative and qualitative components supported each other. This provided rich and reliable data about Omani female adolescent lifestyle. This study is also the first in Oman with such an age group, region, and topic. Thus, this study will significantly add to the body of knowledge regarding the lifestyle of Omani adolescents. Additionally, methodology, precision and elimination of questionable data that characterised this work will hopefully be employed as a foundation for future lifestyle studies within the Sultanate of Oman.
2. The study used the Arabic version of ATLS questionnaire, already validated in other countries in the region.
3. Female adolescents' lifestyle was assessed by triangulation method, using mix self-reporting such as ATLS questionnaire, diet diary, focus group discussion and objective measurements, pedometer and BMI. Instances of misreporting were identified, and the data pertaining to them filtered out.
4. School Health Nurses were all experienced RNs trained in anthropometric measurements and their participation in the technical part of the study improved the data quality. They were also instrumental in increasing the participation rate due to their long-term professional and personal relationship with the students and their families, teachers, and the school administrative staff. Their presence had a positive impact on the entire data collection process.
5. This study used a comparatively large sample size (N=421) and the participants were randomly selected, so the findings can be generalized to similar population and age group within Oman.
6. Participants' body weight and height were measured using an electronic weighing scale (Seca type) for BMI estimation. WHO BMI z-score charts were used to classify

participants' BMI. Additionally, the ambulatory activity was recorded objectively by using pedometers. These practices lead to improve the reliability and accuracy of the measurements of anthropometric and footstep counts and verify self-reported physical activity.

7. Diet Diary misreporters were identified and excluded during the final analysis, which improved the reliability of that aspect of the study (Castro-Quezada et al. 2015).
8. The current study involved adolescent girls in face to face focus group discussion to share their real experiences about their diet and physical exercise during the discussion, this gave more awareness to Omani adolescent girls about their personal needs and wants and increased confidence to share their opinion regarding their lifestyles. They also made several recommendations to improve their dietary and physical activity environments.
9. The process of analysing the study data and comparing it with other studies and discussing the implications generated several recommendations. The researcher has tried to formulate these suggestions to be practical, low-cost, easy to implement, and culturally and politically feasible for implementation in the traditional Arab Islamic society in Oman and its GCC peers.

5.12 Limitations of the Study

Despite the above-mentioned various strengths of the present study, the following limitations are noted:

1. Energy intake was measured by estimation from an unweighted 7-diet diary rather than weighed or direct observation of food intake. A self-administered online questionnaire was used to assess participants' food habits, physical activity and sedentary behaviours. However, this method of data collection was appropriate to the occasion due to time constraints and limited resources.
2. Pedometers measure mostly footsteps; however, physical activity could be measured more accurately by an accelerometer because it measures footsteps and the level of intensity of physical activities as well. The pedometer is not able to measure the strength of physical activity. However, the estimated intensity of physical exercise performed by the participants was collected by ATLS questionnaire.

3. The ATLS questionnaire presented participants' dietary data based on the frequency of consumption per week without the portion size. However, the estimated portion size was collected by unweighted 7-day diet diary.
4. Only 33 participants completed diet diaries (not representative of the wider population). This study did not assess independent predictors of obesity, inactivity etc. BMI is a limited measure of nutritional status. Saturated fat, free sugar, fibre and fruits and vegetables consumption in grams were not assessed.
5. Another limitation was that participants were all from Ibri Wilayat (state) in Oman. Therefore, restriction to one Wilayat and to one gender (female) may not quite represent the diversity in Oman. It is also possible that some of the lifestyle perceptions and the practices of the participants were specific to Ibri Wilayat.

5.13 Dissemination

The final step of research is the dissemination of the findings so the findings from this study will be disseminated to a larger audience of health care providers and academics (Rees 2003), schools, educationists, and policymakers in Oman, its GCC peers and other Middle Eastern countries. The findings of mixed method research with both qualitative and quantities are important to be distributed widely (Curry and Nunz-Smith 2015). Dissemination will start at my present institution by conducting a seminar or presentation and thereafter in various other relevant forms. Reports will be submitted to the authorities in Oman. Research papers will be submitted to various peer reviewed medical and nursing and educational journals in Oman, such as *Sultan Qaboos University Medical Journal*, *Oman Medical Journal* and *Saudi Medical Journal* (all three PubMed indexed). I also hope to publish my findings in UK-based peer-reviewed journals such as the *British Journal of Nutrition* and *Journal of Human Nutrition and Dietetics*.

Journals published in Oman are distributed to all health institutions in the country, and the copies of other regional and international publications are available in the larger health institutions' libraries. However, with most research journals being indexed by PubMed and made available online, they are accessible electronically to all concerned. Thus, the details of the current study will be accessible either in print or online by different health care providers in Oman such as school health nurses, community health nurses, health educators, medical

professionals, as well all healthcare students. Opportunities for presenting the findings in a conference or workshop conducted at national or regional levels will also be sought. Such dissemination might motivate future researchers to conduct their own studies in related matters (Burns and Grove 2005), particularly since I shall also be mentioning the new hypotheses and action plans (already presented in this paper) some of which may have trigger new research. This motivation might contribute to improve the nutritional and physical activity status of Omani youth.

Additionally, Rees (2003) stated that is important to communicate the research findings to individuals who participated actively in this study. Therefore, the researcher is planning to discuss the summary of this research findings with the school health officers, policy makers at the MOH and MOE, this could help in improving the school health programme.

The researcher has developed practical recommendations to decrease the rising trend in obesity and inactivity in Omani adolescent girls (section 6.2), which will also be disseminated via above mentioned routes. Medium of communication will be English or Arabic as appropriate.

5.14 New Knowledge

There are various new insights that have emerged from this study. The most important among them appears to be the methodology adopted. The mixed methods approach to study adolescent girls in Oman is new and fills a major research gap. Further new knowledge and skill learned from the current study was integration of NetWisp 4 (Tinuviel Software) programme and Microsoft Excel 2010, to analyse the reported nutritional data of the un-weighed 7-day Diet Diaries for total daily energy intake and intakes of fat, protein, and carbohydrate by Omani adolescent girls, see details in section (3.8.3). While on the current study many hypotheses, new research ideas, practical solutions etc. have been occurring in my mind, several of which find expression in this paper. I hope a few of them would inspire me and other researchers to embark on new *result-orientated* studies and practical experiments to prevent a youth obesity epidemic in my country.

This is particularly because the realities of Oman are very different from those of the West, due to its desert climate, socio-cultural restrictions that discourage female physical activity, overprotective attitude of the society towards the female gender, and an educational curriculum that promotes a sedentary lifestyle.

The focus group discussions opened up the dynamics of the daily life of Omani schoolgirls and how individual barriers, big and small, add up to generate an increasingly unhealthy lifestyle, which also explained why obesity was rising with age among the participants. Added to this are the heavy homework assignments that often require teenage girls to postpone their bed time, whose domino effect result in morning hurry, skipped breakfast, lower alertness in class, preferring a heavy energy rich lunch, and limited physical activity during the day.

The focus group discussions revealed how traditional home physical activity opportunities have declined due to maids are employed for housework. Further, the climatic and cultural barriers prevent Omani girls from engaging in outdoor activities, a prominent casualty being cycling. A further new finding was regarding the insufficient school PE hours allotted to adolescent girls. The girls themselves disliked exercising outdoors in the school grounds with their culturally imposed heavy clothing in the hot and dusty schoolground. Another way they lose opportunity for physical activity by walking is that motor transport (cost of cars, spare parts and petrol) is cheaper than most other parts of the world. Thus, even for very short distances they have become habituated to relying on cars.

Overall, the barriers for Omani teenage girls to engage in physical activities are much higher and far more culturally determined than in western countries. This is indeed a sensitive problem for MOE and MOH — to effect activity enhancement among girls in an unfriendly climate which also culturally restrictions and discouraging attitudes of parents and elders regarding girls undertaking physical activity. Here also, focus group discussions and subsequent thinking has caused new practical solutions to be incorporated to this thesis, such as classroom based physical activity, which I hope to submit to MOE for consideration.

Chapter (6) Conclusion and Recommendations

6.1 Conclusion

The results of this mixed methods study on the lifestyle characteristics of 421 Omani schoolgirls aged 15–18 years chosen from a typical semi-rural town of Ibri, can be considered representative of this demography in Oman. The tools used in the study included ATLS questionnaire, 7-day un-weighed diet diary, self-reported daily physical activity, pedometer data, as well as focus group discussions. Anthropometric measurements showed that more than one third of total participants were either overweight or obese. Almost all (98%) pedometer-wearing participants took average 5,755 footsteps per day against the recommended 10,000–11,700 steps. There were statistically significant differences in the daily footsteps between participants in different BMI groups. The pedometer data indicated that normal weight participants clocked the highest mean footstep counts of 6,625 per day, which fell to 6,094 footsteps in the overweight girls, falling further to 5,755 for their obese peers. All normal reporter participants reported EI and carbohydrate intake were less than the recommended value of 2400 Kcal and 330g–450g/ day. In addition, overweight and obese participants were significantly more likely to consume fatty and energy rich, foods than participants in other BMI groups. Most participants had low daily energy intake and low physical activity levels. Increased screen time also decreases physical activity levels and could be a leading cause for increasing body weight among Omani adolescent girls. The trend towards obesity appeared to be increasing among Omani adolescent girls along with their age (a notable exception being the 18-year-olds). This is of concern because another Omani study showed even higher BMI was prevalent among young women. Thus, poor lifestyle in teens as revealed by this study suggests a bleak future where obese young mothers becoming poor role models for the next generation of Omani children.

This study has revealed a clear inverse association between Omani teenage girls' time spent using electronic devices, and their daily sleeping time. Screen time has an indirect effect on inactivity and obesity. But it promotes a powerful and self-perpetuating cycle. It begins on week-days with the more than two hours of screen time, which consumes the evening hours that encroach into homework time involving more computer screen time. Staring at the daylight mimicking screen upsets the circadian rhythm leading to late and insufficient sleep. The next morning, breakfast gets skipped in the rush to catch school bus, which in turn triggers the mid-

morning hunger pangs and craving for an energy-rich lunch. In the evening, the screens take over again where fast food advertisements on prime TV and on social media further the desirability of sweet and fat-rich foods. The very act of sitting still in front of attention-grabbing screens might be promoting the sedentary habit among teenagers. Educate parents about establishing screen time contract with their children. Drastically cutting screen time (mainly employing the traditional Arab-Islamic parental authority) should end perpetuation of the above-mentioned cyclical pattern and help Omani adolescent girls towards healthier lifestyle.

The Arab-Islamic world's cultural barriers also discourage female physical activity. The focus group participants perceived several barriers to physical activity, including discouragement from their parents, brothers, and friends. Such cultural bias was evident even in the school curricula. PE hours were less for girls compared to boys. Certain sports such as cycling, and football were restricted to boys. The participants also perceived a shortage of culturally appropriate and female-friendly sporting facilities. They also felt the lack of role models in female sports.

Arabian desert climate is another major deterrent for outdoors physical activity among girls. Girls in the focus groups revealed their dislike for exercising outdoors in the heat and dust wearing culturally mandated sports dresses. Oman's interior spaces may be partly responsible for their attitude. These are inviting spaces, almost universally air conditioned and dust-free. At home, household work was being taken care of by expatriate housemaids. The girls also mentioned how air conditioned motor vehicles deter them from walking even short distances.

Clearly, girls in Oman and in much of the Arab world are facing more complex barriers to a healthy lifestyle than their western counterparts do. Previously, traditional barriers had not prevented Omani females from essential physical activities such as household work, shopping on foot, walking to school etc. Affluence and modern amenities seem to have robbed them of even their traditionally permitted physical activities. Added to this are the convenience and palatability of fast food. It is also possible that the new invisibility of Omani females walking in public places may have made it even more difficult for adolescent girls to exercise publicly without being the centres of attention. Cultural barriers need to be negotiated with great care. Climatic barriers have always been there. This calls for evolving specific custom solutions that tread softly on cultural sensitivities, bypass the climatic difficulties, and keep adolescent girls of Oman empowered within their restricted sphere of freedom to extract the most out of it. This means that health education and other intellectual initiatives may have to be supplemented by

strong proactive measures, some of which may need to be enforced. With this understanding, some recommendations are presented below.

6.2 Recommendations

From the current findings, the problems have become clear and some practical solutions have emerged all of which have been discussed in detail in the previous sections, particularly in sections (5.4.6.1, 5.6.3, 5.7.1). The researcher of the current study seeks to start with simple changes that can be readily introduced, cost very little, are easily enforceable, culturally appropriate, and climate-friendly. Schools and homes are where changes should begin.

Also suggested are more strategic long-term changes that transform the ground reality, encourage voluntary relaxation of some cultural barriers to promote female empowerment, and seeking long-term changes that ultimately impact the lifestyle habits of the female population of Oman. Such strategic reforms may need to be made by public policy, whose implementation should be persistently monitored and periodically audited:

1. Promote and enforce in-school physical activity:

- Introduce classroom-based physical activity in girls' schools in Oman, both governmental and private. Classroom based physical activity seems to prevail over all the Arab world's cultural and gender-specific arguments against girls exercising. It also suits Oman's climate and makes use of existing facilities with minimum costs. Teacher will play the key role here, as revealed by our focus group participants. Teachers need to be educated about the obesity crisis, and appropriately trained so that it becomes their part of their professional commitment. (Details in Section 5.4.6.1)
- The above may be supplemented by increasing the present weekly 45-minute PE sessions for grade ten to bi-weekly and conducted in air-conditioned school gymnasiums except in the winter months. Indoor-compatible games such as basketball, volleyball and badminton, which take up less space despite being activity-intensive, should be prioritized. Even among these basketball and volleyball (which accommodate more participants in given space) might be the best options. It is also suggested that during winter months sporting activities be moved

outdoors to encourage the habit of spending more time outdoors when the weather permits.

- School teachers must be asked to reduce the load of homework to prevent late sitting at night. Well-slept and breakfasted children are likely to be more alert and learn more during school hours thus compensating for less homework.
- Schools should conduct semester-end ‘sport open days’ open to all students, mothers, and teachers to participate in different types of competitive and fun activities by including moderate to vigorous activities suitable for different age groups. The participation of role models like mothers and teachers might motivate the students to increase their own participation. The physical education department of each school might coordinate the events by giving the major responsibility to students (head-girls or class leaders) to own and organise these.
- Give Physical Education the status of a core academic subject rather than an elective.
- Construction of walking paths in Ibri Wilayat (where this study was conducted) may increase residents’ physical activity level, as has been found in another Omani town, Nizwa. Given the Omani social male/female interaction standards, to increase female physical activity their privacy during path walk time must be protected. To ensure that a special female only path use time would have to be introduced. This could contribute to motivating women and girls to perform physical exercises to improve their general health and BMI.

2. Enforce bedtime:

- Parental authority in the Arab-Islamic world can be capitalised here. Parents need to enforce a strict rule of ‘lights-out, screens-off’ at 8–9 pm according to their child’s age, removing all mobile phones and tablets from their bedside. However, in order to motivate parents to enforce the discipline, they and other elders should first be educated on the need to enforce early dinner and strict bedtime so that adolescents receive at least eight hours of sleep, so that they get up refreshed in the morning and have time to eat breakfast before going to school.

- Ministry of Education needs to instruct teachers to reduce the homework of children and adolescents to prevent delaying bedtime on that account.
- Omani homes need to switch over to warm/yellow LED lighting (as opposed to white LEDs) in living rooms and children's rooms to facilitate earlier sleep at night. Government subsidies for warm LED lights would also help increase their popularity.

3. Discourage fast food and encourage healthy food:

- Reshape school canteens as centres of model nutrition and nutrition education. School canteens should be closely supervised by the ministries of health and education. The allowable foods and their presentation may be defined. Canteen walls could have posters with nutrition education content. Letter boxes may be provided in canteens to receive suggestions from students and their parents which should be read periodically by school committees and action taken.
- The Scottish model of physical activity promotion among children and adolescents, with its high volunteer participation, low costs, and collaboration with sports clubs, deserves to be examined for viability with cultural adaptation, could be adopted, for countries with high youth obesity risk such as Oman and its GCC peers.
- 'Food Health and Textiles Technology' is part of the curriculum of Liberton High School, Scotland, which teach boys and girls of S1–S3 grades (13–15 years of age) about various food groups, kitchen hygiene, and basic healthy cooking. Introducing such a subject into the Omani high school curriculum (both high school boys and girls) might help improve dietary habits and help narrow the gender gap.
- Encourage school children the habit of carrying a lunch bag with healthy homemade snacks, milk, fruits, and vegetables will help in modifying the dietary habits among children and adolescents. The school should inform mothers the importance of encouraging their children to carry the lunch bag filled with healthy snacks.
- To compensate for breakfast skipping, breakfast clubs similar to those in Scotland could be introduced in primary and secondary schools in Oman.

- The Omani government in collaboration with other GCC governments may consider declaring illegal all advertisements and promotional campaigns for unhealthy foods and beverages.
- Obese and overweight students may need psychological support and counselling particularly at the beginning stages of any lifestyle change. High BMI children's needs need to be prioritized. They should receive physical and psychological support from their parents, school health nurses, school administration and teachers during their physical activity programme.

4. Health Education:

Educate young children about the health consequences of obesity, its prevention, and early diagnosis. The findings of this study provide evidence to improve the physical activity and food habits among school age children and adolescents in Oman.

- Educate the Omani public on the powerful physiological reasons we naturally choose fatty and sweet food and sedentary lifestyles over healthier options so that they understand and accept some top-down enforcement of healthy lifestyle.
- In Oman, 'Healthy Lifestyle' education should be given to school children, parents, teachers as well as the public. Ministries of health and education should work together for the successful implementation of this health education programme. This could be part of Oman's School Health Programme and school health nurses should be responsible for its implementation. It is important to make health education a prominent part of the school biology curriculum. Learning healthy habits at young age might help in improving health in later life.
- Train school teachers, particularly science teachers, to transfer the knowledge and skill about healthy food to a larger group of young learners. These learners may subsequently transfer their learning to their families and community.
- Organise essay and poster competitions among children and teenagers that promote healthy lifestyle. This can be jointly supervised by MOE and MOH.

6.3 Further research

- There is a shortage of studies from Oman regarding the impact of the widely practiced siesta/midday nap on the lifestyle and BMI of adolescents in the region. This needs to be included in future studies on sleep, food habits, physical activity, and BMI in Oman and its GCC peers.
- Future research could include employing weighed 7-day diet diaries to assess adolescents' energy intake which would provide more accurate energy intake reporting. Replicate the study by enrolling both genders and extend the age group from 12 years to 18 years to involve early adolescents in assessing their lifestyle and to explore differences between genders. The study can involve more than two schools and increase participant numbers if possible, in a different region than the studied one.
- In order to practically observe whether the “Six Stages of Change” are happening among the diet diary participants, three focus group sessions can be conducted, the first before their diet diary maintenance begins, the second after the diet diary period is over, and a third, one month later. Their BMI can also be measured after the third focus group session can compared with previous BMI.

RCTs of interventions to reduce obesity, improve lifestyle outcomes should be conducted in the adolescent population group.

- To date, no study has been published regarding Omani parent perceptions of their children's or adolescents' lifestyle. As parents are primarily responsible and empowered in developing healthier lifestyles for their children, understanding their perception might help in finding the appropriate actions to correctly educate and motivate Omani families to follow healthy lifestyle.

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Appendices

Appendix (1) Ethical approval from Queen Margaret University, UK

23/11/2015

REP 0124 - Z Al Mahrouqi - Confirmation of Ethical Ap... - AlMahrouqi, Zuwaina

REP 0124 - Z Al Mahrouqi - Confirmation of Ethical Approval

Research Ethics

Thu 12/11/2015 13:16

To: AlMahrouqi, Zuwaina <ZAlMahrouqi@qmu.ac.uk>;

Cc: Drummond, Sandra <SDrummond@qmu.ac.uk>;



Queen Margaret University
EDINBURGH

12 November 2015

Dear Zuwaina,

Ethical Approval – Assessing the Lifestyle (Physical Activity Level and Eating Habits) among Adolescent Girls in Oman: A Mixed Methods Study.

Thank you for your response to the letter I sent you following consideration of your application by the Research Ethics Panel.

Dr Chee-Wee Tan, Convener of the Panel, has reviewed your response to the points you were required to address, and has confirmed that he is happy to take Convener's Action to grant full ethical approval for your research.

A standard condition of this ethical approval is that you are required to notify the Panel, in advance, of any significant proposed deviation from the original protocol. Reports to the Committee are also required once the research is underway if there are any unexpected results or events that raise questions about the safety of the research.

We would like to thank you for your co-operation and wish you well with your project.

Yours sincerely

Lucy

~~~~~

Lucy Hinds

Quality Enhancement Officer

Governance and Quality Enhancement

Queen Margaret University, Edinburgh, EH21 6JU

Tel: 0131 474 0000; Say "Lucy Hinds" when prompted by our automated system

<https://outlook.office.com/owa/#viewmodel=ReadMessageItem&fileID=AAMkADY2ZTEOTM2LWVMYzEiNDgyYs04YzkyLWFIMTY2NzFkMWYxMA...> 1/2

## Appendix (2) Ethical approval from Ministry of Education, Oman

Sultanate of Oman  
Ministry of Education  
Directorate General of Education  
Al-Dhahira Governorate

سلطنة عمان  
وزارة التربية والتعليم  
المحافظة الظاهرة للتعليم  
لمحافظة الظاهرة

التاريخ  
١٢/١٩/٢٠١٥

الرقم  
المحترمة

الفاضلة/مديرة مدرسة الغالية بنت ناصر للتعليم الأساسي  
المحترمة

الفاضلة/مديرة مدرسة فاطمة بنت أسد للتعليم الأساسي (٥-١٢)  
السلام عليكم ورحمة الله وبركاته

بعد التحية ، وبالإشارة إلى المخاطبة أعلاه ، نفيديكم بأن الفاضلة/ زوينة بنت حميد المحروقية، طالبة دراسات عليا دكتوراه بجامعة الملكة ماجريت بالملكة المتحدة، تقوم حاليا بإجراء دراسة بعنوان: "تقييم نمط الحياة ( مستوى النشاط البدني وعادات الأكل) بين الطالبات في سن المراهقة في سلطنة عمان" وترغب الباحثة في تطبيق أداة الدراسة على عينة من طالبات المدرستين المذكورتين (نافذة تنبع).

عليه يرجى التكرم بتسهيل مهمة الباحثة في تطبيق أدوات دراستها ، حيث أنها ستقوم بزيارتكم ، وذلك لتوزيع الاستبانات على عينة من طالبات المدرستين، كما ستقوم بعمل بعض المقابلات مع بعض الطالبات .

فترجو التكرم بتسهيل مهمتها بحيث لا يؤثر على سير دراسة الطالبات. وفي حالة وجود أي استفسار يمكن الاتصال بالباحثة مباشرة على هاتف رقم (٩٥٥٩٠٠١٤).

شاكرين ومقدرين تعاونكم.  
وتفضلوا بقبول فائق الاحترام والتقدير،،،

حكيم بن سام بن حكم الفارسي  
دائرة تنمية الموارد البشرية  
مدير دائرة تنمية الموارد البشرية

www.moe.gov.om. : الموقع على الانترنت : ٢٥٦٨٩١١٠ ، فاكس : ٢٥٦٩٠٤٤٦ ، هاتف : ٥١١ عيري ،  
P.O. Box : 1, Postal Code : 511 lbri, Tel. : 25690446, Fax : 25689110, Website : www.moe.gov.om.

## Appendix (3): Parental and Participants' Consent Forms



Queen Margaret University

EDINBURGH

### Parental Consent Form

#### Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study

I have read and understood the information sheet and this consent form. I have had an opportunity to ask questions about my daughter's participation.

I agree to ----- (daughter's Name) participate in this study.

I understand that I have the right to withdraw my daughter from this study at any stage without giving any reason.

Signature of Parent/ Guardian: \_\_\_\_\_

Signature of researcher: \_\_\_\_\_

Date: \_\_\_\_\_

Contact details of the researcher

Name of researcher: Zuwaina Humaid Al Mahrouqi

Address: Department of Dietetics, Nutrition and Biological Sciences.

Queen Margaret University, Edinburgh

Queen Margaret University Drive

Musselburgh

East Lothian EH21 6UU

Email / Telephone: [ZAlmahrouqi@qmu.ac.uk](mailto:ZAlmahrouqi@qmu.ac.uk) / 0131 474 0000



Queen Margaret University  
EDINBURGH

### Participant Consent Form

#### Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study

I have read and understood the information sheet and this consent form. I have had an opportunity to ask questions about my participation.

I understand that I am under no obligation to take part in this study.

I understand that I have the right to withdraw from this study at any stage without giving any reason.

I agree to participate in this study: Please (✓) as appropriate, **Yes/ No**

Name of participant: \_\_\_\_\_

Signature of participant: \_\_\_\_\_

Signature of researcher: \_\_\_\_\_

Date: \_\_\_\_\_

#### Contact details of the researcher

Name of researcher: Zuwaina Humaid Al Mahrouqi

Address: Department of Dietetics, Nutrition and Biological Sciences.

Queen Margaret University, Edinburgh

Queen Margaret University Drive

Musselburgh

East Lothian EH21 6UU

Email / Telephone: [ZAlmahrouqi@qmu.ac.uk](mailto:ZAlmahrouqi@qmu.ac.uk) / 0131 474 0000

## Appendix (4): Parental and Participants' Information Sheets



Queen Margaret University

EDINBURGH

### Participant Information Sheet (Questionnaire)

My name is Zuwaina Humaid Al Mahrouqi and I am a PhD student from the School of Health Sciences at Queen Margaret University in Edinburgh. To fulfil the criteria for my PhD, I am undertaking a research project. The title of my project is: **Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study.**

This study aims to investigate the physical activities, sedentary behaviour and eating habits among female adolescents aged from 15-18 years old. The findings of the project will be valuable in improving the school health population and the school health programme as well.

I am looking for volunteers to participate in the project. They should be female Omani students aged between 15-18 years old, studying in the tenth to twelfth grades and free from any physical disabilities. If you agree to participate in the study, your weight and height will be measured. Additionally, you will be invited to complete an online questionnaire about your physical activities and food habits; it should take approximately 25 minutes. Your name will be replaced with a participant number, and it will not be possible for you to be identified in any reporting of the data gathered. You will be free to withdraw from the study at any stage and you would not have to give a reason.

The results may be published in a journal or presented at a conference.

If you have any questions about this study, you can contact me or my director of studies Dr. Sandra Drummond. All contact details are given below.

If you have read and understood this information sheet and you are willing to participant in this study, please sign the attached consent form and return it to me.

Thank you in advance for your participation in my study.

**Contact details of the researcher:**

Zuwaina Humaid Al Mahrouqi  
PhD Student.  
Department of Dietetics, Nutrition and  
Biological Sciences.  
**Queen Margaret University, Edinburgh**  
Queen Margaret University Drive  
Musselburgh  
East Lothian EH21 6UU  
[ZAlmahrouqi@qmu.ac.uk](mailto:ZAlmahrouqi@qmu.ac.uk) / 0131 474 0000

**Contact details of the Director of Studies: Dr. Sandra Drummond**

Programme Leader & Senior Lecturer in Nutrition.  
Department of Dietetics, Nutrition and  
Biological Sciences.  
**Queen Margaret University, Edinburgh**  
Queen Margaret University Drive  
Musselburgh  
East Lothian EH21 6UU  
[sdrummond@qmu.ac.uk](mailto:sdrummond@qmu.ac.uk) / 0131 474 0000



Queen Margaret University  
EDINBURGH

### **Participant Information Sheet** (Diet Diary, Pedometer)

My name is Zuwaina Humaid Al Mahrouqi and I am PhD student from the School of Health Sciences at Queen Margaret University in Edinburgh. To fulfil the criteria for my PhD, I am undertaking a research project. The title of my project is: **Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study.**

This study aims to investigate the physical activities, sedentary behaviour and eating habits among female adolescents aged from 15-18 years old. The findings of the project will be valuable in improving the school health population and the school health programme as well.

I am looking for volunteers to participate in the project. They should be female Omani students aged 15-18 years old, studying in the tenth to twelfth grades and free from any physical disabilities. If you agree to participate in the study, you will be asked to record your diet intake for 7 days and wearing an activity monitor (pedometer) around your waist for 7 days to record your physical activities. The monitor should not interfere with your daily activities. You have to remove the monitor before taking a bath and before going to bed. You will be given more details in one-hour orientation session on how to complete your diet diary and use the pedometer.

Your name will be replaced with a participant number, and it will not be possible for you to be identified in any reporting of the data gathered. You will be free to withdraw from the study at any stage and you would not have to give a reason.

The results may be published in a journal or presented at a conference.

If you have any questions about this study, you can contact me or my director of studies Dr. Sandra Drummond. All contact details are given below.

If you have read and understood this information sheet and you are willing to participate in this study, please sign the attached consent form and return it to me.

Thank you in advance for your participation in my study.

**Contact details of the researcher:**

Zuwaina Humaid Al Mahrouqi  
PhD Student.  
Department of Dietetics, Nutrition and  
Biological Sciences.  
**Queen Margaret University, Edinburgh**  
Queen Margaret University Drive  
Musselburgh  
East Lothian EH21 6UU  
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[sdrummond@qmu.ac.uk](mailto:sdrummond@qmu.ac.uk) / 0131 474 0000



Queen Margaret University  
EDINBURGH

### **Participant Information Sheet (Focus Group)**

My name is Zuwaina Humaid Al Mahrouqi and I am PhD student from the School of Health Sciences at Queen Margaret University in Edinburgh. To fulfil the criteria for my PhD, I am undertaking a research project. The title of my project is: **Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study.**

This study aims to investigate the physical activities, sedentary behaviour and eating habits among female adolescents aged from 15-18 years old. The findings of the project will be valuable in improving the school health population and the school health programme as well.

I am looking for volunteers to participate in the project. They should be female Omani students aged 15-18 years old, studying in the tenth to twelfth grades and free from any physical disabilities. If you agree to participate in the study, you will be invited to attend a focus group discussion to understand more about the adolescent's activity behaviours and food choices by sharing their real experiences during the discussion for approximately one hour. During the discussion your voice will be audio recorded but not identifiable from the recording.

Your name will be replaced with a participant number, and it will not be possible for you to be identified in any reporting of the data gathered. You will be free to withdraw from the study at any stage and you would not have to give a reason.

The results may be published in a journal or presented at a conference.

If you have any questions about this study, you can contact me or my director of studies

Dr. Sandra Drummond. All contact details are given below.

If you have read and understood this information sheet and you are willing to participant in this study, please sign the attached consent form and return it to me.

Thank you in advance for your participation in my study.

**Contact details of the researcher:**

Zuwaina Humaid Al Mahrouqi  
PhD Student.  
Department of Dietetics, Nutrition and  
Biological Sciences.  
**Queen Margaret University, Edinburgh**  
Queen Margaret University Drive  
Musselburgh  
East Lothian EH21 6UU  
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East Lothian EH21 6UU  
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Queen Margaret University  
EDINBURGH

### **Parental Information Sheet (Questionnaire)**

My name is Zuwaina Humaid Al Mahrouqi and I am a PhD student from the School of Health Sciences at Queen Margaret University in Edinburgh. To fulfil the criteria for my PhD, I am undertaking a research project. The title of my project is: **Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study.**

This study aims to investigate the physical activities, sedentary behaviour and eating habits among female adolescents aged from 15-18 years old. The findings of the project will be valuable in improving the school health population and the school health programme as well.

I am looking for volunteers to participate in the project. They should be female Omani students aged 15-18 years, studying in the tenth to twelfth grades and free from any physical disabilities. If you agree to your daughter to participate in the study, her weight and height will be measured. Additionally, she will be invited to complete an online questionnaire about her physical activities and food habits; it should take approximately 25 minutes. Her name will be replaced with a participant number, and it will not be possible for her to be identified in any reporting of the data gathered. She will be free to withdraw from the study at any stage and she would not have to give a reason.

The results may be published in a journal or presented at a conference.

If you have any questions about this study, you can contact me or my director of studies Dr. Sandra Drummond. All contact details are given below.

If you have read and understood this information sheet and you are willing to your daughter to participant in this study, please sign the attached consent form and return it to me.

Thank you in advance for your participation in my study.

**Contact details of the researcher:**

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PhD Student.  
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Biological Sciences.  
**Queen Margaret University, Edinburgh**  
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Queen Margaret University

EDINBURGH

### **Parental Information Sheet** (Diet Diary, Pedometer)

My name is Zuwaina Humaid Al Mahrouqi and I am PhD student from the School of Health Sciences at Queen Margaret University in Edinburgh. To fulfil the criteria for my PhD, I am undertaking a research project. The title of my project is: **Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study.**

This study aims to investigate the physical activities, sedentary behaviour and eating habits among female adolescents aged from 15-18 years old. The findings of the project will be valuable in improving the school health population and the school health programme as well.

I am looking for volunteers to participate in the project. They should be female Omani students aged 15-18 years old, studying in the tenth to twelfth grades and free from any physical disabilities. If you agree to your daughter participate in the study, she will be asked to record her diet intake for 7 days and to wear an activity monitor (pedometer) around her waist for 7 days to record her physical activities. The monitor should not interfere with her daily activities. She has to remove the monitor before taking a bath and before going to bed. She will be given more details in one-hour orientation session on how to complete her diet diary and use the pedometer.

Her name will be replaced with a participant number, and it will not be possible for her to be identified in any reporting of the data gathered. She will be free to withdraw from the study at any stage and she would not have to give a reason.

The results may be published in a journal or presented at a conference.

If you have any questions about this study, you can contact me or my director of studies Dr. Sandra Drummond. All contact details are given below.

If you have read and understood this information sheet and you are willing to your daughter to participate in this study, please sign the attached consent form and return it to me.

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[sdrummond@qmu.ac.uk](mailto:sdrummond@qmu.ac.uk) / 0131 474 0000



Queen Margaret University

EDINBURGH

### **Parental Information Sheet** (Focus Group)

My name is Zuwaina Humaid Al Mahrouqi and I am PhD student from the School of Health Sciences at Queen Margaret University in Edinburgh. To fulfil the criteria for my PhD, I am undertaking a research project. The title of my project is: **Assessing the Lifestyle (Physical Activity Level, Sedentary Behaviour and Eating Habits) of Omani Adolescent Girls: A Mixed Methods Study.**

This study aims to investigate the physical activities, sedentary behaviour and eating habits among female adolescents aged from 15-18 years old. The findings of the project will be valuable in improving the school health population and the school health programme as well.

I am looking for volunteers to participate in the project. They should be female Omani students aged 15-18 years old, studying in the tenth to twelfth grades and free from any physical disabilities. If you agree to your daughter participate in the study, she will be invited to attend a focus group discussion to understand more about the adolescent's activity behaviours and food choices by sharing their real experiences during the discussion for approximately one hour. During the discussion her voice will be audio recorded but not identifiable from the recording.

Her name will be replaced with a participant number, and it will not be possible for her to be identified in any reporting of the data gathered. She will be free to withdraw from the study at any stage and she would not have to give a reason.

The results may be published in a journal or presented at a conference.

If you have any questions about this study, you can contact me or my director of studies

Dr. Sandra Drummond. All contact details are given below.

If you have read and understood this information sheet and you are willing to your daughter to participant in this study, please sign the attached consent form and return it to me.

Thank you in advance for your participation in my study.

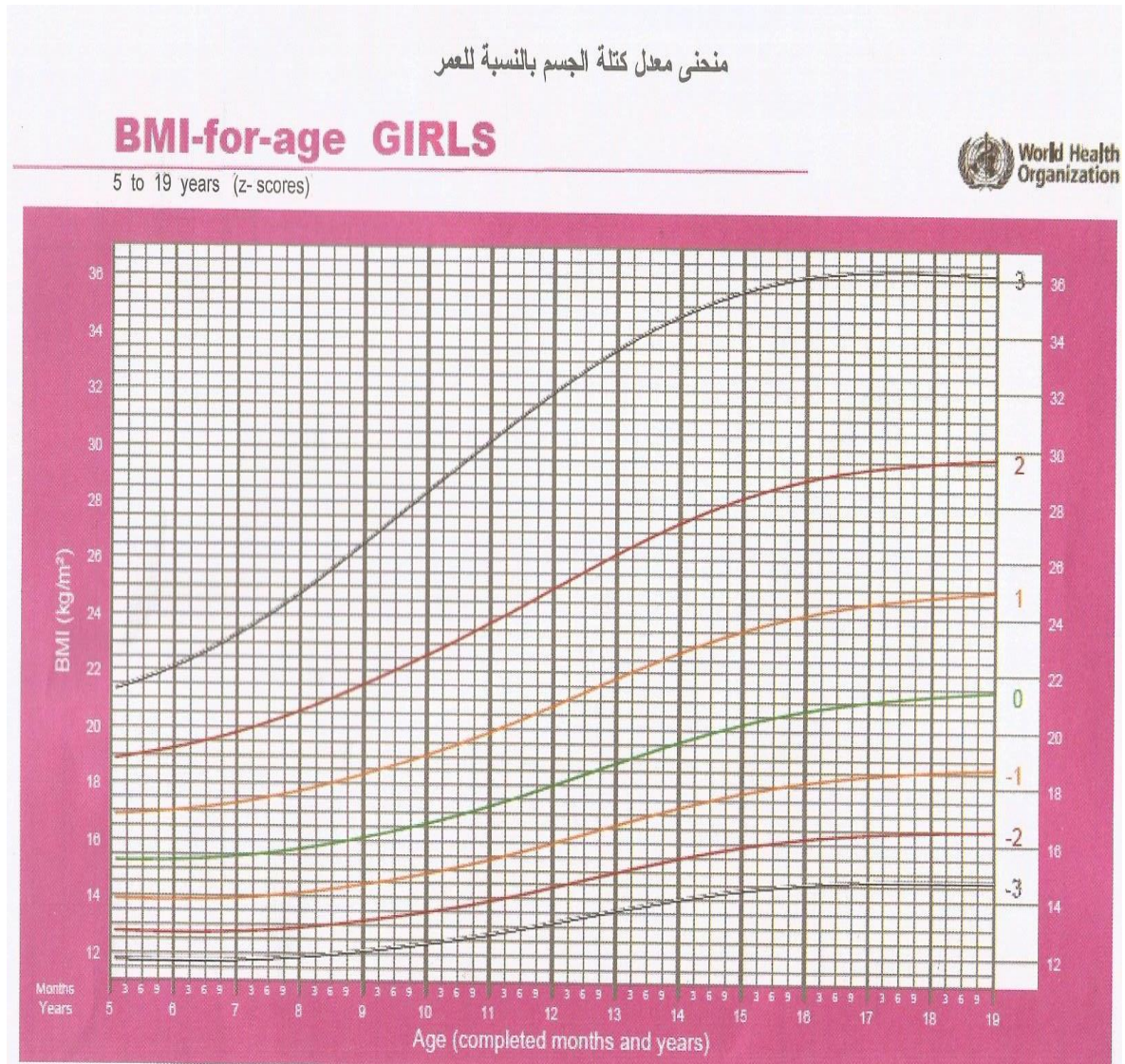
**Contact details of the researcher:**

Zuwaina Humaid Al Mahrouqi  
PhD Student.  
Department of Dietetics, Nutrition and  
Biological Sciences.  
**Queen Margaret University, Edinburgh**  
Queen Margaret University Drive  
Musselburgh  
East Lothian EH21 6UU  
[ZAlmahrouqi@qmu.ac.uk](mailto:ZAlmahrouqi@qmu.ac.uk) / 0131 474 0000

**Contact details of the Director of Studies:**

Dr. Sandra Drummond  
Programme Leader & Senior Lecturer in Nutrition.  
Department of Dietetics, Nutrition and  
Biological Sciences.  
**Queen Margaret University, Edinburgh**  
Queen Margaret University Drive  
Musselburgh  
East Lothian EH21 6UU  
[sdrummond@qmu.ac.uk](mailto:sdrummond@qmu.ac.uk) / 0131 474 0000

Appendix (5): BMI Chart, source MOH (2007, p.11).



According to the WHO (2014b) the overweight, z-score cut-off point is, >1 standard deviation and obesity is >2 standard deviation.

## **Appendix (6): Permission from ATLS Questionnaire Author**

From: halhazzaa@hotmail.com

To: zalmahrooqi@hotmail.com

Subject: RE: Arabic version of ATLS

Date: Fri, 31 Oct 2014 18:18:29 +0000

Thanks, Zuwaina. Kindly check out this link for the revised ATLS Questionnaire in Arabic or English.

<http://faculty.ksu.edu.sa/hazzaa/DocLib31/Forms/AllItems.aspx>

BW.

Hazzaa

Professor Hazzaa M. Al-Hazzaa, PhD, FACSM, FECSS  
Director, Pediatric Exercise Physiology Research Laboratory  
College of Education, King Saud University  
P. O. Box 2458  
Riyadh 11451  
Saudi Arabia  
Office: 966-1-4678411  
Lab: 4678406  
Fax: 4674852  
[alhazzaa@ksu.edu.sa](mailto:alhazzaa@ksu.edu.sa)  
[halhazzaa@hotmail.com](mailto:halhazzaa@hotmail.com)  
<http://faculty.ksu.edu.sa/hazzaa>

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## Appendix (7): Online ATLS Questionnaire

### Arab Teens Lifestyle (ATLS) Questionnaire

Dear participant:

Your contribution in this study is very valuable, the purpose of this study is to assess your lifestyle habit, including physical activity, sedentary behaviour and dietary habits. Please, read the question well and your answers will be based on what you actually know or do, select only one suitable answer. To answer the question just click on submit radio button before each answer. After completion of all questions click on submit button.

The completion of this questionnaire will take approximately 25 minutes.

The information that you are going to give will remain confidential to this researcher and used only for research purpose so, your name will not be shown on the questionnaire page.

1. Name of the School:

- **School 1**
- **School 2**

2. Study Level (grade):

- **Tenth**
- **Eleventh**
- **Twelfth**

3. Your Age:

- **15 years**
- **16 years**
- **17 years**
- **18 years**

#### **PART ONE: Physical Activity/Inactivity**

4. How many times per week do you regularly walk?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

5. If you regularly walk, what is the pace of your walk?

- **Slow**

- **Moderate**
- **Fast**

6. If you regularly walk, how many minutes do you walk each time?

Number of minutes: .....

7. How many times per DAY you use the stairs in school, home, or elsewhere? (one floor of stair counts as 1 time)

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **More than 5, How many .....**

8. How many times per week do you regularly jog or run?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

9. If you regularly jog or run, how many minutes do you do each time?

Number of minutes: .....

10. How many times per week do you regularly cycle (either on an outdoor or a stationary cycle)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

11. If you use an outdoor or a stationary cycle regularly, how many minutes do you cycle each time?

Number of minutes: .....

12. How many times per week do you regularly swim?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

13. If you regularly swim, how many minutes do you swim each time?

Number of minutes .....

14. How many times per week do you regularly engage in moderate intensity sports (e.g. volleyball, table tennis, bowling, badminton, or other similar activities)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

15. If you regularly play moderate intensity sports, how many minutes do you play each time?

Number of minutes: .....

16. How many times per week do you regularly engage in high intensity sports (e.g. soccer, rugby, hockey, netball, basketball, handball, athletics, tennis, squash, etc.)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

17. If you regularly play high intensity sports, how many minutes do you play each time?

Number of minutes: .....

18. How many times per week do you participate in self-defence sports (e.g. kick-boxing, judo, karate, taekwondo, etc.)?

- **None**
- **Once**
- **Twice**



- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

19. If you participate in self-defence sports regularly, how many minutes do you do each time?

Number of minutes: .....

20. How many times per week do you regularly do strength training (weight training or body building or calisthenics exercise)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

21. If you regularly do strength training (weight training, body building or calisthenics exercise), how many minutes do you do it each time?

Number of minutes: .....

22. How many times per week do you engage in household work (e.g. gardening, vacuuming, washing, car cleaning)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

23. If you do household work, how many minutes does it take per day?

Number of minutes: .....

24. Where do you normally do your physical activities or sports?

- **Home**
- **School**
- **Park or public area**
- **Sports or recreation centre**
- **Health/Fitness Club**
- **Other:**

25. With whom do you normally do your physical activities or sports?

- **Alone**
- **Friends**
- **School peers**
- **Parents**
- **Other relatives**
- **Other:**

26. When do you usually do your physical activities or sports?

- **Morning**
- **Noon time**
- **Afternoon**
- **Evening**
- **After evening meal**
- **No specific time**

27. If you participate in physical activities or sports regularly, what are the main reasons for that? Please answer either item 29 (if you are active) or item 30(if not active).

- **Health**
- **To lose weight**
- **Social**
- **Recreation**
- **Competition**
- **Other:**

28. If you don't participate in physical activities or sports regularly, what are the main reasons for that?

- **No time**
- **Not important**
- **No suitable facilities**
- **Health reasons**
- **Afraid of criticism**
- **Other:**

**PART TWO: Sedentary Behaviours**

29. On average, how long per day do you watch TV and/or DVD/Video during week days?

- **Do not watch TV**
- **½ hour**
- **1 hours**
- **2 hours**
- **3 hours**
- **4 hours**
- **5 hours**
- **More than 5 hrs, How many.....**

30. On average, how long per day do you watch TV and/or DVD/Video during weekends?

- **Do not watch TV**
- **½ hour**
- **1 hours**
- **2 hours**
- **3 hours**
- **4 hours**
- **5 hours**
- **More than 5 hrs, How many.....**

31. On average, how long per day do you spend on the computer and/or the internet (for leisure) during week days?

- **Do not use computer or internet**
- **½ hour**
- **1 hours**
- **2 hours**
- **3 hours**
- **4 hours**
- **5 hours**
- **More than 5 hrs, How many.....**

32. On average, how long per day do you spend on the computer and/or the internet (for leisure) during weekends?

- **Do not use computer or internet**
- **½ hour**
- **1 hours**
- **2 hours**
- **3 hours**
- **4 hours**
- **5 hours**
- **More than 5 hrs, How many.....**

33. On average, how many hours per day do you sleep during week days?

- **3 hours**
- **4 hours**
- **5 hours**
- **6 hours**
- **7 hours**
- **8 hours**
- **10 hours or more**

34. On average, how many hours per day do you sleep during weekends?

- **3 hours**

- **4 hours**
- **5 hours**
- **6 hours**
- **7 hours**
- **8 hours**
- **10 hours or more**

**PART THREE: Dietary Habits**

35. How many times (days) per week do you have your breakfast? I don't have breakfast

- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times**

36. How many times per week do you drink sugary drinks /soft drinks (e.g. Cola, Pepsi, 7up, Sports drink)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

37. How many times per week do you eat vegetables (fresh or cooked)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

38. How many times per week do you eat fresh fruit?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**

- **5 times**
- **6 times**
- **7 times or more**

39. How many times per week do you have dairy products (e.g. milk, yogurt, cheese)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**

40. How many times per week do you eat fast food (e.g. burgers, sausage, pizza, or Arabic shawarma, inside or outside your home)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

41. How many times per week do you eat French fries and/or potato chips?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

42. How many times per week do you eat cakes, biscuits, donuts, or similar food?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

43. How many times per week do you eat sweets and/or chocolates?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

44. How many times per week do you drink energy drinks (e.g. Red Bull, Power Horse)?

- **None**
- **Once**
- **Twice**
- **3 times**
- **4 times**
- **5 times**
- **6 times**
- **7 times or more**

45. BMI Value: -----

46. BMI:

- **Underweight**
- **Normal**
- **Overweight**
- **Obese**

**The End**

Appendix (8): Un-weighed 7-Day Diet Diary



# 7-Day Food & Drink Diary

مذكرة الطعام و الشراب الاسبوعية



School: \_\_\_\_\_

Participant's Code: \_\_\_\_\_

DOB: \_\_\_\_\_

WT: \_\_\_\_\_ HT: \_\_\_\_\_ BMI: \_\_\_\_\_

Dear Participants:

I am a PhD student in the Department of Dietetics and Nutrition at Queen Margaret University, Edinburgh, Scotland and one aspect of my research study is to investigate adolescent eating and drinking habits and if you kindly complete this diet diary you will contribute positively to my study. To help you complete the diary, please, read and follow the instructions below.

**Instructions:**

- Please, write clearly everything you actually eat and drink each day from when you wake to when you go to bed for 7 days.
- Take your diary with you at all time - even if you are going outside your home to eat or drink.
- Try to indicate the proper amount eaten or drunk accurately by using given measurement tools.
- Try to give a description of the types of food and drink you consume as much as possible and write it immediately after you consume it.
- State the place where you had your food eg, at home, school, restaurant, friends' or relatives' house.
- For cooked foods please, give a description of the cooking method if this is known to you also indicate the name of the dish and give the ingredients, if possible.
- Eat normally as you are eating every day. Do not change from your normal eating pattern.
- The given table is as an example on how to describe your food and drink and the amount taken.
- Return the completed diary to the researcher on the eighth day.



Examples of Un-weighted 7-Day Diet Diary and its descriptions:

| Sr. | Type of food                             | Size                                      | Description                                                                                                                          |
|-----|------------------------------------------|-------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| 1   | Rice                                     | ½, 1, 2 cups                              | White, spicy, with vegetable                                                                                                         |
| 2   | Bread                                    | ½, 1,2,...                                | (Small/big & white/ brown) Omani, Lebanese, slice, Ruddy, chapatti                                                                   |
| 3   | Vegetables                               | ½, 1/4, 1,... cups                        | (Small/ big) Raw or cooked, fresh or frozen, type                                                                                    |
| 4   | Fruits                                   | ½, whole                                  | (Small/ big), type                                                                                                                   |
| 5   | Tea/ Coffee                              | Cup, Finjan                               | With/ without milk or sugar.                                                                                                         |
| 6   | Egg                                      | ½, 1,2,...                                | Boiled, Fried                                                                                                                        |
| 7   | Milk/ yogurts                            | ½, 1, 2 cups                              | Whole or skimmed                                                                                                                     |
| 8   | Drinks                                   | ½, 1, 2 cups<br>Or amount from the packet | Water, juice (orange, mango,...)<br>Canned or fresh, cold drinks (type).                                                             |
| 9   | Biscuits/ sweets/ chips/ cake/ chocolate | Number or weight from packet              | Name from the packet                                                                                                                 |
| 10  | Legume/ pulses                           | ½, 1,2,... tablespoon.                    | Type (Red beans, fava beans, Harees), mixing type if any, Ghee or butter added.                                                      |
| 11  | Fish/ meat/ chicken                      | Number of slices/ portions                | Fried/ cooked curry with vegetable.<br>Fish Type (King, Safi fish, Cuttlefish, Hamour, Lobster, Tuna)<br>Meat Type (Beef or Mattoon) |
| 12  | Dates                                    | Number                                    | Fresh/ dry                                                                                                                           |
| 13  | Burger, Hot dog, Kabab,                  | 1,2, 3,....                               | Beef/ Chicken, (fried/ grilled)                                                                                                      |
| 14  | Pizza                                    | 1,2,... portion/                          | Vegetable and chicken or beef, Cheese.                                                                                               |
| 14  | Cheese, Honey, Jam                       | 1,2,... portion/ teaspoon.                | Portion or spread.                                                                                                                   |
| 15  | Noodles & Macaroni                       | ½, 1,2,... tablespoon.                    | Mixed with vegetable and chicken or beef.                                                                                            |
| 16  | Soup                                     | ½, 1, 2 cups                              | Vegetable and chicken or beef.                                                                                                       |

**Note:** the above table is only an example, you might eat or drink some other items which is not included in the table, please, write them.

## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 1

### One day dietary-intake.

| Meal                                     | Time               | Food Item                        | Amount                 | How Prepared/ Brand Name<br>(If applicable)                 |  |
|------------------------------------------|--------------------|----------------------------------|------------------------|-------------------------------------------------------------|--|
| <b>Breakfast<br/>Meal (1)</b>            | 6.30               | Tea with milk (whole)            | 200 ml                 |                                                             |  |
|                                          |                    | Sugar                            | 2 teaspoon             |                                                             |  |
|                                          |                    | Omani bread                      | 3 pieces               |                                                             |  |
|                                          |                    | Cheese                           | 2 Portion              |                                                             |  |
|                                          |                    | Omelette fried with Ghee<br>Ghee | 1 egg<br>1 tea spoon   |                                                             |  |
|                                          | water              | 150 ml                           |                        |                                                             |  |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   | 10.30              | Egg & cheese sandwich:           |                        |                                                             |  |
|                                          |                    | Rutty                            | 1                      |                                                             |  |
|                                          |                    | Boiled egg                       | 1                      |                                                             |  |
|                                          |                    | Cucumber                         | 2 slices               |                                                             |  |
|                                          |                    | Mayonnaise                       | 2 teaspoon             |                                                             |  |
|                                          | Mango juice        | 100 ml                           | Al Marai type, sweeten |                                                             |  |
|                                          | 12.15              | water                            | 150 ml                 |                                                             |  |
|                                          | 1.00               | Biscuits                         | 1 Packet<br>100 gm     | Nabeel                                                      |  |
| <b>Lunch<br/>Meal (3)</b>                | 3.00               | Chicken Baryani:                 |                        | Cooked with fried Mixed vegetables,<br>spices & little oil. |  |
|                                          |                    | Rice                             | 10 table spoon         |                                                             |  |
|                                          |                    | Chicken                          | ¼ piece                |                                                             |  |
|                                          |                    | Vegetable salad                  | 5 tablespoon           | Different types vegetables                                  |  |
|                                          |                    | Water                            | 200 ml                 |                                                             |  |
|                                          | Dates              | 5 pieces                         | Dry                    |                                                             |  |
|                                          | Yoghurt            | 2 tablespoon                     | Al Rwabi Brand         |                                                             |  |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> | 5.00               | Boiled chickpeas                 | 5 tablespoon           | Boiled with water and salt                                  |  |
|                                          |                    | Ghee                             | 1 teaspoon             |                                                             |  |
|                                          |                    | Omani Bread                      | 2                      |                                                             |  |
|                                          |                    | 5.30                             | Omani coffee           | 2 Finjan<br>40 ml                                           |  |
|                                          |                    |                                  | Dates                  | 3 pieces                                                    |  |
|                                          |                    | Kit Kat                          | 20.8 gm<br>2 Fingers   |                                                             |  |
|                                          | 7.00               | water                            | 100 ml                 |                                                             |  |
| <b>Dinner<br/>Meal (5)</b>               | 8.30               | Chicken Burger Sandwich:         |                        | Restaurant made.                                            |  |
|                                          |                    | Chicken Burger                   | 1 piece                |                                                             |  |
|                                          | White burger bread | 1                                |                        |                                                             |  |
|                                          | Cheese             | 1slice                           |                        |                                                             |  |
|                                          | Ketchup            | 1 teaspoon                       |                        |                                                             |  |
|                                          | Tomato             | 2 slice                          |                        |                                                             |  |
|                                          |                    | Cold Drink                       | 200 ml                 | Pepsi                                                       |  |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   | 9.00               | Sohar Chips                      | 1 Packet<br>15 gm      |                                                             |  |
|                                          | 9.00               | Orange Juice                     | 200 ml                 | No sugar added, fresh homemade.                             |  |
|                                          | 10.30              | Water                            | 300 ml                 |                                                             |  |

## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 1

| Meal                                     | Time | Food Item | Amount | How Prepared/ Brand Name<br>(If applicable) |
|------------------------------------------|------|-----------|--------|---------------------------------------------|
| <b>Breakfast<br/>Meal (1)</b>            |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Lunch<br/>Meal (3)</b>                |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Dinner<br/>Meal (5)</b>               |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |

Description:

## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 2

| Meal                                     | Time | Food Item | Amount | How Prepared/ Brand Name<br>(If applicable) |
|------------------------------------------|------|-----------|--------|---------------------------------------------|
| <b>Breakfast<br/>Meal (1)</b>            |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Lunch<br/>Meal (3)</b>                |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Dinner<br/>Meal (5)</b>               |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |

Description:

## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 3

| Meal                                     | Time | Food Item | Amount | How Prepared/ Brand Name<br>(If applicable) |
|------------------------------------------|------|-----------|--------|---------------------------------------------|
| <b>Breakfast<br/>Meal (1)</b>            |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Lunch<br/>Meal (3)</b>                |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Dinner<br/>Meal (5)</b>               |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |

Description:

## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 4

| Meal                                     | Time | Food Item | Amount | How Prepared/ Brand Name<br>(If applicable) |
|------------------------------------------|------|-----------|--------|---------------------------------------------|
| <b>Breakfast<br/>Meal (1)</b>            |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Lunch<br/>Meal (3)</b>                |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Dinner<br/>Meal (5)</b>               |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |

Description:

## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 5

| Meal                                     | Time | Food Item | Amount | How Prepared/ Brand Name<br>(If applicable) |
|------------------------------------------|------|-----------|--------|---------------------------------------------|
| <b>Breakfast<br/>Meal (1)</b>            |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Lunch<br/>Meal (3)</b>                |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Dinner<br/>Meal (5)</b>               |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |

Description:

## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 6

| Meal                                     | Time | Food Item | Amount | How Prepared/ Brand Name<br>(If applicable) |
|------------------------------------------|------|-----------|--------|---------------------------------------------|
| <b>Breakfast<br/>Meal (1)</b>            |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Lunch<br/>Meal (3)</b>                |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Dinner<br/>Meal (5)</b>               |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |

Description:



## Un-weighed 7-Day Diet Diary

Date: \_\_\_\_\_ Day of week: \_\_\_\_\_ Day: 7

| Meal                                     | Time | Food Item | Amount | How Prepared/ Brand Name<br>(If applicable) |
|------------------------------------------|------|-----------|--------|---------------------------------------------|
| <b>Breakfast<br/>Meal (1)</b>            |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Morning<br/>Snacks<br/>Meal (2)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Lunch<br/>Meal (3)</b>                |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Afternoon<br/>Snacks<br/>Meal (4)</b> |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Dinner<br/>Meal (5)</b>               |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |
| <b>Evening<br/>Snacks<br/>Meal (6)</b>   |      |           |        |                                             |
|                                          |      |           |        |                                             |
|                                          |      |           |        |                                             |

Description:

Thank you very much for your valuable contribution.

**Contact details of the researcher**

Name of researcher: Zuwaina Humaid Al Mahrouqi

Address:                    Research Student, Division, School  
                                  Queen Margaret University, Edinburgh  
                                  Queen Margaret University Drive  
                                  Musselburgh  
                                  East Lothian EH21 6UU

Email / Telephone: [ZAlmahrouqi@qmu.ac.uk](mailto:ZAlmahrouqi@qmu.ac.uk)/ 0131474 0000 (UK),  
00968-95590014 (Oman)

## Appendix (9): Focus Group Discussion Guide Questions

The following questions are developed as a guide to enable the focus group discussion.

### Physical Activity:

- What do you understand by physical exercises?
- How many of you do physical exercises? What kind of exercises are you doing?

### Physical Activity barriers:

- Do you practice cycling regularly? If not, Why?
- Do you practice swimming regularly? If not, Why?
- Do you practice intensive physical activities? If not, Why?
- Do you help in household activities? If not, Why?

### Improving physical activity:

- What would need to happen for you to exercise?
- What would make it easier for you to exercise? Or – what would have to change to make you exercise?
- How would young girls can increase their physical activity?

### Food habits:

- What do you understand by fast food?
- How many of you eat fast food? What kind of fast food that you are eating? Or can you give an example of fast food that you are eating?
- How many times per week do you eat fast food?
- Why do you like to eat fast food?
- How does eating fast food make you feel?
- Do you eat breakfast? If not, Why might you skip breakfast?
- What do you eat for your breakfast? probe about what is included/missing?

### Improving food intake in the school:

- Tell me about the foods you eat at the school canteen? So, what do you think about the food at the school canteen?
- If you are responsible for the school canteen, how would you change the services provided by this canteen?

Are there any comments would anyone like to add in relation to physical activity or food habits?

### Probing questions:

- Please, expand your idea,
- Tell me more about your opinion,
- Can you clarify your suggestion,
- Anyone would like to add .....
- Give me an example (s), .....
- Do you all agree .....

## **Appendix (10): Focus Group Guidelines**

### **Introduction:**

Good morning

Thank you very much in advance for your participation in this study. I am Zuwaina Al Mahrouqi, I am a research student at Queen Margaret University. The aim for today's discussion is to explore the perception and opinions of Omani female adolescents in relation to your lifestyle choices (diet and exercise), by sharing your real experiences during the discussion.

The moderator introduced herself as well. Each participant introduced herself to the group. Then, the moderator reminded the participants with the following instructions.

### **Focus Group Instructions:**

- The discussion will be audio recorded but your identity will be protected by anonymity and your voices will not be identifiable from the recording, the code number will be used.
- Additionally, your ideas will be written briefly in the flip chart.
- All members must speak and give their valuable opinions during the discussion and one participant should speak at a time, please.
- All information that you are going to give remain confidential and it will be used for the research purpose only.
- Be sure that, the findings of this study will contribute in improving the health services offered to adolescents in particular and to other school children in general.
- This meeting will last approximately for one hour.
- If you are not willing to participate in this discussion you have the right to withdraw at any time.

## **Appendix (11): Peer Reviewer Report**

### **Peer Review Report**

The qualitative research question is clearly framed including the how and why of the phenomenon. The question clearly states the characteristics of the participants and constructed in a simple way to understand the objectives. The thematic mind mapping helps in representing how the themes were arrived at. Quotes from the focus group discussions support the suggested theme and add an element of understanding for the reader and give good insight to the outlined themes.

The report is well organized and is presented within the text; under subheadings. The results of the study describe of all the contexts such as social, cultural physical and environmental, that allows the readers to analyse the transferability of the study findings to another setting. The report presents not only the perception of female adolescents regarding their food habit also the factors that influence the same. The report clearly describe about the cultural influences of how the female adolescents are discriminated from performing exercises. The direct quotations from study participants provided an insightful description of perception of Omani female adolescents regarding the diet and exercise. If the author includes a table or chart with the questions used and provided examples of the additional probing questions that were used to explore the answers to the main questions it will be useful in replicating the study. The study can also have a note on who lead the focus group discussions.

The qualitative objective is framed with clarity of the phenomena to be explored. The results of the study clearly explore the reason, why the Omani female adolescents choose a particular life style for performing exercises and eating. The data collection methods are clearly explained, and another researcher can replicate the study. The data from the focus group discussions are taped, transcribed and translated to English language. The direct recording of the study participants reduces the personal biases.

The themes and the findings are described and revealed in an organized and logical manner. Perhaps rationale for the development of the themes should be described. There is good level of description of themes and direct quotes from the data which aids in transparency and audit ability of the research. The supplementary questions used by the facilitator/ researcher for the semi-structured interviews can also be added to support the methodology.

Dr. Manoranjitham. S

Professor and head Psychiatric Nursing Department

College of Nursing, Tamilnadu, India

## Appendix (12): Code Tree Version (1)

### Coding Tree (1)

1. Physical exercise (PE)
  - 1.1. Perception about PE
    - 1.1.1. Physical benefits
      - 1.1.1.1. Activate body cells
      - 1.1.1.2. Burn calories
      - 1.1.1.3. Improve the blood circulation
      - 1.1.1.4. Enhance muscle movement
    - 1.1.2. Types of exercise
      - 1.1.2.1. Walking, running and climbing the stairs
      - 1.1.2.2. Football and volleyball
      - 1.1.2.3. Abdominal muscles exercises
    - 1.1.3. Place of practicing PE
      - 1.1.3.1. School and house
    - 1.1.4. Barrier to physical exercise
      - 1.1.4.1. unavailability of resources
      - 1.1.4.2. Privacy
      - 1.1.4.3. Culture
        - 1.1.4.3.1. Community beliefs
        - 1.1.4.3.2. Gender stereotype
          - 1.1.4.3.2.1. Girls should not cycle
          - 1.1.4.3.2.2. This activity is for boys
          - 1.1.4.3.2.3. For small children
      - 1.1.4.4. Family System
        - 1.1.4.4.1. More school homework
        - 1.1.4.4.2. Housemaid at home
      - 1.1.4.5. Changing in lifestyle
        - 1.1.4.5.1. Using cars
        - 1.1.4.5.2. Electronic devices
      - 1.1.4.6. Environmental Factor
        - 1.1.4.6.1. Weather Hot
      - 1.1.4.7. Time constrains
      - 1.1.4.8. Lack of skill
      - 1.1.4.9. Body Image
        - 1.1.4.9.1. Don't know how to ride a bike
        - 1.1.4.9.2. Body structure doesn't help
      - 1.1.4.10. Motivation
        - 1.1.4.10.1. Self-Motivation
        - 1.1.4.10.2. Motivation from parent, friends, teachers,
        - 1.1.4.10.3. curriculum and relatives
      - 1.1.4.11. Suggestion to improve physical exercise
        - 1.1.4.11.1. Availability of physical exercise

- 1.1.4.11.2. Availability of gym halls for ladies
- 1.1.4.11.3. Sport machine with high quality
- 1.1.4.11.4. close place with air conditioner
- 1.1.4.11.5. Time management
- 1.1.4.11.6. Increase PE classes in school
- 1.1.4.11.7. To have Ladies sport clubs, motivation from family members and friends

## 2. Food Habits

### 2.1. Fast Food

- 2.1.1. Perception about fast food
- 2.1.2. Popular
- 2.1.3. Quickly prepared
- 2.1.4. Delicious
- 2.1.5. Easily accessible

### 2.2. Types of fast food

- 2.2.1. Burger
- 2.2.2. Chips, Pizza
- 2.2.3. Shawarma Sandwich
- 2.2.4. Zinger, Arabic Sandwich
- 2.2.5. Max Sandwiches (Double Sandwiches)

### 2.3. Feeling after taking Fast Food

- 2.3.1. Feeling full and heaviness
- 2.3.2. Feeling sleepy and guilty

### 2.4. Reasons for taking fast food

- 2.4.1. Delicious
- 2.4.2. Attraction
- 2.4.3. Advertisement
- 2.4.4. Need to change once in a while from homemade to restaurant made
- 2.4.5. Advertisement
- 2.4.6. Packet Money

### 2.5. Harmful for the body

- 2.5.1. Leads to increase body weight

### 2.6. Breakfast (BF)

- 2.6.1. Reasons for not eating breakfast (BF)
- 2.6.2. No appetite
- 2.6.3. No time school bus is coming too early

### 2.7. Reasons for not eating Vegetables and fruits

- 2.7.1. No appetite to eat
- 2.7.2. Don't like the taste

### 2.8. Food Items taken for BF

- 2.8.1. Cup of tea
- 2.8.2. Boiled or fried Egg
- 2.8.3. Omani bread and cheese
- 2.8.4. Omani dish egg and tomato, cooked together

### 2.9. Food Items available at school canteen

- 2.9.1. Falafel sandwich, doughnuts, juice, croissant, sweet corn
- 2.9.2. Cheese pastry, yogurt, and chocolate bar
- 2.9.3. Cheese and bread
- 2.9.4. Water, biscuits, chocolate bar (break chocolate)
- 2.9.5. Cheese pastry, juice, sweet corn, chocolate
- 2.10. Perception about school canteen
  - 2.10.1. Has some healthy food like milk, nuts and sweet corns
  - 2.10.2. Not clean, files, dust.
  - 2.10.3. Lack of healthy snacks in the canteen.
  - 2.10.4. Fitting the purpose
  - 2.10.5. No suitable place to eat
- 2.11. Suggestion to improve school canteen
  - 2.11.1. Serve food in attractive way
  - 2.11.2. Suitable place to sit and eat
  - 2.11.3. 5 minutes to eat a snack in the first period.
  - 2.11.4. Provision of fruits and vegetables, fresh juice and milk, homemade traditional meals
  - 2.11.5. Bring their own snacks from home. This could be a piece of cucumber, carrot or a fruit, students who are not able to take their breakfast at home.
  - 2.11.6. Taking opinion of students through questionnaires and give them according to their needs.



## **Appendix (13): Code Tree Version (2)**

### **Code Tree (2)**

1. Perception of physical exercises
  - 1.1. Exercise as a positive activity
  - 1.2. Enablers to be active
2. Barriers to perform physical exercise
  - 2.1. Environmental factors
  - 2.2. Sociocultural factors
  - 2.3. Exercise as Gendered
  - 2.4. Modernisation of Omani Society
    - 2.4.1. Automobile
    - 2.4.2. Technology
    - 2.4.3. Housemaids
  - 2.5. Lack of Motivation/ role models
  - 2.6. Perceived lack of time to perform physical exercise
3. Perception of dietary habits
  - 3.1. Fast Food is harmful
  - 3.2. Fast Food is popular
  - 3.3. Influences that promote eating fast food
    - 3.3.1. Media
    - 3.3.2. Westernisation
  - 3.4. Availability and resources
  - 3.5. Lack of time is perceived as constraints to eat breakfast
4. Enablers to suggest a healthy and sociable eating environment at school
  - 4.1. Food types and availability
  - 4.2. Physical environment
  - 4.3. Allocating additional time for meals/snacks within the curriculum
  - 4.4. Engaging students in decision making of food choices and implementing change in partnership.

### Appendix (14): Mind Map Version (1)

Perception of Food Habits and Exercise among Omani Adolescent Girls

