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Factors affecting food intake and the role of Nutrition Education in the understanding and implementation of healthy dietary habits in Saudi adolescent girls

Alamri, Eman

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University of Plymouth

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**Factors affecting food intake and the role of Nutrition
Education in the understanding and implementation of
healthy dietary habits in Saudi adolescent girls**

By

Eman Saad Alamri

A thesis submitted to Plymouth University in
Partial fulfilment for the degree of

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Abstract:

Factors affecting food intake and the role of Nutrition Education in the understanding and implementation of healthy dietary habits in Saudi Adolescent girls

Eman Saad Alamri

Over the past two decades, the prevalence of obesity has increased among Saudi adolescents. Amongst the many environmental factors predisposing to obesity is the increase in the quantity of certain foods and changes in food quality.

This study was undertaken in two phases. Phase 1 explored factors affecting food intake in Saudi adolescent girls (16-18 years) and findings from this were employed in Phase 2 which investigated a school nutrition education programme in Saudi adolescent girls.

In Phase 1, cross-sectional data was gathered from 29 Saudi adolescent girls and their mothers from a single school in Tabouk City. Body mass index and waist circumference were measured and participants completed a 3-day food diary and questionnaires on nutrition knowledge, eating patterns and home food availability. The findings demonstrated that 20 (69%) of mothers were categorised within the overweight and obese category, compared to 10 (34%) of their daughters. Adolescents with higher nutritional knowledge consumed significantly more fruit ($p<0.05$), and significantly lower amounts of fizzy drinks, sweets and chocolate ($p<0.05$). In addition, mothers' nutritional knowledge was negatively associated with

household availability of sweets, chocolate, cakes and biscuits ($r = -0.226$, $p < 0.05$), and the availability of these products was positively associated with adolescents' food intake ($p < 0.05$).

In phase 2, adolescent girls and their mothers were recruited from 3 matched high schools in Tabouk. A 4-week cluster randomised design was employed. Adolescents in school A received nutrition education alongside interactive nutrition activities to complete at home with their mothers, those in school B received nutrition education only, and those in school C acted as the control group. Nutrition knowledge and food frequency questionnaires were collected pre and post intervention and at a further 2 months follow up. Till receipts for food purchases were collected for 4 weeks pre intervention, and 4 weeks post intervention. In total 163 out of 229 participants (71%) completed the study across all schools.

Results demonstrated that the nutrition education intervention was effective in significantly increasing nutritional knowledge ($p < 0.05$) in adolescents from schools A and B. Adolescents in school A also showed significant improvements in their food intake ($p < 0.05$). Mothers in school A only showed significant improvements in nutritional knowledge ($p < 0.05$), food intake and household food purchased ($p < 0.05$). Increasing the frequency of interactive nutrition activities shared between mother and daughter led to greater improvements in food intake ($p < 0.05$) of mothers and daughters compared to those who interacted less frequently.

In conclusion interactive activities effectively supported nutritional knowledge transfer from the school to home resulting in improvement in both adolescent and mothers' nutritional knowledge and food intake. Interactive nutrition activities could be used for obesity prevention strategies in future research.

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List of abbreviation:

ANOVA	Analysis of variance
BMI	Body mass index
WC	Waist circumference
CRT	Cluster Randomization Trial
Spss	Statistical Package for the Social Science
USA	United State of America
UK	United Kingdom
KSA	Kingdom of Saudi Arabia
WHO	Word Health Orgnization
DDA	Dietitian association of Australia
USDA	United States Department of Agriculture.
HFA	Home food availability
g	Gram
Cm	Centimetre
FFQ	food frequency questionnaire
Kg	kilo gram
SD	standard deviation

CDC	Centres for Disease Control and Prevention
EPIC	European prospective investigation of cancer
GCC	Gulf Cooperation Council
KJ	kilojoules
KN	Nutritional knowledge

Glossary:

Adolescence: refers to teenage years between thirteen and nineteen (inclusive) and is represents a dramatic period of transition to adulthood and is associated with marked physical growth (McNamara, 2000) and sexual development (Sisk and Foster, 2004).

Obesity: it is defined as excess subcutaneous and visceral adipose tissue to an extent that impairs both physical and psychosocial health and well-being (James, 2004). The criteria (and cut-off points) defining obesity (and a person's overweight status) differ considerably depending and is an area of active research (The International Association for the study of Obesity, 2004) (Prentice and Jebb, 2001).

Food purchases: refers to the buying of food from the supermarket, grocery store, butcher or local shop. Food is then prepared at home and eaten by the family members.

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Authors Declaration:

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Conferences and presentations:

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3. May 2015, 22th European Congress on obesity (ECO2015), Prague, Czech Republic, poster presentation
4. June 2015, postgraduate research society conference, Plymouth university, poster presentation
5. June 2015, IHC/Institute of Education Postgraduate Research Conference, Plymouth university, poster presentation.
6. July 2015, the 23rd annual Pop Fest conference (Population Postgraduate Conference), Plymouth university, poster presentation.
7. Jun 2015, School of Health professions student research conference, Plymouth University, oral presentation.
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Chapter 1: Introduction

1.1 Introduction

This chapter describes the background for the overall research area. It also discusses the justification for, and need to, conduct this research, as well as the purpose of the study.

1.2 The prevalence of overweight and obesity in adolescents

Obesity is a growing global concern of epidemic proportions in developed countries, and is also rapidly increasing in middle-income and less developed countries (WHO,2015). Obesity has more than doubled globally since 1980 until 2013 in developed and developing country, with trends reporting the greatest increases to be among adult males (28% to 38%) and females (29% to 38%) (Marie., 2014). A similar pattern was observed in Saudi Arabia, indicating that increasing rates of obesity were present across all segments of the Saudi population (Ziad et al., 2014). Recent data from the World Health Organisation (WHO) showed that 72%, 58% and 62% of women in the Saudi Arabia, UK and USA, respectively, were overweight. The same source cited 41%, 29% and 34% for males (WHO., 2014).

The prevalence of overweight and obesity has also increased worldwide in children and adolescents by nearly 50%: from 8% (1980) to 12% (2013) in boys and from 8% to 13% in girls (Marie., 2014; IHME, 2014). Data from thirteen health centres from different regions of Saudi Arabia showed adolescents have equal or greater BMI scores than Western counterparts (Al Herbish et al., 2009). Moreover, evidence from cross-sectional analyses of BMI and body fat percentage, conducted in Saudi adolescents has confirmed the rising trend in obesity over the past two decades (Al-Hazzaa., 2007). The prevalence rates of severely obese (2%), obese and (10%) or

overweight (26%) Saudi adolescents (aged 13-18) are significantly higher than for younger school-age children (5-12) (El Mouzan et al., 2011). Al-Hazzaa *et al.* (2013) revealed that the prevalence of overweight and obesity among Saudi adolescents (14-18) was significantly higher (38%) than adolescents in the UK (24%). Data for adolescents and adults aged 15 years and older from 16 countries in the Eastern Mediterranean Region showed Saudi Arabia to be one of the 6 top countries in the region for the prevalence of obesity.

1.3 Saudi culture and lifestyle and their impact on eating habits

Social and cultural characteristics of Arab Muslim societies differ from those of Western societies (Dadfar et al., 2003). Saudi Arabia, amongst the spectrum of cultural characteristics across the Gulf Cooperation Council countries, is distinctly tribal and conservative in its adherence to Islam (Dadfar et al., 2003). Saudi culture is strongly religious and family oriented, and women usually remain out of public view (ALFaris et al., 2015). Females usually stay in separate places from males, even in the workplace, universities and schools, and women are not allowed to access the buildings of males, and *vice versa*.

Saudi law does not allow women to drive a car, and therefore, men (normally a father, brother, son or family's driver) are responsible for selecting and purchasing food items for the household, often from a list provided by the mother. Most of Saudi people are wealth and live in very big houses, villas or even palaces. However, others have limited income and live in flats. The price of food (e.g. fruit and vegetables) in Saudi is very cheap compared to other countries in Europe and even in the Middle East, which enables low income people to purchase these types of foods.

In Saudi Arabia mothers or servants are solely responsible for household cooking and it is uncommon for men to cook. Sharing daily meals with family members is common amongst the Saudi population, not only in the home, but also in the restaurant (AL Rethaiaa et al., 2010). Along these lines, female adolescents are less independent than adolescents in many other countries. For example, it is not acceptable in Saudi culture for adolescents to go to restaurants or cafes without their mothers. However, they can gather together in an adolescent's home and order food; delivered by a male relative or male family driver. In school, girls become more independent and select food without their mothers' monitoring.

Traditionally, the majority of Saudis were Bedouin Arabs living in desert tents and using camels for transportation. They relied on consuming food from their environment, such as dates, fresh and dried milk products, livestock and animal products (eggs, meat), bread, and a limited quantity of vegetables (Musaiger., 2006).

After the discovery of crude oil in Saudi Arabia in 1950, the traditional lifestyle began a radical modernization, concomitant with an overall increase in per capita income (Musaiger, 1993). Saudi Arabia has been influenced by significant exposure to the West (Dadfar et al., 2003), which has led to dramatic and rapid change in food consumption patterns; away from a traditional "Arabian Peninsula" diet (of dates, cereals and dairy products) and towards a westernized diet high in energy, salt, fats and sugar (Al-Rethaiaa et al., 2010; Washi & Ageib., 2010; Bakhotmah., 2011; Benajiba., 2016).

Moreover, recent modernization has led to increased physical inactivity in the Saudi population, something that is especially apparent in females (Al-Hazzaa, 2004; Al-Nozha et al., 2007; Al-Zalabani et al., 2015). Servants do the house work (e.g.

cleaning), whilst nursemaids look after children instead of mothers especially wealthy people or have a busy mothers. As males drive females as required, females do not walk. Culturally, women are not expected to practice physical activities in public, and although walking-for-fitness is relatively acceptable for women in cities, it may not so in rural regions. This “transitional” period reached its peak at the beginning of the twenty-first century, with record rates of obesity, diabetes and osteoporosis (Al Qauhiz., 2010; Alissa et al., 2011).

Obesity and being overweight in Saudi rises with increased family income (Al Alwan et al., 2013). Families, who can afford to eat in restaurants or have food delivered by the family’s driver, may lead to an increased number of meals and more energy dense foods. Furthermore, the rapid spread of supermarket chains, food courts, and fast-food restaurants in Saudi has led to wider availability of energy dense foods associated with the Western diet (Musaiger & Al-Hazzaa., 2012). In general, changes in food quality and quantity are contributing factors to the prevalence of increasing BMI (Naeem et al., 2012; Al Nohair et al., 2014; ALFaris et al., 2015).

In typical Gulf Arab state household, formal dinners and celebrations generally involve large quantities of lamb (e.g. a whole lamb on each platter) and rice (eaten from large shared platters) surrounded by different types of sweets and soft drinks. The most common traditional dish is kabsah, which is mainly composed of white rice plus fatty meat (Musaiger., 2006). It is the most common “traditional” fast food bought from traditional fast foods shops (Midhet & Sharaf., 2011).

Eating fruit and vegetables is uncommon in the Saudi population, with many individuals not meeting the minimum daily recommendations (ACFN., 2011) for fruit

(2-4 servings /day) and vegetables (3-5 servings/day) (Musaiger et al., 2012a; Ziad et al., 2014; Al-Muammar et al., 2014; Alsunni et al., 2015).

Many of the Saudi population obtain health information from the television, magazines, daily newspapers and the internet. However, some people who have health conditions receive health information from a dietitian or doctor in the hospital as a part of their treatment. Some private health centres can also provide health information for their customers.

1.4 Importance of eating habits and nutrition in adolescence

Many researchers have investigated eating habits, in adolescents in particular (Al-Hazzaa et al., 2011; Musaiger & Zagzoog et al., 2013; Al-Muammar et al., 2014 Al-Faris et al; 2015). Adolescence is a crucial developmental period due to the increased nutrient demand for rapid growth and the functional changes taking place in different bodily tissues (Gong & Heald., 1994). During this period, adolescents achieve the final 15-20% of their height, gain 50% of their adult body weight, and accumulate up to 45% of their skeletal mass (Gong & Heald., 1994). Therefore, meeting nutritional recommendations helps ensure successful growth and development.

As children enter adolescence, growing independence influences food intake (Auld et al., 2002), and individuals experience increased control over their food intake. At this time, they begin to develop dietary habits (Videon & Manning, 2003). Unhealthy dietary habits (e.g. consuming less fruit and vegetables, and more fat) and lifestyle choices in adolescents are major risk factors for nutrition-related diseases in adulthood (WHO., 2013).

Indeed, a number of studies have demonstrated that adolescence is an important time for establishing food choice behaviour. Lake *et al.* (2006) examined longitudinal changes in food habits between adolescence (11–12 years) and adulthood (32–33 years) in Northumberland, England. The study revealed that food intake in adolescence was a significant predictor of intake in adulthood; there were no significant changes in the consumption of bread, other cereals, potatoes, meat, and fish from adolescence to adulthood. However, there was significant reduction in milk and dairy products consumption, in-keeping with the reduced requirement of milk from birth in diverse species. Dietary changes are thought to be influenced by variables including gender, location and socio-economic status (Lake *et al.*, 2006).

1.5 Eating habits and food intake amongst Saudi adolescents

Statistics show that adolescents in Arab countries, including Saudi Arabia, suffer from nutritional problems and diseases, such as iron deficiency anaemia, calcium and vitamin D deficiencies, and those associated with over nutrition and changes in lifestyle such as obesity (Musaiger *et al.*, 2011).

Nutrition habits and lifestyle in Saudi Arabia have been the focus of a number of studies. Al-Hazzaa *et al.* (2011) reported that around one third of Saudi adolescent girls aged between 14-19 years (from Riyadh, Jeddah and Al-Kobar) consumed sugar-sweetened drinks on a daily basis, whilst 60% consumed such drinks 3 to 6 times per week. Moreover, all of those adolescents did not consume fruit or vegetables on a daily basis. It was found that consumption of sugar-sweetened drinks was positively associated with BMI in Saudi adolescents (Collison *et al.*, 2010). Worryingly, Al-Hazzaa *et al.* (2011) found that approximately three quarter of girls (age 14-19 years) who live in Riyadh, did not consume vegetables or fruit daily, 53%

of them consumed sweets and chocolates and 52% ate fast foods (e.g shawarma, pizza, French fries) more than three times per week. Similar results were reported amongst adolescents in Jeddah (Musigar and Zagzoog., 2013).

A study in Jeddah of 1,067 Saudi adolescent girls aged 12–18 conducted by Shaath and colleagues (2008) found that 64.3% of participants consumed fast foods one to three times per week mainly at dinner, and that 74.5% of them drank sweetened carbonated beverages daily. Shaath (2008) also reported that kabsah, chicken shawarmah, and masoub (bread mixed with, sugar, and butter) are favourite fast foods for lunch, dinner, and breakfast, respectively. In Saudi Arabia fried chicken, pizza, and noodles are the preferred “westernized” fast foods, and American-cuisine restaurants came top of the participants’ favourites when dining outside such as McDonald (Shaath 2008).

ALFaris *et al.* (2015) examined fast food consumption trends among Saudi adolescent girls living in Riyadh (13-18 years). Among study participants, 79.1% consumed fast food at least once weekly. Burgers and soft drinks were the main types of fast food consumed. ALFaris *et al.* (2015) suggested that the increasing portion size of fast food led to a significant increase in an adolescent’s BMI. Al-Muammar *et al.* (2014) revealed that around 90% of Saudi adolescent girls in Riyadh consumed chips, chocolate and sweets daily, as well as fizzy drinks. Fruit and vegetables on the other hand were consumed daily by only 15% of them.

The adverse health consequence that may result from excessive intake of soft drinks and fast food is hypothesised to be increasing the rate of obesity (Michael & Alden., 2012; Lu Qi., 2015). Now numerous studies have demonstrated an association between body weight and eating behaviour (Rampersaud et al., 2005; Al-Muammar

et al., 2015; ALFaris et al., 2015). The changes in these prevalence rates are attributed to the major socio-cultural and lifestyle changes that have accompanied the overall increase in per capita income and recent modernization (Musaiger 1993; Al Qauhiz., 2010).

1.6 Eating habits and health consequence

Previous research has shown that food plays a major role in disease prevention (Tjønneland and Olsen., 2011). For example, food containing dietary fibre can reduce the risk of diseases and disorders such as colon cancer, diverticular disease and haemorrhoids (Tjønneland and Olsen, 2011). Soluble fibre, may slow digestion and absorption of carbohydrates and hence lower the rise in blood glucose that follows a meal and downstream insulin response (Tjønneland and Olsen, 2011). Moreover, higher consumption of fibre was associated with lower blood pressure (Evans et al., 2015). In addition, calcium intake has been found to be lower than recommendations in adolescents, and is thought to be a contributing factor to the increased risk of osteoporosis in later life (Mesías et al., 2012).

Limiting portion sizes, especially for energy dense foods, may also reduce the risk of obesity (WHO., 2014). Unsurprisingly, several studies provide evidence for a relationship between portion size and energy intake (Albar et al., 2014), although some studies have considered only snack foods (Kerr et al., 2009), fast foods or sugar-sweetened beverages (Forshee et al., 2008; Gibson et al., 2007) when assessing the effect of body weight (Albar et al., 2014).

The energy density of food is defined as the number of kilo joules (kJ) in a given weight of food (kJ/g) (Westterterp-Plantenga., 2001). The World Cancer Research Fund UK (2007) has classified foods that contain more than 941–1151 kJ/100 g

(225–275 kcal/100 g) as high-energy-dense foods, normally due to elevated fat and/or sugar content. Foods that contain between 418–941 kJ/100 g (100–225 kcal/100 g) are defined as medium-energy-dense foods, and foods that contain 251–628 kJ/100 g (60–150 kcal/100 g) are defined as low-energy-dense foods.

1.7 Overweight, obesity and health

Obesity is a metabolic condition that is complex and multifactorial (Butland et al., 2007; Larrañaga et al., 2007). It develops from the interaction between predisposing factors (genotype) and environmental factors (Larrañaga et al., 2007). The WHO has recognised obesity as being one of the top ten health problems globally (Davis et al., 2004).

Insulin resistance is a common feature of the obese state and is considered to be an important link between adiposity and the associated risk for type 2 diabetes and cardiovascular disease (Chiarelli and Loredana., 2008; Nathan and Moran., 2008). The co-existence of type 2 diabetes and obesity has been frequent enough to lead to the creation of the term “diabesity” (Astrup and Finer, 2010).

Numerous physical problems are associated with obesity. For example, breathing difficulties (sleep apnoea – a temporary cessation of breath during the night) (Fiorino and Brooks., 2009), musculoskeletal problems (knees, ankle and foot problems, neck back pain) (Krul et al., 2009), neoplasia (breast, endometrial and colon cancer), and skin lesions (Kushi et al., 2012) are all associated with obesity. Moreover, obesity can lead to chronic diseases such as hyperlipidaemia (dyslipidaemia), hypertension and atherosclerosis, as well as psychiatric conditions (Cole et al., 2010; Larrañaga et al., 2007). It is likely that overweight adolescents remain overweight

into adulthood (Janssen et al., 2004; Singh et al., 2008); with 70% of obese adolescents predicted to become obese adults (Reilly., 2006).

Ziad *et al.* (2014) showed that Saudis (age 15 or older) with elevated blood pressure, hypercholesterolemia, or diabetes were more likely to be obese than healthier subjects. Adolescents who are overweight or obese are at greater risk of type 2 diabetes, fatty liver (hepatic lipidosis), as well as endocrine and orthopaedic disorders (Larrañaga et al., 2007). Saudi Arabia is witnessing increasing rates of type 2 diabetes mellitus (Al-Agha et al., 2012). Saudi health ministry spent millions of its budget to treat those people and prescribe their medication freely which require an urgent action to prevent these diseases. Therefore, nutrition education is required to improve nutritional knowledge and food intake, and could subsequently reduce the risk of being overweight or obese, and associated clinical conditions.

1.8 Improving nutritional knowledge through Nutrition Education

There is a lack of nutrition education in Saudi Arabia, especially as it is absent from the school curriculum. For example, Al-Almaie (2005) found that adolescents in the eastern region of Saudi Arabia had low levels of nutritional knowledge. Other groups conducted nutrition education Interventions amongst college students in the north of the country (Hail City), revealing that students answered less than 31% of the total questions pre intervention “correctly” – i.e. in ways indicative of an appreciation of the role of food in health (Alshammary et al., 2014). The study revealed a significant increase in the proportion of “correct” answers by 50%, from pre to post intervention. Change in food intake was not measured by this study.

The literature showed that no nutrition education intervention is available for Saudi adolescents enrolled in school; which would be expected to increase their nutritional knowledge and/or improve their food intake habits. Several researchers in Saudi Arabia have concluded that there is an urgent need for nutrition education for adolescents and their parents to promote dietary habits among adolescents (Al-Almaie, 2005; Farghaly et al., 2007; Al-Agha et al., 2009; ALFaris et al., 2015; Benajiba., 2016). Thus, nutrition education is one of the first steps towards increasing nutritional knowledge; subsequently improving food intake and overall health and wellbeing.

1.9 Conclusion

Saudi Arabia is witnessing increasing rates of overweight and obesity; a trend which has been present throughout the past two decades, particularly amongst adolescents and adults. This has been attributed to various aspects of Saudi culture, such as a lack of demanding physical activity; radical and rapid change from a traditional Arabic diet towards a more Western diet (Shaath, 2008; Al-Rethaiaa et al., 2010; Washi & Ageib, 2010; Bakhotmah, 2011; Benajiba, 2016).

Several groups have reported that Saudi adolescents do not meet the recommended daily amounts of fruit and vegetables (ACFN, 2011), and consume large portion sizes of convenience foods (Bello & Al-Hammad, 2006; Al-hazzaa et al., 2011; Al-hazzaa, 2013; Al Muammar et al., 2014; Musaiger et al., 2014; ALFaris et al., 2015). An increase in the quantity of food consumed, and changes in food quality, are therefore, contributing factors to the prevalence of obesity amongst adolescents (Naeem, 2012; Al Nohair, 2014; ALFaris et al., 2015). The literature also demonstrates a significant lack of nutrition education in the Saudi population,

particularly in schools as there was none. Therefore, nutrition education intervention is a means by which to increase nutritional knowledge and subsequently improve food habits.

Chapter 2: Literature review

2.1 Introduction

This chapter will focus on the importance of nutrition education in improving nutritional knowledge and food intake among adolescents. This chapter explores the literature concerning the role of nutritional knowledge on food intake, and other factors that affect dietary behaviour.

2.2 Nutrition Education

Nutrition education has been defined as “any combination of educational strategies, accompanied by environmental supports, designed to facilitate the voluntary adoption of food choices and nutrition-related behaviours conducive to health and well-being; nutrition education is delivered through multiple venues and involves activities at the individual or community” (Contento., 2008). This may involve many additional activities that are not usually referred to as Nutrition Education, such as cooking demonstrations (FAO., 2014) and gardening (McAleese et al., 2007; Christian et al., 2014) as well as social media and campaigns.

The hypothesis is that people need an understanding of what constitutes a good diet in order to make good food choices and subsequently improve food intake (FAO., 2014). However, food intake is a complex human behaviour affected by many interdependent factors, and it is neither fully determined by the physiological and nutritional needs of a person, nor the perceptions and interest of a person in the health effects of certain foods and diets (Shepherd, 1999). Its complex aetiology depends upon a group of factors ranging from biological mechanisms and genetic

predisposition (at one end of the scale), to social and cultural factors (at the other) (Shepherd, 1999).

Story *et al.* (2002) described four useful factors influencing food intake:

1. Individual or intrapersonal influences (e.g. psychosocial and biological)
2. Social environmental or interpersonal (e.g. family and peers)
3. Physical environmental or community settings (e.g. schools, fast food outlets, convenience stores).
4. Macro system or societal (e.g. mass media, marketing and advertising, social and cultural norms)

Nutrition education could be delivered to the participants in different ways, such as handing out printed materials (Casazza and Ciccazzo., 2007), face-to-face sessions (Farid *et al.*, 2013), or virtually (Casazza and Ciccazzo., 2007; Haerens *et al.*, 2007; Ajie *et al.*, 2014). Also, nutrition education can be delivered in different places, such as in the home (Williamson *et al.*, 2006) or in the school setting (Shirk *et al.*, 2009; Farid *et al.*, 2013; Tavassoli *et al.*, 2015).

2.3 School - based nutritional education interventions

Schools are considered important channels of intervention because they offer access to large populations of adolescents and provide the opportunity to institutionalize programs in communities (Li *et al.*, 2008). In addition, the closely supervised environment of a classroom, along with the potential for social support from fellow classmates and teachers, may enhance the effect of a school-based intervention over a home-based approach, which may be completed alone (Kothandan., 2014).

Additionally, the school setting increases the likelihood of participants attending and using the materials of the intervention, due to the mandatory attendance requirements (Kothandan et al., 2014). Evidence by Kothandan *et al.* (2014) showed that a family-based intervention in the home - for obesity treatment by improving food intake (i.e. reduce energy intake) – demonstrated effectiveness for children under the age of twelve, whilst school based interventions were more effective for those aged between 12-17.

Shirk *et al.* (2009) conducted a study in a high school for American adolescents (13-18 years old) over 3 weeks. Adolescents received nutrition education for 60 minutes, 4 days a week. The nutrition programme included education and activities such as meal planning. For example, adolescents completed a 24-hour food recall at the beginning of the programme and were encouraged to modify it to make it healthier. The author revealed that nutritional knowledge increased by 24% from pre- to post-intervention. Another study carried out in Palestine, showed a significant increase in nutritional knowledge by nearly 41% after 5 classroom-based lessons for adolescents (16-18 years old) (Farid et al., 2013). Furthermore, Abood *et al.*, (2008) found a significant increase in nutritional knowledge amongst 551 adolescents (mean age 14.5 years) in the USA after a nutritional intervention of two 30-minute time slots over 1 week. All of these studies measured only nutritional knowledge as a main indicator of intervention success, and did not measure if the acquired nutritional knowledge had a positive impact on food intake.

However, other researchers have measured both nutritional knowledge and food intake. For example, Fahlman *et al.* (2008) conducted a pilot study to examine the effect of nutrition intervention (8 lessons within a month) on nutritional knowledge

and behaviour change in 783 middle school students. Adolescents in the intervention group demonstrated a significant increase in nutritional knowledge by 53%, and also scored significantly higher than the control group post intervention. In addition, the study revealed that the intervention group significantly increased their fruit (3.25 portions/day) and vegetables intake (2.3 portions/day), as compared to the control group (fruit 2.41portion/day, vegetables 1.2 portions/day).

Another study, based in Khuzestan Province in Iran, examined the effects of a nutrition education programme on nutritional knowledge and dietary calcium in female adolescents enrolled in a junior high school (mean age 15 ± 0.7) (Naghashpour et al., 2014). In total, 188 adolescents were recruited - 95 into the intervention group and 93 into the control group. Adolescents in the intervention group received eight 30-minute to one-hour sessions during a two-month period, through lectures. The results showed a significant increase in nutritional knowledge of 17% at the 2-month follow-up, compared to baseline for the intervention group, as well as significant increases in dairy product consumption by 3 months.

Recently, Tavassoli *et al.* (2015) conducted a school-based health education intervention including 120 female adolescents in high schools in Isfahan city (Iran). As before, the participants were divided randomly into two groups - intervention (60) and control (60) group – and the nutrition intervention was delivered through lectures over 6 sessions (45-60 minutes per session). The study showed a significant increase in nutritional knowledge post intervention of 88%, compared to pre intervention. The amount of increase in fruit intake was 149 grams/day (around 2 portions/day) and in vegetables 207 gram /day (around 2.5 portions/day). Investigators in Libya carried out weekly nutrition education sessions for adolescents

(n=189) in 6 schools for 3 months (Sachithanathan et al., 2012), revealing a significant reduction in chocolate, chips and fast food intake post intervention. However, none of these nutrition education intervention looked at the range of factors that could influence adolescents' food intake such as parents' nutritional knowledge and their level of education, HFA and household income (Bjelland et al., 2011; Pearson et al., 2011; Campbell et al., 2013; Ansem et al., 2014; Shariff et al., 2015).

Nutricise 4 Life programme (N4L) is a school based nutrition education programme for adolescents (aged 16-18) in the USA (Blake et al., 2012). It is hypothesised that nutritional knowledge and dietary intake will improve over the 19-week duration of the intervention. The study revealed that nutritional knowledge increased significantly from pre- to post-intervention by 21%. However, no changes were observed in dietary intake. This may be that adolescents may have not recalled accurately what and how much they ate or it could be that cross contamination occurred as both intervention and control groups were at the same school. Also, it could be due to low HFA, household income, parents' level of education or parents' nutritional knowledge that influence adolescents' food intake as stated earlier.

O'Neil *et al.* (2002) conducted a 4-year study with environmental support, offering more fruit and vegetables in the school cafeteria and stimulating parental involvement to increase the availability of fruit and vegetables in the home. The cohort comprised 14 to 15-year-old adolescents who were followed until the ages of 17-18 years. Nutritional knowledge and consumption of fruit and vegetables

increased significantly post intervention in the intervention group compared to the control group

Although, nutrition education for adolescents is an important to improve their food intake, educating parents in particular mothers is an essential since they act as nutrition “gatekeepers” for their children, providing them with the ability and opportunity to make healthy food choices and make food available in the home which can influence adolescents’ food intake (Hanson., 2005; Hingle et al., 2010; Campbell et al.,2013). Also, educating mothers is an essential as they can support and encourage their daughters to improve their food intake (e.g. eating more fruit and vegetables) (Shokrvash et al., 2013). For this reason some studies involved them in school based the intervention which could enhance its effectiveness.

2.4 Enhancing nutrition education interventions through parental involvement for behavioural change

Parents are attractive targets for nutrition intervention programmes because they act as nutrition “gatekeepers” for their children, providing them with the ability and opportunity to make healthy food choices (Hanson., 2005; Hingle et al., 2010). Most studies in the literature which involved parents in the intervention were for the ages 2-11 years (Haire-Joshu et al., 2008; Paineau et al., 2008; Chen et al., 2010; Hu et al., 2010; Sweitzer et al., 2010; Hendrie and Golley, 2011; Wyse et al., 2012; Yin et al., 2012; Fletcher et al., 2013; McGowan et al., 2013), while few studies are available for 11-15 (Haerens et al., 2006; Haerens et al., 2007; Hopper et al. 1992) and 16-18 year olds (De Bourdeaudhuij et al., 2002; Neumark-Sztainer et al., 2003a; O’Neil & Nicklast, 2002).

Parental support interventions targeting parents of young children are considered more effective than those targeting parents of older children (Kader et al., 2015). This may be partially because a child's autonomy, independency and decision-making power increases with age (Golan and Crow., 2004), which could influence their food choice and consumption (Fitzgerald et al., 2009). However, the culture in Saudi Arabia is different from other countries (as stated in chapter 1), which makes the adolescent girl, in particular, less independent compared to adolescents in other countries. For example, the mother still has the power to control food availability in the home.

Previous researchers have found that parental involvement in nutrition education intervention when conducted outside the USA (e.g. Australia, Belgium, and Europe) had a positive impact on an adolescents' dietary intake, while parental involvement did not result in a positive impact in adolescent food intake in the USA (USDA., 2012). This suggests that culture and ethnicity play vital and differing roles when considering parental involvement in research.

Hingle *et al.* (2010) has suggested that there are 2 different types of strategies of parental involvement, namely:

1. Indirect strategies:
 1. Provision of information that did not require a parental response (e.g. newsletter, sheets with nutrition information sent to the home through mail, email or with child).
 2. Invitations to parents and children to participate in activities sponsored by the study (e.g. family fun nights)

3. Communications directed at the child and/or parent meant to involve parents in intervention activities (e.g. “try this at home”).
 1. Direct strategies:
 1. Parents’ presence requested at nutrition education sessions (e.g. didactic or workshop format).
 2. Parents’ attendance and participation requested for family behaviour counselling or parenting training sessions (e.g. counselling sessions or home/clinic visits involving parent training).

Many school-based nutrition interventions involving parents use indirect strategies (O’Neil C & Nicklast., 2002; Reynolds et al., 2000; Neumark-Sztainer et al., 2003; Baranowski 2003a; Caballero et al., 2003; Hearens et al., 2006, 2007) due to time constraints in the school setting (Hingle et al., 2010). A systematic review conducted by Hingle et al. (2010) examined what type of parent involvement was effective in achieving positive dietary outcome of children (e.g. increase consumption of dairy products, fruit and vegetables, and decrease fat intake). The author revealed that studies using direct methods to engage parents were more likely to report positive results (e.g. increase consumption of fruit and vegetables) compared to studies that used indirect methods. Furthermore, studies where “parent and child” engaged together in an activity were also more likely to report positive results (Hingle et al., 2010).

Haerens *et al.* (2007) evaluated the effect of nutrition education intervention, with and without parental involvement, in fifteen middle schools in Belgium (mean age 15 years) over two years. The schools were randomly assigned to one of 3 conditions:

intervention with parental involvement, intervention without parental involvement and a control group. During classes, adolescents received a computer-tailored intervention for fat and fruit intake and parents were sent information about nutrition to read, which was also included in the school newsletter. Post intervention dietary fat intake decreased significantly for girls in the intervention group with parental support, 85 ± 35 gram/day, compared to 98 ± 40 and 95 ± 40 , for the intervention alone group and the control group, respectively. It could be that girls are more responsive, since in general, the issue of diet and body size and appearance is attractive to girls (McVey et al., 2005). However, there was no significant change in fruit, vegetable or soft drink consumption in either boys or girls, although it could be argued that a longer intervention period (or more intensive sessions) are necessary to assess significant positive effects; as after 9 months, fruit intake increased by 0.1 servings per week in the intervention with parental support group, and decreased by 0.5 servings per week in the control group. The decline in fruit intake could be due seasonal variations in the availability of fruit. Also, the availability of a vending machine outside the school may have been the reason why no change in soft drink consumption was noted, with adolescents compensating for the lack of soft drinks at school by consuming more soft drinks outside of school (Finkelstein et al., 2004). However, HFA and mothers' nutritional knowledge were not measured which known factors that influence adolescents' food intake as stated earlier. Another limitation of this study, was that it did not measure their parents' food intake, since they are considered as a good model for food consumption of their children (Elfhag et al., 2008). Another study has shown that parental involvement in nutrition education intervention did not influence their children's food intake (De Bourdeaudhuij et al., 2002). This could be that 68% of adolescents without parental support reported that

they had discussed the nutrition information with their families; suggests that families were involved in some way (De Bourdeaudhuij et al., 2002).

As seen above, several studies have involved parents in a school nutritional intervention; however, they did not measure the efficacy of parents' involvement. A systematic review conducted by Van Lippevelde *et al.* (2012) aimed to determine the impact of parental involvement in school-based obesity preventions in children and adolescents, revealing that no conclusive evidence could be provided concerning the added value of parent involvement. This was due to the limited number of studies to test the hypothesis and inconsistencies in the evidence (Hingle et al., 2010; Van Lippevelde et al., 2012). Similarly, Ajie *et al.* (2014) concluded that there is insufficient evidence concerning parental involvement in nutrition education intervention to know whether parental involvement makes a positive impact. Nevertheless, direct methods or activities engaging parents in the intervention were shown to be more effective at improving children food intake than indirect methods (Hingle et al., 2010).

The aim of interactive activities between a parent and an adolescent is to transfer knowledge and encourage behavioural changes. In a study by Reynolds *et al.* (2000), nutrition education was conducted in the school of fourth grade students and parents were involved in the intervention, with the content of the study being described to parents at the beginning of the intervention (in the school setting). Parents were asked to complete the Freggie book with their children at home. The Freggie book contained seven homework assignments that parents were required to

complete; one interactive lesson with their child each week for seven weeks. The author revealed that post-intervention, children in the intervention group showed a significant increase in fruit and vegetable consumption (3.96 portions/day), compared to the control group (2.28 portions/day). Also, parents in the intervention group showed a significant increase ($p < 0.05$) in their fruit and vegetable intake post-intervention (4.23 portions/day) compared to (3.90 portions/day) in the control school. However, this study only compared the intervention group with the control group and did not compare the intervention group with parental support to the other intervention group without parental support which would allow to see if the change in students' food intake was due to parental involvement or from nutrition education sessions in the school only. Also, this study was conducted amongst children in elementary schools, who are less independent than adolescents, and there is no study available in the literature for adolescents. In addition, the study did not assess a mother's nutritional knowledge or home food availability which considers one of the factors that could influence adolescents' food intake.

2.5 The role of nutritional knowledge on home food availability and food intake

Previous research has shown that mothers' nutritional knowledge was significantly associated with home food availability which can influence adolescents' food intake (Slusser et al., 2011; Campbell et al., 2013). Turkish children who had mothers with higher nutritional knowledge consumed more fruit and vegetables compared to those who had mothers with lower nutritional knowledge (Yabanc et al., 2014).

The research showed that also nutritional knowledge of adolescents themselves could influence their food intake. To illustrate Grosso *et al.* (2013) found a positive association between nutritional knowledge and the consumption of healthier foods

(fish, vegetable and fruit intake), and a negative association with sweets, snacks, fried foods and sugary drinks in a rural area of southern Italy.

Furthermore, a survey performed in 11-year old school children in Iceland demonstrated that knowledge of the recommended portions of fruit and vegetable had a positive impact on their consumption (Kristjansdottir et al., 2006), whilst a systematic review examining the relationship between nutritional knowledge and dietary intake in adults (mean age ≥ 18 years) revealed a significant, positive association between nutritional knowledge and food intake (Spronk et al., 2014). Several nutritional interventions amongst adolescents have confirmed that increasing nutritional knowledge results in an improvement in dietary intake, such as reducing fat consumption (O'Neil et al., 2002; Casazza & Ciccazzo., 2007; Sachithanathan et al., 2012).

Pirouznia *et al.* (2001) examined the association between nutritional knowledge and eating behaviours of adolescents from middle schools in the US (n=532). Their findings indicated a positive association between nutritional knowledge and food intake (eating fruit, vegetables and milk) for both girls and boys in the seventh and eighth grades. However, there was no association observed for girls in the sixth grades. This difference could be due to using a different version of the administered questionnaire for sixth grade compared to the seventh and eighth grades. Conversely, other researchers have shown that increasing nutritional knowledge scores did not result in changes in high school adolescents' food intake (Shakkour et al., 2007; Blake., 2009) (see section 2.3 for more details). This due to the other of factors that could influence adolescents' food intake such as HFA.

2.6 The role of home food availability on adolescents' food intake

Home food availability (HFA) refers to the presence of food in the home (Hearn et al., 1998). Food purchases are predictive of HFA (Baranowski et al., 2008) which is positively associated with adolescents' food intake such as fruit, vegetables, milk, beverages and chocolate (Neumark-Sztainer et al., 2003; Hanson et al., 2004; Rasmussen et al., 2006; Jago et al., 2007; Bauer et al., 2011; Pearson et al., 2011).

All the studies in the literature that measured HFA used a specific questionnaire asking about how often specific food available at home. However, food till recipes can be used as an alternative method to measure HFA especially for Saudi culture (Ransley et al., 2003; Martin et al., 2006). This way has advantages as it could show the amount of food available at home.

A qualitative study in the US focused on how the food decisions of children and adolescents (aged 8-17) were shaped by environmental factors, and concluded that many factors contribute to food intake (e.g. food preference, cost of food, convenience and advertisements and HFA) (Swanson et al., 2013). Several studies have shown an association between HFA and an adolescents' food intake. Pearson *et al.* (2011) revealed that the home availability of energy-dense foods was inversely associated with fruit consumption of Australian adolescents, and positively associated with energy-dense snack consumption. Another study found an inverse relationship between fast food availability and American adolescents' intake of fruit and vegetables (Gretchen et al., 2011). In addition, decreasing the home availability of soft drinks is associated with decreasing adolescent soft drink consumption over a four-month period in Holland (Ezendam et al., 2010). Similar results in the USA were reported by Bauer *et al.* (2011).

Moreover, some researchers have shown a negative association between milk consumption and soft drink availability in the home (Hanson et al., 2004). Home food consisting of fruit and vegetables was significantly associated with their intake by adolescents (Neumark-Sztainer et al., 2003; Hanson et al., 2004; Rasmussen et al., 2006; Jago et al., 2007; Bauer et al., 2011; Pearson et al., 2011). Befort et al. (2006) did not find a significant association between fruit, vegetables or fat intake and their home availability amongst black adolescents in the USA, whilst white adolescents showed significant correlations for fruit intake. This study did not measure adolescents' nutritional knowledge level, which can impact on food consumption, as discussed in 2.6. Furthermore, the study did not compare household income and a parents' level of education which can influence HFA (Bjelland et al., 2011; Ansem et al., 2014; Tavassoli et al., 2015). For example, parents in the highest socio-economic category were more likely to have fruit and vegetables available at home compared to parents in the lowest or intermediate socio-economic categories (Ansem et al., 2014). In addition to these factors, mothers' nutritional knowledge was significantly associated with HFA which can influence adolescents' food intake (Campbell et al., 2013). Table 1 summarizes the studies that have looked at association between HFA and an adolescents' intake.

Table 1: association between home food availability and adolescents' food intake

Authors	Total number	Age	Country	Association between HFA and adolescents' food intake	Notes
Pearson et al. (2011)	1850	High school 7-12 grade Mean age	Australia	-ve between availability of energy-dense foods with fruit intake +ve between availability of energy-dense foods	The study did not control for nutritional knowledge level, household income

		Mean 13.4		with adolescent's consumption of these products. +ve between availability of fruit and vegetables with adolescents intake.	or parents' level of education.
Hanson et al. (2005)	902	13-18	USA	+ve between availability of fruit, vegetables and milk with adolescents' consumption. -ve between availability of soft drinks with consumption of milk.	The study did not control for nutritional knowledge level, household income or parents' level of education.
Neumark-Sztainer et al. (2003)	3995	Mean age 14.9	USA	+ve between availability of fruit and vegetables with adolescents' consumption of these products.	The study did not control for nutritional knowledge level
Befort et al. (2006)	228	10-19 mean age 15	USA	No association between availability of fruit, vegetables and fat consumption amongst black adolescents. White adolescents showed significant positive association for fruit intake only.	The study did not control for nutritional knowledge level, household income or parents' level of education.
Gretchen et al. (2011)	4647	13-18	USA	-ve between availability of fast food with intake of fruit and vegetables.	The study did not control for nutritional knowledge level.
Jago et al. (2007)	Literature review	6-18		+ve between availability of fruit and vegetables	

				with adolescents' intake.	
Rasmussen et al. (2006)	Literature review	6-18		+ve between availability of fruit and vegetables with adolescents' intake.	
Ezendam et al., (2010)	348	12-13	Holland	+ve decreasing home availability of soft drinks has been associated with decreases in adolescent soft drink consumption.	The study did not control for nutritional knowledge level, household income or parents' level of education.
Bauer et al. (2011)	365	14-20	USA	+ve between availability of fruit and vegetables with adolescents' intake +ve between availability of soft drinks with adolescents' intake.	The study did not control for nutritional knowledge level, household income or parents' level of education.
Ansem et al. (2014)	1318	11	Holland	+ve between availability of fruit and vegetables with adolescents' intake.	The study did not control for nutritional knowledge level.
Campbell et al. (2007)	347	12-13	USA	+ve between availability of sweets and high-energy fluid with adolescents intake.	The study did not control for nutritional knowledge level, household income or parents' level of education.

+ve - Positive association

-ve - Negative association

In general, all of these studies show significant association between HFA and adolescent food intake, although none were conducted in Saudi Arabia.

Auld *et al.* (2002) indicated that approximately three quarters of adolescent girls (16-17 years old) reported that milk was always available in the home, whilst also noting the availability of alternative beverages within the home. In other words, the availability of beverages at home may be a key barrier to drinking milk. Along the same lines, a qualitative study showed that the availability of some foods, such as sweets, was a barrier to consuming fruit (Gellar *et al.*, 2007). The same adolescents stated that they preferred to eat pre-packaged foods that require little/no preparation, instead of fruit and vegetables which take time to prepare (Gellar *et al.*, 2007).

Semi-structured interviews were conducted with adolescents (aged 11 to 14 years) (n=47) from one middle school in the USA to explore an adolescent's food choices in the home, with particular attention to environmental influences (Holsten *et al.*, 2012). It was concluded that adolescents made food choices in the home through an interactive process based on three factors: *the adolescent*, *the parent*, and *the food*, which are embedded within the context of time as depicted in Figure 1.

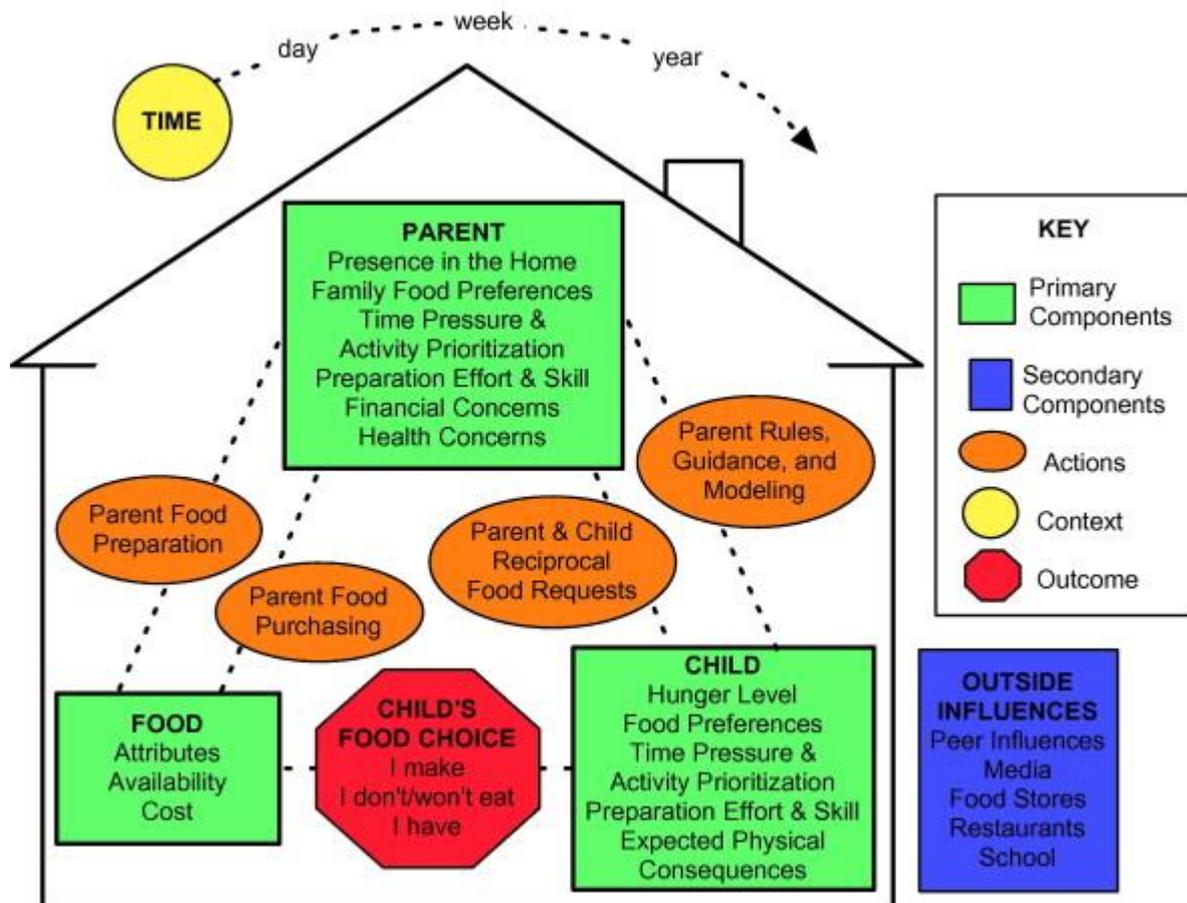


Figure 1: This model depicts the process of adolescent's food choices in the home setting, derived from interview data with middle school children (Holesten et al., 2012).(permission was obtained).

Baranowski *et al.* (2008) went on to develop and test a model for predicting the availability of fruit and vegetables in the home. In this model, social support and shopping practices were the primary predictors of their availability. Figure 2 presents an alternative model of the influences shaping home fruit and vegetable availability and consumption. Despite the large variable effect on HFA and food consumption household income is considered one of the factors that ply an important role in food consumption.

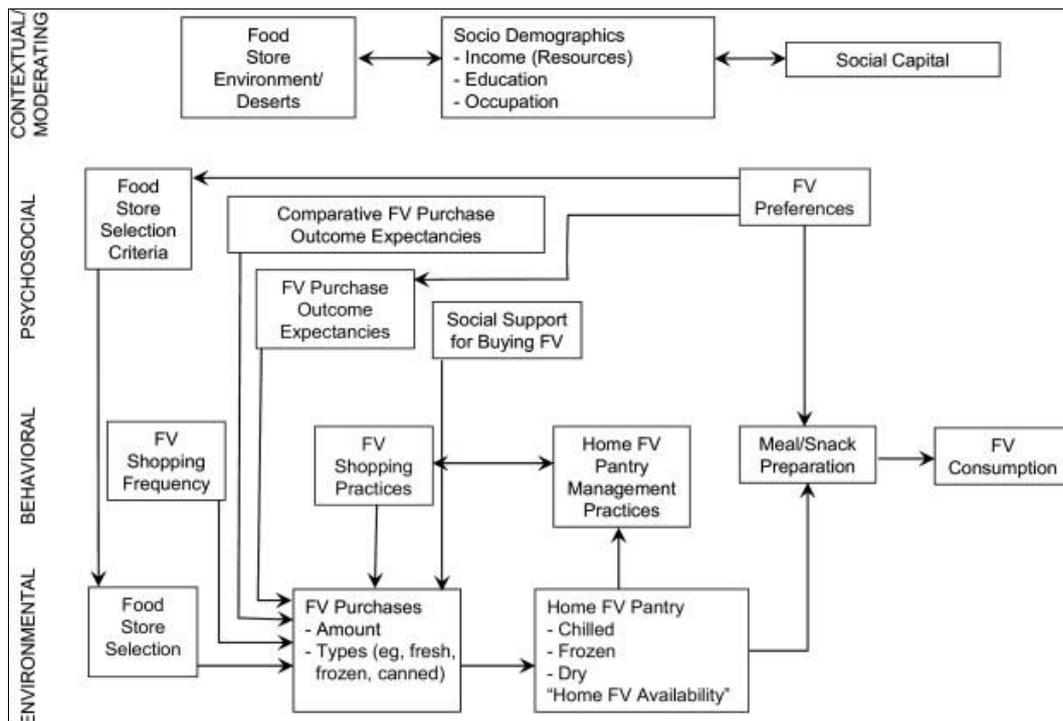


Figure 2: model of influences on home Fruit and vegetables availability and consumption (adopted from Baranowski et al., 2008). (Permission was obtained)

2.7 The role of income on adolescents' food intake

Income is considered one of the factors to influence food intake (Ricciuto et al., 2006; Ree et al., 2008). Evidence by Turrell *et al.* (2002) shows that individuals from socio-economically disadvantaged backgrounds purchased fewer types of fruit and vegetables, and less often, than their more affluent counterparts. Researchers also showed that Dutch children aged 11 years, in the lowest or intermediate socio-economic category, had a lower fruit (on average 0.96 pieces per day) and vegetable (on average 94.0 grams per day) consumption compared to children in the higher socio-economic category - whose fruit (on average 1.07 per day) and vegetable (on average 117 grams per day) consumption was comfortably higher (Ansem et al., 2014).

A significant negative association were found between the income of Hispanic households and the intake of fat and sodium by adolescents (aged 4-16) (Mazur et al., 2003). This was due to their parents' level of education (Mazur et al., 2003); since, a previous study revealed that low formal education remained predictive of a lower nutritional knowledge score (Lane et al.,2013), which could influence children's food intake (Yabanc et al., 2014). However, no study available in the literature looked at the role of income in Saudi Arabia.

Indeed, evidence exists across the globe that income influences food habits. Shariff *et al.* (2015) found that in Malaysian children (aged 1-10) there were significant differences based upon household income; low-income pre-schoolers had the lowest mean intake of fruits (0.07 portions), compared to (0.18 portions) and (0.13 portions) of those in the middle- and high-income categories, respectively. However, consumption of fruit and vegetables of school children did not differ significantly based on the household income. It could be that fruit and vegetables served at schools could influence their intake. The level of their mothers' nutritional knowledge is also not known.

2.8 The role of parents' level of education on adolescents' food intake

The educational level of a parent represents another primary environmental determinant of dietary intake amongst children and adolescents (Horst et al., 2007; Pearson et al., 2009). Several research groups have looked at the association between a parents' level of education and an adolescents' food intake. Hilsen *et al.* (2011) stated that the intake of fruit and vegetables decreased amongst adolescents of parents in the lowest educational category, but was increased in adolescents of parents in the highest education category; based on Norwegian 11–13 year olds

sampled between 2001–2008. Similar results have been reported for Dutch 8-12 year olds (Johansen et al., 2006; Bere et al., 2008; Ansem et al., 2014).

In addition, parental education level was inversely associated with fat intake amongst children and adolescents (aged between 4-16 years) (Mazur et al., 2003). A systematic review conducted by Horst *et al.* (2007) further examined the environmental factors associated with obesity-related dietary behaviours in 4-18 year olds and concluded that parental education has an impact on children and adolescents food intake - being positively correlated with an adolescents' fruit and vegetables intake, and negatively with fat intake (Horst et al., 2007). Other groups have found similar significant relationships between a parent's education level and the improvement of intake of fruits and vegetables, importantly, after nutrition education intervention amongst Iranian adolescents (Tavassoli et al., 2015). One explanation for these differences could be that parents with a higher level of education had a higher income and nutritional knowledge level (Lane et al., 2013; Ansem et al., 2014), which was associated with increased availability of fruits and vegetables (Campbell et al., 2013; Ansem et al., 2014), and in turn, adolescent consumption of fruits and vegetables (Campbell et al., 2013).

Bjelland *et al.* (2011) found a significant negative association between Norwegian adolescents' intake of sugar-sweetened beverages, and the parental educational level. However, no significant difference was seen for the intake of fruit and vegetables (times/d) amongst Norwegian adolescents, although the proportion of adolescents who reported that fruit was available at home was significantly higher amongst adolescents with parents in the higher-level category of education (Bjelland et al., 2011). This could have been attributed to the low intake by their parents

(Bjelland et al., 2011), as they are considered to be a good model in food consumption for their children (Elfhag et al., 2008; Horst et al., 2007; Pearson et al., 2009).

2.9 Conclusion

In summary, the present review demonstrates that many factors influence an adolescent's food intake, with nutrition education intervention playing an active role in changing behaviours towards foods. Most studies examining the role of income and parental education have shown that higher income and parental education levels have a positive impact on an adolescent's food intake. Furthermore, HFA was linked to an adolescent's food intake, demonstrating that the household unit still plays a primary role in shaping healthy dietary decision.

The literature indicates that increasing nutritional knowledge has led to improvement in the quality of food consumed, such as increasing fruit and vegetables, and decreasing sweets and chocolate. Thus, nutrition education could increase an adolescent's nutritional knowledge, and subsequently, improve food intake (e.g. increase fruit and vegetables) especially when conducted in the school setting (Naghashpour et al., 2014; Tavassoli et al., 2015), and when parents were actively involved in the process (Reynolds et al., 2000). However, additional evidence shows that an increase in nutritional knowledge is not always associated with beneficial behaviour changes (Blake, 2009), since there are many factors that could influence adolescents' food intake such as HFA, nutritional knowledge of their parents' household income, parents' level of education, food preference (likes and dislikes), parents as role models, cost of food, convenience and advertisements (Story et al.,

2002; Elfhag et al., 2008; Swanson et al., 2013; Campbell et al., 2013; Grosso et al., 2013; Yabanc et al., 2014; Ansem et al., 2014; Tavassoli et al., 2015).

The present study, therefore, will aim:

1. To identify factors that influence food intake in Saudi adolescent girls that could assist in the development of an effective school-based nutrition education intervention (phase 1).
2. To explore the efficacy of the school based nutrition education intervention on improving dietary habits of Saudi adolescent girls and to determine whether additional home interactive nutrition activities involving adolescent girls and mothers will enhance the effectiveness of this intervention (phase 2).

Phase 1 exploring factors affecting food intake in Saudi adolescent girls is presented and discussed in Chapter 3. Phase 2 investigating the nutrition education intervention on changing the eating habits of Saudi adolescents is presented and discussed in chapter 4 and the involvement of mothers in nutrition education intervention is presented and discussed in chapter 5.

Chapter 3: Factors affecting food intake in Saudi adolescent girls (16-18 years)

3.1 Introduction

As has been established in the introductory chapters, there is considerable urgency to develop a nutrition education intervention that targets Saudi adolescents. However, before, such an intervention can be developed, the factors that could affect food intake need to be identified, as these will facilitate the development of the nutrition education intervention for phase 2 of this work.

3.2 Aim

To explore factors affecting food intake in Saudi adolescent girls (16-18 years).

3.3 Objectives

1. To identify the eating patterns using a 3-day food diary for both parents and adolescents.
2. To feasibility of measuring the demographics (BMI for parents and adolescents, health status, parents' level of education and household income).
3. To measure other factors such as household food availability, food shopping habits, nutritional knowledge for parents and adolescents and determine the relationship with food intake.

3.4 Methodology

3.4.1 Study design

A prospective survey on a selected population

3.4.2 Participants and recruitment

Althaltha School in Tabuk city (a small city in the north west of Saudi Arabia) was selected as 100% of the female adolescents were of Saudi ethnicity. In the school

there were 6 classes, each with approximately 18 adolescents aged between 16 and 18 years. As females between the ages of 16-18 are often soon to become mothers, and have the responsibility of cooking and serving of food in the home, being educated about the importance of nutrition and health is, therefore, crucial. Also, there is a lack of nutritional research in the adolescent age group of 16-18 years particularly in Saudi adolescents. Thus, Saudi adolescent girls were chosen for this doctoral work.

Recruitment started towards the end of the first semester (first week of December 2013).

The following recruitment process was used:

1. Permission for the study from the General Administration of Education in Tabouk (GAET) was first sought via letter correspondence.
2. After gaining permission from GAET, the principal researcher contacted the Head of School and provided study details (appendix C1) to request permission for the study.
3. Following approval, 2 out of the 6 classes were randomly selected, to provide at least 28 adolescents. Previous nutrition education programmes recruited 28 adolescents and showed significant results (Blake et al., 2012).
4. Adolescents from the chosen classes were recruited through researcher-led information sessions held at specific times during the school day.
5. Adolescents who showed an interest in taking part in the study were given a letter describing the study (appendix C2) to take home to their parents/guardian and read (appendix C3).
6. A subsequent meeting in the school was arranged to describe the study to the mothers/guardians, and answer any questions or concerns. Men were

excluded from this meeting as men are not allowed to enter girls' schools under Saudi law.

3.4.3 Inclusion criteria

1. Females aged 16 -18 years (in grades 1-3 high school).
2. Informed consent (appendix D) obtained from:
 1. Both parents who live permanently with adolescent.
 2. Single parent, in the case of adolescent living permanently with single parent.
 3. A relative/guardian, in the case of adolescent living permanently with a relative/guardian who has responsibility for the adolescent.

3.4.4 Exclusion criteria

1. Adolescents who lived in orphanage.
2. Adolescents who were married.

3.4.5 Data collection

All data was collected over an eight-week period between December 2013 and January 2014. All information and questionnaires (originally in English) were translated into Arabic and quality checked (by an Arabic specialist). Adolescents who had illiterate parents were advised to read the questions to their parents and record their responses. All adolescents were given their own questionnaire and that of their parents to take home to be completed and returned to the school for collection by one of the teachers.

Participants' physical measurements (height and weight) were taken in a private place in the school, during class hours and under the direct supervision of a teacher.

Mothers' measurements were taken by the researcher in a private place in a shopping centre, at a specific time. Suitable places away from public view were chosen, as it is not acceptable in Saudi culture for ladies to take such measurements in the presence of men; whereas fathers' were asked to send their measurements as self-reported to the researcher. Saudi culture does not allow women to take such measurements from men. The following table summarises all measurement used in Phase 1 of the study.

Table 2: Summary of measurements

Measurement	Mother/guardian	Father	adolescents
Height and weight (Body mass index)	Measured by researcher	Self-reported	Measured by researcher
Waist circumference	Measured by researcher	Self-reported	Measured by researcher
Demographic Screening questionnaire	Completed by participant	Completed by participant	Completed by participant
Nutritional knowledge questionnaire	Completed by participant	Completed by participant	Completed by participant
Dietary record	Completed by participant	Completed by participant	Completed by participant

3.4.6 Body Mass Index (BMI)

BMI and BMI percentile were used in the current study to assess the prevalence of overweight and obesity amongst Saudi adolescent girls and their parents (WHO, 2009). BMI and BMI percentile were chosen because they are easy to measure and interpret, inexpensive and do not require expert personnel (NOO, 2009).

Both methods are widely used around the world and have formed part of clinical medicine across different populations for considerable time, facilitating the ease of comparison to other groups and work (NOO, 2009), i.e. threshold and growth references to which children should adhere exist. BMI percentile in children until 18 years varies with age and sex, however, which prevents the use of fixed threshold as in adults. Equivalent growth references do not exist for other measures, such as waist circumference (WC) (NOO, 2009).

Height (cm) was recorded to the nearest 0.5 cm using a stable stadiometer (Model Seca 217, UK). Participants were asked to remove their shoes, hats, and hair ornaments and stand up straight on the footplate with their back against the stadiometer rule. They were requested to keep their arms by their sides, their shoulders relaxed and head upright.

Weight (kg) was measured to the nearest 0.1 kg using digital scales (model Seca 264, UK). The scale was set to zero and participants were asked to remove their shoes, heavy outer clothing (jackets, vests, sweaters, and hats) and empty their pockets (cell phones, iPods, and keys). Participants were asked to step on the scale with both feet, and remain still with arms hanging naturally by their side and looking forward.

3.4.7 Waist Circumference

WC was used in our study along with BMI, since BMI interpretation can be influenced by variables such as fitness (muscle mass) and ethnic origin (CDC, 2011). Furthermore, WC is an easy, inexpensive and convenient index of abdominal obesity. It is also significantly correlated to BMI in adults (Gierach et al., 2014), and BMI percentile in adolescents (Spolidoro et al., 2013).

WC was measured to the nearest 0.1 millimetre using a stretch-resistant tape measure. The measurement was taken twice and averaged to ensure that the difference between the two measurements did not exceed 1 cm (WHO, 2008). The tape was wrapped snugly around the subject, but not to a point of constriction, and kept parallel to the floor.

Participants were asked to stand with their arms by their sides, with their feet positioned closely together and standing up straight, with their bodyweight evenly distributed. They were advised to relax and take a few deep, natural breaths before the measurements were taken; minimising the inward pull of the abdominal contents during waist measurement (WHO, 2008b). Measurements were made at the midpoint between the top of the iliac crest and the lower margin of the last palpable rib (WHO, 2008b).

3.4.8 Screening questionnaire

The screening questionnaire (see appendix E1) was developed and piloted by the researcher. The aim of this questionnaire was to collect information on the following: demographic and health; home food availability; and some additional information about food purchases. This questionnaire took approximately 15 minutes to complete and was composed of five sections.

1) Demographic information: to identify participants' age, total household income and level of education for parents/guardian.

2) Medical information: participants were asked about their health status and whether they had been diagnosed with any particular disease, such as diabetes, hypertension or others diseases likely to affect dietary intake.

3) Meal pattern: identifying participants' eating patterns, such as the frequency of eating fruit, vegetables, fizzy drinks, sweets, chocolate, cakes and biscuits. They were also asked about frequency of eating meals with their families.

4) Home food availability: this section of the questionnaire based on previous questionnaire (Baranowski et al.2008). Participants were asked how often certain products are available in their homes, such as fruit, vegetables, cakes, biscuits, chocolate and fizzy drinks.

5) Food shopping habits: completed by parents, who were asked about the household main shopper, the type of fruit and vegetable purchased, and the reasons for choosing this type.

3.4.9 Nutritional knowledge questionnaire

This questionnaire was developed (appendix E2) based on a previously validated questionnaire in the literature (Parmenter and Wardle, 1999). The original questionnaire contained 50 questions in total, while, the current questionnaire contained 16 questions to reduce burden on participants. It aimed to assess adolescents' and their parents' level of nutritional knowledge. The questionnaire was also piloted prior to use (see section 3.4.11), and consisted of 16 questions in total, each in a multiple-choice format that took approximately 10-15 minutes to complete. Participants (parents and adolescents) were advised to mark 'not sure' rather than guess at answers. Furthermore, they were asked about the main sources of their nutritional knowledge.

3.4.10 Dietary data collection

Self-completion food and drink diaries were used to assess participants' eating patterns and calculate portion size of foods, such as sweets, chocolates, cakes and biscuits. Each participant was provided with an instruction booklet (Appendix F1)

and a blank food diary. This method has previously been used in research conducted in adolescents in Saudi Arabia (Washi & Ageib, 2010).

Parents and adolescents were asked to record the details of all food and beverages consumed at home and outside the home (as well as the time of consumption) for a period of 3 days, including two weekdays and one weekend day. A single day of intake is not representative of an individual's usual intake and will does not allow for estimating variability of an individual's intake from day-to-day (Willett, 1998). Food and drink diaries do not rely on memory, compared to food frequency questionnaire. Previous research showed that 3 day-food records could be used for dietary assessments for adults and adolescents (Schröder et al., 2001; Yang et al., 2010, Ambrosini et al., 2011). To help in the estimation of portion sizes, pictures were attached to the participant's food dietary forms (Appendix F2). Each adolescent was met individually at the school to check their food records before submission, whereas their mothers' data were checked directly after taking their measurements.

3.4.11 Piloting the questionnaires

Both nutritional knowledge and screening questionnaires were piloted on a group of students from Plymouth University and 8 Saudi adolescent girls and their parents. Permission was sought and granted from all participants and their parents. Piloting the questionnaire ensured that ambiguous questions were identified, rephrased and modified to be suitable for Saudi culture. The same procedure was used for piloting the dietary record.

3.4.12 Ethical considerations

The following section presents the ethical considerations related to this study, such as the permissions and approvals obtained to conduct the study, the informed consent procedure, and confidentiality rules.

3.4.12.1 Permission and approval

The protocol for Phase 1 was submitted for consideration, comment and approval to the Faculty Research Ethics Committee, Faculty of Health and Human Science. The protocol was reviewed by the Faculty Research Ethics committee and ethical approval was granted. Permission to conduct this study was also sought and given by:

1. Royal Embassy of Saudi Arabia in London
2. University of Tabouk in Saudi Arabia
3. General Administration of Education in Tabouk
4. Schools' Head Teacher

3.4.12.2 Informed consent:

The researcher obtained the consent of all adolescents and their parents/guardians in writing after they had read the information sheet (appendix C4) and had time to ask questions.

3.4.12.3 Confidentiality

Participants were notified that all data collected were treated anonymously and kept confidential. All data was designated for research purposes only. The researcher assigned a unique code to each participant so that their names did not appear alongside their data, allowing confidentiality and anonymity to be assured and maintained. The participants' codes were kept securely locked, and only used by the researcher. The code list was kept separate from the study notes, as well as all electronic study data.

3.5 Statistical analysis

Data handling and analysis was performed using SPSS (version 21.0, IBM, USA). Descriptive statistics were calculated for independent variables and results are given as numbers, percentages, means and standard deviations. Relationships between variables were evaluated using Pearson correlation coefficients. Chi-square statistics were used to compare (and explore differences in) fruit, vegetable, sweets and chocolate intake between obese, overweight and normal weight persons. It was also used to compare an adolescents' food intake and their nutritional knowledge, as well as their mothers' level of education.

3.5.1 Classification of weight status

The WHO-BMI standard was adopted to define the obesity for adults (WHO, 2009).

The classification for adults is as follows:

Underweight - defined as a body mass Index $<18.5 \text{ k/m}^2$

Normal weight - as BMI $18.5\text{-}24.9 \text{ k/m}^2$

Overweight - $25\text{-}29.9 \text{ k/m}^2$

Obese - $>30 \text{ k/m}^2$

The classification for adolescents is as follows (WHO, 2009): underweight is defined as BMI percentile less than the 5th percentile; normal weight as BMI percentile 5th percentile to less than 85th percentile; overweight as BMI percentile 85th percentile to less than 95th percentile; and obese, BMI percentile equal or greater than the 95th percentile.

3.5.2 Waist circumference

There is no specific cut-off point used in Saudi Arabia for adults, so the WHO classification was used ($<80 \text{ cm}$) (WHO, 2008). No cut-off point in the literature exists for adolescents.

3.5.3 Portion size estimation

A portion of fruit or vegetables was estimated as 80g (British Nutrition Foundation., 2014). This is taken as:

1. One medium sized piece of fruit, such as a banana, apple, pear or orange.
2. Two or more small fruits, such as plums, kiwi fruit or apricots.
3. A large handful of berries, cherries or grapes.
4. One heaped tablespoon of dried fruit, such as raisins, cranberries or sultanas.
One dessert bowl of salad.
5. Three heaped tablespoons of vegetables;

The portion size of other foods was estimated (Wrieden et al., 2008; Albar et al., 2014) as follows. For each participant, the mean portion size of each food group was calculated by dividing the total weight of the food consumed by the frequency of consumption. Thereby, each subject had a single portion weight, avoiding the possibility of participants who eat certain foods more frequently than others skewing the data (Wrieden et al, 2008). For example, if participants consumed sweets two times on the first day and three times on the 2nd day, then the total grams of sweets consumed over the 2 days would be divided by 5. The manufacturer's package weight for sweets, cakes, biscuits and chocolate was recorded and used. The weight of some products (obtained from the bakery) were estimated by asking the participants in combined with photographs.

3.6 Results

3.6.1 Participants and recruitment

A total of 35 invitation letters were distributed and the overall response rate was 89%, equating to 31 Saudi adolescent girls from the second grade of high school and their parents. Two adolescents were subsequently excluded from the study as they did not return the questionnaires and dietary records. The final total number of participants in the study was, therefore, 29 adolescent girls and 29 mothers. None of the fathers returned their questionnaires or self-reported measurements and so were excluded from the study. The recruitment and participation flow chart can be seen in figure 3.

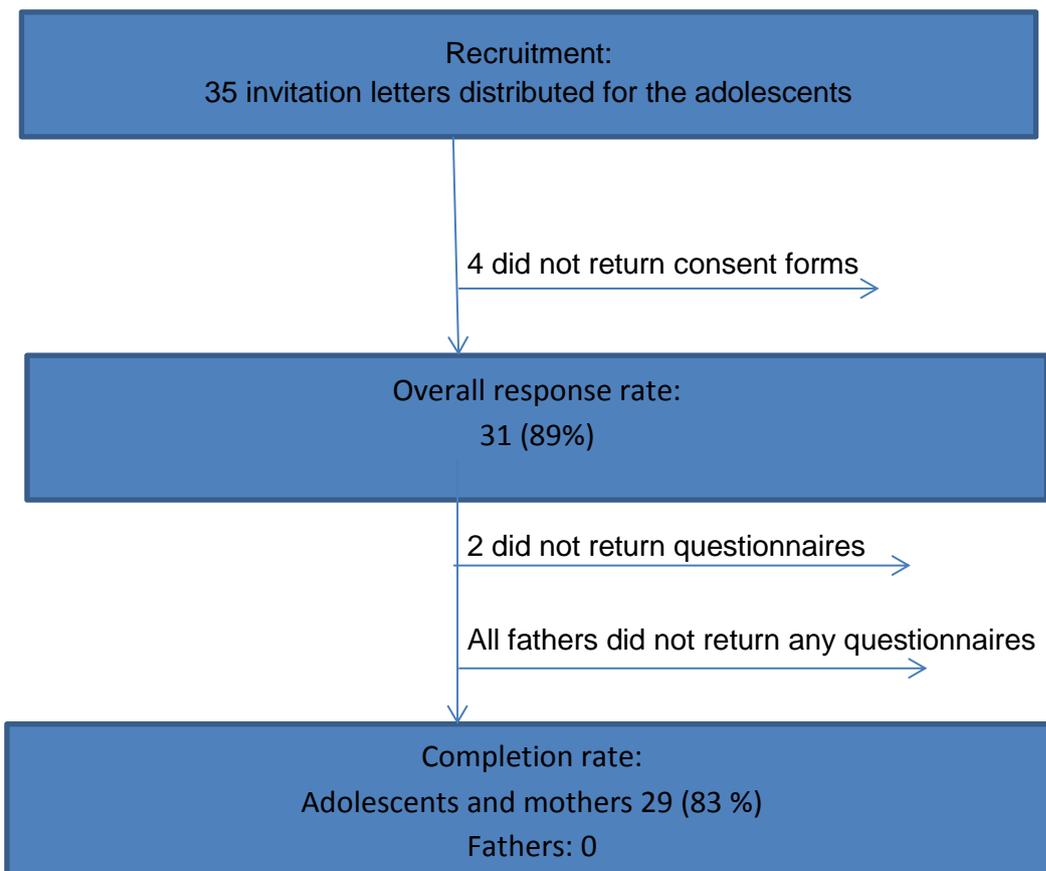


Figure 3: The recruitment and participation flow chart.

3.6.2 Participants' characteristics

The reported monthly income for 27 (93%) was over > 10000 S.R (greater than £2000). Table 3 shows the demographic characteristics of the study subjects. The mean age for adolescents and mothers was 17 and 53 years, respectively. In terms of participants' health, about half of mothers had medical conditions compared to nearly a quarter of their daughters. Three (10%) of the adolescents followed a special diet for weight loss. Fourteen percent of adolescents' mothers completed bachelor degrees as presented in Table 3. All of the participants reported that the main person who prepared food at home was the mother.

Table 3: Demographic characteristics of the participants

Variables	Adolescents (n=29)	Mothers (n=29)
Age (year) (mean \pm S.D)	17.4 \pm 0.5	53.2 \pm 7.3
Medical condition: Diabetes	6 (21%)	4 (13%)
Anaemia	1 (3%)	2 (7%)
Hypertension		6 (21%)
Following a weight loss diet	3 (10%)	0
Level of education		
Not completed high school	Not applicable	11 (38%)
Completed high school		10 (34%)
Completed bachelor degree		8 (28%)

3.6.3 Prevalence of overweight and obesity

According to WHO-BMI (WHO, 2009) classifications for adults and BMI percentile classifications for children (WHO, 2009), 20 (69%) of mothers were categorised within the overweight and obese category, compared to 10 (34%) of their daughters (Table 4). The WC of mothers was also higher than their daughters, as can be seen in Table 5. The mean WC for both overweight and obese mothers and adolescents was higher than normal weight (Table 5). Furthermore, all overweight and obese adolescents having overweight or obese mothers. Interestingly, all adolescents who had a medical condition were categorised as normal weight.

Table 4: Number and percentage of overweight and obese mothers and adolescents according to body mass index for adults and body mass index percentile for adolescents

Weight status	Adolescents (n=29)	Mothers (n=29)
Normal weight	19 (66%)	9 (31%)
Overweight	7 (24%)	12 (41%)
Obese	3 (10%)	8 (28%)

Table 5: Mean value of waist circumference of the participants according to their body mass index.

Measurement	Adolescents		Mothers	
BMI classification	Number	Adolescents' mean value of WC (cm)	Number	Mothers' mean value of WC (cm)
Normal (healthy) weight	19	72.1 ± 6.1	9	78.5 ± 3.2
Overweight	7	91.2 ± 7.4	12	99 ± 6.2
Obese	3	115 ± 5.3	8	125 ± 4.3

Data are expressed as mean ± SD

3.6.4 Food intake

The study revealed that obese and overweight adolescents and mothers consumed significantly ($p < 0.05$) larger portion sizes of sweets, chocolate, cakes, biscuits and fizzy drinks, than normal weight adolescent and mothers (Tables 6 and 7). However, no significant difference was found between them in the portion size of fast food, fruit and vegetables (Tables 6 and 7). Frequency of fizzy drink and fast food consumption were significantly higher amongst overweight and obese mothers and adolescents compared to normal weight individuals (Tables 8 and 9).

Table 6: Mean of food portion size for all adolescents related to body mass index percentile classification

Food groups	All adolescents (n=29)	Normal weight (n=19)	Overweight and obese (n=10)
Sweets, chocolate, cakes and biscuits (g)	91 ± 40	45 ± 16	109* ± 12
Fizzy drinks (ml)	294 ± 90	201 ± 40	340* ± 23
Fast food (g)	276 ± 81	251 ± 89	280 ± 84

Fruit (g)	143 ± 98	141 ± 117	158 ± 41
Vegetables (g)	170 ± 80	181 ± 140	179 ± 75

Data are expressed as mean ± SD

* Mean portion size is significantly higher than the size for normal weight (p<0.05).

Table 7: Mean of food portion size for all mothers classified according to body mass index

Food groups	All mothers (n=29)	Normal weight (n=9)	Overweight and obese (n=20)
Sweets, chocolate, cakes and biscuits (g)	81 ± 44	59 ± 12	111* ± 7
Fizzy drinks (ml)	301 ± 83	250 ± 39	342* ± 25
Fast food (g)	299 ± 88	276 ± 79	270 ± 81
Fruit (g)	155 ± 90	151 ± 120	144 ± 44
Vegetables (g)	188 ± 75	187 ± 132	190 ± 66

Data are expressed as mean ± SD

* Mean portion size is significantly higher than normal weight (p<0.05).

Table 8: Range of food consumed by the adolescents by body mass index percentile

Food groups	All adolescents (n=29)	Normal weight (n=19)	Overweight and obese (n=10)
Sweets, chocolate, cakes and biscuits (times/week)	5-14	5-14	7-14
Fizzy drinks (times/week)	1-14	1-4*	6-14
Fast food (times/week)	1-6	1-2*	4-6
Fruit (times/week)	1-21	1-21	1-14
Vegetables (times/week)	7-14	7-14	7-14

* Frequency of consumption among normal weight is significantly lower than overweight and obese ($p < 0.05$).

Table 9: Range of food consumed by the mothers by body mass index

Food groups	All mothers (n=29)	Normal weight (n=9)	Overweight and obese (n=20)
Sweets, chocolate, cakes and biscuits (times/week)	4-14	4- 14	6-14
Fizzy drinks (times/week)	1-7	1-4*	6-7
Fast food (times/week)	1-5	1-2*	4-5
Fruit (times/week)	4-14	4-14	5-14
Vegetables (times/week)	7-14	7-14	7-14

* Frequency of consumption among normal weight is significantly lower than overweight and obese ($p < 0.05$).

3.6.5 Nutritional knowledge

The maximum score achievable on the nutrition questionnaire was 16. Twenty two (76%) adolescents scored ≤ 8 and 7 adolescents (24%) scored >8 of the nutritional knowledge questionnaire (Figure 4). All of those adolescents scoring > 8 had a medical condition. Their mothers have similar scores (Figure 4). No significant association was found between the mothers' nutritional knowledge and their level of education.

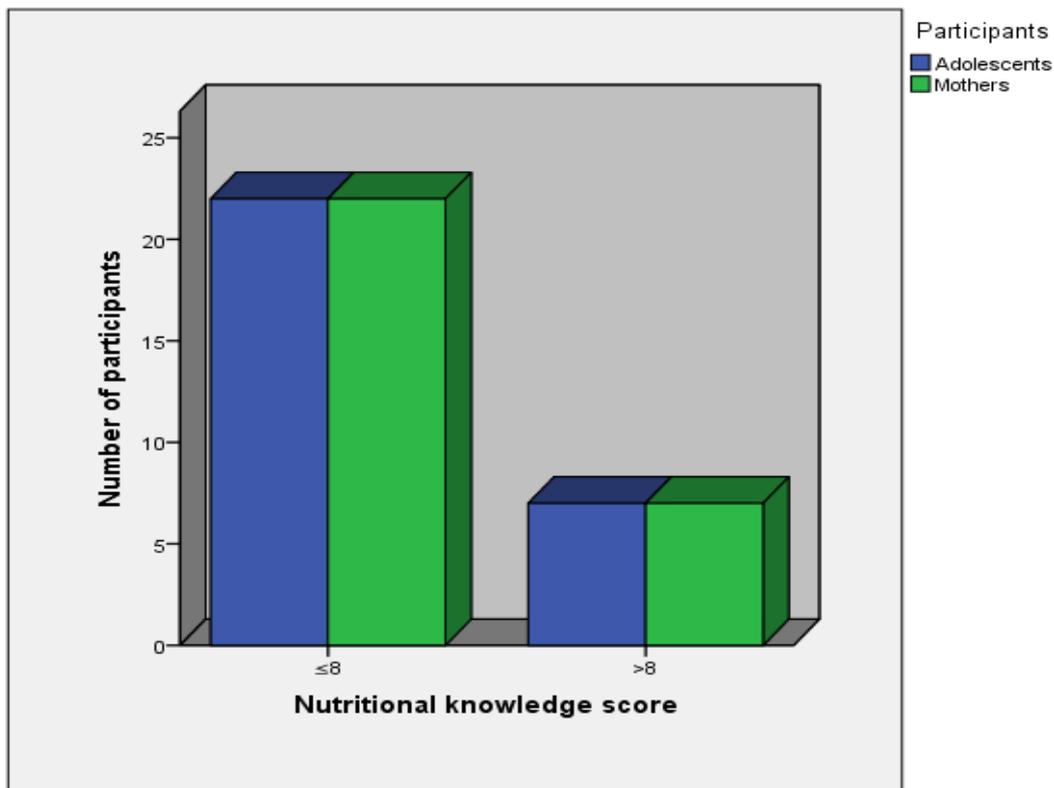


Figure 4: Number of adolescents and mothers achieving the correct answer on the nutritional knowledge questionnaire.

It was reported that adolescents with medical conditions 7 (24%) - received nutritional advice mainly from health centre staff and their mothers, whilst the rest of the adolescents 22 (76%) - received their advice solely from their mothers. However, 24 (83%) of their mothers stated that television was the main source for their nutritional knowledge, whereas only 5 (17%) stated that they got the nutritional information from television and health centre staff. A significant association was found between a mothers' and an adolescents' nutritional knowledge scores ($r=0.626$, $p < 0.05$).

In addition, this study reported that adolescents who scored >8 ($n=7$) on the nutritional knowledge questionnaire consumed fruit on a daily basis, whereas those who scored ≤ 8 did not do so, except for those who followed special diets ($n=3$). Fruit

portions sizes were also significantly higher amongst adolescents with higher nutritional knowledge scores (2-3 portions/day), compared to those with lower nutritional knowledge scores (1-2 portions/day) ($p < 0.05$). However, the portion size of vegetables did not differ significantly between all adolescents (1-2 portions/day).

Moreover, those adolescents who scored >8 on the nutritional knowledge questionnaire did not consume sweets, chocolates, cakes and biscuits on a daily basis, compared to those who scored ≤ 8 , who consumed these items daily. The frequency of fizzy drinks and fast food consumption was also significantly lower ($p < 0.05$) in adolescents with higher nutritional knowledge. No significant difference was found in frequency of vegetables consumption (Table 10).

Table 10: Frequency of food consumption by adolescents based on their nutritional knowledge level

Number of correct answers for nutritional knowledge	Frequency of fruit consumed (times/week)	Frequency of vegetables consumed (times/week)	Frequency of fizzy drinks consumed (times/week)	Frequency of fast food consumed (times/week)
≤ 8 (n=22)	1-7	7-21	4-14	1-6
>8 (n=7)	14-21*	7-21	1-2*	1-2*

* The difference is significant at the 0.05 level between adolescents based on their nutritional knowledge level

A similar pattern was seen in 7 (24%) mothers who scored >8 of the nutritional knowledge questionnaire, as they consumed fruit on daily basis, whilst sweets, chocolates, cakes and biscuits were not consumed daily. Twenty two (76%) mothers who scored ≤ 8 of nutritional knowledge did consume such foods on a daily basis. The frequency of fizzy drink and fast food intake was also significantly lower, for those who scored >8 of the nutritional knowledge questionnaire (Table 11).

Adolescents who had mothers with higher nutritional knowledge, also showed significantly lower fast food and fizzy drink consumption frequency, compared to those who had mothers with lower nutritional knowledge ($p < 0.05$). Fruit consumption was also significantly ($p < 0.05$) higher among those who had mothers with higher nutritional knowledge (Table 12). It is apparent that mothers who knew more about

nutrition were choosing foods which were apparently considered to be 'healthy options'.

Table 11: Frequency of food consumption by mothers based on their nutritional knowledge level

Number of correct answers for nutritional knowledge	Frequency of fruit consumed (times/week)	Frequency of vegetables consumed (times/week)	Frequency of fizzy drinks consumed (times/week)	Frequency of fast food consumed (times/week)
≤ 8 (n=22)	4-6	7-21	4-7	1-5
>8 (n=7)	7-14*	7-21	1-2*	1-2*

* The difference is significant at the 0.05 level between mothers based on their nutritional knowledge level.

Table 12: Frequency of food consumption by adolescents based on their mothers nutritional knowledge level

Number of correct answers for nutritional knowledge of mothers	Frequency of fruit consumed (times/week)	Frequency of vegetables consumed (times/week)	Frequency of fizzy drinks consumed (times/week)	Frequency of fast food consumed (times/week)
≤ 8 (n=22)	1-7	7-21	4-14	1-6
>8 (n=7)	14 -21*	7-21	1-2*	1-2*

*The difference is significant at the 0.05 level between Adolescents' intake according to their mothers scores.

Mothers who reported that sweets and chocolates were usually or sometimes available in their homes, showed a significantly higher nutritional knowledge than those who reported that these products were always available. In other words, a

significant negative association was found between a mother's nutritional knowledge scores and the household availability of sweets, chocolates, cakes and biscuits ($r = -0.226$, $p < 0.05$). However, no significant association was found between mothers' nutritional knowledge scores and household availability of fruit and vegetables ($p > 0.05$), as they were always available in all households.

3.6.6 Home food availability

The availability of fruit, vegetables, cakes, biscuits, sweets and chocolates in the home, as reported by mothers and adolescents, is shown in Figure 5. Fresh fruit and vegetables were reported to be always available in home by 100% of the participants in all income categories. However, 22 (76%) of participants reported that cakes, biscuits and fizzy drinks were also always available in their home; compared with 24 (82%) reporting that sweets and chocolates were always available in the home. Sweets and chocolates were consumed daily by 19 (66%) adolescents, whereas cakes and biscuits were consumed by 22 (67%) of them, with all of them reporting that these products were always available in their homes.

Adolescents' intake of sweets, chocolate cakes, biscuits and fizzy drinks was positively correlated to the household availability of sweets and chocolate ($r = 0.733$, $p < 0.05$), cake and biscuits ($r = 0.756$, $p < 0.05$) and fizzy drinks ($r = 0.676$, $p < 0.05$). However, no significant relationship was found between the availability of fruit and adolescent consumption.

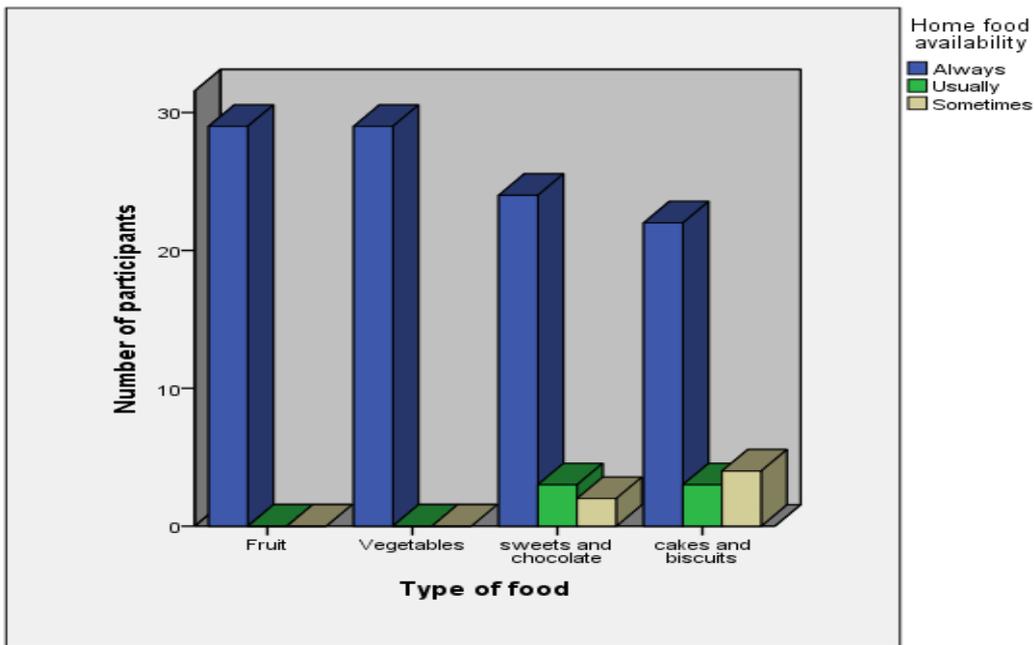


Figure 5: participants' report of household food availability

3.6.7 Mothers' level of education and income

No significant differences were seen in fruit and vegetable availability in the home, or adolescents' fruit and vegetables intake, between adolescents with highly qualified mothers (\geq bachelor degree) and those who had mothers with minimal education (\leq high school or illiterate) qualification (Table 13). No significant associations were found between a mother's level of education or household income with the availability and consumption of sweets, chocolates, cakes, biscuits, fast food and fizzy drinks.

Table 13: portions of fruit and vegetable consumed by adolescents according to their mothers' level of education

Mother' level of education	Adolescents' mean intake of fruit (portion/day) (n=29)	Adolescents' mean intake of vegetables (portion/day) (n=29)
Illiterate (n=11)	2.3 ± 1.5	1.8 ± 1.3
High school or less (n=10)	2 ± 1.2	1.7 ± 1.1
Bachelor degree or higher (n=8)	2.1 ± 1.2	2 ± 1.4

Value are expressed as mean ± S.D

3.6.8 Sharing meals with family particularly mothers

Approximately three quarters of adolescents - 23 (79%) - ate all of their meals with their families on a daily basis, with just 6 (21%) of them eating only breakfast and lunch daily with their families. Adolescents who did not eat all of their meals with their families ate fast food and fizzy drinks more often than those who consumed all of their meals with their families (Table 14). All of the adolescents who did not consume the evening meal with their families were obese or overweight.

Adolescents who scored in >8 of the nutritional knowledge questionnaire and shared their families their meals drank fizzy drinks between 1-2 times per week, compared to 4-6 times per week for those who scored ≤ 8. Eating meals with the family in the current study was associated with consumption of vegetables by all adolescents, although eating with the family did not lead to increased fruit consumption among adolescents. Mothers who consumed all meals with their families were lower in fast food and fizzy drinks consumption compared to the rest of mothers (Table 15).

Table 14: Effect of eating meals with the family on adolescents' food intake

Frequency of eating meals with family	Frequency of fast food consumption at dinner	Frequency of fizzy drinks consumption
All meals (n=23)	1-2 times / week	1-6 times / week
Just breakfast and lunch (n=6)	4-6 times / week	7-14 times / week

Table 15: Effect of eating meals with the family on mothers' food intake

Frequency of eating meals with family	Frequency of consumption fast food at dinner	Frequency of fizzy drinks consumption
All meals	1-2 times / week	1-5 times / week
Just breakfast and lunch	3-5 times / week	1-7 times / week

3.6.9 Food shopping habits

All mothers reported that the person who went to the local shop to purchase food was the father, but that the foods to be chosen were itemised on a list written by the mother. Fresh fruit and vegetables were regularly bought by all participants according to their families' preferences 27 (93%), with only 2 (7%) participants stating that they purchased fruit and vegetables because they knew them to be good for their health. 100% of the participants reported that they purchased sweets, chocolates, cakes and biscuits according to their families' preference. These products were always purchased for the households in which the mothers had significantly lower nutritional knowledge scores (see Section 3.6.6).

Habit was the main factor affecting the food choices of mothers during writing food shopping lists for 27 (93%) of them, while 2 (7%) mothers reported that health was the main factor dictating food choice. Twenty five (86%) mothers stated that their daughters never went shopping with the main household shopper, whilst the rest - 4 (14 %) – reported that they rarely went with the main household shopper. All mothers reported that their daughters are free to request any food to be bought by asking it to be added to the shopping list.

The following table summarizes factors affecting food intake in Saudi adolescent girls in this study (16-18 years)

Table 16: summary of factors affecting food intake in Saudi adolescent girls (16-18 years)

Factors affecting food intake	Adolescents' fruit intake	Adolescents' vegetables intake	Adolescents' sweets, chocolate, cake and biscuits intake	Adolescents' fast food intake	Adolescents' fizzy drinks
Nutritional knowledge	+ve	NA	-ve	-ve	-ve
Home food availability	NA	NA	+ve	Not applicable	+ve
Eating meals with family	NA	+ve	NA	-ve	-ve
Obesity and overweight	NA	NA	+ve	+ve	+ve
Mothers' level of education	NA	NA	NA	NA	NA
Household income	NA	NA	NA	NA	NA
Mothers' nutritional knowledge	+ve	NA	-ve	-ve	-ve

NA= No association; +ve= Positive association -ve=Negative association

3.7 Discussion

3.7.1 Prevalence of overweight and obesity

Obesity is a growing healthcare concern worldwide, and the associations reported by the present study and others demonstrate the need for improved nutritional education initiatives if the worrying global trends towards obesity and related metabolic diseases are to be reversed. The current study found 34% of adolescents to be classified as overweight or obese, in agreement with other studies reporting that 15-47% of adolescents in the KSA were overweight or obese (Al-Hazzaa, 2007; Al Herbish et al., 2009; El Mouzan et al., 2012; Al-Hazzaa et al., 2013; Al-Muammar et al., 2014). The higher levels recorded in the present study may be due to regional variations in: the prevalence of overweight and obese individuals, influenced by the ethnic background of the adolescent; cultural dietary habits and levels of physical activity; family education levels and income; and also regional differences in access to health care and physical activities (Kipping et al., 2008). El Mouzan (2012) reported a higher proportion of adolescents in the north of Saudi Arabia were overweight or obesity; 47% compared to 25% in the south of Saudi Arabia. From personal observations, the authors believe that the composition of traditional food in the south contains less fat than the food in the north. Furthermore, people in the south do more free walking in surrounding areas as the weather is cooler.

In the current study, the prevalence of overweight and obesity for mothers and adolescents was 69% and 34%, respectively. Waist circumferences were higher in mothers than their daughters, a finding also reported in Riyadh city (KSA) by ALFaris *et al.* (2015). There also appeared to be a relationship between a mother being overweight or obese and their children being so too; similar to findings in China for

children aged between 6-17 (Jiang et al., 2013). This relationship may be due to mothers being more intimately involved with activities relating to food choice and preparation in the home or it could be due to genetic predisposition (Brown & Ogden, 2004).

3.7.2 Food intake

The present thesis did not find significant differences in the frequency of consumption of chocolates, sweets, cakes and biscuits between adolescents based on their weight status. Consuming chocolates and sweets more than 3 times per week has been also linked to a greater risk of obesity in Saudi adolescents in Jeddah city (Musaiger et al., 2014). However, in this thesis, the portion sizes of sweets, chocolates, cakes and biscuits were significantly linked to a participant being obese or overweight. According to Kerr (2009), three elements should be considered in the potential link between snack food intake and obesity among adolescents, namely: the types of food consumed, the intake frequency, and the portion size, which might help explain the finding above. Recently, Albar *et al.* (2014) showed a positive association between the portion sizes of high-energy-dense foods and the BMI percentile of British adolescents.

Fizzy drink consumption is another factor linked to the prevalence of overweight and obesity in this present study, and has been reported amongst Chinese and British adolescents (Albar et al., 2014; Wen et al., 2010). However, consumption of fizzy drinks did not correlate with obesity or overweight amongst Saudi adolescent girls in Riyadh (Collison et al., 2010), Jeddah or Alkobar City (Al-Hazzaa et al., 2012). These findings differing from the current findings, perhaps due to the differences in dietary assessment methods used and limited sample sizes and study duration.

Another explanation could be that overweight/obese adolescents underestimate their intake of sugar-sweetened beverages (Albar et al., 2014), whilst others may have switched to low calories fizzy drinks (Ree et al., 2008).

In addition, the current study found that overweight and obese adolescents consumed fast food more frequently than normal weight individuals. This was in agreement with a study conducted among Saudi adolescent girls in Jeddah City which found a positive association between fast food consumption (more than 3 times a week) and obesity or overweight status in (Musaiger et al., 2014). No significant differences were found in fast food portion sizes between normal, overweight and obese adolescents. However, ALFaris *et al.* (2015) revealed a significant association between fast food portion size and abdominal obesity among Saudi adolescent girls in Riyadh. The study conducted by ALFaris *et al.* (2015) did not show the frequency of fast food consumption among overweight and obese adolescents, which the present thesis found to be significantly higher compared to normal weight participants.

It was found by the present study that there were no significant differences in fruit and vegetable intake based on an adolescents' weight status (BMI). This was confirmed by Musaiger *et al.* (2014) who stated that no significant differences in fruit and vegetable intake existed between obese and non-obese Saudi adolescent girls in Jeddah. The same results were found among younger Saudi adolescent girls (aged 12-15) in Riyadh (Al Muammar et al., 2014). However, those with a better nutritional knowledge score in current study consumed fruit on a daily basis more often (2-3 portions/day), compared to those with lower nutritional knowledge scores

(1-2 portion/day). Therefore, nutrition education intervention is required to improve their food intake (Farghaly et al, 2007; Al-Muammar et al., 2014).

3.7.3 Nutritional knowledge

The present study showed that adolescents in general had a low level of nutritional knowledge. This is in agreement with previous studies, which demonstrated that Saudi adolescents (both male and female) in the eastern region of Saudi Arabia had low levels of nutritional knowledge (Al-Almaie et al., 2005). A possible explanation for this is a lack of nutritional education in school, as well as the level of nutritional knowledge of their mothers, since 76% of adolescents received advice only from their mothers; and their answers were correlated with their daughters' answers. However, in the adolescents (24%) who showed higher nutritional knowledge scores, this was attributed to their regular visits to health centres, where staff provide nutritional information to complement a mother's advice. Overall, the current results suggest that both mothers and adolescents would benefit from greater levels of nutritional education, as their behaviours are closely tied to one another.

In this current study, the daily intake of fruit was significantly higher amongst adolescents scored higher on nutritional knowledge questionnaire. Other studies conducted amongst adolescents of a slightly younger age group (in the USA and Italy) found a positive association between nutritional knowledge and both fruit and vegetable intake (Pirouznia, 2001; Kristjansdottir et al., 2006; Grosso et al., 2013). However, vegetable intake by the adolescents in the present study was found to be contrary to these studies, as no significant differences in vegetable intake based on an adolescent's nutritional knowledge were found. One explanation, is that

vegetables are usually served as a part of cooked Saudi dishes. However, they did not meet the recommendation (3-5 portion/day) (ACFN, 2011), as they consumed only between 1-2 portions/day.

Furthermore, Grosso *et al.* (2013) found a negative association between nutritional knowledge and sweets and sugary drinks consumption, among a younger age group of adolescents living in a rural area in south Italy. This was also demonstrated by the current study, which found the frequency of sweets, chocolates, cakes, biscuits and fizzy drink consumption was significantly lower among adolescents who scored higher on the nutritional knowledge questionnaire than those who scored lower.

It is important to consider not only an adolescents' nutritional knowledge, but also that of their mothers, since the present study found a negative association between a mothers' nutritional knowledge and an adolescents' fast food, fizzy drinks, sweets and chocolates consumption, and positive association with an adolescents' fruit consumption. Evidence by Yabanc *et al.* (2014) demonstrated a positive association between Turkish mothers' nutritional knowledge and adolescents' fruit and vegetable intake (mean age 12.5 ± 1.8 years for both male and females). Therefore, mothers should be involved in any nutrition education interventions to improve their nutritional knowledge as a factor to improve food intake of the adolescents.

3.7.4 Home food availability

A significant positive association was found between the consumption of energy-dense snacks (e.g. cakes, chocolates, and sweets) and the home availability of these products among adolescents. These findings are in agreement with previous

research conducted in Australia (Pearson et al., 2011) and in the UK (Cutler et al., 2011), which found positive relationships along these lines.

However, the present thesis did not show a relationship between the availability of fruit in the home, and an adolescents' intake. This is contrary to prior studies conducted in the USA and Europe, which demonstrated a positive relationship between fruit availability in the home and adolescent intake (Neumark-Sztainer et al., 2003; Hanson et al., 2004; Rasmussen et al., 2006; Jago et al., 2007; Bauer et al., 2011; Pearson et al., 2011). This difference could be attributed to cultural differences that impact upon eating habits. Furthermore, the age of the adolescents in this current study was higher than those in the referenced studies, which may explain the differences. Collison *et al.* (2010) revealed that older Saudi adolescents consumed less fruit and vegetables than younger adolescents.

Many additional factors can affect fruit intake. Firstly, the availability of some types of food in the home such as sweets, chocolate and biscuits were reported as a key barrier for choosing healthy foods, such as fruit and vegetables, especially as a snack (Auld et al., 2002; O'Dea, 2003; Gellar et al., 2007; Cutler et al., 2011; Pearson et al., 2011). To illustrate this, in the current study, fruit was reported to be always available across all income categories. However, only 34% of adolescents consumed fruit daily, whereas chocolates and sweets were consumed daily by 66%, and cakes and biscuits were consumed daily by 76% of adolescents. Secondly, although fruit was always available in the home, it is not clear how much was available and whether the favourite types of fruit were available. Lastly, an adolescents' nutritional knowledge level is considered a factor that could play a role in adolescents' food intake, as mentioned in Section 3.6.5.

A mother's nutritional knowledge has also been linked to home food availability. For example, Campbell *et al.* (2013) found that a mother's nutritional knowledge was associated with a reduced availability of salty snacks and soft drinks. This was confirmed by the current study, which showed a significant negative association between mothers' nutritional knowledge scores and household availability of sweets and chocolates. This supports a focus on nutrition education that expands on a mothers' understanding of what foods to buy, prepare and serve. Subsequently this may impact on adolescents' consumption (Campbell *et al.*, 2013).

A mother's nutritional knowledge did correlate with fruit and vegetables home availability in the current study. One explanation for fruit and vegetables being always available in the home could be due to the lower prices of fruit and vegetables in Tabouk, compared to big cities such as Riyadh and Jeddah. Indeed, Tabouk is heavily agricultural, and many families in Tabouk have their own farms on which they grow fruit and vegetables.

3.7.5 Mothers' level of education and income

The present study demonstrated that there were no significant differences between adolescent fruit and vegetable intake based on their mothers' level of education.

This result is in accordance with a study conducted amongst Norwegian adolescents of a younger age group, which revealed no significant difference in daily intake of fruit and vegetables based on parental education (Bjelland *et al.*, 2011). However, these results are contrary to prior studies that revealed a significant positive association between parental level of education and Norwegian adolescents' intake of fruit and vegetables (aged 11-13 years) (Hilsen *et al.* 2011), Dutch children aged

8-12 years old (Johansen et al., 2006; Bere et al., 2008; Ansem et al., 2014) and American adolescents aged 4-18 (Horst et al., 2007). One explanation for these differences is that adolescents experience an increase in control over their food intake as they age, and develop dietary habits during adolescence (Videon & Manning, 2003). Alternatively, a lack of food availability in the home, especially when concerning an adolescent's favourite fruit due to the level of a mother's nutritional knowledge, might contribute (Yabanc et al., 2014).

Ansem *et al.* (2014) revealed that the maternal level of education led to the increased home availability of fruit and vegetables, which subsequently increased adolescent fruit and vegetable consumption. This is inconsistent with the current study, which demonstrated that there was no association between a mothers' level of education, and fruit and vegetable availability. This could be attributed to cultural and ethnicity differences between populations, as well as household income or nutritional knowledge of the mothers, as mentioned earlier.

Investigators have demonstrated that Dutch children aged 11 years old, in the lowest or intermediate socio-economic category, had lower fruit and vegetables consumption scores compared to children in higher socio-economic categories (see Section 2.7) (Ansem et al., 2014). However, the present study found no association between income and the availability of fruit and vegetables. This could be due to the lower prices of fruit and vegetables in Tabouk city, the fact that there is no tax on food in Saudi Arabia. In addition, many families have their own farm, allowing fruit and vegetables to be readily available in their homes. Furthermore, 93% of the participants in the current study were from the high-income category.

3.7.6 Eating meal with family

The current study also revealed a significant difference in fast food and fizzy drink consumption between adolescents who ate all of their meals with their families, and those who only ate lunch together. The frequency of eating fast food and fizzy drinks was increased amongst adolescents who did not eat all of their meals with their mothers. This indicates the importance of mothers as “gatekeepers” of the food in the home. Indeed, research has found positive associations between fast food and fizzy drink consumption and obesity in adolescents from Saudi Arabia, China and Britain (Wen et al., 2010; Albar et al., 2014; Musaiger et al., 2014). Family meals in the current study were associated with the consumption of vegetables (for all adolescents), but did not correlate with fruit consumption. This is possibly due to the level of nutritional knowledge, as discussed in Section 3.7.3 or vegetables more likely to be part of meal.

In Saudi Arabia mothers are responsible for household cooking and it is uncommon for men to cook. Sharing daily meals with family members is common amongst the Saudi population, not only in the home, but also in the restaurant (AL Rethaiaa et al., 2010). In addition, it is common in the Saudi family to eat from one large platter in the meal and not acceptable to have a meal away from the family (e.g. in bedroom).

Several previous studies have demonstrated the role of a mother in controlling food availability in the meal. Videon *et al.* (2003) found that a parental presence during the meal can affect the type of food consumed by adolescents in the USA. To illustrate, adolescents who ate more than 3 meals per week with their parents showed positive associations with vegetable consumption. Meta-analysis methods across 17 studies showed that adolescents who shared meals with their parents

regularly (i.e. 3 times per week or more), consumed more vegetables, and were more likely to be in a normal weight range, compared to those who shared meal less frequently (Hammons and Fiese, 2011).

Parental control over the types of food in the meal can influence the weight status of adolescents. Many studies have examined the relationship between the frequency of family meals and bodyweight among American adolescents. The lowest mean values of BMI percentile were found among adolescent females in Canada who often ate meals with their families; whilst the highest values were recorded in adolescents who rarely ate family meals (Goldfield et al., 2011). However, Fulkerson *et al.* (2008) showed that females eating family meals during high school were not affected in terms of weight status (BMI), compared to younger age adolescents. This may be due to high school age pupils in the USA being more independent with regards to food. In contrast, Saudi adolescent girls in the high school are perhaps less independent, due to the Saudi lifestyle. Together, the results of this thesis and other indicate that mothers play an important role in the home environment by controlling the types of food in the home.

3.7.7 Food shopping habits

The main household shopper was the father for all participants. However, mothers are considered to be the main “gatekeeper” of home food, since all mothers reported that they wrote the food shopping lists for their partners. A previous study in the US revealed that mothers as “gatekeepers” of food availability directly influence adolescents’ eating practices (Neumark-Sztainer et al., 2003). A mother’s nutritional knowledge also influences food purchasing and preparation in households in the

USA, and mothers are considered the key means for encouraging fruit and vegetable consumption in these populations (Slusser et al., 2011; Campbell et al., 2013).

The current study showed that 93% of families purchased fresh fruit and vegetables, and 100% of them purchased sweets, chocolates, cakes and biscuits according to family preferences; which was the main reason for purchasing these types of food in the first place. Holesten *et al.* (2012) stated that a parent's concern for the food preferences of family members is a factor that can affect a parent's food purchasing and preparation practices, and subsequently, influence a child's food intake and dietary habits.

3.8 Strengths and limitations

A major strength of this study is that the culture sensitivity was considered, since the adolescents' and mothers, measurements were taken in private rooms and away from public view as it is shameful to do such measurements in public as well as fathers were asked to send self-reported measurements since it is not acceptable for ladies to take measurements of males. Moreover, all questionnaires were designed and modified to suit Saudi culture. Also, the use of standardised data collection procedures and analysis techniques that aimed to minimise bias and enhance validity, as well as the ability to ensure confidentiality. This study was the first study which looked at factors affecting food intake in Saudi adolescent girls.

A sample of 29 adolescents and their mothers represents a limited sample size to draw firm conclusions about eating habits and behaviours, which may not necessarily be representative of the entire population in Saudi, this is a limitation of the study in terms of the generalisability of the findings. Furthermore, nutritional knowledge questionnaire was validated by adults in the original study but not for adolescents; however, it was piloted on a group of Saudi adolescent girls and their mothers before the study undertaken. The study did not involve private or religious schools, but only a government school, and therefore, cannot be considered as a national study.

An additional limitation is that fruit and vegetables was reported to be available at home; however, it is not clear how much was available, as the amount of food available at home can influence adolescents food intake. Estimating the amount of

vegetables in homemade dishes was another limitation; because the amount will vary between families. Therefore, the researcher used the original recipe of each dish to estimate the amount of vegetables consumed by the participants which could underestimate or overestimate the amount of vegetables in homemade dishes. Also the food portion sizes were estimated from a food portion size guide for UK foods and consumers. So this might not be appropriate for Saudi foods. A food portion guide for Saudi foods was not available and so this limits the accuracy of the estimation of amounts of foods.

3.9 Conclusion

In conclusion, Phase 1 explores the factors affecting food intake in Saudi adolescent girls aged 16-18 years. Phase 1 produced a number of credible and significant findings that have corroborated previous findings, and have provided new insights into the characteristics of the population under the study. The present study demonstrated that approximately 2/3 of mothers categorised within the overweight and obese category, compared to 1/3 of their daughters. Those overweight and obese participants consumed significantly larger portion sizes of sweets, chocolate, cakes, biscuits and fizzy drinks, than normal weight participants.

Another factor that could influence adolescents' food intake is the home availability of sweets, chocolate cakes and biscuits were positively associated with an adolescent's intake, and a mother's nutritional knowledge was negatively correlated to the household availability of these products. Therefore, mothers' nutritional knowledge should be taken into account in order to improve the types of food available in the home; especially important as mothers control the food shopping lists for the primary household shoppers. Furthermore, a significant association between mothers' and daughters' nutritional knowledge was observed, with 22 (76%) of adolescents receiving nutritional advice mainly from their mothers.

Another, piece of evidence that supports the idea of increasing maternal nutritional knowledge, is the significant negative association found between mothers' nutritional knowledge and adolescents' fast food, fizzy drink, sweets and chocolates consumption; as well as a positive association with adolescents' fruit consumption.

In addition to these factors, it was found that the nutritional knowledge level of the adolescents can influence their food intake, since those who scored higher in nutritional knowledge consumed fresh fruit on a daily basis, alongside the fruit being consumed in significantly higher portion sizes compared to those a lower in the nutritional knowledge questionnaire. The frequency of intake of fizzy drinks and fast food was also significantly lower in adolescents with higher nutritional knowledge. Also, adolescents who consumed all of their meals with their families were lower in fizzy drinks consumption compared to those who missed dinner meal with their families which reflect the role of mothers in controlling the type of food consumed by their children. Therefore, educating both adolescents and mothers is predicted to have a significant effect on the food intake of adolescents.

Chapter 4: Evaluation of an educational programme for improvement of food intake of Saudi adolescent girls (16-18 years) and their mothers.

4.1 Introduction

4.1.1 Role of nutrition education and nutritional knowledge on adolescents' food intake

A growing body of scientific literature has focused on associations between nutritional knowledge and food consumption among adolescents (Pirouznia, 2000; Pirouznia, 2001; Kristjansdottir et al., 2006; Grosso et al., 2013; Spronk et al., 2014) (see chapter 2 for more details). Many nutritional educational interventions among adolescents have demonstrated that increasing nutritional knowledge leads to an increase in dairy products, fruit and vegetables intake and reduced fat intake (O'Neil et al., 2002; Casazza & Ciccazzo 2007; Sachithananthan et al., 2012; Naghashpour et al., 2014; Tavassoli et al., 2015). Results from phase 1 of this work (see section 3.6.5) also support these findings as adolescents who scored higher on the nutritional knowledge questionnaire consumed significantly more fruit and less, fizzy drinks, cake, biscuits, sweets and chocolate compared to those with a lower score. Although researchers have showed that knowledge is one of the determinants of food intake, several environmental factors may also play a role, leading to a different attitude towards changing behaviour such as mothers' nutritional knowledge (Yabanc et al., 2014).

4.1.2 Role of the mothers' nutritional knowledge on home food availability and adolescents' food intake

Campbell *et al.* (2013) investigated whether HFA mediates the association between mother's nutritional knowledge and their children's (5-12 years) food intake. The author demonstrated that increasing a mother's nutritional knowledge was associated with increased availability of fruits and vegetables and in turn, adolescent

consumption of fruits and vegetables (Campbell et al., 2013). Also, a mother's nutritional knowledge was associated with a reduced availability and adolescent consumption of salty snacks and soft drinks (Campbell et al., 2013). This result was confirmed by results of phase 1 of this work which showed a negative association between mothers' nutritional knowledge with cake, biscuits, sweets and chocolate availability in the home. In addition to these findings mothers in phase 1 stated that they wrote food items as a list to be purchased by the main household shopper (father). Thus, it is necessary to focus on the mothers' nutritional knowledge and their understanding of what foods to prepare and serve which may impact on an adolescents' consumption.

Slusser *et al.* (2011) stated that a mother's nutritional knowledge may influence food purchases and preparation, both of which are considered the key for healthy eating. Food purchases are predictive of HFA (Baranowski et al., 2008) which is positively associated with adolescents' food intake such as fruit, vegetables, milk, beverages and chocolate (Neumark-Sztainer et al., 2003; Hanson et al., 2004; Rasmussen et al., 2006; Jago et al., 2007; Bauer et al., 2011; Pearson et al., 2011). Findings from phase 1 of this work also found that household availability of cake, biscuits, sweets and chocolate was significantly correlated to adolescents' intake of these products ($r=0.890$, $p < 0.05$).

4.1.3 Measuring food purchase behaviour using till receipts and food shopping lists

Till receipts were used in the present study as a proxy measure for the amount of food available at home and as marker for the success of the intervention. Rigby & Tommis (2008) demonstrated that improvement in food purchase behaviour after a nutritional education intervention can be measured from till receipts. The intervention group was asked to provide till receipt over 4 weeks pre intervention and

then given an information booklet about nutrition and labelling information. Further till receipts were returned from successive shopping trips over the following 4 weeks.

The intervention group showed a significant increase in purchases fruit and vegetables, reduction in purchases of saturated fats, and a reduction in white cereal purchases. However, the control group showed no significant difference in food purchases.

Table 17 summarises studies which have looked at food purchase behaviour using till receipts. These studies showed that food purchases behaviour can be measured from till receipts. The authors of the current study compared the amount of food purchased in till receipts with food on food shopping lists to see if there is any significant difference between them. This comparison is important because it will show whether the main household shopper purchases food items as requested by the food shopping list. Findings of phase 1 of this work indicated that the main household shopper was the father but the food items were written down as a list by the mother, as is common in Saudi Arabia. Therefore, both till receipts and food shopping lists were used in the current study to measure food purchases in the home of Saudi adolescent girls (16-18 years).

Table 17: Summary of studies which looked at food purchases using till receipts

Reference	Study population	Country	Aims	Methods	Results
Anderson et al. (1997)	127	US	Examine the effect of supermarket nutrition education intervention on food purchases.	Participants were recruited from the supermarket and randomly assign to intervention or control group. The intervention included 10 lessons presented by interactive software on a computer at supermarket. The system kept track of the participant's progress (via log-on number). Collected till receipts 4 weeks pre and post intervention for both intervention and control group. Daily intake of fat and fibre per person were generated for the total food purchases and for purchases in groups of foods representing significant sources of fat and fibre in US diet using specific software to analyse them.	Increase purchase of fibre, fruit and vegetables and decrease total fat.

Sekula et al. (2005)	1243	Poland	Compared receipts to g/day for 21 food groups with 24 hr recalls for all household members	Collected till receipts for a month, 24 hour recall for each member of the family and recorded any food eaten away from home, and food obtained from gardens, farms.	Significant association was found between some foods purchased with participants' food intake.
Hamilton et al. (2007)	882	New Zealand	To examine food and nutrients availability in New Zealand using supermarket sales data	The top selling 3000 foods purchased over one year were selected using the following process to analyse them: Fixed-weight products purchased by units (e.g. canned food) were ranked by the total number of units purchased and variable –weight items (fruit) were ranked by total number of kilograms purchased. The food composition data were obtained for each product: energy, protein, fat, sugar, carbohydrate per 100 g. These were taken from manufactured food data base for some food but unbranded food (e.g. fruit) were sourced from New Zealand food	Key food sources of macronutrients were similar between supermarkets.

				composition database. Average nutrients per 100 g were multiplied by the weight of the product to get the total nutrients available in each product unit.	
Eyles (2010)	49 primary shoppers	New Zealand	Compare nutrients of data sale with nutrients of dietary recall.	Random participants from the supermarket were recruited. Sales data were collected for 3 months directly from the supermarket data warehouse for each participant. Food purchases were converted to nutrient purchases by merging with especially developed brand specific supermarket food and nutrient database. 24 hour recall was used to collect information about food intake	Association between household purchase and individual intake
Cullen et al. (2007)	115	US	To characterize food purchase from grocery receipts by food group	Family's primary food shoppers were recruited from the supermarket to participate in the study Till receipts were collected over 6	The greatest purchase was protein foods, followed by drinks, grain, vegetables, dairy and lastly fruit

				weeks. Food items were coded by food categories.	
Martin et al. (2006)	48	US	To establish the feasibility and utility of simple data collection methodology for dietary assessment	The participants were recruited from the grocery store and they were asked whether they would volunteer their grocery receipts and answers a few questions. Till receipts were coded into 3 categories (fats, oils and sweets), non-food, cigarettes and alcohol items were excluded from the total purchases.	Household where no one was perceived to be overweight spent a smaller proportion of their food budget on fat, oil and sweets than did households where at least one person was perceived to be overweight
Ransley et al. (2003)	241	UK	Compare the energy and fat content of food purchase for home consumption by households comprising mainly overweight individual with those	The participants were recruited randomly from Tesco if they were an active club card member. Households collected supermarket receipts and completed a shopping diary for 28 days, and each member of the household completed a 4-day	Overweight individuals purchased foods higher in fat than lean individuals. Food purchases behaviour may be linked to the prevalence of obesity in the households and who shopped at the

			comprising mainly lean individual.	food record. Nutritional analysis of food diaries and food items on till receipts was undertaken using the weighed intake software programme.	supermarket.
Ransley et al. (2001)	214	UK	To validate the use of supermarket receipts of fat and % energy intake.	Same method above for (Ransley et al., 2003)	Strong association between estimates of fat intakes and energy and percentage energy from fat using 4-day food diaries and 28 days of receipts.

4.2 Summary and overview

Evidence suggests that adolescents' and adults' food consumption is linked to their level of nutritional knowledge. It is also demonstrated that nutritional education intervention among adolescents can increase their nutritional knowledge and thereby improving their food intake such as increasing fruit and vegetables intake. The literature suggests that mothers' nutritional knowledge can influence households' food purchases, HFA and subsequently adolescents' food intake. Therefore, a nutritional education intervention could lead to increase in adolescents' and mothers' nutritional knowledge and improve their food intake.

4.3 Aim

The aim of phase 2 is to examine whether a nutritional education intervention in a Saudi school for adolescent girls plus additional home interactive nutrition activities leads to a change in nutritional knowledge and food purchases thereby changing adolescents' and mothers' food intake.

Chapter 4 focuses on the impact of nutrition education intervention in the school setting on nutritional knowledge, food purchases and food intake. Chapter 5 explains the role of the interactive nutrition activities between mothers and daughters in the home on nutritional knowledge, food purchases and food intake.

4.4 Objectives

1. To adapt and deliver nutritional learning package within the school via a PowerPoint presentation.
2. To measure the nutritional knowledge for both mother and adolescent using a questionnaire (pre, post and 2 months follow up after the intervention).
3. To detect a change in food purchases pre and post intervention through till receipts and food shopping lists.
4. To compare food intake data pre, post and 2 months follow up post intervention for both the mother and adolescent using a food frequency questionnaire.
5. To measure the variables (demographics) that affect food intake using a screening questionnaire.

4.5 Methodology

4.5.1 Study design

A cluster randomised trial using 3 matched schools (i.e. matched in socioeconomic groups, class sizes and school type “government schools”) was employed. The main advantages of this design included increased administrative efficiency and lessened risk of experimental contamination across individuals e.g. an individual's changing behaviours may influence another individual to do so (Donner and Klar, 2004). The disadvantages of CRCT compared with individually randomized controlled trials include greater complexity in design and a requirement for more participants to obtain the same statistical power (Donner and Klar, 2004).

Adolescents in school A received nutrition education in the school and were given nutritional interactive activities to complete with their mothers; adolescents in school B received nutrition education only; and school C acted as the control school, so adolescents did not receive any education or interactive activities during the project period. Repeated measures at 3 time points (pre, post and 2 months follow up post intervention) for adolescents and mothers from schools A, B and control school C were performed. Figure 7 presents the time line of the study.

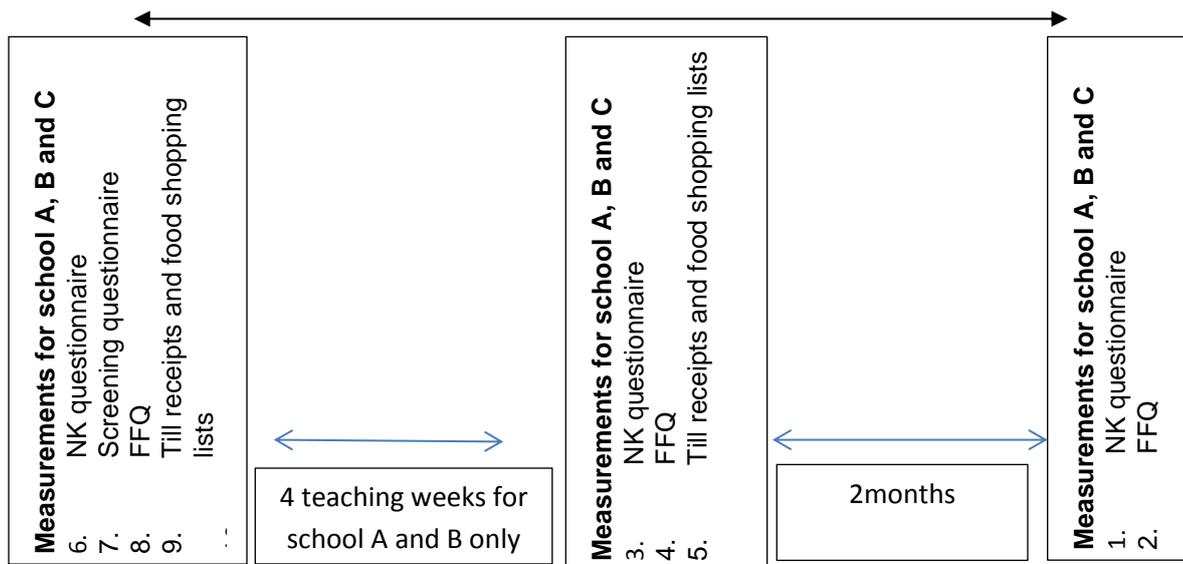


Figure 6: Time line of the study

4.5.2 Participants and recruitments

The schools were selected as all the adolescents were of Saudi and the schools were also closely matched as mentioned above. Each school was randomly allocated to one of the 3 arms of the study. This cluster randomisation was performed after the schools had provided their consent. In each school there were 9 classes (each with approximately 12 adolescents) and 6 classes from each school were randomly allocated. Only classes in one year group (second grade) participated in this study. All participants were informed that the head teacher had agreed that the school could take part in this study. See appendix G2 and G3 for mothers' and adolescents' information letter.

4.5.3 Inclusion criteria

1. Females aged 16 -18 years (grade 2 of high school).
2. Adolescents with a completed consent form completed by both mother/guardian and adolescent (see appendix D).

3. Adolescents who live with their mothers or guardian.

4.5.4 Exclusion criteria

1. Mother and/or daughter involved in another nutritional education programme.
2. Mother and/or daughter following a special diet.
3. Mother and/or daughter with a medical condition (chronic disease such as diabetes type 1 or type 2) which can affect food intake.

4.5.5 Calculation of sample size required

A statistician in University of Plymouth was consulted and a power calculation using Minitab (version 14) was used to determine the sample size required in this study. Fifty five participants were required in each school to detect 87% power at the 0.05 significant level, with a relevant difference of nutritional knowledge = 1.5, SD = 2.4 (SD was informed from phase 1 of this thesis).

4.5.6 Nutrition education intervention

The nutritional education intervention was delivered during the school day to adolescents in both schools A and B. This reduced the risk of adolescents' dropping out from this part of the study. All teaching materials (see appendix H1) had been adapted from the British Nutrition Foundation (British Nutrition Foundation, 2013) and permission had been granted to use these materials. It should be noted that the lessons of the intervention were piloted on a group of Saudi adolescent girls by the researcher before the intervention was initiated; further information about piloting can be seen in appendix I. Some words were modified or excluded from the education package, such as ham and alcohol, as the consumption of these types of food are not permitted in Saudi Arabia. This education package was chosen from a reputable

source and all of the resources were developed by the British Nutrition Foundation and tested within schools across the UK.

Adolescents in both schools A and B completed one 45 minute session/week for 4 weeks. This time was chosen since a previous study among African-American adolescents (11-15 years) received one 30 minute session/week for 4 weeks and showed significant increase in fruit and vegetable consumption compared to controls post intervention (Di Noia et al., 2008). However, the present study was 45 minutes as a discussion was employed which requires longer time. The sessions were held in the computer lab in the schools. The computer labs in both schools accommodated 50 adolescents in the same time, so 2 consecutive sessions in each school were run for 6 classes (3 classes in each session).

The researcher introduced the lesson topic to the adolescents through a PowerPoint presentation and explained the content of the session. Each session contained different learning objectives as presented in Table 18. At the beginning of each session the researcher tried to remind the adolescents about the content of the previous sessions by making a quick revision and asked a couple of questions to see to what extent they recalled the content of previous sessions.

The researcher engaged the adolescents in a discussion after dividing them into small groups. The researcher directed questions to these groups rather than to one individual and waited for an answer. This gave adolescents time to think and showed them that you care more about their learning than about the speed of their responses (William., 2011). Then, as the discussion began, each group had at least one idea to offer, and felt better prepared to respond. At the end of the session adolescents were

given a memory stick containing the lesson to enable them to access the lessons later at home.

Table 18: Learning objectives for each session

Sessions	Learning objectives
Session 1	<ol style="list-style-type: none"> 1. To understand a healthy diet is made up from a variety and balance of different foods and drinks, as depicted in the Eatwell plate. 2. To learn more about the different food groups of the Eatwell plate model. 3. To understand and be able to categorise foods and drinks into groups as depicted in the Eatwell guide. 4. To be able to classify composite dishes.
Session 2	<ol style="list-style-type: none"> 1. To introduce macronutrients and micronutrients. 2. To explain the functions and sources of carbohydrate, protein and fat. 3. To explain the functions and sources of different vitamins and minerals. 4. To understand the consequences of not having enough carbohydrate, protein and fat.
Session 3	<ol style="list-style-type: none"> 1. To understand the functions and sources of dietary fibre (e.g. fruit and vegetables). 2. To understand the sources of dietary fibre. 3. To know the benefits of dietary fibre. 4. To understand the consequences of not having enough fibre .

Session 4	<ol style="list-style-type: none"> 1. To recognise the 6 tips for healthy eating. 2. To understand the health benefits of the 6 tips for healthy eating. 3. To identify ways of achieving the 6 tips for healthy eating.

During the study period the adolescents/mothers were asked not to discuss this study with adolescents/mothers from other schools to minimize contamination. The teachers from each of these schools were not involved in the study. However, at the end of the study period the control classes and all of other classes in the same year group which had not taken part were offered nutritional education delivered by one of the teachers. The nutritional education package used in this study was offered to the teachers to help with their delivery of this education.

4.5.7 Materials

Tables 19 and 20 summarize materials used in the study:

Table 19: Measurements for the adolescents

Measurements	School A	School B	School C
Pre intervention questionnaires:			
1. Nutritional knowledge.	✓	✓	✓
2. FFQ.	✓	✓	✓
3. Screening questionnaire.	✓	✓	✓
1. 4 weeks classroom teaching about nutrition	✓	✓	
2. Participation in interactive nutrition activities with their mothers at	✓		

home			
Post intervention questionnaires:			
1. Nutritional knowledge	✓	✓	✓
2. FFQ.	✓	✓	✓
2 months follow up intervention questionnaires:			
1. Nutritional knowledge.	✓	✓	✓
2. FFQ.	✓	✓	✓
Height and weight	✓	✓	✓

Table 20: Measurements for the mothers

Measurements	School	School	School
	A	B	C
Pre intervention questionnaires:			
1. Nutritional knowledge.	✓	✓	✓
2. FFQ	✓	✓	✓
3. Screening questionnaire	✓	✓	✓
4. Household food purchases.	✓	✓	✓
Participation in interactive nutrition activities with their daughters in the home	✓		
Post intervention questionnaires:			
1. Nutritional knowledge	✓	✓	✓
2. FFQ	✓	✓	✓
3. Household food purchases.	✓	✓	✓

2 months follow up intervention questionnaires:			
1. Nutritional knowledge.	✓	✓	✓
2. FFQ	✓	✓	✓
Self –reported height and weight	✓	✓	✓

4.5.7.1 Demographic screening questionnaire

The screening questionnaire used in this phase was slightly different from the screening questionnaire used in phase 1. It was completed by both adolescents and mothers at the beginning of the study to collect information on total household income, participants’ medical condition, mothers’ level of education (see appendix H3). It was estimated that this questionnaire took approximately 5-10 minutes to complete. All adolescents were given both their own questionnaire and their mothers’ questionnaire to take home to be completed and returned to the school for collection by one of the teachers to forward to the researcher.

4.5.7.2 Nutritional knowledge questionnaire

The questions of this questionnaire were adopted from the British Nutrition Foundation after permission has been granted (British Nutrition Foundation, 2013) (see appendix H4). This questionnaire was different from the one used in phase 1 as it was based on the nutritional information in teaching slides. It was used to assess the level of adolescents’ and mothers’ nutritional knowledge level pre, post and 2 months follow up post intervention. It consisted of 16 questions in total each in multiple choice formats and the estimated time to complete it was 10-15 minutes. Both mother and adolescent were asked to complete it in the school setting.

However, the questionnaire was sent to the mothers who were unable to attend the school.

4.5.7.3 Amount of food purchased

This was measured by till receipts and food shopping lists pre and post intervention.

All participants were asked to bring all their till receipts and food shopping lists of the successive shopping trips over 4 weeks pre intervention and 4 weeks post with their daughters into the school to be collected by one of the school teachers or email them to the researchers.

4.5.7.4 Food frequency questionnaire

The food frequency questionnaire (FFQ) was selected in the current study due to its easy administration and low cost. The burden on subjects is modest when using a FFQ as compared to the use of dietary food records (Willett, 1998). It was used in the current study to measure the average food intake in grams per day for adolescents and their mothers, pre, post and at 2 months follow up post intervention. It consists of 144 items in total and the estimated completion time varies from between 20-25 minutes (see appendix H5).

4.5.7.5 Body Mass Index (BMI)

BMI was described in chapter 3. Height (cm) was recorded to the nearest 0.5 centimetre using a stadiometer (Model Seca 217, UK). Adolescents were asked to remove their shoes, hat, and hair ornaments and stand up straight on the footplate with their back against the stadiometer rule. They also were asked to keep their arms at their sides, shoulders relaxed and their head upright.

Weight (kg) was measured to the nearest 0.1 kilogram using digital scales (model Seca 264, UK). The scale was set at zero and participants were asked to remove

their shoes, heavy outer clothing (jacket, vest, sweater, and hat), and empty pockets (cell phones, iPods, and keys). Participants were asked to step on the scale platform, with both feet on the platform, and remain still with arms hanging naturally at their side and look forward.

4.5.7.6 Validity of the materials

All questionnaires (screening questionnaire, nutritional knowledge and FFQ questionnaire), till recipes and food shopping lists were piloted on group of Saudi adolescents girls and their mothers prior to intervention (see appendix I). Then feedbacks were received from the participants and changes were made accordingly. Despite, the FFQ has already been validated in a similar study population (Tayyem et al., 2013), it was piloted as well.

4.5.8 Ethical consideration

4.5.8.1 Permission and approval

The protocol for Phase2 was submitted for consideration, comment and approval to the Faculty Research Ethics Committee, Faculty of Health and Human Science in July 2014. The protocol was reviewed by the Faculty Research Ethics committee and ethical approval was granted in September 2014.

Permission to conduct this study was also sought and given by:

1. Royal Embassy of Saudi Arabia in London
2. University of Tabouk in Saudi Arabia
3. General Administration of Education in Tabouk
4. Schools' Head Teacher

4.5.8.2 Informed consent form

Informed consent was gained from mother and adolescent (see appendix C4)

4.5.8.3 Confidentiality

Participants were informed that all data collected were confidential and for research purposes only. The researcher assigned a specific code for each participant so that their names did not appear with their data allowing confidentiality and anonymity to be assured and maintained. The participants' codes were kept confidential and securely locked, and only used by the researcher. The code list was kept separate from the study notes as well as electronic data.

4.6 Statistical analysis

SPSS (version 21.0) programme was used in the present study to analyse data.

Descriptive statistics were calculated for independent variables. Results are given as numbers, percentage, means and standard deviation for numerical variables.

A one way ANOVA was used to compare mean nutritional knowledge scores, food purchased and food intake between schools. A post hoc test was used to determine which school was significantly different from the other schools. Some data was log transformed as it was not normally distributed. Chi-square was used to compare amount of food purchased from till receipts with amount of food requested in food shopping list.

4.6.1 Classification of weight status

Weight status was categorised for adults as follows (WHO, 2009):

1. Underweight defined as a BMI $<18.5 \text{ kg/m}^2$
2. Normal weight as a BMI of $18.5\text{-}24.9 \text{ kg/m}^2$
3. Overweight as a BMI of $25\text{-}29.9 \text{ kg/m}^2$
4. Obese as a BMI $>30 \text{ kg/m}^2$

The classification for adolescents is as follows (WHO, 2009).

1. Underweight defined as BMI percentile less than 5th percentile.
2. Normal weight as BMI percentile 5th percentile to less than 85th percentile.
3. Overweight as BMI percentile 85th percentile to less than 95th percentile.
4. Obese BMI percentile equal or greater than the 95th percentile.

4.6.2 Till receipts

Four types of food in till receipts were analysed as a marker for the success of the intervention namely: fizzy drinks, sweet and chocolate, fruit and vegetables. Weights of these foods were recorded from the manufacturer's package weight. However, weights of some types of fruit, vegetables and sweet were estimated by the researcher by taking the average weight of 10 pieces to get the estimated weight of one piece. Then the total weight of each types of food e.g. fruit for each household were divided by 28 days (as till receipts were collected for four weeks) to get the weight of fruit per day per household (Hamilton et al., 2007) (see appendix J1 for more information about the analysis). To calculate the amount of food purchased per person, per day an adjustment was made for the number of children present. This was done by calculating the mean weight of food purchased for male and female children up to the age of 18 years using ACFN dietary recommendations (ACFN, 2011) and expressing this as a percentage of the mean of adults (male and female) requirement (Ransley et al., 2003). Two children (over one year-18 year) requirements were nearly equivalent to one adult requirement (see appendix J2 for more information about the calculation).

4.6.3 Food shopping lists

The same procedure for till receipts analysis was used to analyse food shopping lists (see appendix J3 for more information).

4.6.4 Food frequency analysis

FETA software was used in this study to analyse FFQ into food group in gram per day (Mulligan et al., 2014). FETA is a tool to calculate food group data from food frequency questionnaires. This software designed originally to analyse EPIC-Norfolk

FFQ. However, it could be modified to process other FFQ by adding new foods and portion weights per food item if it is different from EPIC-Norfolk FFQ (EPIC, 2014).

4.7 Results

4.7.1 Participants and recruitment

A total of 229 invitation letters were distributed to adolescents in the three schools resulting in a total number of 458 participants (including adolescents and mothers). The overall response rate for all adolescents in the three schools were 90% with a total number of 207 Saudi adolescent girls and their mothers. In schools A and B adolescents were randomly recruited from 6 out of 10 classes (by a toss of a coin) ,whereas in the control school adolescents were randomly selected from 6 out of 9 classes. The recruitment and participation flow chart can be seen in figure 8.

No adolescent or mother was excluded from this study except for adolescents who did not return their consent form or their questionnaires (FFQ, nutritional knowledge). It should be noted that if the questionnaire was excluded pre intervention, the post and follow up questionnaires were excluded as well, even if they had been completed, and vice versa. Adolescents and mothers who were excluded from the nutritional knowledge analysis were excluded from the other analyses such as the FFQ and till receipt data. Figure 8 summarises the number of mothers and adolescents who were included in the analysis.

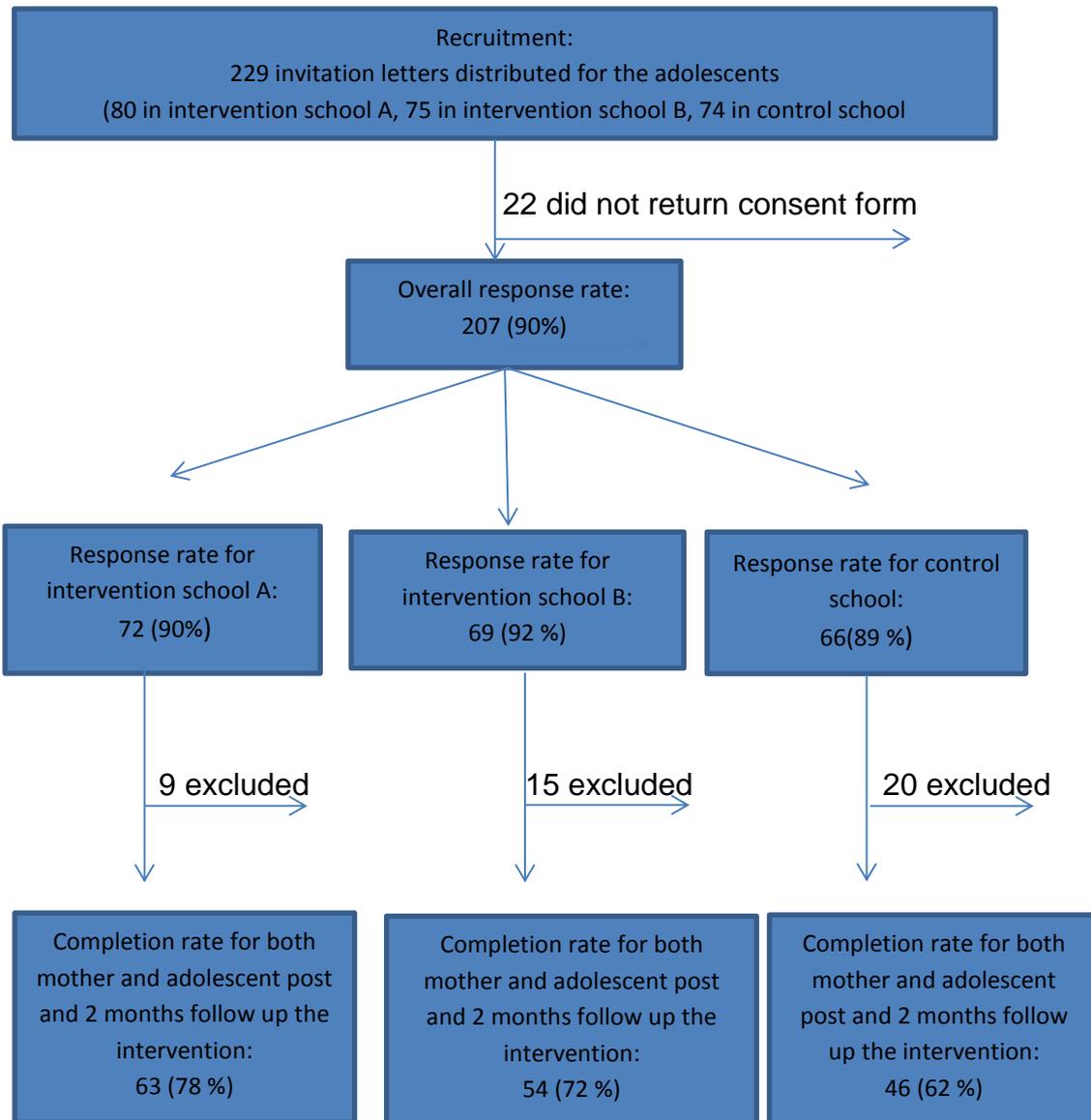


Figure 7: Recruitment and participation flow chart.

4.7.2 Participants' characteristics

Table 21 shows characteristics of the study participants. The reported monthly household income for all participants in all schools was more than 10000 S.R. (about >£2000). No significant difference was found between adolescents' weight status (BMI) in the three schools as well as their mothers. None of the adolescents or their mothers followed a special diet or had a medical condition such as diabetes and hypertension. The mean (\pm SD) age for mothers was 54.1 ± 7.1 , 51.4 ± 6.3 and 59.3 ± 10 for schools A, B and C respectively, whereas the mean age for the adolescents was 17 ± 0.41 , 17 ± 0.22 and 17 ± 0.15 for schools A, B and C respectively.

Table 21: Characteristics of mothers and adolescents

	School A (n=63)	School B (n=54)	School C (n=46)
Level of education for mothers			
Elementary school	1 (1%)	0	2 (4%)
Intermediate school	17 (25%)	4 (7%)	15(29%)
Secondary school	40(59%)	43(74%)	31(60%)
Bachelor's degree	10(15%)	11 (19%)	4 (7%)
Total household incomes			
under 5000 SR	0	0	0
Between 5000 and 10000 SR	0	0	0
Over 10000 SR	63(100%)	54(100%)	46(100%)
Number of overweigh and obese mothers	32 (51%)	30(56%)	22 (47%)
Number of overweigh and obese adolescents	30(48%)	26 (48%)	22 (47%)

4.7.3 Number of household members

Table 22 summarizes the average number of household members for adolescents recruited.

Table 22: Number of household members for each age group in all schools

	School A (n=63)	School B (n=54)	School C (n=46)
mean and median number of household members	8 ± 2.2	8.4 ± 1.8	7.3 ± 2.6
mean and median number of seniors per household (> 60 year)	1.1 ± 0.76	0.52 ± 0.72	0
mean and median number of adults per household (> 18-60 year)	4.1 ± 1.6	4.4 ± 3.3	2.4 ± 2.5
mean and median number of adolescents per household (14-18 year)	1.7 ± 0.67	1.3 ± 0.87	1.6 ± 1.34
mean and median number of children per household (2-13)	1.1 ± 0.79	1.4 ± 1.1	2.0 ± 0.76
mean and median number of infants >6 months	0	0.82 ± 0.5	1.3 ± 0.45

Data are expressed as mean ± SD

4.7.4 Adolescents' nutritional knowledge

4.7.4.1 Pre intervention scores

The maximum score of correct answers achievable was 16. No significant difference was found between adolescents' mean value of correct answers on nutritional knowledge between school A (4.9 ± 1.9), school B (4.7 ± 1.5) and school C (4.3 ± 1.3).

4.7.4.2 Post intervention scores and 2 months follow up post intervention

The mean value of changes in adolescents' nutritional knowledge in school A and B were significantly higher than school C ($p < 0.05$), and no significant difference were detected between schools A and B (see Table 23). In school A nutritional knowledge of adolescents increased from 30% to 57%, while in school B nutritional knowledge increased from 28% to 54%, and no improvement was found in nutritional knowledge in school C. Similar values were observed in mean value of changes in adolescents' nutritional knowledge 2 months follow up the intervention and no significant difference between post and 2 months follow up the intervention (see table 23).

Table 23: The mean number of changes in adolescents' nutritional knowledge

Stage of intervention	School A (n=63)	School B (n=54)	School C (n=46)
Changes in adolescents' nutritional knowledge post intervention	5 ± 1.8	4.7 ± 1.6	$4.47^* \pm 1.51$
Changes in adolescents' nutritional knowledge 2 months follow up the intervention	4.1 ± 1.2	4.3 ± 1.1	$4.96^* \pm 1.83$

Data are expressed as mean \pm SD

* The mean difference is significant at the 0.05 level between school C compared to schools A & B.

4.7.5 Mothers' nutritional knowledge

4.7.5.1 Pre-intervention scores

The maximum score of correct answers achievable was 16. No significant difference was found between mothers' mean value of correct answers on nutritional knowledge between school A (4.9 ± 1.3), school B (4.4 ± 1.1) and school C (4.1 ± 1.3).

4.7.5.2 Post intervention scores and 2 months follow up post intervention:

The mean value of changes in mothers' nutritional knowledge in school A were significantly higher than school B and C ($p < 0.05$), and no significant difference was detected between schools B and C (see Table 24). In school A nutritional knowledge of mothers was increased from 31% to 56%, and no improvement was found in nutritional knowledge in school B and C. Similar values were observed in mean value of changes in adolescents' nutritional knowledge 2 months follow up the intervention and no significant difference between post and 2 months follow up the intervention (see table 24).

Table 24: The mean number of changes in adolescents' nutritional knowledge

Stage of intervention	School A (n=63)	School B (n=54)	School C (n=46)
Changes in adolescents' nutritional knowledge post intervention	$4.4^* \pm 1.4$	$.56 \pm .62$	$.57 \pm .41$
Changes in adolescents' nutritional knowledge 2 months follow up the intervention	$4.1^* \pm 1.2$	$.43 \pm .71$	$.76 \pm .63$

Data are expressed as mean \pm SD

* The mean difference is significant at the 0.05 level between school A compared to schools B & C.

4.7.6 Foods purchase

The total numbers of till receipts received were 397, 413 and 343 for schools A, B and C respectively. Numbers of food shopping lists received were 311, 325 and 303 for schools A, B and C respectively. The following sum up some of the difficulties that the researcher faced during collection and analysis of the till receipts and food shopping lists:

1. Estimation of the weight of some food such as leaves and some foods from the bakery (appendix J1). However, care was taken as the researcher took the average weight of different sizes for each product which could minimize the variation of the weight.
2. Two of the participants got some types of fruit and vegetables from their own farm and therefore they were asked to estimate the amount of food acquired from their farm and email it or text it to the researcher or take a picture of the amount and send it to the researcher to be estimated. None of those participants were excluded as they did not make any significant difference when the analysis was run with and without them.

4.7.7 Comparison between the amounts of food requested in food shopping lists with food purchased from till receipts

Tables 25, 26 and 27 present a comparison between amount of food requested by the mothers using food shopping lists and amount of food purchased by the main household shopper using till receipts pre and post intervention. The results demonstrated that there were no significant differences between them. When comparing the amount of food requested in the food shopping lists pre with post intervention in school A, fruit and vegetables showed a significant increase ($p < 0.05$),

while, fizzy drinks showed significant ($p < 0.05$) reduction (Table 25). However, schools B and C did not show any significant change in their food purchased from pre to post intervention (Tables 26 and 27).

Table 25: Comparison between the amounts of food requested per day per individual from food shopping lists with the amounts of food purchased from till receipts in school A

Items purchased	Pre intervention (n=63)		Post intervention (n=63)	
	Food shopping list	Till receipts	Food shopping list	Till receipts
Fruit (g)	170 ± 89	184 ± 87	360* ± 122	381** ± 118
Vegetables (g)	220 ± 40	245 ± 43	378* ± 107	366** ± 110
Sweets, chocolate, cake and biscuits (g)	210 ± 105	198 ± 104	203 ± 108	190 ± 100
Fizzy drinks (ml)	279 ± 115	283 ± 117	201* ± 30	203** ± 30

Data are expressed as mean ± SD

* The difference is significant at the 0.05 level between foods requested pre and post intervention using food shopping lists.

** The difference is significant at the 0.05 level between foods purchased pre and post intervention using food till receipts.

Table 26: Comparison between the amounts of food requested per day per individual from food shopping lists with the amounts of food purchased from till receipts in school B

Items purchased	Pre intervention (n=54)		Post intervention (n=54)	
	Food shopping	Till	Food shopping	Till

	list	receipts	list	receipts
Fruit (g)	200 ± 88	190 ± 86	184 ± 88	181 ± 88
Vegetables (g)	266 ± 52	257 ± 50	255 ± 53	260 ± 51
Sweets, chocolate, cake and biscuits (g)	180 ± 88	177 ± 87	197 ± 91	189 ± 89
Fizzy drinks (ml)	310 ± 111	314 ± 110	320 ± 110	327 ± 113

Data are expressed as mean ± SD

Table 27: Comparison between the amounts of food requested per day per individual from food shopping lists with the amounts of food purchased from till receipts in school C

Items purchased	Pre intervention (n=46)		Post intervention (n=46)	
	Food shopping list	Till receipts	Food shopping list	Till receipts
Fruit (g)	178 ± 91	170 ± 92	180 ± 93	173 ± 90
Vegetables (g)	237 ± 54	230 ± 52	237 ± 50	241 ± 56
Sweets, chocolate, cake and biscuits (g)	177 ± 98	183 ± 91	189 ± 92	185 ± 88
Fizzy drinks (ml)	230 ± 122	277 ± 125	260 ± 128	265 ± 122

Data are expressed as mean ± SD

4.7.8 The amount of food purchased per individual in the household using till receipts

Till receipts only were used in this part of analysis as they were more reliable than food shopping lists. No significant difference was found between schools in the amount of household food purchased pre intervention (Table 28). However, post intervention school A was significantly ($p < 0.05$) higher in purchases of fruit and vegetables and significantly ($p < 0.05$) lower in fizzy drinks purchases compared to schools B and C (Table 28). Sweets, chocolate, cake and biscuits did not significantly decrease post intervention.

Table 28: The amount of food purchased per day per individual in the household using till receipts

Food purchased	Pre intervention			Post intervention		
	School A (n=63)	School B (n=54)	School C (n=46)	School A (n=63)	School B (n=54)	School C (n=46)
Fruit (g)	184 ± 91	203 ± 86	170 ± 95	381* ± 125	181 ± 90	162 ± 99
Vegetables (g)	245 ± 43	257 ± 50	230±56	400* ± 110	260 ± 44	241 ± 50
Sweets, chocolate, cake and biscuits (g)	198 ± 81	177 ± 87	183±91	190 ± 100	189 ± 89	185 ± 88
Fizzy drinks (ml)	410 ± 117	325 ± 110	377 ± 125	203* ± 68	327 ± 113	365 ± 122

Data are expressed as mean ± SD

* The difference is significant at the 0.05 level between schools post intervention.

4.7.9 Food frequency questionnaire results of adolescents

4.7.9.1 Pre intervention

No significant difference was found between mean daily intakes of food consumed by the adolescents pre intervention in the three schools as presented in table 29.

4.7.9.2 Post and two months follow up intervention

Adolescents in school A consumed significantly more fruit and vegetables ($p < 0.05$) compared to schools B and C post intervention (Table 29). However, a significant ($p < 0.05$) reduction was also found in sweets, chocolate, cake, biscuits and fizzy drinks among adolescents in school A compared to the other two schools post

intervention (Table 29). These changes were maintained 2 months at follow up post intervention (Table 29).

Table 29: Mean daily intake of foods by the adolescents pre, post and 2 months follow up of the intervention

Food	Pre intervention			Post intervention			Two months follow up intervention		
	School A (n=63)	School B (n=54)	School C(n=46)	School A (n=63)	School B (n=54)	School C(n=46)	School A (n=63)	School B (n=54)	School C(n=46)
Fruit (g)	90 ± 20	103 ± 17	120 ± 22	339* ± 95	97 ± 23	116 ± 19	332** ± 99	109 ± 17	111 ± 21
Vegetables (g)	177 ± 44	189 ± 51	165 ± 45	384* ± 100	181 ± 50	168 ± 45	389** ± 103	185 ± 53	159 ± 38
Sweets, chocolate, cake and biscuits (g)	156 ± 23	166 ± 40	174 ± 46	101* ± 39	170 ± 22	188 ± 44	112** ± 38	181 ± 28	174 ± 49
Fizzy drinks (ml)	270 ± 90	300 ± 88	243 ± 80	180* ± 70	309 ± 83	238 ± 84	197** ± 71	321 ± 80	245 ± 87

Data are expressed as mean ± SD

*The mean difference is significant at the 0.05 level in school A post intervention compared to schools B and C.

** The mean difference in school A two months follow up post intervention is significant at the 0.05 level compared to schools B and C.

4.7.10 Food frequency questionnaire results of mothers

4.7.10.1 Pre intervention

No significant difference was found between mean daily intakes of food consumed by the mothers in the three schools as presented in table 30.

4.7.10.2 Post and two months follow up post intervention

Mothers in school A consumed significantly ($p < 0.05$) higher amount of fruit and vegetables compared to schools B and C (Table 30). A significant reduction ($p < 0.05$) was also found in sweets, chocolate, cake, biscuits and fizzy drinks among mothers in school A compared to the other two schools (Table 30). These changes were maintained at 2 months follow up post intervention (Table 30).

Table 30: Mean daily intake of foods by the mother pre, post and 2 months follow up post intervention

Food	Pre intervention			Post intervention			Two months follow up intervention		
	School A (n=63)	School B (n=54)	School C (n=46)	School A (n=63)	School B (n=54)	School C (n=46)	School A (n=63)	School B (n=54)	School C (n=46)
Fruit (g)	99 ± 28	113 ± 18	130 ± 21	344* ± 99	101 ± 16	120 ± 20	338** ± 97	121 ± 20	111 ± 21
Vegetables (g)	183 ± 49	192 ± 39	169 ± 56	389* ± 99	172 ± 46	175 ± 42	381** ± 102	194 ± 51	159 ± 38
Sweets, chocolate, cake and biscuits (g)	133 ± 31	154 ± 42	165 ± 41	110* ± 36	181 ± 22	170 ± 42	121** ± 36	181 ± 28	174 ± 49
Fizzy drinks (ml)	282 ± 92	315 ± 80	270 ± 76	171* ± 66	320 ± 81	229 ± 82	210** ± 74	321 ± 80	245 ± 87

Data are expressed as mean ± SD

*The mean difference is significant at the 0.05 level in school A compared to schools B and C.

** The mean difference in school A two months follow up post intervention is significant at the 0.05 level compared to school B and C.

4.7.11 Comparison between the changes in nutritional knowledge, food purchases and food intake

Both mothers and adolescents in school A showed a significant increase in their nutritional knowledge post intervention and there was no significant difference between the mean values of their nutritional knowledge. Purchases of fruit, vegetables significantly increased post intervention in school A ($p < 0.05$) and fizzy drinks decreased significantly. The consumption of fruit and vegetables by both mothers and adolescents in school A significantly increased ($p < 0.05$), and significant reduction in fizzy drinks. Sweets, chocolate, cake and biscuits purchases did significantly reduce, however, mothers' and daughters' consumption reduced significantly post intervention in school A (Table 31). No significant change was observed in household food purchased and food consumed by both mothers and adolescents in school B; although, the adolescents showed a significant increase in their nutritional knowledge post intervention (Table 32).

Table 31: Comparison between nutritional knowledge, the amount of food intake by adolescents and mothers and food purchases per day per individual in school A

	Adolescents' intake/day (n=63)		Mothers' intake/day (n=63)		Food purchased/day/person (n=63)	
	Pre	Post	Pre	Post	Pre	Post
Fruit (g)	90 ± 20	339* ± 95	99 ± 28	344* ± 99	184 ± 91	381* ± 125
Vegetables (g)	177 ± 44	384* ± 100	183 ± 42	389* ± 99	245 ± 43	400* ± 110
Sweets, chocolate, cake and biscuits (g)	156 ± 23	101* ± 39	133 ± 31	110* ± 36	198 ± 81	190 ± 100
Fizzy drinks (ml)	270 ± 90	180* ± 70	282 ± 92	171* ± 66	410 ± 117	203* ± 68
Mean of nutritional knowledge (the maximum score is 16)	4.9 ± 1.9	9.1* ± 1.1	4.9 ± 1.3	9* ± 3.4		

Data are expressed as mean \pm SD

* The mean difference is significant at the 0.05 level from pre to post intervention (p<0.05).

Table 32: Comparison between nutritional knowledge, the amount of food intake by adolescents and mothers and food purchases per day per individual in school B

Food items	Adolescents' intake/day (n=54)		Mothers' intake/day (n=54)		Food purchased /day/person (n=54)	
	Pre	Post	Pre	Post	Pre	Post
Fruit (g)	103 \pm 17	97 \pm 23	113 \pm 18	101 \pm 16	203 \pm 86	181 \pm 90
Vegetables (g)	189 \pm 51	181 \pm 50	192 \pm 39	172 \pm 46	257 \pm 50	260 \pm 44
Sweets, chocolate, cake and biscuits (g)	166 \pm 40	170 \pm 22	154 \pm 42	181 \pm 22	177 \pm 87	189 \pm 89
Fizzy drinks (ml)	300 \pm 88	309 \pm 83	315 \pm 80	320 \pm 81	325 \pm 110	327 \pm 113
Mean of nutritional knowledge (the maximum score is 16)	4.7 \pm 1.5	8.7* \pm 1.2	4.4 \pm 1.1	4.4 \pm 1.2		

Data are expressed as mean \pm SD

* The mean difference is significant at the 0.05 level from pre to post intervention (p<0.05).

The following table summarizes the main findings that found in phase 2 of this study

Table 33: Summary of the main findings of phase 2

Measurements of electiveness (post intervention)	School	School	School
	A	B	C
Mothers' nutritional knowledge level	↑	—	—
Adolescents' nutritional knowledge level	↑	↑	—
Fruit purchased in the household	↑	—	—
Vegetables purchased in the household	↑	—	—
Fizzy drinks purchased in the household	↓	—	—
Sweets and chocolate purchased in the household	—	—	—
Fruit consumed by mothers and adolescents	↑	—	—
Vegetables consumed by mothers and adolescents	↑	—	—
Sweets and chocolate consumed by mothers and adolescents	↓	—	—
Fizzy drinks consumed by mothers and adolescents	↓	—	—

↑ = significant increase ↓ = significant decrease — = no significant changes

4.8 Discussion

To the authors' knowledge, this study is the first school based nutrition education intervention for Saudi adolescent girls, and it was the first study that involved mothers in the intervention group and compared against an intervention group without mothers' involvement for this age group (16-18 years). Also, it adds to the literature to show the efficacy of mothers' involvement, as there are a few studies for this age group. The intervention was successful in improving adolescents' nutritional knowledge in school A and B. However, only adolescents in school A showed significant improvements in their food intake as well as household food purchases.

Tavassoli et al., 2015 conducted a quasi-experimental intervention study among Iranian adolescent girls. The results demonstrated significant improvements in Iranian adolescents' nutritional knowledge and food intake after participating in 6 sessions (45-60 minutes per session) in the school. The amount increase in fruit was 149 g/day (around 2 portions /day) and in vegetables 207 g/day (around 2.5 portions/day). These results were in accordance with the present study, as adolescents in school A only showed a significant increase in fruit intake by 190 g/day (approximately 2.5 portion/day), whereas, vegetable increased by 167 g/day (approximately 2 portions/day). In addition, a cluster randomization study was undertaken by Wang et al (2015) among Chinese middle school students aged 13-15 years, showed a significant increase in their nutritional knowledge, fruit and vegetables consumption post the intervention.

There are a few school based nutrition education intervention available in Arab countries. Habib-Mourad and Carla (2014) conducted a cluster randomization trial

for 3 months among Lebanon children aged 9-11 years. Nutritional knowledge was significantly increased post intervention as well as significant improvements in fruit and fizzy drinks consumption. Another cluster randomization trial in Palestine showed that nutritional knowledge of adolescents (aged 16-18 years) significantly increased post the intervention (Farid et al, 2013). However, the study did measure the change in adolescents' behaviour changes as an indicator for the success of the intervention.

A study by Shama and Abdou (2009) among adolescents in Oman aged 13-16 years using static group comparison design, found a significant increase in their nutritional knowledge as well as fruit and vegetables intake post intervention. A pilot study was undertaken in Lebanon among 7-9 grade children for 2 weeks demonstrated that children significantly decreased their consumption of soft drinks post the intervention (Abi Haidar et al.,2011). Similar results were found among Tunisian adolescents aged 12-16 years old (Kebaili et al, 2014).

These results have provided an evidence for the success of school based nutrition education intervention, to be considered by the policy maker and Saudi ministry of education to include nutrition education in Saudi school curriculum. This will be the first step to improve adolescents' food intake and hopefully influence their weight status. This is because there is a high prevalence of overweight and obesity among Saudi adolescents in the last ten years (El Mouzan et al.,2011). Al-Hazzaa *et al.* (2013) revealed that the prevalence of overweight and obesity among Saudi adolescents (14-18) was significantly higher (38%) than adolescents in the UK (24%). Data for adolescents and adults aged 15 years and older from 16 countries in the

Eastern Mediterranean Region showed Saudi Arabia to be one of the 6 top countries in the region for the prevalence of obesity which require an urgent action from the policy maker and Saudi minister of education to cope this issue.

However, simply knowing about nutrition and health among adolescents does not necessarily lead to behavioural changes as the home environment can play a vital role in their food intake (Berg et al., 2006). To illustrate, adolescents in school B did not show a significant change in food consumption, despite, the nutritional teaching was the same for adolescents in school A and B and no significant difference was found between the mean score of adolescents' nutritional knowledge post intervention. This reflects the importance of home food environment, as mothers in school A were involved in the intervention which considered one of the factors that would enhance the intervention.

Since mothers' nutritional knowledge significantly increased post the intervention which had a positive impact on household food purchase and home food availability (e.g. fruit and vegetables) and subsequently their children food intake. Slusser *et al.* (2011) reported that mothers' nutritional knowledge may influence food purchases and preparation which are considered predictive of HFA (Baranowski et al., 2008). In addition, Campbell *et al.* (2013) demonstrated a significant relationship between mothers' nutritional knowledge and home food availability and in turn, adolescent consumption of fruits and vegetables. Additionally, McKinnon *et al.* (2014) examined the association between nutritional knowledge levels of main household food shoppers in Australia with household food purchasing choices (based on self-

reported purchasing). The study revealed that higher levels of nutritional knowledge were associated with healthier food purchasing behaviours such as fruit.

Another indicator for the effectiveness of nutritional intervention on mothers is indicated by a significant change in the amount of requested fruit, vegetables and fizzy drinks from food shopping list. Since it is common in Saudi Arabia that food items written down as list by the mothers, and these items purchased by household shopper (usually father). However, it is not necessarily that the main household shopper purchased all the food requested by the mothers. Thus, it was very important to compare the amount of food requested in food shopping lists with the amount of food purchased from till receipts which were not significantly different from each other as this could influence home food availability.

Interestingly, consumption of sweets, chocolate, cake and biscuits significantly decreased post intervention for both mothers and adolescents, although, no significant change was detected in household purchases of these products. This result showed the importance of mothers on influencing their daughters' food intake even if unhealthy food (e.g. sweets and chocolate) was available in the home, as it is well known that availability of energy-dense food is associated with adolescents' consumption of these products (Campbell et al., 2007; Pearson et al., 2011). It could be that mothers' support and encouragement impact on food consumption of their children (Shokrvash et al., 2013). The results from the present study that could support the role of mothers in supporting their daughters, is that adolescents in school B showed a significant increase in their nutritional knowledge level post intervention, however, no significant changes were observed in their food intake.

These findings add to a growing body of literature that concluded that there was inconsistent and insufficient evidence about the influence of parental involvement in nutritional education intervention on food intake of adolescents (Lippevelde et al., 2012; Ajie et al., 2014). Due to this new evidence their mothers' involvement should be encouraged and the dietitians in Saudi Arabia should activate their roles and increase the mothers' awareness about nutrition and food.

However, some studies showed that school based intervention even with parental involvement did not make any difference in adolescents' food intake. For example, Blake *et al.* (2012) reported that no significant changes occurred in the dietary intake of adolescents (age 16-18) in the US as a result of 19 weeks of nutritional education intervention, although their nutritional knowledge increased significantly post intervention and their parents were involved (by sending weekly nutritional information and make monthly educational sessions). This may be adolescents may have not recalled everything they consumed and how much, or it could be that cross contamination occurred as both intervention and control groups were at the same school (Blake et al., 2012).

Moreover, Hearans *et al.* (2007) conducted a school based nutrition education intervention over 2 years for adolescents in Belgium (mean age 15 years) and parents were sent written information about nutrition and a compact disc (CD) including nutritional information. The study revealed that no significant change in fruit, vegetables or soft drinks consumption for both intervention groups with and without parental involvement, which was in contrary to the present study. The author stated that a longer intervention period or more intensive sessions may be necessary to assess significant positive effects. Since after 9 months fruit intake increased by 0.1

servings a week in the intervention with parental support group compared to the control group (Hearans et al., 2007). Also, the availability of vending machines outside the school may have been the reason why no change was seen for the soft drinks consumption and those adolescents would compensate for the lack of soft drinks at school by consuming more soft drinks outside school (Finkelstein et al., 2004). The other reasons for the significant change in food intake among adolescents in school A in the current study compared to above studies could be due to:

1. Adolescents in these studies from both gender, whereas the adolescents in present study were only female and it is known that Saudi adolescent girls are less independent compared to the adolescents girls in the other countries due to Saudi culture (e.g sharing meals with family), which could maximize the benefits of parental involvement in these studies.
2. A mother in Saudi Arabia still has the power to control the food availability in the home.
3. The socioeconomic status are vary between the studies which can influence home food availability and adolescents food intake.
4. The type of the parental involvement in school based intervention could have an impact on adolescents' food intake. The level of parental involvement varied from low, with parents providing consent only, medium, where parents were provided health information, and high, with parents being exposed to intervention components (Nixon et al, 2012) (see chapter 5 for more details).

All of the results in the present study have provided a support for a focus on improving not only adolescents' nutritional knowledge, but also mothers' nutritional knowledge (see chapter 5). It seems that family support, in particular mothers' support, should be an integral part of any health education programs to improve the quality of food consumed by adolescents (Stanton et al., 2007). However, before conducting any nutrition education in Saudi Arabia, culture sensitivity should be considered. Recent reviews have suggested that effective interventions must be culturally appropriate (Waters et al, 2011). The present study was tailored according to Saudi and Arab culture. For example, Saudi traditional food was replaced instead of British food in the teaching package, as this package was adopted from the British Nutrition Foundation. Also, some foods were excluded from the package such as ham and alcohol as these foods are not permitted in Saudi. Arabic was the main language used during sessions, meetings and on printed material. As Saudi families gather together for meals this allows parents to meet their children and control the type of food consumed which is considered a positive for dietitian when trying to improve the food intake of children and adolescents.

Several effective studies have also integrated cultural elements specific to the population under study, and this proved to be useful in reaching the desired outcomes (Caballero et al, 2003; Robinson et al, 2003; Gutin, 2008; Spiegel & Foulk, 2006). There is a need for culturally appropriate nutrition promotion interventions for the prevention of obesity and its related health risk factors among Saudi children and adolescents. There are no nutrition educational programmes specifically developed for the Saudi population, these are urgently needed to help with obesity management. To do this the Saudi dietitian needs to establish links with other

oversea dietitians and researchers to help and encourage more research in nutrition and increase the awareness of this problem so helping to improve the food intake of Saudis. This current research was conducted to achieve part of the vision of Saudi Arabia 2030.

4.9 Strengths and limitations

A major strength of this study is that the design of educational programme was driven by the results obtained in Phase 1 and, therefore, targeted the specific variables relevant to the population under study. As was the case in Phase 1, other strengths include using standardised data collection procedures and analyses techniques. In addition, teaching package was delivered by the researcher herself to avoid variability in teaching methods and to ensure that they got the same level of knowledge.

Additional strength is that the intervention was tailored according to Saudi and Arab culture. It featured traditional foods in all educational material and excluded prohibited foods in Saudi from the teaching package such as ham and alcohol. In the teaching package pictures featuring popular traditional foods (such as kabsa, tabouli, Arabic sweets and pastries, margoog...) helped adolescents relate messages to their daily routine and foods available in their environment. Using a cluster randomization design was a strength to avoid contamination between schools. Investigating the effectiveness of the mothers' involvement in the intervention on adolescents' food intake was an additional novel aspect of this study.

The results of this study must be interpreted in the light of its limitations. Food that was purchased from the supermarket does not necessarily reflect the total household diet, e.g. food that was brought into the house by others (e.g. relatives) is not accounted for, which could make a significant difference if added to food purchased in till receipt. However, food in till receipts can be used as an indicator for home food availability. The other limitation is the FFQ was validated by a previous

study for adults but not for adolescents which can influence the validity of using this FFQ for adolescents. However, it was piloted on both adolescents and mothers before being initiated for the intervention on a group of Saudi adolescent girls and their mothers.

Furthermore, food purchased was divided by the number of household members; however, it is not clear whether all of them were living permanently in the household which could make the amount of food purchased per day per individual significantly higher than the present study. Also, the estimation of the weight of food acquired from families' farm was estimated by them and sometimes they sent a picture to the researcher to estimate the weight. This could be underestimation or overestimation which could influence of the accuracy of food purchased data in the current results.

In addition to these limitations, the weight of some types of food purchased such as leaves (e.g. lettuce) was estimated by the researcher which could be a limitation as the size of the leaves was variable and the actual weight of these leaves could be higher or lower than the weight estimated by the researcher. However, the average weight of different sizes of leaves (e.g. lettuce) was taken by the researcher.

Moreover, the researcher delivered the intervention herself. For sustainability reasons, further investigations need to assess the effectiveness of such interventions when delivered by other trained personnel, such as the school teachers. Also, the study duration was relatively short (1 month), which could be not sufficient to induce proper and sustained behaviour change and to detect changes in body composition. Longer duration interventions must be considered when planning for later research studies.

4.10 Conclusion

Collectively, school based nutritional education intervention was successful in increasing nutritional knowledge of the adolescents in both intervention schools. However, only mothers in school A showed a significant increase in their nutritional knowledge along with a significant change in their household food purchases and their food intake as well as their daughters.

Moreover, the present study demonstrated that increasing adolescents' nutritional knowledge alone is not sufficient to improve their food intake, since nutritional knowledge of adolescents in school B increased significantly post intervention but no change occurred in their food intake. This result demonstrates that is very important to consider the adolescents' home environment such as the mothers' nutritional knowledge level which could be the main key for changing food shopping practice, food availability in the home and subsequently the adolescents' food intake. Therefore, home environment should be an integral part of any school based nutritional intervention to support adolescents to change their food intake as described in more detail in chapter 5.

Chapter 5: Impact of engagement on the interactive nutritional activities of Saudi adolescent girls (16-18 years) and their mothers

5.1 Introduction

5.1.1 Interactive activities and knowledge transfer

Family communication arises as a result of interaction between parents and their children. When this happens knowledge/advice will often be transferred (Mosavel and Thomas, 2009). Saphir (2006) hypothesized that adolescents in a high school in California after exposure to an educational intervention in the school can influence family communication patterns. Parents and adolescents were interviewed separately at baseline, post-test and at 6 months follow up. The interview included self-reports of family communication patterns and parents' reports of adolescent-initiated discussion. Results showed that the intervention stimulated adolescents to initiate discussion at home with their parents.

Despite limited attention being paid to adolescents' ability to educate their parents, some studies have explored the feasibility of daughters providing health advice to their mothers (Mosavel and Thomas, 2009). Twelve focus groups were conducted with 78 African-American and Latina daughters between the ages of 12 and 17 from low-income neighbourhoods in a Mid-Western city in the United States. The findings indicated that many daughters reported providing their mothers with a wide spectrum of advice, including health advice which indicates the potential role of adolescents as family health educators (Mosavel and Thomas, 2009). However, no interview was conducted with the mothers to compare their response with their daughters. Also, it is not clear whether the mothers had acted on any of the health advice from their daughters.

Some investigators in the field of disease prevention found that adolescents (12 to 14 years of age) in Denmark who were taught cardiopulmonary resuscitation (CPR) on resuscitation manikins in the school were able to train relatives and friends at home on how to do CPR (Isbye et al., 2007). However, the study did not measure the change in the knowledge of the trainee or obtain any feedback about the training session conducted by the adolescent.

Reynolds *et al.* (2000) conducted a school based nutrition education intervention on fourth grade students in the US. Parents were asked to complete seven homework assignments together with their children once a week for seven weeks. Post intervention children showed a significant increase ($p < 0.05$) in fruit and vegetable consumption (3.96 portions/day) compared to the control group (2.28 portions/day). Also, parents in the intervention group showed a significant ($p < 0.05$) increase in their fruit and vegetable intake post intervention compared to of the control school (4.23 portions/day versus 3.90 portions/day).

However, the participants in the study by Reynolds *et al.* (2000) were in elementary school; the author is not aware of any such studies in adolescents. Moreover, it is only compared the parental intervention group with the control group; they did not compare against the other intervention group without parental involvement. If there was another intervention group without parents' support this would help establish whether the change in students' food intake arose due to parental involvement or only from the nutrition education sessions in the school. In addition, the main aim of the activities was for parents to support their children as they were familiar with content of the intervention and encouraged to eat 5 portions as well as their children. A systematic review demonstrated that a nutritional education intervention which

involved parents using activities common to parents and their children was more likely to report positive results of the children's food intake (e.g. increase consumption of fruit and vegetables) compared to other indirect methods (e.g. newsletter, sheets with nutrition information sent to the home through mail, email or with the child) (Hingle et al., 2010). It could be that such activities allow both parents and children to discuss and explore more about nutrition. Therefore, parental involvement using interactive activities has been shown to be of benefit for influencing their children dietary intake such as increasing their fruit and vegetables intake.

5.2 Aim

To explore the efficacy of interactive nutritional activities between mothers and Saudi adolescents girls in the home based on nutritional knowledge, household food purchases and food intake.

5.3 Objectives

1. To create interactive nutritional activities for both mothers and adolescents for participation at home.
2. To monitor evidence of the interaction between mothers and adolescents during the intervention and at 2 months follow up using a questionnaire.
3. To measure the changes in nutritional knowledge, food purchases and food intake (pre versus post intervention) between mothers and daughters who engaged in the interactive activities, with those who did not engage in the activities.
4. To identify the variables (demographics) that influence the interaction between mothers and daughters.

5.4 Methodology:

5.4.1 Study design:

A cluster randomised trial using 3 matched schools was employed (see section 4.4.1) and participants were the same as in chapter 4. Adolescents in the randomly selected classes from school A received nutritional education in the school as stated in chapter 4 and were given nutritional interactive activities to complete with their mothers at home; adolescents in school B received nutritional education only; and school C acted as the control school, so adolescents did not receive any educational or interactive activities during the project period. Mothers and adolescents in all schools were required to complete evaluation questionnaires from the interactive activities and nutritional education as relevant.

5.4.2 Calculation of sample size required

It is the same sample size in chapter 4

5.4.3 Materials

5.4.3.1 Interactive activity

The interactive activities were developed by the researcher and piloted on a group of Saudi adolescent girls and their mothers prior the intervention and they were amended according to the participants' feedback. There were two specific types of interactive activities: one which focused on modifying recipes to make traditional Saudi dishes more healthy; and the other which asked mother and adolescents to cook or prepare together a healthy snack or meal (see appendix H2). Recipe modification was used for the first and the second week of the intervention to encourage thinking about improvements to the most common Saudi dishes, while the second activity was undertaken in the third and fourth week enabled participants

to cook from what they had previously learnt. Adolescents were asked to return the interactive activity sheets to the school to be collected by the school teacher or email them to the researcher.

5.4.3.2 Evaluation questionnaire:

Both mothers and adolescents in school A were asked to complete a questionnaire (see appendix H6) about engagement in the interactive activities at the end of the 4 week intervention period. In addition, they were asked whether they discussed the study with children/mothers from other schools. The participants in the other schools (B and C) were also given a questionnaire (see appendix H6) asking whether their food habits have changed over the period of the intervention and if so, why; and whether they were in contact with children/mothers from other schools or discussed the study with them. The questionnaires were returned to the school via the adolescents for analysis.

Food frequency questionnaire

The food frequency questionnaire (FFQ) was selected in the current study due to its easy administration and low cost. The burden on subjects is modest when using a FFQ as compared to the use of dietary food records (Willett, 1998). It was used in the current study to measure the average food intake in grams per day for adolescents and their mothers, pre, post and at 2 months follow up post intervention. It consists of 144 items in total and the estimated completion time varies from between 20-25 minutes (see appendix H5).

5.4.3.3 Nutritional knowledge questionnaire:

The questions of this questionnaire were adopted from the British Nutrition Foundation after permission has been granted (British Nutrition Foundation, 2013)

(see appendix H4). This questionnaire was different from the one used in phase 1 as it was based on the nutritional information in teaching slides. It was used to assess the level of adolescents' and mothers' nutritional knowledge level pre, post and 2 months follow up post intervention. It consisted of 16 questions in total each in multiple choice formats and the estimated time to complete it was 10-15 minutes. Both mother and adolescent were asked to complete it in the school setting.

5.5 Data analysis

SPSS (version 21.0) was used to analyse data. Descriptive statistics were calculated for independent variables. Results are presented as numbers, percentage, means and standard deviation for numerical variables. The chi-square test was used to compare nutritional knowledge, food intake and the household food purchased of adolescents and mothers in school A who engaged in the interactive nutrition activities with those who did not engage the interactive nutrition activities. Also, it was used to compare adolescents' nutritional knowledge, food intake changes based on frequency of interactive activities. Wilcoxon was used to compare food purchased and food intake pre and post the intervention. Each qualitative question (free writing of the participants) were analysed by creating code for each similar response to categorize them.

5.6 Results:

5.6.1 Participants and recruitment:

As reported in chapter 4 the number of adolescents and mothers who completed the study was 63, 54 and 46 from schools A, B and C respectively.

5.6.2 Participants' characteristics:

Table 40 shows characteristics of the study participants. The reported monthly household income for all participants in all schools was >10000 S.R. (about >£2000). No significant difference was found between adolescents' weight status (BMI) in the three schools as well as their mothers (see section 4.6.2 for more details).

5.6.3 Engagement in the interactive nutrition activities

All mothers and adolescents reported that they had no contact with any child or mother from any other school. The total number of mothers who engaged (cooked and modified recipes) with their daughters in the interactive nutrition activities was 45 (71%), whereas 18 (29%) did not engage in these interactive nutrition activities with their daughters. Mothers who engaged in the interactive activities with their daughters stated that their daughters educated them during the interactive activities 36 (57%), and 5 (8%) educated their mothers during the main meals, 3 (4%) educated them at Arabic coffee time and only 1 (2%) educated her mother during the whole family meeting at the weekend. Mothers who did not engage in the interactive activities with their daughters reported that they did not discuss the study with their daughters.

5.6.4 Role of engagement in the interactive activities on nutritional knowledge level in school A

Mothers who engaged with their daughters in the interactive activities showed a significant increase in their nutritional knowledge level from pre to post and at 2 months follow up post intervention ($p < 0.05$). Their nutritional knowledge level at both

post and 2 months follow up post intervention was significantly higher ($p < 0.05$) than those who did not engage with their daughters in the interactive activities (Table 34). However, all adolescents who engaged or did not engage in the interactive activities with their mothers in school A showed a significant increase ($p < 0.05$) in their nutritional knowledge scores from pre to post, and 2 months follow up post intervention and there was no significant difference between them (Table 34).

Table 34: Changes and differences in the mean scores of nutritional knowledge level in school A based on the engagement in the interactive activities

Stage of intervention	Mothers and daughters who engaged in the activities (n=45)	Mothers and daughters who did not engage in the activities (n=18)
	Mothers' nutritional knowledge score	
Pre intervention	3.9 ± 1.3	4.3 ± 1.2
Post intervention	9.7* ∞ ± 1.1	5.1 ± 1.4
Two months follow up the intervention	9.6* √ ± 1.1	4.6 ± 1.4
Daughters' nutritional knowledge score		
Pre intervention	4.9 ± 1.2	4.7 ± 1.3
Post intervention	9.8∞ ± 1.1	9.5∞ ± 1.8
Two months follow up the intervention	9.6 √ ± 1.1	9.8√ ± 1.7

Data are expressed as mean ± SD

* The mean difference is significant at the 0.05 level between mothers who engaged with their daughters in the activities compared to those who did not engage.

∞ The mean difference is significant at the 0.05 level from pre to post intervention.

√ The mean difference is significant at the 0.05 level from pre to two months follow up intervention.

5.6.5 Role of engagement in the interactive activities on food purchased in school A

Table 35 shows changes and differences in food purchased for mothers who

engaged with their daughters in the interactive activities and those who did not.

Mothers who engaged in the interactive activities showed a significant increase in

their household purchases of fruit and vegetables and significant decrease in

purchases of fizzy drinks for post, as compared to pre intervention ($p < 0.05$). Fruit

and vegetables purchases were significantly higher ($p < 0.05$) and fizzy drinks

purchases significantly lower ($p < 0.05$) in households who engaged, as compared to

households who did not engage, in the interactive activities (Table 35).

Table 35: Changes and differences in food purchased per day in school A among mothers who engaged in interactive activities with their daughters and those who did not

	Mothers who engaged in the interactive activities with their daughters (n=45)	Mothers who did not engage in the interactive activities with their daughters (n=18)
Pre intervention		
Nutritional knowledge score	3.9 ± 1.3	4.1 ± 1.2
Food groups		
Fruit (g)	168 ± 66	172 ± 70

Vegetables (g)	178 ± 54	201 ± 32
Fizzy drinks (ml)	387 ± 99	310 ± 130
Sweets and chocolate(g)	221 ± 107	199 ± 98
Post intervention		
Nutritional knowledge score	9.7 ^{∞*} ± 1.2	5.1 ± 1.4
Food groups		
Fruit (g)	411 ^{∞*} ± 39	186 ± 67
Vegetables (g)	451 ^{∞*} ± 55	225 ± 32
Fizzy drinks (ml)	191 ^{∞*} ± 9	280 ± 33
Sweets and chocolate (g)	197 ± 109	218 ± 113

Data are expressed as mean ± SD

* The mean difference is significant at the 0.05 level between mothers who engaged with their daughters in the interactive compared to those who did not engage post intervention.

∞The mean difference is significant at the 0.05 level between pre and post intervention.

5.6.6 Role of engagement in the interactive activities on food intake in school A

Mothers and daughters who engaged in the interactive activities consumed significantly more fruit and vegetables post intervention ($p < 0.05$) and consumed significantly less sweets, chocolate and fizzy drinks ($p < 0.05$) compared to pre intervention, and compared to mothers and daughters who did not engage in the interactive activities ($p < 0.05$) (Tables 36 & 37). The changes in food intake among mothers and daughters who engaged in the interactive activities were sustained at 2 months follow up post intervention (Tables 36 & 37)

Table 36: Changes and differences in food intake per day amongst mothers who engaged in the interactive activities with their daughters and those who did not

	Mothers who engaged in the interactive activities with their daughters (n=45)	Mothers who did not engage in the interactive activities with their daughters (n=18)
Pre intervention		
Nutritional knowledge score	4.8 ± 1.3	4.6 ± 1.1
Food groups		
Fruit (g)	98 ± 29	139 ± 18
Vegetables (g)	109 ± 40	164 ± 27
Fizzy drinks (ml)	331 ± 55	299 ± 79
Sweets and chocolate (g)	165 ± 22	121 ± 35
Post intervention		
Nutritional knowledge score	9.7 ^{∞*} ± 1.2	5.1 ± 1.4
Food groups		
Fruit (g)	340 ^{∞*} ± 33	120 ± 26
Vegetables (g)	362 ^{∞*} ± 18	159 ± 42
Fizzy drinks (ml)	159 ^{∞*} ± 56	289 ± 74
Sweets and chocolate (g)	92 ^{∞*} ± 10	147 ± 23
2 months follow up post intervention		
Nutritional knowledge score	9.6 ^{∞*} ± 1.1	4.6 ± 1.4
Food groups		

Fruit (g)	331 ∞^* \pm 31	116 \pm 22
Vegetables (g)	370 ∞^* \pm 20	166 \pm 44
Fizzy drinks (ml)	164 ∞^* \pm 58	280 \pm 71
Sweets and chocolate (g)	100 ∞^* \pm 13	152 \pm 25

Data are expressed as mean \pm SD

* The mean difference is significant at the 0.05 level between mothers who engaged in the interactive activities with their daughters and those who did not.

∞ The mean difference is significant at the 0.05 level between pre interventions compared to post and 2 months follow up post intervention.

Table 37: Changes and differences in food intake among adolescents who engaged in the interactive activities with their mothers and those who did not

	Daughters who engaged in the interactive activities with their mothers (n=45)	Daughters who did not engage in the interactive activities with their mothers (n=18)
Pre intervention		
Nutritional knowledge score	4.9 \pm 1.2	4.7 \pm 1.3
Food groups		
Fruit (g)	94 \pm 31	124 \pm 22
Vegetables (g)	148 \pm 27	105 \pm 39
Fizzy drinks (ml)	343 \pm 24	297 \pm 33
Sweets and chocolate (g)	179 \pm 20	132 \pm 41
Post intervention		
Nutritional knowledge score	9.8 ∞ \pm 1.1	9.5 ∞ \pm 1.8
Food groups		
Fruit (g)	336 ∞^* \pm 32	117 \pm 20

Vegetables (g)	355 ^{∞*} ± 17	123 ± 44
Fizzy drinks (ml)	170 ^{∞*} ± 59	300 ± 78
Sweets and chocolate (g)	99 ^{∞*} ± 19	155 ± 25
2 months follow post intervention		
Nutritional knowledge score	9.6 [∞] ± 1.1	9.8 ± 1.7
Food groups		
Fruit (g)	349 ^{∞*} ± 29	111 ± 22
Vegetables (g)	334 ^{∞*} ± 27	159 ± 45
Fizzy drinks (ml)	172 ^{∞*} ± 54	285 ± 70
Sweets and chocolate (g)	116 ^{∞*} ± 13	141 ± 29

Data are expressed as mean ± SD

* The mean difference is significant at the 0.05 level between adolescents who engaged in the interactive activities with their mothers and those who did not.

∞The mean difference is significant at the 0.05 level between pre interventions compared to post and 2 months follow up post intervention.

5.6.7 Frequency of interactive activities

The total number of mothers and daughters who engaged in the interactive nutrition activities was 45 (71%). Thirty five of those reported that they participated in the interactive nutrition activities once a week and ten of them engaged in the interactive nutrition activities more than once a week. All of the participants (mothers and adolescents) stated that they modified recipes and did not create a new recipe.

All mothers who engaged in the interactive activities once or more than once a week showed a significant increase ($p < 0.05$) in their nutritional knowledge and significant improvements ($p < 0.05$) in their households' food purchased from pre to post intervention (Table 38). For example, they purchased significantly more fruit and vegetables ($p < 0.05$) and significantly less fizzy drinks ($p < 0.05$) compared to pre intervention. No significant differences in the amount of food purchased were observed between those who interacted with their daughters once or more than once

a week (Table 38). However, mothers and daughters who engaged in the interactive activities more than once a week consumed significantly more fruit ($p < 0.05$) and significantly less fizzy drinks ($p < 0.05$) compared to those who engaged once a week as presented in table 39.

Table 38: Changes and difference in food purchased between mothers in school A based on frequency of participating in interactive activities

Food groups	Mothers who engaged in the interactive activities with their daughters more than once a week (n=10)	Mothers who engaged in the interactive activities with their daughters once a week (n=35)
	Pre intervention	
Nutritional knowledge	3.9 ± 1.3	4 ± 1.2
Fruit (g)	169 ± 59	144 ± 67
Vegetables (g)	225 ± 39	268 ± 27
Fizzy drinks (ml)	281 ± 116	232 ± 111
Sweets and chocolate (g)	233 ± 44	206 ± 58
Post intervention		
Nutritional knowledge	9.8* ± 1.1	9.2* ± .78

Fruit (g)	390* ± 37	409* ± 35
Vegetables (g)	410* ± 51	399* ± 53
Fizzy drinks (ml)	188* ± 19	210* ± 17
Sweets and chocolate (g)	225 ± 103	190 ± 88

Data are expressed as mean ± SD

* The mean difference is significant at the 0.05 level compared to pre intervention

Table 39: Differences in food intake among mothers and adolescents post intervention in school A based on frequency of participating in interactive activities

Food groups	Participants who engaged more than once a week (n=10)	Participants who engaged once a week (n=35)
	Mothers	
Nutritional knowledge	9.8 ± 1.1	9.6 ± .78
Fruit (g)	336* ± 10	291 ± 15
Vegetables (g)	355 ± 29	374 ± 20
Fizzy drinks (ml)	145* ± 17	190 ± 26
Sweets and chocolate (g)	109 ± 11	94 ± 16
Adolescents		
Nutritional knowledge	10.1 ± 1.4	9.6 ± 1
Fruit (g)	343* ± 12	285 ± 10
Vegetables (g)	354 ± 26	360 ± 24

Fizzy drinks (ml)	156* ± 16	199 ± 25
Sweets and chocolate (g)	120 ± 10	111 ± 15

Data are expressed as mean ± SD

* The mean difference is significant at the 0.05 level between participants (mothers and adolescents) who engaged once a week and those who engaged more than once a week.

5.6.8 Factors affecting engagement in interactive activities in school A

All mothers who engaged in the interactive activities with their daughters 45 (71%) reported that they always spoke daily with their daughters about different issues especially during the meals, Arabic coffee time or during meal preparation. Fifteen out of 18 of mothers who did not engage with their daughters in the interactive activities reported that they did not speak daily with their daughters.

Thirty seven out of 45 of mothers who engaged in the interactive activities with their daughters stated that their daughters used to help them daily with cooking and only five out of 18 of those who did not engage with their daughters in the interactive activities stated that their daughters helped them with cooking. The rest (13 out of 18) stated that both mothers and daughters did not cook because the servant was the person who was responsible for cooking for their families for the following different reasons namely: mothers had a busy schedule and do not have time to cook, mothers and daughters never cook, servant's cooking was tastier than their cooking and, servant can cook different types of dishes in a short time. The following are

quotations from mothers' responses about why they did not engage in the interactive activities with their daughters:

"I am so busy because I work for 12 hours a day"

"I do not used to cook even before I got married"

"My servant can cook very delicious food better than me"

"I am so slow in cooking but my servant can cook many tasty dishes in short time"

"I have 7 children and I spend most of time to look after them, so no time for cooking"

"I have two jobs one in the morning and one in the evening and I cannot manage to cook for my family"

"I do not like cooking, so never cook"

5.6.9 Analysis of the Interactive activities on recipe modifications in school A

5.6.9.1 Mothers' and adolescents' suggestion for modified recipes

Tables 40 and 41 show examples of mothers' and adolescents' suggestions for modified recipes and the reasons for choosing these recipes. Both mothers and adolescents tried to reduce the amount of fat and increase foods containing fibre and vitamins. Twenty six of obese and overweight adolescents and their mothers suggested fat decreases, and none of the normal weight suggested this. Twenty one of overweight and obese suggested cooking with wholemeal rice instead of white rice to feel fullness and to lose weight. None of normal weight mentioned this.

Table 40: Typical suggestion by mothers and adolescents for modification of a traditional recipe called Kabsah.

Common ingredients for	Amended recipe by	Reason for choosing the
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Saudi Kabsah	participants	amended recipe
5-10 full spoon butter	1 spoon of oil	“Butter is a saturated fat but oil is not saturated fat”
White rice	Wholemeal rice	“Because it contains more fibre to help me to feel fullness and to lose weight”
Fried chicken	Grilled chicken in the oven or boiled	“It contains minerals and it is a good source for B1”
Fried vegetables (carrot, peas etc.)	Grilled vegetables and nuts but in a pan which one spoon of oil instead of deep oil in the pan	“Fewer calories than fried chicken especially for losing weight”
	Add more vegetables	“Because we need small quantity of fat daily as 1 gram of fat give us with 9 calories”
		“Contain different kinds of vitamins and more fibre”

Table 41: Typical suggestion by mothers and adolescents for modification of a traditional recipe called Musage.

Common ingredients for Saudi Kabsah	Amended recipe by participants	Reason for choosing the amended recipe
Fried eggplants	Roast eggplant	“This dish contains huge amount of fats and I tried to reduce the amount of fat by cooking the vegetables in the oven instead of frying them and use oil instead of butter as butter contains saturated fat”. “Fat was at the top of the food pyramids which
Fried potatoes	Roast potatoes	
Fried carrots	Roast carrots	
Fried onion	Roast onion	
Homemade tomato Sauce	Tomato sauce with olive oil instead of corn oil	

Minced meat cooked in butter	Minced meat with oil	means we need take a little bit or avoid” add it to the food because many food contain fat already”
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5.6.9.2 Participants’ views (mothers and daughters) about the modified recipe they suggested

Table 42 shows a summary of participants’ responses (both mothers and daughters together) about what they thought about the modifications they suggested. The key themes established were about the taste of the modified recipe, the time they required to prepare the recipe, the difficulties that the mothers face in changing the eating habits of the family, the recipe is healthy and some ingredients are expensive.

Table 42: Participants’ thinkig about the modifications they suggested (n=45)

Participants’ views	Example of participants responses
Healthy	<p><i>“in the past I could not feed my babies from these dishes because they are not healthy for babies but after the modification I can feed them from these two dishes or any other dish but after modification as I learnt”</i></p> <p><i>“my husband like Musage dish but he could not eat it from 6 years ago as he has a diabetes and this dish is not healthy, but after modification he can eat it and that is make him so pleased.</i></p>
Improving thinking to amend other recipe	<p><i>“I am trying to lose weight and recipe modification gave me an idea on how to modify other dishes to be suitable for me to lose weight ”</i></p> <p><i>“actually recipe modification is the first to me to lose weight</i></p>

	<i>because now I can modify my favourite dish as a part</i>
Taste of the dish	<i>“they were very delicious dishes”</i> <i>“I like its taste”</i> <i>“I did not like the taste of the modified dishes”</i>
Take time to prepare	<i>“cooking a new recipe require additional time than normal recipe, and not always able to modify especially during working days”</i> <i>“using wholemeal rice in Kabsah require double time that the white rice require, so I cannot us it as I am teacher and I have limited time to prepare meals”</i>
Difficulty in changing eating habits	<i>“actually it is healthy but it is hard to change family eating habits”</i> <i>“modified dish was a good lesson for me on how difficult to get my family to make changes to food they eat”</i> <i>“my family did not accept the taste of the modified dishes, so I will try to create another way to attract them”</i>
Prices of some ingredients	<i>“I want to improve my daily recipe but some healthy food like brown rice and brown bread are more expensive than white rice and bread because we eat rice daily “</i>

5.6.10 Analysis of the interactive activities about cooking meal or snack in school A

5.6.10.1 Description of the meals and snacks which were cooked by the participants (mother and daughter) together:

All mothers and daughters stated that they make up the meals and snacks from their previous knowledge about food and cooking but for the study they tried to create healthier versions than before. Table 43 shows some examples for the most common food in Saudi Arabia which was prepared by participants (mothers and daughters) for the interactive nutrition activities. Twenty seven obese and

overweight adolescents prepared healthy snacks, not the main meal (e.g. Khaleyat nahel and Kataif), compared to five normal weight adolescents.

Table 43: Examples of dishes which prepared by mothers and adolescents in the interactive activities

Name of the dish	Original recipe	Amended recipe cooked by mothers and daughters	Why the amended recipe was healthier in their views
Kataif	A piece of dough filled with some chocolate and syrups at the top	Filled with dates and pure honey at the top along with glass of milk	<i>"Because it contains all food groups in"</i>
Margoog	Small circular pieces of dough cooked in chicken broth and small amount of vegetables	Increased the amount of vegetables and add mixed Salad as aside with fresh juice	<i>"Because it had higher amount of vegetables than the original recipe, so more vitamins, fibre and minerals"</i>
Fried potatoes	Cook in deep oil	Cooked in the oven without oil and drink juice with it	<i>"it has less fat than original recipe as we want to lose weight"</i>
Kabsa	White rice with fried meat and add at least 6 table spoons of butter	Wholemeal rice with roasted meat and no added butter with plate of mixed salad	<i>"it contains more fibre and vitamins and less fat"</i>
Khaleyat nahel	A piece of dough filled by marshmallow and add sugar at the top	Filled by dried fruit and no added sugar	<i>"Less calories and more vitamins"</i>

5.6.11 Mothers' views about the interactive nutrition activities in school A:

Table 44 summarizes mothers' views about the interactive activities with some quotations. The key themes established encouraged mothers and daughters to read about nutrition; encouraged daughters to speak to mothers about nutrition related topics; assisted mothers to plan meals for their family members to become healthier; assisted mothers to improve the types of food served to their children; corrected some wrong ideas about nutrition; and changed some food shopping habits.

Table 44: Mothers' responses about their views of the interactive activities

Mothers' view	Quotations from mothers' responses
Encouraged mothers and daughter to read about nutrition	<i>"Actually interactive activities encouraged me and my daughter to read more about food and health to improve our daily dishes to be less fatty as my husband and I have high level of cholesterol and this is the first time to use oil instead of butter in my daily cooking"</i>
Encouraged daughters to speak to their mothers about nutrition related topics and also break some communication issues between them	<i>"Thanks Eman for doing these interactive activities because my daughter did not speak with me at all and these activities help to break some barriers between us and made us as friends. She was very excited when explained the content of the sessions because both of us like cooking and this activities become as a part of our daily schedule"</i> <i>"encouraged my daughter to speak to me about any topic related to nutrition"</i>
Assists mothers to plan meal for their family members to be healthier	<i>"Usually my husband bought a huge amount of fruit but my children do not eat them because I do not recognize the importance of serving them with the meals or with the snacks but now I and my daughter decided to serve them with each meal "</i> <i>"Interactive activities helped me and my daughter to plan what we should to eat more like, fruit, vegetables etc. and what food we should to eat less like sweet and chocolate because she is trying to lose weight"</i> <i>"I put food pyramids and eat well plate pictures on my kitchen's wall to help me for planning of my family's meals"</i>
Assists mothers to improve the types of food served to their children	<i>"Always my baby suffer from constipation and my daughter explained to me that increasing amount of fibre in my baby food will remove the constipation"</i>

	<i>“My children do not like to eat fruit but now I and my daughter tried to explores some attractive ways to encourage them to eat more fruit “</i>
Correct some wrong thoughts about nutrition	<i>“I had some thoughts that we need to eat less of starchy food (once a day) but my daughter told me about food pyramids and eat well plate and now I recognized that I had wrong thoughts “</i>
Change food shopping habits and selection of food	<i>“Sweets and chocolate were available always in my home and my children ate them any time during the day but now I serve fruit and vegetables instead of sweet and chocolate and I bought them just in the weekend “</i>

5.6.12 Mothers’ responses about what they learned most from participating in the interactive activities in school A

Table 45 summarizes mothers’ responses about what they learned most from participating in the interactive activities with their daughters on a scale of 1- 5 where 1 indicates what they learned most. Most mothers who engaged in the interactive activities with their daughters learned most about how to change recipes to make them healthier; followed by how to choose foods that are healthy; and then how difficult it is to get their families to make changes to the food they eat. However, mothers who did not engage with their daughters in the interactive activities (18 (29%) were excluded from this part of analysis because 16 out of 18 did not answer this question.

Table 45: Mothers' responses about what they learned most from participating in the interactive activities with their daughters in school A

Options	Ranking (n= 45)				
	1	2	3	4	5
I learned most about how to change recipes to make them more healthy	38 (84%)	7 (16%)	0	0	0
I learned most about how to choose foods that are healthy	4 (8%)	30 (67%)	11 (25%)	0	0
I learned most about how difficult it is to get my family to make changes to food they eat	3 (6%)	8 (18%)	34 (76%)	0	0
I learned most about how much nutrition and health knowledge my daughter had	0	0	0	35 (78%)	10 (22%)
I learned most about the health risks of obesity	0	0	0	10 (22%)	35 (78%)

5.6.13 Adolescents' views about the intervention in school B

All adolescents agreed that the intervention was useful but they could not change their eating habits over the period of the intervention for many reasons as summarized in table 46.

Table 46: A summary for the barriers to changing eating habits amongst adolescents in school B

Barriers for changing eating habits	Quotations from adolescents' responses
Serving food in the snack or the meal	<i>"actually, I want to reduce frequency of eating sweet and chocolate but I cannot as my mum used to serve them always in our snacks or at the end of the meals"</i> <i>"my mum does not serve fruit with the meal or snack"</i>
Home food availability	<i>"fruit is not always available in the home"</i>

Availability of preferred food in the home	<p><i>“my dad always buy orange, apple and banana only and I do not like them”</i></p> <p><i>“I like strawberry and cherry only but unfortunately they are not available always in the home”</i></p>
Eating habits of the family	<p><i>“I cannot change my eating habits alone as I used to eat all meals with my family daily”</i></p> <p><i>“it is hard to me to eat different food from my family food”</i></p>
The person who responsible about cooking in the home was not the mothers	<p><i>“the servant always cook the food for my family and I cannot teach her”</i></p> <p><i>“my grandfather used to cook for us daily because my mother is busy and work until late and I shay to ask her a specific type of food”</i></p>
Food accessibility	<p><i>“I want to eat fruit daily but my mother used to keep it in the fridge and sometimes I did not notice the availability of fruit”</i></p>

5.7 Discussion

To the authors' knowledge, this study is unique in its methodology which promotes daughters to educate their mothers and transfer the nutritional knowledge from school to home. Also, it was novel in describing the role of engagement in the interactive nutrition activities on mothers' nutritional knowledge, food intake and households' food purchases. The results demonstrated that daughters were able to educate their mothers and transfer the nutritional knowledge to them in the home. The study revealed that mothers and daughters who engaged in the interactive nutrition activities showed significant improvements in household food purchases and food intake.

The results of chapter 4 demonstrated that mothers' involvement in the nutrition education intervention can enhance the effectiveness of the intervention and their involvement should be encouraged. However, the type of mothers' involvement should be considered as this challenge for any nutrition education, since a systematic review demonstrated that a nutritional education intervention which involved parents using interactive activities common to parents and their children was more likely to report positive results of the children's food intake (e.g. increase consumption of fruit and vegetables) compared to other indirect methods (e.g. newsletter, sheets with nutrition information sent to the home through mail, email or with the child) (Hingle et al., 2010). This was confirmed by the present study which found significant improvements in food intake of adolescents in school A post the intervention. The author is not aware of any other study which has involved mothers

in school based nutrition interventions using such interactive nutrition activities used in present work.

However, others studies in the literature involved parents by different types of interactive activities and for younger age group. To illustrate, Reynolds *et al.* (2000) conducted a school based nutrition education intervention on fourth grade students in the US. Parents were asked to complete seven homework assignments together with their children once a week for seven weeks. Post intervention children and their parents showed a significant increase in fruit and vegetable consumption compared to the control group. Another school based nutrition education intervention involved parents of children in 3-5 grades by sending tips on how to prepare healthful snacks at home and asked them to discuss these tips with their children (Caballero *et al.*,2003). The study found that there was a significant increase in fruit and vegetables intake of children, but parents' dietary behaviour did measured in this study. The present in this thesis was slightly different from these studies, as the present thesis involved mothers in the intervention not only to create supportive environment for healthy behaviours at home, but also to test the ability of daughters to transfer the knowledge to their mothers and subsequently influence household food purchased and both adolescents and mothers' food intake.

A qualitative study was undertaken in 4 countries in Europe to get insight in determinants of and perspective on parental participation in a school based intervention on dietary behaviour on parents of 10-12 years old in order to develop an effective parental module for school based intervention concerning dietary behaviour. Parents proposed interactive and practical activities together with their

children at school or at home is the best way to involve them such as cooking, food tasting, and nutrition workshops (Van Lippevelde et al, 2011).

However, Blom-Hoffman et al (2009) conducted a study among elementary school children in the US for two years. The findings demonstrated that interactive activities (5 books contained many activities, some tips and massages related to nutrition) between mother and the child in the home were not effective in increasing fruit and vegetables intake of the children, despite the nutritional knowledge of children and mothers significantly increase post intervention. This is because the fruit and vegetables availability and accessibility did not significantly increased post the intervention compared to pre intervention. This could be due to the socioeconomic status of those populations which can impact the food intake of people (Ansem et al., 2014, Shariff et al., 2015).

The current study showed that no significant difference was found between adolescents' nutritional knowledge in school A based on their engagement in the interactive nutrition activities with their mothers, which indicates the homogeneity in the awareness about nutrition post the nutrition education sessions. However, nutritional knowledge of mothers in school A who engaged in the interactive nutrition activities were significantly higher than those who did not engage in the interactive activities. This could be that interactive nutrition activities encouraged them to read and explore more about the topic that they learnt, since a group of those mothers stated this when asked about their views about the interactive nutrition activities. This reflects the importance to engage the daughter and mother together in some activity.

Moreover, increasing mothers' nutritional knowledge demonstrated that adolescents were able to educate their mothers in the home and influence their nutritional knowledge which indicates the potential role of adolescents as family health educators. This method has advantages as it is an inexpensive way to teach mothers in the home, which will allow health educators to teach them, especially busy mothers who cannot attend nutritional sessions in the school and reach large number of them with effort. A study conducted among adolescents aged 12 to 14 years in Denmark found that they were able to train relatives and friends at home on how to do cardiopulmonary resuscitation. However, the study did not measure the change in the knowledge of the trainee or obtain any feedback about the training session conducted by the adolescent which the current thesis has resolved (Isbye et al., 2007).

Additionally, mothers and daughters who engaged in the interactive nutrition activities showed significant changes in food purchases and food intake as a result of increasing their nutritional knowledge compared to those who did not engage in school A, which demonstrated the importance of social support within home environments (mother and daughters encourage each other). Recently, Shokrvash *et al.* (2015) demonstrated that family support (e.g. mother share her child milk drinking, provide their children nutritional information or encourage them to drink milk etc.) was significantly correlated to Iranian adolescents' food intake (e.g. milk and dairy products). In addition, the lack of family support represents an increased risk for lacking in daily fruit and vegetable consumption among adolescents in Iran (Shokrvash et al., 2013). Also, it could be that mothers consider a good model in food consumption for their children (Elfhag et al., 2008). This is supported by reviews

of the literature showing that parental fruit and vegetables intake is positively associated with children's intakes (Horst et al., 2007; Pearson et al., 2009). Baranowski *et al.* (2008) revealed that social support from friends was the primary predictor of fruit and vegetables purchases by the parents and subsequently adolescents' consumption. However, in the current study daughters supporting their mothers is associated with an improvement in household food purchases.

Moreover, the present study reported a significant difference in food intake between participants based on the frequency of interactive nutrition activities. One explanation could be that interactive activities influence self-regulation (capability of people to set and achieve goals) of the participants and subsequently their food intake (de Wit et al., 2014). This suggests that mothers and carers not only influence adolescents' eating behaviours through their control over the availability of foods and support of specific eating behaviours, but also could be by communication and interaction in shared activities.

Additionally, the recipes modified by the participants may impact on the type of food consumed by adolescents and could influence their overall energy intake and body weight, as twenty six of them suggested decreasing the amount of fat in the recipes. Recently Allioua et al (2015) demonstrated that increasing fat intake among adolescents was associated with increasing BMI. Other evidence which demonstrates the advantages of using recipe modification as a teaching tool is that twenty one of the overweight and obese adolescents suggested cooking with wholemeal rice instead of white rice because it contains more fibre. A previous study showed that dietary fibre provides bulk to the diet without adding significant

amount of energy, it has a satiating effect on appetite; helping with weight management (Marlett et al., 2009).

It is interesting that 27 out of 30 of overweight and obese adolescents tried to modify popular Saudi snacks not main meal. According to Kerr (2009), the types of food consumed in the snack by the adolescents should be considered, as it could be linked to overweight or obesity. Increasing snacking calories are associated with overweight/obesity in Italian middle-school adolescents (Bo et al, 2014). Therefore, this suggests that cooking and recipe modification can be used to reach those groups and hopefully influence their weight status.

Furthermore, the positive responses received from mothers about their views of the interactive nutrition activities, indicates that this is an acceptable method which could be used as an alternative method for face to face sessions which require a location and additional costs to conduct.

The current study found that 15 out of 18 of mothers who did engage with their daughters in the activities reported that they did not speak daily with their daughters. This could be that their mothers were very busy or these families were very rich families, as it is common in Saudi that rich families live in very big houses (villa or palace) and each member of the family lives in a separate suite and rarely meet. In addition, relationship issues between mother and daughter can be another factor that could influence communication between them (Sunder et al., 2006; Mosavel & Thomas, 2009). However, the present study did not measure the relationship between mother and daughter which is a limitation for the study.

Also, the other barrier that could influence the engagement in the interactive nutrition activities is the availability of servants in the home especially if the servant is responsible for cooking for the householders. This could minimize the chance for both mothers and adolescents to discuss issues related to food and exchange the knowledge about food and nutrition. In this case the health educator should find another type of interactive activity (not cooking) to encourage both mother and daughter to engage in nutritional educational discussions.

One of the views about modified recipes reported by some mothers was the difficulties that they faced to change the eating habits for their families. This emphasises the importance to involve other family members in nutritional intervention, which could be helpful for the mother to change and improve the quality of food served and consumed by the family members. In addition, some mothers stated that they chose only their favourite dishes to modify. Previous research has shown that parents' concern for everyone's food preferences is a factor that affects parent's actions including food purchasing and preparations and subsequently children's food intake (Holesten et al., 2012).

Adolescents in school B who received nutritional education only, stated that they did not notice any obvious changes in their food habits. Home food availability was the most obvious barrier preventing food changes. Several studies including phase 1 of the current study demonstrated association between home food availability and adolescents' food intake (Neumark-Sztainer et al., 2003; Hanson et al., 2004; Rasmussen et al., 2006; Jago et al., 2007; Bauer et al., 2011; Pearson et al., 2011; Nepper & Chai, 2015). In addition, availability of a favourite food in the home such as certain types of fruit should be considered, as this is one of the barriers for food

intake for some adolescents in current study. Furthermore, food accessibility (in the form and location, and at a time that make consumption easy) was another barrier for food intake (Cullen et al., 2003). The other barrier for changing food intake reported by adolescents was serving food (e.g. fruit) during a family meal or snack. Neumark-Sztainer *et al.* (2003) demonstrated that family meals were positively associated with intake of fruits and vegetables of American adolescents.

Moreover, eating a meal with family was another barrier for changing their eating habits as they used to eat the same food. Sharing meals with family on a daily basis is a common habit in Saudi Arabia (Al Rethaiaa, 2010). Previous research in the US demonstrated that family members' eating habits would be predicted by the eating habits of the person who prepares the majority of the family's meals (Hannon, 2003). Another study in Holland for adolescents (aged 13-16 years) found similarities between daughters and mothers (Snoek et al., 2009). Therefore, these studies reflect the importance of mothers' involvement in the nutritional intervention as they play an important role in food purchasing and preparation (Holsten et al., 2012) and they could enhance the effectiveness of the intervention as demonstrated in the present thesis.

5.8 Strengths and limitations

The main strength of the findings is that the intervention was very well received by the participants in this study and they gave positive feedback about the interactive activities. Moreover, the target sample size of completers in the study was met.

However, the study would have been strengthened if the non-completers answered the final questionnaire as their reasons for non-completion would have given further insight into how nutrition education in Saudi could be improved. In addition, interactive activities were designed to suit Saudi culture by using popular Saudi traditional dishes to amend and all materials including nutritional teaching package were translated to Arabic and checked by specialist in Arabic to check clarity. Moreover, it was the first study examines the ability of daughter to transfer the knowledge to their mothers via interactive activities.

On the other hand, the study had some limitations such as the relationship between mothers and daughters was not measured. This considered very important element when designing active learning between mother and daughter because it could influence communication between them (Sunder et al., 2006; Mosavel & Thomas, 2009), and subsequently preventing engagement in the interactive activities. The present study did not measure what type of mothers' support (e.g. emotional support, practical support) which can lead to in improvements of their daughters' food intake (Shokrvash et al., 2015). Comparing the effect of these two types of mothers support can gave a new insight for the nutrition education in the future.

Another limitation is that the study was conducted in one city in Saudi Arabia (Tabuk) which consider small city and socioeconomic status is slightly different compared to

big cities such as Riyadh and Jeddah, and therefore it is not clear if these results can be transferred to other regions of Saudi Arabia. The study did not involve private or religious schools, but only a government school, and therefore, cannot be considered as a national study. All limitations mentioned in chapter 4 were also limitations for this chapter.

5.9 Conclusion

In conclusion, the present study has provided evidence that daughters were able to educate their mothers and transfer the nutritional knowledge from school to home through interactive nutritional activities. Mothers who engaged in the interactive activities showed significant improvements in their nutritional knowledge ($p < 0.05$) and their food ($p < 0.05$) intake as well as their daughters. In addition, they showed significant changes in household food purchased ($p < 0.05$). Participants who participated in the interactive activities more than once a week consumed significantly more fruit ($p < 0.05$) and significantly less fizzy drinks ($p < 0.05$) compared to those who engaged once a week. However, there are factors which may impact on the engagement in the interactive activities such as time constraints of the mothers, cooking abilities, the use of servants to cook for the family and the frequency of communication between mother and daughter. Therefore, health educators should take all of these issues into account when planning for interactive nutrition activities.

Furthermore, increasing adolescents' nutritional knowledge does not mean that this will lead to behavioural changes. This is because there are some barriers that prevent behavioural changes as stated by the adolescents in school B namely:

1. Home food availability, in particular availability of preferred food in the home
2. Serving food as a snack or as a meal
3. Eating habits of the family
4. If a person who's responsible for cooking in the home was not the mother
5. Food accessibility in the home

Chapter 6: overall conclusions

6.1 Introduction

This study set out to determine factors that could affect food intake of Saudi adolescent girls (16-18 years) with the purpose of developing an effective nutritional education intervention to improve dietary intake of adolescents.

This study was undertaken in two phases. Phase 1 was to explore factors affecting food intake in Saudi adolescent girls (16-18 years). The results of phase 1 found that nutritional knowledge of adolescents and HFA was associated with their food intake. It was also found that mothers' nutritional knowledge can influence adolescents' food intake as well as home food availability. Based on the results of Phase 1, Phase 2 was designed to see if improving nutritional knowledge in Saudi adolescent girls via a school nutrition education programme in addition to home interactive nutrition activities with their mothers leads to a change in nutritional knowledge and food purchases of the household thereby changing mothers' and adolescents' food intake.

6.2 Findings, contribution to knowledge and implications

Phase 1 was the first study that investigates factors that could affect food intake of Saudi adolescent girls. Phase 1 found that nutritional knowledge is one of the factors that could influence adolescents' food intake, since adolescents with higher nutritional knowledge consumed fruit on a daily basis compared to those with a lower nutritional knowledge ($p < 0.05$). These results were in agreement with previous studies conducted in adolescents of a slightly younger age group (in the USA and Italy) which found a positive association between nutritional knowledge and fruit intake (Pirouznia, 2001; Kristjansdottir et al., 2006; Grosso et al., 2013).

Furthermore, Grosso *et al* (2013) found a negative association between nutritional knowledge and sweets and sugary drinks consumption, among a younger age group of adolescents living in a rural area in south Italy. This was also demonstrated by the current study, which found the frequency of sweets, chocolates, cakes, biscuits and fizzy drink consumption was significantly lower ($p < 0.05$) among adolescents who scored higher on the nutritional knowledge questionnaire than those who scored lower.

Nutrition education interventions have proved successful in decreasing chocolate intake amongst adolescents aged between 16-18 years in Libya (Sachithanathan *et al.*, 2012). Also, Iranian adolescents of the same age group showed a significant increase in their fruit (149 gram/day) and vegetables (207 gram/day) post 6 sessions nutrition education intervention (Tavassoli *et al.*, 2015). However, it is not necessarily the case that increasing adolescent's nutritional knowledge alone can lead to improvements in food intake (Blake *et al.*, 2009), since there are many factors that could influence adolescents' food intake such as home food availability, nutritional knowledge of their mothers, household income, parents' level of education, food preference (likes and dislikes), parents as role models, cost, convenience and advertisements (Story *et al.*, 2002; Elfhag *et al.*, 2008; Swanson *et al.*, 2013; Campbell *et al.*, 2013; Grosso *et al.*, 2013; Yabanc *et al.*, 2014; Ansem *et al.*, 2014; Tavassoli *et al.*, 2015). However, the researchers cannot influence all of these factors i.e. food preference, household income or parents' level of education. Therefore, they may be able to influence the adolescents' and the mothers' nutritional knowledge/food choice/food availability.

The present study found that adolescents' intake of sweets, chocolate cake, biscuits and fizzy drinks was positively correlated to household availability of sweets and chocolate ($r=0.733$, $p < 0.05$), cake and biscuit ($r=0.756$, $p < 0.05$). These results were in accordance with studies conducted in Australia (Pearson et al., 2011) and in the UK (Cutler et al., 2011), which found positive relationships between availability of energy-dense foods with adolescents' consumption of these products. However, the present study did not show a relationship between the availability of fruit in the home, and an adolescents' intake of fruit. This is contrary to prior studies conducted in the USA and Europe, which demonstrated a positive relationship between fruit availability in the home and adolescent intake (Neumark-Sztainer et al., 2003; Hanson et al., 2004; Rasmussen et al., 2006; Jago et al., 2007; Bauer et al., 2011; Pearson et al., 2011). This difference could be attributed to cultural differences that impact upon eating habits. Furthermore, the age of the adolescents in this current study was higher than those in the referenced studies, which may explain the differences. Collison *et al.* (2010) revealed that older Saudi adolescents consumed less fruit and vegetables than younger adolescents

The other factors that could influence adolescents' food intake is their mothers' nutritional knowledge level, since findings of the present work found a negative association between mothers' nutritional knowledge with adolescents' fizzy drinks, sweet and chocolate consumption and a positive association with adolescents' fruit consumption. This is because in Saudi Arabia mothers are responsible for the household cooking and it is uncommon for men to cook. Also, mothers were responsible for writing the food shopping lists to be purchased by the household shopper (usually father), since Saudi law does not allow women to drive a car. One

of the important aspects of Saudi culture is that family members sharing all or most of their meals which gives the mothers an opportunity to control the type of food consumed by their children and can led to success of educational programme.

In addition, in the present study it was found that the mothers' nutritional knowledge was negatively correlated to the household availability of sweets and chocolate ($r=-0.226$, $p < 0.05$) and with the availability of cake and biscuits ($r=-0.354$, $p < 0.05$) as well as the availability of fizzy drinks ($r=-0.311$, $p < 0.05$). Campbell et al. (2013) confirmed that mother's nutritional knowledge was associated with both a reduced availability and reduced adolescent consumption of salty snacks and soft drinks. Another finding which supports the importance of mothers' nutritional knowledge is that a significant association was found in the current study between mothers' and daughters' nutritional knowledge ($r=0.626$, $p < 0.05$) with 22 (76%) who received advice about nutrition, mainly from their mothers.

In view of these findings, it was felt to be important to educate the mothers as well as exploring their role in enhancing nutrition education intervention as the literature has shown inconsistent and insufficient evidence about the influence of parental involvement in nutrition education intervention on food intake of adolescents (Lippevelde et al., 2012; Ajie et al., 2014). The mothers' influence on adolescents' food intake can be seen if we educate two groups of adolescents, one with mothers' support and another without mothers' support. Also, this way would help establish whether the change in adolescents' food intake arose due to a mothers' involvement or from nutrition education sessions in the school only.

In phase 2, a cluster randomised trial using 3 matched schools was employed. Adolescents in school A received nutrition education in the school and were given nutritional interactive activities to complete with their mothers at home; adolescents in school B received nutrition education only; and school C acted as the control school.

Phase 2 was the first nutritional education intervention conducted in Saudi Arabia to increase adolescents' nutritional knowledge and improve their food intake. The intervention was effective in increasing the nutritional knowledge of adolescents in by in schools A and B. However, only adolescents in school A showed significant improvements in fruit, vegetables, fizzy drinks, sweet and chocolate. A cluster randomization trail was undertaken by Wang et al (2015) among Chinese middle school students aged 13-15 years, showed a significant increase in fruit and vegetables consumption post the intervention. Similar results were found in Arab countries. For example, Habib-Mourad and Carla (2014) conducted a cluster randomization trial for 3 months among Lebanon children aged 9-11 years. Nutritional knowledge significantly increased post intervention as well as significant improvements in fruit and fizzy drinks consumption. Similar results were found among adolescent in Tunis and Oman aged 13-16 years old and among Lebanon children 7-9 grade (Shama and Abdou., 2009; Abi Haidar et al.,2011; Kebaili et al, 2014).

The differences in food intake between school A and B could be attributed to the mothers' involvement in the intervention in school A as this is one of the factors that could enhance the intervention. Also, the differences in food intake between both schools demonstrated that increasing adolescents' nutritional knowledge does not

necessarily lead to behavioural change due to the range of factors influencing food intake e.g. home food environment (Berg et al., 2006).

However, Blake et al (2012) reported that no significant change occurred in the dietary intake of adolescents (age 16-18) in the US as a result of a 19 week nutrition education intervention, although their nutritional knowledge increased significantly post intervention and their parents were involved (by sending weekly nutritional information at home). This may be due to the type of the parental involvement in the intervention that could influence the adolescents' food intake, as the present study used interactive learning between mothers and daughters as a tool to involve mothers in the intervention/learning, whereas, Blake et al. (2012) sent weekly nutritional information to the mothers. A systematic review demonstrated that a nutrition education intervention which involved parents using activities between parents and their children was more likely to report positive changes on children's food intake (e.g. increase consumption of fruit and vegetables) compared to other indirect methods (e.g. newsletter, sheets with nutrition information sent to the home through mail, email or with child) (Hingle et al., 2010).

These findings add to a growing body of literature that concluded that there was inconsistent and insufficient evidence about the influence of parental involvement in nutritional education intervention on food intake of adolescents (Lippevelde et al., 2012; Ajie et al., 2014). Due to this new evidence their mothers' involvement should be encouraged.

Furthermore, the results also revealed that only mothers in school A showed a significant increase in their nutritional knowledge as well as a significant increase in fruit and vegetables consumption; and significant reduction in fizzy drinks, sweet and

chocolate, cake and biscuits consumption. Moreover, only households in school A showed significant improvements in household food purchases compared to school B and C due to involvement in the interactive activities. These results demonstrated that interactive activities were an effective method involving mothers in the nutrition education intervention which could facilitate knowledge transfer from daughter to mother. In addition, these results have provided a support for a focus on improving not only adolescents' nutritional knowledge, but also mothers' nutritional knowledge.

The findings also demonstrate that mothers' engagement in the interactive activities does not always lead to improvement in the food intake of the mother or their daughter. This could be due to factors influencing the engagement in the interactive activities, such as, time constraints, the frequency of dialogue between mother and daughter, cooking abilities of the mothers and the use of servants to cook for the family.

One possible way to overcome the time constraints of the mothers is to ask the adolescents to discuss what nutrition they had learnt with their mothers during family meals. Sharing daily meals with family members is common among Saudi population so it is anticipated that other members of the family may also benefit.

Another possible way to overcome this barrier is to ask the adolescents to educate their mothers during the weekly family meeting held at the weekend. Also, if it is not possible for mothers and daughters to cook together they could just focus on modifying recipes.

In addition, the present study demonstrated that daughters can be used as health educators for their mothers, and transfer the knowledge obtained from school to home thereby influencing their mothers' nutritional knowledge and food intake, as well as household food purchases. By doing this, health educators can simply reach large numbers of mothers in their homes and influence their food intake as well as their daughters' food intake. Also, hopefully the food intake of other household members could be influenced. This also could be used as another obesity prevention strategy for future research.

The current study is novel because it showed that with more frequent engagement in interactive nutrition activities, more positive changes were seen in fruit and vegetable consumption of both the adolescents and their mothers. This result highlights the importance of utilising interactions between mothers and daughters which could be used as obesity prevention strategies in future research.

However, it is not clear whether these results are transferable or can be used in other regions of Saudi Arabia, especially in larger cities such as Riyadh and Jeddah where the majority of the families are wealthy and servants are employed to cook for the family. Also, it is not clear if these results can be transferred to countries such as the UK and US because of cultural differences between these Western and Arabic countries.

Also, the current study did not measure the relationship between mother and daughter which could influence the engagement in the interactive activities. Another limitation is whether the changes in food intake will be maintained for longer than 2

months. In addition, the food intake of other family members was not measured. This could determine if the mothers' nutritional knowledge could influence the food intake of all family members, both male and female.

6.3 Recommendations and policy implications

This study has made significant contributions to the literature. It has further elucidated the literature on nutrition education and identified the efficacy of mothers' involvement using interactive activities. Avenues for future research have been identified. Further research needs to be done:

1. The next steps would entail to plan for a large scale evaluation of a randomised controlled trial to test the effectiveness of the present intervention on a greater number of schools from different regions of Saudi Arabia with the school personnel as the study deliverer. The large scale trial will also assess the impact of the intervention at follow up (of one year). The dissemination and sustainability of the project would then be monitored to address long-term effects of such interventions on obesity prevention in Saudi and the region.
2. Furthermore, given the particular social and cultural context of the present study, its applicability and transferability to other countries of the region ought to be considered.

Factors that influence transferability of interventions from the study setting to another include: the baseline prevalence of the health problem in the other setting, the characteristics of the target population, social acceptability, and available resources and skills of the local providers (Wang et al, 2005).

3. To measure the relationship between mothers and daughters before applying the interactive activities, since 15 out of 18 of mothers who did not engage

with their daughters in the interactive activities reported that they did not speak daily with their daughters. This could be attributed to the relationship between mothers and daughters (Sunder et al., 2006; Mosavel & Thomas, 2009).

4. Future research can use adolescent boys as well, and see whether they can transfer the knowledge to home and influence their mothers' nutritional knowledge.

The following recommendations are suggested to policy makers:

1. Integrate nutrition educational components into regular school curriculum through fun and interactive activities spread across the whole academic year.
2. Engage with local university nutrition education programmes to provide training and support to teachers and staff in implementing and promoting healthy behaviours and activities. Hiring a full time nutritionist can be envisaged by schools who can afford it.
3. Improve the nutritional quality of foods available to students in school shops and canteens by enforcing laws preventing the sale of high energy dense foods and snacks and the provision of healthy alternatives that would appeal to children.
4. Involve parents in the programme to complement and encourage healthy behaviours in the home environment. Parents can help by making healthy foods available and accessible at home, and by encouraging physical activity and limiting access to sedentary ones.

5. Extend the intervention to younger children and their parents to build good eating habits early on and maximise the likelihood of sustaining those habits for life. It has been established that as of preschool age, children develop specific tastes for certain foods and these habits are maintained through adolescence and adulthood.

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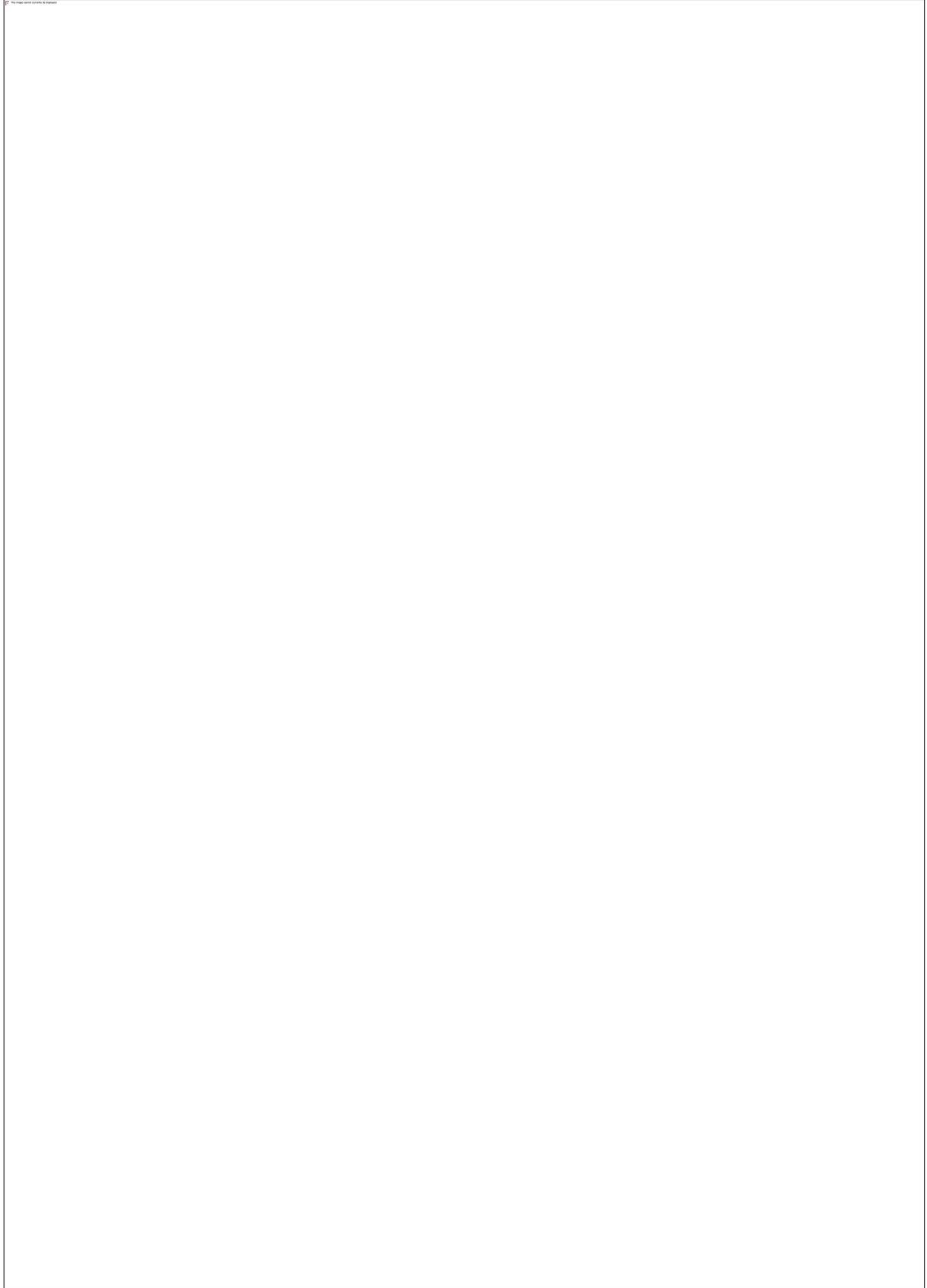
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Appendix A: publication

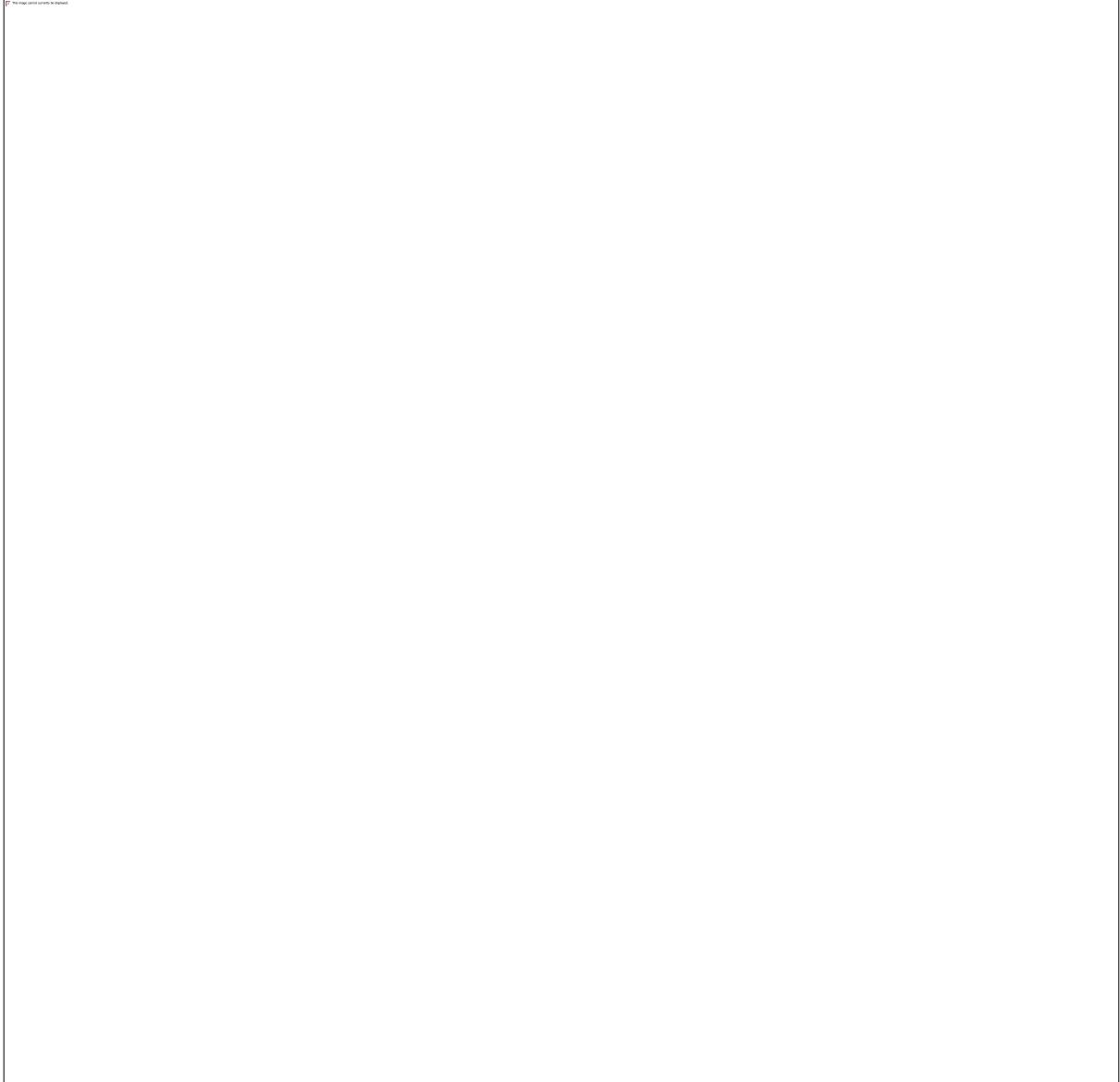


Appendix B: setting of the study

B.1 Location of Saudi Arabia on world map



B.2 Location of Tabouk on map of Saudi Arabia



Appendix C- invitations letters (phase 1)

C1-headteacher invitation letter

UNIVERSITY OF PLYMOUTH

Faculty of Health and Human science

Head teacher permission letter

Dear Madam:

I am writing to request your permission to carry out a research project in this school as part of my doctoral degree in health and education which is supported by Tabouk University (Saudi Arabia) and Plymouth University (United Kingdom). The title of this project is development of an educational programme for improvement of food intake in the home of Saudi adolescent girls (16-18 years). The collection of data will be sometime between 30/11/2013 and 28/2/2014. During this period I will identify factors which affect food intake in Saudi girls aged 16-18 years. Participation in this study will be voluntary and the students can withdraw at any time without giving reason.

The data collection will include the students' height, weight, and waist circumference. These measurements will need to be taken in the school and so I will require a private place and some extra time to take these measurements. It is anticipated that collecting this data will take 15 minutes per student. Due to the time constraint, I envisage that I would need to visit the school four times to take these measurements for 20-25 students (one class). The student will also be required to complete a questionnaire in the home on their meal patterns, shopping practice, home food availability and nutritional knowledge. In addition they will be asked to record their food intake in the home for three out of seven day period. In order to check the accuracy of the food records I will need to meet with each student individually for an additional 10 minutes per student. For further information about the study please see the attached sheet.

I will also be asking parents to participate in this study, so students who are willing to take part will be asked to take a consent form to home to their parents / Guardian with a detailed letter describing the study. No student will be excluded from this study with the exception of students who fail to return their completed consent forms or one of their parents /Guardian. The parent/Guardian will also, be required to give their permission for their daughter to participate in this study.

Please be reassured that all information collected will remain confidential. All participants' data will be coded and no name will occur with the data. The student names and codes will be kept confidential and available only to the researcher for the sole purpose of the study. I would be very grateful for your permission and support.

If you have any questions about the study, please feel free to contact me by email or one of my supervisors by email as listed below.

Yours faithfully

Eman Alamri

Contact details:

Eman Alamri (Doctoral Student); Mobile: 0505372007

Email: Eman.alamri@plymouth.ac.uk

Professor Linda la Velle. Executive Research
Professor

Professor A. de Looy
Professor of Dietetics

Dr Avril Collinson
Lecturer in Dietetics

Information sheet:

1) Screening questionnaire:

o This questionnaire should take about 15 minutes to be completed and it includes questions about some personal information such as: age, income and education ; meal pattern; home food availability and shopping practice.

2) Nutritional knowledge questionnaire:

O This questionnaire should take about 15 minutes to complete and it includes 16 questions in total.

3) Height and weight:

These measurements require removing shoes, heavy outer clothes (i.e. jacket, sweater) and emptying pockets of heavy items (i.e. phone, iPod, loose change.....)

O Student's height and weight will be measured in school in private place.

O students' mother's weight and height will be taken in Alhokair shopping centre in a private place (prayer area) on Saturday on (date) between 5pm and 8pm. If this time is not convenience an alternative time can be arranged.

O students' father's height and weight will be sent to me as self-reported.

4) Waist circumference:

Waist circumference is a simple measurement of the distance around the smallest part of your abdomen which is used to indicate abdominal obesity of the individual. You will be asked to remove any heavy outer clothes and the measurement of your waist circumference will be taken using a tape measure that is wrapped snugly around your waist.

O Student waist circumference will be measured in school in private place.

O students' mother's waist circumference will be taken in Alhokair shopping centre in a private place (prayer area) on Saturday on (date) between 5pm and 8pm. If this time is not convenience an alternative time can be arranged.

O students' father's waist circumference will be sent to me as self-reported.

5) Dietary record:

All participants (students, father and mother) will be asked to record all of their food or drink consumed over a three day period (two week days and one weekend). This will include all types, amount of food and drink consumed from the early morning until bed time

The following table summarizes the measurement that will be used:

Measurement	Father	Mother	Students
Body mass index	Self-report	By researcher	By researcher
Waist circumference	Self-report	By researcher	By researcher
Demographic questionnaire	By participant	By participant	By participant

Nutritional knowledge questionnaire	By participant	By participant	By participant
Dietary record	By participant	By participant	By participant

C2-adolescents' invitation letter

UNIVERSITY OF PLYMOUTH

FACULTY OF HEALTH AND HUMAN SCIENCE

Student invitation letter

Dear student:

Thank you for showing an interest in taking part in this research study. This research study is supported by University of Tabouk (Saudi Arabia) and University of Plymouth (United Kingdom). The title of this project is development of an educational programme for improvement of food intake in the home of Saudi adolescent girls (16-18 years). This study aims to identify factors which affect food intake in Saudi adolescent girls (16-18 years).

You will be eligible to join the study if you return the consent form to the school teacher. Participation is voluntary and it is not associated with your class grade. You are free to stop taking part at any time during the study without giving a reason. The head teacher of the school has agreed for this study to be based at this school. During the study we will assign you a specific code so your name will not appear with your data. This will allow your data to remain confidential.

The following is summary and further information is attached to this letter:

- *You will be asked to complete two questionnaires.
- *You will be asked to record your food intake and drink for 3days from morning to bed time.
- * You will have your height, weight and waist circumference measurement.

If you have any questions about the study now or during the study, please feel free to contact me by email or one of my supervisors by email as listed below. If you would like to see the results of the study please email me.

Yours faithfully

Eman Alamri

Contact details:

Eman Alamri (Doctoral Student); Mobile: 0505372007
Email: Eman.alamri@plymouth.ac.uk

Professor Linda la Velle. Executive
Research Professor
Plymouth Faculty of Arts & Humanities
lavelle@plymouth.ac.uk

Professor A. de Looy
Professor of Dietetics
Faculty of Health and Human Science
adelooy@plymouth.ac.uk

Dr Avril Collinson
Lecturer in Dietetics
Faculty of Health and Human
Science
Avril.collinson@plymouth.ac.uk

Information sheet:

1) Screening questionnaire:

o This questionnaire should take about 15 minutes to be completed and it includes questions about some personal information such as: age, income and education ; meal pattern; home food availability and shopping practice.

2) Nutritional knowledge questionnaire:

O This questionnaire should take about 15 minutes to complete and it includes 16 questions in total.

3) Height and weight:

These measurements require removing shoes, heavy outer clothes (i.e. jacket, sweater) and emptying pockets of heavy items (i.e. phone, iPod, loose change.....). Your height and weight will be measured in school in private place.

4) Waist circumference:

Waist circumference is a simple measurement of the distance around the smallest part of your abdomen which is used to indicate abdominal obesity of the individual. You will be asked to remove any heavy outer clothes and the measurement of your waist circumference will be taken using a tape measure that is wrapped snugly around your waist. Your waist circumference will be measured in school in private place.

5) Dietary record:

You will be asked to record all of your food or drink consumed over a three day period (two week days and one weekend). This will include all types, amount of food and drink consumed from the early morning until bed time

C3- mothers' invitation letter

UNIVERSITY OF PLYMOUTH

FACULTY OF HEALTH AND HUMAN SCIENCE

Invitation letter for parents/guardian

Dear Parent/Guardian:

I am doctoral student from Plymouth University in the United Kingdom. I would like to invite you and your daughter to participate voluntarily in a research study. This research study is supported by University of Tabouk (Saudi Arabia) and University of Plymouth (United Kingdom). The title of this project is development of an educational programme for improvement of food intake in the home of Saudi adolescent girls (16-18 years). The purpose of this research study is to identify factors which affect food intake in Saudi adolescent girls (16-18 years).

Your daughter will be eligible to join the study if she is between the ages of 16 and 18 years old. Participation in this study will be voluntary and is not associated with your daughter's class grade. You and your daughter will be free to stop taking part at any time during the study without giving a reason. The head teacher of the school has agreed for this study to be based at this school. Furthermore, during the study we will use specific code for all data to maintain confidentiality and these data will only be used for the purposes of this research and destroyed when the study is complete.

The following is summary and further information is attached to this letter:

- *You and your daughter will be asked to complete two questionnaires.
- *You and your daughter will be asked to record your food intake and drink for 3 days from morning to bed time.
- * You and your daughter will have your height, weight and waist circumference.

If you have any questions about the study now or during the study, please feel free to contact me by email or one of my supervisors by email as listed below. If you or your daughter would like to see the results of the study please email me.

Yours faithfully

Eman Alamri

Contact details:

Eman Alamri (Doctoral Student); Mobile: 0505372007
Email: Eman.alamri@plymouth.ac.uk

Professor Linda la Velle, Executive
Research Professor
Plymouth Faculty of Arts & Humanities
lavelle@plymouth.ac.uk

Professor A. de Looy
Professor of Dietetics
Faculty of Health and Human Science
adelooy@plymouth.ac.uk

Dr Avril Collinson
Lecturer in Dietetics
Faculty of Health and Human Science
Avril.collinson@plymouth.ac.uk

Information sheet:

1) Screening questionnaire:

o This questionnaire should take about 15 minutes to be completed and it includes questions about some personal information such as: age, income and education ; meal pattern; home food availability and shopping practice.

2) Nutritional knowledge questionnaire:

O This questionnaire should take about 15 minutes to complete and it includes 16 questions.

3) Height and weight:

These measurements require removing shoes, heavy outer clothes (i.e. jacket, sweater) and emptying pockets of heavy items (i.e. phone, iPod, loose change.....)

O your daughter's height and weight will be measured in school in private place.

O Your weight and height will be taken in Alhokair shopping centre in a private place (prayer area) on Saturday on (date) between 5pm and 8pm. If this time is not convenience an alternative time can be arranged.

4) Waist circumference:

Waist circumference is a simple measurement of the distance around the smallest part of your abdomen which is used to indicate abdominal obesity of the individual. You will be asked to remove any heavy outer clothes and the measurement of your waist circumference will be taken using a tape measure that is wrapped snugly around your waist.

O your daughters' waist circumference will be measured in school in private place.

O Your waist circumference will be taken in Alhokair shopping centre in a private place (prayer area) on Saturday on (date) between 5pm and 8pm. If this time is not convenience an alternative time can be arranged.

5) Dietary record:

You and your daughter will be asked to record all of your food or drink consumed over a three day period (two week days and one weekend). This will include all types, amount of food and drink consumed from the early morning until bed time

Appendix D- participants' consent form

UNIVERSITY OF PLYMOUTH

FACULTY OF Health & Human Sciences

CONSENT TO PARTICIPATE IN RESEARCH PROJECT

Name of Principal Investigator: Eman Alamri

*The objectives of this research have been explained to me.

* I understand that I am free to withdraw from the research at any stage, and ask for my data to be destroyed if I wish.

* I understand that my anonymity is guaranteed.

Under these circumstances, I agree to participate in the research

Name of mother/guardian: **Signature**..... **Date**.....

Name of Father/guardian:..... **Signature**..... **Date**.....

Name of student : Signature.....Date:.....

Allocated codes:

Daughter:.....

Father/guardian:.....

Mother/guardian:.....

Appendix E-Questionnaires (phase1)

E1-Screening questionnaire

Participant code:

Questionnaire for adolescent

Choose one of the following options:

A) Personal information:

What is your age?

- 1) 16
- 2) 17
- 3) 18

Do you have any special diet at the moment for losing Weight?

- 1) Yes
- 2) No

Who is usually responsible for preparing food at home?

- 1) Mother
- 2) Servant
- 3) You
- 4) Father
- 4) Others (indicate).....

B) Medical information:

DO you suffer from any medical conditions such as diabetes or hypertension, allergy.....?

- 1) Yes
- 2) No

If yes indicate this disease.....

C) Meal pattern:

Choose one of the following options:

How many times per week do you normally eat fast food at meal?

- 1) Once a week

- 2) *Twice a week*
- 3) *Three times a week*
- 4) *Four times or more a week (indicate how many times if more than four times a week).....*
- 5) *Never*

How many times per week do you normally eat fruit?

- 1) *Once a week*
- 2) *Twice a week*
- 3) *Three times a week*
- 4) *Four times or more a week (indicate how many times if more than four times a week).....*
- 5) *Never*

How many portions of fruit do you used to eat each time? (Look at food guide serving attached to this questionnaire for more details)

.....

How many times per week do you normally eat vegetables?

- 1) *Once a week*
- 2) *Twice a week*
- 3) *Three times a week*
- 4) *Four times or more a week (indicate how many times if more than four times a week).....*
- 5) *Never*

How many portions of vegetables do you used to eat each time? (Look at food guide serving attached to this questionnaire for more details)

.....

How many times per week do you normally eat sweet and chocolate?

- 1) *Once a week*
- 2) *Twice a week*
- 3) *Three times a week*
- 4) *Four times or more a week (indicate how many times if more than four times a week).....*
- 5) *Never*

How many times per week do you normally eat cake and biscuits?

- 1) *Once a week*
- 2) *Twice a week*

- 3) *Three times a week*
- 4) *Four times or more a week (indicate how many times if more than four times a week).....*
- 5) *Never*

How many times per week do you normally drink fizzy drinks?

- 1) *Once a week*
- 2) *Twice a week*
- 3) *Three times a week*
- 4) *Four times or more a week (indicate how many times if more than four times a week).....*
- 5) *Never*

Do you usually eat your meals with your family especially parents?

- 1) *Yes*
- 2) *No (go to section D)*

Do you eat meal with them daily?

- 1) *Yes*
- 2) *No*

Which meal do you usually eat with them?(you may tick more than one)

- 1) *Breakfast*
- 2) *Lunch*
- 3) *Dinner*
- 4) *All of them*

D) Home food availability:

How often are fruits available in your home?

- 1) *Always*
- 2) *Usually*
- 3) *some times*
- 4) *Never*

How often are fresh vegetable available in your home?

- 1) *Always*
- 2) *Usually*
- 3) *some times*
- 4) *Never*

How often are fizzy drinks available in your home?

- 1) *Always*
- 2) *Usually*
- 3) *some times*

4) Never

How often are chocolates and sweets available in your home?

- 1) Always
- 2) Usually
- 3) some times
- 4) Never

How often are cakes and biscuits available in your home?

- 1) Always
- 2) Usually
- 3) some times
- 4) Never

Thank you

Please return to Eman Alamri by (date) in the school. If you need to contact me please use 0505372007 or email me eman.alamri@plymouth.ac.uk

Participant code:

Questionnaire for Mather/Guardian

Choose one of the following options (you may tick more than one as appropriate):

A) Personal information:

What is your age?.....

What is the highest level of education your mother has completed?

- 1) *Elementary school*
- 2) *Intermediate school*
- 3) *Secondary school*
- 4) *Bachelor's degree*
- 4) *Professional degree*

What is your total household income per month?

- 1) *Under 5000 S.R*
- 2) *5000 S.R and 10000S.R*
- 3) *Over10000 S.R*

Do you have any special diet at the moment for losing Weight?

- 1) *Yes*
- 2) *No*

Who is usually responsible for preparing food at home?

- 1) *You*
- 2) *Servant*
- 3) *Your daughter*
- 4) *Father*
- 4) *Others (indicate).....*

B) Medical information:

DO you suffer from any medical problem such as diabetes or hypertension, allergy..... ?

- 1) *Yes*
- 2) *No*

If yes indicate this disease.....

C) Meal pattern:

Choose one of the following options (you may tick more than one as appropriate):

How many times per week do you normally eat fast food at meal?

- 1) Once a week
- 2) Twice a week
- 3) Three times a week
- 4) Four times or more a week (indicate how many times if more than four times a week).....
- 5) Never

How many times per week do you normally eat fruit?

- 1) Once a week
- 2) Twice a week
- 3) Three times a week
- 4) Four times or more a week (indicate how many times if more than four times a week).....
- 5) Never

How many portions of fruit do you used to eat each time? (Look at food guide serving attached to this questionnaire for more details)

.....

How many times per week do you normally eat vegetables?

- 1) Once a week
- 2) Twice a week
- 3) Three times a week
- 4) Four times or more a week (indicate how many times if more than four times a week).....
- 5) Never

How many portions of vegetables do you used to eat each time? (Look at food guide serving attached to this questionnaire for more details)

.....

How many times per week do you normally eat sweet and chocolate?

- 1) Once a week
- 2) Twice a week

3) *Three times a week*

4) *Four times or more a week (indicate how many times if more than four times a week).....*

5) *Never*

How many times per week do you normally eat cake and biscuits?

1) *Once a week*

2) *Twice a week*

3) *Three times a week*

4) *Four times or more a week (indicate how many times if more than four times a week).....*

5) *Never*

How many times per week do you normally drink fizzy drinks?

1) *Once a week*

2) *Twice a week*

3) *Three times a week*

4) *Four times or more a week (indicate how many times if more than four times a week).....*

5) *Never*

Do you usually eat your meals with your family especially daughter?

1) *Yes*

2) *No (go to section D)*

Do you eat meal with them daily?

1) *Yes*

2) *No*

Which meal do you usually eat with them?(you may tick more than one)

1) *Breakfast*

2) *Lunch*

3) *Dinner*

4) *All of them*

D) Home food availability:

How often are fruits available in your home?

1) *Always*

- 2) Usually
- 3) some times
- 4) Never

How often are vegetable available in your home?

- 1) Always
- 2) Usually
- 3) some times
- 4) Never

How often are fizzy drinks available in your home?

- 1) Always
- 2) Usually
- 3) some times
- 4) Never

How often are chocolates and sweets available in your home?

- 1) Always
- 2) Usually
- 3) some times
- 4) Never

How often are cakes and biscuits available in your home?

- 1) Always
- 2) Usually
- 3) some times
- 4) Never

E) Food purchases:

1) Who often does household food shopping?

- 1) Mother
- 2) Father
- 3) Other (indicate)

2) Who is responsible about writing food shopping list ?

- 1) Father
- 2) Mother
- 3) other

3) Which type of fruit do you regularly buy most often?

- 1) Fresh fruit
- 2) Frozen fruit
- 3) Dried fruit
- 4) Canned fruit

4) What is the main reason for choosing this type of fruit? (Tick one option please)

- 1) Price

2) Preference

3) health

4) Other (indicate).....

5) Which type of vegetable do you regularly buy most often?

1) Fresh vegetable

2) Frozen vegetable

3) Canned vegetable

6) What is the main reason for choosing this type of vegetable?(Tick one option please)

1) Price

2) Preference

3) Health

4) Other (indicate).....

What is the main reason for choosing the type of sweets and chocolate?

1) Price

2) Preference

3) Health

4) Other (indicate).....

Does your daughter go shopping with the household shopper?

1) Always

2) some times

3) Rarely

4) Never

Does your daughter ask you for any particular food?

1) Always

2) some times

3) Rarely

4) Never

12) What influences your food choice during writing food shopping list?

1) Cost

2) Habit

3) Health

4)other (specify please)

Please return to Eman Alamri by (date) in the school. If you need to contact me please use 0505372007 or email me eman.alamri@plymouth.ac.uk

E-2 Nutritional knowledge

Nutritional knowledge questionnaire

Please can you answer the following questionnaire about your nutritional knowledge. It is important that you complete it by yourself.

For each question please choose only one option and if you do not know the answer, mark 'not sure' rather than guess. Thank you.

Which of these breads contain the most vitamins and minerals? (Tick one)

- (a) White
- (b) Brown
- (c) Wholegrain
- (d) Not sure

Saturated fats are mainly found in :(tick one)

- (a) Vegetable oils
- (b) Dairy products
- (c) Both (a) and (b)
- (d) Not sure

There is more calcium in a glass of whole milk than a glass of skimmed milk.

- (a) Agree
- (b) Disagree
- (c) Not sure

Some foods contain a lot of fat but no cholesterol.

- (a) Agree
- (b) Disagree
- (c) Not sure

A glass of unsweetened fruit juice counts as a helping of fruit.

- (a) Agree
- (b) Disagree
- (c) Not sure

Which one of the following has the most calories for the same weight? (tick one)

- (a) Sugar
- (b) Starchy foods
- (c) fibre/roughage
- (d) Fat
- (e) Not sure

Which fat do experts say is most important for people to cut down on? (tick one)

- (a) Monounsaturated fat
- (b) Polyunsaturated fat
- (c) Saturated fat
- (d) Not sure

Which do you think is higher in calories: butter or regular margarine? (tick one)

- (a) Butter
- (b) Regular margarine

- (c) Both the same
- (d) Not sure

Why is drinking milk especially important?

- (a) For a proper bowel function
- (b) For healthy skin and good eyesight
- (c) For strong bones and strong teeth
- (d) Not sure

Do you think these are high or low in added sugar? (tick one box per food)

	High	Low	Not sure
Bananas			
Ice-cream			
Orange squash			
Tomato ketchup			
Tinned fruit in natural juice			

Do you think experts put these in the starchy foods group? (Tick one box per food)

	Yes	No	Not sure
Cheese			
Pasta			
Butter			
Nuts			
Rice			

Do you think these are high or low in fibre/roughage? (Tick one box per food)

	High	Low	Not sure
Bananas			
Eggs			
Red Meat			
Broccoli			
Rice			

Nuts

Fish

Are you aware of any major health problems or diseases that are related to a low intake of fruit and vegetables?

- (a) Yes
- (b) No
- (c) Not sure

If yes, what diseases or health problems do you think are related to a low intake of fruit and vegetables?

.....
.....
.....

Are you aware of any major health problems or diseases that are related to a low intake of fibre?

- (a) Yes
- (b) No
- (c) Not sure

If yes, what diseases or health problems do you think are related to sugar?

.....
.....
.....

Are you aware of any major health problems or diseases that are related to the amount of fat people eat?

- (a) Yes
- (b) No
- (c) Not sure

If yes, what diseases or health problems do you think are related to fat?

.....
.....
.....

Where do you get your advice regarding nutritional information?

- (a) School
- (b) Internet (official website)
- (c) Internet (non -official website)
- (d) Health centre staff
- (e) Television
- (f) Others (mention)

Thank you for answering this questionnaire. Please return to Eman Alamri by (Date) in the school. If you need to contact me please use 0505372007 or email me eman.alamri@plymouth.ac.uk



Appendix F- dietary data collection
F1- participants' instruction booklet

Food and Drink Diary Instructions

Please read through these pages before starting your diary:

We would like you to keep this diary of everything you eat and drink over 3 days. Please include all food consumed at home and outside the home e.g. work, school or restaurants. It is very important that you do not change what you normally eat or drink just because you are keeping this record. Please keep to your usual food habits.

-Day and date

Please write down the day and date at the top of the page each time you start a new day of recording.

-Time

Please note the time of each eating occasion should be recorded into the space provided.

-presence of family

Please record whether you eat this meal with family or not .

- Type of the meal

Please record the name of the meal (breakfast ,lunch, dinner)

What do you eat?

Please describe the food you eat in as much detail as possible such as quantity, the ingredients e.g. vegetable curry containing chickpeas, aubergine, onion and tomato.

For foods, quantity can be described using:

- **Household measures**, e.g. one teaspoon (tsp) of sugar, two thick slices of bread, 4 tablespoons (tbsp) of peas. Be careful when describing amounts in spoons that you are referring to the correct spoon size.

- Weights from labels**, e.g. 420g tin of baked beans, 125g pot of yoghurt.

- Number of items**, e.g. 4 fish fingers, 2 chicken nuggets

- Picture examples** for specific foods on pages 5-6-7.

For drinks, quantity can be described using:

- The **size of glass, cup etc** (e.g. large glass) or the **volume** (e.g. 300ml). Examples of typical drinks containers are on pages 8.

- Volumes from labels** (e.g. 330ml can of fizzy drink).

We would like to know the amount that was actually eaten which means taking into account leftovers and only record the amount actually eaten .

When to fill in the diary

Please record your eating as you go, not from memory at the end of the day. Use written notes on a pad if you forget to take your diary with you. Each diary day covers a 24 hr period, so please include any food or drinks that you may have had during the night. Remember to include foods and drinks between meals (snacks) .

➤ **In page 3 you can see example of one day dietary record that have been filled in by different people. These examples show you how we would like you to record your food and drink.**

➤ **If you have any queries about how to complete the diary please contact the researcher.**

All the information you give us is strictly confidential. It will only be used for research purposes.

Only your code appears on the record form. Nobody will be able to identify you from the record form.

- **Thank you for your co-operation and time - we really appreciate it!**

Example for dietary record:

Day: Thursday	Date: 18/9/13					
Time	Food /drink description	Portion size or	Location of	Presence of	Type of meal	

		quantity eaten	eating	family	
6:30 am	<i>Tea</i> <i>Sugar white</i> <i>Toast, white medium sliced</i> <i>Triangle cheese</i> <i>Fried egg</i> <i>Olive oil</i> <i>Salt</i> <i>Black pepper</i>	<i>Mug</i> <i>1 level tsp</i> <i>3 slice</i> <i>10 g</i> <i>1</i> <i>2 tablespoons</i> <i>A little</i> <i>A little</i>	<i>Home</i>	<i>Yes</i>	<i>breakfast</i>
11:00 am	<i>dates</i> <i>Arabic coffee</i> <i>Sinkers</i>	<i>10 pieces</i> <i>6 Arabic coffee cup</i> <i>1 small bar</i>	<i>Home</i>	<i>Yes</i>	<i>snack</i>
3:00 pm	Mixed salad (lettuce, tomato, onion, 2 tablespoons of olive oil, salt, , half of a squeezed lemon) Grilled fish White rice (boiled)	1 bowl 300 g 15 handful	Home	Yes	Lunch

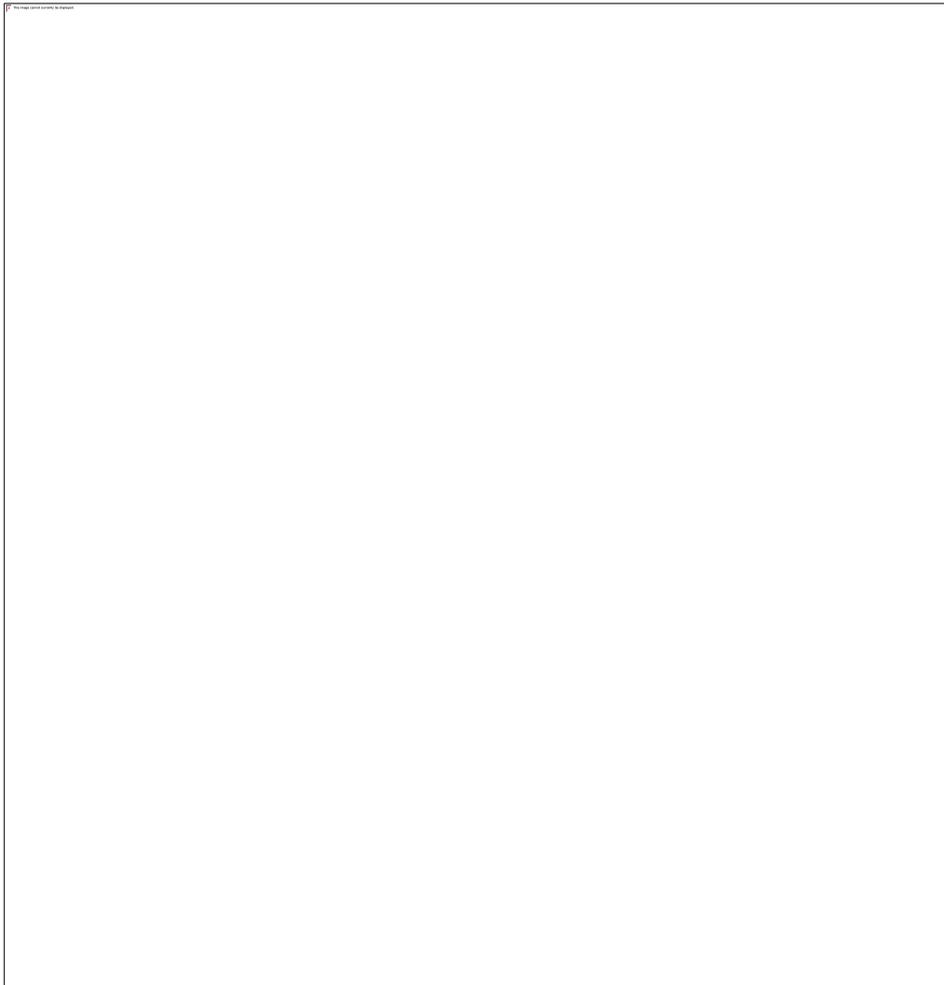
6:30 pm	(Ma`amoul) (see recipe) Arabic coffee	2 pieces(about 25g each one) 3 Arabic coffee cup	Home	Yes	snack
9:00 pm	Yogurt (low fat) Honey Banana Brown bread	200 g 4 tablespoons Medium size quarter	Home	Yes	dinner
11:30 pm	Milk (fresh, semi-skimmed)	1 small mug	Home	No	snack

F2- Examples of some pictures to estimate food portion size



Here is a life size glass showing what typical quantities look like.

You can use the picture as a guide for estimation how much volume or drink the glass holds you are drinking from.



Appendix G- invitation letters (phase2)

G2- Example of mothers' invitation letter (school A)

Invitation letter for mothers/guardian

Dear Parent/Guardian:

I am doctoral student from Plymouth University in the United Kingdom. I would like to invite you and your daughter to participate voluntarily in a research study .This research study is supported by University of Tabouk (Saudi Arabia) and University of Plymouth (United Kingdom). The title of this project is development of an educational programme for improvement of shopping habits and food intake in the home of Saudi adolescent girls (16-18 years). The purpose of this research study is to examine whether a nutritional intervention in the school leads to an improvement in shopping habits, knowledge about food and food intake in the homes of Saudi adolescent girls (16-18 years).

Your daughter will be eligible to join the study if she is between the ages of 16 and 18 years old. Participation in this study will be voluntary and is not associated with your daughter's class grade. You and your daughter will be free to stop taking part at any time during the study without giving a reason. The head teacher of the school has agreed for this study to be based at this school. Furthermore, during the study we will use specific code for all data to maintain confidentiality and these data will only be used for the purposes of this research and destroyed when the study is complete.

The following is summary and further information is attached to this letter:

- *You and your daughter will be asked to complete 4 questionnaires.
- * Your daughter will participate in nutritional education sessions in the school for 45 minutes once a week for 4 weeks.
- *Your daughter will be asked to bring shopping list and till receipts into the school where they will be collected by the teacher.

If you have any questions about the study now or during the study, please feel free to contact me by email or one of my supervisors by email as listed below. If you or your daughter would like to see the results of the study please email me.

Yours faithfully
Eman Alamri

Contact details:

Eman Alamri (Doctoral Student); Mobile: 0505372007
Email: Eman.alamri@plymouth.ac.uk

Professor Linda la Velle. Executive
Research Professor
Plymouth Faculty of Arts & Humanities
lavelle@plymouth.ac.uk

Professor A. de Looy
Professor of Dietetics
Faculty of Health and Human Science
adelooy@plymouth.ac.uk

Dr Avril Collinson
Lecturer in Dietetics
Faculty of Health and Human Science
Avril.collinson@plymouth.ac.uk

Information sheet:

What is the nature and purpose of the research?

The purpose of this research study is to examine whether a nutritional intervention in the school plus additional home interactive activities lead to an improvement in shopping habits, knowledge about food and food intake in the homes of Saudi adolescent girls (16-18 years)'.

What you will be asked to do?

You will be asked to do the following:

1. Demographic screening questionnaire.

A questionnaire will be completed by both you and your daughter at the beginning of the study to collect information on age, mothers level of education, income. It will require about 5 minutes to complete.

2. Nutritional knowledge questionnaire:

This questionnaire will assess the level of nutritional knowledge level for you and your daughter pre and post intervention. It consisted of 16 questions in total each in multiple choice formats and will require about 15 minutes to complete. This questionnaire will be completed in the school

3. Food shopping habits:

This will be measured by your food shopping list and till receipt pre and post intervention.

4. Food frequency questionnaire:

This questionnaire will be used to measure the frequency of food consumption for you and your daughter pre and post intervention. It consisted of 131 items in total and the estimated completion time varies from 20-25 minutes.

5. General questionnaire:

This questionnaire will be about how you did or might change your food habits for you and your daughter after the intervention.

6. Intervention:

A nutrition intervention package will be delivered for your daughter during the school classes focusing on health and food. The intervention will consist of a 45 minute session given once a week for 4 weeks. The sessions will be held in the computer lab in the school. The researcher will introduce the lesson topic to your daughter through the computer. Each session contains different learning objectives. Session 1 will concentrate on understanding what a healthy diet is. Session 2 will be about macronutrients and micronutrients, their functions and sources. Session 3 will be about portion size and session 4 will be about recognising the 6 tips for healthy eating and understanding the health benefits. Your daughter will be given a memory stick containing all lessons to enable her to access the lesson at home.

The following table summarizes the measurement that will be used:

	Mother	Adolescent
Measurements pre intervention	<ol style="list-style-type: none"> 1. Knowledge about food and health 2. Food intake 3. Food shopping habit. 4. Screening questionnaire 	<ol style="list-style-type: none"> 1. Knowledge about food and health 2. Food intake 3. Screening questionnaire 4. Food shopping habit.
Measurements post intervention	<ol style="list-style-type: none"> 1. Knowledge about food and health 2. Food intake 3. Food shopping habit 4. General questionnaire 	<ol style="list-style-type: none"> 1. Knowledge about food and health 2. Food intake 3. Food shopping habit. 4. General questionnaire

Do I and my daughter have to take part?

No, participation in this study will be voluntary and it is your choice. If you decide not to take part it will not affect your daughter normal school studies in any way.

Can I withdraw?

You and your daughter are free to stop taking part at any time during the study without giving a reason.

Is this a test of my daughter?

No and it is not associated with your daughter's class grade

Is the information confidential and can I be identified in any way?

All the data will be confidential because we will use a specific code and no names for any data collected. Therefore the data is anonymous. These data will only be used for the purposes of this research and destroyed when the study is complete.

Where can I get further information?

If you have any questions about the study now or during the study, please feel free to contact me by email or one of my supervisors by email as listed below.

Contact details:

Eman Alamri (Doctoral Student); Mobile: 0505372007

Email: Eman.alamri@plymouth.ac.uk

Professor Linda la Velle. Executive
Research Professor
Plymouth Faculty of Arts & Humanities
lavelle@plymouth.ac.uk

Professor A. de Looy
Professor of Dietetics
Faculty of Health and Human Science
adelooy@plymouth.ac.uk

Dr Avril Collinson
Associate Professor in Dietetics
Faculty of Health and Human
Science
Avril.collinson@plymouth.ac.uk

G 3- Example of adolescents' invitation letter

Student invitation letter

Dear student:

Thank you for showing an interest in taking part in this research study. This research study is supported by University of Tabouk (Saudi Arabia) and University of Plymouth (United Kingdom). The title of this project is development of an educational programme for improvement of food shopping habits and food intake in the home of Saudi adolescent girls (16-18 years). The purpose of this research study is to examine whether a nutritional intervention in the school leads to an improvement in shopping habits, knowledge about food and food intake in the homes of Saudi adolescent girls (16-18 years)'.

You will be eligible to join the study if you return the consent form to the school teacher. Participation is voluntary and it is not associated with your class grade. You are free to stop taking part at any time during the study without giving a reason. The head teacher of the school has agreed for this study to be based at this school. During the study we will assign you a specific code so your name will not appear with your data .This will allow your data to remain confidential.

The following is summary and further information is attached to this letter:

- *You will be asked to complete 4 questionnaires.
- * You will attend nutritional education sessions in the school for 45 minutes once a week for 4 weeks.
- * You will be asked about your snacking and food purchases and to bring shopping list and till receipts (from your mother) into the school where they will be collected by the teacher.

If you have any questions about the study now or during the study, please feel free to contact me by email or one of my supervisors by email as listed below. If you would like to see the results of the study please email me.

Yours faithfully
Eman Alamri

Contact details:

Eman Alamri (Doctoral Student); Mobile: 0505372007
Email: Eman.alamri@plymouth.ac.uk

Professor Linda la Velle. Executive
Research Professor
Plymouth Faculty of Arts & Humanities
lavelle@plymouth.ac.uk

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Professor of Dietetics
Faculty of Health and Human Science
adelooy@plymouth.ac.uk

Dr Avril Collinson
Lecturer in Dietetics
Faculty of Health and Human Science
Avril.collinson@plymouth.ac.uk

Information sheet:

What is the nature and purpose of the research?

The purpose of this research study is to examine whether a nutritional intervention in the school leads to an improvement in shopping habits, knowledge about food and food intake in the homes of Saudi adolescent girls (16-18 years)'.

What you will be asked to do?

You will be asked to do the following:

1. Demographic screening questionnaire.

A questionnaire will be completed by both you and your mother at the beginning of the study to collect information on age, your mothers level of education, income. It will require about 5 minutes to complete.

2. Nutritional knowledge questionnaire:

This questionnaire will assess the level of nutritional knowledge level for you and your mother pre and post intervention. It consisted of 16 questions in total each in multiple choice formats and will require about 15 minutes to complete. This questionnaire will be completed in the school

3. Food shopping habits:

You will be asked to bring in information about any snacks or other food that you have purchased pre and post intervention plus copies of your mother's food shopping lists and till receipts

4. Food frequency questionnaire:

This questionnaire will be used to measure the frequency of food consumption for you and your mother pre and post intervention. It consisted of 131 items in total and the estimated completion time varies from 20-25 minutes.

5. General questionnaire:

This questionnaire will be about how you might change your food habits for you and your mother after the intervention.

6. Intervention:

A nutrition intervention package will be delivered for you during the school classes focusing on health and food. The intervention will consist of a 45 minute session given once a week for 4 weeks. The sessions will be held in the computer lab in the school. The researcher will introduce the lesson topic to you through the computer. Each session contains different learning objectives. Session 1 will concentrate on understanding what a healthy diet is. Session 2 will be about macronutrients and micronutrients, their functions and sources. Session 3 will be about portion size and session 4 will be about recognising the 6 tips for healthy eating and understanding the health benefits. You will be given a memory stick containing all lessons to enable you to access the lesson at home.

The following table summarizes the measurement that will be used:

	Mother	Adolescent
Measurements pre intervention	7. Knowledge about food and health 8. Food intake 9. Food shopping habit. 10. Screening questionnaire	11. Knowledge about food and health 12. Food intake 13. Screening questionnaire 14. Food shopping habit
Measurements post intervention	15. Knowledge about food and health 16. Food intake 17. Food shopping habit 18. General questionnaire	19. Knowledge about food and health 20. Food intake 21. General questionnaire 22. Food shopping habit

Do I have to take part?

No participation in this study will be voluntary and it is your choice. If you decide not to take part it will not affect your normal school studies in any way.

Can I withdraw?

You are free to stop taking part at any time during the study without giving a reason.

Is this a test of me?

No and it is it is not associated with your class grade

Is the information confidential and can I be identified in any way?

All the data will be confidential because we will use a specific code and no names for any data collected. Therefore the data is anonymous. These data will only be used for the purposes of this research and destroyed when the study is complete.

Where can I get further information?

If you have any questions about the study now or during the study, please feel free to contact me by email or one of my supervisors by email as listed below.

Contact details:

Eman Alamri (Doctoral Student); Mobile: 0505372007

Email: Eman.alamri@plymouth.ac.uk

Professor Linda la Velle. Executive
Research Professor
Plymouth Faculty of Arts & Humanities
lavelle@plymouth.ac.uk

Professor A. de Looy
Professor of Dietetics
Faculty of Health and Human Science
adelooy@plymouth.ac.uk

Dr Avril Collinson
Associate Professor in Dietetics
Faculty of Health and Human
Science
Avril.collinson@plymouth.ac.uk

Appendix H- materials of phase 2

H1- Some slides of teaching materials



Eating different types of protein can ensure sufficient intake of essential amino acids which are needed by the body.

Can you think of dishes which combine protein from different sources?

For example:

- Baked beans on wholegrain toast
- Breakfast cereal with milk
- Cottage pie with vegetables
- Hummus and salad wrap
- Fish pie and peas
- Spinach and chickpea curry with rice



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Fat

Fat provides fat-soluble vitamins A, D, E and K, and is necessary for their absorption. It is also important for essential fatty acids the body cannot make.

Fat provides a concentrated source of energy:
1 gram of fat provides 9 kcal (37 kJ).

Foods that contain a lot of fat provide a lot of energy.



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Structure of fat

Depending on their chemical structure, fatty acids are usually classified as:

- saturated;
- monounsaturated;
- polyunsaturated.

High intakes of saturated fat may raise blood cholesterol and increase the risk of heart disease and stroke.

A diet high in unsaturates is associated with a lower level of blood cholesterol and reduces the risk of heart disease.



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All foods provide different types of fatty acids in varying proportions.

Butter is often described as a 'saturated fat' because it has more saturated fatty acids than unsaturated fatty acids.

Most vegetable oils are described as 'unsaturated fats' as they have more mono- and polyunsaturated fatty acids than saturated.

Most saturated fats are solid at room temperature and tend to come from animal sources.

Most unsaturated fats are liquid at room temperature and are usually from plant sources.



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Micronutrients

There are two types of micronutrients:

- vitamins;
- minerals.

Vitamins and minerals are needed in much smaller amounts than macronutrients. Their amounts are measured in milligrams (mg) and micrograms (μg).

(1mg = 0.001g)

(1 μg = 0.001mg).



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Vitamins

There are two groups of vitamins:

- fat-soluble vitamins, which can be stored in the body, e.g. vitamins A and D.
- water-soluble vitamins, which cannot be stored in the body and are therefore required daily, e.g. B vitamins and vitamin C.



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H2- Interactive activities sheets

Participant code:

Interactive activity first week

This activity should be completed by you and your mother together in the home please.

This picture is Musage dish with its common ingredients as presented in table 1

Please discuss this with your mother and then can you both suggest how you can improve the recipe of this dish to make it healthier and explain why you think your recipe is healthier?



Table 1: Common ingredients of Musage.

Common ingredients for Saudi kabsah	Participants suggestion for healthier recipe	Reason (why)
Fried eggplants		
Fried potatoes		
Fried carrots		

Fried onion		
Tomato Sauce		
Minced meat cooked in butter		

1. Did you cook the modified dish?

- 1. Yes
- 2. No

3. If you did, what did you think about the modifications you suggested?

.....

4. Do you have any other thoughts about this recipe or others that you make?

.....

5. Did you complete and discuss this activity together?

- 1. Yes
- 2. No

3. If no who completed this activity sheet and how did the daughter teach the mother?

.....

Thank you for completing this activity please can you return it to the school teacher by (date and day)

Participant code:

Interactive activity second week

This activity should be completed by you and your mother together in the home please.

This picture is Kabsah dish with its common ingredients as presented in table 1

Please discuss this with your mother and then can you both suggest how you can improve the recipe of this dish to make it healthier and explain why you think your recipe is healthier?



Table 1: common ingredients of kabsah.

Common ingredients for Saudi kabsah	Participants suggestion for healthier recipe	Reason (why)
5-10 full spoon butter White rice Fried chicken Fried vegetables (carrot ,peas...etc.)		

1. Did you cook the modified dish?

- 2. Yes
- 3. No

4. If you did, what did you think about the modifications you suggested?

.....

5. Do you have any other thoughts about this recipe or others that you make?

.....

6. Did you complete and discuss this activity together?

- 7. Yes
- 8. No

9. If no who completed this activity sheet and how did the daughter teach the mother?

.....

Thank you for completing this activity please can you return it to the school teacher by (date and day)

Participant code:

Interactive activity third and fourth week

This activity should be completed by you and your mother in the home please.

Can you cook or prepare a healthy snack or meal (together) and then describe the composition of this dish and why you think it is healthy and then answer some of the questions below?

.....
.....
.....
.....
.....
.....
.....
.....
.....

1. Can you both explain why you chose those foods for your meal/snack?

.....
.....
.....
.....
.....

2. Did you have to find a new recipe or did you make it up from your previous knowledge about food and cooking?

.....

3. Did you eat the snack or meal?

.....

4. If yes, what did you think about it? for example would you make it again or change it in anyway?

.....

.....

.....

Thank you for completing this activity please can you return it to the school teacher or e-mail to me by (date and day).

H3-screeing questionnaire

Screening questionnaire for Mather/Guardian

Choose one of the following options:

1. What is your age?

.....

2. Do you suffer from any medical problem such as diabetes or hypertension, allergy....?

1. Yes

2. No

If yes indicate this disease.....

3. What is your total household income per month?

1. Under 5000 S.R

2. 5000 S.R and 10000 S.R

3. Over 10000 S.R

4. What is the highest level of education you has completed?

5. Elementary school

6. Intermediate school

7. Secondary school

8. Bachelor's degree

9. Professional degree

10. Do you fellow special diet?

11. Yes

12. No

13. Have you involved in any another nutritional education programme?

1. Yes

2. No

3.

4. Do you live with your daughter?

1. Yes

2. No

3. How many members live in the household?

..... (please specify the age for each member)

4. Do you speak freely with your daughter daily?

- 5. Yes
- 6. No (specify pleas.....)

7. When do you speak to her usually?(you can tick more than one

- 8. During the meal
- 9. During Arabic coffee time
- 10. During cooking
- 11. Other (specify please.....)

12. Who responsible about cooking in the home?

- 1. Mother
- 2. Adolescents
- 3. Servant (why please.....)
- 4. Other(specify please.....)
- 5. **In case you cook for your family does your daughter help you during cooking?**
- 6. Yes (specify frequency please.....)
- 7. No

8. How many members in the household? (please specify their ages)

9. What is your height and weight please?

- 1. Height.....
- 2. Weight.....

3. Do you have a farm and get your food from it

Screening questionnaire for adolescent

Choose one of the following options:

1. What is your age?

.....

2. DO you suffer from any medical problem such as diabetes or hypertension, allergy..... ?

3. Yes

4. No

If yes indicate this disease.....

5. Do you live with your mother?

6. yes

7. no

8. Have you involved in any another nutritional education programme?

9. yes

10. no

11. Do you fellow special diet?

12. Yes

13. no

H4-Nutritional knowledge questionnaire

Nutritional knowledge questionnaire

Please can you answer the following questionnaire about your nutritional knowledge. It is important that you complete it by yourself.

For each question please choose only one option and if you do not know the answer, mark 'not sure' rather than guess. Thank you.

1. Fat soluble vitamins can be stored in the body?

True

False

Not sure

2. Water soluble vitamins can be stored in the body?

True

False

Not sure

3. All types of dietary fibre have the same functions

True

False

Not sure

4. Food high in saturates never provide never provide monounsaturates or polyunsaturates .

True

False

Not sure

5. Which two types of carbohydrate that provide dietary energy?

Starch and sugar

Dietary fibre and water

Starch and protein

Not sure

6. Which of the following is not type of fatty acid?

Saturated

Unsaturated

Amino acid

Not sure

7. Which vitamin can help the body absorb calcium?

Vitamin A

Vitamin B

Vitamin C

Vitamin D

Not sure

8. Which vitamin can help our bodies absorb iron?

Vitamin A

Vitamin B

Vitamin C

Vitamin D

Not sure

9. Iron is needed for the transport of oxygen in red blood cells?

True

False

Not sure

10. Which of these best represents a portion of fruit or vegetables?

1 cucumber

2 piums

3 oranges

4 raising

Not sure

11. How often should starchy foods be eaten day?

Just little bit

Just as snacks

With each meal

Never

Not sure

12. Which food group is practically important for calcium?

Fruit and vegetables

Bread, potatoes, rice and other starchy food

Milk and dairy products

Meat, fishes and other non-dairy sources of protein

Not sure

13. In which food group does butter belong?

Bread, potatoes, rice and other starchy food

Milk and dairy products

Meat, fishes and other non-dairy sources of protein

Food and drinks high in fat and /or sugar

Not sure

14. Which is the following is not the main function of calcium?

Help release energy from food

Contribute maintenance of normal bones and teeth

Contribute to normal blood clotting

Not sure

15. Which one of the following conditions is the most associated with iron deficiency?

Brittle bones

Impaired night vision

Anaemia

Not sure

16. Which of the following provides the largest amount of saturated fat?

Olive oil

Butter

Sunflower seeds

Not sure

Thank you

Please return to Eman Alamri by (date) in the school. If you need to contact me please use 0505372007 or email me eman.alamri@plymouth.ac.uk

H5-FFQ

Food frequency questionnaire (FFQ)

Participant code:.....

1. Please answer every question, if you uncertain about how to answer a question then do the best you can, but please do not leave any lines blank.
2. Please indicate the frequency of food consumed and estimate your average food use as best you can.

Over the last months.....
1. How frequency did you consume vegetables juice?

1. Never
2. 1-3 per month
3. Once a week
4. 2-4 per week
5. 5-6 per week
6. Once a day
7. 2-3 per day
8. 4-5 per day
9. 6+per day

Estimated portion size each time was

1. Less than $\frac{3}{4}$ glasses
2. Between $\frac{3}{4}$ and $1\frac{1}{4}$ glasses
3. More than $1\frac{1}{4}$ glasses

4. How frequency did you consume orange or grapefruit juice?

5. Never
6. 1-3 per month
7. Once a week
8. 2-4 per week
9. 5-6 per week
10. Once a day
11. 2-3 per day
12. 4-5 per day
13. 6+per day

Estimated portion size each time was

14. Less than $\frac{3}{4}$ glasses
15. Between $\frac{3}{4}$ and $1\frac{1}{4}$ glasses
16. More than $1\frac{1}{4}$ glasses

17. How frequency did you consume 100% fresh fruit juice (e.g. apple, grapes)?

18. Never
19. 1-3 per month
20. Once a week
21. 2-4 per week
22. 5-6 per week
23. Once a day
24. 2-3 per day

25. 4-5 per day

26. 6+per day
Estimated portion size each time was

27. Less than $\frac{3}{4}$ glasses
28. Between $\frac{3}{4}$ and $1\frac{1}{4}$
29. More than $1\frac{1}{4}$

30. How frequency did you consume milk?

31. Never
32. 1-3 per month
33. Once a week
34. 2-4 per week
35. 5-6 per week
36. Once a day
37. 2-3 per day
38. 4-5 per day
39. 6+per day

Estimated portion size each time was

40. Less than a glasses
41. Between 1 and $1\frac{1}{2}$ glasses
42. More than $1\frac{1}{2}$ glasses

Type of milk consumed?

43. Full fat milk
44. Low fat milk
45. No fat milk

46. How frequency did you consume fizzy drinks?

47. Never
48. 1-3 per month
49. Once a week
50. 2-4 per week
51. 5-6 per week
52. Once a day
53. 2-3 per day
54. 4-5 per day
55. 6+per day

Estimated portion size each time was

- 56. Less than a bottle (<12 ounce)
- 57. One bottle(12-16 ounce)
- 58. More than one bottle (<16 ounce)

59. How frequency did you consume freekah?

- 60. Never
- 61. 1-3 per month
- 62. Once a week
- 63. 2-4 per week
- 64. 5-6 per week
- 65. Once a day
- 66. 2-3 per day
- 67. 4-5 per day
- 68. 6+per day

Estimated portion size each time was

- 69. Less than $\frac{3}{4}$ glasses
- 70. Between $\frac{3}{4}$ and $1\frac{1}{4}$ glasses
- 71. More than $1\frac{1}{4}$ glasses

72. How frequency did you consume corn flex contained bran?

- 73. Never
- 74. 1-3 per month
- 75. Once a week
- 76. 2-4 per week
- 77. 5-6 per week
- 78. Once a day
- 79. 2-3 per day
- 80. 4-5 per day
- 81. 6+per day

Estimated portion size each time was

- 82. Less than a glasses
- 83. Between 1 and $1\frac{1}{2}$ glasses
- 84. More than $1\frac{1}{2}$ glasses

85. How frequency did you consume corn flex?

- 86. Never
- 87. 1-3 per month
- 88. Once a week
- 89. 2-4 per week
- 90. 5-6 per week
- 91. Once a day
- 92. 2-3 per day
- 93. 4-5 per day
- 94. 6+per day

Estimated portion size each time was

- 95. Less than a glasses
- 96. Between 1 and $1\frac{1}{2}$ glasses
- 97. More than $1\frac{1}{2}$ glasses

98. How frequency did you consume apple?

- 99. Never
- 100. 1-3 per month
- 101. Once a week
- 102. 2-4 per week
- 103. 5-6 per week
- 104. Once a day
- 105. 2-3 per day
- 106. 4-5 per day
- 107. 6+per day

Estimated portion size each time was

- 108. Less than one apple
- 109. One apple
- 110. More than one apple

111. How frequency did you consume ajas?

- 112. Never
- 113. 1-3 per month
- 114. Once a week
- 115. 2-4 per week
- 116. 5-6 per week
- 117. Once a day
- 118. 2-3 per day
- 119. 4-5 per day
- 120. 6+per day

Estimated portion size each time was

- 121. Less than one
- 122. One only
- 123. More than one

- 124. How frequency did you consume banana?

- 125. Never
- 126. 1-3 per month
- 127. Once a week
- 128. 2-4 per week
- 129. 5-6 per week
- 130. Once a day
- 131. 2-3 per day
- 132. 4-5 per day
- 133. 6+per day

Estimated portion size each time was

- 134. Less than one
- 135. One only
- 136. More than one

- 137. How frequency did you consume dried fruit?

- 138. Never
- 139. 1-3 per month
- 140. Once a week
- 141. 2-4 per week
- 142. 5-6 per week
- 143. Once a day
- 144. 2-3 per day
- 145. 4-5 per day
- 146. 6+per day

Estimated portion size each time was

- 147. Less than one
- 148. Between 2-5 spoons
- 149. More than 5 spoons

- 150. How frequency did you consume milk?

- 151. Never
- 152. 1-3 per month

- 153. Once a week
- 154. 2-4 per week
- 155. 5-6 per week
- 156. Once a day
- 157. 2-3 per day
- 158. 4-5 per day
- 159. 6+per day

Estimated portion size each time was

- 160. Less than ½ glasses
- 161. Between 1 and 1 ½ glasses
- 162. More than 1 glasses

- 163. How frequency did you consume shamam?

- 164. Never
- 165. 1-3 per month
- 166. Once a week
- 167. 2-4 per week
- 168. 5-6 per week
- 169. Once a day
- 170. 2-3 per day
- 171. 4-5 per day
- 172. 6+per day

Estimated portion size each time was

- 173. Less than ½ glass
- 174. One glass
- 175. More than 1 glass

- 176. How frequency did you consume watermelon ?

- 177. Never
- 178. 1-3 per month
- 179. Once a week
- 180. 2-4 per week
- 181. 5-6 per week
- 182. Once a day
- 183. 2-3 per day
- 184. 4-5 per day
- 185. 6+per day

Estimated portion size each time was

- 186. Less than ½ glass

- 187. One glass
- 188. More than 1 glass

- 189. How frequency did you consume strawberry?

- 190. Never
- 191. 1-3 per month
- 192. Once a week
- 193. 2-4 per week
- 194. 5-6 per week
- 195. Once a day
- 196. 2-3 per day
- 197. 4-5 per day
- 198. 6+per day

Estimated portion size each time was

- 199. Less than $\frac{1}{4}$ glass
- 200. Between $\frac{1}{4}$ - $\frac{3}{4}$
- 201. More than $\frac{3}{4}$ glass

- 202. How frequency did you consume orange?

- 203. Never
- 204. 1-3 per month
- 205. Once a week
- 206. 2-4 per week
- 207. 5-6 per week
- 208. Once a day
- 209. 2-3 per day
- 210. 4-5 per day
- 211. 6+per day

Estimated portion size each time was

- 212. Less than one
- 213. One only
- 214. More than one

- 215. How frequency did you consume grapefruit?

- 216. Never
- 217. 1-3 per month
- 218. Once a week

- 219. 2-4 per week
- 220. 5-6 per week
- 221. Once a day
- 222. 2-3 per day
- 223. 4-5 per day
- 224. 6+per day

Estimated portion size each time was

- 225. Less than one
- 226. One only
- 227. More than one
- 228. How frequency did you consume other types of food (specify)?

- 229. Never
- 230. 1-3 per month
- 231. Once a week
- 232. 2-4 per week
- 233. 5-6 per week
- 234. Once a day
- 235. 2-3 per day
- 236. 4-5 per day
- 237. 6+per day

Estimated portion size each time was

- 238. Less than $\frac{1}{4}$
- 239. Between $\frac{1}{4}$ - $\frac{3}{4}$
- 240. More than $\frac{3}{4}$
- 241. How frequency did you consume moleekia?

- 242. Never
- 243. 1-3 per month
- 244. Once a week
- 245. 2-4 per week
- 246. 5-6 per week
- 247. Once a day
- 248. 2-3 per day
- 249. 4-5 per day
- 250. 6+per day

Estimated portion size each time was

- 1. Less than $\frac{1}{2}$ cup
- 2. Between $\frac{1}{2}$ -1 cup
- 3. More than a cup

4. How frequency did you consume leaves?
5. Never
6. 1-3 per month
7. Once a week
8. 2-4 per week
9. 5-6 per week
10. Once a day
11. 2-3 per day
12. 4-5 per day
13. 6+per day

Estimated portion size each time was

14. Less than $\frac{1}{2}$ cup
15. Between $\frac{1}{2}$ -1 cup
16. More than a cup

17. How frequency did you consume culsola?

18. Never
19. 1-3 per month
20. Once a week
21. 2-4 per week
22. 5-6 per week
23. Once a day
24. 2-3 per day
25. 4-5 per day
26. 6+per day

Estimated portion size each time was

27. Less than $\frac{1}{4}$ cup
28. Between $\frac{1}{4}$ - $\frac{3}{4}$ cup
29. More than $\frac{3}{4}$

30. How frequency did you consume carrot?

31. Never
32. 1-3 per month
33. Once a week
34. 2-4 per week
35. 5-6 per week
36. Once a day
37. 2-3 per day

38. 4-5 per day
39. 6+per day

Estimated portion size each time was

40. Less than $\frac{1}{4}$ cup
41. Between $\frac{1}{4}$ - $\frac{3}{4}$ cup
42. More than $\frac{3}{4}$

43. How frequency did you consume culsola?

44. Never
45. 1-3 per month
46. Once a week
47. 2-4 per week
48. 5-6 per week
49. Once a day
50. 2-3 per day
51. 4-5 per day
52. 6+per day

Estimated portion size each time was

53. Less than $\frac{1}{4}$ cup
54. Between $\frac{1}{4}$ - $\frac{3}{4}$ cup
55. More than $\frac{3}{4}$

56. How frequency did you consume peas?

57. Never
58. 1-3 per month
59. Once a week
60. 2-4 per week
61. 5-6 per week
62. Once a day
63. 2-3 per day
64. 4-5 per day
65. 6+per day

Estimated portion size each time was

66. Less than $\frac{1}{2}$ cup
67. Between $\frac{1}{2}$ - 1 cup
68. More than a cup

69. How frequency did you consume fasolia?

- 70. Never
- 71. 1-3 per month
- 72. Once a week
- 73. 2-4 per week
- 74. 5-6 per week
- 75. Once a day
- 76. 2-3 per day
- 77. 4-5 per day
- 78. 6+per day

Estimated portion size each time was

- 79. Less than $\frac{1}{4}$ cup
- 80. Between $\frac{1}{4}$ - $\frac{3}{4}$ cup
- 81. More than $\frac{3}{4}$

82. How frequency did you consume corn?

- 83. Never
- 84. 1-3 per month
- 85. Once a week
- 86. 2-4 per week
- 87. 5-6 per week
- 88. Once a day
- 89. 2-3 per day
- 90. 4-5 per day
- 91. 6+per day

Estimated portion size each time was

- 92. Less than $\frac{1}{2}$ cup
- 93. Between $\frac{1}{2}$ - a cup
- 94. More than a cup

95. How frequency did you consume broccoli?

- 96. Never
- 97. 1-3 per month
- 98. Once a week
- 99. 2-4 per week
- 100. 5-6 per week
- 101. Once a day
- 102. 2-3 per day
- 103. 4-5 per day
- 104. 6+per day

Estimated portion size each time was

- 105. Less than $\frac{1}{4}$ cup
- 106. Between $\frac{1}{4}$ - $\frac{3}{4}$ cup
- 107. More than $\frac{3}{4}$

108. How frequency did you consume zahraa?

- 109. Never
- 110. 1-3 per month
- 111. Once a week
- 112. 2-4 per week
- 113. 5-6 per week
- 114. Once a day
- 115. 2-3 per day
- 116. 4-5 per day
- 117. 6+per day

Estimated portion size each time was

- 118. Less than $\frac{1}{4}$ cup
- 119. Between $\frac{1}{4}$ - $\frac{3}{4}$ cup
- 120. More than $\frac{3}{4}$

H6- Evaluation questionnaire post and two months follow up the intervention

Mothers in school A

Choose one of the following options please:

1. Are you in contact with any mother from any other schools?

1. Yes

2. No (go to question 4)

3. Which school are you in contact with? (mention the name of the school)

.....

.....

.....

4. Did you discuss the study with any mother from the school that you were in contact with?

1. Yes

2. No

3. How often did you do the interactive activities with your daughter?

1. Never

2. 1-3 times

3. 4 times

4. At least 4 times during the project

5. More than once a week

6. Other (specify).

7. Who did most of the cooking during the interactive activities?

1. Mother

2. Daughter

3. Both together

4. In what ways were the interactive activities most useful in your view?

.....

5. What do you think you learned most from doing the interactive activities?

Put a number 1 against the statement you learned most about and a number 2 against the one you learned next and so on for '3' '4' '5' '6'

1. I learned most about how much nutrition and health knowledge my daughter had.....

2. I learned most about how important milk is for health

3. I learned most about how to change recipes to make them more healthy

4. I learned most about how difficult it is to get my family to make changes to food they eat

5. I learned most about how to choose foods that are healthy

6. I learned most about the health risks of obesity .

7. What change did you notice in your food habits ? (please delete the answer that does not apply)

1. Increase/decreased/stayed the same consumption of fruit

2. Increase/decreased/stayed the same consumption of vegetables

3. Increase/decreased/stayed the same consumption of milk and dairy products

4. Increased/stayed the same consumption of sweet and chocolate

5. Any other change(mention please)

6. Nothing (go to question 10)

7. If you changed your food habits do you think that the change is as a result of the study intervention?

1. Yes

2. No

If no please specify what factors may have led to a change.....

3. Did you change your shopping habits as a result of this study?

1. Yes.....

Please specify.....

2. No.....

3. Not sure.....

4. What do you think you will remember most about food and health after this project?

Mothers in school B

Choose one of the following options please:

1. Are you in contact with any mother from any other schools?
1. Yes
2. No (go to question 4)
3. which school are you in contact with?(mention the name of the school)

.....

4. Did you discuss the study with any mother from the school that you in contact with?
1. Yes
2. No
3. In what way were the nutritional education sessions useful in your view?

.....

4. Did you do any interactive activities with your daughter with food, for example, cooking or recipe development over the past few weeks?
1. Yes
2. No

Please describe what have you done?

.....

.....

.....

3. What is the change that you notice in your food habits?
1. increase/decreased/stayed the same consumption of fruit
2. increase/decreased/stayed the same consumption of vegetables
3. increase/decreased/stayed the same consumption of milk and dairy products
4. increase/decreased/stayed the same consumption of sweet and chocolate
5. any other change(mention please)
6. nothing (go to question 8).

7. Do you think the change that you mentioned above is as a result of the study intervention?
1. Yes
2. No

If no please mention what other factors may have led to a change in your food habits.....

3. What do you think you will remember most about food and health after this project

Mothers and adolescents in school C

Choose one of the following options please:

1. Did you notice any change in your food habits over the past 3 months?
1. Yes
2. No

3. What is the change that you noticed in your food habits over the past 3 months?
4. increase/decreased/stayed the same consumption of fruit
5. increase/decreased/stayed the same consumption of vegetables
6. increase/decreased/stayed the same consumption of milk and dairy products
7. increase/decreased/stayed the same consumption of sweet and chocolate
8. any other change(mention please).....

9. Can you explain what r factors may have led to a change in your food habits.....

Adolescent in school A

Choose one of the following options please:

1. Are you in contact with any student from any other schools?
2. Yes
3. No (go to question 4)

4. Which school are you in contact with? (mention the name of the school)
.....
.....
.....
5. Did you discuss the study with any student from the school that you were in contact with?
6. Yes
7. No

8. How often did you do the interactive activities with your mother?
9. Never
10. 1-3 times
11. 4 times
12. At least 4 times during the project
13. More than once a week
14. Other (specify).

15. Who did most of the cooking during the interactive activities?
16. Mother
17. Daughter

18. Both together

19. In what ways were the interactive activities most useful in your view?

.....

20. What change did you notice in your food habits ? (please delete the answer that does not apply)

21. Increase/decreased/stayed the same consumption of fruit

22. Increase/decreased/stayed the same consumption of vegetables

23. Increase/decreased/stayed the same consumption of milk and dairy products

24. Increased/stayed the same consumption of sweet and chocolate

25. Any other change(mention please)

26. Nothing (go to question 9)

27. If you changed your food habits do you think that the change is as a result of the study intervention?

28. Yes

29. No

If no please specify what factors may have led to a change.....

30.

31. What do you think you will remember most about food and health after this project?

.....

Adolescent in school B

Choose one of the following options please:

- 1. Are you in contact with any student from any other schools?
- 2. Yes
- 3. No (go to question 4)

4. which school are you in contact with?(mention the name of the school)

.....

- 5. Did you discuss the study with any student from the school that you in contact with?
- 6. Yes
- 7. No
- 8. In what way were the nutritional education sessions useful in your view?

.....

- 9. Did you do any interactive activities with your mother with food, for example, cooking or recipe development over the past few weeks?
- 10. Yes
- 11. No

Please describe what have you done?

.....

.....

.....

- 12. What is the change that you notice in your food habits?
- 13. increase/decreased/stayed the same consumption of fruit
- 14. increase/decreased/stayed the same consumption of vegetables
- 15. increase/decreased/stayed the same consumption of milk and dairy products
- 16. increase/decreased/stayed the same consumption of sweet and chocolate

17. any other change(mention please)

18. nothing (go to question 8).

19. Do you think the change that you mentioned above is as a result of the study intervention?

20. Yes

21. No

If no please mention what other factors may have led to a change in your food habits.....

22. What do you think you will remember most about food and health after this project?

Appendix I- piloting study materials

The lessons and questionnaires of the intervention were piloted on a group of Saudi adolescent girls before the intervention was initiated. Researcher obtained the permission from 4 adolescents and their mother to participate in this pilot study. The researcher asked the participants to record their comments about the intervention in general (e.g. clarity of the content, readability, length of the session, if the researcher delivered the information clearly for each session, their comments about interactive activities ...etc). The adolescents met the researcher in a specific place to teach them and provide with a memory stick that contain the lessons. All steps were the same like the real intervention except for the frequency of the sessions. The sessions were twice a week instead of once a week due to the time constraint. At the end of the pilot study the researcher met all participants (mothers and daughter) to ask them about their feedback about the study.

Appendix J- data analysis

J1- Till receipts analysis

1. Some fruit and vegetables were bought by kilos and it was easy to calculate the total of fruit and vegetables purchased.
2. However some of them were bought by box and the size of the box was written in the receipt (small, medium and large) and it was not clear how many kilos in each box. In this case the researcher check the weight which written outside of each box from the supermarket.
3. Leaves were written in the till receipts as total number of packs for each kind of vegetables not by weight, in this case the researcher check the weight by calculating the average weight for 10 packs for each type of leaves (e.g. mints).
4. The weight of other food such as drinks, canned food , were recorded from manufacturer label which appear on the can or bottle for each one.
5. Some participants bought juices and drinks by box, so the researcher checked number of bottles in each box and the weight of each bottle.
6. The weight of bread, rolls and some products from bakery were found on the products. However, some kind of product from the bakery did have weight in the till receipts just how many of pieces of this product was bought, in this case the researcher check the average weight for each type.
7. Weight of Saudi traditional sweet such as backlawa ,kunaffa ...ect was already recorded in the till receipts as these types of sweet bought by kilos
8. Other types of chocolate and sweet which bought by bars was calculated by taking the weight which available on the product from manufacturer, because the total purchased of bars was available in till receipts. However, some participants bought boxes of sweet and chocolate but the size of the box and number of boxes were available in till receipts.in this case the researcher check how many bars in ach size of these boxes and then calculated the total weight.
9. Meat and chicken weight was recorded in the till receipts. however, some participants bought boxes of chicken ,in this case the researcher checked how many chicken in each box and calculate the total weight.
10. Rice in Saudi Arabia bought as bags not by kilos .for example small bag contain 5 kilos medium bag contain 10 kilos and big bag contain 20 kilos

11. Milk bottle has 3 sizes only: small (250 g),medium (500 g) and big (1 litre) and it is written outside the bottle

J2- further information about adjustment for children in the household

Total number of children in each age category * their requirements of food (e.g. fruit) = results 1

The total number of adults × their requirements of food (e.g. fruit) = result 2

Result 1 /result 2× 100= how many children equivalent to adult

The following is describing the formula in details (for fruit as an example).

The yellow means the number of household members
vegetables

blue means their requirements of

For each age category

Children ages 2-3 : 66×1 cup=66

Children 4-8 ages : 55×1.5 cup=82.5

Children 9-13 ages: 35 × 1.5 cup=52.5

Female 14-18 : 71×1.5 cup=106.5

Male 14-18 : 10×2 cups=20

Women 18⁺ : 90×2 cups=180

Men 18⁺ : 196×2 cups=392

66+82.5+52.5+106.5+20=327.5

180+392=572

327.5 / 572×100=57% (this mean that the children until 18 years requirements is about half of adults requirements)

J3- food shopping list analysis

The same procedure was used to analysis food shopping lists:

Example of food shopping list:

1. 2 bags of white bread
2. 1 medium box of banana
3. 3 kilos oranges
4. 6 packs of Arugula
5. 15 alwatanaih chickens (size 1000 g)
6. 10 kilos of beef meat
7. 2 kilos of balah sham
8. Small box of bawanti biscuit
9. 12 pieces of cheesecake
10. 1 kilos of halawani chees
11. 2 big bottle of al low fat almarae milk

