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Eating Patterns and Physical Activity Characteristics Among Urban and Rural Students in Saudi Arabia

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EATING PATTERNS AND PHYSICAL ACTIVITY CHARACTERISTICS AMONG URBAN AND RURAL STUDENTS IN SAUDI ARABIA

by

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Comparison of Eating Patterns and Physical Activity Characteristics Among Urban and Rural High School Seniors in the Central Region of Saudi Arabia

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Omar Ibn Ibrahim Abuzaid, Ph.D.
University of Nebraska, 2012

Adviser: Wanda M. Koszewski

Human obesity has become a global phenomenon. The main goal of this study was to investigate the differences in food consumption and physical activity among high school age youth in two diverse geographical locations (urban and rural areas) and the relationship of some of the factors that may lead to overweight and obesity in Saudi Arabia. There were 300 (150 males and 150 females) high school senior grade level students, recruited from the urban city of Riyadh and 300 high school students recruited from the rural areas of Dawadami (150 males and 150 females). Approval for this study was given by the Ministry of Education in Saudi Arabia as well as Human Subjects Approval was granted from University of Nebraska-Lincoln Institutional Review Board (IRB). Data were collected from January to March, 2012. Anthropometric measurements (BMI), demographic questions, activity questions, food intake/food preferences questions, eating attitudes and behavior questions, medical issues, food frequency questionnaire and a 24-hour food recall, were included in the survey of this study. Results showed that the BMI for rural students was significantly lower than urban. In general, daily activity questions show that the majority of urban teens watched more TV, had more computers and played more video games, came to school with a driver, spent more hours driving a car, were more physically active and had

less hours of sleep compared to rural students. Food intake and behavior survey indicate that skipping breakfast, eating at school, consuming soft drinks and eating snacks were prevalent for both groups. Eating out at fast food restaurants was higher among urban than rural. The food frequency questionnaire showed that fruits, vegetables, breads and cereals consumption for rural teens was lower than urban, whereas protein and milk or dairy intakes was higher among rural compare to urban. Twenty-four hour food recall analysis indicated that energy, carbohydrate, fat and vitamin C were significantly higher among urban compared to rural students. Results of this research indicate the need for prevention based healthy lifestyle programming in Saudi high schools.

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Abbreviations

AAP: American Academy of Pediatrics

AGC: Arabian Gulf Countries

BMI: Body Mass Index

CDC: Center for Disease Control and Prevention

CHO: Carbohydrate

cm: centimeter

DGR: Dietary Guidelines Recommendations

DMV: Department of Motor Vehicle

DRI: Based on Dietary Reference Intakes

EER: Estimated Energy Requirements

EMR: Eastern Mediterranean Region

g: gram

Kcal: Kilocalorie

Kg: Kilogram

KSA: Kingdom of Saudi Arabia

m: meter

mg: milligram

P: P-value

RE: Retinol Equivalents

SA: Saudi Arabia

SD: Standard Deviation

SES: socioeconomic status

SPSS: Statistical Package for the Social Sciences

TV: Television

USA: United States of America

US-NHANES: United States-National Health and Nutrition Examination Survey

vs: versus

WHO: World Health Organization

Chapter I

INTRODUCTION

Saudi Arabia:

The Kingdom of Saudi Arabia (KSA) lies at the furthermost part of southwestern Asia. It is at the crossroads of Europe, Asia and Africa. It is bordered in the north by Kuwait, Iraq and Jordan, in the east by the Arabian Gulf, United Arab Emirates, and Qatar, in the south by Yemen and Oman, and in the west by the Red Sea. It occupies around four-fifths of the Arab Peninsula, with a total area of about 2,250,000 square kilometers (870,000 square miles) (Appendix A). The total population of Saudi Arabia according to the 2010 Census is 27,136,977. Among them, the Saudi population is 18,707,576 (9,527,173 males and 9,180,403 females). The remainder of the population is composed of non-Saudi natives who reside either in country or urban settings. The country is mainly comprised of housemaids, whereas urban centers are populated due to employment opportunities or due to the oil industry. They are from many countries including Asia, the United States, Europe, Canada, and from other African and Arab countries.

The kingdom of Saudi Arabia is divided administratively into thirteen regions (emirates). In addition, each region is divided into a number of governorates.

The region of Ar-Riyadh is located in the middle of the Kingdom. It is bordered in the north by the region of Al-Qaseem, in the east by the Eastern region, in the south by Najran region and part of Aseer region, and in the west by the regions of Almadinah, Makkah and Aseer.

Riyadh (the urban area in this study) is the capital city of the Kingdom which is located in the central province of Saudi Arabia. Whereas, Ad-Dawadami, which is the rural area used in this study (small town 300 kilometer west of Riyadh city) is one of the governorates of Ar-Riyadh region in the middle of Saudi Arabia (1).

Rationales and costs of overweight and obesity

Obesity and overweight has become a global epidemic (2). In 1997, the World Health Organization (WHO) highlighted obesity as a major global health problem (3). According to the WHO in 2005, throughout the world there were about 1.6 billion overweight adults aged 15 years and older and approximately 400 million obese adults. WHO estimates that by 2015, 75% of adults will be overweight and 41% will be obese (4).

A higher body weight is associated with an increased incidence of a number of medical conditions, including type 2 diabetes mellitus, insulin resistance, cardiovascular disease, stroke, some types of cancer, and nonalcoholic fatty liver disease (5). Obesity in childhood and adolescence represents a serious health problem because it tends to continue into adulthood (6).

Overweight and obesity is not only a health issue, but also has economic consequences. Both direct costs related to medical expenditures from obesity related diseases, and indirect costs related to reduced productivity and disability (7).

Data from the United States-National Health and Nutrition Examination Survey (US-NHANES), estimated that the total cost of US healthcare related

to overweight and obesity will increase from 7%, to about 17% by the year 2030(8).

A study by Finkelstein, Fiebelkorn and Wang, projected the annual medical spending due to overweight and obesity approached $92.6 billion in the United States (US) in 2002 (9). On average, individual Americans who are considered obese pay yearly over $1,400 (42 percent increase) in health care costs compared to normal-weight individuals. In addition, it is estimated that the total spending of Medicare and Medicaid would be lower by 8.5% and 11.8%, respectively, in the absence of obesity (10).

Obesity costs are raising overall. For example, Cawley and Meyerhoefer, found that per capita medical spending for obese US individuals was $2,741 higher than for individuals who were not obese (150% increase). Based on data from the Medical Expenditure Panel Survey for 2000-2005, the estimated annual cost of obesity is $190 billion (in 2005 dollars) which represents 20.6% of annual health care spending in the US (11).

Globally direct costs of obesity were estimated to account for between 0.7% and 2.8% of the country's total healthcare expenditures. Moreover, obese people were found to have medical costs that were about 30% greater than their normal weight individuals (12).

The Arabian Gulf Countries (AGC) has higher rates of obesity and diabetes and spends more than 5.6 USD billions a year on diabetes related health care. For example, the Saudi Diabetes & Endocrine Association estimates the direct and indirect costs of overweight and obesity to be about five billion dollars per year in Saudi Arabia (13).

Table 1: Summary of Obesity Research in Saudi Arabia

Author	Year	Age	Subjects (n)		Overweight %		Obese %	
			M	**F**	**M**	**F**	**M**	**F**
Al-Nuaim et al	1996	<15	13177		29	27	16	24
Al-Shammari et al	1996	20-50	1580	-	34.8	-	27	-
Al-Nuaim et al	1996	6-18	9061	-	11.7	-	15.8	-
El-Hazmi & Warsy	1997	>14	6162	8498	27.2	25.2	13.	20.3
Al-Turki	2000	adults	1489	1697	43	28	27	63
Al-Almaie	2001	15-18	675	1091	17.2	10.2	19.3	11.8
Al-Saif et al	2002	30-70	1652	1619	42	31.5	30	49
El-Hazmi & Warsy	2002	1-18	6281	6420	10.7	12.7	6	6.7
Al-Nozha et al	2005	30-70	8215	9008	42.4	31.8	26.4	44
Al-Othaimeen et al	2007	1-75	6796	8165	30.7	28.4	14.2	23.6
Al-Hazzaa & Al-Rasheedi	2007	3-6	109	115	-	-	9.2	11.5
Amin et al	2008	10-14	1139	-	14.2	-	9.7	-
Inam	2008	21-23	241	-	30	-	16.6	-
El-Mouzan et al	2010	5-18	9808	9509	22.4	23.8	10.1	8.4
Mahfouz et al	2011	11-19	1249	620	11.5	15.5	12	14
Al-Nuaim, et al	2012	15-19	663	607	16.8	18.8	19.1	17.7

From researcher's observations in Saudi Arabia (Table 1), and some other studies, it has been found that obesity and overweight is prevalent among all age groups. In addition, it is more prevalent among the people residing in urban rather than in rural areas. Moreover, it considers increase in crisis among children and youth over the next few years.

Based on research observation lifestyle, food consumption and behavior, and socioeconomic and environmental factors are different between these areas. The purpose of this research project is to examine possible factors that influence the higher prevalence of overweight and obesity in urban Saudi Arabian high school students compared to their rural counterparts.

Chapter II

LITERATURE REVIEW

Identification of overweight and obesity

Excess of body adiposity is defined as obesity/overweight. In the 1980s, the approach of the ideal body weight was replaced by Body Mass Index (BMI), which is derived from the equation: body weight in kilograms (kgs.) divided by length or height in squared meters (m) [weight in kgs./(height in m)^2]. BMI commonly uses parameters for underweight (BMI < 20), ideal weight (BMI 20 – 25), overweight (BMI 25 – 30) and obesity (BMI > 30), for both men and women (14).

Causes of overweight and obesity

Obesity is considered a multifactorial disorder derived from genetic and metabolic factors as well as environmental, socioeconomic and behavioral factors (15). The mechanism of the development of obesity is not fully understood, but it is confirmed that obesity occurs when energy intake exceeds energy expenditure (16).

Genetics, sedentary lifestyle, inadequate physical activity (PA), and excessive calorie consumption are the main risk factors that contribute to the increased prevalence of overweight and obesity (17).

Factors that may contribute to overweight and obesity:

1. **Excessive calorie intake, eating habits, and dietary behaviors**

Changes in nutrition patterns such as higher energy dense, nutrient poor food consumption, lack of dairy products, inadequate fruit and vegetable intake, snacking, skipping breakfast, eating while watching television (TV)

increased portion size, and the spread of fast food chains and other restaurants (eating out) are just some of the factors related to excessive calorie consumption, eating habits, and dietary behaviors.

In general, there are many factors leading to diets that are higher in fats, cholesterol and refined carbohydrates (increase of energy and fat intake), and low in dietary fibers and polyunsaturated fatty acids per capita. The consumption of fruits, vegetables and complex carbohydrates has decreased due to the improvement of the economic conditions over the last few decades in both developed and developing countries.

In Arab gulf countries, food consumption and nutrient intake has changed as a result of increased income during the past four decades, especially in urban areas. In addition, the percentage of calories from animal based foods has markedly increased among those societies with increased income (18). For instance, the majority of children and youth from Arab Gulf Countries consume an insufficient amount of fruits and vegetables, which in turn can lead to inadequate dietary fiber and essential nutrient intake(19).

In 2011, Al-Hazzaa et al. documented that from about 67% to more than 80% of adolescents in Saudi Arabia didn’t consume the daily US- Dietary Guidelines Recommendations (DGR) for milk, fruit, and vegetables. Breakfast was not consumed on a regular basis and unhealthy food choices such as sugar sweetened beverages were most often consumed (67% for males and 57% for females). Similarly, candy and chocolate consumption was 37% for male and 52% for female Saudi adolescents (20).

A study done in 2008 by Mahfouz et al. shows that among 2696 adolescent school boys (aged 11–19 years) the proportion of daily intake of

soft drinks among Saudi youth differed from 33% in Abha city (southwestern region of Saudi Arabia) to more than 62% in Riyadh city (21).

There is conflicting research about the influence of frequently eating or snacking in regards to obesity. The WHO reported that the evidence about the role of snacking on obesity is insufficient. In fact, it may depend on the kind, amount, and time of snack consumption (22).

Skipping breakfast is a very common unhealthy dietary habit among youth around the world and many studies show a positive relationship between skipping breakfast and obesity. Meta-analysis done by Horikawa et al. (2011) suggests that a positive relationship between skipping breakfast and overweight and obesity is observed globally regardless of cultural diversity among countries. They recommended that encouraging the consumption of breakfast in all populations may be beneficial in decreasing the risk of being overweight or obesity (23). For example, Szajewaska et al. documented from systematic review in Europe that eating breakfast is associated with a reduction in BMI and decreased risk of becoming overweight or obese among children and youth (24). Furthermore, Rampersaud et al. in 2005 found, in reviewing 47 studies that the prevalence of skipping breakfast in the United States and Europe ranged from 10% to 30%. In addition, they stated that compared to their breakfast-skipping peers, children who reported eating breakfast on a consistent basis tended to have superior nutritional profiles (25).

In Saudi Arabia, Al-Hazzaa et al. documented that the amount of adolescents skipping breakfast ranged from 15% to 49% (20). Among Saudi

school girls 12-16 years old, Musaiger (2007) documented that the frequency of irregularly consuming or skipping breakfast was about 74% (26).

Eating out or consuming food that is ready to eat (heat n' eat) means eating food prepared outside the home. These foods are more likely to be low in dietary fibers and calcium; high in fat, cholesterol, total calories, and sodium; as well as contain an increased amount of artificial components. Eating out has been highly prevalent in the Co-operation Council of the Arab States of the Gulf (GCC) states (United Arab Emirates, Bahrain, Saudi Arabia, Oman, Qatar, and Kuwait) as well as in other predominantly middle-income countries particularly in urban areas. However, studies related to obesity with eating out in GCC are limited. For example, in SA the proportion of obesity is expected to reach more than 52% among children who eat outside the home for five times per week or more (27). US people spend about half of their food budget on foods prepared outside of the home and nearly one-third of their daily calories come from these sources. In addition, parents of families who ate at restaurants weekly or greater reported that their children consumed more sugar-sweetened beverages, more sweet/savory snacks, and less water compared with families who do not frequent restaurants (28).

The frequency of eating food prepared away from home and increased frequency of eating at restaurants may be linked to the rising obesity rates. Factors that have caused this shift are: an increased number of women who are involved in the workforce which leads to decreased time available for preparing food at home; the limited amount of places to spend leisure time for many families, especially in GCC states due to the extreme climate and lack of indoor recreation centers, has caused dinning out at restaurants to become

ideal places to pass time during weekends and holidays. In addition, the increase of income per capita among people from these countries makes it easier to eat out (26).

In Saudi Arabia, Amin et al. documented that the association between the prevalence of obesity and eating outside the home was highly significant ($p<0.001$) in primary school children (6-11 years old). They found that obesity rates increased to about 53% with the increased frequency of eating outside the home more than 5 times a week (29).

Eating at fast food restaurants is one of the eating habits that have increased more among children, adolescents, and adults during the past three decades. The number of fast food outlets has increased dramatically worldwide. For example, in the population of the US, about one-third of total energy is derived from fast food, thus, it has been linked with low overall diet quality and increased risk of overweight or obesity in children, youth and adults (30). Dr. George Ritzer, in 1993, released the term “McDonaldization” to explain the trend of how the fast food industry was spreading to more modernized areas as a global phenomenon (31). For instance, in 2008 McDonalds spread to over 2,000 locations in with plans to open 500 new locations in the next three years (2009-2011) in China. It has also been the number one place for Chinese children’s birthday parties (32). In Saudi Arabia, there are more than 120 McDonald’s restaurants.

Portion size has increased among fast food restaurant chains within the last thirty years. There are calls to action from the US Surgeon General to prevent and decrease overweight and obesity, however, no response has been taken to reduce the portion sizes of sodas, French fries, and

hamburgers (33). Since first introduced, the portion size of burgers, fried potatoes, pizzas and soft drinks at fast food restaurants have all increased 2-5 fold. For example, in the1950s a bottle of soft drink was available at 10, 12, and 16 ounce (oz.), (100-140 calories) now, sizes have increased to 20 or 32 oz. (190-300 calories) for an individual and it has reached up to 42 oz. (420 calories) in some fast food stores (sometime even with free refills) which has increased calorie intake up to 400% or more for those beverages (34).

There are some other elements that may encourage people to eat at fast food restaurants including ease of access, availability, quick service, no wait staff, heavily advertised, low prices, paying for meals before they are received, and the option to consume the meal at the restaurant, takeout, or drive through or even free delivery (35).

2. Physical activity, screen time, and sedentary lifestyle behavior

It is well known that physical activity plays a leading role in preventing overweight and obesity. However, physical activity measurement is difficult to interpret and evaluate (36).

The United States Department of Health and Human Services in 2008 released guidelines for physical activity for children and adolescents. They recommend at least one hour of moderate to vigorous physical activity on a daily basis (37).

A tremendous lifestyle change over the last decades has been seen in Saudi Arabia. Sedentary lifestyle was prevalent especially among Saudi children and youth. For example, among 2,908 Saudi school students from grades 10, 11, and 12, data were collected during October and November 2009, revealing that 60% of children and more than 70% of adolescents do

not engage in sufficient physical activity (20). Based on the results from the Youth Risk Behavior Surveillance Survey, compared to US youth who participate in physical activity, only 18.4% engaged in physical activity to meet the guidelines (38).

Internationally, the Global School Based Student Health Survey, conducted in 2010, showed that among 34 countries only 24% of male and 15% of female school children met the recommendations of 60 minutes of moderate to vigorous physical activity per day (39).

In a recent study done by Al-Hazzaa et al., in Saudi Arabia, among 2,906 adolescents (1,400 males and 1,506 females), about 50% of the males and more than 75% of the females did not meet the recommendation of 60 minutes of daily moderate-intensity physical activity. In addition, results showed that overweight/obesity were significantly and inversely associated with vigorous physical activity levels. Moreover, physical inactivity patterns were found to be significantly higher among females (40).

Screen time is one of the factors influencing physical inactivity. Three possible factors contributing to screen time's effect on overweight/obesity rates include: decreasing time available to engage in physical activity and therefore decreasing energy expenditure, increasing the consumption of food while watching TV (primarily unhealthy food), and increasing exposure to advertisement on purchasing and consumption of such foods. For example, in Western countries, much research has documented a positive relationship between time spent viewing TV and obesity rates among children and youth due to the decrease in time available for physical activity (41). Furthermore,

Ekelund et al. stated that watching TV and physical inactivity independently is positively associated with metabolic risk and obesity in children (42).

In addition, eating food with low nutritional value and snacks while watching TV may be linked to obesity. For instance, Musaiger documented that chocolates, potato chips, nuts and soft drinks are the most common foods consumed while viewing TV among schoolchildren. Moreover, TV is the most widely used media for advertising which has a big effect on eating habits especially for children in the Arab Gulf Countries (27). In a systematic review done by Pearson and Biddle in 2010, using fifty-three studies, totaling 111 independent samples, a higher intake of fast foods, soft drinks and energy dense snacks with lower fruit and vegetable consumption was associated with screen time viewing among children and adolescents (43).

3. Socioeconomic, cultural and environmental factors

One of the most important socioeconomic factors that may be associated with overweight and obesity is income. The increase of family income in developing countries leads to an increase in the adoption of the westernization lifestyle. This leads to increased exposure to Western media in urban settings leading to increased availability of food with lower nutrient density and a decrease in the levels of physical activity. Consequently, the final outcome of westernization and urbanization is overweight and obesity (27).

The rapid development in the Arab speaking countries over the last few decades has brought significant changes in most aspects of life. For instance, extensive road networks for transportation; increased availability of personal

vehicles; increased use of home and farm mechanized tools and appliances; and widespread use of TV, computers, and electronic game devices all lead to a more inactive and sedentary lifestyle leading to greater body fat accumulation (44).

The nature of occupations has also changed throughout the last century. It has shifted away from heavy manual work like farming , animal husbandry, plowing, planting and harvesting to more high technology work and service sector jobs which require less energy expenditure (45).

Maternal employment may also play an important role in the increase of being overweight or obese among children and youth. Studies have found a relationship between maternal employment and childhood obesity. For example, from the National Longitudinal Survey of Youth (NLSY), Anderson et al. studied 6,283 US women, between the ages of 14 and 22 annually between 1979 -1994 and biannually since then. The children of those women have been surveyed biannually as well since 1986. They found that the number of hours per week that the mother worked was positively correlated with the probability of the children being overweight or obese (46). Furthermore, Brown et al. stated that children's weight gain may be explained by specific lifestyle behaviors, and maternal employment status is indirectly linked with children's weight through its association with television viewing (47).

Breastfeeding is also stated as a possible predictive factor to childhood weight gain. Studies from meta-analysis done by Harder et al. (2005) reported that a longer overall duration of breastfeeding was highly linked with decreased overweight among children. They found, in general, that

overweight prevalence was significantly lower among breastfed than non-breastfed children (48).

Education level also contributes to the prevalence of overweight and obesity by either lowering family income or lowering the knowledge level about healthy foods and therefore decreasing the ability to pass that knowledge to their children. For instance, in 2006 Margot stated that young people in households whose parents only had a high school level education were more likely to be overweight or obese than those in households who had the highest levels of education (49). Some studies in the Arab speaking countries documented that illiteracy may increase the level of obesity among children, youth and adults. Moreover, educational background of the parents may be associated with childhood and youth overweight and obesity (44).

There is evidence supporting the idea that short sleep duration may play a role in weight gain and obesity. For instance, a meta-analysis done by Cappuccio et al. (2008) stated that consistently among many cross-sectional studies from around the world risk of obesity increased amongst short sleepers in children and adults (less than the recommendation; 10 h/day for children and 7-8 h/day for adults) (50).

In Saudi Arabia, Bawazeer et al. aimed to investigate the association between amount of sleep and obesity among schoolchildren (aged between 10 and 19 years) by a cross-sectional study established and analyzed in 2007. They randomly selected 5,877 Saudi students (55.2% boys and 44.8% girls) aged between 10 to 19 years in Riyadh. Results showed that sleeping for seven hours or less significantly increased the risk of obesity in

both genders. Furthermore, obesity was higher among those who slept intermittently (18.7%) rather than continuously (14.5%) (51).

The extremely dry climate and hot weather in Saudi Arabia, coupled with the desertification and lack of forestation and vegetation generally forces people to stay indoors which leads to reduced physical exercise time and encourages a sedentary lifestyle (44). Therefore, with some other cultural restrictions, Enas and Hana recently documented that the number of steps taken among the female population is substantially lower than the widely promoted target of 10,000 steps per day. The mean number of steps for Saudi females was between 5,000 and 7,500 steps a day, which places them in the category of low active (52). The widely promoted targeted number of steps per day is 10,000 (53).

Overweight and Obesity around the world

Globesity is a mix of the phrase "global obesity". The term was coined by the WHO to emphasize that obesity is considered a worldwide phenomenon occurring in both developed and developing countries.

Obesity and overweight appears to have no borders and cuts across all age groups, genders, ethnic groups, and all social-economic classes. Worldwide, in 2008, 1.5 billion adults, aged 20 and older, were overweight. Additionally, of this population over 200 million men and nearly 300 million women were classified as obese.

According to the WHO obesity was once considered a problem in high-income countries; however, now it is rising in both low- and middle-income countries, particularly in urban settings. What is causing this global epidemic? The WHO states that it is an imbalance of calories consumed to

calories expended. Changes in dietary and physical activity patterns seem to be a result of changes or lack thereof in policies associated with health, agriculture, transportation, urban planning, environment, food processing, distribution and marketing, and education (54).

In the United States, the prevalence of overweight and obesity has witnessed a dramatic increase over the past three decades. For example, obesity prevalence among adults increased from 13% to 32% between the 1960s and 2004 (55). Currently, 66% of adults in the US are classified as overweight or obese, and 16% of children and adolescents are obese and 34% are overweight (56).

In Europe, the prevalence of overweight and obesity has reached epidemic proportions. For instance, the prevalence of obesity among adult males ranged, by country, from 4% to 28.3% and from 6.2% to 36.5% in females (57). The prevalence among European children, ranges from 5% to more than 25% in some countries, however most countries show a greater proportion of male than female children being overweight (54).

In Australia, the prevalence of overweight and obesity is increasing. A recent national study showed that 52% of Australian females and 67% of males are overweight or obese. In addition, among Australian children, more than 13% of boys and about 17% of girls are obese (58).

Across Africa, the rates of overweight and obesity vary and reflect the stage of transition of each country (59). It is currently estimated that as much as 20-50% of Africans are classified as either overweight or obese (60). Among African children, the trends of overweight and obesity range from 14% to 18% (61).

In Asia, the rate of overweight and obesity has also increased significantly in various countries. Some Asian countries have levels of overweight and obesity similar to the USA (59). The highest rate of obesity in Asia is in Thailand, and the lowest is in India (62). China is currently transitioning from a traditional lifestyle to a Western lifestyle. About 20% of China's one billion people are overweight or obese (63). Among children, data from China's national surveys showed that the number of overweight and obese children and adolescents aged 7-18 years increased 28 times between 1985 and 2000 (64).

In the Arabic Peninsula, rates of obesity and overweight have increased dramatically since 1980, and more than one third of the Arabic Gulf population is obese (65). According to the WHO obesity is a precursor to type 2 diabetes, cardiovascular diseases, and some types of cancers. Five of the six Arabic Gulf Countries are on the top 10 list for diabetes prevalence in the world. These countries include: The United Arab Emirates, Bahrain, Kuwait, Oman, and Saudi Arabia (54). Musaiger et al. reported that among adolescents ages 11-18 obesity rates range from 20% to 45% in the Arabic Peninsula. Factors that may be leading to the obesity epidemic in the Arabic Peninsula include decrease in the consumption of fruits and vegetables; a sharp increase in foods rich in fat, sugar and salt; lack of physical activity; and increased sedentary lifestyle (66).

Overweight and Obesity in Saudi Arabia

During the last four decades, the prevalence of overweight and obesity has increased dramatically in Saudi Arabia and has now reached alarming levels. This seems to be especially true in the urban areas of the country. In

addition, within the next few years, obesity and overweight in SA will be at a crisis level among children, adolescents, and adults (Table 1).

General surveys in Saudi Arabia

Among 17,232 Saudi subjects age 30-70 years, over a five year period between 1995 and 2000, Al-Nozha et al. stated that the prevalence of overweight and obesity was 35.6% and 36.9%, respectively, which means 72.5% of Saudis are either overweight or obese (67).

In a cross sectional national epidemiological household survey from 1994 to 1998, in 12,071 children ages ranged from 1-18 years the prevalence of overweight was 10.7% in boys and 12.7% in girls, and the prevalence of obesity was 6% in boys and 6.7% in girls. In the eastern province, the prevalence of overweight ranged from 8.8% to 27.4% in boys and from 9.3% to 27.6% in girls, whereas the prevalence of obesity ranged from 4.7% to 10.4% in boys and from 4.3% to 13.8% in girls. The results of this study conclude that girls have a higher prevalence of both overweight and obesity than boys (68).

Research conducted in 1988 and 2005 , Al-Hazzaa's analysis showed rising trends in BMI, fat percentage, and obesity among Saudi schoolboys from Riyadh. However, the cause of this increasing trend has yet to be determined (69).

El-Hazmi and Warsy screened a total of 14,660 Saudi adult males and females (>14 years of age). They documented that the prevalence of obesity was 13% in males and 20% in females, and the prevalence of overweight was 27% in males and 25% in females. The prevalence of obesity was highest in the females in the central province and in the males in the western province,

while overweight was more prevalent in both male and female populations in the central province. Generally, obesity was more common in females and overweight was more common in males (70).

In a national survey done by Al-Saif et al. from 1990 to 1993, data collected from 3,271 adult subjects (1,652 men and 1,619 women) aged between 30-70 years showed the prevalence of obesity to be 30% in men and 49% in women, while the prevalence of overweight was 42% in men and 31.5% in women. Obese and overweight men and women were more likely to be between 40-49 years of age (71).

In 2008 a cross sectional study conducted by Inam, among 241 male students from the college of medicine at Al- Qassim University, 16.6% of students were obese, while 30% were overweight, 48% were normal and 6% were underweight. There was no statistically significant difference for student's academic status in the prevalence of obesity and overweight (72).

In 2001, Al-Almaie conducted a cross sectional study in Eastern Saudi Arabia, looking at 1,766 adolescent students (675 male and 1,091 female). Results indicated that 19.3% of males were obese and 11.8% of females were obese, and 17.2% females compared to 10.2% of males were overweight (73).

Using the 2005 Saudi reference data set, among 19,317 healthy children and adolescents from 5 to 18 years of age (9808 males and 9509 females), El-Mouzan et al. documented that overall prevalence of overweight was 23.1% and obesity was 9.3%. Significantly, boys had higher prevalence of obesity than girls (10.2% vs. 8.4%, respectively). On the other hand, girls had higher prevalence of overweight than boys (23.8% vs. 22.4%,

respectively). Moreover, there was a significantly higher prevalence of overweight (26.6% vs. 19.5%), and obesity (10.5% vs. 8.4%) in adolescents from 13 to 18 years, than in school-age children from 5 to12 years (74).

Another study conducted in 2007 by Al-Othaimeen et al. reported that among 19,598 individuals in 2,837 households, the prevalence of obesity was 23.6% in females compared to 14.2% in males, whereas the prevalence of overweight was 30.7% for males verses 28.4% for females. According to this study, obesity ranged from 33.9% in Ha'il (north region of Saudi Arabia) to 11.7% in Jizan (75).

In 2000, El-Hazmi and Warsy examined weight among 14,660 diabetic and non-diabetic Saudis. Data showed that obesity was 13% in males and 20% in females and overweight was 27% in males and 25% in females. Prevalence of both obesity and overweight were significantly higher among diabetics than non-diabetics (76).

In two surveys by Abalkhail, which included 2,708 Saudi students in 1994 and 2,542 students in 2000 (aged between 10-20 years old) results showed that BMI increased by 50% for both sexes between 1994 and 2000. The largest increase of BMI for boys was at ages 10-16 years; whereas girls showed the least increase between ages 14-16 years (77).

Al-Turki estimated the prevalence of overweight and obesity among hypertensive and diabetic adult patients in primary health care centers in Riyadh, Saudi Arabia from August to October 1999. In a total of 3,186 patients (1,489 men and 1,697 women), 43% of men and 28% of women were overweight, and 27% of men and 63% of women were obese (78).

A systematic review done by Alhyas et al. between 1980 and 2010 to estimate the prevalence of overweight and obesity in the GCC, reported that overweight rates were between 25 – 50% and obesity was between 13- 50% among adults and was higher in women than men (79).

Another systematic literature review of studies published in English between January 1st 1990 and June 30th 2009 focused on GCC populations. Among adults, overweight and obesity rates were especially high in Kuwait, Qatar and Saudi Arabia, particularly among 30–60 year olds (70–85% among men; 75–88% among women). The increasing rate of obesity was well-defined in Saudi Arabia and Kuwait. Prevalence of obesity is high among Kuwaiti and Saudi preschoolers (8–9%), while adolescent overweight and obesity are among the highest in the world, and are most highly estimated in Kuwait (40–46%) (18).

A systematic review of literature examining studies conducted between January 1990 and May 2011 explored the prevalence of overweight and obesity among various age groups in the Eastern Mediterranean Region (EMR). Among preschool children (<5 years), the prevalence of overweight ranged from about 2% to 22%, while the prevalence of overweight and obesity among school children ranged from 7% to 45%. In addition, among adults the prevalence of overweight and obesity ranged from 25% to 82% (80).

Rural vs. Urban surveys in Saudi Arabia

Al-Nuaim, et al. in 1996, studied the pattern of body weight distribution and the prevalence of overweight and obesity among 13,177 Saudi subjects aged 15 years or older. They reported that the prevalence of obesity was significantly higher among female subjects than male subjects (24% vs. 16%),

while the prevalence of overweight was significantly higher among male subjects than female subjects (29% vs. 27%). Obesity and overweight were more prevalent among high-income, illiterate subjects residing in urban areas than those living in rural areas (81).

To determine the prevalence of overweight and obesity among male school children in Saudi Arabia, in 1996 Al-Nuaim, et al. (82) studied 9,061 male school children aged 6-18 years. Approximately 12% of subjects were overweight and 15.8% were obese. Regional differences were also noted, 18% were obese in Riyadh, an urban area in the central province compared to 11% in Sabea, a rural region in the southwestern.

Between May and June 1994, Al-Shammari et al. designed a systematic selection for obesity screening yielding 1,580 Saudi males from 15 health centers in urban and rural areas in the Riyadh region. The results showed 34.8% were overweight, while 27% were obese. Subjects living in a rural area had greater BMIs compared to those living in urban areas (83).

Data collected by Al- Nozha et al. from 1995-2000 documented that among 17,232 Saudi subjects aged 30-70 years the prevalence of obesity and overweight for rural and urban participants was 27% and about 40%, respectively (67).

In 2008 Amin et al. stated that among 1,139 male Saudi children enrolled in the 5^{th} and 6^{th} grades in public primary school in Al-Hassa (east region of Saudi Arabia) the prevalence of obesity was 9.7%, while 14.2% were overweight. In the urban area, the prevalence of obesity was also higher among older age students (19% rural vs. 27% urban) (84).

Data was collected in 2008 by Mahfouz et al. from 1,869 students (1,249 boys and 620 girls) in southwestern Saudi Arabia enrolled in intermediate and secondary government or private schools. Students were recruited from both urban and rural locations. Among the boys 11.8% were obese and 11.5% were overweight, while among the girls 13.9% were obese and 15.5% were overweight. In general, 38% of males and about 58% of females spent more than 3 hours watching TV daily. Similarly, about 28% of males and 43% of females participated in less than 30 minutes of physical activity during the previous week. There was no significant value between urban and rural differences (85).

To investigate physical activity, sedentary behaviors, and eating habits relative to obesity in adolescents living in Al-Ahsa city (east region of Saudi Arabia) governorate rural versus urban variations, Al-Nuaim, et al. 2012, recruited 1,270 student volunteers (15-19 years). Results showed that adolescents living in urban areas or on rural farms were more likely to be physically active than other youth who live in rural deserts. In addition, obese youth were less active than youth of normal weight, and females were less active than males. Moreover, the prevalence of obesity was lower among rural compared to urban students (12.7% vs. 21.2%, respectively) (86).

Overweight and obesity among Saudi children and youth

The prevalence of overweight and obesity among children and adolescents in Saudi society is increasing rapidly paralleled with the increase in adults and has reached an epidemic proportion during the past three decades.

For example, El-Hazmi and Warsy conducted a cross-sectional national epidemiological household survey between 1994 and 1998, which included 12,701 children (6,281 boys and 6,420 girls), with ages ranging from 1-18 years. The overall prevalence of overweight was 10.7% and 12.7% in the boys and girls, respectively, and the prevalence of obesity was 6% and about 7%, respectively. Additionally, the lowest frequency of overweight and obesity was in the Southern province, while the highest was in the Eastern province (87).

Al-Hazzaa and Al-Rasheedi (88) conducted research on 224 Saudi preschool children (109 boys and 115 girls) in the city of Jeddah (West region of SA) during April and May of 2006; the prevalence of obesity among the whole sample was 10.8% (9.2% in boys and 11.5% in girls).

Furthermore, Al-Hazzaa documented that among school boys aged 6-14 years, the prevalence of obesity increased seven times from 1988 to 2005 (from 3.4% to 24.5%). During that period, anthropometric measurements also all increased (69).

In Jeddah (the second largest city in Saudi Arabia) Abalkhail conducted a study, which included 2,708 Saudi students in 1994 and 2,542 in 2000 (aged 10-20 years old). The results showed that the BMI increased for both sexes between 1994 and 2000 for 50% of those students. The largest increase of BMI for boys was at ages 10-16 years; whereas girls showed the lowest increase at 14-16 years (77).

In 2001, Al-Almaie (73) conducted a cross-sectional study on a random sample of both male and female third grade intermediate and all 3 grades of high school students in Al-Khobar city, in the Eastern area of Saudi Arabia.

Among 1,766 Saudi students, (675 males and 1,091 females), the mean age was 16.4 ± 1.7 years. A higher proportion of female students than male students were overweight (17.2% versus 10.2%), while, the prevalence of obesity was higher in male than female students (19.3% versus 11.8%).

In addition, Al-Hazzaa reported that from three major national cross-sectional studies, evidence shows progressive increases in BMI of Saudi adolescents from 1988 to 1996. The increase in BMI during this eight year period was between 9.6% to about 11% at the 50th percentiles and was from 11% to 14% at the 90th percentile at ages 15-18 years old (89).

Al-Rukban, mentioned that from a cross-sectional study conducted in intermediate and secondary schools (age 12-20 years) in Riyadh between September 2001 to January 2002, the prevalence of overweight was about 14% whereas the prevalence of obesity was over 20% (90).

From a cross sectional survey conducted in a male student's university primary health care clinic at King Saud University in Riyadh, Al-Turki, found that among university students (mean age 21.7 years) during the period between April to June 2006, the prevalence of overweight was 31% and above 23% of those students were obese (91).

Similarly, Al-Saeed et al. conducted a cross sectional study from January to March 2003 in Al-Khobar city in the eastern region of Saudi Arabia, which showed that 20% of those female school age children between age 6-17 were overweight whereas 11% were obese (92).

A systematic review conducted between 1980 and 2010 by Alhyas et al. found that there are significant indications that the prevalence of

overweight and obesity has increased among younger Saudi populations particularly in urban compared to rural areas (79).

Another systematic literature review of studies published between January 1st 1990 and June 30th 2009 was done for GCC populations. Among children and youth, overweight and obesity prevalence rates were found to be high especially in girls compared to boys in Saudi Arabia (18).

Recently, a systematic literature review of studies published between January 1990 and May 2011 explored the prevalence of overweight and obesity among various age groups in the EMR. Among preschool children (<5 years), the prevalence of overweight ranged from about 2% to 22%, while the prevalence of overweight and obesity among school children ranged from 7% to 45% (27).

In 2012, El Mouzan et al. conducted a study on children aged 2-17 including 3,525 from the Central region, 3,413 from the Southwestern region, and 4,174 from the Northern region of Saudi Arabia. The overall prevalence of overweight was 21%, 13.4% and 20.1%, whereas obesity was distributed as 9.3%, 6% and 9.1% in the Central, Southwestern, and Northern regions, respectively (93).

Review of Literature Conclusion

From the previous studies, it is clear that the prevalence of overweight and obesity are increasing dramatically in Saudi Arabia and have reached critical limits. Overweight and obesity are present in all age and sex groups and spread more in urban compared to rural areas. Policy makers also need to be aware of the importance of the problem of obesity and its cost to the

budget of the health care system. The government and other decision makers need to act immediately and effectually for all levels of society.

Control and prevention of overweight and obesity is essential in order to prevent or reduce the frequency of more serious illness in the Kingdom of Saudi Arabia. Overweight and obesity prevention starts at an early age . Further studies are required to assess whether overweight and obesity prevalence is rising or falling especially among children. Watching TV and spending more time working on computer may be considered a predisposing factor for overweight and obesity among students especially those in high school (94).

This research project is to focus on identifying some factors which may lead to the growing prevalence of overweight and obesity in Saudi Arabia. Some factors to be researched are: type and amount of food intake, time spent in front of TV or/and computer (screen time), hours sleeping, physical activity levels, the effect of lifestyle transition to the western and urban way, and food habits and behaviors among urban youth compare to rural youth of the same age.

Goal and Objectives

Goal:

The main goal of this study is to investigate the differences in food consumption and physical activity levels among high school age youth in two diverse geographical locations (urban and rural areas) while also examining the relationship of some factors that may lead to overweight and obesity in Saudi Arabia.

Objectives:

1) To study the food consumption, physical activity levels, and sedentary time among high school youth in central Saudi Arabia.
2) To compare the situation between urban and rural youth regarding the prevalence of overweight and obesity in central Saudi Arabia.
3) To identify some of the factors that may lead to the development of overweight and obesity in this population.

Dependent variable:

- Body Mass Index (BMI)

Independent variables:

- Genetics factors, demographic information, food consumption (Food frequency questionnaire (ffq), 24-hour food recall), eating habits and dietary behaviors (consumption of soft drinks and energy drinks, snacking, eating breakfast, eating at school, eating at fast food restaurants), physical activity, time spent watching TV/working on computer or using electronic games and smart phones (screen time),

and medical issues (food allergies/intolerance, diabetics, gland disorders …etc.).

Chapter III

MATERIAL AND METHODS

This project was supported by the Ministry of Higher Education in Saudi Arabia. Approval for this study was given by the Ministry of Education (Appendix B) in order to conduct a school based survey in the central region of KSA. Riyadh, located in the central region of the country, is the capitol city and the largest city in Saudi Arabia (Appendix A). Once the Ministry granted approval for this research project, the researcher contacted ten urban schools (five for males and five for females), one from each region in the city of Riyadh, for each gender and ten rural schools (five for males and five for females) in the Dawadami area approximately 300 kilometers west outside the city of Riyadh. The rural schools were chosen from locations north, south, east, and west of the city as well as a village school located in the middle of the rural area for each gender. Principals received a letter of permission from the Ministry of Education, and were asked to provide the researcher access to students during the school day. Schools were randomly chosen from each location to participate in this study. The names of all schools in each region (north, south, east, west, and central) were placed in a bowl and schools were randomly selected to participate in the study. If a school could not participate another was selected. This random selection occurred for each rural or urban school district. The research project received the approval from University of Nebraska-Lincoln Institutional Review Board (IRB) (Appendix C). Each participant was asked to read and sign a consent form (Appendix D). Data collected by survey included: demographic information, anthropometric

measurements, dietary habits, daily activity, eating attitudes and behaviors, and food consumption (Appendix E). The survey was reviewed by experts in the area of nutrition and health behaviors and by native Arab health professionals for content validity.

Selection of subjects

Senior level Saudi students (aged 17 -19) in each of the rural and urban schools were asked to complete the survey (Appendix E), which was developed and administered by the researchers and the University of Nebraska-Lincoln Institutional Review Board (IRB). All senior level students were invited to participate in the study, however participation was entirely voluntary. Each participant was asked to read and sign a consent form (Appendix D). Parents/guardian consent forms were not required. The researcher aimed for 30-40 students from each school for a total of 600 subjects. This study was voluntary and nonprofit.

Out of the 1000 surveys distributed for the study (500 surveys in each area), only 300 were complete and could be used for study analysis. 300 (150 males and 150 females) high school students were recruited from Riyadh, which comprised the urban population used in this study and 300 high school students from the rural areas of Dawadami (150 males and 150 females). The research project received Human Subject approval from the University of Nebraska-Lincoln Institutional Review Board (IRB) (Appendix C) and approval from the Ministry of Education in Saudi Arabia (Appendix B).

Data Collection

Data collected for this study by the survey included: demographic information, anthropometric measurements, dietary habits, daily activity levels, eating attitudes and behaviors, and food consumption (Appendix E).

Data was collected from January to March 2012. Data was collected at each of the randomly selected schools during normal school hours. Approximately 30 to 45 minutes was needed for the students to complete the paper pencil survey in class. The 24-hour food recall was included in the survey. At each school the researcher collected the height and weight measurements for each student by using the same scale and height board which was funded and provided by the Ministry of Education. The researcher purchased a standardized scale and height board in Saudi Arabia.

Data collected included:

Anthropometric measurements

Height: Was measured without shoes to the nearest 0.5 centimeter (cm).

Weight: Was measured by kilogram (kg) in light clothes and without shoes to the nearest 100 gram (g).

Body Mass Index (BMI): Derived from the equation: body weight in kilograms divided by length or height in squared meters [kg/(m^2)] was calculated for all the study participants.

Dietary Intake and Physical Activity Questionnaire:

This survey had four sections: Demographic questions, activity questions, food preference, food frequency, eating attitudes and behavior questions, and food consumption (Appendix E).

Demographics

Demographic questions focused on age, school, level of parental education, living arrangements, and whether parents are relatives of each other. The relative question was asked because in Saudi Arabia close family members can marry.

Activity Questions

Questions in this section focused on how the student spends their day in regards to sedentary time and general activity. Questions being asked included: time spent watching TV and playing games, physical activity, time spent driving a car, and time spent sleeping.

Food Preferences/Food Frequency/Eating Attitudes and Behaviors

Eating breakfast, eating at school, eating at fast food restaurants, consumption of soft drinks and energy drinks, and eating snacks were included in this section of the questionnaire. The final set of questions in this section asked about some medical issues related to obesity such as food allergies or intolerances, diabetes mellitus, genetic disorders like thyroid glands hyper/hypo activity which effect weight status, and/or medical problems or surgeries associated with obesity.

Food consumption:

A. **Food frequency questionnaire (ffq)**

Food frequency questions used the US MyPlate for the main five food groups (fruits, vegetables, milk and dairy products, protein, and bread and cereals) in the questionnaire.

B. 24-Hour Food Recall

A 24-hour food recall was completed for all subjects with instructions on estimating serving size by using some plastic food models. Students were asked to complete the recall based on a typical day for them in regards to their food intake from the time they get up to the time they go to bed. A subset of student's 24-hour food recall was randomly selected to analyze consumption over the past twenty-four hours on the day before anthropometric measurements were gathered.

The survey was translated into Arabic by Zainab Rida, MS, RD. Rida is a native of Iraq and attended college in Saudi Arabia. Her sister, who was also educated in Saudi Arabia, did the translation back to English from the Arabic translation. In addition, three Arabic speaking adolescents reviewed the survey in order to make sure that the questions were clear and understandable. Based on their feedback, small changes were made to the survey. A copy of the final Arabic and English version appears in Appendix E.

Statistical analysis

Once all the data was collected it was entered into an Excel database by the researcher for analysis. Data for the urban and rural student participants were compared using Statistical Package for the Social Sciences computer software (SPSS for Windows, Version 20.0, SPSS, Inc., 2011) (95).

To display data in means, frequencies, standard deviation, and percentages, descriptive statistics were used. To compare data like demographic information and some general data for categorical variables, Chi-square was used. Student's t-test was used to compare food intake between two groups. Food consumption was analyzed using the Food

Processor Plus computer program software (ESHA Version 10.9, Salem, Oregon, 2011) (96). A point-biserial correlation analysis was used to detect the association between food intake and physical activity and the prevalence of overweight/obesity for both groups. P-value ($p<0.05$) was used for level of significance.

The variables

Dependent variable:

- Body Mass Index (BMI)

Independent variables:

- Genetics factors
- Demographic information
- Food consumption, eating habits and dietary behaviors
- Physical activity
- (Screen time) time spent watching TV/working on computer or using electronic games and smart phones
- Eating breakfast
- Eating at school
- Eating at fast food restaurants
- Medical issues (food allergies/intolerance, diabetics, gland disorders …etc.).

Chapter IV

RESULTS

In the first section, the results were divided to three main parts; rural versus urban for all students, rural versus urban for male students, and rural versus urban for female students. These three parts contain: age and anthropometric measurements, demographic information, daily activities, and food attitudes and behaviors (Meal time, type of foods selected, place where meals were eaten, frequency of consuming certain foods, food allergies, and diseases related to food intake).

The second section examined the results for food consumption for both, food frequency questions based on US MyPlate food groups and the analysis of the twenty-four hour food recalls for all subjects then for male students and lastly for female students in both rural and urban areas.

Part A: Rural Versus Urban Total:

Age and anthropometric measurements for all subjects

The mean age of rural area high school students (18.15 years) was older than that of urban area students (17.7 years). The height, weight, and BMI for rural students were 165 centimeters (cms.), 60.1 kilograms (kgs.), and a BMI of 21.9, compared to 167 cms., 74.4 kgs. and a BMI of 26.1, respectively, for urban students (Table 2).

Table 2: Ages and Anthropometric Measurements for all subjects:

Location / Variables	Rural (n=300) Dawadami	Urban (n=300) Riyadh
Age (year)	18.15	17.7
Height (cm)	165	167
Weight (kg)	60.1	74.4
BMI	21.9	26.1

Demographic information for all subjects

Table 3 shows that 69.6% of rural students had parents who were related to each other, in contrast to 54.6% for urban students. Among rural students, 3.6% lived with their fathers only, 6% lived with their mothers only, 88.6% lived with both parents, and 1.6% lived with neither of their parents compared to 0.6%, 6.6%, 92.3%, and 0.3% respectively, for the students from the urban area.

Table 3: Demographic Information for all subjects:

Questions	Answer	Rural (n=300) Dawadami		Urban (n=300) Riyadh		P-value*
		n	%	n	%	
Parents relatives	Yes	209	69.6	164	54.6	0.0007
	No	90	30	135	45	
Living with parents	Father only	11	3.6	2	0.6	0.0177
	Mother only	18	6	20	6.6	
	Both	266	88.6	277	92.3	
	None	5	1.6	1	0.3	
Father's level of education	< High school	163	54.3	61	20.3	0.0001
	= High school	54	18	55	18.3	
	> High school	82	27.3	183	61	
Mother's level of education	< High school	196	65.3	111	37	0.0001
	= High school	41	13.6	73	24.3	
	> High school	58	19.3	115	38.3	
Parents currently have jobs	Father only	156	52	199	66.3	0.0002
	Mother only	7	2.3	6	2	
	Both	53	17.6	53	17.6	
	None	84	28	42	14	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

Parent education levels were higher among parents of urban students compared to parents of rural students. Among urban students the fathers had higher than a high school education compared to the rural where the majority had less than a high school education; this value was significantly different ($p<0.001$). There was a significant difference between the mother's education levels ($p<0.001$). Parental employment from the rural area was classified as either father only (52%), mother only (2.3%) , or both parents (17.6%), with 28% of parents having no job compared to 66.3%, 2%, 17.6%, and 14% respectively for parental employment in the urban area. A significant difference was also found ($p< 0.0002$) between urban and rural students in regards to parental unemployment with rural parental unemployment being significantly higher.

Daily activities for all subjects

Table 4 documents how the high school students plan their daily activities. Chi Square analysis was done comparing the percent responses for urban and rural students.

The first question asked was regarding TV watching. Over 27% of the rural students watched TV less than one hour a day, 45% watched TV from one to three hours a day, and 27.3% watched TV over three hours a day. In contrast, among urban students 34.3%, 52%, and 13.6% watched TV using the same classification respectively.

The second question asked if they had a computer and the third question asked how much time they spent on the computer. Urban students (95.3%) were more likely to have a computer than those students from the

rural area (82%). In regards to time spent on the computer per day in rural students: 31% spent less than one hour, 39% spent from one to three hours, and 29.8% spent more than three hours compared to 22.3%, 45.1%, and 32.5%, respectively, for urban students.

Table 4: Daily Activities for all subjects:

Questions	Answer	Rural (n=300)		Urban (n=300)		P-value*
		n	%	n	%	
Watching T.V. a day	< 1 hour	83	27.6	103	34.3	0.0002
	1 – 3 hours	135	45	156	52	
	> 3 hours	82	27.3	41	13.6	
Having a computer	Yes	246	82	286	95.3	0.0001
	No	54	18	14	4.6	
Hour/day spending on computer	< 1 hour	78	31	64	22.3	0.0714
	1 – 3 hours	98	39	129	45.1	
	> 3 hours	75	30	93	32.5	
Playing video games or computer games	Yes	160	53.3	188	62.6	0.0205
	No	140	46.6	112	37.3	
Hour/day spending on video or computer games	< 1 hour	79	45.4	79	41.8	0.7851
	1 – 3 hours	73	41.9	85	44.9	
	> 3 hours	22	12.6	25	13.2	
Coming to school by driving themselves or by a family member	Walking	29	9.6	23	7.6	0.0001
	By bus	39	13	33	11	
	By your car	214	71.3	158	52.6	
	With driver	18	6	86	28.6	
Driving a car	Yes	133	44.3	125	41.6	0.411
	No	167	55.6	175	58.3	
Hour/day spending on driving	< 1 hour	56	18.6	49	16.3	0.0028
	1 – 3 hours	38	12.6	59	19.6	
	> 3 hours	39	13	17	5.6	
Doing any physical activity	Yes	146	48.6	180	60	0.0065
	No	152	50.6	120	40	
Hour/day spending on physical activity	< 1 hour	72	24	86	28.6	0.095
	1 – 3 hours	73	24.3	89	29.6	
	> 3 hours	7	2.3	4	1.3	
Hours of sleep on average each day	< 7 hours	74	24.6	66	22	0.01023
	7-8 hours	143	47.6	172	57.3	
	> 8 hours	80	26.6	60	20	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

The next questions asked about frequency of playing video and computer games. Over 53% of the rural students played video or computer games versus 62.6% of urban students which was significantly different ($p<0.0205$). In regards to frequency of video or computer game playing in rural students, 45.4% spent less than one hour, 41.9% spent from one to three hours, and 12.6% spent more than three hours compared to urban students who spent 41.8%, 44.9%, and 13.2%, respectively.

Question 6 asked the students about transportation to school. Of the rural students 9.6% walked, 13% traveled by bus, 71.3% traveled by personal car, and 6% traveled with a driver compared to 7.6%, 11%, 52.6%, and 28.6%, respectively, among urban students ($p<0.0001$).

Surveys showed that 44.3% of rural students versus 41.6% of urban students had the ability to drive a car. For frequency of car driving, rural students answered that 18.6% spent less than one hour, 12.6% between one to three hours and 13% more than three hours. In contrast, for students in the urban area, 16.3%, 19.6%, and 5.6%, respectively, spent time driving a car.

Physical activity or lack of has been shown to impact body weight. Several questions on the survey asked about physical activity. The first one asked the students if they were physically active. Approximately, 49% among rural students were physically active compared to 60% of urban students; this was significantly different ($p<0.0065$). The second physical activity question asked the students how many hours per day they were physically active with responses being less than one hour, one to three hours or greater than three hours. For rural students 24% responded less than one hour, 24.3% from one

to three hours, and 2.3% for more than three hours compared to 28.6%, 29.6%, and 1.3%, respectively, among urban students.

For average hours of daily sleep, 24.6% of the rural students reported less than seven hours, 47.6% between seven and eight hours, and 26.6% more than eight hours of sleep as compared to 22%, 57.3%, and 20%, respectively, for the students from the urban area ($p<0.01$).

Food and behaviors for all subjects

Table 5 shows results for meal time, type of foods selected, place where meal were eaten, frequency of consuming certain foods, food allergies, and diseases related to food intake. This table compares rural versus urban students with genders combined.

The first questions asked about eating breakfast before school. Sixty-three percent of the rural students compared to 57% of urban students consumed breakfast before going to school. When asked about eating at school, 81.6% of the rural students ate at school compared to 85.3% of the urban students.

When asked about eating at fast food restaurants, 83.3% from rural schools reported eating at fast food restaurants compared to 93% from urban schools. Weekly frequency of eating at fast food restaurants in rural students was reported as 40% as one or less time, 31.3% from one to three times, 10.3% from four to six times, and 4.3% as seven times or more compared to 41.3%, 37.3%, 11.6%, and 3%, respectively, for urban students.

Table 5: Food and behaviors for all subjects:

(Meal time, type of foods selected, place where meals were eaten, frequency of consuming certain foods, food allergies, and diseases related to food intake).

Questions	Answer	Rural (n=300)		Urban (n=300)		P-value*
		n	%	n	%	
Eating breakfast before going to school	Yes	189	63	171	57	0.1335
	No	111	37	129	43	
Eating at school	Yes	245	81.6	256	85.3	0.2259
	No	55	18.3	44	14.6	
Eating at fast food restaurants	Yes	250	83.3	279	93	0.0002
	No	50	16.6	21	7	
Times/week eating often at fast food restaurants	1 or less t/w	120	40	124	41.3	0.0315
	1 – 3 t/w	94	31.3	112	37.3	
	4 – 6 t/w	31	10.3	35	11.6	
	7 or more t/w	13	4.3	9	3	
Consuming soft drinks	Yes	274	91.3	282	94	0.2663
	No	25	8.3	18	6	
Times/week drinking often soft drinks	1 or less t/w	53	17.6	73	24.4	0.0003
	1 – 3 t/w	77	25.6	96	32.1	
	4 – 6 t/w	48	16	59	19.7	
	7 or more t/w	96	32	52	17.3	
Consuming energy drinks	Yes	110	36.6	93	31	0.1628
	No	189	63	207	69	
Times/week Consuming energy drinks	1 or less t/w	58	19.3	58	19.3	0.0043
	1 – 3 t/w	30	10	26	8.6	
	4 – 6 t/w	15	5	8	2.6	
	7 or more t/w	15	5	2	0.67	
Eating snacks	Yes	268	89.3	272	90.6	0.3985
	No	32	10.6	28	9.3	
Times/day often eating snacks	1 t/d	129	43	143	47.6	0.0325
	1 – 3 t/d	103	34.3	113	37.6	
	> 3 t/d	40	13.3	20	6.6	
Having food allergies or food intolerances	Yes	48	16	60	20	0.2266
	No	251	83.6	240	80	
Having any genetic gland disorders	Yes	6	2	5	1.6	0.2371
	No	292	97.3	295	98.3	
Having Diabetes Mellitus	Yes	8	2.6	10	3.3	0.2237
	No	290	96.6	290	96.6	
Having medical problems	Yes	46	15.3	60	20	0.1335
	No	254	84.6	240	80	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

The next set of questions asked about beverage consumption. When asked about drinking soft drinks, 91.3% of rural students versus 94% of urban students noted soft drink consumption. When asked about how frequently they consumed soft drinks in a week 17.6% of rural students responded one or less time, 25.6% between one and three times, 16% from four to six times, and 32% seven times or more. In contrast, urban students reported 24.4%, 32.1%, 19.7%, and 17.3%, respectively, for weekly soft drink consumption. Based on Chi Square analysis this was significantly different between rural and urban students ($P<0.0003$).

The next question asked the students about their consumption of energy drinks. Approximately 37% of the rural students reported energy drink consumption, while among urban students 31% reported energy drink consumption. When asked about the frequency of consumption per week, rural students reported 19.3% for one or less time per week, 10% from one to three times, 5% from four to six times, and 5% seven times or more compared to 19.3%, 8.6% 2.6%, and 0.67%,respectively, for the students from urban areas ($p<0.0043$).

Snacks contribute both calories and nutrients in the teen diet. Most teens do not eat regular meals but snack throughout the day. The next question on the survey focused on snacking. Snack consumption among rural students was 89.3% versus 90.6% for urban students. Frequency of daily snack consumption was 43% for once per day, 34.3% for one to three times, and 13.3% more than three times per day in rural students compared to 47.6%, 37.6%, and 6.6%, respectively, for urban students. Based on Chi Square analysis this was significantly different at $p<0.0325$.

Medical Issues for all subjects

The final set of questions dealt with medical issues such as allergies, diabetes, and genetic disorders. Of the rural students, 16% stated they had food allergies or food intolerance compared to 20% of the urban students. In regards to having genetic gland disorders 2% of the rural students versus 1.6% among students from the urban area noted they had this condition.

Type 2 diabetes is a growing medical concern worldwide especially among people who are obese. When asked if they had diabetes mellitus 2.6% of the rural students compared to 3.3% of the urban students responded yes. The last question asked about general medical problems. Among the rural students 15.3% stated they had medical problems compared to 20% among the students from the urban areas.

Part B: Rural Versus Urban Males:

Age and anthropometric measurements for rural and urban male students

The mean age for the rural males (18.3 years) was higher than that of participant males from the urban area (17.9 years). The average height, weight, and BMI for rural males were 171 cms., 61.3 kgs., and 20.7, compared to 174 cms., 88.6 kgs., and 28.9, respectively, for urban male students (Table 6).

Table 6: Ages and Anthropometric Measurements for rural and urban males:

Location / Variables	Rural (n=150) Dawadami	Urban (n=150) Riyadh
Age (year)	18.3	17.9
Height (cm)	171	174
Weight (kg)	61.3	88.6
BMI	20.7	28.9

Demographic information for rural and urban student males

Table 7 shows that 79.9% of rural males have parents that were relatives, in contrast to 57.7% for urban males. Among rural male students, 4% reported living with their fathers only, 6.7% with their mothers only, 88.7% with both parents, and 0.7% with neither of their parents compared to 0.7%, 5.3%, 93.3%, and 0.7%, respectively, for the student males from the urban area.

Table 7: Demographic Information for rural and urban male students:

Questions	Answer	Rural (n=150) Dawadami		Urban (n=150) Riyadh		P-value*
		n	%	N	%	
Parents relatives	Yes	119	79.9	86	57.7	0.0002
	No	30	20.1	63	42.3	
Living with parents	Father only	6	4	1	0.7	0.2247
	Mother only	10	6.7	8	5.3	
	Both	133	88.7	140	93.3	
	None	1	0.7	1	0.7	
Father's level of education	< High school	78	52.3	30	20.1	0.0001
	= High school	28	18.8	27	18.1	
	> High school	43	28.9	92	61.7	
Mother's level of education	< High school	98	65.8	57	38	0.0001
	= High school	18	12.1	36	24	
	> High school	33	22.1	57	38	
Parents currently have jobs	Father only	65	43.3	104	69.3	0.0001
	Mother only	4	2.7	3	2	
	Both	29	19.3	26	17.3	
	None	52	34.7	17	11.3	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

Parent levels of education were significantly higher among parents of the urban male students compared to parents of the rural male students ($p<.0001$). Parents of male students in the urban area had an education level greater than high school and parents of the rural students had less than a high school education.

Employment among parents of rural male students was significantly different than urban. The rural male students noted employment of their father only was 43.3%, 2.7% for mother only, 19.3% for both parents, and 34.7% both parent unemployment compared to 69.3%, 2%, 17.3%, and 11.3%,respectively, for parental employment among students from the urban area ($p<0.0001$).

Daily activities for rural and urban student males

Table 8 documents how the high school male students plan their daily activities. Chi Square analysis was done to compare the percent responses for urban and rural male students.

The first question asked about TV watching. Approximately 29% of the rural students reported watching TV less than one hour a day, 46.7% one to three hours a day, and 24% more than three hours a day. In contrast, among TV watching was reported as 34%, 54%, and 12%, respectively, for urban students using the same classification ($p<0.0243$).

The second and third questions regarded computer ownership and the time spent on the computer. Urban students were more likely to have a computer than those from rural areas (78.7% rural vs. 94.7% urban). In regards to daily time spent on the computer in rural students, 4.7% spent less than one hour, 95.3% spent from one to three hours, and 0% spent more than three hours compared to 2.7%, 97.3%, and 0%, respectively, for urban students ($p<0.0005$).

The next questions asked about frequency of playing video and computer games. Over 62% of the rural students reported playing video or computer games versus 82% for urban students, which was significantly different ($p<0.0002$). In regards to hours per day spent playing video or computer games in rural students, 31.4% spent less than one hour, 51.4% spent from one to three hours, and 17.1% spent more than three hours compared to 33.3%, 51.2%, and 15.4%, respectively, for the students from urban area.

Question 6 regarded transportation to school. Of the rural students 14% walked, 0% came by bus, 79.3% drove their own cars, and 6.7% rode with a driver compared to 12%, 4.7%, 66%, and 17.3%, respectively, among urban students ($p<0.0003$). Regarding ability to drive a car, 88.7% of rural students were able to drive a car versus 83.3% of urban students. For hours a day spent on driving a car, rural students answered that 42.1% spent less than one hour, 28.6% between one to three hours, and 29.3% more than three hours. In contrast, for students in the urban area 39.2%, 47.2%, and 13.6%, respectively, was reported for time spent driving a car ($p<0.0015$).

Several questions on the survey asked the male students about physical activity. The first one asked the males if they were physically active. Approximately, 71% among rural students were participating in physical activity compared to 70% for urban students. The second physical activity question asked the male students how many hours per day they were physically active with responses being less than one hour, one to three hours or greater than three hours. For rural students 42.3% responded less than one hour, 54.1% from one to three hours, and 3.6% for more than three hours compared to 37.1%, 60%, and 2.9% respectively, among urban students.

Table 8: Daily Activities for rural and urban males:

Questions	Answer	Rural (n=150)		Urban (n=150)		P-value*
		n	%	n	%	
Watching T.V. a day	< 1 hour	44	29.3	51	34	0.0243
	1 – 3 hours	70	46.7	81	54	
	> 3 hours	36	24	18	12	
Having a computer	Yes	118	78.7	142	94.7	0.0001
	No	32	21.3	8	5.3	
Hour/day spending on computer	< 1 hour	7	4.7	4	2.7	0.0005
	1 – 3 hours	141	95.3	146	97.3	
	> 3 hours	0	0	0	0	
Playing video games or computer games	Yes	94	62.7	123	82	0.0002
	No	56	37.3	27	18	
Hour/day spending on video or computer games	< 1 hour	33	31.4	41	33.3	0.1052
	1 – 3 hours	54	51.4	63	51.2	
	> 3 hours	18	17.1	19	15.4	
Coming to school	Walking	21	14	18	12	0.0003
	By bus	0	0	7	4.7	
	By your car	119	79.3	99	66	
	With driver	10	6.7	26	17.3	
Driving a car	Yes	133	88.7	125	83.3	0.182
	No	17	11.3	25	16.7	
Hour/day spending on driving	< 1 hour	56	42.1	49	39.2	0.0015
	1 – 3 hours	38	28.6	59	47.2	
	> 3 hours	39	29.3	17	13.6	
Doing any physical activity	Yes	106	70.7	105	70	0.8994
	No	44	29.3	45	30	
Hour/day spending on physical activity	< 1 hour	47	42.3	39	37.1	0.7077
	1 – 3 hours	60	54.1	63	60	
	> 3 hours	4	3.6	3	2.9	
Hours of sleep on average each day	< 7 hours	40	26.7	46	30.7	0.207
	7-8 hours	75	50	81	54	
	> 8 hours	35	23.3	23	15.3	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

Regarding daily sleep amounts, the rural male students noted that 26.7% had less than seven hours, 50% between seven and eight hours, and

23.3% more than eight hours of sleep a day compared to 30.7%, 54%, and 15.3%, respectively, for the students from the urban area.

Food and behaviors for rural and urban male students

Table 9 shows results for meal time, type of foods selected, place where meals were consumed, and frequency of consuming certain foods in rural and urban male students. The first question asked about eating breakfast before going to school. Sixty percent of the rural students compared to 53.3% of urban students consumed breakfast before going to school. When asked about eating at school, 75.3% of the rural students ate at school compared to 81.3% of the urban students.

When asked about eating at fast food restaurants, 84% from rural schools reported eating at fast food restaurants compared to 93.3% from urban schools. How often the rural students ate at fast food restaurants per week was reported as 38.3% one or less time, 35.3% from one to three times, 18.8% from four to six times, and 7.5% seven times or more compared to 29.1%, 48.9%, 15.5%, and 6.4%, respectively, for urban male students.

The next set of questions asked about beverage consumption. When asked about soft drink consumption, 95.3% of the rural students versus 94.7% of the urban students noted regular consumption. When asked about weekly frequency of soft drink consumption, 9.8% of male rural students reported one or less time, 19.6% between one and three times, 25.2% from four to six times, and 45.5% seven times or more. In contrast, urban males reported 15.5%, 31.7%, 26.8%, and 26.1%, respectively, for weekly soft drink consumption. Based on Chi Square analysis this was significantly different between rural and urban students ($P<0.0083$).

Table 9: Food and behaviors for rural and urban males:(Meal time, type of foods selected, place where meals were consumed, frequency of consuming certain foods, food allergies, and diseases related to food intake).

Questions	Answer	Rural (n=150)		Urban (n=150)		P-value*
		N	%	n	%	
Eating breakfast before going to school	Yes	90	60	80	53.3	0.2438
	No	60	40	70	46.7	
Eating at school	Yes	113	75.3	122	81.3	0.2066
	No	37	24.7	28	18.7	
Eating at fast food restaurants	Yes	126	84	140	93.3	0.0098
	No	24	16	10	6.7	
Times/week eating often at fast food restaurants	1 or less t/w	51	38.3	41	29.1	0.0904
	1 – 3 t/w	47	35.3	69	48.9	
	4 – 6 t/w	25	18.8	22	15.5	
	7 or more t/w	10	7.5	9	6.4	
Consuming soft drinks	Yes	143	95.3	142	94.7	0.7910
	No	7	4.7	8	5.3	
Times/week drinking often soft drinks	1 or less t/w	14	9.8	22	15.5	0.0083
	1 – 3 t/w	28	19.6	45	31.7	
	4 – 6 t/w	36	25.2	38	26.8	
	7 or more t/w	65	45.5	37	26.1	
Consuming energy drinks	Yes	79	52.7	62	41.3	0.0490
	No	71	47.3	88	58.7	
Times/week Consuming energy drinks	1 or less t/w	38	44.7	32	50.8	0.0266
	1 – 3 t/w	24	28.2	22	34.9	
	4 – 6 t/w	14	16.5	7	11.1	
	7 or more t/w	9	10.6	2	3.2	
Eating snacks	Yes	126	84	133	88.7	0.2384
	No	24	16	17	11.3	
Times/day often eating snacks	1 t/d	62	47.7	71	52.6	0.4106
	1 – 3 t/d	53	40.8	55	40.7	
	> 3 t/d	15	11.5	9	6.6	
Having food allergies or food intolerances	Yes	20	13.4	25	16.7	0.3668
	No	129	86.6	125	83.3	
Having any genetic gland disorders	Yes	6	4.1	4	2.7	0.1988
	No	142	95.9	146	97.3	
Having Diabetes Mellitus	Yes	7	4.7	4	2.7	0.1582
	No	141	95.3	146	97.3	
Having medical problems	Yes	23	15.3	27	18	0.5353
	No	127	84.7	123	82	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

The next question asked the students about their consumption of energy drinks. Approximately 53% of rural male students reported consuming energy drinks, while among urban students only 41.3% reported energy drink consumption ($p<0.490$). The frequency of weekly energy drink consumption in rural males was 44.7% for one time or less, 28.2% from one to three times, 16.5% from four to six times, and 10.6% for seven times or more compared to 50.8%, 34.9% 11.1%, and 3.2%, respectively, for the male students from urban areas ($p<0.0266$).

The next question on the survey focused on snacking. Snack consumption among rural male students was 84% versus 88.7% for urban male students. Frequency of daily snack consumption in rural males was 47.7% for one time, 40.8% from one to three times, and 11.5% more than three times compared to urban males who reported 52.6%, 40.7%, and 6.6% respectively.

Medical Issues for rural and urban male students

The final set of questions dealt with medical issues such as allergies, diabetes, and genetic disorders. More than 13% of the rural students stated they had food allergies or food intolerance compared to 16.7% of urban students. In regards to having genetic gland disorders 4.1% of the rural male students versus 2.7% among the male students from the urban area noted they had this condition.

Type 2 diabetes is a growing medical concern worldwide especially among people who are obese. When asked if they had diabetes mellitus 4.7% of the rural students compared to 2.7% of urban male students responded yes. The last question asked about general medical problems. Among the

rural students 15.3% stated they had medical problems compared to 18% among the urban students.

Part C: Rural Versus Urban Females:

Age and anthropometric measurements for rural and urban female students

The mean age for the rural females (18.0 years) was higher than that of participant student females from urban areas (17.5 years). The average height, weight, and BMI for rural females were 159 cms, 58.9 kgs., and 23.1, compared to urban female students 160 cms, 60.2 kgs., and 23.3, respectively (Table 10).

Table 10: Ages and Anthropometric Measurements for rural and urban females:

Location / Variables	Rural (n=150) Dawadami	Urban (n=150) Riyadh
Age (year)	18	17.5
Height (cm)	159	160
Weight (kg)	58.9	60.2
BMI	23.1	23.3

Demographic information for rural and urban student females

Table 11 shows that 60% of rural females have parents that were relatives, in contrast to 52% for urban females. Among rural female students, 3.3% reported living with their father only, 5.3% with mother only, 88.7% with both parents, and 2.7% with neither of their parents compared to 0.7%, 8%, 91.3%, and 0%, respectively, for the females from the urban area ($p<0.0253$).

Parent education levels were significantly higher among parents of urban female students compared to parents of rural females ($p<.0001$). The

parental education level for urban female students was above high school and the rural parents had less than a high school education.

Parental employment for rural female students was significantly different than urban. Parental employment among rural female students was classified as paternal employment only 60.7%, maternal only 2%, both paretns16%, and 21.3% for unemployment of both parents compared to parental employment of urban area female students reported as, 63.3%, 2%, 18%, and 16.7%, respectively.

Table 11: Demographic Information for rural and urban females:

Questions	Answer	Rural (n=150) Dawadami		Urban (n=150) Riyadh		P-value*
		n	%	n	%	
Parents relatives	Yes	90	60	78	52	0.1626
	No	60	40	72	48	
Living with parents	Father only	5	3.3	1	0.7	0.0253
	Mother only	8	5.3	12	8	
	Both	133	88.7	137	91.3	
	None	4	2.7	0	0	
Father's level of education	< High school	85	56.7	31	20.7	0.0001
	= High school	26	17.3	28	18.7	
	> High school	39	26	91	60.7	
Mother's level of education	< High school	98	67.1	54	36.2	0.0001
	= High school	23	15.8	37	24.8	
	> High school	25	17.1	58	38.9	
Parents currently have jobs	Father only	91	60.7	95	63.3	0.7712
	Mother only	3	2	3	2	
	Both	24	16	27	18	
	None	32	21.3	25	16.7	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

Daily activities for rural and urban female students

Table 12 documents how the high school female students plan their daily activities. Chi Square analysis was done comparing the percent responses for urban and rural female students.

The first question asked about watching TV. Twenty-six percent of the rural female students reported watching TV less than one hour a day, 43.3% reported watching TV from one to three hours a day, and 30.7% reported watching TV more than three hours a day. In contrast, among urban students 34.7%, 50%, and 15.3% reported watching TV using the same classification ($p<0.0055$).

The second question asked about computer ownership and usage. Urban students were significantly ($p<0.0011$) more likely to have a computer than students from rural areas (85.3% rural vs. 96% urban). In regards to time spent on the computer per day in rural females: 0.07% spent less than one hour, 99.3% spent from one to three hours, and 0% spent more than three hours compared to 4%, 96%, and 0% respectively for urban students ($p<0.0118$).

The next question asked about time spent per day playing video and computer games. Over 44% of the rural students reported playing video or computer games versus 43.3% in urban female students. In regards to hours per day spent playing video or computer games in rural female students, 66.7% spent less than one hour, 27.5% spent from one to three hours, and 5.8% spent more than three hours compared to 57.6%, 33.3%, and 9.1%, respectively, for the students from the urban area.

Question 6 asked the female students about transportation to school. Of the rural students 5.3% reported walking, 26% riding the bus, 63.3% came by cars, and 5.3% rode with a driver compared to 3.3%, 17.3%, 39.3%, and 40% respectively among urban students (p<0.0001). No female student was able to drive a car since it is illegal in Saudi Arabia for a female to drive.

Table 12: Daily Activities for rural and urban females:

Questions	Answer	Rural (n=150) Dawadami		Urban (n=150) Riyadh		P-value*
		n	%	N	%	
Watching T.V. a day	< 1 hour	39	26	52	34.7	0.0055
	1 – 3 hours	65	43.3	75	50	
	> 3 hours	46	30.7	23	15.3	
Having a computer	Yes	128	85.3	144	96	0.0011
	No	22	14.7	6	4	
Hour/day spending on computer	< 1 hour	1	0.7	6	4	0.0118
	1 – 3 hours	149	99.3	144	96	
	> 3 hours	0	0	0	0	
Playing video games or computer games	Yes	66	44	65	43.3	0.9073
	No	84	56	85	56.7	
Hour/day spending on video or computer games	< 1 hour	46	66.7	38	57.6	0.6962
	1 – 3 hours	19	27.5	22	33.3	
	> 3 hours	4	5.8	6	9.1	
Coming to school by a family member	Walking	8	5.3	5	3.3	0.0001
	By bus	39	26	26	17.3	
	By your car	95	63.3	59	39.3	
	With driver	8	5.3	60	40	
Driving a car	Yes	0	0	0	0	0
	No	150	100	150	100	
Hour/day spending on driving	< 1 hour	0	0	0	0	0
	1 – 3 hours	0	0	0	0	
	> 3 hours	0	0	0	0	
Doing any physical activity	Yes	40	27	75	50	0.0001
	No	108	73	75	50	
Hour/day spending on physical activity	< 1 hour	25	61	47	63.5	0.0004
	1 – 3 hours	13	31.7	26	35.1	
	> 3 hours	3	7.3	1	1.4	
Hours of sleep on average each day	< 7 hours	34	23.1	20	13.5	0.0462
	7-8 hours	68	46.3	91	61.5	
	> 8 hours	45	30.6	37	25	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

Several questions on the survey asked the female students about physical activity. The first one asked the females if they were physically active. Twenty-seven percent among rural students were participating in physical activity compared to 50% for urban students ($p<0.0001$). The second physical activity question asked the female students how many hours per day they were physically active with responses being less than one hour, one to three hours or greater than three hours. For rural students 61% responded less than one hour, 31.7% from one to three hours, and 7.3% for more than three hours compared to 63.5%, 35.1%, and 1.4% respectively, among urban students ($p<0.004$).

For average daily hours of sleep in the rural female students 23.1% reported less than seven hours, 46.3% between seven and eight hours, and 30.6% more than eight hours of sleep a day compared to 13.5%, 61.5%, and 25% respectively, for the students from urban area ($p<0.0462$).

Food and behaviors for rural and urban female students

Table 13 shows results for meal time, type of foods selected, place where meals were eaten, and frequency of consuming certain foods in rural and urban female students. The first questions asked about eating breakfast before going to school. Sixty-six percent of the rural students compared to 60.7% of urban students consumed breakfast before going to school. When asked about eating at school, 88% of the rural students ate at school compared to 89.3% of the urban students

When asked about eating at fast food restaurants, 82.7% from the rural schools reported eating at fast food restaurants compared to 92.7% from the urban schools ($p<0.0076$). Regarding weekly frequency of eating at fast

food restaurants for rural female students 55.2% reported one or less time, 37.6% from one to three times, 4.8% from four to six times, and 2.4% reported seven times or more compared to 59.7%, 30.9%, 9.4%, and 0% respectively, for urban female students.

The next set of questions asked about beverage consumptions. When asked about soft drink consumption 87.9% of the rural students versus 93.3% of the urban students noted they regularly consumed soft drinks. When asked about weekly frequency of soft drink consumption 29.8% responded one or less time, 37.4% between one and three times, 9.2% from four to six times, and 23.7% seven times or more for rural females. In contrast, urban females reported 37.4%, 36.7%, 15.1%, and 10.8% respectively, for weekly soft drink consumption. Based on Chi Square analysis difference between rural and urban students was statistically significant ($P<0.0157$).

The next question asked the students about their consumption of energy drinks. Approximately 20.8% of rural female students reported consuming energy drinks, while among urban females 20.7% reported energy drink consumption. The weekly frequency for energy drink consumption was 60.6% for one or less time, 18.2% from one to three times, 3% from four to six times, and 18.2% seven times or more for rural females compared to 83.9%, 12.9%, 3.2%, and 0% respectively, for students from urban area ($p<0.0493$).

The next question on the survey focused on snacking. Snack consumption among rural females was 94.7% versus 92.7% for urban students. Regarding daily snack consumption in rural females 47.2% reported one time, 35.2% from one to three times, and 17.6% more than three

times compared to 51.1%, 41.1%, and 7.8% respectively, for females in urban schools.

Table 13: Food and behaviors for rural and urban females:

(Meal time, type of foods selected, place where meals were consumed, frequency of consuming certain foods, food allergies, and diseases related to food intake).

Questions	Answer	Rural (n=150)		Urban (n=150)		P-value*
		n	%	n	%	
Eating breakfast before going to school	Yes	99	66	91	60.7	0.3377
	No	51	34	59	39.3	
Eating at school	Yes	132	88	134	89.3	0.7156
	No	18	12	16	10.7	
Eating at fast food restaurants	Yes	124	82.7	139	92.7	0.0076
	No	26	17.3	11	7.3	
Times/week eating often at fast food restaurants	1 or less t/w	69	55.2	83	59.7	0.0078
	1 – 3 t/w	47	37.6	43	30.9	
	4 – 6 t/w	6	4.8	13	9.4	
	7 or more t/w	3	2.4	0	0	
Consuming soft drinks	Yes	131	87.9	140	93.3	0.1351
	No	18	12.1	10	6.7	
Times/week drinking often soft drinks	1 or less t/w	39	29.8	52	37.4	0.0157
	1 – 3 t/w	49	37.4	51	36.7	
	4 – 6 t/w	12	9.2	21	15.1	
	7 or more t/w	31	23.7	15	10.8	
Consuming energy drinks	Yes	31	20.8	31	20.7	0.4989
	No	118	79.2	119	79.3	
Times/week Consuming energy drinks	1 or less t/w	20	60.6	26	83.9	0.0493
	1 – 3 t/w	6	18.2	4	12.9	
	4 – 6 t/w	1	3	1	3.2	
	7 or more t/w	6	18.2	0	0	
Eating snacks	Yes	142	94.7	139	92.7	0.4761
	No	8	5.3	11	7.3	
Times/day often eating snacks	1 t/d	67	47.2	72	51.1	0.0928
	1 – 3 t/d	50	35.2	58	41.1	
	> 3 t/d	25	17.6	11	7.8	
Having food allergies or food intolerances	Yes	28	18.7	35	23.3	0.3207
	No	122	81.3	115	76.7	
Having any genetic gland disorders	Yes	0	0	1	0.7	0.2385
	No	150	100	149	99.3	
Having Diabetes Mellitus	Yes	1	0.7	6	4	0.0442
	No	149	99.3	144	96	
Having medical problems	Yes	23	15.3	33	22	0.1375
	No	127	84.7	117	78	

*Bases on chi square analysis P-value greater than or equal to 0.05 are considered significant.

Medical Issues for rural and urban female students

The final set of questions dealt with medical issues such as allergies, diabetes, and genetic disorders. Approximately 19% of the rural students stated they had food allergies or food intolerance compared to 23.3% of the

urban students. In regards to having genetic gland disorders 0% of the rural female students versus 0.7% among the female students from the urban area noted they had this condition.

Type 2 diabetes is a growing medical concern worldwide especially among people who are obese. When asked if they had diabetes mellitus 0.7% of the rural students compared to 4% of urban female students responded yes ($p<0.0442$). The last question asked about general medical problems. Among the rural students 15.3% stated they had medical problems compared to 22% among the urban female students.

Food consumption

This section will examine the results of responses to food frequency questions based on the US MyPlate food groups and the analysis of the twenty-four hour recalls of the urban and rural teens. The food frequency questions were analyzed based on total responses from urban and rural teens as well as differences based on gender and location. A subset of student's 24-hour food recall was randomly selected for analysis of consumption over the past twenty-four hours on the day before anthropometric measurements were collected.

Food consumption for all participants

A. Food frequency questionnaire for rural and urban students

Table 14: Food frequency questionnaire based on the main food groups for all rural and urban participant male and female students:

Questions	Answer	Rural (n=300)		Urban (n=300)		P-value*
		n	%	n	%	
Eating fruits	1 or less t/w	169	56.3	127	42.3	0.0098
	1 – 3 t/w	79	26.3	99	33	
	4 – 6 t/w	36	12	53	17.6	
	7 or more t/w	16	5.3	20	6.6	
Eating vegetables	1 or less t/w	122	40.6	68	22.6	0.0001
	1 – 3 t/w	106	35.3	113	37.6	
	4 – 6 t/w	43	14.3	71	23.6	
	7 or more t/w	28	9.3	48	16	
Consuming milk or dairy products	1 or less t/w	99	33	65	21.6	0.0001
	1 – 3 t/w	78	26	70	23.3	
	4 – 6 t/w	37	21.3	93	31	
	7 or more t/w	86	28.6	72	24	
Consuming protein foods	1 or less t/w	30	10	13	4.3	0.0023
	1 – 3 t/w	67	22.3	63	21	
	4 – 6 t/w	74	24.6	113	37.6	
	7 or more t/w	128	42.6	110	36.6	
Consuming breads and cereals	1 or less t/w	25	8.3	9	3	0.0003
	1 – 3 t/w	67	22.3	45	15	
	4 – 6 t/w	70	23.3	101	33.6	
	7 or more t/w	136	45.3	145	48.3	

*Bases on chi square, P-value greater than or equal to 0.05 are considered significant.

Table 14 describes the food frequency questionnaire results for questions regarding the main food groups (fruits, vegetables, dairy, protein foods, and breads/cereals) for all the students from urban and rural areas and gender. Of rural students, 56.3% reported eating fruits one time or less a week, 26.3% from one to three times, 12% from four to six times, and 5.3%

seven times or more compared to 42.3%, 33%, 17.6%, and 6.6% respectively, for urban students ($p<0.0098$).

Vegetable consumption in rural students was more gradual with 40.6% consuming one time or less per week, 35.3% from one to three times, 14.3% from four to six times, and 9.3% seven times or more, while for urban students 22.6%, 37.6%, 23.6%, and 16%, respectively, was reported ($p<0.0001$).

The same classifications were used to report how many times a week the students consumed milk or dairy products which was 33%, 26%, 21.3%, and 28.6% respectively for the rural subjects, versus 21.6%, 23.3%, 31%, and 24% respectively for the urban students ($p<0.0001$). Among rural students 10% reported consuming protein foods one time a week or less, 22.3% from one to three times, 24.6% from four to six times, and 42.6% seven times or more whereas for the urban subjects consumption was reported as 4.3%, 21%, 37.6%, and 36.6% respectively ($p<0.0023$).

For bread and cereal consumption the rural students were consuming on average 8.3% one time or less a week, 22.3% from one to three times, 23.3% from four to six times, and 45.3% seven times or more compared to 3%, 15%, 33.6%, and 48.3% respectively, for urban students ($p<0.0003$).

B. 24-hour food recalls for rural and urban students

Table 15: Mean and Standard Deviations of 24-hour food recalls and BMI for rural and urban high school students:

Location / Nutrients	RURAL (Dawadami) (Mean ± SD*)	URBAN (Riyadh) (Mean ± SD*)
Energy (kcals)	1537 ± 599[a]	1754 ± 806[b]
CHO (g)	209 ± 85[a]	238 ± 109[b]
Protein (g)	65 ± 28	66 ± 39
Fat (g)	50.4 ± 26.7[a]	63.9 ± 38.6[b]
Cholesterol (mg)	263.6 ± 168	275.5 ± 253
Iron (mg)	10.5 ± 4.4	10.5 ± 5.1
Calcium (mg)	742 ± 428	881 ± 622
Vitamin A (RE)	430 ± 370	467 ± 319
Vitamin C (mg)	75.5 ± 87[a]	111.3 ± 104[b]
BMI	22.98 ± 5.5[a]	25.46 ± 6.2[b]

*Means with different superscripts are significantly different based on t-test at $p<0.05$

Table 15 shows the mean and standard deviations of the students based on location (urban versus rural). There were a number of significant differences between the two locations.

A significant difference was found in the average total consumption of kilocalories (kcals) between urban and rural students. The rural students had a mean energy intake less than urban students (1537 ± 599 rural vs. 1754 ± 806 for urban).

Nutrients contributing to energy consumption include carbohydrates, protein, and fat. Carbohydrate (CHO) and fat consumptions were significantly different between the urban and rural students. Mean CHO intake for rural students was 209 grams and for the urban students was 238 grams. There

were no significant differences in the consumption of protein among both rural and urban students (65 gms. vs. 66 gms.). However, the average daily intake of fat for the rural students was significantly lower than that for the urban students (50.4 gms. vs. 63.9 gms.).

The daily dietary cholesterol recommendation is 300 milligrams (mgs) or less. In both locations the average cholesterol intake met this recommendation. The rural students had a mean intake of 263.6 mg per day of cholesterol compared to 275.5 mg for the urban students, which was not significantly difference.

The four nutrients that are most likely to be low in the diet are calcium, iron, vitamin A and vitamin C. Consumption of these nutrients was used to determine diet quality. The average daily consumption of iron was 10.5 mg for both rural and urban students. The daily consumption of calcium for rural students was lower than that for urban participants (742 mg vs. 881 mg) which was not significantly different. On average, approximately 430 retinol equivalents (RE) of vitamin A was consumed daily for the rural students compared to 467 RE for the urban students. Average vitamin C intake was significantly lower for the rural students (75.5 mg) compared to the urban students (111.3 mg).

The average BMI for this subset of rural and urban students was significantly difference; lower among the rural students compared to the urban (22.98 $\pm$ 5.5 rural vs. 25.46 $\pm$ 6.2 urban).

In addition, a correlation analysis was done on all students to see what nutrients from the 24-hour recall correlated to BMI. Table 16 below

demonstrates the correlation matrix for this analysis. The only nutrient from the dietary recalls that correlated with BMI was vitamin C.

Table 16: Correlation Matrix of Dietary Intake to BMI on all Subjects

		Kcals	CHO	Protein	Fat	Chol	Iron	Ca	Vit A	Vit C	BMI	Continuous version of Location
Calories	Pearson Correlation	1	.915**	.798**	.881**	.434**	.739**	.657**	.539**	.350**	.006	.151*
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000	.000	.000	.930	.032
	N	200	200	200	200	200	200	200	200	200	200	200
CHO	Pearson Correlation	.915**	1	.605**	.681**	.275**	.720**	.470**	.413**	.340**	.006	.146*
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000	.000	.000	.930	.039
	N	200	200	200	200	200	200	200	200	200	200	200
Protein	Pearson Correlation	.798**	.605**	1	.698**	.607**	.631**	.640**	.578**	.155*	-.025	.014
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000	.000	.029	.727	.839
	N	200	200	200	200	200	200	200	200	200	200	200
Fat	Pearson Correlation	.881**	.681**	.698**	1	.419**	.600**	.731**	.534**	.373**	.007	.201**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000	.000	.000	.922	.004
	N	200	200	200	200	200	200	200	200	200	200	200
Cholesterol	Pearson Correlation	.434**	.275**	.607**	.419**	1	.388**	.499**	.549**	.160*	-.002	.028
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000	.000	.024	.976	.696
	N	200	200	200	200	200	200	200	200	200	200	200
Iron	Pearson Correlation	.739**	.720**	.631**	.600**	.388**	1	.448**	.491**	.214**	.052	.006
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000	.000	.002	.465	.928
	N	200	200	200	200	200	200	200	200	200	200	200
Calcium	Pearson Correlation	.657**	.470**	.640**	.731**	.499**	.448**	1	.628**	.322**	-.050	.130
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		.000	.000	.482	.067
	N	200	200	200	200	200	200	200	200	200	200	200
Vitamin A	Pearson Correlation	.539**	.413**	.578**	.534**	.549**	.491**	.628**	1	.258**	.006	.054
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000		.000	.930	.444
	N	200	200	200	200	200	200	200	200	200	200	200
Vitamin C	Pearson Correlation	.350**	.340**	.155*	.373**	.160*	.214**	.322**	.258**	1	.274**	.185**
	Sig. (2-tailed)	.000	.000	.029	.000	.024	.002	.000	.000		.000	.009
	N	200	200	200	200	200	200	200	200	200	200	200
BMI	Pearson Correlation	.006	.006	-.025	.007	-.002	.052	-.050	.006	.274**	1	.209**
	Sig. (2-tailed)	.930	.930	.727	.922	.976	.465	.482	.930	.000		.003
	N	200	200	200	200	200	200	200	200	200	200	200
Continuous version of Location	Pearson Correlation	.151*	.146*	.014	.201**	.028	.006	.130	.054	.185**	.209**	1
	Sig. (2-tailed)	.032	.039	.839	.004	.696	.928	.067	.444	.009	.003	
	N	200	200	200	200	200	200	200	200	200	200	200

Food consumption for rural and urban males

A. Food frequency questionnaire for rural and urban male students

Table 17: Food frequency questionnaire for the main food groups for rural and urban male students:

Questions	Answer	Rural (n=150) Dawadami		Urban (n=150) Riyadh		P-value*
		n	%	n	%	
Eating fruits	1 or less t/w	87	58	59	39.6	0.0207
	1 – 3 t/w	36	24	51	34.2	
	4 – 6 t/w	19	12.7	27	18.1	
	7 or more t/w	8	5.3	12	8.1	
Eating vegetables	1 or less t/w	58	38.9	35	23.3	0.0187
	1 – 3 t/w	56	37.6	62	41.3	
	4 – 6 t/w	26	17.4	35	23.3	
	7 or more t/w	9	6	18	12	
Consuming milk or dairy products	1 or less t/w	43	28.7	30	20	0.0126
	1 – 3 t/w	46	30.7	39	26	
	4 – 6 t/w	23	15.3	46	30.7	
	7 or more t/w	38	25.3	35	23.3	
Consuming protein foods	1 or less t/w	9	6	2	1.3	0.0804
	1 – 3 t/w	25	16.8	31	20.7	
	4 – 6 t/w	46	30.9	56	37.3	
	7 or more t/w	69	46.3	61	40.7	
Consuming breads and cereals	1 or less t/w	11	7.4	6	4	0.0852
	1 – 3 t/w	34	22.8	22	14.7	
	4 – 6 t/w	40	26.8	56	37.3	
	7 or more t/w	64	43	66	44	

*Bases on chi square, P-value greater than or equal to 0.05 are considered significant.

Table 17 documents the food frequency questionnaire for the main food groups for rural and urban participant male students.

Weekly fruit consumption in rural males showed 58% reported one or less time a week, 24% from one to three times, 12.7% from four to six times, and 5.3% seven times or more compared to 39.6%, 34.2%, 18.1%, and 8.1% respectively, for urban student males ($p<0.0207$). The consumption of vegetables was varied in rural male students as 38.9% reported one time or less a week, 37.6% from one to three times, 17.4% from four to six times, and 6% seven times or more, while for urban students reported consumption was 23.3%, 41.3%, 23.3%, and 12% respectively ($p<0.0187$).

Using the same classification, weekly consumption of milk or dairy products was 28.7%, 30.7%, 15.3%, and 25.3% respectively for rural males versus 20%, 26%, 30.7%, and 23.3% respectively, for male students from the urban area ($p<0.0126$). Among rural male students, 6% reported consuming protein foods one time a week or less, 16.8% from one to three times, 30.9% from four to six times, and 46.3% seven times or more whereas urban males reported 1.3%, 20.7%, 37.3%, and 40.7% respectively ($p<0.0804$).

For consuming breads and cereals the rural student males reported increasingly 7.4% one time or less a week, 22.8% from one to three times, 26.8% from four to six times, and 43% seven times or more compared to 4%, 14.7%, 37.3%, and 44% respectively, for urban male students ($p<0.0852$).

B. 24-hour food recalls for rural and urban male students

Table18 shows that there was no significant difference in the average total consumption of energy (kcals) between urban and rural student males. The rural students had a mean energy intake less than urban students (1751 $\pm$ 613 rural vs. 1912 $\pm$ 929 urban).

Table 18: Mean and Standard Deviations of 24-hours food recall and BMI for rural and urban high school male students:

Location / Nutrients	DM (RURAL) (Mean ± SD*)	RM (URBAN) (Mean ± SD*)
Energy (kcals)	1751 ± 613	1912 ± 929
CHO (g)	238 ± 84	250 ± 113
Protein (g)	77 ± 29	75 ± 46
Fat (g)	55 ± 30[a]	71 ± 50[b]
Cholesterol (mg)	308 ± 157	333 ± 323
Iron (mg)	12 ± 4.2	11 ± 4.5
Calcium (mg)	836 ± 478	932 ± 739
Vitamin A (RE)	505 ± 482	495 ± 357
Vitamin C (mg)	71.3 ± 84[a]	131 ± 115[b]
BMI	20.8 ± 3.5[a]	28.9 ± 6[b]

*Means with different superscripts are significantly different based on t-test at $p<0.05$

No significant difference was found between the urban and the rural male students in CHO and protein consumption. Mean CHO intake for the rural students was 238 grams and for the urban students was 250 grams. The average daily intake was 77 gms. for the rural students from protein compared to 75 gms. for the urban male students. There were significant differences in the consumption of fats among both rural and urban students (55 gms. rural vs. 71 gms. urban).

The average cholesterol intake was higher than the daily recommendation, but not significantly different between the two locations. The rural student males had a mean intake of 308 mgs of cholesterol compared to 333 mgs for the urban students.

The average daily consumption of iron was 12 mgs for rural and 11 mgs for urban males. The daily consumption of calcium for rural students was lower than that for urban students (836 mgs vs. 932 mgs), which was not significantly different. Average daily consumption of vitamin A was approximately 505 RE for rural students compared to 495 RE for urban students. Average vitamin C intake was significantly lower for the rural students (71.3 mgs) compared to the urban students (131 mgs).

The average BMI for this subset of rural and urban male students was significantly different; lower among rural students compared to urban students (20.8 $\pm$ 3.5 rural vs. 28.9 $\pm$ 6 urban).

Food consumption for rural and urban females

A. Food frequency questionnaire for rural and urban female students

Table 19 documents the food frequency questionnaire for the main food groups for rural and urban participant female students. It shows that fruit consumption in rural females was 54.7% eating fruits one or less time a week, 28.7% from one to three times, 11.3% from four to six times, and 5.3% seven times or more compare to 45.3%, 32%, 17.3%, and 5.3% respectively, for urban female students ($p<0.3232$). Vegetable consumption was reported as 42.7% one time or less a week, 33.3% from one to three times, 11.3% from four to six times, and 12.7% seven times or more for rural participant student females while for urban student females consumption was reported as 22%, 34%, 24%, and 20% respectively ($p<0.0002$).

Table 19: Food frequency questionnaire for the main food groups for rural and urban female students:

Questions	Answer	Rural (n=150) Dawadami		Urban (n=150) Riyadh		P-value*
		n	%	n	%	
Eating fruits	1 or less t/w	82	54.7	68	45.3	0.3232
	1 – 3 t/w	43	28.7	48	32	
	4 – 6 t/w	17	11.3	26	17.3	
	7 or more t/w	8	5.3	8	5.3	
Eating vegetables	1 or less t/w	64	42.7	33	22	0.0002
	1 – 3 t/w	50	33.3	51	34	
	4 – 6 t/w	17	11.3	36	24	
	7 or more t/w	19	12.7	30	20	
Consuming milk or dairy products	1 or less t/w	56	37.3	35	23.3	0.0001
	1 – 3 t/w	32	21.3	31	20.7	
	4 – 6 t/w	14	9.3	47	31.3	
	7 or more t/w	48	32	37	24.7	
Consuming protein foods	1 or less t/w	21	14	11	7.4	0.002
	1 – 3 t/w	42	28	32	21.5	
	4 – 6 t/w	28	18.7	57	38.3	
	7 or more t/w	59	39.3	49	32.9	
Consuming breads and cereals	1 or less t/w	14	9.4	3	2	0.0065
	1 – 3 t/w	33	22.1	23	15.3	
	4 – 6 t/w	30	20.1	45	30	
	7 or more t/w	72	48	79	52.7	

*Bases on chi square, P-value greater than or equal to 0.05 are considered significant.

Using the same classification for weekly consumption of milk or dairy products, rural female students reported 37.3%, 21.3%, 9.3%, and 32% respectively versus 23.3%, 20.7%, 31.3%, and 24.7% respectively for female students from the urban area ($p<0.0001$). Among rural student girls 14% reported consuming protein foods one time a week or less, 28% from one to three times, 18.7% from four to six times, and 39.3% seven times or more

whereas for urban females consumption was reported as 7.4%, 21.5%, 38.3%, and 32.9% respectively ($p<0.002$).

For bread and cereal consumption, rural female students reported 9.4% one time or less a week, 22.1% from one to three times, 20.1% from four to six times and 48% seven times or more compared to 2%, 15.3%, 30% and 52.7% respectively for urban participant student females ($p<0.0065$).

B. 24-hour food recalls for rural and urban female students

Table 20: Mean and Standard Deviations of 24-hours food recall and BMI for rural and urban high school female students:

Location / Nutrients	DF (RURAL) (Mean ± SD*)	RF (URBAN) (Mean ± SD*)
Energy (kcals)	1323 ± 505[a]	1596 ± 631[b]
CHO (g)	180 ± 78[a]	226 ± 105[b]
Protein (g)	53 ± 20	57 ± 27
Fat (g)	45.7 ± 22.4[a]	56.6 ± 29.1[b]
Cholesterol (mg)	219.1 ± 169	217.5 ± 133
Iron (mg)	8.7 ± 3.8	10 ± 5.6
Calcium (mg)	647 ± 350[a]	830 ± 480[b]
Vitamin A (RE)	354 ± 180	439 ± 277
Vitamin C (mg)	80 ± 91	92 ± 88
BMI	23.2 ± 5.4	23.4 ± 5.7

*Means with different superscripts are significantly different based on t-test at $p<0.05$

Table 20 shows significant difference ($p\leq 0.05$) in the average total consumption of energy (kcals) between urban and rural student females. The

rural students have a mean energy intake less than urban students (1323 ± 505 rural vs. 1596 ± 631 urban).

Carbohydrate and fat consumption was significantly different ($p \leq 0.05$) between the urban and rural student females. Mean CHO intake for the rural students was 180 grams and for the urban students was 226 grams. There were no significant differences in the consumption of protein among both rural and urban students (53 gms. vs. 57 gms.). However, the average daily intake of fat for rural students was significantly lower than that in urban students (45.7 gms. vs. 56.6 gms.).

The average cholesterol intake met the daily recommendations. In addition, it was not significantly different between the two locations for female students. The rural students had a mean intake of 219 mg of cholesterol compared to 217 mg for the urban female students.

The average daily consumption of iron was 8.7 mg for rural and 10 mg for urban female students. The daily consumption of calcium for rural students was lower than that for urban participants (647 mg vs. 830 mg) which was significantly different ($p \leq 0.05$). Average daily consumption of vitamin A was approximately 354 RE for rural students compared to 439 RE for urban students which were not significantly different. However, average vitamin C intake was lower for rural students (80 mg) compared to urban female students (92 mg), but was not significantly different.

The average BMI for this subset of rural and urban female students was not significantly difference (23.2 ± 5.4 rural vs. 23.4 ± 5.7).

Chapter V

DISCUSSION

Age and anthropometric measurements

The results of this study show that the mean age of rural area high school students (18.15 years) was older than that of the students from urban areas (17.7 years). Delayed school registry of children is common parental behavior in rural areas of Saudi Arabia, and due to lower education levels, parents usually pay less attention to their children's studying which may lead to delayed progress through school which may explain the increase of the average age of the rural region.

The BMI for rural students (21.9) was significantly lower than that for urban students (26.1). Previous studies have shown differences in the prevalence of overweight among urban and rural areas. In 2008, Roxane et al., found that among 1,687 boys and 1,729 girls recruited from rural areas, small cities, and urban areas in the state of Iowa in the US, rural children had higher prevalence of overweight than children from urban areas and small cities (97).

Also, Wichai et al. document that there were significantly lower odds among rural men of being overweight or obese compared with urban men(98). In addition, Hodgkin et al. state from a large national cross-sectional population survey that children from rural areas had a significantly lower BMI than their urban counterparts (99). Moreover, Mascie and Goto in their review using the WHO BMI database about the universality of BMI cut-offs, stated

that in general, urban rates of overweight and obesity are higher than rural rates for both sexes (100).

In 2003, Abdul-Rahim et al, found that among urban men and women BMI levels were significantly higher compared to those of rural counterparts (101). Therefore, these results seem to be in line with several research projects focusing on BMI of youth in rural and urban areas particularly in developing countries.

Demographic information

Significant differences were found between rural and urban students who had parents who were related to each other. Rural students have significantly higher prevalence than urban students in this study. Approximately 70% of rural students compared to 55% of urban students had parents who were related to one another. In fact, it is common in Saudi Arabia and Arabic culture to get married to someone who a relative or within families. Moreover, this practice is more common among rural people than in the urban communities. Studies have indicated that overweight and obesity is highly linked to genetic factors. The evidence presented in many studies, suggests a very strong case for genetics as a cause of obesity (102).

In this study, parent education level and employment were significantly higher among parents of urban students compared to parents of rural students. Ronald et al. reported that parents of urban students are more likely to have higher levels of education and students from rural areas are more likely to come from families with lower socioeconomic status (SES) and have lower paid jobs (103).

Economic impacts on obesity in Saudi Arabia might be due to two basic reasons. First, families' low income may be linked to less available computer or electronic games, which were significantly lower among rural students therefore leading to less screen time. Second, low education of parents may affect their children's ability to learn about healthy food habits and the importance of physical activity behaviors. Physical activity may also be impacted by income. Families with lower incomes cannot enroll their children in sports clubs and activities or even afford sporting equipment like bikes, scooters, etc.

There are many studies exploring the relationship between the prevalence of overweight and socioeconomic status. Studies noted either positive or negative or no effect (49).

To determine the relationship between socioeconomic status (SES) and obesity, Lindsay McLaren, (2007) used a comprehensive list of studies published from 1988–2004. From this database she found a total of 333 published studies, representing 1,914 primarily cross-sectional associations of SES and obesity. The overall pattern of results, for both sexes, was of an increasing proportion of positive relations between SES and obesity showing that as income increased, obesity also increased. She also found a decreasing proportion of negative relations showing that obesity levels decreased with income levels.(104).

Daily activities

"Screen time" is a term used to describe (watching TV programs, movies, videotapes and ads, playing electronic games, using a computer, or

using smart phones); it will be used to describe those behaviors throughout this discussion.

This study shows that watching TV for less than one hour and from one to three hours was significantly lower among rural students. Davis et al. found that urban children engaged in more TV viewing as a sedentary activity compared to rural children (105). However, watching for more than three hours was lower among urban students. Patriarca et al. documented that children and adolescents with parents from a lower socio-economic level were more likely to view TV a longer amount of time (106).

A cross sectional descriptive study done by Sodhi conducted on 10,000 schoolchildren aged 5 years and above to identify the trends of TV viewing and playing on obesity while comparing both sexes and place of residence, found a positive relationship between TV viewing and obesity. The relationship was significantly higher among urban students compare to rural participants (107).

The American Academy of Pediatrics (AAP) has issued national guidelines to limit children's total screen time (with entertainment media) to no more than 60 to 120 minutes per day for children 2 years of age and older (108).

This research found that on average, the students reported the highest percentages overall for screen time between 1 to 3 hours or greater than 3 hours, which is higher than the recommendations.

Many studies found that there is a positive relationship between time spent watching TV and increased BMI. For example, Al-Hazzaa stated that

among Saudi children, obese children spent significantly more time watching TV than their non-obese peers (88).

Robinson documented three hypothesized mechanisms to try to explain the relationship between television and video game use and obesity. First, because time spent watching television and/or using video games is related to increased weight in children by displacing physical activity. Second, in particular, television viewing is linked to increased caloric intake either as a result of food advertising or food consumption during viewing. The third major hypothesis is that, television viewing actually decreases metabolic rates more than simply resting or sleeping (109).

Urban students, in general, came from families with higher incomes. According to the results from this study parental employment and computer ownership was more likely in urban students than cause students to decrease time spent engaged in physical active, which may lead to weight gain (110). In addition, Shi and Mao, document that excessive computer use predicts undesirable eating behaviors, which also leads to overweight and obesity (111). Vandewater et al. documented that there were a positive relationship between video game use and children's BMI status (112). Carvalhal et al. found a significant relationship between BMI and time playing electronic games for boys and girls (113). Moreover, Chaput et al. mentioned that video game playing in healthy adolescents is associated with an increase of food intake, regardless of their appetite (114). Furthermore, Al-Nuaim et al. found a relationship between greater computer usage and higher BMI for youth in Saudi Arabia (86). In addition, Al-Hazzaa et al. conducted research on adolescents from three major urban Saudi cities (Al-khobar, Jeddah and

Riyadh), which provides evidence on the high prevalence of sedentary behaviors and low levels of physical activity (20).

In Saudi driving a car even for short distances has become the norm as the country has moved to a more Western lifestyle. This is especially true in the urban areas. This change has negatively impacted the level of physical activity in Saudi Arabia. This study also found that time spent driving a car was significantly higher among rural adolescent students compared to those from urban area. However, amount of students with drivers was significantly higher in urban versus rural participants. Another factor, maybe that due to overcrowding of cars in the urban cities means that the teens spend more time in a car trying to get to a location. It is well known that adolescents in rural areas are more likely to drive a car compared to those in urban regions. Even the Department of Motor Vehicle (DMV) in most states and countries around the world usually gives earlier permission to rural teens to drive cars (in their areas) than urban adolescents according to their laws and regulations. In addition, it is also more common to have a driver in urban cities than in rural areas making them less likely to walk, which could impact their physical activity. This could impact their total amount of daily physical activity but more research is needed to determine if this correlation truly exists.

Promoting physical activity during childhood is an important strategy to avoid the increasing rates of overweight and obesity among children, youth and adults (115). The recent guidelines of physical activity levels for children and adolescents (5-18 years) recommend moderate to vigorous intensity PA for at least one hour and up to several hours per day along with minimized sedentary time (116).

Results from the youth risk behaviors surveillance in the United States, document that only 18.4% of adolescents met these physical activity recommendations (38). Physical activity levels among urban students were significantly higher than rural students. However, more than 50% of rural students and 40% of urban students did not engaged in any physical activity in this study. Other local data showed that physical inactivity was 60% in Saudi children and 70% of youth did not engage in health enhancing PA for sufficient duration and frequency (117-118).

In fact, there are some methodological difficulties in measuring physical activity which makes it hard to accurately access the number of minutes per day teens are truly physically active (113).

Al-Nuaim et al. suggest some justifications for the contrasting levels of PA between rural and urban locations. For example, some physical activities such as farm work or field activities including: plowing, planting, harvesting, and working with grazing cattle may not have been reported. In addition, there is a general lack of parks, sports facilities and playgrounds in rural areas compare to urban cities. Additionally, due to cultural factors and beliefs in rural areas of Saudi Arabia, youth engagement in PA is not regarded as a desired pursuit. Families usually encourage their children toward academic excellence rather than physical activity (86).

Wen et al. stated that a significant proportion of children who spend less than half an hour a day playing outdoors after school have important implications for physical activity promotion and obesity prevention (27). Moreover, children who spent more time in sedentary activities were of higher weight than those with engaged in physical activities (119).

Sleep duration was also found to be associated with overweight and obesity. A recent study among Saudi adolescents aged 15 to 19 years old observed a high prevalence of short sleep duration, which was significantly associated with increased risk of overweight and obesity (120).

Food and behaviors

Eating breakfast before going to school was more highly reported among rural students than urban participants; however, the difference was not significant. Davis et al. 2009, found that US urban children were more likely to skip breakfast (105). In addition, in the United States and Europe, research has shown a large prevalence of breakfast skipping (25).

Eating at fast food restaurants was significantly higher among urban students compare to rural students. Fast food consumption is one factor often held responsible for the obesity epidemic (121). Similarly, the increase of energy density and excess energy intake associated with fast food consumption has been one of the factors held responsible for the increase in public health problems (122). Higher concentration of fast food restaurants in disadvantaged neighborhoods has also been associated with the increasing the prevalence of obesity (123).

US fast food chains have responded little or not at all to calls to reduce the portion sizes of sodas, French fries, and hamburgers (124). Also, no significant association has been found between proximity to fast food outlets and BMI (35). Fast-food restaurants are more commonly located in low-income and minority neighborhoods. This may suggest fast food as an environmental contributor to the high prevalence of obesity in minority and low-income populations (123).

In fact, there are many factors that impact eating behaviors involved in consuming fast food. For example, increased portion size (big, large, supersize and free refill), snacking and night eating, low nutritional value, eating out, availability (24/7) and easy accesses (everywhere and anywhere), low price, entertainment (place for playing and small toys), sedentary life (drive through), and marketing (low price meals and advertisements). Therefore, fast food restaurants play a leading role in increased calorie consumption among all age groups and genders, which may lead to overweight and obesity especially among children and adolescents.

In this study, the BMI for males from urban areas was significantly higher than those from rural areas. Easy access to fast food and other restaurants because of their density in urban areas might be one factor that influences this difference. The most significant factor leading to the urban males higher BMI may be the lower physical activity levels.

On the other hand, the results of this study show that for female students there were no significant differences for BMI in both urban and rural females. Females 12-19 year of age are more concerned about their weight and bodies than their male counterparts. Teenage girls are more likely to be watching their weight and dieting than teenage males.

Food consumption

A. Food frequency questionnaire

In general, the food frequency questionnaire in this study showed that urban participants had a higher consumption of fruits and vegetables than rural students. Urban families tend to have a higher level of education, which

may positively influence educating children about the importance of increasing the consumption of healthy foods (125).

Studies focusing on the Arab Gulf States indicated that fruit and vegetable consumption among children and youth is not sufficient, which can impact intake of important and essential nutrients (20). Furthermore, results from the US CDC showed that about 78% of students in high school had not eaten fruits and vegetables the recommended five or more times per day during the seven days preceding the survey (38).

Results from this study show that the consumption of milk and dairy products was higher among rural students compared to urban students. This may be due to rural families having more access to local farm raised dairy cattle or/and different cultural beliefs about the importance of consuming milk as a part of their daily dietary habits.

Consumption of protein was slightly higher for urban students compared to rural. One of the factors contributing to urban students higher protein consumption may be due to high protein content of fast food meals. Another possible reason is accessibility and ability to purchase high protein foods. Children from higher income level urban families may have increased ability to buy higher protein foods compared to rural lower income families due to the higher cost.

In this study, snack and soft drink consumption was high among both rural and urban students. Platat et al. documented a significant positive relationship with snack consumption, which negatively correlated with a high vegetable and fruit intake (126). Moreover, systematic review results showed that screen time in youth was associated with a higher consumption of energy

dense snacks, drinks, fast foods, and with unhealthy dietary habits including lower fruit and vegetable intake (43).

Furthermore, Collison et al. stated a significant positive relationship between sugar sweetened beverage intake and poor dietary habits among Saudi children aged 10-19 years (127).

B. 24-hour food recalls

Based on Dietary Reference Intakes (DRI) and Dietary Guidelines Recommendations (DGR), Estimated Energy Requirements (EER) to maintain calorie balance for school children between 14-18 years of age was from 2,200 kcals for non-active males to 3,200 kcals for vigorously active males with an average of 2800 kcals for the moderately active male. Whereas for females from 1800 kcals for non-active to 2,200 for vigorously active with an average of 2000 kcals for the moderately active. This study found that the daily energy intake based on 24-hour food recall analysis for rural students was 1,537 $\pm$ 599 (mean $\pm$ standard deviation), compared to 1,754 $\pm$ 806 for urban students. Even though the mean daily caloric intake is less than the recommended levels the range of kcals was from 482 kcals per day to 4140 kcals per day with 63 students meeting the recommend caloric levels. Even though twenty-four hour recalls is one of the most commonly used methods to assess dietary intake it has several limitations. For example, reported intake was just for one random day but can be extrapolated to beyond that. It is obvious that there is a positive relationship between student's BMI and calorie intake. For instance, both BMI and calorie intake for rural students was low, whereas, for urban students the opposite was true. The consumption of CHO among both rural and urban students was higher than the DGR. Rural

students consumed significantly lower dietary fat than urban students (50.4 ± 26.7 vs. 63.9 ± 38.6) respectively. A higher energy and fat consumption among urban students were documented in comparisons between the rural and urban communities (101).

Vitamin C consumption was significantly lower among rural students compared to urban students (75.5 ± 87 vs. 111.3 ± 104) respectively. However, both rural and urban met the daily recommendation for vitamin C of between 65mg/day to 75mg/d for youth age between 14-18 years old.

The Arab Teen Lifestyle Study noted that in the last four decades there have been changes in lifestyle patterns of youth in almost all major Arab cities. This lifestyle change has led to an epidemic of youth overweight and obesity in the Arab world, especially in Saudi Arabia. They noted that unhealthy eating behaviors such as consumption of sugar sweetened beverages, fast foods, breakfast skipping, and decreased consumption of fruits and vegetables has led to this change (128). In addition, the decrease in physical activity and the increase in sedentary behaviors have compounded this problem. This research supported the previous findings so the question being raised now is, how they change the course of these unhealthy behaviors.

In general, unhealthy dietary habits and behaviors are common in youth. The problem is youth are consuming more calories than they expend and those calories are coming from energy dense, nutrient poor foods. Concepts that should be included in reaching Saudi teen age youth should include: balancing calories you eat with your physical activity, balancing nutrients from the food groups, risk factors of obesity, limiting the consumption

of fast foods, and healthy snacking. In the Arab Teen Lifestyle Study, Al-Hazzaa and Musaiger (128) stated that:

> "These formative years of adolescence represent a crucial stage in the human life cycle, as it is the stage where lifestyle habits are formed and well established. During this period, adolescents become more independent and have increased access to food choices apart from those available at home. It is also during this period that the adolescent increases his/her social interaction with peers of similar age and develops individual eating habits and physical activity patterns. Research has also shown that dietary habits are established in the mid-teens and they are closely associated with lifestyle. A better understanding of the relationships of healthy behavior among youth is necessary for effective prevention and management of lifestyle-related risk factors."

This research project has also come to the same realization that teens need to have a better understanding of the relationship between healthy eating and physical activity behaviors in an obesity prevention program.

Conclusion

Overweight and obesity has become a global issue in both developing and developed countries. It has no geographical limits. Preventing this world wide health issue is critical for all health agencies. Research over the past decade has shown this epidemic has reached crisis level in the Arab world especially in Saudi Arabia. This research project focused on the issue of overweight and obesity in urban and rural teens in the Riyadh region of the

country. However, urban youth may be at greater risk for obesity due to urban lifestyle compared to the rural teens. Rural youth who stay with traditional Arabic lifestyle of eating traditional foods, which focus more on fruits, vegetables, low fat dairy and whole grains, and being physical active by walking or farming may be at reduced risk.

Results of this research indicate the need for prevention based healthy lifestyle programming in Saudi schools. The program should include topics dealing with balancing calorie intake with physical activity; healthy food choices at home, school and in eating out; nutritional density of foods to calories; and the need for traditional foods and lifestyle compared to the western lifestyle.

It is important that the Saudi Ministry of Education take an active role in working on developing this school based program. This researcher recommends training teachers on an obesity prevention curriculum that could be implemented in their classrooms. In addition a national survey should be done to collect diet, physical activity, BMI and waist circumference data. The need for a national database would help define best practices and areas of concern.

In addition, parents need to be included in a healthy lifestyle program for their children. Parents are the decision makers and role models for their teens. They can influence their diet and physical activity behaviors. Any program implemented in schools must include a parent component.

Another possible intervention would be to look at the school environment since children spend approximately half their waking hours in school. This would include school designs such as walking/bike paths, areas

of public physical activity on school grounds, lighting of school properties so youth and their parents could be physically active in the cooler parts of day when the sun is down, and other environmental changes that would promote physical activity. Also the school can look at how school meals are prepared, displayed, and served. In 2012 the United States has begun to implement healthier school meal programs to increase fruit, vegetable, whole grain, lean protein and low-fat dairy consumption.

Changes in the eating environment can also lead to behavior changes. Recommendations such as increasing meal time so youth have more time to consumer healthier foods, offering fresh fruits and vegetables and low-fat dairy as snacks during the school day, developing an approved list of school snacks to be offered at school events, and using teachers as role models are just some of the ideas to create a healthier school environment.

Limitation

There were several limitations with this study. First, this study focused mainly on the Riyadh area in the central region of Saudi Arabia. The results of this study may not be true for the other regions of this nation. Another limitation was that the study only looked at teens who attend public schools. It did not include private schools or youth who may not be attending school especially those in the rural areas. The third limitation for this study is that it only looked at the teen's behaviors, and did not include the parents or families. The final limitation for this study was that the definition of fast foods in the rural areas in SA was not established.

Further research

Saudi Arabia needs to establish a national governmental database about overweight and obesity for children, youth, and adults. This national survey should be similar to the national conducted in the US. Another research idea is the need for a national study done on youth which includes all cities and rural areas for all regions of country. Future research also needs to be done looking at parents, families and the home environment. Finally research needs to be done on how nutrition and physical activity is promoted in the school environment in Saudi Arabia. What schools are demonstrating best practices in regards to this overwhelming health problem? How can these best practices be applied to schools throughout the country? These would be important research questions to answer in the near future.

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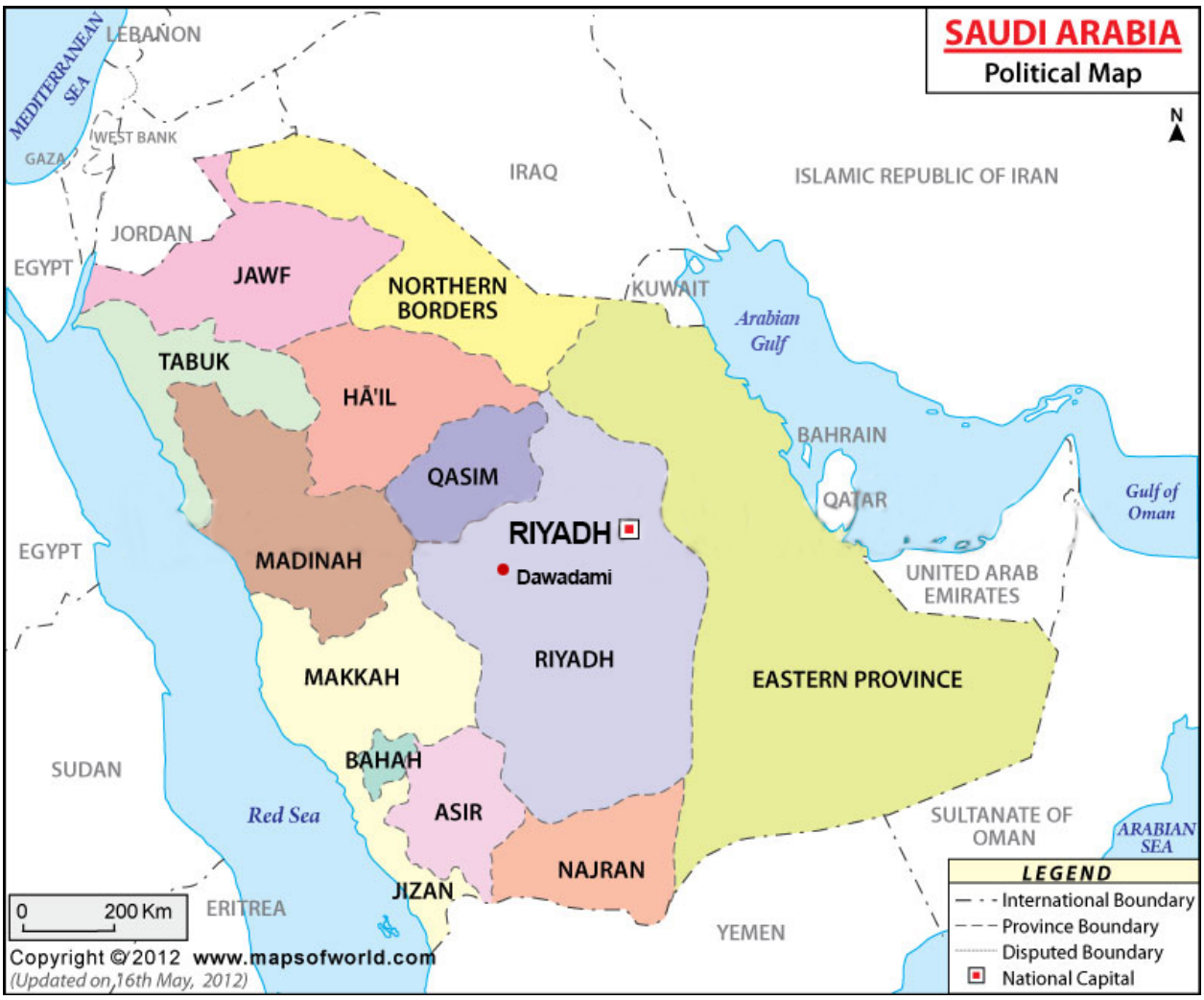
Appendix A

The Kingdom of Saudi Arabia



Appendix B

Ministry of Education Approval Letter in Arabic and English

بسم الله الرحمن الرحيم

المملكة العربية السعودية
وزارة التربية والتعليم
(٢٨٠)

وزارة التربية والتعليم
MINISTRY OF EDUCATION

الرقم: ٣٣٦٨٩٩٥
التاريخ: ١٤٣٣/١/١٠هـ
المشفوعات: -

وكالة الوزارة للتخطيط والتطوير
الإدارة العامة للبحوث

الموضوع : بشأن إجراء دراسة على عينة من طلاب المدارس الثانوية التابعة للوزارة

سعادة الأستاذ/ عمر بن إبراهيم أبو زيد وفقه الله

السلام عليكم ورحمة الله وبركاته، وبعد:

إشارة إلى خطاب سعادتكم بشأن طلب إجراء دراسة على عينة من طلاب المدارس الثانوية التابعة للوزارة حول العادات الغذائية والنشاط البدني .

نفيد سعادتكم باستلام استبيان الدراسة، وأنه لا مانع لدينا من قيامكم بتطبيق الاستبانة .

وتقبلوا وافر التحية والتقدير ،،،

مدير عام البحوث

د. محمد بن عبدالله الضويان

ص. للإدارة .
ص. لخدمات البحث
ص. للباحث .

English Translation for Ministry of Education Approval Leter

In the name of Allah the most merciful

Logo:

The Ministry of Education

Number:31775917

Date:7/7/1431

Attachments:

The Kingdom of Saudi Arabia
The Ministry of Education
Deputy Ministry of Planning and Development

Subject:

Regards conducting a study on some of the high schools that belong to the ministry

Dear Mr. Omar ibn Ibrahim Abuzaid:

Greeting,

This letter is to inform you that we have reviewed and approved your request in regards conducting a study on some of the high school students that belong to the ministry about: “Nutrition Practices and physical activity among senior high school students”.
Sincerely,

Dr. Mohammed ibn Abdullah Al-Thewian
Research Unite Director
Signature

In the name of Allah the most merciful

Logo:

The Ministry of Education

Number: 3368992

Date:10/1/1433

Attachments:

The Kingdom of Saudi Arabia
The Ministry of Education
Deputy Ministry of Planning and Development

Subject:

Regards conducting a study on some of the high schools that belong to the ministry

Dear Mr. Omar ibn Ibrahim Abuzaid:

Greeting,

This letter is to inform you that we have reviewed and approved your request in regards conducting a study on some of the high school students that belong to the ministry about: “Nutrition Practices and physical activity among senior high school students”.
Sincerely,

Dr. Mohammed ibn Abdullah Al-Thewian
Research Unite Director
Signature

Appendix C

Approval Letter by IRB

University of Nebraska Lincoln

December 9, 2011

Omar Abuzaid
Department of Nutrition and Health Sciences
601 Lakeside Dr #201 Lincoln, NE 68528

Wanda Koszewski
Department of Nutrition and Health Sciences
120C LEV, UNL, 68583-0806

IRB Number: 20111211426EP
Project ID: 11426
Project Title: Comparison of the prevalence of overweight/obesity among urban and rural school students in the central region of Saudi Arabia

Dear Omar:

The Institutional Review Board for the Protection of Human Subjects has completed its review of the Request for Change in Protocol submitted to the IRB. It has been approved to include Dr. Koszewski as secondary investigator.

We wish to remind you that the principal investigator is responsible for reporting to this Board any of the following events within 48 hours of the event:
* Any serious event (including on-site and off-site adverse events, injuries, side effects, deaths, or other problems) which in the opinion of the local investigator was unanticipated, involved risk to subjects or others, and was possibly related to the research procedures;
* Any serious accidental or unintentional change to the IRB-approved protocol that involves risk or has the potential to recur;
* Any publication in the literature, safety monitoring report, interim result or other finding that indicates an unexpected change to the risk/benefit ratio of the research;
* Any breach in confidentiality or compromise in data privacy related to the subject or others; or
* Any complaint of a subject that indicates an unanticipated risk or that cannot be resolved by the research staff.

This letter constitutes official notification of the approval of the protocol change. You are therefore authorized to implement this change accordingly.

If you have any questions, please contact the IRB office at 472-6965.

Sincerely,

Julia C. Torquati

Julia Torquati, Ph.D.
Chair for the IRB

Appendix D

Informed Consent Form

Informed Consent Form

Title: Comparison of prevalence of obesity/overweight among urban and rural school students in Saudi Arabia.

You are invited to participate in this research study that will determine the prevalence of obesity among urban and rural school students in Saudi Arabia. You have been asked to participate in this study because of your age and area/location. This sponsored by the University of Nebraska Lincoln (UNL).

Participation in this study is entirely voluntary. Participation will asked to take your weight and height. Questionnaire will be given to get information about demographic, physical activity, basic family history and food consumption. 24-hour food recalls will be provided. Child health record will be obtained from the school. Participation will be during school hours, it will take 30-45 minutes in a quiet room in the school.

You may not benefit directly as a result of taking part in this study, but knowledge may be gained that might benefit others and future studies in Saudi Arabia.

There will be no risks or discomforts in this research.

Beneficial information will provided from this study about the present dietary intake and actual physical activity for schoolchildren from different areas in Saudi Arabia. In addition, recognition the nutritional status will help to determine the possible reasons of the prevalence of overweight and obesity among school students to prevent or treatment it to reduce the dangerousness of overweight and obesity and to decrease the expected costs of treatment for it and its disorders.

No compensation will be there for participating in this study.

All data gathered from this study will be kept strictly confidential. The information will kept in locked office and will be seen by the researchers only during the study and for five years after the complete of research. The results of this study may be published in scientific journals or presented at professional meetings.

You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with your school or the investigators or the University of Nebraska Lincoln.

You may ask any questions concerning the study either before or during participate this research. If you have any questions that have not been answered by the researchers about your rights of this research, you may contact the University of Nebraska-Lincoln Institutional Review Board (UNLIRB), Telephone (402) 472-6965 or email at irb@unl.edu.

Your signature certifies that you having read and understood the information presented, you have decided to participate. You will be given a copy of this consent form to keep. Thank you,

Name: **Signature:** **Date:**

Investigators:

Omar Abuzaid **E-mail: oabuzaid@yahoo.com** **(Office): (001)-(402)-472-7984**

Dr. Wanda Koszewski **E-mail: wkoszewski1@unl.edu** **(Office): (001)-(402)-472-7966**

Appendix E

Questionnaire with food frequency and 24-hour food recall in Arabic and English

استبيان حول العادات الغذائية والنشاط البدني

الهدف من هذه الدراسة هو لمعرفة اذا كان هناك اي فروقات في تناول الاغذية والنشاط البدني لدى طلاب السنة الاخيرة من المرحلة الثانوية في قرى ومدن المنطقة الوسطى للمملكة العربية السعودية.

يرجى الاجابة على الأسئلة التالية بقدر المستطاع. اجاباتك سوف تحفظ بسرية تامة ومجمل البيانات سوف تستخدم فقط لاتمام رسالة الدكتوراه.

القسم الأول: الديموغرافيا

الطول: _____ سم. الوزن: _____ كجم. مؤشر كتلة الجسم: _____ الجنس: _____

الرقم:_____ اسم المدرسة:_____

العمر:_____ سنة تاريخ اليوم:____/_____/_____20 م

---

1. هل هناك صلة قرابة بين الوالدين؟

☐ نعم ☐ لا

2. انت تسكن مع:

☐ الأب فقط ☐ الأم فقط ☐ كلاهما ☐ لا احد منهما

3. ما هو المستوى التعليمي لوالدك؟

☐ اقل من الثانوي ☐ ثانوي ☐ اعلى من الثانوي

4. ما هو المستوى التعليمي لوالدتك؟

☐ اقل من الثانوي ☐ ثانوي ☐ اعلى من الثانوي

5. هل الوالدين لديهم وظائف حالياً ؟

☐ الأب فقط ☐ الأم فقط ☐ كلاهما ☐ لا احد منهما

القسم الثاني:

هذا القسم من الاستبيان سوف يستفسر عن كيفية قضاء وقتك بالنشاطات اليومية.

1. كم ساعة في اليوم تقضيها في مشاهدة التلفاز؟

☐ اقل من ساعة ☐ 1-3 ساعات ☐ اكثر من 3 ساعات

2. هل لديك كمبيوتر؟

☐ نعم ☐ لا

اذا كان الجواب نعم، كم ساعة في اليوم تقضيها على الكمبيوتر؟

☐ اقل من ساعة ☐ 1-3 ساعات ☐ اكثر من 3 ساعات

3. هل تلعب العاب الفيديو أو العاب الكمبيوتر؟

☐ نعم ☐ لا

اذا كان الجواب نعم، كم ساعة في اليوم تقضيها على العاب الفيديو/الكمبيوتر؟

☐ اقل من ساعة ☐ 1-3 ساعات ☐ اكثر من 3 ساعات

4. كيف تأتي الى المدرسة في الغالب؟

☐ مشياً على الأقدام ☐ بالباص ☐ بسيارتك الخاصة ☐ مع السائق

5. هل تقود سيارة؟

☐ نعم ☐ لا

اذا كانت الاجابة نعم، فكم ساعة في اليوم تقضيها غالباً في ممارسة القيادة؟

☐ اقل من ساعة ☐ 1-3 ساعات ☐ اكثر من 3 ساعات

6. هل تمارس اي نشاط بدني او رياضي؟

☐ نعم ☐ لا

اذا كان الجواب نعم، ما هو نوع الرياضة او النشاط البدني الذي تمارسه

_____.

اذا كان الجواب نعم، كم ساعة في اليوم تقضيها غالباً في ممارسةِ النشاط؟

☐ اقل من ساعة ☐ 1-3 ساعات ☐ اكثر من 3 ساعات

7. ما هو معدل ساعات نومك في اليوم؟

☐ اقل من 7 ساعات ☐ 7-8 ساعات ☐ اكثر من 8 ساعات

القسم الثالث: هذا القسم من الاستبيان يستفسر عن اوقات الوجبات، نوع الغذاء، مكان تناول الوجبة، مدى تكرار تناول بعض الأغذية، الحساسية للأغذية، والأمراض المتعلقة بالغذاء.

8. هل تتناول الافطار قبل الذهاب للمدرسة؟

☐ نعم ☐ لا

9. هل تتناول طعاماً في المدرسة؟

☐ نعم ☐ لا

10. هل تأكل في مطاعم الوجبات السريعة؟

☐ نعم ☐ لا

اذا كانت الاجابة نعم، فكم مرة خلال الأسبوع غالباً تأكل هناك؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

11. هل تتناول المشروبات الغازية؟

☐ نعم ☐ لا

اذا كانت الاجابة نعم، فكم مرة خلال الاسبوع تتناولها؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

12. هل تتناول مشروبات الطاقة (بايسون، رد بول، هورس باور، ...)؟

☐ نعم ☐ لا

اذا كانت الاجابة نعم، فكم مرة خلال الاسبوع تتناولها؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

13. كم مرة غالباً تتناول الفواكه؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

14. كم مرة غالباً تتناول الخضروات؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

15.كم مرة غالباً تتناول الحليب أو منتجاته؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

16. كم مرة غالباً تتناول البروتينات (اللحوم مثل الغنم، البقر، الابل، الدواجن، الأسماك و/او البقوليات مثل الفول، العدس، الفاصوليا) ؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

17. كم مرة غالباً تتناول الخبز و الحبوب (الأرز، القمح، الجريش، الذرة، الشوفان) ومنتجاتها؟

☐ مرة او اقل اسبوعيا ☐ 1-3 مرات اسبوعياً

☐ من 4-6 مرات اسبوعياً ☐ 7 مرات او اكثر اسبوعياً

18. هل تتناول وجبات خفيفة بين الوجبات (آيسكريم، شكولاته، بسكويت، بطاطس، كيك، مكسرات، ...)؟

☐ نعم ☐ لا

اذا كانت الاجابة نعم، كم مرة في اليوم غالباً تتناول الوجبات الخفيفة؟

☐ مرة يومياً ☐ 1-3 مرات يومياً ☐ اكثر من 3 مرات يومياً

اذا كانت الاجابة نعم، فضلاً اذكر الغالب تناوله من هذه الوجبات الخفيفة؟

_____.

19. هل لديك اي نوع من الحساسية للطعام او عدم القدرة على هضمه؟

☐ نعم ☐ لا

اذا كانت الاجابة نعم، فما هو نوع الغذاء الذي يسبب الحساسية أو عدم القدرة على الهضم؟

_____.

20. هل لديك اي اضطرابات في الغدد مثل تضخم الغدة الدرقية او عدم نشاطها؟

☐ نعم ☐ لا

21. هل انت مصاب بالسكري او سبق تنبيهك لمراقبة السكري؟

☐ نعم ☐ لا

22. هل لديك أي مشاكل صحية؟

☐ نعم ☐ لا

اذا كانت الاجابة نعم، يرجى ذكر هذه المشاكل الصحية:

_____.

23. هل لديك أي ملاحظات تود المشاركة بها؟

_____
_____
_____
_____
_____
_____

_____ شكراً لكم.

استمارة تذكر الغذاء المتناول خلال 24 ساعة

ليوم:_____ الموافق لتاريخ: _____/_____/_____20 م

اذكر جميع الأغذية والمشروبات التي تناولتها منذ استيقاظك صباحاً وحتى نومك ليلاً.

- لوقت الوجبة الغذائية، يرجى ذكر موعد الوجبة: الصباح، الضحى، الظهر، بعد الظهر، المساء، او المساء المتأخر (قبل النوم).
- اذكر جميع مكونات الطبق (مثلاً: بيتزا، طبقة رقيقة بالسجق اوالنقانق، ببروني، فطر المشروم).
- يرجى ذكر التفاصيل فيما يتعلق بكمية ونوعية الوجبة المتناولة قدر المستطاع (ملعقة صغيرة، ملعقة كبيرة، كأس او كوب، حبة، شريحة، قطعة، جم، مل، لتر، طبق، كبير، متوسط، صغير ...)، النوع (لحم غنم، صدر دجاج، مرقة خضار: قرع ع بطاطس مع كوسة، سلطة: خيار، طماطم، خس...)، وطريقة طبخ واعداد الطعام (مسلوق، مقلي، مشوي ...).

مثال تطبيقي:

وقت الوجبة	الطعام والمشروبات	الكمية وطريقة الاعداد
الصباح	شرائح خبز مع جبن	شريحتين من خبز التوست مع شريحة جبن
	شاي	2 كأس
الظهر	كبسة (ارز مع لحم أو دجاج)	طبق كبير- مسلوق
	سلطة (خيار مع طماطم مع خس)	طبق متوسط
	لبن	كوب (240 مل)
بعد الظهر	قهوة عربية	1 كوب
	تمر	7 حبات
المساء	ساندويش دجاج (خبز صامولي محشي بالدجاج)	1 ساندويش
	ببسي	1 علبة
المساء المتأخر	زبادي أو تفاح	علبة أو حبة

وقت الوجبة	الطعام والمشروبات	الكمية وطريقة الاعداد

Dietary Practice and Physical Activity Questionnaire

The purpose of this study is to determine if there are differences in food consumption and physical activity among urban and rural senior high school students in central region of Saudi Arabia. Please answer the following questions to the best of your ability. Your answers will be kept confidential and only aggregated data will be used for the completion of a doctoral dissertation.

Height: _____cm. Weight: _____kg. BMI: _____ Gender: _____

ID. Code: _____ School's Name: _____

Age:_____years date: ____/_____/ 20____

Section I: Demographics:

1- Are your parent's relatives of each other?

☐ Yes ☐ No

2- You are living with:

☐ Dad only ☐ Mom only ☐ Both ☐ None

3- What is your Father's level of education?

☐ < High school ☐ High school ☐ > High school

4- What is your Mother's level of education?

☐ < High school ☐ High school ☐ > High school

5- Do your parents currently have jobs?

☐ Dad only ☐ Mom only ☐ Both ☐ None

Section II: This section of the survey will be asking you questions in regards to how you spend your time throughout the day in daily activities.

1. How much time do you spend watching T.V. a day?

☐ < 1 hour ☐ 1 – 3 hours ☐ > 3 hours

2. Do you have computer?

☐ Yes ☐ No

If yes, how many hour/day do you spend on them?

☐ < 1 hour ☐ 1 – 3 hours ☐ > 3 hours

3. Do you play video games or computer games?

☐ Yes ☐ No

If yes, how many hour/day do you spend on them?

☐ < 1 hour ☐ 1 – 3 hours ☐ > 3 hours

4. How do you come to school often?

☐ Walking ☐ By bus ☐ By your car ☐ With driver

5. Do you drive a car?

☐ Yes ☐ No

If yes, how many hour/day do you spend on driving?

☐ < 1 hour ☐ 1 – 3 hours ☐ > 3 hours

6. Do you do any physical activity?

☐ Yes ☐ No

If yes, what type of physical activity do you do?

_____.

If yes, how many hour/day do you spend often?

☐ < 1 hour ☐ 1 – 3 hours ☐ > 3 hours

7. How many hours of sleep do you get on average each day?

☐ < 7 hours ☐ 7-8 hours ☐ > 8 hours

Section III: This section of the survey will be asking you questions in regards to meal time, type of foods you select, place where you eat meals, frequency of consuming certain foods, food allergies, and diseases related to food intake.

8. Do you eat breakfast before going to school?

☐ Yes ☐ No

9. Do you eat at school?

☐ Yes ☐ No

10. Do you eat at fast food restaurantes?

☐ Yes ☐ No

If yes, how many times/week do you eat often?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

11. Do you consume soft drinks (pop, soda, cola)?

☐ Yes ☐ No

If yes, how many can/day do you drink often?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

12.Do you consume energy drinks (pyson, red ball, horse power, …)?

☐ Yes ☐ No

If yes, how many can/day do you drink often?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

13. How often do you eat fruit?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

14. How often do you eat vegetables?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

15. How often do you consume milk or dairy products?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

16. How often do you consume protein foods (meats like lamb, beef, camel, chicken, fish and/or Legumes like beans, lentils, nuts)?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

17. How often do you consume breads and cereals (rice, wheat, groats, corn, oats) and its products?

☐ 1 or less time/week ☐ 1 – 3 times/week

☐ 4 – 6 times/week ☐ 7 or more times/week

18. Do you eat snacks (ice cream, chocolate, biscuit, chips, cake …)?

☐ Yes ☐ No

If yes, how many times/day do you often eat?

☐ 1 time/day ☐ 1 – 3 times/day ☐ > 3 times/day

If yes, what kind of snaks do you eat?

_____.

19. Do you have any food allergies or food intolerances?

☐ Yes ☐ No

If yes, what type of allergies or food intolerances do you have?
_____.

20. Do you have any genetic gland disorders such as enlarged thyroid or an inactive thyriod?

☐ Yes ☐ No

21. Do you have Diabetes Mellitus or have you been told that you need to watch your sugars?

☐ Yes ☐ No

22. Do you have any medical problems?

☐ Yes ☐ No

If yes, please explain:
_____.

23. Do you have any comments or anything else you would like to share?

_____
_____
_____
_____
_____
_____
_____. Thank you

24-Hours Food Recall Form

For Day: _____Date: ____/____/20____

List all foods and drinks you ate/drank.

- For Meal Time, please write: Morning, Midmorning, Noon, Afternoon, Evening, or Late Evening
- List all ingredients in mixed dishes (ex: pizza, thin crust with sausage, pepperoni, mushrooms)
- Include as much detail as possible regarding amount, type, and preparation of food
- Use the following abbreviations: TBSP = tablespoon; tsp = teaspoon; c = cup; oz = ounce; lb = pound; sl = slice; p=piece

Example		
Meal Time	**Food and Drinks**	**Amount and how preparation**
Morning	Toast with cheese	2 slices of toast with 1 slice of cheese
	Tea	2 c
Noon	Kabsah (rice with lamp or chicken)	1 big boiled plate
	Salad with cucumbers and tomatos	1 medium plate
	Laban (butter milk)	1 c
Afternoon	Arabic coffee	1 c
	Dates	7 p
Evening	Sandwich of chicken (samoli bread stuffed with chicken)	1
	Pepsi	1 can
Late Evening	Apple or Yogurt	1

Meal Time	Food and Drinks	Amount and how preparation