PREVALENCE OF CARDIOVASCULAR DISEASE RISK FACTORS AND MEETING NUTRITION RECOMMENDATIONS IN KUWAITI SCHOOLCHILDREN BY GENDER AND WEIGHT STATUS

By

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ABSTRACT

PREVALENCE OF CARDIOVASCULAR DISEASE RISK FACTORS AND MEETING NUTRITION RECOMMENDATIONS IN KUWAITI SCHOOLCHILDREN BY GENDER AND WEIGHT STATUS

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Cardiovascular disease (CVD) is the leading cause of death globally, responsible for 17.5 million deaths (31%) annually. In Kuwait, CVD accounts for 41% of all deaths. In the 1980s Kuwait had economic growth that influenced food supply and led to a higher intake of caloric dense foods in children, which contributed to increases in childhood OB rates (<1% in 1985 and 31% in 2012). The most recent nutrition study on Kuwaiti children was conducted in 2008–2009 and indicated that ~80% of children did not meet nutrition recommendations, and ~50% exceeded their kcal needs. However, limited studies reported on the prevalence of multiple CVD risks or gender differences. Thus, the primary study objectives were to evaluate a sample of Kuwaiti schoolchildren to determine: 1) the prevalence of CVD risk factors, and if boys will have greater risks than girls; 2) the proportion meeting the US Dietary Guidelines for Americans (DGA) and DRIs, and the WHO joint Food and Agriculture Organization (FAO) nutrition recommendations, and if boys meet fewer recommendations than girls; 3) in a sample of OB, OW, NW and UW children determine if there are differences between weight categories in 1) prevalence of CVD risks 2) meeting US and WHO/FAO nutrition recommendations. Design: A cross-sectional analysis of 367 fifth-graders (age10.4 ± 0.4 years; 53% girls) in Kuwait. Measures: Anthropometric and biometric assessments were conducted to obtain CVD risk factor variables, and an Arabic/English food frequency questionnaire (FFQ) was used to obtain nutrition variables. The CVD risk factor variables were: OW, OB, at risk levels of TC, TG, HDL, TC:HDL, non-HDL, LDL, systolic blood pressure (SBP) and diastolic BP (DBP). Nutrition variables: food groups, macronutrients, and selected micronutrients. Statistical analysis included general linear models and logistic regression controlling for physical activity (PA), screen time (ST), and Kcals with $P \leq 0.05$. Results: Objective 1: The overall prevalence of OB 39%, at risk BP 23%, and dyslipidemia ranged from 13.2 % to 45.5%. The OB prevalence was not significantly different between gender, though girls had a significantly higher prevalence of OW, and at risk TG, HDL and BP, than boys. Objective 2: The proportion of children meeting the nutrition recommendations was <50% for most variables and ~70% exceeded Kcal needs. There were few significant gender differences. More boys met fruit recommendations while more girls met vegetable and sodium recommendations. Objective 3: OB children had a greater prevalence of at risk for TG, HDL and TC:HDL and BP, while NW children had a greater prevalence of TC and LDL than OB children. The only significant differences for meeting nutrition recommendations by weight status group; more OW met sodium, more OB met protein, and more UW met carbohydrate recommendations. Conclusion: Based on the findings of the three objectives in Kuwaiti children 1) The prevalence of OB has increased, and the prevalence of dyslipidemia and elevated BP are high, particularly among girls, and was contrary to our hypothesis. 2) Few children met nutrition recommendations with few gender differences. 3) As expected, OB children had the highest prevalence of CVD risks; however, NW also had concerning levels of dyslipidemia. These findings indicate a need for CVD risk assessment, and intervention programs for Kuwaiti children regardless of weight status, to improve dietary and other lifestyle behaviors to prevent or reduce CVD risks

This dissertation is gratefully dedicated to the children of Kuwait, to my family and friends, and to every person in Kuwait and in the United States who contributed to the success of this work.

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KEY TO ABBREVIATIONS

%BF:	percent body fat
AI:	adequate intake
AMDR:	acceptable macronutrient distribution Range
AHA:	American Heart Association
BMI:	body mass index
BP:	blood pressure
CVD:	cardiovascular disease
DBP:	diastolic blood pressure
DGA:	dietary guidelines for Americans
DRI:	dietary reference intake
FAO:	Food and Agriculture Organization of the United Nations
FI:	dietary fiber index
g/day:	grams per day
HDL:TC:	high-density lipoprotein-total cholesterol ratio
HDL-C:	high-density lipoprotein cholesterol
HEI:	healthy eating index
IOTF:	International Obesity Task Force
kcals:	kilocalories
kg:	kilogram
KNSS:	Kuwait National Nutrition Surveillance System
LDL-C:	low-density lipoprotein cholesterol
mcg/day:	micrograms per day

mg/day: milligrams per day

MVPA: moderate and vigorous physical activity

NCEP: National Cholesterol Education Program

NCHS: National Center for Health Statistics

NHANES: National Health and Nutrition Examination Survey

non-HDL: non-high-density lipoprotein

OB: obese

OW: overweight

PA: physical activity

RDA: recommended dietary allowance

RNI: recommended nutrient intake

SBP: systolic blood pressure

ST: screen time

TG: triglycerides

TC: total cholesterol

UL: tolerable upper intake level

WC: waist circumference

WHtR: waist-to-height ratio

WHO: World Health Organization

CHAPTER 1: INTRODUCTION

Background/Overview

A This chapter will first provide a global overview of concerns related to cardiovascular disease and an overview of concerns on children in Kuwait. This is followed by a summary of CVD risk factors, including the role of diet behaviors and inactivityThis includes literature on the prevalence of childhood OB, dyslipidemia, and elevated blood pressure BP is reviewed. The emphasis of literature review will be on Kuwaiti children since they are the focus of this research. This will be followed by the gap in the literature and the study rationale for the study objectives which are listed.

According to the World Health Organization (WHO), cardiovascular disease (CVD) is the leading cause of non-communicable disease (NCD) deaths worldwide [6] and responsible for approximately 31% of total global deaths annually [7-9]. It is predicted that by the year 2020, coronary artery disease (CAD) and stroke will be the first and second leading cause of death and of loss of disability-adjusted life years [9]. A concern in many countries is the increase in obesity (OB) and other CVD risk factors in children, which has been linked to changes in dietary behaviors including increases in refined and added sugar and saturated fat intakes and decreases in physical activity (PA). The most recent OB data from Kuwait indicates 31% of children aged 6–18 (34% of boys and 28% of girls) are OB [1 2].

Cardiovascular disease (CVD) is a broad term, which includes diseases of the heart and systemic circulatory system, including coronary heart disease (CHD), myocardial infarction, stroke and transient ischemia, congestive heart failure, valvular heart disease, rheumatic heart disease, peripheral arterial disease and congenital heart failure [1]. The Framingham Heart Study indicates that hypertension, dyslipidemia, smoking, diabetes and OB are primary risk factors of CVD in adults [3-8]. The Bogalusa Heart Study indicates that the initial signs of atherosclerosis are “fatty streaks” (comprised of cholesterol, triglycerides and blood clotting factors), which have been shown to accumulate in the thoracic and abdominal aorta and the right coronary artery as early as age two. [9] Cardiovascular risk factors tend to increase with age and vary according to gender, ethnicity, activity level, diet quality, alcohol consumption, smoking, stress and depression [10-12]. Selected studies have indicated that CVD risk factors vary between boys and girls. Possible reasons for this include physiological factors such as variance in rates of growth and maturation, environmental factors (such as parental OB), chronic diseases, nutrition and physical inactivity [13]. Poor dietary intake (high-energy and nutrient-dense diet) is an independent risk factor for atherosclerosis in children. [14] [9] [10]

According to the Global Burden of Disease database, OB, hypertension, dyslipidemia, poor dietary quality, and physical inactivity are significant contributors to chronic diseases including CVD. [20-22] It is established that nutrition influences many CVD risk factors, [15] including, dyslipidemia, type 2 diabetes, and hypertension with or without OB. [16 17] Based on this and other evidence, there are many organizations that have guidelines to combat this burden. This includes the US Department of Health and Human Services (HHS), US Dietary Guidelines for Americans, the WHO, the American Heart Association (AHA), and the American Academy of Pediatrics, which all have pediatric specific guidelines that emphasize the importance of healthy nutrition and PA behaviors to prevent CVD and other chronic diseases. [18-22] and other health organizations have created nutrition and PA recommendations. [23-28] The HHS, AHA, and WHO recommend at least 60 minutes of moderate-to-vigorous PA per day for children and adolescents. [59, 176]

Physical inactivity is the fourth leading cause of death worldwide [23]. The PURE study (2003–2010) examined the association between the amount of PA and mortality from CVD in 130,000 people from 17 high, middle and low-income countries and showed that low PA was associated with mortality (6%), myocardial infarction (3%), stroke (2%) and heart failure (0.42%) [24]. The European Youth Heart Study assessed associations between PA duration and clustering CVD risk factors in 1,732 randomly selected 9–15 year-old schoolchildren and indicated decreased odds of metabolic disorders with PA bouts above 2000 cpm (equivalent to walking about 4 km/h) for 116 min in 9-year-olds and 88 min in 15-year-olds [25]. In essence, CVD morbidity and mortality increase with physical inactivity, which can lead to other potential CVD risks such as OB.

Obesity is an independent risk factor, hence a potential determinant of CVD through increased risk for hypertension, dyslipidemia and elevated blood glucose, in addition to inflammatory markers and thrombogenic factors. [5, 30-32] Between 1990 and 2010, the percentage of childhood OB worldwide increased from 4.2% to 6.7%; it is expected to reach 9.1% (60 million children) by 2020 [21]. Increased intake of unhealthy dietary calories (high fat, processed food and sugar) has been linked to OB, dyslipidemia and elevated blood glucose in children. [18]

Obese children tend to have more CVD risk factors than non-OB children. Nutrição et al. (2012) assessed factors associated with dyslipidemia (elevated TG and TC) in 937 children aged 7–14. The study reported higher prevalence and likelihood of dyslipidemia in OW and OB categories (26.4% and OR 3.10 [1.949–4.931]) than in normal weight (NW) categories (20.2% and OR 0.83 [0.471–1.369]) [26]. Among 1,482 children aged 8–17, the National Health and Nutrition Examination Survey (NHANES) (2011–2012) reported higher prevalence of dyslipidemia (high TC, low HDL or high non-HDL) in OB (39.3%) than in OW (18.2%) and NW (14.6%) children. [27] Moreover, NHANES (1999–2014) data on 15,647 children and adolescents aged 5–18 demonstrates prevalence of elevated BP (14.2%) mostly in OW (≥85th percentile, 35.9%) and OB (≥95th percentile, 19.5%) children. [28] Despite this, some non-OB children may have one or more CVD risk factors, though the prevalence of CVD risk factors in non-OB Kuwaiti children is unknown.

In Kuwait, CVDs contributed to the highest portion (41%) of total deaths from non-communicable diseases in 2012. [29] One main reason is poor public knowledge about CVD and its causes and risk factors, leading to lack of prevention. [30] Previous studies and reports in Kuwait have presented evidence that poor dietary intake and physical inactivity are prevalent among the majority of the Kuwaiti population. [1 31-38] There is a lack of assessment and tracking of CVD risk factors in non-OB children especially [45], and the risk of CVD exists with and without OB.

The majority of previous published studies focus on the increasing OB rate in Kuwait. [46-62] The Kuwaiti Nutrition Surveillance System (KNSS, 2012) reported rates of 21.7 % for OW and 36% for OB adults [39], which has been considered among the highest rates in the Arab Peninsula [40] and globally. Moreover, childhood OB is notably of concern among preschoolers and school-aged boys and girls. [41-45] A study during 2008–2009 on Kuwaiti children aged 9–13 estimated prevalence of OB at 36.5% of (a sample of 111) boys and at 24% of (a sample of 94) girls. [63] A study from 2012–2013 on Kuwaiti youth aged 6–18 reported a prevalence of OW (17.7% and 21.6% based on CDC and WHO criteria, respectively) and an alarming rate of OB (33.9% and 30.5% based on CDC and WHO criteria, respectively). [2]

Data describing rates of OW and OB in Kuwaiti children vary between studies. This is in part due to variations in sample sizes and statistical methods and the use of different categorical standards and cut points. For example, NHANES-I has cut points of 85th and 95th percentiles (NCHS/WHO); the age- and sex-specific BMI cut points are based on the International Obesity Task Force (IOTF) and weight or height standard scores (z-scores) are based on the National Center for Health Statistics (NCHS) reference (utilized by childhood OB studies in Kuwait) [2 46]. In contrast to this, a 2012–2013 evaluation shows variations in estimating the prevalence of OW and OB among youths aged 6–18, based on CDC (2000), WHO (2007) and IOTF references. The IOTF and WHO values demonstrate a higher rate of OW at 23.3% and 21.6% respectively, compared to the CDC value of 17.7%. However, the IOTF and WHO (2007) references show a lower rate of OB at 28.2% and 30.5% respectively, compared to the CDC value of 33.9% [2]. Clearly, the findings vary depending on the reference used. This may indicate that the CDC reference (NHANES data) and cut point (≥95th percentile) for OB is not applicable for international use. The IOTF is constructed based on international longitudinal data (US, UK, Hong Kong, the Netherlands, Singapore and Brazil) [47 48]. The WHO standards (2007) merge international cross-sectional data (0–5 years old) with NHANES (NCHS/WHO, 1977), whereas the CDC (2000) includes only NHANES II and III data [49 50]. In essence, any other equivalent measure for a specific population subgroup, the use of national reference curves, or a reference developed for international comparisons, such as the IOTF [51 52], would be more beneficial for tracking the rate of OB in Kuwaiti children.

BMI z-score is a measure of relative weight adjusted for child age and sex. It is commonly used in cross-sectional and cohort studies for evaluating weight status and changes in OB in schoolchildren. A prospective study in children aged 6–13 indicates that BMI z-score reveals a linear increase in cardiometabolic risk factors across the entire range of BMI values regardless of thresholds [53]. BMI z-score was found to be significantly (*P* <.01) but negatively associated with energy intake and daily food intake in 2–9 year-old children [54]. In another cross-sectional study, of 148 schoolchildren in grades 4–8, BMI z-score was found to be significantly associated (*P*<.001) with low HDL-C and high triglycerides (TG) [55]. However, BMI z-score has shown less validity for following data over time.

Waist circumference (WC) and derived waist-to-height ratio (WHtR), in addition to percentage body fat (%BF, or skin folds) are surrogate anthropometric indices for estimating abdominal OB and body fat (visceral and subcutaneous), considered as predictors of risks for CVD in children [56]. For US children and adolescents, percentile curves for WC and cardiovascular risk factors (lipid profile) were established based on NHANES surveys (1988–1994 and 1999–2006) combined with the Bogalusa, Fels, Muscatine and Princet datasets. For example, abnormal cut-off values of serum TG (≥150 mg/dL) for boys and girls were assigned at 85th and 90th percentiles, respectively. At or after age 11, serum TG peaks in girls, while HDL declines in boys [57]. Agredo-Zúñiga et al. (2015) evaluated the association of WC and WHtR with metabolic syndrome (MetS), adjusted for BMI and skin folds, in 1,672 adolescents aged 10–17, 50% of whom were girls. The study indicated that high WC (≥90^{th} percentile) was associated with high TG (≥110 mg/dL) in boys (OR= 2.57 [95% CI: 1.91–3.44) and girls (OR= 1.92 [95% CI: 1.49–2.47]) and with high BP, particularly in girls (OR= 3.07 [95% CI: 1.58–5.98]), whereas high WHtR (>0.50) was associated with high TG in girls (OR= 1.99 [95% CI: 1.55–2.56]) only [58]. Percentage body fat (%BF) is an important indicator of body fatness, or adiposity, which is difficult to estimate via BMI, or WC and WHtR (which measure abdominal fatness). Bibiloni et al. (2013) interpreted the WHO measures of BMI, fat mass index (FMI) and

WHtR across weight categories in 1,231 adolescents aged 12–17. The results show that some boys and girls with normal %BF (1.3% and 3%) and normal WHtR (9.5% and 4%) were classified as OB. [59] Therefore, %BF, and WC and WHtR, are useful surrogate anthropometric indices for distinguishing body fat from body mass (BMI), and for identifying differences in CVD risk factors in children of different sexes, respectively.

Studies described the prevalence at risk of CVD, particularly dyslipidemia, in Kuwaiti children or have compared by gender are not available. A paired-matched case-control study from 1995–1996 reported adverse effects of OB versus a non-OB control group on serum lipids and BP in 460 OB Kuwaiti schoolchildren aged 6–13. [60] The data shows that 38 (8.3%) OB and 3 (0.7%) non-OB children had elevated systolic blood pressure (SBP) >130 mmHg and only 3 OB children had elevated diastolic blood pressure (DBP) >90 mmHg. SBP and DBP indicated a significant correlation with BMI among OB (r=.333, P<0.001) boys and girls, with significant weak correlation among non-OB (r=.156, P<0.01) children. The study also indicated that BMI was positively correlated with mean TG (r=.198, P<0.001), which was higher among OB boys than girls, and inversely correlated with mean high-density lipoprotein cholesterol (HDL-C) (r=-.204, P<0.001), which was relatively lower among OB girls than boys. The data of the study has also indicated other mean serum blood lipids which were higher in OB boys than girls include total cholesterol (TC), low-density lipoprotein (LDL), and TC:HDL. Whereas among non-OB, the mean levels of TG, LDL, and TC:HDL, except for TC, were similar between boys and girls. In summary, this study has indicated that boys, especially with a higher prevalence of OB than girls discussed earlier, would be at risk for CVD than more than girls.

With respect to nutrition in Kuwait, there is a lack of data describing dietary intake such as macronutrients (including saturated fat and trans fat and added sugar) and food groups and evaluating dietary quality. The KNSS was established in 1995 and is based on WHO/Eastern Mediterranean Regional Office (EMRO) guidelines [61 62]. The KNSS does not report data on dietary behavior and intake of children above five years of age [1]. Despite WHO jointed with the Food and Agriculture Organization (FAO)-established international nutrition guidelines for nations that lack national nutrition guidelines (including Kuwait) [21 22 63-65], there are no available data indicating the use of WHO/FAO nutrition recommendations for Kuwaiti children. A study of 1704 members of the Kuwaiti population aged 3–86, conducted during the period 2008–2009 by Zaghloul et al. (2012), describes nutrient intakes based on US Department of Agriculture (USDA) 5-step multiple-pass single 24-hour recalls. Its findings show that ~ 50% of children and ~ 33% of adults exceeded the recommended energy intake. In addition, 78%–100% of the study population exceeded the estimated average requirement (EAR) of protein and carbohydrates. The dietary recommendation for sodium intake was exceeded by two-thirds of males above four years of age, while 80% of the overall sample did not meet the US Dietary Reference Intake (DRI) recommendations for vitamin D, vitamin E, calcium and essential fatty acids (FAs) *n*-3 and *n*-6. In addition, more than 80% of children did not meet the recommended level for fiber [36]. Furthermore, the study described the nutrition status of 9 to 13-year-olds, in which 43.5% of (111) boys and 63.3% of (94) girls exceeded the recommended calorie intake, at 2236 kcal for boys (recommended intake 1800–2000 kcal) and 1992 kcal for girls (recommended intake 1600–1800 kcal). Moreover, ~40% of boys and girls exceeded the acceptable macronutrient distribution range (AMDR) for fat, and the DRI for sodium intake (boys: 3508 mg; girls: 2975 mg [≤2200 UL]). For both boys and girls, mean intakes for calcium (717.6 mg and 543.8 mg), magnesium (216.6 mg and 182.1 mg), vitamin D (75.3 IU and 49.5 IU) and dietary fiber (18.1 g and 16 g) were below the US DRI recommendations [66].

With respect to PA engagement, Kuwaiti children and adolescents, especially females, were reported to be less likely to engage in vigorous or moderate exercise. Based on self-reported data on PA performance in a cross-sectional study on 635 OB and 1,765 non-OB schoolchildren aged 6–13, Moussa et al. (1999) found that vigorous (36.7% and 33.5%), moderate (41.6% and 45.5%) and light (21.7% and 20.9%) PA was low [67]. Based on a modified Harvard step test, El-Bayoumy (2009) showed that 97% of 5402 adolescents aged 10–14 had physical fitness scores below the medium range (65–79) [37]. The absence of health education programs promoting PA and healthy lifestyles in schools and communities, dusty and hot weather, the lack of cities designed for walking and biking, social engagements and social pressure and security are all considered major barriers to PA in Kuwait.

Gap in Literature

Overall, given that poor dietary behaviors and inactivity are prevalent in Kuwaiti schoolchildren, there is limited literature providing insights into CVD risk factors other than increasing rates of OB amongst Kuwaiti schoolchildren: 36.5% of boys and 24% of girls aged 9 to 13 [36] and 34% of boys and 28% of girls aged 10–14 are OB. [1 68] Additionally, there are no research updates on the prevalence of elevated BP (5%) in Kuwaiti schoolchildren beyond the year 2000 [60 69] and whether the prevalence has increased. Importantly, no available data estimates the prevalence of dyslipidemia in Kuwaiti schoolchildren; one study indicates higher mean levels of blood lipids in OB boys than in OB girls; however, among non-OB, those levels were equavilant by gender. [60] No data assesses potential gender differences in the prevalence of multiple CVD risk factors in Kuwaiti schoolchildren, although there is literature showing that girls may have higher levels of dyslipidemia and lower SBP and DBP levels than boys, at or beyond the age of ten. [70] On the nutritional side, the data on Kuwaiti schoolchildren's dietary intake and quality are also limited. One study from 2008–2009 describes nutrient intakes and how far DRI recommendations are met in a small sample of 205 schoolchildren aged 9–13; however, there are no available data on the proportion of children meeting recommendations of food groups, saturated fat, *trans*-fat and added sugar, which are important in the prevention of OB and risks of CVD [15 19 71 72]. There are also no data on dietary indices such as the Healthy Eating Index (HEI) or Fiber Index (FI) in Kuwaiti schoolchildren. Therefore, the overall objective of this study is to determine the prevalence of CVD risk factors and to determine the proportion of Kuwaiti schoolchildren meeting nutrition recommendations and dietary indices' scores and levels. Additionally, the study will determine whether there are differences in CVD risk factors and in the levels to which recommendations are met according to gender and weight status (BMI-for-age categories).

Specific Aims and Hypotheses

<u>Specific Aim 1:</u>

In a sample of Kuwaiti fifth graders, determine the prevalence at risks for CVD (BMI, WC, WHtR, BF%, SBP, DBP, TG, TC, LDL, non-HDL, TC:HDL and HDL) and determine if there are differences by gender; 2) determine if there are differences in mean levels of CVD risk factor by gender..

<u>Hypotheses for Specific Aim 1:</u>

Hypothesis 1a: The prevalence of at-risk BMI, WC, WHtR, SBP, DBP, TG, TC, LDL, non-HDL and TC:HDL will be significantly higher in boys than in girls.

Hypothesis 1b: Mean BMI, WC, WHtR, SBP, DBP, TG, TC, LDL, non-HDL and TC:HDL will be significantly higher in boys than in girls.

Specific Aim 2:

In a sample of Kuwaiti fifth graders, 1) determine the proportion of children that are meeting recommendations for food groups (fruit, vegetables, dairy and whole grains), macronutrients (total calories, total fat, saturated fat, *trans*-fat, *n*-6 and *n*-3 FAs, protein, carbohydrates, fiber and added sugar), selected micronutrients (calcium [Ca+], potassium [K+], magnesium [Mg+], sodium [Na+] and vitamin D) and two dietary indices (HEI and FI); 2) determine if there are gender differences in meeting the recommendations.

Nutrition variables used are based on US Dietary Guidelines for food groups and DRI for macronutrients and micronutrients, in addition to WHO/FAO ranges and recommended nutrient intakes (RNI) for food groups, macronutrients and micronutrients.

Hypotheses for Specific Aim 2:

Hypothesis 2a: The proportion of boys meeting recommended intakes of fruit, vegetables, dairy and whole grains will be significantly lower than that of girls.

2b: The proportion of boys meeting recommended intakes total calories, total fat, saturated fat, *trans*-fat, FAs *n*-6 and *n*-3, protein, carbohydrates, fiber and added sugar will be significantly higher than that of girls.

Hypothesis 2c: The proportion of boys meeting recommended intakes of Ca+, K+, Mg+ and vitamin D, but not Na+, will be significantly lower than that of girls.

Hypothesis 2d: The overall diet quality (HEI) and FI will be significantly lower for boys than for girls.

Specific Aim 3:

In a sample of OB, OW, NW and UW Kuwaiti fifth graders, determine if there are differences between weight categories in: 1) prevalence of CVD risks (SBP, DBP, TG, TC, LDL-C, non-HDL-C, TC/HDL-C and HDL-C); 2) meeting US and WHO/FAO nutrition recommendations for food groups (fruit, vegetables, dairy and whole grains), macronutrients (calories, total fat, saturated fat, trans-fat, protein, carbohydrates, fiber and added sugars), selected micronutrients (Ca+, K+, Mg+, Na+ and vitamin D).

Nutrition variables used are based on US Dietary Guidelines for food groups and DRI for macronutrients and micronutrients, in addition to WHO/FAO ranges and RNI for food groups, macronutrients and micronutrients.

<u>Hypotheses for Specific Aim 3:</u>

Hypothesis 3a: The prevalence of at-risk SBP, DBP, TG, TC, LDL-C, non-HDL-C, TC/HDL-C and low HDL-C will be significantly higher for obese than for non-obese Kuwaiti children.

Hypothesis 3b: Obese Kuwaiti children will be significantly less likely to meet recommendations for fruit, vegetables, dairy, whole grains, calories, total fat, saturated fat, *trans*-fat, protein, carbohydrates, added sugars, fiber, Ca+, K+, Mg+, Na+ and vitamin D than non-obese children.

CHAPTER 2: LITERATURE REVIEW

This chapter contains a brief overall background of the Kuwaiti children population related to the current research objectives and hypotheses followed by detailed sections discussing the main study variables and associated factors as they relate to the population studied.

Kuwait

Kuwait is a small, affluent, oil-rich Arab country located in the Arab Gulf Region of the Middle East with an area of 17,818 km^2 (about 6,880 mi^2) [73], populated with 4,239,006; 31% of which are citizens [74]. Kuwait is bordered on the north and west by Iraq, on the south by Saudi Arabia, and on the east by the Arabian Gulf [75]. The country is 92% urban, and divided into six governorates (Capital, Hawalli, Farwania, Ahmadi, Jahra, and Mubarak Al-Kabeer). The citizens of Kuwait are constitutionally privileged with a high standard of living which includes free education, medical care, and housing as major benefits [75]. In the past five decades, Kuwait has experienced a rapid economic growth and modernization. Following discovery of oil in the late 1940s, the resulting increased revenue may have potentially impacted the nutritional and lifestyle pattern and diseases state of the Kuwaiti population [73]. An increase in energy intake from calorie-dense foods, especially, fat, sugar, and protein are reflected by an increase in imported foods (approximately 90% of food consumed) and reduced food prices due to government subsidies [37]. As a result, rates of obesity have increased throughout most of the Kuwaiti governorates and across all population age groups [1 67] . Kuwait now ranks among countries with the highest obesity rates worldwide [1 76]. Additionally, mortality rates from coronary heart disease (CHD), hemiplegia (cerebrovascular), and type 2 diabetes mellitus have increased [77-80]. Moreover, these increases warrent when about a future with exacerbated health and disease burdens. The increased magnitude of chronic diseases in Kuwait is most likely attributed to insufficient education strategies for preparing the society for modern lifestyle and social changes [81].

Cardiovascular Diseases (CVD)

Cardiovascular diseases (CVD) are diseases that affect the heart and circulatory system including coronary artery disease (CAD), stroke, congestive heart failure, valvular heart disease, rheumatic heart disease, peripheral arterial disease, and congenital heart failure [82]. According to the World Health Organization (WHO), CVD is considered a major contributor to morbidity and mortality from non-communicable diseases (NCDs) worldwide [29], being responsible for 56% of total death from NCDs in 2014 [6]. Globally, by 2020 cardiovascular diseases (CVDs) are predicted to be responsible for 25 million deaths (36%) each year, surpassing deaths caused by infectious diseases. It is also predicted that by the year 2020, coronary heart disease (CHD) and stroke will be the leading causes of death and loss of disability-adjusted life years [9] worldwide. In the Middle East, coronary heart diseases (CHD) is the leading chronic disease associated with mortality from NCDs (60% of NCD deaths). According to Amuna et al., the rates of type 2 diabetes mellitus (T2DM) and CVD are estimated between 25% and 35% among adult population in the Arab Gulf region and are considered indicators of the emergence of metabolic syndrome (MetS) among children and adolescents [6, 7]. In addition, high blood pressure, high blood cholesterol, increased abdominal obesity associated with poor nutrition behavior and physical inactivity, and tobacco use were also considered major contributors to the emergence of MetS in children and adolescents [83 84].

Cardiovascular Disease Risk Factors

There are several risk factors for CVD that are non-modifiable including, age, gender, ethnicity, and genetics (family history). In addition, there are modifiable risk factors which include unhealthy behaviors, (e.g., smoking, physical inactivity, and poor diet), and clinically measurable risk factors (e.g., dyslipidemia, hypertension, diabetes, and obesity) [82].

Gender-specific Predictors of Cardiovascular Disease in Children

Studies have shown that cardiovascular disease risk predictors are exclusively gender specific, which can be influenced by biological or environmental factors [85]. Boys or girls can have predominantly higher mean levels of certain cardiovascular and or cardiometabolic risk components related to abdominal obesity, blood pressure and blood lipids, and insulin resistance. Stavnsbo et al. (2018) published an international reference value of for cardiometabolic risk variables based on cohorts of children (observations of 11,234 girls and 11,245 boys 6-11 years) from Europe and the United States (51.3%). The mean values of blood lipids such as total cholesterol, low-density lipoprotein, high-density lipoprotein, and triglycerides become higher in girls than boys beyond age 10, while boys maintain relatively higher mean systolic and diastolic blood pressure [70]. Some studies indicated higher means of certain risk factors in girls than boys during late childhood or early prepuberty periods, related to growth and maturation, also related to parenteral factors. Peterson et al. (2012) assessed 2,800 6th graders cardiometabolic risk factors. Girls had higher mean triglycerides than boys, in addition to increased metabolic syndrome score (MetS) related to parenteral history of CVD [13]. Also, Morandi et al. (2014) evaluated MetS risk components in a cohort sub-sample of 425 obese children and reported marginally (p=0.09) higher mean triglycerides in girls (11 years and older) than boys (12 years and older) [86].

Pediatric Cardiovascular Risk Cut-Points

According to US standards from CDC 2000 Growth Charts for the US; Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents using cutpoints for children ages 1 to <13 years; and the Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents.

Obesity

The cut-points for children considered at-risk for CVD is defined for OW as BMI for sex and age ≥85th percentile and <95th percentile, and for OB as BMI for sex and age ≥95th percentile [87].

Blood Pressure

The cutpoint for determining the prevalence of children at risk corresponds with the "Elevated" range or higher, which is SBP >120 and or DBP >80. The "Elevated" numerical cutpoint is based on children population data ("*derived from a comprehensive review of almost 15,000 published articles between January 2004 and July 2016"* page 1) [88] which corresponds to ≥90^{th} to < 95^{th} percentile by sex, age, and height. Levels > 95^{th} percentile are defined as hypertension which includes stage I and II.

Blood Lipids

At risk cut point values: total cholesterol (TC) at or above 170 mg/dL, LDL at or above 110 mg/dL, HDL at or lower than 45 mg/dL, TG at or above 90 mg/dL, non-HDL at or above 120 mg/dL, and total cholesterol: HDL ratio at or above 3.5. High risk cut point values: total cholesterol (TC) at or above 200 mg/dL, LDL at or above 130 mg/dL, HDL at or lower than 40 mg/dL, TG at or above 130 mg/dL, non-HDL at or above 145 mg/dL[89].

Cardiometabolic Risk (metabolic syndrome [MetS])

The WHO cut-points were set at >95th or 97th percentile for WC or BMI; ≥95th percentile for TG (mg/dL); <5th percentile for HDL-C (mg/dL); ≥95th percentile for BP (mmHg); and ≥110 mg/dL for blood glucose[85].

The Prevalence of Cardiovascular Diseases and Risk Factors in Kuwait

According to the World Health Organization (WHO) country profile for Kuwait, CVD contributed to 41% of total death from NCDs in 2012 [29]. Coronary heart disease (CHD), particularly, acute myocardial infarction with a rate of 13.1/10,000 population/year, (the rate in males is 3.7 times the rate for females) [78], and ischemic heart disease (IHD) are considered major components of CVD in Kuwait [76]. Secular data showed that within a period of 14 years (1980-1981 to 1993-1994), the prevalence of obesity (≥30kg/m2) among adults increased around 10% in men (15% to 25%) and women (29% to 39.3%), respectively [90]. It continued increasing in both men 11.3% and women 14.6% during the periods 1998-1999 and 2008-2009 [76]. The most recent data (2011 – 2012) indicated nearly steady obesity rates at 30.7% and 38.3% among men and women (>20 to <50 of age), respectively [1]. Dyslipidemia included, hypercholesterolemia was estimated 7.6% and 6.5% in men and women, respectively [91]. Additionally, hypertriglyceridemia 13.2%, low HDL (41%), and elevated LDL (11.2%) [80]. El-Rashed et al. (1997) reported that hypertension was responsible for 935 hospital admissions as well as contributing to incidents of ischemic heart disease, cerebrovascular accidents (stroke), and congestive heart failure [92]. The prevalent rate of hypertension among 2836 Kuwaiti adults was 26.3%, higher among males (28.3%) than in females (22.9%); 86% of subjects had mild to moderate diastolic BP (>109 mmHg) [92]. Increased age (>35 years), presence of diabetes, and obesity were strongly associated with hypertension. Based on a national cross-sectional survey

(2006) of a representative sample of the Kuwaiti population (n=2280), the overall prevalence of hypertension was shown to be 24.3%, and was higher among obese individuals (35.7%) as compared to non-obese individuals (13.9%) [93]. Several studies indicate that Kuwait is ranked among the top ten countries with elevated rates of T2DM, worldwide [94-96]. An overall prevalence of T2DM among adults was estimated 18.1% [93] , or ~17% in women and 19.4% in men [80]. In addition, there is a fluctuating trend in reduction of prevalence of impaired fasting glucose (7.4% and 6.8%) and T2DM (9.8% and 8.9%) among men and women, respectively [95].

Prevalence of Overweight and Obesity

The prevalence of overweight and obesity refers to a state of positive energy balance that occurs when an individual's caloric intake exceeds their energy expenditure, as reflected by weight gain [97]. Obesity refer to an excess in fat mass great enough to increase the risk of morbidity, altered physical, psychological, or social well-being and/or mortality, defined by the World Health Organization (WHO) [98]. Elevated global obesity (BMI ≥30 kg/m^2 for adults, and BMI for age and sex ≥95th or ≥97th percentile for children based on CDC or WHO, respectively) rates and related chronic diseases has been associated with dramatic changes in living environments. Nutritional transitions associated with changes in diet and lifestyles driven by global income growth and rapid urbanization has affected low, middle, and high income populations and countries [97]. A global epidemic of overweight (OW) and obesity (OB) was recognized in 1980 as the most significant contributor to ill health worldwide; adverse health attributed to increased accumulation of body fat. Obesity is a major, independent modifiable cardiovascular risk factor associated with high morbidity rates [14], insulin resistance (IR), and metabolic syndrome (MetS) or metabolic cardiovascular syndrome [MCS] [14]. Obesity is also associated with hyperinsulinemia, hypertension, hyperlipidemia, T2DM, and an increased risk of atherosclerosis in adults and children [15-17].

Between 1980 and 2013, the number of OW and OB individuals increased from 857 million to 2.1 billion, worldwide [24]. The rates of OW and OB in children of developing countries increased from 12.9% to 23.8% among boys, and from 13.4% to 22.6% among girls [24]. An increased availability of high-caloric foods along with a sedentary lifestyle, and genetic susceptibility are known to be specifically correlated factors for obesity. Risk for adverse health consequences in relationship to economic transitions and industrialization or urbanization are associated with rapid shifting from a dietary deficit to excess caloric intake. During 2010, 3.4 million deaths were estimated to be caused by OW and OB, worldwide. Obesity has been attributed to up to 7% of total health costs in developed countries, representing a significant expenditure of national healthcare budgets [99].

Childhood Obesity

Childhood Obesity is considered a group of diseases or conditions involving several health complications and/or clusters of CVD risk factors including hypertension, dyslipidemia, hyperinsulinemia, increased blood clotting, and chronic inflammation [100]. Rates of childhood obesity are rapidly increasing in countries that are experiencing rapid economic growth or high-income created nutrition transition and sedentary lifestyles, including Kuwait [97]. Between 1990 and 2010 the global rate of childhood OW and OB rose from 4.2% to 6.7% and is expected to reach 9.1% (60 million children) by 2020 [97 101].

Childhood Obesity and Cardiovascular Disease (CVD)

Children have less disease related to obesity than adults, particularly, childhood obesity health risks extend into adulthood [48]. Childhood obesity is associated with increased risk parameters for CVD including, elevated blood pressure, and dyslipidemia, particularly abnormal TG, TC, LDL-C, and HDL-C levels [102]. The appearance of obesity during childhood increases the risk of its persistence throughout adolescence and adulthood [21, 104], which increases the risk for chronic diseases and disability later in life [97]. An increase in BMI after age ten is considered a strong predictor for premature death associated with heart attack in adulthood. Several prospective studies have indicated that obesity tracks from childhood to adulthood and becomes more associated with CVD risk factors and the incidence of CVD [103 104]. In essence, hypertension and dyslipidemia associated with childhood obesity are considered an early sign of CVD morbidity and mortality in adulthood [9 14 102 105].

Overweight and Obesity among Kuwaiti Children

The Kuwaiti population is considered uniquely heavy as compared to other modern affluent countries, the prevalence of OW and OB has been shown to affect every age group [2 76 106]. Generally, data indicate that the overall trend toward increased weight in Kuwait is remarkably elevated among women of childbearing years, schoolchildren, and adolescents [40 107]. Childhood obesity is rapidly increasing in Kuwait [40], and the rate of OW and OB is considered among the highest in the Middle East and globally. The prevalence of OW and OB among Kuwaiti adolescents has exceeded some regional and global rates including, Dubai, Saudi Arabia, Malta, US, Spain, Canada, England, Italy, Greece, France, and Germany [108]. According to a recent study of 6,574 Kuwaiti students (6-18 years), the prevalence of OW and OB was 17.7% and 33.9%, respectively, based on CDC data; 21.6% and 30.5%, respectively, based on

WHO data; and 23.3% and 28.2%, respectively, based on IOTF reference standards.[2]. Moreover, the Kuwait Nutrition Surveillance System (KNSS 2011-2012) have shown that the prevalence of OW and OB by age in male and female children was 6.6% OW and 2.5% OB in preschoolers (<60 months; genders combined); 14.9% OW and 17.3% OB for male, and 18.9% OW and 17.3% OB for female primary school children (5 – < 10 years); 19.1% OW and 34% OB for male, and 24.4% OW and 28.1% OB for female intermediate school children (10 - < 15 years); and 19.1% OW and 34.1% OB for male and 22.2% OW and 22.0% OB for female secondary school children (15 – 18 years) based on WHO/CDC reference standards [63]. Zaghloul et al. (2012), indicated that 37% of boys and 24% of girls of Kuwaiti schoolchildren (9 - 13 years) were obese based on WHO standards [107]. Whereas, the prevalence of OW and OB among adolescents (10-14 years) ranged from 13.9% to 14.6% for prevalence of OW and from 30.7% to 30.9% for OB according to Al-Isa et al. [109] and El-Bayoumy et al. [37]. Males younger than 14 years old were predominantly heavier than females who tend to become obese at 14 years and older [41 109 110].

Changes in the Nutritional Status of Kuwait's children based on NCHS/CDC Reference Population

Recent research shows that modern Kuwaiti children (6 - 13 years) are taller and heavier than their counterparts from thirty years earlier, with an enormous shift in BMI status [111]. A national cross-sectional survey of Kuwaiti children in (1983-1984) involved 2,554 children (1,319 males and 1,235 females) including, preschoolers (0 - 5 years) and school children (6 – 9 years) comparing stature and weight status in relation to their nutritional status, and in comparison to the US population reference standards (NCHS/CDC) [112]. In both age groups the Kuwaiti children's stature was described as shorter (47.7% preschoolers and 48.3%

schoolchildren falling < 30th centile) as compared to the US children. However, in regards to weight, preschool children (0 – 5 years) were found to be 51.8% (> 50th percentile) [112], whereas schoolchildren (6 – 9 years) were relatively heavier at 61.1 % (> 50th percentile) compared to the NCHS/CDC reference population [113]. Al-Isa et al. compared height and weight data from a national cross-sectional study between 1985 and 1995 of primary school children (6 -10 years), supporting the data that the height-for-age and weight-for-height percentiles of elementary school children has changed or significantly increased from 1985 to 1995, especially in obesity among boys (15.7%) as compared to girls (13.8%). The data also demonstrated that Kuwaiti children (6 -10 years) were heavier and shorter than the NCHS/CDC reference population [45].

International Definition of Childhood Overweight and Obesity

The International Obesity Task Force (IOTF) proposed that adult cut off points for overweight and obesity (BMI 25 kg/m^2, 30 kg/m^2) be linked (regressed) to BMI centiles for children to provide child cut off points [114]. Cole et al. (2000) developed an internationally acceptable definition of child overweight and obesity (2 – 18 years old) based on averaging the centiles of six countries (Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States) [48]. Each of six datasets (longitudinal surveys), had over 10,000 subjects with ages ranged from 6 to 18 years, were used to estimate the centiles that pass through the adult values of BMI 25 and 30 at age 18 years. The data were then averaged to provide the published cut-points [115]. The curves indicated a wide range of values spanning several units of BMI in both sexes; in addition, national differences and variability in fatness, particularly centiles for overweight. Chinn et al (2001) compared international cut-points for overweight and obesity in children (n=6,000 white children aged 4-11 years) with alternative cut-points based on the UK 1990 reference data [16]. The results indicated that international cut-points exaggerate the difference in prevalence of overweight and obesity between British boys and girls in comparison to comparable measures based on UK data by up to 7% and are not compatible with the UK reference charts for BMI. A limitation of the international definitions associated with averaging data from different countries that vary in sample size and time, age range, and the choice of reference age (age 18 years) [8]. Furthermore, Cole et al. (2007) reformulated the international BMI cut-offs for each dataset by sex using the LMS age specific curves method, averaged the LMS curves for the six countries, allowing BMI to be expressed as centile or z-score. The new IOTF cut-offs enabled direct comparison with other BMI centiles and z-scores such as the WHO's. The M and S curves correspond to the median and coefficient of variation of BMI at each age, whereas the L curve allows for the substantial age dependent skewness in the distribution of BMI [47]. L.M. Keˆke et al. (2015) compared the IOTF (reformulated), WHO 2007, and French references BMI cut-offs for age-sex of 1382 male and female schoolchildren (4 to 12 years). The study tested the agreements between the three references by using Cohen's kappa coefficient, and concluded that agreement between the three references ranged from moderate to perfect ($0.43 \leq k \leq 1.00$; $P < 0.0001$). The results of the study also indicated overestimation in overweight and/or obesity by the WHO references compared to the French references and the IOTF. The French references and IOTF yielded closer agreement in defining overweight [116].

Nutritional Status - Growth Charts

Growth charts are important diagnostic and tracking tools used in the prediction and prevention of diseases and health related nutrition disorders, including malnutrition, during infancy, childhood, and adolescence. They are used to assess the nutritional and health status of infants and older children and to monitor individual growth in pediatric medical practices. [117].

Besides evaluating individual health status, growth assessments can also provide an indirect measurement of quality of life of an entire population [62]. Several growth references, growth patterns of defined populations, have been developed to assess childhood obesity including, those developed by the National Center for Health Statistics and WHO (NCHS/WHO), Centers for Disease Control and Prevention (CDC 2000), WHO 2007, and International Obesity Task Force (IOTF) [118].

In the US, growth charts developed in 1977 by the NCHS based on longitudinal data from the Fels study. In 1978, a normalized version of the NCHS percentile curves was produced by the CDC. The CDC curves were later adapted by WHO as the international references, NCHS/WHO growth charts [119 120]. WHO then utilized the BMI cutoffs to define thinness in children (underweight, wasted, or stunted) as an international reference at -2 z scores [121 122]; these NCHS/WHO indicators were used to measure nutritional imbalances resulting in under-nutrition and overweight.

NCHS/WHO Growth Charts

The NCHS/WHO growth references for children and adolescents were based on the 1977 NCHS growth charts. The references were developed using cross-sectional data collected from four separate surveys of US children and adolescents between 1963 and 1974. The age and sex specific BMI percentiles endorsed by WHO for global use were based on the 1971–1974 NHANES I data [118]. Because these references were constructed based on purely US data, they have limitations in geographical coverage and function when describing optimal growth patterns for children internationally [62]. For instance, the NCHS/WHO growth reference provides a positive skew in body weight when compared with other growth references such as, the CDC 2000 growth charts and the IOTF cutoffs [118].

CDC 2000 Growth Charts

The CDC 2000 growth charts (birth to 20 years), released in May of 2000, were based on a series of five national surveys collected between 1963 and 1994. The surveys, also, provided data from two national surveys (NHANES II [1976–80] and NHANES III [1988–1994]) to replace the limited Fels Longitudinal Study infant data used to construct the 1977 NCHS infant reference data [50]. Kain et al. (2002), studying 6 year old Chilean children from 1987 to 2000, demonstrated that the revised CDC growth charts reflect lower increased rates of OW (13.2 to 19.2% for boys and 12 to 18.5% for girls) as compared to NCHS 1977 data (15% to 20% for boys and 17.2 to 21.8% for girls) [123].

IOTF Reference

The IOTF cut-points for children and adolescents (2–18 years) was developed using a database of consisting of 97,876 males and 94,851 females (from birth to 25 years of age) from six countries (Brazil, Great Britain, Hong Kong, the Netherlands, Singapore and the US). Percentile curves were constructed using the LMS method, and BMI values of 25 and 30 for 18 year old males and females, respectively [124]. According to a Fu et al. study (2003) of 623 Chinese children (6–11 years), the prevalence of obesity was lower using IOTF-BMI cutoffs (6.9%) than when using percentage-weight-for-height cutoffs (16.4%). The IOTF-BMI cutoff values had a lower sensitivity (75.0%) and specificity (91.6%) with sensitivity differing between boys (83.3%) and girls (66.6%) ($P<0.35$). The percentage-weight-for-height cutoffs values had higher sensitivity (91.6%) but lower specificity (86.6%), with no specific gender differences [125].

WHO 2007 Reference

The WHO 2007 reference for children and adolescents (5 to 19 years) developed by merging the 1977 NCHS/WHO growth reference with the WHO Child Growth Standards

(Multicentre Growth Reference Study). This allowed WHO to establish reference curves assessing children starting from age 5 years compared with previous reference curves (NCHS/WHO), which start from age nine years. It also provided transition from standard curves for the under-fives to the reference curves for older children [49 126 127]. In April 2006, WHO released new standards for assessing the growth and development of children from birth to five years of age known as the Child Growth Standards (WHO standards). The standards are based on primary standardized data collected through the WHO Multicentre Growth Reference Study, a population-based study conducted between 1997 and 2003 in Brazil, Ghana, India, Norway, Oman, and the US [50]. The analysis combined a longitudinal follow-up study of 888 children (birth to 24 months) and a cross-sectional study of 6697 children (18–71 months) consisting of healthy breastfed infants and young children raised in environments that do not constrain growth [127 128]. The goal of the analysis was to establish new parameters allowing for international comparisons of nutritional data of an under-five year old population[62].

Contrasting of WHO 2007, CDC 2000, and IOTF Cut-points

The NCHS/CDC and WHO references, in addition to IOTF cutoffs were utilized for studies in Kuwait [2 126 129] to estimate nutrition status and rate of obesity [130]. Several studies indicated substantially skewed curves related to BMI, height-for-weight, and weight-for height of all three reference standards, resulting in substantial underestimating of OB in children and adolescents [50 118 128]. Similar results were seen with the use of references designed and smoothed for specific population, particularly the NCHS/CDC, and cutoffs based on a specific select samples [49 121]. For example, Elkum et al. (2016) has indicated a varied prevalence of OW (CDC=17.7%, IOTF=23.3%, WHO=21.6%) and OB (CDC=33.9%, IOTF=28.2%, WHO=30.5%) among 6,574 Kuwaiti schoolchildren (6 to 18 years) [2]. The variations in estimates by the WHO and IOTF references were closer than compared to the CDC cutoffs. However, Shields et al. (2010) found similar results in a combined data analysis (1978-1979 and 2004) of 10,501 Canadian children and adolescents (2-17-years). WHO cut-points indicated higher prevalence (35%) of combined OW and OB as compared to the IOTF (26%) or CDC (28%) cut-points. Whereas WHO and CDC cut-points provided similar estimates of the prevalence of obesity (13%) compared with lower prevalence (8%) for the IOTF cut-point estimate [131]. This time, the variations in estimates by the WHO and CDC references were closer than compared to the IOTF cutoffs. As illustrated earlier, each of these references have their own unique characteristics and limitations. The IOTF was constructed based on international longitudinal data (US, UK, Hong Kong, the Netherlands, Singapore and Brazil), the WHO 2007 merged international cross-sectional data with NHANES (NCHS/WHO), whereas the CDC 2000 included only NHANES data [43-45]. In essence, any measure means the same thing for a specific population subgroup.

Anthropometrics - Assessing Obesity

Body Mass Index (BMI)

Body mass index (BMI) $\frac{Weight\ (kg)}{Height\ (m^2)}$ defines obesity and is the measurement most frequently used in epidemiological studies. BMI values provide valuable insight into overall body fatness using graded classifications for OW and OB. It helps comparing weight status within and between populations, in addition to identifying individuals and groups at risk of morbidity and mortality. However, BMI does not take into account the detrimental effects of intra-abdominal fat on morbidity and mortality associated with degrees of excess in body fatness including overweight. Moreover, BMI may vary in degree of fatness across different populations

[99]. Therefore, it is an imperfect measurement method of degree of adiposity because it does not differentiate between fat mass and lean mass in the body [121]. Based on the Prospective Studies Collaboration on more than 66,000 deaths, a BMI of 22.5-25 kg/m^2 is considered an optimal survival range in the BMI distribution. Whereas moderate to high BMI (30 - 35 kg/m^2) and extreme BMI levels (40 – 50 kg/m^2) reflect a reduction in life expectancy of 3 to 10 years [56]. However, this might not always be the case considering there is evidence that CVD risk factors, such as hypertension, can exist below a BMI of 25 kg/m2 [132]. According to the literature, elevated BMI is potentially attributed to developing CVD during various life stages beyond childhood [10-12], and the risk of CVD increases with increased BMI [22]. Life expectancy may be reduced in individuals with moderate (BMI 30–35kg/m2) and extreme obesity (BMI 40–50kg/m2) [23].

BMI Z-scores for defining weight status in children

A BMI standard deviation (S.D.) scores are measures of relative weight adjusted for child age and sex [52]. A z-score, or standard deviation, is a measure ($\frac{Measured\ value - Average\ value\ in\ the\ reference\ population}{Standard\ deviation\ of\ the\ reference\ population}$) of the dispersion of data. Waterlow et al. (1977) [133] recommended the use of z-scores for the definitions of underweight, wasting (weight for height), and stunting (height for age) proposed by Seoane and Latham (1971) [134], with the cut offs defined in terms of standard deviations (SDs) below the median rather than as percentages of the median reference. Weight-height relation depends on age during infancy and adolescence [121], especially, during adolescence, weight growth continues while height growth becomes stagnant. BMI for children can be calculated based on weight-to-height indexes including *the ponderal index (weight:height^3)*, or the *Benn Index "index weight/height power ^{p}"*. The *Benn Index* is adjusted for age and sex. The *height power (p)* restricts height, making the index uncorrelated with height among children at each age [114]. This allowed many countries to have their own national reference centile for BMI-for-age such as the United States (US) [135 136]. Moreover, encouraged establishing of International BMI cut offs for child overweight and obesity, based on data from six countries [48]. BMI z-scores can be converted into their equivalent BMI-for-age percentiles. Both can be used to determine cut points and classify weight status of children and adolescents. The CDC 2000 (2-20 years) [137] and the WHO 2007 (5-19 years) [138 139] provide normal distribution tables for comparison of BMI z-scores. However, when assessing change in weight status longitudinally, BMI z-scores and BMI for- age percentiles will not be equivalent [52]. BMI z-score is appropriate in tracking changes in adiposity [53 140], association with energy and food intake [54], and cardiometabolic risks [55] in children.

Reference Centiles Curves/LMS Method (Smoothed parameters):

Reference centiles curves presents a distribution of a measure as it changes by age (covariate). The LMS method involve three curves describing changes in the distribution of the measure. Accordingly, LMS (lambda-mu-sigma) stands for, L (median), M (coefficient of variation), and S (skewness). The LMS curves can be constructed as cubic splines by non-linear regression to be expressed as smoothing parameters and or equivalent degrees of freedom [141].

Generating BMI-for-age Standard Deviation Scores (Z-scores)

Body weight and height are measured to calculate BMI, which become transformed (power in the Box-Cox) into z-scores based on $z = ([BMI/M]^{L} - 1)/(L \times S)$[141].

The IOTF BMI-for-age z-scores (2-18 years) derived by Cole et al (2007) [47 121] include, thinness -2SD [2nd to <15th centiles], normal weight -1SD to +1SD [≥15th to <90th centiles], overweight >+1SD [≥90th to <98.7th centile], and obese >+2SD [≥98.7th centile] [47 121]. The IOTF BMI z-scores can be generated via LMSgrowth http://www.healthforallchildren.com/shop-base/shop/software/lmsgrowth/) [116].

The WHO 2007 BMI-for-age-sex-specific z-scores range (5 to 19 years) are the following: sever thinness -3SD [5th], thinness ≥-2SD to <-1SD [≥10th to <25th], normal weight ≥-1SD to + <+1SD [≥25th to <85th], overweight ≥+1SD [≥85th to <97th centile], obese ≥+2SD [≥97th to <99th centile], and +3SD morbid obese >99th centile available at http://www.who.int/growthref/who2007_bmi_for_age/en/ . The WHO 2007 provided LMS tables that can be obtained from http://www.who.int/growthref/who2007_bmi_for_age/en/ [49].

The CDC 2000 BMI-for-age-sex-specific z-scores range (2 to 20 years) are the following: thinness ≥-2SD to <-1SD [≥5th to <25th], normal weight ≥-1SD to + <+1SD [≥25th to <85th], overweight ≥+1SD [≥85th to <95th centile], obese ≥+2SD [≥95th]. The CDC LMS/centiles tables are available at https://www.cdc.gov/growthcharts/percentile_data_files.htm [142].

BMI in Kuwait Children

Research data indicates fluctuating, but also a continuous increase in mean BMI over the past two decades. In a pair-matched case study conducted in 1996, Moussa et al. showed that mean BMI for obese and non-obese boys and girls (6 - 13 years) was 25.7 kg/m^2 and 26.5 kg/m^2 for boys, respectively, and 17.4 kg/m^2 and 18.1 kg/m^2 for girls, respectively [60]. Al-Isa et al. (2010) reported mean BMI among OW and OB male elementary school children (n=662, 6–10 years) were 20.2 kg/m^2 and 16.8 kg/m^2, respectively [143], and Zaghloul et al. (2012) reported mean BMI among 9 to 13 years old children were 20.6 kg/m^2 for boys and 19.7 kg/m^2 for girls

[107]. A more recent study (2012-2013) reports that mean BMI of children and adolescents (n=6574, 6-18 years) are 23.5 kg/m^2 for boys and 22.8 kg/m^2 for girls [2].

Waist Circumference (WC)

It is known to be the best anthropometric obesity index including visceral (metabolically active) and subcutaneous (under the skin) abdominal fat in relation to cadiometabolic risk factors in adults and in children [109 144 145]. Therefore, considered a reliable method for predicting CHD risk as it correlates with hypertension and blood lipid level [99 146]. Internationally, abdominal obesity is defined as WC >75th to 95th based International Diabetes Federation (IDF), or >95th to 97th centile based on World Health Organization (WHO). Also defined as 85th to 97th centile by the National Cholesterol Education Program's Adult Treatment Panel (ATP) [85], and ≥ gender- and age-specific 90th percentile according to data from the National Health and Nutrition Examination Survey (NHANES) [147]. WC is known to be highly sensitive and specific marker to upper body fat accumulation providing effective measure of truncal adiposity in children and adolescents compared with waist-to-hip ratio (WHR) [148 149].

WC and Waist-to-Height Ratio (WHtR)

According to literature, WC and WHtR are considered effective and simple anthropometric surrogate measures of abdominal obesity (excessive accumulation of both central subcutaneous and visceral fat) [150] associated with multiple CVD risk factors including hypertension, T2DM, and dyslipidemia compared to BMI in adults, and in children and adolescents [56 129 151]. Because WHtR takes height into account, it is better to use as an index for visceral fat in children. It encompasses the adjustment in several different statures and in different population [152]. In addition, WHtR can identify metabolic risks in individuals within moderate BMI range [153]. For instance, a longitudinal research has indicated that WHtR is more closely linked to childhood morbidity than BMI that neither provide indication of body fat distribution nor distinguish between fat mass and free-fat mass [148]. WHtR is calculated as the ratio of waist (cm) and Height (cm) to determine central obesity in children and adolescents of both gender, based on cutoff 0.5 according to CDC standard methods used by NHANES in (6 to 19 years) including different ethnic groups [150]. Savva et al. validated the prediction of CVD by BMI (75th percentile), WC, and WHtR in children (1037 boys and 950 girls), he concluded that WC and WHtR were better predictors of plasma lipid and lipoproteins except for TG and HDL-C respectively compared with BMI that was better in predicting TG only. The three parameters were significant in predicting BP [146]. Freedman et al. examined the relation between BMI-for-age z score and WHtR in predicting BP, dyslipidemia, and fasting insulin in 2498 (5 to 17 years) in the Bogalusa (Louisiana) Heart Study. He indicated that WHtR was slightly better in predicting concentrations of total-to-HDL-C ratio as well as LDL-C, whereas BMI-for-age z score was better predictor for BP and fasting insulin [151].

Waist Circumference (WC) of Kuwaiti Children

Based on data from 2012-2013, the overall mean WC in youth 6 to 18 years was 77.9 cm for boys and 74.3 cm for girls [88]. A study conducted on 9,593 children and adolescents (5-19 years old) during 2008 and 2009 revealed a dramatic trend of increasing WC with age starting from age 7 years, especially among boys. The prevalence of children who are at risk of CVD related to elevated total blood cholesterol (WC $\geq$ 90th percentile) become inclined around age of 10 [129]. In adolescents, data between 2009 and 2010 on 906 10th to 12th graders, the mean WC was somehow similar among males (83.1 ± 16.4) and females (84.9 ± 14.6) respectively [108] .

Waist-to-Height Ratio (WHtR) in Kuwait

Available data on measuring abdominal obesity in the Kuwaiti youth population were based on using waist-to-hip ratio (WHR) [60 109] and WC [109 129] indices, but not WHtR. However, one available study conducted on 906 adolescents during 2009 and 2010 and has shown a significant (p<0.001) difference in WHtR between females (53.9 ± 9.0) and males (49.1 ± 9.3) respectively [108].

Percentage Body Fat (%BF)

A percentile for body fat the can be derived either by bioelectrical impedance analysis (BIA) or by skinfold thickness values which can be converted into %BF via Slaughter equation [154 155] . According to NHANES (1999–2004) data %BF peaks for boys and girls at ages 10 and 11 with a median of 17.0% and 27.8% respectively [155]. Furthermore, %BF thresholds of 22.3% and 35.1% in boys and 31.4% and 38.6% in girls (at age 18 years) also help identifying MetS including predicting SBP and TC abnormality [156]. Some research has shown that percent body fat (%BF) is an effective indicator of CVD risk factors in children [151 157] and adults [158].

Percentage Body Fat in Kuwait

According to data from a multistage cluster sample (n=1,830) collected during 2008-2009, mean %BF in adult males and females was 23.3 and 37.7 respectively [159]. There is no available research data estimated %BF in Kuwaiti children.

Dyslipidemia

Dyslipidemia, most commonly hyperlipidemia, involves a disruption in the quantity of blood lipids (mg/dL), including elevation of total cholesterol(TC) ≥200 , low density lipoprotein cholesterol (LDL-C) ≥170, TC/HDL ratio ≥3.5, and triglycerides (TGs) ≥130, accompanied elevated atherogenic LDL-C levels related to quantitative changes in small density particles, in addition to declined high-density lipoprotein cholesterol (HDL-C) <40 levels. Dyslipidemia is most commonly associated with an improper diet and sedentary lifestyle, which can result in increased body weight [82 160] Overall, elevated blood lipids contribute to an increase incidence of coronary events and deaths at various ages and stages of life depending on type and severity [161].

Prevalence of Dyslipidemia among Kuwait Children

No data available could describe the prevalence of dyslipidemia in children of Kuwait. However, Moussa et al. 1999 conducted a pair-matched control study in schoolchildren (n=920, 6-13 years). The study showed that obese boys had higher mean TC (171.7 mg/dL), LDL-C (108.6 mg/dL), TG (76.2 mg/dL), and TC:HDL ratio (3.64), and lower mean HDL-C (49.8 mg/dL) than girls TC (165.5 mg/dL), LDL-C (103.6 mg/dL), TG (66.4 mg/dL), and TC:HDL ratio (3.50). In addition, obese boys and girls had higher mean dyslipidemia when compared to non-obese boys and girls [60].

Hypertension

Hypertension refers to an elevated blood pressure (BP) ≥130 mmHg SBP and/or ≥85 mmHg DBP, SBP or DBP ≥95th percentile [162]. Hypertension is considered a potent risk factor for atherosclerosis as it tracks with age from childhood into adulthood [163], therefore, elevated BP is considered a potential risk factor for CVD [163]. Hypertension is associated with increased risk for myocardial infarction, stroke, and cardiovascular mortality [164]. The expert panel on integrated guidelines for cardiovascular health and risk reduction in children and adolescents recommend that early detection of high BP, especially during childhood, is vital for improving long-term cardiovascular health outcomes [27 89]. According to Chobanian et al. (2003), hypertension affects approximately one billion individuals, and is attributed to 7.1 million deaths annually, worldwide [165]. Moreover, suboptimal BP (>115 mmHg SBP) is associated with 62% of cerebrovascular diseases and 49% of incidence of ischemic heart disease [165 166].

Hypertension in Children

According to the Seventh Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, hypertension in children is defined as elevated BP at the 95th percentile or greater for age, height, and gender (Table 18, appendix) on three or more separate occasions [167]. According to The Fourth Report on the Diagnosis, Evaluation, and Treatment of High Blood Pressure in Children and Adolescents [164], prehypertension in children is defined as average BP between the 90th and 95th percentile. Hypertension is considered a potent risk factor for atherosclerosis [124]; which can begin during childhood [87], developing as early as nine years of age [122], and the clinical end-point of CVD almost always occurs later in life [125]. Persistent hypertension in children is associated with increased risk of adverse outcomes including left ventricle hypertrophy (LVH), hypertensive encephalopathy, seizures, cerebrovascular accidents, and congestive heart failure [164 166]. Adverse life style behaviors (physical inactivity, poor dietary habits including high intake of fat and salt, and increased body weight) are factors associated with elevated BP in children [116 124]. Therefore, lifestyle modification, weight management through increased physical activity and intake of nutrient dense food (e.g., fruits, vegetables, and whole grains), while reducing dietary sodium is an effective method for preventing hypertension [151].

Prevalence of Hypertension in Kuwait Children

Based on a study of 1312 primary school children (6 - 10 years), the overall prevalence of hypertension (>95th percentile for age and sex, ≥130 mmHg SBP and/or ≥85 mmHg DBP) was 5.1%, and shown to be associated with obesity and family history of hypertension [69]. A cross-sectional study by Moussa et al. (1999), reported that elevated blood pressure (SBP>120 mmHg, DBP >80 mmHg) was higher in obese (4.9%) compared to non-obese (0.4%) male and female schoolchildren (n=2400, 6 - 13 years) [67]. In a pair-matched study in schoolchildren 6 – 13 years, Moussa et al. (1999) showed that the mean SBP/DBP was 114/69 mmHg and 105/64 mmHg in obese and none-obese boys, respectively. Among obese and non-obese girls, mean SBP/DBP was 115/71 mmHg and 106/65 mmHg, respectively. The results of the study have indicated that 8% of obese males and females (n=460) had SBP (>130 mmHg), and 0.7% had DBP (>90 mm Hg). Also fewer none-obese children (0.7%) had SBP > 130 mmHg [60]. . Overall, the study has indicated nearly a two-fold chance (1.7, [1.34 - 2.16] 95% CI) for hypertension among Kuwaiti schoolchildren [48].

Role of Nutrition in Pediatric/Childhood Health and CVD Risk Factor Status

Proper nutrition intake is known to counteract OB, WC, hypertension, dyslipidemia, and blood glucose [15], and therefore, both help delay and prevent the onset of CVD [20]. For example, alterations in intake of dietary fat have been shown to reduce cardiovascular events and mortality [168]. Consumption of whole grains is known to improve blood cholesterol levels, while reducing added sugar intake (<10% of energy intake) prevents hypertriglyceridemia and IR [15]. According to the nutrition recommendations and guidelines, a sufficient or increased intake of fruits and vegetables (50% to 75% of each meal/ ≥2 servings of fruit and ≥3 servings of vegetables per day) can help reduce the risk for many of the leading causes of death including CVD; in addition to their important role in weight management [169]. Furthermore, poor nutrition and a sedentary life style are associated with an increase in CVD risk factors [170].

Nutritional Recommendations - Dietary Guidelines for Americans (DGA), WHO/FAO

The Dietary Reference Intakes (DRIs)

The current dietary references for the US and Canada have expanded from the recommended dietary allowances (RDA) established in 1941 for Americans, and the recommended nutrient intakes (RNI) established for Canadians in 1938. The DRIs were established in 1994 and include four nutrient-based reference values (the estimated average requirement [EAR], the RDA, the adequate intake [AI], and the tolerable upper intake level [UL] The DRIs are used to assess and plan diets for healthy people based on scientifically founded relationships between nutrient intake and indicators of adequacy, as well as to the assist with chronic disease prevention [106]. They are intended to help individuals optimize their health, prevent disease, and avoid excesses of any nutrient; and used by health practitioners, educators, and researchers. In some cases, (e.g., for children who are small for their age) reference heights and weights for different life stages and gender groups are useful in determining specific nutrient requirements in relation to body size. Most importantly, DRIs apply to healthy people and not to individuals who are sick or malnourished or whose special circumstances may alter their nutrient needs; therefore, they are intended to provide a reasonable estimate of nutrient levels required to ensure adequate dietary intake and to prevent adverse effects due to excess intake [106]. The DRI values and ranges for total energy, and macronutrients, as well as recommendations for PA are provided via a classified term; whereas, the acceptable macronutrient distribution range (AMDR) sets ranges for intake of fat, carbohydrate, protein, and *n*-6 (Linoleic acid [LA]) and *n*-3 (Alpha-linolenic acid [ALA]) polyunsaturated fatty acids (PUFAs) associated with reduced risk of chronic disease. The estimated energy requirement (EER) introduces dietary energy which is defined as ‘the average dietary energy intake necessary to maintain a healthy individuals energy balance or need as defined by age, gender, height, weight, and level of physical activity (Table 14) [106].

FAO/WHO International Nutritional Intake Ranges

The Joint WHO/FAO Expert Consultation (2002) has reviewed and updated current international recommendations on diet, nutrition, and the prevention of chronic diseases established by the 1989 WHO Study Group [84]. The Joint WHO/FAO Expert Consultation has considered some important changes in the value of several dietary components adjacent to the most recent scientific evidence regarding adverse effects of excess intake of some macronutrient such as, sugar [98-100], sodium, and fat on cardiovascular [101-103] and metabolic health throughout life from infancy to old age [84, 104]. The 1989 WHO Study Group and the 2002 Joint WHO/FAO Expert Consultation recommendations provided ranges of nutrient intake goals (% of total energy) for promoting balanced diets and CVD prevention among nations lacking national nutrition and health guidelines, including Kuwait [21 22]. The ranges (WHO guidelines) were developed based on the FAO food balance sheet dataset, records of major food sources in each country, and their how they are consumed. Thus, providing estimates of per capita calorie, fat, and protein intake for each food category [63].

Food groups and food proportions (US DGA and FAO/WHO)

The current study will assess the levels of macronutrients, micronutrients, and select vitamins and minerals in children's diets according to the DRI for heart health and disease prevention and the 2002 Joint FAO/WHO Expert Consultation.

The WHO/FAO [2002] recommendations for food groupsper day include, fruits (400 g [~1.7 cup]) and vegetables (400g [~1.7 cup]), and NSP (whole grains) from food [22 63].

The current DGA's recommendations for food groups for children (9-13 years) recommends a daily intake of 1.5 cups of fruit, 2 cups of vegetables for females, and 2.5 cups for males; 3 cups of dairy or dairy products for both male and female; 5 oz. of grains for females and 6 oz. for males, and 3 oz. equivalents of whole grain are recommended for both sexes [66].

Macronutrients

Macronutrients are a type of nutrient (chemical compound) required in large amounts in the human diet including, protein, carbohydrates, and fat**.**

The Joint WHO/FAO Expert Consultation [2002] recommended: total fat (15% to 30% of daily kcals), saturated fat (<10% of daily kcals), *trans*-fat (<1%), polyunsaturated fatty acids (PUFA 6% to 10%), *n*-6 PUFA (5% to 8% of daily kcals), *n*-3 PUFA (1% to 2% of daily kcals), total protein (10% to 15% of daily kcals), total carbohydrates (55% to 75% of daily kcals), complex carbohydrates (50–70% of daily kcals), free sugars (<10% of daily kcal), dietary fiber (from food), and NSP wholegrain (from food) for both males and females [21 22].

The acceptable macronutrient distribution range (AMDR) for children (9 to 13 years) are as follows: total fat (25% to 35% of daily kcals), saturated fat (less than 10% of daily kcals), total carbohydrate (45% to 65% of daily kcals), dietary fiber (31 g for males and 26 g for females), and total protein (10% to 30% of daily kcals) [262].

Micronutrients

Micronutrients are comprised of vitamins and minerals, which are required in small quantities to ensure normal metabolism, growth, and physical well-being.

The 2002 Joint FAO/WHO Expert Consultation on human vitamin and mineral requirements provided recommendations for nutrient intake (RNI) defined as the amount necessary to meet the needs of most (97.5%) of the population, set as the EAR plus 2 standard deviations. The RNI is equivalent to the recommended daily (or dietary) allowance (RDA) used by the Food and Nutrition Board of the US National Academy of Science [65], and is targeted for non-industrialized nations or less developed countries. Therefore, the levels for some of the micronutrients such as, vitamin D for children (200 IU) are lower as compared to levels set for industrialized nations or developed countries (600 IU) [64].

The FAO/WHO (RNI) for children (7 to 9 and 10 to 18 years) for micronutrients (selected) are as follows: vitamin D (200 IU), Na (<2000 mg), K (4500 mg), Ca (1300 mg), and Mg (230 mg) [65].

The DRIs (AI, UL, and RDA) for children (9-13 years) were as follows: vitamin D (600 IU), Na (<2300 mg), K (4500 mg), Ca (1300 mg), and Mg (240 mg) [262].

Selected minerals in this study, potassium, magnesium, and calcium, in addition to vitamin D, are known to protect from the risks for CVD; whereas, dietary sodium can affect CVD risk by increasing BP [14].

Nutritional Intake and Behavior among Kuwait Children

It is important to note that in Kuwait, there is no national nutrition guidelines. Instead, Kuwait has retrieved and or utilized nutritional guidelines in accordance to WHO, the FAO, and the National Research Council (1989) RDA [31 39 171 172].

Several previous research studies of local and regional Kuwaiti diets described the characteristics of both traditional, domestically prepared, and modern, imported foods and cuisines, diets as atherogenic, which are known to contain high amounts of cholesterol and saturated fatty acid, in addition to excess trans-fat, sodium, and sugar [173-176]. Sawaya et al.

(1998), indicated that most traditional Kuwaiti dishes are rich in cholesterol (up to 371 mg/100g) and *trans*-fat, where palmitic and stearic acids are the predominant saturated fatty acids, in addition to high polyunsaturated fatty acid-to-monounsaturated fatty acids (P:S ratios) [177]. Most of the Kuwaiti traditional diet are of a plant origin such as, wheat and rice (75%); in addition to fish and animal products, and fat and oils, which contribute 24% and 15% of the food energy-supply, respectively [31]. Nevertheless, increased food availability and food imports have shifted the Kuwaiti diet into a mix of traditional and foreign cuisines, and westernized diets with varied eating styles. As a result, more dishes have become available with a wide range of micronutrients per food proportion (100g) including Na (13–1567 mg), K (181–1033 mg), Ca (9.97–677 mg), Mg (10.4–133 mg), iron (14–5.12 mg), zinc (13–4.16 mg), and iodine (7.4 μg–61.2 μg) [178]. According to Al-Hooti et al. (2002), the nutrient intake of the Kuwaiti population exceeded the RDA for energy (1.19 fold), protein (2.1 fold), vitamin A (2.59 fold), thiamine (1.37 fold), riboflavin (1.39 fold), niacin (1.41 fold), vitamin C (2.52 fold), iron (1.56 fold), and Ca (1.10 fold) [31].

The Kuwait Nutrition Surveillance System (KNSS 2012) report shows that the majority (81.5%) of young children (2 to <5 years) consumed less than five servings per day of fruits and vegetables, and only 44.6% of children consumed ≥2 cups/day of dairy, based on the WHO/EMRO specialized survey. However, the KNSS did not report any data regarding nutrition intake and behavior of children above 5 years of age or adolescents [1].

Zaghloul et al. (2012) also described the nutritional intakes of Kuwaiti boys (n=111) and girls (n=94) (9 -13 years) based on the USDA 5-step multiple-pass single 24-h dietary recall method [193 194]. The study results indicated higher intakes of energy and macronutrients, particularly among boys, and lower intake of micronutrients and dietary fiber, particularly among females. Caloric intake of both males and females (2236 ± 106 kcal, and 1992 ± 92 kcal, respectively) exceeded the recommendations for children 9 to 13 years (1800 kcals, and 1600 kcals, respectively). The study showed higher percentage energy intake of fat (36%, 38%), in addition to excess sodium (3508 mg, 2975 mg) in males and females respectively. Moreover, males had a higher mean intake of cholesterol (272.7 mg) compared to females (220.2 mg). Intakes for calcium (717.6 mg, 543.8 mg), magnesium (216.6 mg, 182.1mg), vitamin E (4.8 mg, 4.2 mg), vitamin D (75.3 IU, 49.5 IU), and dietary fiber (18.1g, 16g) were below the US DRI recommendations for males and females, respectively. The study did not report intakes from food groups such as fruits and vegetables, whole grains, and dairy, or provided insights on children's diet quality [36]. Research has shown that high energy-density diets are associated with poor diet quality. Patterson et al. (2010) reported lower intake of fruits and vegetables, and dietary fiber among 9 years old Swedish children (n=551), which was significantly (p< 0.001) associated with high-energy-density diets [195].

There is no perfectly accurate dietary tool to assess individual dietary intakes and behaviors in children. A concern with the use of 24-hr recalls is it does not estimate an individual's usual overall dietary pattern and is not considered an ideal dietary tool to use with children considering their limits in cognition, quantification, and memory [46 47]. Montgomery et al. (2005) and Baxter et al. (2006) implemented the USDA 5-step multiple-pass 24-hr recall in children. It was reported that preschool and primary schoolchildren, particularly females, reported higher energy intake using this method [10]. In addition, over-reported items were observed among overweight as compared to normal weight children, and among boys as compared to girls on three occasions [11]. There are alternative dietary assessment tools such as food frequency questionnaires (FFQs) designed to estimate children's usual dietary intake and are commonly used in epidemiological studies to associate health risk factors with dietary behaviors [196-198].

Nutritional Assessment Instruments

Dietary assessment tools are used to assess and quantify individuals' dietary intake to help identify the nutritional status and/or needs relative to that particular individuals' dietary behavior. Food frequency questionnaire (FFQ), 24-hour recall, food record, and diet history approaches are widely used subjective (self-reporting) dietary assessment methods for assessing individual(s) dietary intake in research including intervention studies. The current study will be using a food frequency questionnaire for assessing participants' nutritional intake.

Food Frequency Questionnaire (FFQ)

The FFQ is an assessment tool characterized by reporting the frequency of each food consumed from a list of foods for a specific time period. It is commonly used in cross-sectional/surveillance, case-control (retrospective), cohort (prospective), and intervention studies. FFQ has been widely used in epidemiological studies regarding CVD since it is helpful in studying the relationships between particular dietary variables and the incidence of diseases [253-256].

Essentially, the FFQ collects dietary intake information regarding frequency (how often), portion size (how much), in addition to details involving characteristics of food as eaten; such as methods of cooking or food preparation as single or combined meals. The importance of incorporating a portion size question or specifying portion sizes as part of each question helps in estimating relative or absolute nutrient intake. FFQ can be developed or tailored for different populations and different purposes. The Health Habits and History Questionnaire (HHHQ) or

Block questionnaires, the Harvard University Food Frequency Questionnaires or Willett questionnaires, and the National Cancer Institute Diet History Questionnaire are among those evaluated and commonly used for US adults [179]. Also, there are other types of FFQs designed to capture the diverse diets of ethnic groups such as, Latinos and Native Americans [180]. There are also abbreviated FFQs which assesses total diet and are composed of shorter lists of 40 to 60 line items from the original 100 or more items [181]. There are steps to process an FFQ involve collecting quantitative dietary intake information from a target population to define the typical nutrient density of a particular food group category. For example, the macaroni and cheese food group food codes reported from all individuals in a population survey are collected, then the mean or median nutrient composition (by portion size, if necessary) is estimated, and then, these values can be tabulated by age and gender. The last step is to compute nutrient intakes for individual respondents using specific dietary analyses software [182].

The benefits of using FFQs are the lower costs of administration and processing as compared to diet records or recalls, estimating typical food intake over extended periods of time, which can also help avoid recent changes in diet, and as a useful tool in collecting pre-data or baseline data, and retrospective diet reports. However, FFQs are not limited by issues involving missing food details associated with the appropriateness of the food list. Variability within individual diets is a crucial factor in designing a typical food list. Also, there is a possibility for inaccuracy when obtaining reports for foods eaten both as single items and in mixtures [183]. In addition to issues involved with FFQ design including length, closed versus open-ended response categories and their definition, portion size, seasonality, and period have to be defined. Moreover, listing too many individual line items and additional portion size questions will increase the responders' burden and affect FFQ validity. Other critical limitations include errors involving measurement [184], estimation of serving sizes [185], self-reported energy intake and protein [184], and inaccuracy in quantification of intake related to the incomplete listing of all possible foods.

The Block Kids 2004 Food Frequency Questionnaire (FFQ)

The Block kids FFQ is a valid and reliable dietary method in dietary research studies. Marshall et al. investigated the relative validity of the Iowa Fluoride Study using a targeted nutrient semi-quantitative questionnaire and Block Kids' FFQ in assessing beverage, calcium, and vitamin D intakes using 3-day diaries for a reference. The findings showed that the method reported equal and high correlation regarding milk intakes (r=0.571), 100% juice intakes (r=0.550), diaries for calcium (r=0.515), and vitamin D (r=0.512) when compared to the Iowa Fluoride Study targeted nutrient semi-quantitative questionnaire for relative validities [255]. Cullen et al. tested the reliability and validity of the Block Kids Questionnaire to assess diet of 10- to 17-year old children and adolescents during the past 7 days, who had completed two 24-hour recalls. The Block kids FFQ showed a moderate reliability intraclass correlation (>0.30) when compared with 24-hour dietary recall, except for percent energy from protein, and fruit and vegetable servings [256]. Some other studies implemented the Block Kids 2004 FFQ. Lauren E. Au et al. (2012) investigated association between saturated fat, carbohydrates, MUFA and PUFA, and cardiometabolic risk in 148 fourth- through eighth-grade students. However, no associations found [55]. In Michigan, A pre-post study examined 181 boys and girls (5th grade) nutritional intake indicated increased intake of saturated fat intake 6% (p=0.038). Also significant positive changes in intakes from whole grains (40%; p=0.03), vegetables (33%; p=0.01), and vitamin A (13%; p=0.047) [186].

The current study has implemented a modified, translated (Arabic version) of the 2004 Block Kids (FFQ) (Block Dietary Data Systems, Berkeley, CA; http://www.nutritionquest.com) to assess the nutritional intake including food groups and nutrient intakes of Kuwait schoolchildren [249 218].

Dietary Indices for Measuring Diet Quality

Changes in eating patterns are related to an increase in CVD risk factors including obesity in children. For example, intake of carbohydrates, protein, and sugar in addition to snacking has increased as compared to intake of grains, fruits, and vegetables [187]. Additionally, measuring nutrient density in children's diet is important for identifying children at risk for chronic diseases.

There are several predefined indexes of overall diet quality developed to assess nutrition adequacy and associated health outcome. In addition, dietary quality can also be assessed by individual dietary factors, such as fiber, to predict morbidity and mortality. The healthy eating index (HEI) is among one of the original diet quality scores including the Diet Quality Index, the Healthy Diet Indicator, and the Mediterranean Diet Score. They are comprised of both food groups and nutrients, and are reliable and extensively validated [188]. A meta-analysis of cohort studies indicated that diets that score high on diet quality indices including healthy eating index (HEI), the alternative healthy eating index (AHEI), and the dietary approaches to stop hypertension (DASH) score are associated with a significant reduction in the risk of all-cause mortality (22%), CVD (22%), cancer (15%), and T2DM (22%) [189].

Healthy Eating Index (HEI)

Healthy Eating Index (HEI) is a scoring system (0 to 100) developed based on the USDA Food Patterns and editions of the Dietary Guidelines for Americans (DGA), including Dietary Approches to Stop Hypertension (DASH) eating plan, to measure diet quality in US population and subpopulations. The index examines the overall diet components from food groups and single nutrients in adherence to DGA for chronic disease prevention in adults and in children related to obesity. The HEI 2010 (retained several features of the 2005 version) consisted of nine adequacy and three moderation (12) components [190]. The index was updated with changes including replacing dark green and orange vegetables and legumes with a greens and beans component, and replacing saturated fat with monounsaturated and PUFAs including the ratio of polyunsaturated and monounsaturated to saturated fatty acids. Moreover, adding seafood and plant proteins, and a moderation component, refined grains, replaced the adequacy component; and total grains to assess overconsumption [190]. The HEI 2010 components consist of total fruit, whole fruit, total vegetables, total grains, and sodium (forwarded from the HEI 2005), dairy and total protein foods, and empty calories (component calories from solid fats, alcoholic beverages, and added sugars) [190]. The HEI 2010 uses a density approach to set standards (per 1,000 calories or as a percentage of calories) and employs less restrictive standards (vary by energy level, sex, and/or age) for determining maximum score. Maximum points are allocated when intakes at the level of the standard or higher for adequacy components, also when intakes at the level of the standard or lower for moderation components. For example, the maximum score for Na was assigned to diets that have less than 1,100 mg of Na per 1,000 calories. There are four steps for deriving HEI-2010 scores: 1) identify the set of foods under consideration; 2) determine the amount of each relevant food group, subgroup, and nutrient in the set of foods; 3) derive the pertinent ratios; and 4) score each component using the appropriate standard [190].

A study compared the quality of the diet (HEI) of 2,703 children ages 2 to 17 years who participated in NHANES (2003-2004, 2005-2006, and 2007-2008) dietary intake records. Their average scores, averaged 47 to 50%, were below the standards for all HEI-2010 components across the three periods. Their intakes from dark green vegetables, beans, and whole grains were the lowest (14-18 % and 16-18 %, respectively). Nonetheless, during the period of 2007-2008, intakes from an adequacy component such as fruit, including 100% fruit juice and whole fruit, were higher, in addition to lower intakes from empty calories (moderation component) compared to periods of 2003-2004 and 2005-2006 [191]. Drenowatz et al. (2012) reported that the median HEI score of 210 MI 5th graders was 62, only 5 participants (2.5%) had "good" diet scores (HEI> 80), and 18 participants (8.6%) scores reflected as "poor" diet (HEI < 50) [192]. Feskanich and Rockett et al. (2016) developed the youth healthy eating index (YHEI), a modified and simplified HEI to study 551 children and adolescents (9-14 years) [193]. The YHEI focuses on foods high in trans-fatty acids, added sugars, and foods low in fiber, which contribute to obesity and CVD [56, 166, 167] . The study compared data from the Growing Up Today Study cohort with original HEI scores in relation to BMI and time spent on daily activates. The results showed that the original HEI was strongly correlated (r=0.67) with total energy intake, in addition to several other correlated components including total and saturated fat (r=0.78) than did the YHEI (r=0.12) [193]. Some studies looked for associations or correlations between HEI and MetS and/or CVD risk factors. For example, Yang Pan et al. (2008) found significant association (P<0.001) between high overall HEI and fruit scores and low MetS in adolescents (12 - 19 years) [194]. On the other side, Drenowatz et al. (2013) did not find significant correlations between CVD risk factors and HEI in 5th graders [192]. The HEI 2010 is useful in investigating the relationship of diet quality between parents and children. Robson and colleagues found a significant relationship between a parent's diet quality and their children's diet quality (standardized $\beta=0.39$; $P<0.001$) [195]. Diet quality can also be measured using specific nutrients or food factors such as the dietary fiber index (FI), which will be used in this study.

The Fiber Index (FI)

The Fiber Index (FI) is a surrogate marker for nutrient density (or the amount of nutrients/1,000 kcal) based on a high-fiber diet consisting of plant-based foods, which includes total dietary fiber (soluble and insoluble). The intake of dietary fiber-containing foods (e.g., fruits, vegetables, whole grains, legumes, nuts, and seeds), are directly related to dietary fiber level as well as nutrients and phytochemicals associated with cardiovascular health [196-198]. Carlson and colleagues (2015) compared the relationship of metabolic syndrome (MetS) in youth (12 - 19 years) with a fiber index (FI), saturated fat index (gs/ 1000 Kcals), and the cholesterol index (mgs/1000 kcals). The findings indicated a significant inverse relationship ($P<0.001$) between increases in dietary fiber intake and lower risks of MetS. There were no significant relationships between saturated fat index ($P<0.87$) or the cholesterol index ($P<0.22$) and MetS. [199] Ventura et al (2008) examined relationship between diet and MetS in 109 overweight Latino children in age 10 to 17 years, and found a lower mean dietary fiber (7.5 ± 2.8 gs/ 1000 kcal) in children (n=24) with MetS, while children without MetS (n=85) had a higher mean fiber intake (8.4 ± 3.1/ 1000 kcals). [200]

Benefits of Physical Activity (PA) in Children and Recommendations

According to WHO, physical inactivity is the fourth leading risk factor for early mortality worldwide [11], and among major risk factors for CVD. According to the American College of Sports Medicine, PA involves any bodily movement produced by the contraction of skeletal muscles, which maintains and improves cardiorespiratory fitness along with reducing the risk of obesity and related comorbidities [[201]]. In children and adolescents, PA influence energy expenditure, improves cardiorespiratory fitness as well as metabolic performance [193]. PA has beneficial effects on CVD risk factors including adiposity, BP, plasma lipids and lipoproteins levels, also inflammatory markers, endothelial function, and heart rate variability. In addition to reducing CVD risk factors, PA has been shown to also improve mental health (including depression) and bone health [193]. Studies have indicated that the more PA, the greater the benefit, even with modest amounts (average of 60 min/day) of moderate intensity, this is especially true in high-risk youngsters. Therefore, for the past two decades AHA and WHO have recommended at least 60 minutes of moderate-to-vigorous PA per day for children and adolescents [11 119].

Current Physical Activity Behaviors in Kuwait

In Kuwait, physical inactivity is affecting a clear majority of the population at all ages and both genders, which is considered a major concern. Available local research has described the overall PA status as weak and needs to be given more attention [38]. Several studies have shown that increased screen time and physical inactivity were found to be associated with MetS, abnormal glucose, and fat metabolism in adults [186-188], and elevated BP and OB in children and adolescents [189-191]. A sedentary lifestyle is known to be associated with an increase in CVD risk factors [193].

Based on a paired-matched control study (n=920, 6-13 years), Moussa et al. (1996) reported that the overall PA level in children was low, with participation in PA levels of light (20%), moderate (43%), and vigorous (30%) [48]. El-Bayoumy et al. (2006), reported that physical inactivity was prevalent among male (n=2657) and female (n=2745) adolescents (10 – 14 years). A modified Harvard step test showed that the majority (97%) had a low physical fitness score (65 to 79). In addition, they spent an average of 2.8 hours per day of screen time, 1.8 to 2.1 hours per day of outdoor activity, and 4.8 to 5.2 hours of sporting activities per week [45]. Al-Haifi et al. (2013) examined the relative contribution of selected lifestyle factors on OW and OB in 463 boys and 443 girls (14 – 19 years) via a self-reported PA questionnaire (Arab Teens Lifestyle Study). Lack of moderate and vigorous PA were strongly associated ($P<0.0001$) with OW and OB among boys (50.5%) and girls (46.5%) [112].

Barriers among Kuwaiti Population

Poor eating habits [137-141, 152], lack of PA, and lack of nutrition knowledge are major lifestyle factors associated with prevailing health problems including CVD [194]. The absence of national dietary guidelines and lack of food regulations and policies are major contributors to obesity and comorbidities [76-79]. The food environment in Kuwait involves a huge growth in the availability of fast-food restaurants, supermarkets, and hypermarkets that are affordable and easy to access, encouraging unhealthy eating pattern. After 1991, the number of fast-food restaurants increased dramatically and became attractive destinations for youth since they often offer playgrounds and electronic games to patronize. As a result, increased leisure time activities including screen time and associated poor dietary behaviors became rooted in the Kuwaiti society [114]. Moreover, hot dusty weather during most of the year (temperatures exceeding 50 C○ or 120 F○), lack of cycle paths and walking trails, asthma, smoking, socio-cultural norms, and increased indoor shopping malls are strongly related to the general lack of physical activity among the vast majority of the Kuwaiti population [34 195].

Physical Activity related Assessment Instruments

There are several categories of techniques used to assess PA in children, including self-report, electronic or mechanical monitoring (accelerometers, pedometers, heart rate monitors), direct observation, indirect calorimetry, doubly labeled water, and direct calorimetry [202] . Self-report instruments such as questionnaires, interviews, and activity diaries (logs) are commonly used methods for the assessment of PA in epidemiological research, which known as subjective methods [203]. Studies using self-report measures usually find more PA than those using objective measures [204], but are limited by biased reporting and low validity [205]. Studies that were published between 1971 and 1997 indicated that test-retest reliability (the reliability of a score measured two or more times), interinstrument reliability (between two or more instruments), and validity (the degree to which an instrument measures what it is intended to measure) were variable and less likely to be consistent in young children [202 206]. Overall, there is a variation in studies worldwide regarding the estimation of PA in youth due to the lack of unified standards, criterions, and cut points, as well as the use of different study designs [207].

Self-reported methods

Self- reported methods involve collecting information retrospectively, which are influenced by the ability to recall details of PA by children or guardians. The methods are relatively inexpensive, quickly administered, unobtrusive, and obtain several sources of PA information; therefore, they are frequently used in large-scale studies and compared using electronic monitors [202]. Nevertheless, self-report methods are influenced by the opinions and perceptions of the participants, proxy (parent/guardian) reporters, or investigators [203], which may result in misuse, lack of accuracy, and faulty interpretations. Self-report methods are not typical estimators of energy expenditures in children as compared to a more precise laboratory instrument, such as calorimetry and doubly labeled water. Additionally, self-report uses energy costs standard of specific activities in adults. Also, children are less likely to recall their physical activity compared with adolescents and adults, which may result in overestimations of PA [208].

In the current study used a self-reported retrieved from the Youth Risk Behavior Surveillance (YRBS) [209], and used by (S)Partners for Heart Health program [210] to assess moderate-to-vigorous physical activity (MVPA) on seven days per week (>60 min) and ST (≥2h/d) [186 192 211]. The question stated *"During the last 7 days, how many days were you physically active for a total of at least 60 minutes per day (add up all of the time you spend in any type of activity that increases your heart rate and makes you breath hard some of the time)?" The scale range is 0- 7 days"* [211]. The study participants were provided with the question in both Arabic and English languages (Appendix). The screen time question involved estimating the weekly amount of time viewing television, playing video games, and online computer use, which was translated into Arabic Language (Appendix). Children indicated the number of hours (watch/play) on weekdays and weekends for each of the three-screen media. Average hours of screen time per week was determined using the formula: (Hours of TV time on weekdays* 5 days) + (Hours of TV time on weekends * 2 days))/7 days + ((Hours of Video game time on weekdays * 5 days) + (Hours of Video game time on weekends * 2 days))/7 days + ((Hours of Computer time on weekdays * 5 days) + (Hours of Computer time on weekends * 2 days))/7 days [212]. Screen time equal or more than 2 h per day will be considered high ST. Less than 2 h/day of ST will be considered low ST [213].

Nutritional & Physical Activity Educational Program

The (S)Partners for Heart Health

The results from the current study compared a sample of 5th graders in Kuwait with the latest available data of the (S)partners for Heart Health on CVD risk factors and nutrition and lifestyle behaviors in Michigan 5th graders. The (S)partners for Heart Health is a multi-level intervention program intended to promote nutrition and PA behaviors related to cardiovascular health and CVD risk reduction. The program was designed by a multi-disciplinary team of Michigan State University (MSU) faculty of nutrition, exercise physiology, physical education, child growth and maturation, psychology, and public health, along with MSU health clinicians, medical students, allied health profession students, and MSU Extension staff. Moreover, The (S)partners for Heart Health program incorporates components of Bandura's Social Cognitive Theory involved in promoting self-sufficiency toward making positive nutrition and PA choices to contributed to heart health in students. The (S)Partners program develops and implements a cost-effective sustainable intervention program for CVD risk factor prevention among 5th grade students; thereby, augmenting the existing 5th grade physical education, nutrition and health curriculum to sustain or improve heart-healthy behaviors and health status. The primary aims of the program are to increase the percentage of students achieving national recommendations for PA and nutrition behaviors; to improve the public-school students' knowledge, attitudes, and self-efficacy about heart healthy nutrition and PA behaviors as recommended by national guidelines; and to improve or maintain the number of students with a desirable CVD risk factor status. In addition, as secondary aims of the program, to promote school staff and parental support for heart healthy activities to help children achieve their heart health goals, and to provide hands-on learning and training for MSU health profession students [210]. The program involves intervention and measurement assessment performed by undergraduate dietetic and kinesiology students and second year medical students by partnering ([S]partnering) and mentoring 5th grade students.

Summary of Literature Review

Cardiovascular disease (CVD) is the leading cause of death globally, responsible for around 17.5 million deaths (31%) annually. In Kuwait, CVD accounts for 41% of all deaths. In children, CVD risk factors such as obesity, hypertension, dyslipidemia, and diabetes tend to track into adulthood and lead to premature morbidity and mortality. CVD risk factors vary between gender related to biological and environmental factors. Poor nutrition and physical inactivity contribute to numerous CVD risks, regardless of weight status. A concern in Kuwait is the increasing rates of childhood obesity from 0.3% in 1985 to 31% in 2012. Also, hypertension and diabetes were estimated at 5.1% and ~35% in schoolchildren, respectively. Literature has shown that most of the food consumed in Kuwait (90%) is imported and subsidized, which result in exceeding the RDA for macronutrients and micronutrients. Moreover, a study during 2008-2009 has indicated that half of Kuwaiti schoolchildren were exceeding kcal intake, while 80% were not meeting nutrients recommendations. Regardless, there is a lack of data on multiple CVD risk factors and dietary quality in schoolchildren of Kuwait. This study's overall objective is to determine the prevalence of multiple CVD risk factors and the extent to which are met nutrition recommendations by gender and by weight status.

CHAPTER 3: PREVALENCE OF CARDIOVASULAR DISEASE RISK FACTORS IN KUWAITI SCHOOLCHILDREN COMPARED BY GENDER

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Abstract

Background: Cardiovascular disease (CVD) is the leading cause of death from non-communicable diseases worldwide (31%), and in Kuwait, it accounts for 41% of deaths. Concerns in Kuwaiti children include their 31% OB rate in 2012, and boys had higher rates than girls. Also, data is limited on other CVD risk factors, and potential gender differences.

Objective: To determine the prevalence of CVD risk factors in Kuwaiti schoolchildren, and if boys are at greater risk than girls.

Methods: A cross-sectional evaluation of fifth grade schoolchildren (N=367, 53% girls, age 10.4 ± 0.4 years) in Kuwait. Outcome variables (at risk) included: BMI (overweight (OW) >+1SD, OB (>+2SD), waist circumference (WC) ≥90th centiles, waist-to-height (WHtR) ≥.50, percentage body fat (%BF) ≥90^{th} centiles, TC ≥170 mg/dL, LDL ≥110 mg/dL, HDL ≤45 mg/dL, non-HDL ≥120 mg/dL, TC:HDL ≥3.5, TG ≥90 mg/dL, systolic blood pressure (SBP)≥120 mmHg, and diastolic BP (DBP) ≥80 mmHg. General linear model and logistic regression controlled for physical activity (PA) and screen time (ST), with $P \leq 0.05$.

Results. The overall % at risk for CVD included: OW 21.6%, OB 42%, high WC 10.2%, WHtR 43.3%, %BF 10.1%, TC 26.4%, LDL 13.2%, HDL 36.9%, non-HDL 22.5%, TC:HDL

25.9%, TG 45.5%, BP 23.3%. Gender differensce included more girls were OW than boys (27.1 vs. 15.5%, *P*=0.007), and more boys (41.4%) were OB vs. girls (38%), but was not significant. Girls versus boys had a greater % at risk for TG (52.3% vs 37.7%, *P*=0.032), elevated SBP (21% vs 10.7%, *P*=0.008), and DBP (21% vs 8.8%, *P*=0.001), respectively.

Conclusions: The prevalence of CVD risk factors include OB and BP among Kuwaiti children is alarming. Contrary to our hypothesis, girls had greater risks for OW, elevated TG, SBP and DBP compared to boys. Intervention studies on Kuwaiti children are warranted to reduce CVD risk factors.

Introduction

Cardiovascular disease (CVD) is the leading cause of death worldwide, and is responsible for 17.5 million deaths (31%) annually, including 41% in Kuwait. CVD risk factors in children tend to track into adulthood and lead to premature morbidity and mortality [214]. A concern worldwide is that between 1990 and 2010, rates of childhood overweight (OW) and obesity (OB) increased from 4.2% to 6.7%, and are expected to reach 9.1% (60 million children) by 2020 worldwide [97 215]. In Kuwait, there is significant concern about increases in the prevalence of childhood OB during the past several decades. For example, in 1985, Bayoumi et al. reported the prevalence of OB (BMI >2SD) in children aged six-to-nine was only 0.3% among boys and 0.2% for girls. [216] However, a study on the same age group from 1995 to 1996 indicates the prevalence of OB as 12.2% among boys and 12.3% among girls; additionally, among 10-to-13-year-olds, OB prevalence was 16.3% for boys and 17.4% for girls [67]. Data from 2012 to 2013 indicate the overall OB rate in Kuwaiti children and adolescents (six to 18 years) was 34% according to Center for Disease Control and Prevention (CDC), 31% according to WHO, and 28% according to International Obesity Task Force (IOTF) [2]. These data indicate that between 1985 [216] and

2013 [2 39], the prevalence of childhood OB in Kuwait increased by more than 30%. In 2014, data from the Kuwait Nutrition Surveillance System report (KNSS, 2014) denoted OB rates by gender for boys and girls. In ages five to <10 years OB rates were nearly identical in boys (20.1%) and girls (20.3%) though among ages of 10 to <15 years, the OB prevalence was higher in boys (34.1%) than in girls (27.1%). [68] The increasing levels of childhood OB in Kuwait is concerning given OB is linked with attenuating other CVD risk factors including blood pressure [67] and adverse levels of blood lipids. [60]

There are several potential factors for the increases in childhood OB in Kuwait since 1985. These include Kuwait transitioning into rapid economic growth, increases in urbanization, and social and lifestyle changes including dietary changes from increased food imports, food subsidies, and a decrease in physical activity (PA). [34 177 217]

With the exception of data on the prevalence of OB, OW and elevated BP, there are limited data on the prevalence of other CVD risk factors among Kuwaiti children. Moussa et al. (1999) reported the prevalence of hypertension as 5% in OB boys and girls aged six to 13 years. [67] Saleh et al. (2000) also reported hypertension as 5% among Kuwaiti schoolchildren (six to 10 years) [69]. No data available on the prevalence of dyslipidemia in Kuwaiti children, however, a study conducted during 1995 and 1996 and indicated mean blood lipid levels among normal weight children were equivocal, but were higher in OB boys than in OB girls [60] Therefore, the study purpose was to determine the prevalence of CVD risk factors in Kuwaiti fifth graders, and if there are gender differences. It was hypothesized that boys would have a greater prevalence of CVD risk factors than boys. Secondarly, to determine if the mean levels of CVD risk factors are greater in boys versus girls.

Methods

Study Design and Participants

A cross-sectional evaluation was conducted with 367 fifth graders (10.4 ± 0.4 years of age; 53% girls) in Kuwait. For student recruitment, informed parent/guardian consent and child assent forms were distributed to 39 primary schools (19 boys schools, 20 girls schools) within 6 Kuwaiti cities. Data was collected from 16 schools which were supportive of participating during the timeline available in Spring of 2019. The reasons for schools who did not participate included lack of interest or support from school administrators, and or the inability to participate during the limited timeline. Of the 493 consents and assents forms (boys [258] and girls [235]) that were collected, 35 parents chose not to have their child participate in the study, and 65 boys and 42 girls were absent on measurement day, resulting in a sample of 367 for this study. The study protocol was approved by the Michigan State University (MSU) Institutional Review Board (IRB) and the Ministry of Health Research Ethics Committee, and by the Department of Educational Research in Kuwait.

Measurement

Data collection occurred in Kuwait between February 2018 and March 2018, and included anthropometric, biometric, and lifestyle behavior assessments. Following training, data collection was performed by nursing trainers, as well as nursing and nutrition students from the College of Nursing and the College of Health Sciences of the Public Authority for Applied Education and Training (PAAET), Kuwait. The training protocol followed procedures used by MSU's (S)Partners for Heart Health school program [210], to ensure the reliability, validity, and safety of measurement techniques. The protocol included following pediatric CVD risk factor assessment procedures from the American Academy of Pediatrics guidelines [20], an expert panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents [89], and Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. [218]

Anthropometric Assessments

Several anthropometric measures were used in this study to derive outcome measures. Measures included height and weight, which was used to calculate body mass index (BMI), body fat percentage (%BF), waist circumference (WC), and derived waist-to-height ratio (WHtR). Each of the anthropometric measurements are summarized below.

Standing height was measured using a ShorrBoard (Shorr Production, Olney, MD) or wall mounted, or calibrated stadiometer (210 Holtain Limited, Dyfed, UK), to the nearest 0.1cm, without shoes. Body weight (to the nearest 0.1 kilogram) and BF percentage were measured using a calibrated electronic scale (Tanita BC-534), which employs foot-to-foot bioelectrical impedance (BIA) (Tanita Corporation, Tokyo, Japan). Height and weight were used to calculate BMI $\frac{Weight\ (kg)}{Height\ (m^2)}$, which was converted to Z-scores based on methods devised by Cole et al. (1992, Z= $\frac{(\frac{BMI}{M})^{L-1}}{L * S}$). [219] Waist circumference (WC) was measured to the nearest 0.1 centimeter using a Gulick measuring tape (Gulick Co., Tokyo, Japan). The Gulick tape was positioned in a horizontal plane around the abdomen at a level 1cm above the superior border of the iliac crest [144 220]. Waist-to-height ratio (WHtR) was derived from $\frac{WC\ (cm)}{height\ (cm)}$, according to Ashwell et al. (2005). [153]

CVD risk factors (dependent variables)

Obesity

Overweight and OB were assessed via BMI-for-age z-scores, according to the International Obesity Task Force (IOTF) cutpoints for OW >1+SD (90th centile), and OB >2+SD (98.7th centile) [47]; the WHO (2007) cutpoints for OW ≥+1SD (≥85th to <97th centile), OB ≥+2SD (≥97th centile), [54]; CDC (2000) cutpoints for OW ≥+1SD (≥85th to <95th centile), and OB ≥+2SD (≥95th centile). [124]

The cutpoint for abdominal OB included WC at or above the 90th percentile, and was determined according to the International Diabetes Federation (IDF) [221], and growth curves for cardio-metabolic risk factors in children and adolescents, devised by Cook et al. (2009) (NHANES III). [57] In addition, WHtR was calculated for children at or above 0.5, as per Ashwell et al. (2005) [153] The cutpoint for high-risk BF percentage at or above the 90th percentile was indicated according to NHANES (1999 to 2004) smoothed curves. [156]

Dyslipidemia

Assessment of blood lipids involved the following cutpoints from the Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents. [89] At risk cut point values: total cholesterol (TC) at or above 170 mg/dL, LDL at or above 110 mg/dL, HDL at or lower than 45 mg/dL, TG at or above 90 mg/dL, non-HDL at or above 120 mg/dL, and total cholesterol: HDL ratio at or above 3.5. High risk cutpoint values: total cholesterol (TC) at or above 200 mg/dL, LDL at or above 130 mg/dL, HDL at or lower than 40 mg/dL, TG at or above 130 mg/dL, non-HDL at or above 145 mg/dL.

A blood sample was collected from participants in a non-fasted state by finger prick (40 µL), using heparinized capillary tubes. The blood sample was analyzed using CardioCheck Plus (version 1.09; Maria Stein, OH). CardioCheck is a portable analyzer that was calibrated prior to testing at each school site. Per protocol, each blood sample was placed on a multi-lipid panel cassette to obtain analysis of total cholesterol (TC), HDL cholesterol, and triglycerides within 90 seconds. Levels of LDL were calculated based on the Friedewald formula (LDL = TC - (HDL + TG/5) [222]. Additionally, the TC:HDL ratio, and non-HDL cholesterol were calculated.

Regarding CardioCheck Plus accuracy, Whitehead et al. (2013) evaluated CardioCheck and Cholestech LDX accuracy using laboratory methods. CardioCheck exhibited higher intra and inter-batch imprecision and external quality assessment (EQA) scheme between-analyzer variation for the measurement of TC, HDL, compared to the Cholestech LDX cholesterol analyzer in Li Hep whole blood and plasma. [223] Steiner et al. indicated that differences between non-fasted and fasted measures of pediatric lipids LDL and TG were minor and clinically acceptable. [224] Moreover, it has been determined that non-fasting TC and HDL measurements are appropriate and in strong agreement (intra-class correlation .92) with fasting values. [225] Non-HDL was calculated by subtracting HDL from TC and deemed acceptable for using non-fasting samples. [232] Non- HDL is used clinically as a marker for atherogenic apolipoprotein B containing lipoproteins [226 227], and considered an effective predictor for dyslipidemia and subclinical atherosclerosis in adulthood. [227]

Resting Blood Pressure

Manual resting systolic and diastolic blood pressure (BP) were assessed following standardized procedures [164], using a stethoscope and a standard BP aneroid, with an appropriately sized inflatable cuff on the subject’s right arm, using a Professional Aneroid

Sphygmomanometer (AllHeart, Louisiana, MO). Once a participant had been seated for five minutes, two measures were taken at one minute intervals to determine an average. If the first two measures differed beyond parameters (4 mmHg), a third measure was taken. The blood pressure values were classified using the 2017 Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents using cutpoints for children ages 1 to <13 years . [218] The cutpoint for determining the prevalence of children at risk corresponds with the "Elevated" range or higher, which is SBP >120 and or DBP >80. The "Elevated" numerical cutpoint is based on children population data ("*derived from a comprehensive review of almost 15,000 published articles between January 2004 and July 2016"* page 1) [88] which corresponds to $\geq 90^{th}$ to $< 95^{th}$ percentile by sex, age, and height. Levels $> 95^{th}$ percentile are defined as hypertension which includes stage I and II . The prevalanece of "at risk" for SBP and DBP were also determined individually based on same cutpoints (SBP >120 mmHg and DBP $\geq$ 80 mmHg.

Covariate assessment

Physical Activity (PA)

A self-reported question taken from the Youth Risk Behavior Survey (YRBSS) [209] was administered in both Arabic and English (Appendix B). The question was designed to assess the number of days over the preceding week participants engaged in $\geq$60 minutes of moderate-to-vigorous physical activity (MVPA). [209] The question states: *"During the last 7 days, how many days were you physically active for a total of at least 60 minutes per day (add up all of the time you spend in any type of activity that increases your heart rate and makes you breath hard some of the time)?*" The scale range measured zero to seven days. [211]

Screen Time (ST)

Screen time was assessed using the ST questions from the YRBSS [209] and was administered in both Arabic and English (see Appendix B). Participants of the study self-reported the weekly amount of time spent viewing television, playing video games, and using an online computer, and indicated the number of hours (watch/play) on weekdays and weekends for each of the three screen media types. The average hours of screen time per week was determined using the following formula: (hours of TV time on weekdays * 5 days) + (hours of TV time on weekends * 2 days)/7 days + (hours of video game time on weekdays * 5 days) + (hours of video game time on weekends * 2 days)/7 days + (hours of computer time on weekdays * 5 days) + (hours of computer time on weekends * 2 days)/7 days. [212] Screen time equal to or above two hours per day is considered high ST. Less than two hours a day is considered low ST. [213]

Statistical Analysis

Power sampling (β 0.2, α 0.05) t-test, used to test for differences between two independent means, indicated a minimum of 128 participants was required. Z-tests, used for determining differences between two independent groups (boys and girls), indicated a minimum of 300 participants was required (results by G*Power software). All variables were tested for normality of distribution using a Q-Q box plot; statistical skewness and kurtosis values >1 or less than -1. TG was found to be positively skewed, and was logarithmically transformed. Descriptive statistics and independent t-test were used for continuous variables, and chi-square tests were used for categorical variables (percentage at risk). A general linear model and binary logistic regression (odds ratios) were used to compare boys to girls in terms of mean differences, and their risk prevalence for CVD (BMI, WC, WHtR, %BF, TG, TC, TC/HDL, non-HDL-C, LDL-C, HDL-C SBP, DBP), and controlled for covariates MVPA and ST. Data analysis was conducted using SPSS version 24 (SPSS Inc., 2016, Chicago, IL). Results are presented as mean ± SD or S.E, at significance level $p \leq 0.05$.

Results

The final sample was composed of 367 Kuwait 5th graders (53% girls). For selected measures there was a lower sample size due to participants opting out of the measure or technical issues when obtaining blood sample. Missing data included one respondent's body weight (so unable to calculate BMI or assess %BF) 0.3%, three respondents' WC (0.8%), six respondents' (~2%) SBP and DBP, eight respondents' PA (2%), and two respondents' ST (0.5%). There were 94 participants that did not have blood lipid data due to 64 participants who opted out from the test and 30 participants whom either did not have an adequate volume of blood for analysis, , and or technical or assay issues. The missing blood lipid data included TC (n=106, 28%), HDL-C (n=96, 26%), LDL-C (n=133, 36%), TC:HDL-C ratio (n=108, 29%), non-HDL-C (n=109, 29%), and TG (n=123, 33%).

Table 1 summarizes demographic characterisitics and overall mean anthropometrics, biometrics and covarietes, and the comparison between boys and girls based on general linear model. There were no gender differences for mean BMI Z-scores and other anthropometric variables, except for greater (P=0.029) mean %BF in girls than boys. Mean TG, SBP, DBP, and MAP were significantly (P<0.001) greater in girls than boys. Whereas, mean MVPA was significantly (P<0.001) greater in boys, however, mean ST did not differ between boys and girls.

Table 1. Demographic characteristics and mean values of anthropometrics, biometrics, and covariates (moderate-to-vigorous physical activity [MVPA] and screen time [ST]) of boy and girl fifth graders in Kuwait [1]

Participants	Overall (N=367)	Boys (*n*=174)	Girls (*n*=193)	*P-value*	
City					
Capital	44 (12%)	15 (8.6%)	29 (15%)	0.060	
Hawalli	137 (37.3%)	66 (37.9%)	71 (36.8%)	0.822	
Farwaniya	23 (6.3%)	12 (6.9%)	11 (5.7%)	0.638	
Mubarak Alkabir	83 (22.6%)	43 (24.7%)	40 (20.7%)	0.363	
Ahmadi	38 (10.4%)	5 (2.9%)	33 (17.1%	0.001	
Jahra	42 (11.4%)	33 (19%)	9 (4.7%)	0.001	
Age (years)	10.43 ± 0.40	10.42 ± 0.37	10.43 ± 0.41	0.825	
Anthropometry					
Height (cm)	141.5 ± 6.70	140.8 ± 7.17	142.1 ± 6.21	0.067	
Weight (kg)	43.52 ± 13.20	42.91 ± 14.38	44.06 ± 12.04	0.403	
BMI (kg/m^2)	21.39 ± 5.07	21.22 ± 5.46	21.55 ± 4.70	0.541	
BMI z-score					
IOTF[2]	1.27 ± .066	1.22 ± .099	1.32 ± .089	0.447	
WHO[3]	1.30 ± .074	1.32 ± .11	1.29 ± .098	0.449	
CDC[4]	0.90 ± .061	0.88 ± .089	0.93 ± .084	0.820	
BMI Centiles					
IOTF	76.91 ± 1.48	74.07 ± 2.21	79.49 ± 1.98	0.069	
WHO	75.77 ± 1.59	73.49 ± 2.38	77.84 ± 2.13	0.174	
CDC	72.79 ± 1.59	70.73 ± 2.37	74.63 ± 2.13	0.226	
BF%	27.8 ± 10.3	26.6 ± 11.79	29.0 ± 8.72	0.029	
WC (cm)	69.16 ± 14.0	68.46 ± 15.18	69.79 ± 12.85	0.365	
WHtR	0.482 ± .085	0.478 ± 0.09	0.485 ± 0.07	0.442	
Blood Lipids[5]					
T C (mg)	152.4 ± 31.9	149.1 ± 28.1	155.5 ± 35.0	0.106	0.399 [adj]
LDL (mg)	81.7 ± 25.3	82.2 ± 25.8	81.3 ± 25.0	0.795	0.538 [adj]
HDL (mg)	52.2 ± 14.7	53.01 ± 13.5	51.4 ± 15.8	0.390	0.227 [adj]
Non-HDL (mg)	100.1 ± 26.2	98.2 ± 25.7	101.9 ± 26.7	0.263	0.459 [adj]
TC:HDL	3.03 ± .825	2.94 ± 0.75	3.10 ± 0.88	0.127	0.176 [adj]
TG (mg)	100.3 ± 52.5	91.03 ± 42.7	108.5 ± 58.6	0.009	0.014 [adj]
Blood Pressure[6]					
SBP (mmHg)	105.5 ± 12.12	102.4 ± 11.5	107.7 ± 12.09	0.001	0.001 [adj]
DBP (mmHg)	67.7 ± 9.58	64.8 ± 8.72	70.2 ± 9.64	0.001	0.001 [adj]
MAP	150.6 ± 17.1	146.2 ± 15.8	154.58 ± 17.3	0.001	0.001 [adj]

Table 1 (cont'd)

Covarietes[7]				
MVPA (days/wk)	2.95 ± 2.41	3.50 ± 2.44	2.47 ± 2.28	0.001
% met MVPA	20.9%	26.9%	15.6%	0.008
ST (hrs/d)	4.84 ± 2.73	5.02 ± 2.60	4.68 ± 2.84	0.232
% met ST ≤2 hrs/day	16.2%	9.9%	21.8%	0.002

1Descriptive statistics. General linear model (P^{adj} controlling for MVPA and ST). Data shown as mean S.D (or S.E for BMI Z-Score), $p \leq 0.05$ for differences between gender. **2** IOTF (International Obesity Task Force) [47 121]; **3** WHO, 2007 (World Health Organization) [49 228] ; **4** CDC (Center for Health and Diseases Prevention) [135 137 142 229]; BMI (body mass index); %BF (percentage body fat); WC (waist circumference); WHtR (waist-for-height ratio). **5** Blood lipids: total cholesterol (TC), LDL-C (low density-lipoprotein cholesterol), HDL-C (high density-lipoprotein cholesterol), non-HDL-C (total cholesterol - HDL-C), TC: HDL-C ratio (TC/HDL-C), TG (triglycerides). **6** Blood pressure: SBP (systolic blood pressure), DBP (diastolic blood pressure), MAP (mean arterial pressure ([SBP - DBP/3) + DBP]). Blood lipids and BP cutpoints for children according to an expert panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents [89 170]. Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. [218] **7** Covariates: MVPA (Moderate-to-vigorous physical activity [number of days over past week (7 days) meeting > of 60 min]); ST (screen time).

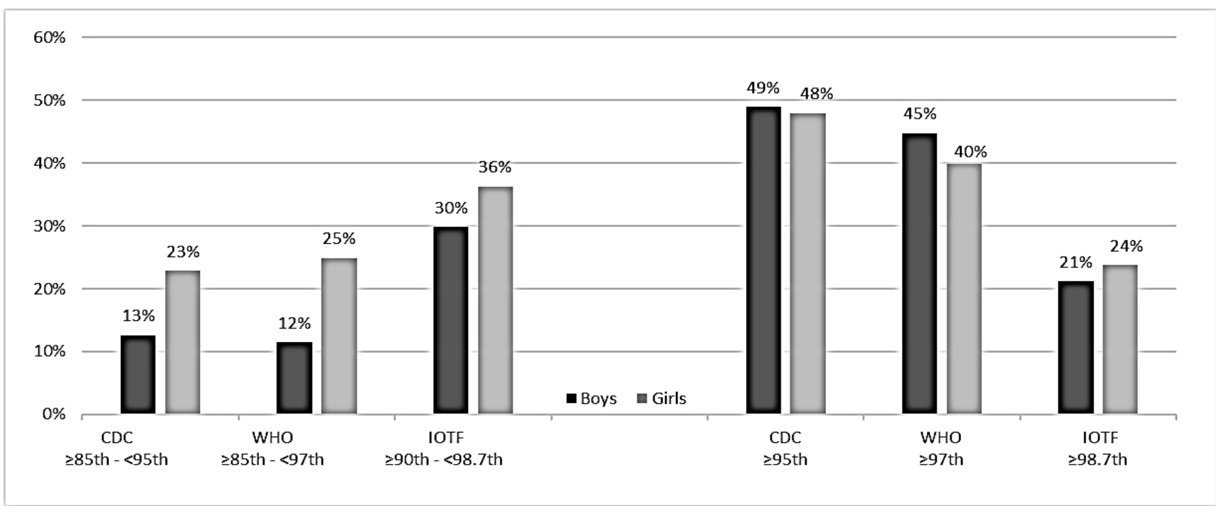

Figure 1. Prevalence of Overweight (OW) and Obesity (OB) in Kuwaiti fifth Grade Boy and Girl (N=367) according to the International Obesity Task Force (IOTF) cutpoints for OW ≥ 90th to < 98.7th centile, and OB ≥98.7th centile [47]; the WHO (2007) cutpoints for OW ≥85th to <97th centile and OB ≥97th centile [54]; CDC (2000) cutpoints for OW ≥85th to <95th centile and OB ≥95th centile. [124]

Figure 1 represents the prevalence of OW and OB, based on centiles. Table 2 illustrates the prevalence of CVD risk factors and the analysis of gender differences. The overall prevalence of OW (BMI >1 SD) was 24.6% (IOTF), 21.6% (WHO), and 39.6% (CDC), and was greater among girls than boys. The overall prevalence of OB (BMI >2 SD) was 36.1% (IOTF), 39.6% (WHO), and 16.9% (CDC), respectively, and was not statistically different between boys and girls.

With respect to measures of abdominal OB and body fat mass, the overall prevalence of high WC ($\geq 90^{th}$ percentile) was 10.1% and WHtR ($\geq$0.5) was 43.3%, and neither were statistically different between boys and girls. The overall prevalence of a high % BF ($\geq 90^{th}$ percentile) was 10.2%, and was also not statistically different between genders.

The prevalence for being at risk of dyslipidemia in the overall sample (Table 2), based on logistic regression while controlling for MVPA and ST, indicated elevated TG (45.5%), TC (26.4%), LDL (13.2%), non-HDL (22.5%), TC:HDL (25.9%), and low HDL (36.9%). There were significant gender differences that girls had a higher likelihood of at risk for elevated TG (OR= 1.809 [95% CI: 1.053 – 3.107]; P=0.032), in addition to a greater likelihood of high risk for low HDL (OR= 2.196 [95% CI: 1.072 - 4.499]; P=0.032), compared to boys.

Regarding BP, Table 2 illustrates the overall prevalence of children classified as being at risk of elevated SBP (16.1%) and DBP (15.2%), and elevated BP (23.3%). Girls were more likely to be at risk of elevated SBP (OR= 2.446 [95% CI: 1.259 to 4.735]; P =0.008), DBP (OR= 3.448 [95% CI: 1.682 to 7.068]; P<0.001), and elevated BP (OR= 3.232 [95% CI: 1.813 – 5.761]; P=0.001) than boys.

Table 2. Prevalence (at risk) of CVD risk factors between fifth grade Kuwaiti boys [§] and girls [1]

At Risk Cut Points	Overall (N=367)	Boys (*n*=174)	Girls (*n*=193)	Crude *OR (95% CI)*	Crude *P*	Adjusted for MVPA and ST *OR (95% CI)*	Adjusted for MVPA and ST *P*
Overweight (BMI >1SD)							
IOTF [2]	24.6%	20.1%	28.6%	1.542 (.944-2.519)	0.058	1.496 (.903-2.479)	0.118
WHO [3]	21.6%	15.5%	27.1%	1.889 (1.121-3.184)	0.007	1.813 (1.061-3.097)	0.029
CDC [4]	39.6%	34.4%	43.8%	1.444 (.941-2.216)	0.070	1.349 (.869-2.095)	0.182
Overweight (BMI Centile)							
IOTF (≥90th)	33.3%	29.9%	36.5%	1.286 (.827-2.002)	0.264	1.218 (.773 – 1.918)	0.396
WHO (≥85th)	18.6%	11.5%	25.0%	2.399 (1.355-4.248)	0.003	2.262 (1.259 – 4.063)	0.006
CDC (≥85th)	18.0%	12.6%	22.9%	2.020 (1.143-3.571)	0.016	1.923 (1.073 – 3.447)	0.028
Obesity (BMI >2SD)							
IOTF	36.1%	35.6%	36.6%	1.059 (.687-1.632)	0.795	.931 (.594-1.459)	0.755
WHO	39.6%	41.4%	38%	.901 (.589-1.377)	0.629	.796 (.512-1.238)	0.311
CDC	16.9%	17.8%	16.1%	.922 (.529-1.606)	0.774	.786 (.440-1.390)	0.402
Obesity (BMI Centile)							
IOTF (≥98.7th)	22.7%	21.3%	24%	1.241 (.751-2.050)	0.399	1.083 (.645-1.818)	0.764
WHO (≥97th)	42.3%	44.8%	40.1%	.849 (.557-1.293)	0.445	.757 (.489 – 1.172)	0.212
CDC (≥95th)	48.6%	49.4%	47.9%	.963 (.636-1.459)	0.860	.846 (.548 – 1.305)	0.449
Abdominal obesity [5]							
WC ≥90th centile	10.2%	10.4%	9.9%	.974 (.488-1.942)	0.940	.818 (.401-1.671)	0.582
WHtR ≥0.50	43.3%	42.8%	43.7%	1.051 (.690-1.602)	0.817	.926 (.598-1.433)	0.729
Body fat mass [6]							
%BF (≥90th centile)	10.1%	9.8%	10.4%	1.185 (.586-2.397)	0.636	.956 (.461-1.981)	0.904

Table 2 (cont'd)

Dyslipidemia [7]							
At risk TG ≥90 mg/dL	45.5%	(43/114) 37.7%	(68/130) 52.3%	1.811 (1.086 - 3.021)	0.022	1.809 (1.053 – 3.107)	0.032
High TG ≥130 mg/dL	17.6%	(14/114) 12.3%	(29/130) 22.3%	2.051 (1.023 – 4.110)	0.040	2.041 (.979 – 4.258)	0.057
At risk TC ≥170 mg/dL	26.4%	(30/128) 23.4%	(39/133) 29.3%	1.328 (.762 - 2.314)	0.317	1.152 (.644 - 2.059)	0.634
High TC ≥200 mg/dL	5%	(7/128) 5.5%	(6/133) 4.5%	.817 (.267- 2.499)	0.722	1.686 (.513 - 5.537)	0.389
At risk LDL ≥110 mg/dL	13.2%	(15/110) 13.6%	(16/124) 12.9%	.938 (.440- 1.999)	0.869	1.167 (.522 - 2.609)	0.707
High LDL ≥130 mg/dL	3.8%	(5/110) 4.5%	(4/124) 3.2%	.686 (.179 - 2.622)	0.581	.469 (.113 - 1.949)	0.298
At risk HDL ≤ 45 mg/dL	36.9%	(44/131) 33.6%	(56/140) 40%	1.318 (.803 - 2.164)	0.274	.718 (.426 - 1.209)	0.213
Low HDL <40 mg/dL	16.6%	(16/131) 12.2%	(29/140) 20.7%	2.127 (1.077 - 4.278)	0.030	2.196 (1.072 - 4.499)	0.032
At risk non-HDL ≥120 mg/dL	22.5%	(24/126) 19%	(34/132) 25.8%	1.474 (.816 - 2.664)	0.197	.728 (.419 - 1.460)	0.440
High non-HDL ≥145 mg/dL	6.6%	(8/128) 6.3%	(9/132) 6.8%	1.222 (.441- 3.390)	0.699	.936 (.319 – 2.742)	0.904
TC:HDL ≥3.5	25.9%	(28/127) 22.0%	(39/132) 29.5%	1.598 (.902 - 2.831)	0.108	1.437 (.794 – 2.602)	0.232
Blood Pressure [8]							
Elevated BP	23.3%	(23/170) 13.5%	(61/191) 31.9%	2.999 (1.757 – 5.118)	0.001	3.232 (1.813 – 5.761)	0.001
SBP SBP≥120 mmHg	16.1%	(18/170) 10.6%	(40/191) 20.9%	2.237 (1.227 – 4.077)	0.007	2.446 (1.259 – 4.735)	0.008
DBP SBP≥80 mmHg	15.2%	(15/170) 8.8%	(40/191) 20.9%	2.737 (1.452 - 5.162)	0.001	3.448 (1.682-7.068)	0.001

[1] Chi-square test for proportional differences between boys (§= reference) and girls. Binary logistic regression with controlling for MVPA and ST, $P \leq 0.05$ for differences between genders. [2] IOTF (International Obesity Task Force) [47 121]; [3] WHO (2007) (World Health Organization) [49]; [4] CDC (Center for Health and Diseases Prevention) [87]; BMI (body mass index). [5]Abdominal obesity: WC (waist-circumference), WHtR (waist-to-height ratio). [6] Body fat mass: %BF (percentage body fat). [7] Dyslipidemia: TG (triglycerides), LDL-C (low density-lipoprotein cholesterol), HDL-C (high density-lipoprotein cholesterol), no-HDL-C (total cholesterol – HDL-C), TC: HDL-C ratio (TC/HDL-C). Blood lipids cut points according to an expert panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report. [89] [8] Elevated BP (SBP≥120 and/or DBP ≥80 mmHg); SBP (systolic blood pressure), DBP (diastolic blood pressure). Blood pressure cut points according to Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. [218]

Discussion

Few studies have assessed multiple CVD risk factors other than OB and BP in Kuwaiti children. This is the first study, to the authors' knowledge, to conduct a comprehensive CVD risk factor assessment on fifth grade children in Kuwait. The primary objectives were to determine the prevalence of CVD risk factors in Kuwaiti fifth graders, and as hypothesized we determined if boys had higher risks than girls. Our primary findings indicated a high prevalence of CVD risk factors in Kuwaiti children that is concerning. There is little previous data from Kuwait to compare prevalence rates except for OB and elevated BP and both have increased as compared to previous studies in Kuwait. For most risk factors the prevalence rates of at risk was higher or equal to similar aged populations globally that have been identified to have a high prevalence of CVD risks. With respect to gender, contrary to our hypothesis the prevalence of several CVD risks were higher in girls than in boys, while the prevalence of OB was not significantly different between boys and girls, which was not expected. Each of the primary outcome variables are discussed below as well as mean levels of risk factors.

Our findings of an overall OB prevalence of 39.6% is higher than previously reported in the literature on Kuwaiti children (Table 2). A study conducted during 2008 to 2009 reported childhood OB as being 36.5%, and 24% in 111 boys and 94 girls aged nine to 13 years [36], respectively. Additionally, the prevalence of OB was found to be higher than estimated by the KNSS (2011 to 2012), i.e. 34.6% and 28.1% in 2,300 boys and 2,261girls (10 to <15 years of age), respectively. [39] Additionally, data collected in 2012 to 2013 by Elkum et al. (2016) reported slightly lower prevalence of childhood OB, 37.4% in boys and 25.3% in girls (n= 6,574, 60.4% girls, 12.0 ± 3.4 years), respectively. [2]

Regarding measures of abdominal OB, the overall prevalence of WC and WHtR (table 2) was not significantly different between boys and girls, also was lower than previously estimated in Kuwaiti primary school children. On the other hand, the mean WC levels, which was also not statistically different between boys and girls of our study, was higher than reported in Kuwaiti primary schoolchildren. Jackson et al. (2012) evaluated WC in Kuwaiti children and adolescents aged five to 19 years (N=9,593), including primary schoolchildren. [129] The prevalence of WC in boys and girls was estimated 13% and 12%, while the mean WC was approximated 58.4 cm and 58.1 cm, respectively. Among US children aged six to 11 years, NHANES (2011 to 2012) reported overall higher prevalence of WC (21.8%) [147], but lower overall prevalence of WHtR (30.7%), compared to our findings. The higher prevalence of WHtR in Kuwaiti vs US children may be related to variations in stature. Previously, Al-Isa et al. (2000) assessed Kuwaiti children's nutritional status (aged six to 10 years) using a NCHS/CDC reference population, where they were found to be shorter than US children. [45] Nevertheless, a study conducted in 2007 to 2008 on Spanish children aged six to 14 years (N=2,323; 50% girls), reported boys and girls being of relatively similar height (140 cm and 140.5 cm), but with a lower mean WC (66.3 cm and 62 cm) and WHtR (0.45 and 0.46), respectively, compared to our sample. [230] This may also have been due to Spanish boys and girls being leaner (%BF 18.6 and 21.2, respectively), compared to our study sample.

With respect to mean % BF, based on NHANES (1999 to 2004) smoothed curves (aged eight to 19 years), Ogden et al. (2011) indicated mean percentage BF in US girls and boys to be roughly 33% and 28%, respectively, starting from age eight, which is relatively higher than what our results indicate. [231] However, we found a higher overall mean % BF of 23.9, reported for 281 fifth grade children in Michigan, USA. [211] Moreover, regardless of the lower mean age in our study sample, the mean % BF in our sample was higher than ages six to 14 years among Spanish school-going boys (18.6%) and girls (21.2%) (Marrodan et al., 2013) [230]. In summary, the current study sample indicates that Kuwaiti children have risk for measures associated with OB including high WHtR and %BF. The levels in the current study were higher as compared to other child populations.

No data have been published on the prevalence of dyslipidemia in Kuwaiti children. In Saudi Arabia, Al-Shehri et al. (2003) reported high risk TG prevalence of ~34.8% for boys and girls aged nine to 12 years (N=1,390), which is higher than our findings; however, the study found a lower overall prevalence of children with at risk levels for TC:HDL (21.7%), compared to our results. [232] Overall, our findings on the prevalence of being at risk for TC (27%) and TG (45.5%) with 17.6% classified as high risk, are higher than previously reported in global child populations. For example, Ding et al. (2014) reported that 16% of 3,249 Chinese children (aged six to 18 years) had high risk TG levels. [233] Haroun et al. (2018) indicated at risk prevalence for at risk TC at 23% and TG at 13.6% (with 5.5% high risk) among 596 United Arab Emirates (UAE) students 10 to 15.9 years old. [234] Ribas et al. (2012) reported the prevalence at risk for TC at 26% and TG at 21% among 874 Brazilian children six to 13 years old. [235] We detected an overall prevalence of 6.6% for those at high risk for non-HDL, which is relatively similar to recent data from other countries. NHANES (2011 to 2012) data reported the prevalence of being at high risk for non-HDL as 6.9% among US children aged eight to 12 years. [27] Additionally, in a slightly younger aged sample in Beijing, Wenqing Ding et al. (2016) reported the prevalence of high risk for non-HDL among 1649 children include aged six to nine was 7.3% and in 10 to 18 year olds was 6.9%. [233]

We found a higher mean level of TG (Tables 1 and 2) in girls compared to boys, which was not anticipated. Higher levels of TG are associated with OB. We expected a higher level of TG in boys versus girls given we expected boys would have a higher prevalence of OB. The current study findings, reveal that the mean TG level increased among Kuwaiti children, particularly for girls, when compared to previous study conducted in Kuwait. Previously, a paired-matched study conducted in Kuwait (1995 to 1996) compared mean blood lipids between 460 OB and control (normal weight) individuals (schoolchildren aged six to 13), and reported higher mean TG among OB boys compared to girls, and a relatively equal mean TG in non-OB girls (n=230) and boys (55 ± 26 mg/dL vs 54 ± 31 mg/dL). [60] Nonetheless, the mean TG among the girls in our study is higher than what was reported for girls vs. boys in other studies, among various childhood age ranges. For example, among US sixth graders (N=2,866), Peterson et al. (2012) reported significantly higher mean TG in girls compared to boys (96.4 ± 57.8 mg/dL vs 85.6 ± 48.2 mg/dL; $P<0.001$). [13] Among children aged six to nine (n=1,649) in Beijing, Ding et al. (2016) reported a modestly higher mean TG among girls (73.5 ± 2.6 mg/dL) than in boys (70.8 mg/dL). [233] Among Brazilian children aged six to 10 years (n=874), Ribas et al. (2012) described higher median TG among girls than in boys (80 mg/dL [65-102] vs 76 mg/dL [59-99]). [235] Moreover, among Korean children 9.9 years of age (n=770), the mean TG found was slightly higher in girls than in boys (71.1 ± 27.6 mg/dL vs 68.6 ± 25.2 mg/dL). [174] Finally, Ying Liao et al. (2008) also reported higher mean TG among Chinese girls aged six to 10 (n=177), compared to boys (n=312) (74.4 ± 34.5 mg/dL vs 72.6 ± 39.8 mg/dL). [236] Additionally, compared with other child populations, the level of risk for dyslipidemia among Kuwaiti children is considered to be high.

Girls in our study exhibited an overall greater prevalence of being at risk of high TG and low HDL compared to boys, contrary to our hypothesis. Our basis for expecting boys to have greater risks than boys, was based on the KNNS [1] data indicating a higher prevalence in OB in boys comparted to girls, in addition to a study during 1995 and 1996 indicated higher mean lipids level among OB boys than girls, whearas, among non-OB, the levels were were similar by gender. [60]; and thus the boys would likely have greater dyslipidemia. However, several studies have reported a higher prevalence of dyslipidemia in girls than boys. [27 233 235] The primary reasons that explain these differences include biological or environmental factors. [85] At a certain age around ten during childhood, girls often have higher adverse blood lipid levels compared to boys. Prebutery is considered a potential factor for adverse blood levels in children. Ruiz et al. (2007) examined the associations of cardiovascular fitness (CVF) with a clustering of metabolic risk factors in 429 boys and 444 girls, aged nine to 10 years of age, considering Tanner's pupertal (breast vs genital) development classification (Tanner % in girls, 54/44/2/0/0 vs boys, 99/1/0/0/0). The results showed girls with second and third Tanner stages, had significantly higher (P<0.01) mean TG levels and significantly lower mean HDL levels (1.4 mmol/L vs 1.5 mmol/L), compared to boys. Also the mean levels of TG (P=.026) and HDL (P=.067) in girls were also associated with lower CVF. [237] Stavnsbo et al. (2018) published an international reference value for cardiometabolic risk variables, based on cohorts of children (observation of 11,234 girls and 11,245 boys, aged six to 11 years) from Europe and the United States (51.3%). The mean values of blood lipids such as TC, LDL, declined HDL, and TG become higher in girls than boys beyond age 10 [70]. Moreover, NHANES surveys (1988 to 1994 and 1999 to 2006), combined with the Bogalusa, Fels, Muscatine, and Princet datasets, also indicate serum TG peaks in girls at or after age 11 years [57]. In summary, Kuwaiti girls in the current study, overall were at higher risk of dyslipidemia than boys. Based on previous studies, this is likely due to maturation factors in girls involve higher adverse blood lipid levels as compared to boys. Additionally, it is possible that the significantly higher proportion of girls that were OW and their higher %BF may have contributed to their elevated risks as compared to boys.

Our findings on the prevalence of children with BP levels above the healthy normal range indicated that 23% were classified as elevated BP. We anticipated these to be higher in boys than girls in our study sample (Table 2), compared to data gathered earlier about Kuwaiti children (aged six to 13 years) by Moussa et al. (1999). Moussa et al. reported 5% elevated SBP (≥120 mmHg) and 0.7% elevated DBP (≥80 mmHg) [67], in addition to 5% of elevated BP, particularly, in OB boys and girls. Overall, our findings, based on current at risk cutpoints for SBP, DBP, and prehypertension, indicate a significant increase in BP among Kuwaiti children.

The overall prevalence of BP was significantly higher in girls than in boys (Table 2), in addition to the girls` higher mean SBP and DBP than boys (Table 1), which was no in agreement with a previous study in Kuwaiti children. Despite Moussa et al. (1999) reporting a relatively higher mean SBP in boys and girls aged six to 13 years old (110.5 ± 12 mmHg vs 109.5 ± 11.5 mmHg, respectively) compared to our findings, their estimated mean DBP (girls 68 ± 8 vs boys 66.5 ± 7 mmHg) [67] was lower, particularly among girls. In summary, the data indicates no change or decline in SBP and DBP among boys over time; however, the mean DBP has slightly increased among girls.

In the context of our findings, i.e. that girls had a greater prevalence at risk BP than boys, Roland et al. (1980) examined 9,977 public school children aged six to 9, and found height to be directly related to both SBP and DBP, regardless of age, when accounting for BMI and skinfold

[238 239]. Miles-Chan et al. (2013) indicated that height-for age was positively correlated (*r*=.29; *P*<0.001) with SBP and DBP in children aged five to 10 years of age, (N=2,489), of various Asian ethnicities. [240] To better understand Miles-Chan et al.'s findings, we conducted a secondary analysis, using a stepwise multiple linear regression (data not shown), included sex, age, height, weight, BMI, WC, WHtR, and %BF, in addition to MVPA and ST as independent predictors of SBP and DBP. We found that %BF and height were directly (*P*<0.001) related to 1 mmHg increase in SBP with every 0.462% (*r*=.482) increase in body fat, as well with every 0.351 cm (*r*=.378) increase in height. On the other hand, with every 0.282 kg (*r*=.385) increase in body weight, DBP increased (*P*<0.001) by 1 mmHg. This may explain the higher mean SBP and DBP among the girls in our study, compared to boys. In spite of this, the literature indicates body weight may not be a significant indictor of BP in children, due to the need for determining both maturation and adiposity when compared to height as an independent indicator. [241] We found both adiposity (%BF) and stature (height) to be associated with a higher risk of BP among girls, which may be related to maturation factors.

The strengths of the current study include recruiting sufficient sample size to determine the prevalence at risk of CVD and to evaluate potential gender differences. Also, the comparison by gender controlled for the potential influence of MVPA and ST on CVD risk factors. Furthermore, the study participants were recruited from 16 schools within six cities in Kuwait. Measures were performed by a trained research team, according to established pediatric protocols and standards [170]. There were also several potential study limitations. The research was a cross-sectional evaluation of as is true for all cross-sectional studies, no cause and effect inferences can be made from the findings. Our study sample was convenience and may not be a representative sample of all Kuwaiti fifth graders. Challenges in Kuwait were related to school collaborations, obtaining parental approvals (consent), restricted time for data collection and research team availability, and children's absence. The sample size for blood lipids was lower than other variables due to being unable to collect a sufficient blood volume to evaluate theblood lipid variables, technical issues with analyzer, or some children opted out of the blood lipid test. Selected CVD risk factors may have been influenced by varying levels of hydration, or medications taken by some children. Neither of these factors were accounted for.

Summary and Conclusion

This is the first study to determine the prevalence of multiple CVD risk factors among Kuwaiti children, and expected more boys would be at risk of CVD than girls. Our primary findings indicated a higher prevalence of obesity (42%) and elevated BP (23%) in Kuwaiti children than previously reported. Moreover, the alarming prevalence ar risk for CVD risk found to be higher than in many children's populations globally, which is concerening. Contrary to our hypothesis that boys will have greater risks of CVD than girls, the prevalence of OB was not statistically different between boys (41%) and girls (38%), though girls had a higher prevalence of OW (27%) compared to boys (15%). Moreover, girls were also at risk for dyslipidemia and elevated BP compared to boys. While we found gender differences in the prevalence of dyslipidemia and BP, it is difficult (in this age group) to determine if the primary reason for differences had been related to biological factors that influence risk factors including maturation, and or environmental factors such as dietary and PA behaviors. These findings suggest the need for follow-up and lifestyle interventional studies or programs to prevent and manage risks of CVD among children in Kuwait.

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CHAPTER 4: PROPORTION OF KUWAIT SCHOOLCHILDREN MEETING US AND WHO/FAO DIETARY RECOMMENDATIONS FOR FOOD GROUPS AND NUTRIENT INTAKE, COMPARED BY GENDER

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Abstract

Background: There are few studies on nutrition behaviors in Kuwaiti children despite the high prevalence of childhood obesity. The most recent study (2008-2009) reported that $\geq$50% of the children exceeded the calorie requirements and only ~20% met the dietary reference intake (DRI) recommendations for key nutrients. Also, data are lacking on gender differences.

Objectives: To determine the proportion of Kuwaiti schoolchildren meeting US Dietary Guidelines for Americans (DGA) and DRI and WHO/FAO dietary recommendations and compare differences by gender.

Methods: A cross-sectional study of fifth graders (N = 313; 53% girls, 10.4 ± 0.4 years) from Kuwait. Self-administered Block Kids Food Frequency Questionnaire (Arabic/English) was used to evaluate nutrition intake. Dependent variables: food groups, macronutrients, micronutrients, and healthy eating index (HEI). Statistics: General linear model and logistic regression with controlling for physical activity (PA) and sceen time (ST) with $P<0.05$.

Results: The proportion of children who met the recommendations (% US; %WHO): fruit (69% DGA; 62% WHO), vegetables (29% DGA; 46% WHO), dairy (33% DGA), whole grains (0% DGA; 17% WHO). Total kcal (17%), total fat (66% AMDR; 24% WHO), SFA (31%), *TFA* (0%), protein (97% AMDR; 74% WHO), carbohydrates (91% AMDR; 50.5%

WHO), added sugar (17%), and fiber (41%). Calcium (20%), magnesium (41.5%), potassium (13%), sodium (17% DRI; 13% WHO), and vitamin D (0% DRI; 19% WHO). More boys than girls met the fruit recommendation (76% vs. 62%; *P*=0.037 [DGA]), while more girls than boys met the vegetables (36.4% vs. 20%; *P*=0.003 [DGA]) and sodium (18% vs. 8%; *P*=0.022 [WHO]) recommendations.

Conclusion: Few children met food group and nutrient recommendations, or had desirable HEI scores, even though most children exceeded their kcal needs. There were few gender differences in meeting the recommendation. The high kcal low nutrient density diet reportedby the majority of Kuwaiti children is related to numerous health risks, and warrants attention.

Introduction

Poor dietary behaviors, characterized by excessive dietary energy with low nutrient density, are known to adversely affect childhood health; including increases in obesity (OB). [97] In the 1980s economic transitions [81] began shifting Kuwaiti children's behaviors and nutritional status from being under nourished as reflected by < 1% prevalence of OB in 1985 [216], over nourished state with a OB prevalence of 31% in 2012. [2]

There is evidence for dietary behaviors and patterns that promote health and prevent disease risks. [18-22] These studies have led to the establishment of nutritional guidelines for promoting health and preventing chronic disease, particularly, the US Dietary Guidelines (DGA) including the dietary reference intake (DRI) for individuals by age and gender. [66] Aligning with US dietary guidelines, the Joint WHO/FAO Expert Consultation (2002) provided population based dietary recommendations for preventing OB and chronic diseases. [21 64 65] These international nutrition recommendations were developed based on the population's per capita food intake estimated according to each country's nutrition balance sheets. [31 63] Therefore, there are variations between the WHO/FAO and US guideline cutoffs, particularly in the level of carbohydrates (WHO range: 55–75% vs. AMDR: 45–65%), some food groups (fruits, vegetables, and whole grains [lack dairy group]), and micronutrients, particularly vitamin D (WHO: 200 UL vs. DRI: 600 UL). The US DGA and DRI and WHO/FAO guidelines stress on limiting intake of saturated fat, *trans*-fat, added sugars, and sodium, while sufficiently consuming essential fatty acids such as *n*-3, fiber, fruits and vegetables, whole grains, in addition to micronutrients such as calcium and vitamin D to prevent childhood OB and associated health risks. Kuwait does not have national nutrition standards and does not use WHO/FAO nutrition recommendations for children beyond the age of five years. [1] Utilizing US and WHO/FAO nutritional guidelines for estimating Kuwaiti children's dietary intake may provide a better understanding of the dietary status of Kuwaiti schoolchildren to improve their dietary behaviors and prevent OB.

The data on Kuwaiti children's dietary intake are limited. The only study available by Zaghloul et al 2012, involved data collected during 2008–2009 using the USDA 5-steps 24-hour recall to described the dietary intake of 205 boys (n = 111) and girls (n = 94) aged 9–13 years old. using USDA 5-steps 24-hour recall. The results indicated 63.3% of the girls and 43.5% of the boys exceeded their calorie intake. The study also indicated that fewer boys than girls exceeded micronutrient recommendations including vitamin D (0.7% and 0%), calcium (16.4% and 6.7%), and magnesium (48% and 31%), but not sodium (72% and 61%). [107] In summary, the findings on Kuwaiti children's dietary behavior indicated high energy density and low nutrient density. Similar studies from other countries have reported similar results. Patterson et al. (2010) reported that low intake of fruit, vegetables, fiber and micro-nutrients among 551

Swedish schoolchildren (9.6 years, 52% girls) was related to their energy-dense diet. [242] Another study on Irish children (*n* = 594) and teenagers (*n* = 441) showed that they consumed a high-energy diet which was associated ($P < .001$) with lower micronutrient and fiber intake. [243] Also, among Canadian fifth graders (N = 4,966; 51.5% girls), Veugelers et al. (2005) reported the mean daily kcal intake for boys (2256 kcal [>1800 kcal]) and girls (2077 [>1600 kcal]); their mean daily calcium and fiber intake was lower than recommended levels. [244]

Several indices are used to in evaluate the dietary intake of children including the healthy eating index (HEI). The HEI is a scoring (0 to 100 points) system for monitoring dietary compliance with DGA guidelines [190]; it has been shown to be a reliable and valid tool. [189] An HEI score at or above 80 points is considered good, while a score of 50 points or lower is considered below the standards. [191] Studies involving children that have used the HEI indicate that the majority are not meeting most recommendations , given the poor HEI scores. For example, NHANES 2011–2012 (N = 2,857; 2–17 years) reported a total HEI-2010 score of 55 points, which was considered poor in relation to not meeting the recommendations, including high sodium intake. [245] Also, within same period of time, a study in Michigan USA reported a total HEI-2010 score of 62 points among fifth graders (N = 210). [192] Veugelers et al. (2005) reported a mean HEI-2005 of 62 points among Canadian fifth graders (N = 4,966; 51.5% girls), indicating low vegetable, fruit, and grain intake. [244] Some studies have related the HEI scores to CVD risk factors. Camhi et al. (2015) showed that the HEI score (high fruit, vegetable, dairy, less solid fats) was related to fewer cardiometabolic risks in children. [16] Another index that has been reported in the literature that is considered a marker of nutrient density and plant based food intake is gs of dietary fiber intake per 1000 kcal) and has been referred to as fiber index (FI). [199] Several studies have shown that high intake of dietary fiber is inversely related to CVD risk factors. [196 197 246] Carlson. et al. (2011) determined that dietary fiber intake as measured by dietary FI was inversely associated ($P < 0.001$) with the risk of metabolic syndrome (MetS) among adolescents, but found no relationship with the cholesterol index (mg/cholesterol/1000 kcal ($P = 0.22$) or saturated fat index (gs saturated fat/10000 Kcal). [199] Ventura et al (2008) examined relationship between diet and MetS in 109 overweight Latino children in age 10 to 17 years, and found a lower mean dietary fiber (7.5 ± 2.8 gs/ 1000 kcal) in children (n=24) with MetS, while children without MetS (n=85) had a higher mean fiber intake (8.4 ± 3.1/ 1000 kcals) [200] In summary, the HEI is a useful dietary tool for evaluating children's dietary status and determine if they are meeting the DGA and DRI recommendations, for food group and nutrient levels recommended to promote health and prevent disease. The FI provides a quick measure nutrient density based on the amount the of dietary fiber /1000 Kcals.

In Kuwaiti, there is limited nutrition data pertaining to children and no study has reported intakes in reference to pediatric guidelines for food groups, fats, and added sugars nor have there been studies which reported on the HEI or FI. Also, there is little data to determine if there are significant differences in nutrition intakes by gender. Therefore, the primary objectives of this study were to determine the proportion of Kuwaiti fifth grade children that are meeting nutrition recommendations for food groups, macronutrients, and selected micronutrients according to the DGA and DRI, WHO/FAO recommendations, and two dietary indices (HEI and FI). The secondary objective was to determine if there are differences by gender in meeting the nutrition recommendations, and dietary indices scores and levels. We hypothesized that boys will be less likely to meet the nutrition recommendations and have poorer dietary quality than girls.

Methods

Study Design and Participants

A cross-sectional evaluation was conducted with 367 fifth graders (10.4 ± 0.4 years of age; 53% girls) in Kuwait. For student recruitment, informed parent/guardian consent and child assent forms were distributed to 39 primary schools (19 boys schools, 20 girls schools) within 6 Kuwaiti cities. Data was collected from 16 schools which were supportive of participating during the timeline available in Spring of 2019. The reasons for schools who did not participate included lack of interest or support from school administrators, and or the inability to participate during the limited timeline. Of the 493 consent forms (boys [258] and girls [235]) that were collected, 35 parents chose not to have their child participate in the study, and 65 boys and 42 girls were absent on measurement day, resulting in a sample of 367 for this study. Of the 367 study participants who completed the food frequency questionnaire (FFQ), 54 participants (26 boys and 28 girls) FFQs were deemed invalid leaving a total sample of 313 participants for the analysis. The study protocol was approved by the Michigan State University (MSU) Institutional Review Board (IRB) as well by the Ministry of Health Research Ethic Committee, and by the Department of Educational Research in Kuwait.

Measurements

Self-report surveys were used to obtain participants dietary intake, and co-variates including moderate-to-vigorous physical activity (MVPA), and screen time (ST). The surveys were administered by nursing trainers as well as nursing and nutrition students from the Colleges of Nursing and Health Sciences of the Public Authority for Applied Education and Training (PAAET) in Kuwait. The measurement team was trained as per the protocol procedures used by MSU's (S)Partners for Health school program in MI, USA. [283] This included procedures to ensure consistent instructions and guidance for participants to accurately complete the self-report FFQ (which used instructions from manufacturer NutritionQuest) and the MVPA and ST survey questions. [210]

The following sections will provide details on the modified and translated Block Kids 2004 FFQ used to assess the children's nutrition behavior, and the procedures used to administer, validate, and process the data prior to analysis. Additionally a summary of all variables , including co-variates (MVPA and ST), used in the analysis is provided.

Nutritional Behaviors

Block Kids 2004 Food Frequency Questionnaire

Originally, the Block Kids 2004 Food Frequency Questionnaire (FFQ) (Block Dietary Data Systems, Berkeley, CA) [247] was an 8-page FFQ asking about the frequency and quantity of 78 foods eaten during the past week which takes approximately 20 to 30 minutes to complete. The results are quantified as daily intake in grams (or milliliters for liquids) and summarized into daily intake. The FFQ reported equal and high correlation for milk intake (r = 0.571), 100% juice intake (r = 0.550), diary for calcium (r = 0.515), and vitamin D (r = 0.512) when compared with the Iowa Fluoride Study targeted nutrient semi-quantitative questionnaire for relative validities. [248] Moreover, it showed reliability intraclass reliability (>.30), when compared with 24-hour dietary recall, except percent energy from protein and fruit and vegetable servings. [249]

Modified Arabic/English version of Block Kids 2004 FFQ

The Block Kids 2004 FFQ was translated by the researcher and staff at NutritionQuest Company during 2016–2017. The process of modifying the FFQ involved incorporating cultural food choices in NutritionQuest Company's data dictionary based on the USDA surveys "the

Continuing Survey of Food Intakes by Individuals (CSFII) 1989-91 and the CSFII 1994-96, 1998" [250] and analysis configuration to account for changes in food questions (added and or omitted). The modified FFQ consisted of eight pages (72 foods), assessing the frequency and quantity of food consumption from food groups and nutrients during the past week. A descriptive list of modifications to the original Block Kids 2004 FFQ food items is illustrated in APPENDIX F. Decisions regarding selecting cultural foods from Kuwait for the modified FFQ were objectively proposed based on data describing Kuwaiti traditional dishes and food contents. [33 177 178] Also, data on consumption of non-traditional foods in Kuwait [251] and the dietary pattern of the Arab Gulf region population living abroad were considered. [252]

In the modified FFQ, foods that are restricted for religious reasons were excluded: pork (pork chops, ribs, or cooked ham, slice ham, hamburger, and bacon). Moreover, questions related to foods that were deemed rarely or never consumed by children in Kuwait were deleted : tacos, burritos, and enchiladas. For example, which kind of tacos, burritos, enchiladas do you usually eat? With meat or chicken/Without meat or chicken. Additionally, questions on foods such as hot dogs and corn dogs, lunch meat like boloney, sloppy Joes, chicken helper, tomato soup, pop tarts, pie, fruit pie, fruit crisp, cobbler, and fruit roll-ups were also deleted. Pinto beans, black beans, chili with beans, or bean burritos were excluded from the beans selections in the FFQ (green beans, string beans or peas, chickpeas [added], and refried beans).

Cultural foods added into the FFQ included "kabab and shawarma (beef/chicken), fatayer (pastries), pita bread, sambosa, and lentil soup, in addition to vegetables such as eggplant, zucchini, and okra. Other cultural foods mentioned in the FFQ are rice, white/wheat/bread, hummus, and refried beans.

Moreover, some food questions were altered: "Chicken noodle soup" to "Any other soup like chicken noodle, Cup-a-Soup, ramen noodles, or menudo, posole", "Whole wheat bread or whole wheat rolls" to " Whole wheat bread, bran, rye, whole grain", "White bread, toast or rolls, including sandwiches or bagels" to "White bread, pita bread, toast, bun", "Sweet potatoes, or sweet potato pie" to "Sweet potatoes", "Cake, cupcakes, Tasty Cakes, Ho-Ho's, Twinkies" into "Cake, cupcakes", and beef burgers to hamburger. Similarly, for snacks and beverages, some non-popular brands were modified including "snack crackers like Cheez-Its, Ritz Bits, Goldfish" to "Cheez-Its, Ritz Bits, Goldfish, TIK, Marie", and "Hi-C, Tang, Tampico, Mr. Juicy, Ssips punch" to "Fruit drinks like Tang", "Dr. Pepper, Pepsi, or 7-UP".

Administering the Modified and Translated version of the Block Kids 2004 FFQ

The nutrition behaviors of our study sample were assessed by using the translated (Arabic/English) and modified version of the Block Kids 2004 FFQ described earlier. The modified instrument was administered by trained nursing trainers as well as nursing and nutrition students from the colleges of Nursing and Health Sciences (PAAET) in Kuwait. The completed FFQs were analyzed by NutritionQuest and were validated for outliers, which will be described in the next sections.

Nutrition Variables

Data for analysis were derived from variables including food groups and selected macronutrients and micronutrients. These variables were used to evaluate our study objectives and nutrition recommendations according to the following nutrition guidelines: The US Dietary Guidelines (DGA) and Dietary Reference Intake (DRI) [66] for children (9 to 13 years), and WHO/FAO ranges of population dietary intake goals [22] and recommended nutrient intake (RNI). [64]

Food Groups

Fruit portions (1.5 cups DGA; [>400 g ~1.7 cups WHO]), vegetable portions (males: 2.5 cups; females: 2 cups DGA; [>400 g ~1.7 cups WHO]), dairy portions (2 cups DGA), whole grain (3 oz equivalents DGA ~1 oz WHO).

Macronutrients

Total calories (girls 1600–2000 kcal; boys1800–2200 kcal), fat (AMDR 25–35%; WHO 15– 30% of total kcal/day), saturated fat (<10% of total kcal/day), *trans*-fatty acids (less than 1% of total kcal/day), linoleic acid (PUFA *n*-6, 10–12 g DRIs, [5–8% WHO of total kcal/day]), linolenic acid (PUFA *n*-3, 1–1.2 g DRIs, [1–2% WHO of total kcal/day]), and cholesterol (<300 mg). Protein (AMDR 10–30%, [10–15% WHO] of total kcal/day). Carbohydrates (AMDR 45–65%, [55–75% WHO] of total kcal/day) and added sugar (less than 10% of total kcal/day); dietary fiber (boys: 25.2 g; girls: 24.4 g DGA).

Micronutrients

Sodium (less than 2200 mg [UL]; less than 2000 mg [RNI]), potassium (4500 mg [AI/RNI]), calcium (1300 mg [RDA/RNI]), and magnesium (240 mg [AI]; 230 mg [RNI]) and vitamin D (600 IU [RDA], 200 IU [RNI]). [253]

Dietary Indices

Healthy Eating Index 2010

A scoring system (0 to 100) based on the USDA Food Patterns and the editions of the DGA was developed to measure the diet quality of the US population. The index examined the overall diet components from food groups and single nutrients in adherence to DGA for chronic disease prevention in adults. The HEI 2010 has 12 components including 9 adequacy and 3 moderation components [190]. The components for adequacy are total fruit, whole fruit, total vegetables, greens and beans, whole grains, dairy and total protein, seafood and plant proteins, and fatty acids (PUFAs + MUFAs/SFAs).

The components for moderation are refined grains, sodium, and empty calories (component calories from solid fats, alcoholic beverages, and added sugars). [190] The HEI 2010 uses a density approach to set standards (per 1,000 calories or as a percentage of calories) and employs least restrictive standards (vary by energy level, sex, and/or age) for determining the maximum score. A high score in the adequacy components (participants maximum points) indicates better quality, while in moderation components, a minimum score higher than zero indicates low diet quality The HEI's "maximum" are allocated when intakes are at the level of the standard or higher for adequacy components, and when intakes are at the level of the standard or lower for moderation components. Mean daily consumption frequency from HEI components were scored (0 to 10 points each) and summed for an overall score (range from 0 to 100). [192 193 254] An HEI score above 80 is considered "good", and a score of 50 or lower, "poor" [255]. A recent update by the National Cancer Center (NIH) on HEI 2010 to become HEI 2015 (13 components) (https://epi.grants.cancer.gov/hei/comparing.html). The update involved substituting a moderation component "empty calories" with "saturated fat" and "added sugar" as separate components. We generated and reported both HEI 2010 and 2015.

Calculating total Healthy Eating Index (HEI-2010 and 2015)

Based on the FFQ output, the total HEI-2010 scores were generated in SPSS in the following steps. (1) selecting nutrient components: Fatty acid components (Total MUFA + PUFA/Total saturated fat); total protein foods (dry beans + soy beans + just eggs + total meat [red meet/poultry/organ meet/lunch meat] + nut/seeds + seafood), seafood (fish high in omega-3

+ fish low in omega-3), and plant proteins (dry beans + soy foods + nuts/seeds); total fruit, whole fruit (total fruit – [fruit from juice + 100% juice]); total vegetables, greens, and beans (Leafy vegetables + beans and peas); whole grain; total dairy; refined grains (non-whole grain); empty calories (added sugar g*4 + solid fat g*9 [total saturated + total trans-fat]); sodium. (2) Each value was multiplied by 1000/total calories to be converted into per 1000 calorie. (3) Each HEI-2010 component (variables) was ranked based on cut-off points, including "Adequacy": Total fruit (0 to ≥0.8 cup per 1000 kcal), whole fruit (0 to ≥0.4 cup per 1000 kcal), total vegetables (0 to 1.1 cup per 1000 kcal), greens and beans (0 to ≥0.2 cup per 1000 kcal), whole grains (0 to ≥1.5 ounces per 1000 kcal), dairy (0 to ≥1.3 cup per 1000 kcal), total protein (0 to ≥2.5 ounces/1000 kcal), seafood and plant proteins (0 to ≥0.8 ounce per 1000 kcal), and fatty acids (≤1.2 to ≥2.5). Moderation: refined grain (maximum ≤1.8 ounces to ≥4.3 [poor] ounces per 1000 kcal), sodium (maximum ≤1.1g to ≥2.0g [poor] per 1000 kcal), empty calories (maximum ≤19% of energy to ≥50% [poor] of energy) [190]. (4) All the ranked components were summed up to generate the total HEI-2010 score for the study participants. Calculating HEI 2015 required exempting "empty calorie", selecting and ranking "saturated fat" and "added sugars" individually to be incorporated into the moderation components. Additional methods and instructions on calculating the HEI 2010 and 2015 are available at the National Cancer Institute website. [256]

Fiber Index

Dietary fiber intake is a surrogate marker for nutrient density based on assessing the amount of fiber in grams per 1000 kcal. The intake of dietary fiber-containing foods (e.g. fruits, vegetables, whole grains, legumes, beans, nuts, and seeds) is directly related to dietary fiber level as well as nutrients and phytochemicals associated with cardiovascular health. [196-198] For the current study the total daily gs of dietary fiber intake and total kcals of each participants diet was derived from the FFQ. The FI was calculated by coverting the amount of total dietary fiber gs and total Kcals to fiber intake in gs /1000 kcal.

Covariate Assessment

Physical Activity (PA)

A self-reported question taken from the Youth Risk Behavior Survey (YRBSS) [209] was administered in both Arabic and English (Appendix B). The question was designed to assess the number of days over the preceding week participants engaged in $\geq$60 minutes of moderate-to-vigorous physical activity (MVPA). [209] The question states: *"During the last 7 days, how many days were you physically active for a total of at least 60 minutes per day (add up all of the time you spend in any type of activity that increases your heart rate and makes you breath hard some of the time)?*" The scale range measured zero to seven days. [211]

Screen Time (ST)

Screen time was assessed using the ST questions from the YRBSS [209] and was administered in both Arabic and English (see Appendix B). Participants of the study self-reported the weekly amount of time spent viewing television, playing video games, and using an online computer, and indicated the number of hours (watch/play) on weekdays and weekends for each of the three screen media types. The average hours of screen time per week was determined using the following formula: (hours of TV time on weekdays * 5 days) + (hours of TV time on weekends * 2 days)/7 days + (hours of video game time on weekdays * 5 days) + (hours of video game time on weekends * 2 days)/7 days + (hours of computer time on weekdays * 5 days) + (hours of computer time on weekends * 2 days)/7 days [212]. Screen time equal to or above two hours per day will be considered high ST. Less than two hours a day will be considered low ST. [213]

Statistical Analysis

Identifying Outliers : Verifying and Re-testing the Modified Translated version of the Block Kids 2004 FFQ

Two verification procedures were carried out to ensure the FFQ data were valid. The participants that reported implausibly low/high total calorie intake (kcal) were excluded by two methods. The Exploratory Data Analysis (Tukey 1977) statistical interval for labeling extreme “outside” observations was applied. Cutoffs for kcal were calculated using the interquartile rule formula for determining lower (Q3 - [Q3 [75th percentile] – [Q1 [25th percentile]* *k* [1.5 multiplying factor] and upper (Q3 + [Q3-Q1]**k*) quartiles. [257 258] Additionally, we contrasted participants’ reported total kcal intake versus an estimate of total energy expenditure by Schofield-HW ([TEE *1.7 moderate activity factor [AF]) [259], as well the Joint FAO/WHO/UNU Expert Consultation TEE (impeded moderate AF 1.7). [260] Rodriguez et al. (2000) indicated that Schofield-HW and FAO/WHO/UNU equations for estimating resting energy expenditure (REE) in children and adolescents, OB and non- OB, produced kcal mean differences of -33.1 to -35.3 and -0.62, respectively, when contrasted with the V_{max} calorimeter. [259] The TEE ratio interval (at or below 0.16 to at or above 2 folds) was used to detect over/under reported kcal outliers. The modified FFQ was retested ; it indicated overall moderate absolute agreement (intraclass correlation r = .674) in crude data, as well as in data without kcal outliers (intraclass correlation r = .545).

Power sampling (β 0.2, α 0.05) used a t-test to test for differences between two independent means; it indicted that a minimum of 128 participants were required. Also, Z tests to test for differences between two independent groups indicated that a minimum of 300 participants required (G*Power software). Demographic characteristics and absolute nutrient intakes, HEI, and FI were compared using t-test and Chi-square test. The general linear model controlling for total calories was used to compare the mean nutrient intake between boys and girls. Logistic regression was used to compare the percentages meeting nutrient recommendations, controlling for MVPA and ST. Data analysis was performed using SPSS version 24 (SPSS Inc., Chicago, IL). Results are presented as mean ± SD or SE at a significance level of $P \leq 0.05$. The reliability test, with intraclass correlation coefficient with two-way mixed effects model (absolute agreement), was performed to test for consistency between baseline versus re-tested FFQs estimations.

Results

The self-administered FFQ data were collected from a total of 174 male and 193 female fifth graders in Kuwait between February and March 2018. A statistical interquartile rule, as well Schofield-HW and FAO/WHO/UNU Kcal predictive equations were used for flagging reported total kcal not meeting the cutoff. Of the 367 study participants who completed an FFQ, 54 participants (26 boys [15%] and 28 girls [30%]) were deemed invalid (APPENDIX E). The FFQs consisted of 313 participants, 53% girls and 47% boys (Table 4). The translated modified FFQ was retested on 26 boys (4 kcal outliers) and 32 girls (3 kcal outliers) and indicated overall absolute agreement (intraclass correlation r = .674) in crude data (APPENDIX G) as well as in data without kcal outliers (intraclass correlation r = .545) illustrated in Table 3.

Table 3. Reliability test of the translated (Arabic/English) and modified (cultural food) Block Kids 2004 FFQ completed by Kuwaiti fifth grade boys (*n*=22) and girls (*n*=29) [1]

N=102 FFQs Average Measures Without Kcal outliers	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
All NutritionVariables							
Absolute Agreement	.545	.398	.682	6.946	50	1950	.000
Consistency	.856	.793	.907	6.946	50	1950	.000
Boys							
Absolute Agreement	.605	.421	.779	8.558	21	861	.000
Consistency	.883	.801	.943	8.558	21	861	.000
Girls							
Absolute Agreement	.508	.333	.686	6.050	28	1092	.000
Consistency	.835	.735	.910	6.050	28	1092	.000

[1]Intraclass correlation coefficient statistics for FFQ baseline test versus retest for boys (1-day interval) and girls (4 weeks interval). Two-way mixed effects model, where children effects are random and measure effects are fixed. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Table 4 summarizes the demographic characteristics of the remaining boys (n = 148) and girls (n = 165).

Table 4. Demographic characteristics and anthropometrics, and covariates (moderate-to-vigorous physical activity [MVPA] and screen time [ST]) of Kuwait fifth grade boys versus girls [1]

Participants	Overall (N=313)	Boys (*n*=148)	Girls (*n*=165)	*P*
City				
Capital	11.8%	9.5%	13.9%	0.22
Hawalli	38.7%	37.8%	39.4%	0.77
Farwaniya	5.8%	6.8%	4.8%	0.47
Mubarak Al-Kabir	22.7%	25.7%	20.0%	0.23
Ahmadi	10.5%	3.4%	17.0%	0.001
Jahra	10.5%	16.9%	4.8%	0.001
Age (years)	10.45 ± 0.38	10.44 ± 0.35	10.46 ± 0.40	0.572
Height (cm)	142.06 ± 6.62	141.3± 7.07	142.4 ± 6.12	0.104
Weight (kg)	44.48 ± 13.11	43.93 ± 14.22	44.98 ± 12.05	0.479
BMI (kg/m^2)	21.74 ± 4.99	21.59 ± 5.32	21.87 ± 4.68	0.624
Covariates				
MVPA (d/wk)	2.89 ± 2.34	3.37 ± 2.36	2.47 ± 2.24	0.001
% met MVPA	19.3%	24%	15.2%	0.054
ST(h /day)	4.72 ± 2.68	4.97 ± 2.56	4.50 ± 2.77	0.119
% met ST ≤ 2 hrs/d	17.4%	9.6%	24.2%	0.001

[1]Descriptive statistics presented as mean (SD) or S.E (BMI Z-Score), $P \leq 0.05$ for differences between sexes. [2]WHO 2007 (World Health Organization) [49]. BMI (Body mass Index), BF% (Percentage body fat), WC (Waist circumference), WHtR (Waist-for-height ratio [WC/height]), MVPA (Moderate-to-vigorous physical activity [number of days over past week (7 days) meeting > of 60 min]); ST (Screen time (h /day).

Table 5 summarizes mean nutritional intakes and FI, in addition to the comparison by gender. The overall mean calorie intake was approximately 2,460 kcal and was statistically ($P < 0.001$) higher for boys than girls. Also, the overall mean intake of vegetables, dairy, whole grains, calcium, potassium, and vitamin D, except high sodium, were lower than recommended for children 9 to 13 years old. [66] We hypothesized that boys would have poorer mean dietary intake than girls. The absolute (crude) mean intakes of macronutrients as well micronutrients except vitamin D and calcium, were significantly higher in boys than girls. However, after controlling for total kcal, most of boys and girls mean dietary intakes did not statistically differ, except for higher mean intakes of protein, cholesterol, calcium, vegetables, and dairy among boys. The overall mean FI was 8.9 grams, and less than 2% of our study sample consumed the

DGA recommendation of 14g per 1000 kcal for children 9 to 13 years old. [66] Also, there were no statistical differences between boys` and girls` FI before or after controlling for total calories.

Table 5. Mean food group, macronutrient, and micronutrient intakes, and fiber index (FI) of fifth grade Kuwaiti boys versus girls [1]

Nutrition Variables	Overall (N=313)	Boys (*n*=148)	Girls (*n*=165)	*P*	*P**
Food groups					
Fruits (cup)	2.36 ± .080	2.56 ± .12	2.19 ± .10	0.020	0.487
Vegetables (cup)	1.81 ± .05	1.81 ± .08	1.80 ± .07	0.963	0.011
Dairy (cup)	1.67 ± .04	1.70 ± .06	1.65 ± .06	0.311	0.027
Whole grains (ounces)	0.63 ± .02	0.68 ± .03	0.59 ± .02	0.047	0.785
Macronutrients (g)					
Total Calories	2460.29 ± 52.2	2652.59 ± 76.9	2287.38± 68.5	0.001	
Total Fat	92.08 ± 2.25	99.82 ± 3.34	85.14 ± 2.96	0.001	0.892
Saturated fat	29.21 ± .66	31.3 ± .95	27.3 ± .91	0.002	0.306
Trans-fat	8.15 ± .23	8.82 ± .33	7.55 ± .33	0.008	0.653
n-6 FAs[2]	19.12 ± .62	21 ± .97	17.4 ± .76	0.004	0.829
n-3 FAs	1.67 ± .041	1.82 ± .062	1.53 ± .053	0.001	0.377
Cholesterol (mg)	305.1 ± 8.22	338.3 ± 12.07	275.3 ± 10.73	0.001	0.029
Carbohydrates	335.7 ± 7.10	359.1 ± 10.64	314.6 ± 9.25	0.002	0.414
Total Sugar	162.6 ± 4.04	175.6 ± 6.38	150.9 ± 4.94	0.002	0.790
Added Sugar (tsp)[3]	22.1 ± .68	24 ± 1.09	20.5 ± .84	0.012	0.373
Total Fiber	22.08 ± .55	23.6 ± .82	20.7 ± .72	0.010	0.449
Fiber Index[4]	8.9 ± .11	8.8 ± 2.00	8.9 ± 2.00	0.655	0.418
Protein	83.2 ± 1.85	91.2 ± 2.74	76.2 ± 2.38	0.001	0.028
Micronutrients					
Calcium (mg)	964.04 ± 22.08	1008.8 ± 30.34	923.8 ± 31.58	0.054	0.031
Magnesium (mg)	332.8 ± 8,02	357.9 ± 11.97	310.1 ± 10.51	0.003	0.527
Potassium (mg)	3010.8 ± 66.7	3201.3 ± 108.41	2840.0 ± 97.15	0.007	0.369
Sodium (mg)	3664.2 ± 79.5	3920.3 ± 113.6	3434.5 ± 108.4	0.002	0.695
Vitamin D (IU)[5]	140.7 ± 4.29	145.8 ± 6.28	136.2 ± 5.87	0.267	0.556

[1]General linear model, (*p** controlled for total calories), data presented as mean ± S.E, $P \leq 0.05$ for differences between sexes. [2] *n-6* FAs (Omega 6, Linoleic acid), *n-3* FAs (Omega 3, linolenic acid). [3]One teaspoon equivalent = 4.2 grams of sugar. [261] [4]Fiber Index (grams fiber/1000 kcal). [5]IU (International Unit), 1 IU of vitamin D = 0.025 µg.

Table 6 illustrates the proportion of Kuwaiti fifth graders meeting DGA and DRIs and WHO/FAO (Range/RNI) recommendations and differences between boys and girls, based on binary logistic regression controlled for MVPA and ST. The overall proportion of children that met the recommended calorie intake was 17%. Few children met the DGA recommendations for vegetable (28.8%), dairy (33%), while none did for whole grain compared with relatively higher proportion (less than 50%) who met the WHO/FAO recommendations. Around 42% of the children met total fiber intake, while less than 2% met the recommended 14 g per 1000 kcal level. [66] Most children met the recommendations, particularly the AMDR for protein (97%) and carbohydrate (91%), while more than 80% exceeded added sugar intake. More children met the AMDR versus WHO/FAO ranges for total fat (~66% vs. 24%) and % *n*-3 (47% vs. 0.3%). Few children met the saturated fat (31%) while none met the trans-fat recommendations. Less than 40% met the micronutrient recommendations. None of the children met the recommended daily allowance (RDA) of 600 IU for vitamin D, whereas around 19% met the recommended 200 IU of vitamin D by WHO/FAO.

We controlled for MVPA and ST using binary logistic regression to determine differences in the proportion of boys versus girls meeting the nutritional recommendations. There were more boys met the 1.5 cup (P = 0.037) fruit recommendation than girls, while more girls met the 2–2.5 cup (P = 0.003) vegetable recommendation. However, no other statistical gender differences were found with regard to meeting dairy or whole grains recommendations by either nutritional standards.

The results indicated no statistical differences in the proportion of boys versus girls meeting total calorie recommendations. Also, the proportion of boys versus girls meeting the added sugar, saturated fat, or trans-fat recommendations did not statistically differ. There were a couple of trends for more girls meeting the WHO/FAO recommendations for % *n*-6 (P = 0.053) and carbohydrates (P = 0.080) as compared to boys.

Contrary to our hypothesis that boys would be less likely to meet selected micronutrient recommendations than girls, we found that the proportion of boys and girls meeting calcium, magnesium, potassium, and vitamin D was not statistically different. However, more girls met WHO/FAO sodium recommendations (<2 g), in addition to a trend (P = 0.074) for meeting the DRI (<2.2g) recommendations.

Table 6. Proportion of Kuwaiti schoolchildren meeting the Dietary Guidelines & Dietary Reference Intakes (DRIs) and WHO/FAO (Range/RNI) Recommendations [1], compared by gender

Dietary Recommendations for Children according to DGA[2] and FAO/WHO [3]	Overall (N= 313)	Boys (*n* = 148)	Girls (*n* = 165)	Crude *OR (95% CI)*	Crude *P*	Adjusted for MVPA and ST *OR (95% CI)*	Adjusted for MVPA and ST *P*
Fruit							
1.5 cups [DGA]	68.7%	75.7%	62.4%	2.008 (1.216–3.314)	0.006	1.735 (1.034–2.911)	0.037
400g (1.7 cup) [WHO]	62.0%	68.9%	55.8%	1.847 (1.152–2.962)	0.011	1.612 (.990–2.625)	0.055
Vegetables (cup)							
2-2.5 cup [DGA]	28.8%	20.3%	36.4%	2.248 (1.348–3.747)	0.002	2.210 (1.302–3.750)	0.003
400g (1.7 cup) [WHO]	46.3%	45.9%	47.3%	.931 (.593–1.460)	0.755	.871 (.548–1.384)	0.559
Dairy (cup)							
2 cups/day	32.9%	32.4%	33.3%	1.012 (.629–1.628)	0.961	.926 (.568–1.511)	0.759
Whole grains (ounce)							
3oz [DGA]	0%	0%	0%				
1oz [WHO]	16.9%	20.3%	13.9%	1.506 (.823–2.755)	0.184	1.360 (.729–2.536)	0.334
Total Calories (Kcal) 1600-2000 [girls], 1800-2200 [boys]	16.9%	18.2%	15.8%	.802 (.440–1.465)	0.473	.801 (.432–1.485)	0.482
Total fat							
25% - 35% [AMDR]	65.8%	67%	65%	1.142 (.710–1.837)	0.584	1.055 (.645–1.726)	0.830
15% - 30% [WHO]	24.0%	20.3%	27.3%	.700 (.410–1.195)	0.191	.591 (.336–1.037)	0.067
Saturated fat <10%	31.0%	27.7%	33.9%	.783 (.482–1.272)	0.323	.719 (.435–1.189)	0.199
***Trans*-fat** <1%	0%	0%	0%				
***n-6* FAs [4]**							
5% - 10% [AMDR]	73.5%	68.2%	78.2%	1.823 (1.093-3.041)	0.021	1.679 (.994-2.835)	0.053
5% - 8% [WHO]	64.2%	59.5%	68.5%	1.575 (.985-2.519)	0.058	1.484 (.917-2.401)	0.108
***n*-3 FAs [4]**							
0.6 - 1.2% [AMDR]	47.3%	50.7%	44.2%	.758 (.483–1.190)	0.229	.736 (.463–1.169)	0.194
1 - 2% [WHO]	0.3%	0.7%	0%	.000 (.00–000)	0.996	.000 (.000–.000)	0.995
Cholesterol <300 mg	55.0%	44.1%	64.8%	.424 (.267–.672)	0.001	.450 (.281–.722)	0.001

Table 6 (cont'd)

Dietary Recommendations for Children according to DGA [2] and WHO/FAO/ [3]	Overall (N = 313)	Boys (*n* = 148)	Girls (*n* = 165)	**Crude** *OR (95% CI)*	*P*	**Adjusted for MVPA and ST** *OR (95% CI)*	*P*
Protein							
10% - 30% [AMDR 5]	97.1%	96.6%	97.6%	.685 (.180–2.602)	0.578	.604 (.150–2.438)	0.479
10% - 15% [WHO]	74.4%	70.9%	77.6%	.694 (.415–1.160)	0.163	.642 (.377–1.094)	0.104
Carbohydrates							
45% - 65% [AMDR]	91.1%	90.5%	91.5%	.853 (.392–1.857)	0.689	.800 (360–1.778)	0.584
55% - 75% [WHO]	50.5%	45.5%	55.2%	.714 (.455–1.121)	0.143	.659 (414–1.051)	0.080
Added sugar <10% [6]	16.9%	18.9%	15.2%	1.307 (.713–2.399)	0.387	1.231 (.660–2.294)	0.513
Fiber 22.4g [girls] - 25.2g [boys]	41.9%	40.5%	43%	.927 (.588–1.463)	0.745	.822 (.512–1.321)	0.418
14g per 1000 kcal [7]	1.3%	1.4%	1.2%	.896 (.125–6.440)	0.913	1.301 (.166–10.220)	0.802
Calcium (1300 mg**)**	19.8%	22%	17.6%	1.409 (.806–2.465)	0.229	1.317 (.742–2.337)	0.347
Magnesium (350 mg**)**	41.5%	43.2%	40%	1.184 (.751–1.866)	0.467	1.102 (.690–1.760)	0.683
Potassium (4500mg**)**	12.8%	15%	10.3%	1.671 (.854–3.272)	0.134	1.608 (.808–3.202)	0.176
Sodium (mg)							
<2200 [UL 8]	17.3%	12.2%	21.8%	.484 (.258–.905)	0.023	.556 (.292–1.057)	0.074
<2000 [WHO]	13.4%	8.1%	18.2%	.375 (.180–.780)	0.009	.418 (.198–.882)	0.022
Vitamin D (IU) [9]							
600 [AI 10]	0%	0%	0%	0 (.000–00)	-	0 (.000–00)	-
200 [WHO]	18.8%	19.6%	18.2%	1.146 (.649–2.024)	0.638	.987 (.547–1.780)	0.966

[1] Chi-square test for proportion differences between boys and girls ([ref] = reference). Logistic regression adjusted for MVPA and ST, $P \leq 0.05$ for differences between sexes.
[2] Dietary Guidelines for Americans (DGA 2015-2020) - Eight Edition and DRI (Dietary Reference Intake) [66].
[3]The Joint WHO/FAO Expert Consultation on diet, nutrition, and the prevention of chronic diseases. Public Health Nutrition. 2004 [63]. FAO/WHO expert consultation on human vitamin and mineral requirements. FAO 2001 [64]. **[4]** *n-6* FAs (Omega 6, Linoleic acid), *n-3* FAs (Omega 3, Linolenic acid). [5]AMDR (Acceptable macronutrients distribution range). [6] One teaspoon equivalent = 4.2 grams of sugar [261]. [7] Fiber recommendations for children (9 to 13 years old) [66]. [8] UL (upper limit). [8] UL (Upper limits), [9] IU (International Unit, 1 IU of Vitamin D = 0.025 µg.), [10]AI (Adequate Intake).

Table 7 summarizes the results of determining dietary indices based on the HEI- 2010 total score (0 to 100 points) of the study sample, and differences between boys' and girls'total and components scores. The overall mean total HEI-2010 score ~~s~~ was 58 points, meaning the cutoff point of 80 points or above was not met. [255] Approximately , 14% of the sample scored 50 points or lower, which is considered poor.

We anticipated that boys would have lower total HEI-2010 score than girls, though there were no significant statistical differences between boys and girls. Also, there were no significant differences in the proportion of boys (12.2%) vs. girls (15.8%) who scored poorly (50 points or below). With respect to adequacy components, girls had significantly higher scores for total vegetables, dairy, and fatty acid components than boys, while boys' scores were significantly higher for whole grains and protein components than girls. For moderation components, boys' sodium component score was statistically higher than that of girls.

The results of the analysis using HEI-2015 are summarized in Table 8. The overall mean HEI-2015 score of 52 points was lower than the standard. [191] No child had total scores that were classified as good (80 points or above), but many children (36.4%) had poor total scores (50 or below). No statistical differences were found in the total HEI-2015 score between boys and girls. There was a trend (*P*=.063) for girls (41.2%) having poorer scores (≤50 points) than boys (31.1%). With respect to adequacy components, girls scored significantly higher points in total vegetables, dairy and fatty acid intake than boys. Boys maintained significantly higher scores in whole grains and protein intake than girls. With moderation components, the sodium component score was significantly higher for boys than girls.

Table 7. Healthy Eating Index-2010 (HEI-2010) 12 - Components (0-100 points) of Kuwait 5th grade boys (n = 148) vs. girls (n = 165) [1]

Component	Maximum points	Standard for maximum score	Standard for minimum score of zero	Participants Standard Scores per 1000 kcal			Participants' Maximum Points		
Adequacy:				**Boys**	**Girls**	***p***	**Boys**	**Girls**	***p***
Total Fruit[2]	5	≥0.8 cup equivalent per 1,000 kcal	No fruit	0.99 ± .045	0.98 ± .043	.911	3.33 ± .07	3.29 ± .07	.655
Whole Fruit[3]	5	≥0.4 cup equivalent per 1,000 kcal	No whole fruit	0.54 ± .036	0.53 ± .031	.921	3.09 ± .096	3.12 ± .090	.841
Total Vegetables[4]	5	≥1.1 cup equivalents per 1,000 kcal	No vegetables	0.69 ± .028	0.78 ± .026	.016	2.30 ± .069	2.61 ± .061	.001
Greens and Beans[4]	5	≥0.2 cup equivalent per 1,000 kcal	No dark leafy vegetables or greens and beans	0.20 ± .016	0.23 ± .016	.161	2.56 ± .161	2.64 ± .153	.717
Whole Grains	10	≥1.5 oz equivalents per 1,000 kcal	No Whole Grains	0.26 ± .011	0.26 ± .011	.823	4.09 ± .170	3.63 ± .151	.042
Dairy[5]	10	≥1.3 cup equivalents per 1,000 kcal	No dairy	0.66 ± .020	0.72 ± .024	.036	4.56 ± .123	4.96 ± .136	.034
Total Protein Foods[6]	5	≥2.5 oz equivalents per 1,000 kcal	No Protein foods	2.44 ± .070	2.19 ± .067	.011	3.23 ± .058	2.99 ± .065	.006
Seafood and Plant Proteins[7]	5	≥0.8 oz equivalent per 1,000 kcal	No Seafood or Plant Proteins	1.49 ± .083	1.33 ± .070	.131	3.58 ± .059	3.49 ± .061	.291
Fatty Acids[8]	10	(PUFAs+MUFAs)/SFAs >2.5	(PUFAs+MUFAs)/SFAs ≤1.2	0.81 ± .029	0.96 ± .037	.001	1.26 ± .099	1.73 ± .149	.010
Moderation:									
Refined Grains	10	≤1.8 oz equivalents per 1,000 kcal	≥4.3 oz equivalents per 1,000 kcal	2.80 ± .050	2.83 ± .050	.620	7.27 ± .15	7.15 ± .16	.578
Sodium	10	≤1.1 g per 1,000 kcal	≥2.0 g per 1,000 kcal	1.49 ± .018	1.50 ± .018	.683	9.27 ± .202	8.36 ± .271	.009
Empty Calories[9]	20	≤19% of energy	≥50% of energy	28.56 ± .46	28.69 ± .44	.845	13.98 ± .723	13.86 ± .254	.734

	Boys	Girls	p
Total HEI Score	58.54± 7.02	57.86 ± 7.81	.429
% Good Score ≥80	0%	0%	
% Poor Score ≤50	12.2% (18/147)	15.8% (26/165)	.374

[1]Independent t-test and Chi-square test, data presented as mean ± S.E or SD (Total HEI Score), $P \leq 0.05$ for differences between sexes [2]Includes fruit juice.
[3]Includes all forms except juice.
[4]Includes any beans and peas (called legumes in HEI-2005) not counted as total protein foods (called meat and beans in HEI-2005).
[5]Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.
[6]Beans and peas are included here (and not with vegetables) when the total protein foods (called meat and beans in HEI-2005) standard is otherwise not met.
[7]Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as total protein foods.
[8]Ratio of polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) to saturated fatty acids (SFAs).
[9]Calories from solid fats, alcohol, and added sugars; threshold for counting alcohol is >13 g/1,000 kcal.
Guenther P. et al. *J Acad Nutr Diet*. 2013;113:569-580 [190]

Table 8. Healthy Eating Index-2015 (HEI-2015) 13 - Components (0-100 points) of Kuwait fifth grade boys (n = 148) vs. girls (n = 165) [1]

Component	Maximum points	Standard for maximum score	Standard for minimum score of zero	Participants Standard Scores per 1000 kcal			Participants Maximum Points		
Adequacy:				**Boys**	**Girls**	***p***	**Boys**	**Girls**	***p***
Total Fruit[2]	5	≥0.8 cup equivalent per 1,000 kcal	No fruit	0.99 ± .045	0.98 ± .043	.911	3.33 ± .07	3.29 ± .07	.655
Whole Fruit[3]	5	≥0.4 cup equivalent per 1,000 kcal	No whole fruit	0.54 ± .036	0.53 ± .031	.921	3.09 ± .096	3.12 ± .090	.841
Total Vegetables[4]	5	≥1.1 cup equivalents per 1,000 kcal	No vegetables	0.69 ± .028	0.78 ± .026	.016	2.30 ± .069	2.61 ± .061	.001
Greens and Beans[4]	5	≥0.2 cup equivalent per 1,000 kcal	No dark leafy vegetables or greens and beans	0.20 ± .016	0.23 ± .016	.161	2.56 ± .161	2.64 ± .153	.717
Whole Grains	10	≥1.5 oz equivalents per 1,000 kcal	No Whole Grains	0.26 ± .011	0.26 ± .011	.823	4.09 ± .170	3.63 ± .151	.042
Dairy[5]	10	≥1.3 cup equivalents per 1,000 kcal	No dairy	0.66 ± .020	0.72 ± .024	.036	4.56 ± .123	4.96 ± .136	.034
Total Protein Foods[6]	5	≥2.5 oz equivalents per 1,000 kcal	No Protein foods	2.44 ± .070	2.19 ± .067	.011	3.23 ± .058	2.99 ± .065	.006
Seafood and Plant Proteins[f7]	5	≥0.8 oz equivalent per 1,000 kcal	No Seafood or Plant Proteins	1.49 ± .083	1.33 ± .070	.131	3.58 ± .059	3.49 ± .061	.291
Fatty Acids[8]	10	(PUFAs+MUFAs)/SFAs >2.5	(PUFAs+MUFAs)/SFAs ≤1.2	0.81 ± .029	0.96 ± .037	.001	1.26 ± .099	1.73 ± .149	.010
Moderation:									
Refined Grains	10	≤1.8 oz equivalents per 1,000 kcal	≥4.3 oz equivalents per 1,000 kcal	2.80 ± .050	2.83 ± .050	.620	7.27 ± .15	7.15 ± .16	.578
Sodium	10	≤1.1 g per 1,000 kcal	≥2.0 g per 1,000 kcal	1.49 ± .018	1.50 ± .018	.683	9.27 ± .202	8.36 ± .271	.009
Added Sugars	10	≤6.5% of energy	≥26% of energy	14.98 ± .47	15.17 ± .43	.768	4.43 ± .197	4.46 ± .189	.901
Saturated Fats[9]	10	≤8% of energy	≥16% of energy	10.63 ± .104	10.62 ± .113	.954	3.47 ± .111	3.44 ± .120	.850
						Total HEI Score	52.50 ± 5.68	51.92 ± 6.17	.385
						% Good Score ≥80	0%	0%	
						% Poor Score ≤50	31.1% (48/148)	41.2% (68/165)	.063

[1] Independent t-test and Chi-square test, data presented as mean ± S.E or SD (Total HEI Score), at *P* ≤0.05 for differences between sexes [2]Includes fruit juice.
[3]Includes all forms except juice.
[4]Includes any beans and peas (called legumes in HEI-2005) not counted as total protein foods (called meat and beans in HEI-2005).
[5]Includes all milk products, such as fluid milk, yogurt, and cheese, and fortified soy beverages.
[6]Beans and peas are included here (and not with vegetables) when the Total Protein Foods (called meat and beansin HEI-2005) standard is otherwise not met.
[7]Includes seafood, nuts, seeds, soy products (other than beverages) as well as beans and peas counted as Total Protein Foods.
[8]Ratio of polyunsaturated fatty acids (PUFAs) and monounsaturated fatty acids (MUFAs) to saturated fatty acids (SFAs).
[9]In 2005, the Sodium and Saturated Fats components had three standards each, corresponding to scores of 0, 8, and 10 points.
https://epi.grants.cancer.gov/hei/comparing.html

Discussion

Limited studies have reported dietary intake and meeting nutrition recommendation in Kuwaiti schoolchildren or compared by gender. The overall children's dietary quality was poor, which is known to affect childhood nutritional status and health [262] and promote obesity and chronic diseases in children [15]. Few children met vegetable, whole grains, dairy, kcal, saturated fat, *trans*-fat (none), *n*-3 FAs, added sugar, calcium, potassium, sodium, and vitamin D recommendations. We expected boys to be less likely in meeting nutrition recommendations and to have poorer total HEI and FI than girls, but we found no gender differences. The unexpected gender difference of boys meeting the fruit recommendations can be explained by their higher crude mean fruit intake which was found to be correlated (r = .245; $P < 0.001$) with mean MVPA and found to be associated ($P = 0.002$) with meeting the fruit intake cutoff point.

The proportion of children meeting kcal levels (20%) was lower in our study sample than in a previous study (2008–2009), which reported around 50% Kuwaiti children aged 9 to 13 years met the kcal recommendation. Moreover, macronutrient levels were met by a higher proportion in our study sample, while findings related to micronutrient levels were similar with previous findings. [36] Nevertheless, when contrasted with several similar studies from other countries, our findings showed higher kcal and macronutrient, but lower micronutrient intake, except sodium. Otilia Perichart-Perera et al. (2010) reported that Mexican schoolchildren (9–13 years old, n = 228, 48.2% girls) had lower overall intake of total calories (2,088 kcal/day), cholesterol (270 ± 116 mg/day), but not fiber (19.6± 8.1g). [263] Among Canadian fifth graders (n = 4,966; 51.5% girls), Veugelers et al. (2005) reported lower mean total kcals (2256 kcal [boys] vs. 2077 kcal [girls]), but better mean calcium (1157 mg) and vitamin D (242 IU), except sodium (2626 mg) [244] intake than our findings. More studies reported lower mean nutrition intakes than our estimations. Lauren Au et al. (2012) reported mean kcal and macronutrient intake of racially diverse students from the fourth to eighth grade in Boston: USA (n = 148), White, (n = 57), Hispanic (n = 48), Black (n = 12), Asian (n = 15), and multiracial (n = 16). Accordingly, the study reported mean energy intake (1,277 kcal; 1570 kcal; 1767 kcal; 1315 kcal; and 1775 kcal), mean total fat (50.7g; 46.1g; 55.7g; 47.5g; and 45.8g), saturated fat (17.8g; 16.2g; 17.0g; 15.7g; and 15.4g), and carbohydrate intake (211.2g; 222.2g; 203.2g; 224g; and 226.3g) [55] which were lower than our estimated intakes. Moreover, in their Korean Child-Adolescent four-year cohort Study (n = 770, 48% girls, 9.9 ± 0.3 years old), Yang-Im-Hur et al. (2016) reported boys vs. girls' intake of total kcal (1680 vs. 1664 kcal) and total sugar (32.4 g vs. 35.6 g). [174] Moreover, we contrasted our findings on the overall mean nutritional intakes with the more recent NHANES 2015-2016 (6-11 years old) findings: "*What we eat in America*". [261 264] Our findings revealed relatively higher intakes of solid fats (37g vs. 35g), added sugar (22 tsp. vs. 16.6 tsp.), and sodium (3.6 g vs. 3 g), and slightly lower intakes of whole grains (0.6 oz vs. 1 oz), dairy (1.6 cup vs. 2 cup, calcium (900 mg vs. 1000 mg) and vitamin D (3.5 µg vs. 5.4 µg) than NHANES. However, our study sample's vegetable (1.8 cup vs. 0.9 cup), fruit (2.3 vs. 0.9 cup), fiber (22g vs. 14g), and potassium (3000 mg vs. 2100 mg) intakes were higher than those for US-based children. In summary, the mean nutritional intake of our study sample is considered worse than the average consumption of children in other countries.

To the knowledge of the authors, no study has evaluated Kuwaiti schoolchildren's dietary status based on WHO/FAO recommendations. The KNSS reports children's (0 to 5 years) nutrition intake and behavior. [1] We included the WHO/FAO nutritional recommendations [22 64] and the DGA and DRIs [66] to better understand variations between international and US nutrition guidelines in estimating our study sample's dietary status. We found that there were considerable variations in meeting the AMDR versus WHO ranges for total fat (66% vs. 24%) and carbohydrates (91% vs. 50%); on the other hand, few children met only WHO/FAO cutoff points for vegetables, whole grains and vitamin D, but not the DGA.

With respect to our findings on dietary indices, we calculated both the HEI 2015 as well as the previous HEI 2010 version. Although HEI 2015 was recently released which no studies available, we contrasted with studies used HEI 2010. We estimated an overall total HEI-2010 score of 58 points and no participant possessed a good HEI total score of 80 points or above. A study during 2012 involving fifth graders (N = 210) in Michigan, USA reported a better HEI-2010 total score of 62 points, where 2.5% had good HEI scores. [192] On the other hand, among 2–17-year-olds (N = 2,857), NHANES 2011-2012 reported a slightly lower total HEI-2010 score (55 points). [245] However, our study sample's adequacy components points were generally lower than the HEI score from the NHANES sample. With regard to recently released HEI-2015, there are no published data by NHANES or other studies available on children. We found that the overall HEI-2015 score of 52 points was lower than the total score 58 points of HEI-2010 in our study sample. The boys' and girls' total HEI-2010 and HEI-2015 scores were similar and considered lower than the standards [191], contrary to our hypothesis. Also, unexpectedly, more children, especially girls, had poorer total scores with HEI-2015. This can be explained by their excessive saturated fat and added sugar intake, indicating that few children met the recommendations.

With regard to FI, the overall mean level of FI was not statistically different by gender. The mean FI in the current study (8.9 ± .11 g/1000 kcals) was similar to what Ventura et al. (2008) reported (8.4 ± 3.1 gs) in a sample (*n*=85) of OW Latino children 10-17 years old. [200]

The strengths of the study included using DGA, DRI, and WHO/FAO recommendations for assessing nutritional intakes in a sufficient sample of fifth grade boys and girls based on power analysis considering the potential influence of kcals, MVPA and ST factors. In addition, the study also utilized dietary indices such as HEI and FI for evaluating Kuwaiti children dietary pattern. We used a valid [248 249] nutritional assessment instrument "Block 2004 Kids FFQ", which was translated (Arabic/English) and modified (cultural food) and even re-tested to facilitate accurate responses by Kuwait schoolchildren. Nutrition data collection were performed by a trained research team following research protocols and FFQ instructions by NutritionQuest, also used by the (S)Partners for Heart Health schoolchildren program [210]. We used valid statistical methods [258] and energy expenditure equations [259] for detecting kcal outliers and flagged 26 boys and 28 girls from the original sample (174 boys and 193 girls). However, there were limitations to our study, such conducting cross-sectional comparison and not an intervention or a follow-up study. The study consisted of a convenience sample and not generalizable to all Kuwaiti fifth graders. Several studies have indicated that it can be difficult to obtain accurate nutrition reporting by children owing to issues with memory or proportion estimation. The type of dietary assessment tool that is used (FFQ or recalls) [265] can influence results. Children using FFQ may over- or underestimate energy intake and some micronutrients related to the length of the questions. [266]

Summary and Conclusion

This was the first study to report on the the proportion of Kuwaiti schoolchildren meeting food group and nutrient intake recommendations, and to report on the HEI and FI, compared the results by gender. The overall proportion of children meeting the recommendations was poor. Less than 50% of the children met food group and less than 40% of children met the micronutrients recommendations. Around 80% of the children exceeded calorie, added sugar, saturated fat, and sodium, while none met *trans*-fat recommendations. Also, none of the children had good HEI scores (≥80 points) or FI. With respect to using DGA and WHO/FAO guidelines, some participants met the WHO/FAO but not the DGA recommendations for whole grains and vitamin D. Nevertheless, for most other nutrients and some food group recommendations, the DGA and DRI were found to be more applicable than WHO/FAO in estimating Kuwait fifth graders' nutritional intake. In light of our hypothesis, few exceptions were observed where more girls met vegetable and sodium intake than boys and more boys met the fruit intake. The current dietary pattern of Kuwaiti children indicates that the majority of children are eating a high caloric low nutrient dense diet and likely contribute to the alarming rates of OB and other CVD risk factors. The findings of the study suggest the need for intervention programs to improve Kuwaiti children's dietary behavior.

CHAPTER 5: PREVALENCE OF CARDIOVASULAR DISEASE RISK FACTORS AND MEETING US AND WHO/FAO DIETARY RECOMMENDATIONS IN KUWAITI SCHOOLCHILDREN BY WEIGHT STATUS

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Abstract

Background: Overall data suggests OB children tend to have more CVD risks than non-OB children however a portion of OB children have limited risks factors, while some normal weight children have significant CVD risks. Concerns with Kuwaiti children include high rates of childhood OB and energy dense diets. There is no data on Kuwaiti children's CVD risk status and nutrition intakes by weight status.

Objective: In a sample of OB, OW, NW and UW Kuwaiti children determine if there are differences between weight categories in: 1) prevalence of CVD risks 2) meeting US and WHO/FAO nutrition recommendations.

Method: A cross-sectional evaluation on fifth graders (N=313; age 10.4 ± 0.4) in Kuwait. Assessments included CVD risk factors and a self-administered Food Frequency Questionnaire (FFQ). Independent variables: BMI-for-age weight categories. Dependent variables: at risk TC, LDL, HDL, non-HDL, TC:HDL, and TG; systolic blood pressure (SBP) and diastolic (DBP); food groups, macronutrients, and micronutrients. Analyses included ANCOVA and logistic regression controlling for kcals and gender, with $P \leq 0.05$.

Results: The prevalence of at risk: TG (OB 59.4% vs. OW 40.7%, NW 29.6%, UW 42.9%; *P*=0.002); TC:HDL (OB 43% vs. OW 22.6%, NW 8.2%, UW 11.1%; *P*<0.001); HDL (OB 52.9% vs. OW 35.1%, NW 22.2%, UW 11.1%; *P*=0.013), and BP (OB 37.5% vs. OW 17.1%, NW 16.1%, UW 13.3%; *P*<0.002). The only significant differences in meeting nutrition recommendation between categories were: 82% of OB met protein versus OW (63%), NW (77%), and UW (53%) (*P*=0.004); carbohydrates recommendations were met by UW (100% vs.NW 91.6%, OW 80%, OB 95.5%; *P*=0.008) and sodium by OW (30% vs. UW 20%, NW 9.5%, OB 16%) ; *P*=0.024).

Conclusion: These findings warrant CVD risk assessments for Kuwaiti children regardless of weight status, and interventions to improve dietary behaviors to prevent CVD risks This evaluation of Kwauti children's CVD and nutrition compared by weight status indicated that OB children had the highest risk levels overall, however NW versus OB children had a higher risks for several lipid variables. Overall, few met nutrition recommendation, and few differences between weight categories. These findings warrant CVD risk assessments for Kuwaiti children regardless of weight status, and interventions to improve dietary behaviors. .

Introduction

Cardiovascular disease (CVD) is the leading cause of death worldwide; it is responsible for 17.5 million deaths (31%) annually, [267] and 41% of total deaths in Kuwaiti adults.[29] CVD risk factors are known to track from childhood into adulthood. Overweight (OW) and obese (OB) children are known to have higher risks for CVD. Nevertheless, some OB individuals are found to be metabolically healthy [268] whereas, non-OB individuals can be at risk for one or more CVD risk factors.[17] Studies that have investigated CVD risk factors in Kuwaiti children other than weight status and blood pressure (BP) are limited. A pair-matched study from 1995–

1996 reported familial and environmental factors associated with childhood OB in 460 OB versus normal weight (NW) schoolchildren (from 6 to 13 years old). The prevalence of at-risk schoolchildren in terms of SBP was 8.3% in OB and 0.7% in non-OB, and overall prevalence of at risk BP was 5%. [60]

Poor dietary behaviors, characterized by excessive dietary energy with low nutrient density, are known to adversely affect childhood health; including increases in obesity (OB). [97] In the 1980s economic transitions [81] began shifting Kuwaiti children's behaviors and nutritional status from being under nourished as reflected by < 1% prevalence of OB in 1985 [216], over nourished state with a OB prevalence of 31% in 2012. [2] The data on Kuwaiti children's dietary intake are limited. The only recent study available during 2008–2009 described the dietary intake of 205 children aged 9–13 years old using USDA 5-steps 24-hour recall. The results indicated 50% of the children exceeded their calorie intake. The study also indicated that around 20% of children were meeting micronutrient recommendations including vitamin D (~0.7%), calcium (~12%), and magnesium (~40%), but not sodium (~66%). [107] In summary, the findings on Kuwaiti children's dietary behavior indicated high energy density and low nutrient density.

There is evidence for dietary behaviors and patterns that promote health and prevent disease risks. [18-22] These studies have led to the establishment of nutritional guidelines for promoting health and preventing chronic disease, particularly, the US Dietary Guidelines (DGA) including the dietary reference intake (DRI) for individuals by age and gender. [66] Aligning with US dietary guidelines, the Joint WHO/FAO Expert Consultation (2002) provided population based dietary recommendations for preventing OB and chronic diseases. [21 64 65] Kuwait does not have national nutrition standards and does not use WHO/FAO nutrition recommendations for children beyond the age of five years. [1] Utilizing US and WHO/FAO nutritional guidelines for estimating Kuwaiti children's dietary intake may provide a better understanding of the dietary status of Kuwaiti schoolchildren to improve their dietary behaviors and prevent OB.

In Kuwait, there is limited data regarding the prevalence of CVD risk factors and meeting nutrition recommendations by weight status, among schoolchildren. Data does not exist for the prevalence of dyslipidemia and other CVD risk factors, nor does it exist for the proportion of Kuwaiti children meeting food groups, solid fats, and added sugar recommendations by weight status. Also, with the exception of using US Dietary Reference Intake (DRI), no published studies have reported on WHO/FAO recommendations or dietary indices, such as HEI and FI in Kuwaiti schoolchildren. There is no data on the prevalence of CVD risk factors and the proportion that are meeting nutrition recommendations in non-OB Kuwaiti children. Therefore, using a sample of Kuwaiti fifth graders according to weight categories (underweight [UW], normal weight [NW], OW, and OB), the objectives of the study were to determine the prevalence of CVD risk factors and if there are significant differences between weight categories, Therefore, in a sample of OB, OW, NW and UW Kuwaiti children determine if there are differences between weight categories in: 1) prevalence of CVD risks and determine if risks are greatest in OB children 2) meeting US and WHO/FAO nutrition recommendations and determine if fewer OB children meet the recommendations (food groups, macronutrients, and selected micronutrients).

Methods

Study Design and Participants

A cross-sectional evaluation was conducted on 313 fifth grade children (10.4 ± 0.4 years of age) in Kuwait. For student recruitment, informed parent/guardian consent and child assent forms were distributed to 39 primary schools (19 boys schools, 20 girls schools) within six Kuwaiti cities (Capital 11.8%, Hawalli 38.7%, Farwania 5.8%, Mubarak Al-Kabir 22.7%, Ahmadi 10.5%, and Jahra 10.5%). Data was collected from 16 schools which were supportive of participating during the timeline available in Spring of 2019. The reasons for schools who did not participate included lack of interest or support from school administrators, and or the inability to participate during the limited timeline. Of the 493 consents and assents (boys [258] and girls [235]) that were collected, 35 parents chose not to have their child participate in the study, and 65 boys and 42 girls were absent on measurement day, resulting in a sample of 367 for this study. Of the 367 study participants who completed the food frequency questionnaire (FFQ), 54 participants (26 boys and 28 girls) FFQs were deemed invalid leaving a total sample of 313 participants for the analysis. The study protocol was approved by the Michigan State University (MSU) Institutional Review Board (IRB) as well by the Ministry of Health Research Ethic Committee, and by the Department of Educational Research in Kuwait.

Details of measurement variables are summarized below.

Measurements

Data collection occurred in Kuwait between February 2018 and March 2018. It included CVD risk factor assessments (anthropometric and biometric measures) and self-report surveys to obtain participants' dietary intake and covariates including moderate-to-vigorous physical activity (MVPA) and screen time (ST). Data collection was performed by nursing trainers as well as nursing and nutrition students from the Colleges of Nursing and Health Sciences of the Public Authority for Applied Education and Training (PAAET) in Kuwait. The measurement team was trained following the protocol procedures used by MSU's (S) Partners for Health school program in MI, USA.[210] The protocol includes following pediatric CVD risk factor assessment procedures from the American Academy of Pediatrics guidelines.[20] Nutrition data collection was performed according to the dietary survey instructions by the company, NutritionQuest.

Anthropometric Assessments

Several anthropometric measures were used in this study to derive outome measures. Measures included height and weight, which was used to calculate body mass index (BMI), body fat percentage (%BF), waist circumference (WC), and derived waist-to-height ratio (WHtR). Each of the anthropometric measurements are summarized below.

Standing height was measured using a ShorrBoard (Shorr Production, Olney, MD) or wall mounted, or calibrated stadiometer (210 Holtain Limited, Dyfed, UK), to the nearest 0.1cm, without shoes. Body weight (to the nearest 0.1 kilogram) and BF percentage were measured using a calibrated electronic scale (Tanita BC-534), which employs foot-to-foot bioelectrical impedance (BIA) (Tanita Corporation, Tokyo, Japan). Height and weight were used to calculate BMI $\frac{Weight\ (kg)}{Height\ (m^2)}$, which was converted to Z-scores based on methods devised by Cole et al. (1992, Z= $\frac{(\frac{BMI}{M})^{\ L-1}}{L * S}$).[219] Waist circumference (WC) was measured to the nearest 0.1 centimeter using a Gulick measuring tape (Gulick Co., Tokyo, Japan). The Gulick tape was positioned in a horizontal plane around the abdomen at a level 1cm above the superior border of the iliac crest.

[144 220] Waist-to-height ratio (WHtR) was derived from $\frac{WC\ (cm)}{height\ (cm)}$, according to Ashwell et al. (2005). [153]

Independent Variables

BMI-for-age z-score was classified using the WHO 2007 cut-points for UW ≤ -1, NW >-1 to ≤+1, OW >+1SD to ≤ +2, and OB >+2. [54]

Dependent Variables

CVD Risk Factors

Dyslipidemia

Assessment of blood lipids involved the following cutpoints from the Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents. [89] At risk cut point values: total cholesterol (TC) at or above 170 mg/dL, LDL at or above 110 mg/dL, HDL at or lower than 45 mg/dL, TG at or above 90 mg/dL, non-HDL at or above 120 mg/dL, and total cholesterol: HDL ratio at or above 3.5. High risk cut point values: total cholesterol (TC) at or above 200 mg/dL, LDL at or above 130 mg/dL, HDL at or lower than 40 mg/dL, TG at or above 130 mg/dL, non-HDL at or above 145 mg/dL.

A blood sample was collected from participants in a non-fasted state by finger prick (40 µL), using heparinized capillary tubes. The blood sample was analyzed using CardioCheck Plus (version 1.09; Maria Stein, OH). CardioCheck is a portable analyzer that was calibrated prior to testing at each school site. Per protocol, each blood sample was placed on a multi-lipid panel cassette to obtain analysis of total cholesterol (TC), HDL cholesterol, and TG within 90 seconds.

Levels of LDL were calculated based on the Friedewald formula (LDL = TC - (HDL + TG/5).[222] Additionally, the TC:HDL ratio, and non-HDL cholesterol were calculated.

Regarding CardioCheck Plus accuracy, Whitehead et al. (2013) evaluated CardioCheck and Cholestech LDX accuracy using laboratory methods. CardioCheck exhibited higher intra and inter-batch imprecision and external quality assessment (EQA) scheme between-analyzer variation for the measurement of TC, HDL, compared to the Cholestech LDX cholesterol analyzer in Li Hep whole blood and plasma. [223] Steiner et al. indicated that differences between non-fasted and fasted measures of pediatric lipids LDL and TG were minor and clinically acceptable. [224] Moreover, it has been determined that non-fasting TC and HDL measurements are appropriate and in strong agreement (intra-class correlation .92) with fasting values. [225] Non-HDL was calculated by subtracting HDL from TC and deemed acceptable for using non-fasting samples. [232] Non- HDL is used clinically as a marker for atherogenic apolipoprotein B containing lipoproteins [226 227], and considered an effective predictor for dyslipidemia and subclinical atherosclerosis in adulthood. [227]

Resting Blood Pressure

Manual resting systolic and diastolic blood pressure (BP) were assessed following standardized procedures [164], using a stethoscope and a standard BP aneroid, with an appropriately sized inflatable cuff on the subject's right arm, using a Professional Aneroid Sphygmomanometer (AllHeart, Louisiana, MO). Once a participant had been seated for five minutes, two measures were taken at one minute intervals to determine an average. If the first two measures differed beyond parameters (4 mmHg), a third measure was taken. The blood pressure values were classified using the 2017 Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents using cutpoints for children ages 1 to <13 years. [218] The cutpoint for determining the prevalence of children at risk corresponds with the "Elevated" range or higher, which is SBP >120 and or DBP >80. The "Elevated" numerical cutpoint is based on children population data ("*derived from a comprehensive review of almost 15,000 published articles between January 2004 and July 2016"* page 1) [88] which corresponds to ≥90th to < 95th percentile by sex, age, and height. Levels > 95th percentile are defined as hypertension which includes stage I and II. The prevalanece of "at risk" for SBP and DBP were also determined individually based on same cutpoints (SBP >120 mmHg and DBP ≥ 80 mmHg).

Nutritional Behaviors

Block Kids 2004 Food Frequency Questionnaire

Originally, the Block Kids 2004 Food Frequency Questionnaire (FFQ) (Block Dietary Data Systems, Berkeley, CA) [247] was an 8-page FFQ asking about the frequency and quantity of 78 foods eaten during the past week which takes approximately 20 to 30 minutes to complete. The results are quantified as daily intake in grams (or milliliters for liquids) and summarized into daily intake. The FFQ reported equal and high correlation for milk intake (r = 0.571), 100% juice intake (r = 0.550), diary for calcium (r = 0.515), and vitamin D (r = 0.512) when compared with the Iowa Fluoride Study targeted nutrient semi-quantitative questionnaire for relative validities. [248] Moreover, it showed reliability intraclass reliability (>.30), when compared with 24-hour dietary recall, except percent energy from protein and fruit and vegetable servings. [249]

Modified Arabic/English version of Block Kids 2004 FFQ

The Block Kids 2004 FFQ was translated by the researcher and staff at NutritionQuest Company during 2016–2017. The process of modifying the FFQ involved incorporating cultural food choices in NutritionQuest Company's data dictionary based on the USDA surveys "the Continuing Survey of Food Intakes by Individuals (CSFII) 1989-91 and the CSFII 1994-96, 1998" [250] and analysis configuration to account for changes in food questions (added and or omitted). The modified FFQ consisted of eight pages (72 foods), assessing the frequency and quantity of food consumption from food groups and nutrients during the past week. A descriptive list of modifications to the original Block Kids 2004 FFQ food items is illustrated in APPENDIX F. Decisions regarding selecting cultural foods from Kuwait for the modified FFQ were objectively proposed based on data describing Kuwaiti traditional dishes and food contents. [33 177 178] Also, data on consumption of non-traditional foods in Kuwait [251] and the dietary pattern of the Arab Gulf region population living abroad were considered. [252]

In the modified FFQ, foods that are restricted for religious reasons were excluded: pork (pork chops, ribs, or cooked ham, slice ham, hamburger, and bacon). Moreover, questions related to foods that were deemed rarely or never consumed by children in Kuwait were deleted : tacos, burritos, and enchiladas. For example, which kind of tacos, burritos, enchiladas do you usually eat? With meat or chicken/Without meat or chicken. Additionally, questions on foods such as hot dogs and corn dogs, lunch meat like boloney, sloppy Joes, chicken helper, tomato soup, pop tarts, pie, fruit pie, fruit crisp, cobbler, and fruit roll-ups were also deleted. Pinto beans, black beans, chili with beans, or bean burritos were excluded from the beans selections in the FFQ (green beans, string beans or peas, chickpeas [added], and refried beans).

Cultural foods added into the FFQ included "kabab and shawarma (beef/chicken), fatayer (pastries), pita bread, sambosa, and lentil soup, in addition to vegetables such as eggplant, zucchini, and okra. Other cultural foods mentioned in the FFQ are rice, white/wheat/bread, hummus, and refried beans.

Moreover, some food questions were altered : “Chicken noodle soup” to “Any other soup like chicken noodle, Cup-a-Soup, ramen noodles, or menudo, posole”, “Whole wheat bread or whole wheat rolls” to “ Whole wheat bread, bran, rye, whole grain”, “White bread, toast or rolls, including sandwiches or bagels” to “White bread, pita bread, toast, bun”, “Sweet potatoes, or sweet potato pie” to “Sweet potatoes”, “Cake, cupcakes, Tasty Cakes, Ho-Ho's, Twinkies” into “Cake, cupcakes”, and beef burgers to hamburger. Similarly, for snacks and beverages, some non-popular brands were modified including “snack crackers like Cheez-Its, Ritz Bits, Goldfish” to “Cheez-Its, Ritz Bits, Goldfish, TIK, Marie”, and “Hi-C, Tang, Tampico, Mr. Juicy, Ssips punch” to “Fruit drinks like Tang”, “Dr. Pepper, Pepsi, or 7-UP”.

Administering the Modified and Translated version of the Block Kids 2004 FFQ

The nutrition behaviors of our study sample were assessed by using the translated (Arabic/English) and modified version of the Block Kids 2004 FFQ described earlier. The modified instrument was administered by trained nursing trainers as well as nursing and nutrition students from the colleges of Nursing and Health Sciences (PAAET) in Kuwait. The completed FFQs were analyzed by NutritionQuest and were validated for outliers, which will be described in the next sections.

Nutrition Variables

Data for analysis were derived from variables including food groups and selected macronutrients and micronutrients. These variables were used to evaluate our study objectives and nutrition recommendations according to the following nutrition guidelines: The US Dietary Guidelines (DGA) and Dietary Reference Intake (DRI) [66] for children (9 to 13 years), and WHO/FAO ranges of population dietary intake goals [22] and recommended nutrient intake (RNI). [64]

Food Groups

Fruit portions (1.5 cups DGA; [>400 g ~1.7 cups WHO]), vegetable portions (males: 2.5 cups; females: 2 cups DGA; [>400 g ~1.7 cups WHO]), dairy portions (2 cups DGA), whole grain (3 oz equivalents DGA ~1 oz WHO).

Macronutrients

Total calories (girls 1600–2000 kcal; boys1800–2200 kcal), fat (AMDR 25–35%; WHO 15– 30% of total kcal/day), saturated fat (<10% of total kcal/day), *trans*-fatty acids (less than 1% of total kcal/day), linoleic acid (PUFA *n*-6, 10–12 g DRIs, [5–8% WHO of total kcal/day]), linolenic acid (PUFA *n*-3, 1–1.2 g DRIs, [1–2% WHO of total kcal/day]), and cholesterol (<300 mg). Protein (AMDR 10–30%, [10–15% WHO] of total kcal/day). Carbohydrates (AMDR 45–65%, [55–75% WHO] of total kcal/day) and added sugar (less than 10% of total kcal/day); dietary fiber (boys: 25.2 g; girls: 24.4 g DGA).

Micronutrients

Sodium (less than 2200 mg [UL]; less than 2000 mg [RNI]), potassium (4500 mg [AI/RNI]), calcium (1300 mg [RDA/RNI]), and magnesium (240 mg [AI]; 230 mg [RNI]) and vitamin D (600 IU [RDA], 200 IU [RNI]). [253]

Covariate Assessment

Physical Activity (PA)

A self-reported question taken from the Youth Risk Behavior Survey (YRBSS) [209] was administered in both Arabic and English (Appendix B). The question was designed to assess the number of days over the preceding week participants engaged in $\geq$60 minutes of moderate-to-vigorous physical activity (MVPA). [209] The question states: *"During the last 7 days, how many* *days were you physically active for a total of at least 60 minutes per day (add up all of the time you spend in any type of activity that increases your heart rate and makes you breath hard some of the time)?*" The scale range measured zero to seven days. [211]

Screen Time (ST)

Screen time was assessed using the ST questions from the YRBSS [209] and was administered in both Arabic and English (see Appendix B). Participants of the study self-reported the weekly amount of time spent viewing television, playing video games, and using an online computer, and indicated the number of hours (watch/play) on weekdays and weekends for each of the three screen media types. The average hours of screen time per week was determined using the following formula: (hours of TV time on weekdays * 5 days) + (hours of TV time on weekends * 2 days)/7 days + (hours of video game time on weekdays * 5 days) + (hours of video game time on weekends * 2 days)/7 days + (hours of computer time on weekdays * 5 days) + (hours of computer time on weekends * 2 days)/7 days. [212] Screen time equal to or above two hours per day is considered high ST. Less than two hours a day is considered low ST. [213]

Statistical Analysis

Identifying outliers : Verifying and re-testing the modified translated version of the Block Kids 2004 FFQ

Two verification procedures were carried out to ensure the FFQ data were valid. The participants that reported implausibly low/high total calorie intake (kcal) were excluded by two methods. The Exploratory Data Analysis (Tukey 1977) statistical interval for labeling extreme "outside" observations was applied. Cutoffs for kcal were calculated using the interquartile rule formula for determining lower (Q3 - [Q3 [75th percentile] – [Q1 [25th percentile]* *k* [1.5

multiplying factor] and upper (Q3 + [Q3-Q1]*k) quartiles. [257 258] Additionally, we contrasted participants' reported total kcal intake versus an estimate of total energy expenditure by Schofield-HW ([TEE *1.7 moderate activity factor [AF]) [259], as well the Joint FAO/WHO/UNU Expert Consultation TEE (impeded moderate AF 1.7). [260] Rodriguez et al. (2000) indicated that Schofield-HW and FAO/WHO/UNU equations for estimating resting energy expenditure (REE) in children and adolescents, OB and non- OB, produced kcal mean differences of -33.1 to -35.3 and -0.62, respectively, when contrasted with the V_{max} calorimeter. [259] The TEE ratio interval (at or below 0.16 to at or above 2 folds) was used to detect over/under reported kcal outliers. The modified FFQ was retested ; it indicated overall moderate absolute agreement (intraclass correlation r = .674) in crude data, as well as in data without kcal outliers (intraclass correlation r = .545).

Analysis of covariance (ANCOVA) with Bonferroni post-hoc test analysis was used for comparing the mean differences of CVD risk factors and dietary intake between BMI-for-age (WHO 2007) [49] weight categories (UW, NW, OW, and OB) with controlling for gender (random effect) and total calories. Chi-square or Fisher's exact test was used to compare the proportions at risk for CVD and meeting nutrition recommendations, and binary logistic regression for odds and differences in proportions between weight categories with controlling for gender, MVPA, and ST. Data analysis was performed using SPSS version 24 (SPSS Inc., 2016, Chicago, IL). Results presented as mean ± SD or S.E. at significance level $P \leq 0.05$.

Results

Table 9 summarizes the demographic characteristics of participants from a total sample of Kuwait fifth graders (N=367), who were measured for CVD risk factors and who completed self-reported dietary, MVPA, and ST surveys. Missing data included one respondent's body weight (unable to assess %BF) (0.3%), three respondents' WC (0.8%), six respondents' (~2%) SBP and DBP, eight respondents' MVPA (2%), and two respondents ST (0.5%). The blood lipid sample variables varied due to participants who opted out from the test (n=64), either from an inability to obtain adequate blood samples and technical or assay issues (n=30). The missing blood lipid data included TC (28%, n=106), HDL (26%, n=96), LDL (36%, n=133), TC:HDL (29%, n=108), non-HDL (29%, n=109), and TG (33%, n=123). Of the 367 study participants who completed an FFQ, 54 participants were deemed invalid. The FFQs included in the analysis consisted of 313 participants (Table 1). According to BMI-for-age categories, our total study sample consisted of fewer than 4.8% UW children, most of the participants were deemed OB at 42.3% and for NW, 30.4% compared with children in the OW category, 22.4%.

Table 9. Mean anthropometrics, blood lipids, BP, covariates (moderate-to-vigorous physical activity [MVPA] and screen time [ST])[1] of Kuwait fifth graders by BMI-for-age categories[2]

Variables	Overall N=313	Underweight (UW) (≤ -1 SD) *n*=15	Normal Weight (NW) (>-1 to ≤ +1 SD) *n*=95	Overweight (OW) (>+1 to ≤ +2 SD) *n*=70	Obese (OB) (>+2 SD) *n*=133	*P*
Age	10.45 ± .38	10.39 ± .30	10.48 ± .42	10.50 ± .36	10.42 ± .37	0.395
Anthropometry						
Height (cm)	142 ± 6.63	133.8 ± 4.94	139.1 ± 5.73	142.4 ± 5.17	144.9 ± 6.48	0.001
Post-hoc test		*Ref*	*P*<.0001	*P*<0.001	*P*<0.001	
Weight (kg)	44.4 ± 13.1	25.8 ± 2.06	33.0 ± 4.17	42.6 ± 4.52	55.8 ± 10.8	0.001
Post-hoc test		*Ref*	*P*=0.009	*P*<0.001	*P*<0.001	
BMI Z-Score	1.42 ± 1.37	-1.44 ± .460	0.042 ± .578	1.54 ± .285	2.67 ± .521	0.001
Post-hoc test		*Ref*	*P*<0.001	*P*<0.001	*P*<0.001	
Blood Lipids[3]						
TC (mg)	152.7 ± 33.4	147.7 ± 19.2	148.9 ± 32.2	153.2 ± 31.6	155.3 ± 36.1	0.586
Post-hoc test		*Ref*	*P*=0.967	*P*=0.822	*P*=0.589	
TG (mg)	98.7 ± 48.3	88.4 ± 32.4	83.7 ± 36.1	88.3 ± 32.2	113.7 ± 57.9	0.001
Post-hoc test		*Ref*	*P*=0.798	*P*=0.503	*P*=0.025	
HDL (mg)	51.2 ± 14.3	64.0 ± 18.4	55.8 ± 12.2	52.1 ± 13.1	46.9 ± 14.3	0.035
Post-hoc test		*Ref*	*P*=0.078	*P*=0.039	*P*<0.008	
LDL (mg)	82.7 ± 25.9	72.6 ± 6.49	79.3 ± 28.3	83.2 ± 28.0	85.0 ± 24.0	0.584
Post-hoc test		*Ref*	*P*=0.486	*P*=0.612	*P*=0.219	
TC:HDL	3.06 ± .811	2.46 ± .507	2.69 ± .561	3.0 ± .850	3.37 ± .819	0.046
Post-hoc test		*Ref*	*P*=0.218	*P*=0.146	*P*=0.004	
non-HDL (mg)	100.8 ± 26.5	90.7 ± 9.33	93.4 ± 27.5	100.6 ± 29.2	106.4 ± 24.3	0.008
Post-hoc test		*Ref*	*P*=0.398	*P*=0.461	*P*=0.065	
Blood Pressure[4]						
SBP mmHg	106.3 ± 12.1	99.3 ± 11.7	100.8 ± 12.0	105 ± 10.3	111.8 ± 10.8	0.003
Post-hoc test		*Ref*	*P*=0.722	*P*=0.135	*P*=0.003	
DBP mmHg	68.6 ± 8.64	63.6 ± 8.64	64.9 ± 10.5	67.3 ± 8.92	71.2 ± 8.68	0.008
Post-hoc test		*Ref*	*P*=0.594	*P*=0.193	*P*=0.014	
MAP mmHg	151.6 ± 17.2	141.7 ± 16.6	144.1 ± 17.9	149.9 ± 14.6	159.2 ± 14.7	0.001
Post-hoc test		*Ref*	*P*=0.579	*P*=0.063	*P*<0.001	

Table 9 (cont'd)

Covariate [5]						
MVPA (days/wk)	2.89 ± 2.34	2.0 ± 2.36	3.42 ± 2.45	2.86 ± 2.42	2.64 ± 2.17	0.051
Post-hoc test		*Ref*	*P*=0.119	*P*=0.236	*P*=0.600	
ST (hrs/day)	4.72 ± 2.68	4.65 ± 1.89	4.98 ± 2.63	4.42 ± 2.84	4.70 ± 2.72	0.924
Post-hoc test		*Ref*	*P*=0.964	*P*=0.417	*P*=0.861	

[1]ANCOVA with Bonferroni *post-hoc* test [UW reference] controlled for gender (random effect), data presented as mean ± S.D, $P \leq 0.05$). [2]WHO 2007.[49] [3]Blood lipids: TG (Triglycerides), LDL-C (Low density-lipoprotein cholesterol), HDL-C (High density-lipoprotein cholesterol), none-HDL-C (Total cholesterol – HDL-C), TC:HDL-C ratio (TC/HDL-C). [4]Blood pressure: SBP (Systolic blood pressure), DBP (Diastolic blood pressure), MAP (Mean arterial pressure ([(SBP - DBP / 3) + DBP]). Blood lipids and BP cut-points for children according to the Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report [89] and the Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. [218] [5]Lifestyle behaviors: MVPA (Moderate-to-vigorous physical activity [number of days over past week (7 days) meeting > of 60 min]); ST (screen time)

Table 10 summarizes the overall prevalence of children at risk of CVD across weight categories using binary logistic regression with controlling for gender, MVPA, and ST. We estimated overall prevalence of at risk for elevated TG 46.4%, TC 27.4%, LDL 13.9%, non-HDL 24%, TC:HDL 27.1%, low HDL 35.6%, elevated SBP 18.5% and DBP 15.7%, and elevated BP 25%. The results indicated that OB children had twice the at risk of elevated TG than other weight categories. They were also six times as likely to have elevated TC:HDL, nine times as likely to be at risk of low HDL, six times as likely to be at risk of elevated SBP, four times as likely to be at risk for elevated DBP as well as elevated BP than counterparts in other weight categories.

Table 10. Prevalence at risk for dyslipidemia and BP, and covariates (moderate-to-vigorous physical activity [MVPA] and screen time [ST])[1] in Kuwait fifth graders by BMI-for-age categories[2]

CVD Risk Factors[3]	Overall Prevalence (*n*=313)	Underweight * (≤ -1 SD) *n*=15	Normal Weight (>-1 to ≤ +1 SD) *n*=95	Overweight (>+1 to ≤ +2 SD) *n*=70	Obese (>+2 SD) *n*=133	*P*
At risk TG ≥90 mg/dL	46.4%	42.9%	29.6%	40.7%	59.4%	0.002
OR (95% CI)			.486 (.093 – 2.551)	.801 (.156 - 4.101)	2.001 (.410 – 9.775)	
High TG ≥130 mg/dL	17.1%	14.3%	9.3%	11.1%	25%	0.029
OR (95% CI)			.548 (.052 – 5.753)	.697 (.069 – 7.067)	2.119 (.236 – 19.046)	
At risk TC ≥170 mg/dL	27.4%	22.2%	29.5%	24.1%	28.3%	0.789
OR (95% CI)			1.418 (.267 – 7.528)	1.067 (.196 – 5.817)	1.369 (.267 – 7.021)	
High TC ≥200 mg/dL	5.8%	0%	8.2%	7.4%	4%	0.652
OR (95% CI)			168544245.8 (.000)	114730792.3 (.000)	64661485.64 (.000)	
At risk LDL-C ≥110 mg/dL	13.9%	0%	15.4%	12%	15%	0.909
OR (95% CI)			315440531.2 (.000)	211833153.9 (.000)	300167983.8 (.000)	
High LDL-C ≥130 mg/dL	4.5%	0%	3.8%	8.0%	3.3%	0.754
OR (95% CI)			81467720.35 (.000)	124618548.3 (.000)	51374324.31 (.000)	
At risk HDL-C ≤ 45 mg/dL	35.6%	11.1%	22.2%	35.1%	52.9%	0.001
OR (95% CI)			2.189 (.250 - 19.133)	4.092 (.474 - 35.311)	9.034 (1.084 - 75.316)	
Low HDL-C <40 mg/dL	18.5%	11.1%	7.9%	14.0%	27.9%	0.013
OR (95% CI)			.600 (.059 – 6.086)	1.248 (.131– 11.869)	2.891 (.333 – 25.068)	
At risk Non-HDL ≥120 mg/dL	24%	0%	21.3%	18.9%	30.6%	0.249
OR (95% CI)			457051950.8 (.000)	339003218.2 (.000)	761827425.5 (.000)	
High Non-HDL ≥145 mg/dL	6.3%	0%	4.9%	7.5%	7.1%	0.956
OR (95% CI)			(.000)	(.000)	(.000)	
TC:HDL ≥3.5	27.1%	11.1%	8.2%	22.6%	42.9%	0.001
OR (95% CI)			.738 (.075 – 7.305)	2.342 (.260 – 21.093)	6.328 (.749 – 53.430)	
Elevated BP	25.2%	13.3%	16.1%	17.1%	37.5%	0.002
OR (95% CI)			1.514 (.293 – 7.838)	1.387 (.264 – 7.291)	4.394 (.907 – 21.283)	
Elevated SBP ≥120 mmHg	18.3%	6.7%	8.6%	10.0%	31.3%	0.001

Table 10 (cont'd)

OR (95% CI)			1.488 (.165 – 13.452)	1.617 (.179 – 14.631)	6.926 (.855 – 56.086)	
Elevated SBP ≥80 mmHg	15.7%	6.7%	10.8%	12.9%	21.9%	0.181
OR (95% CI)			1.885 (.214 – 16.626)	2.075 (.235 – 18.311)	3.900 (.477 – 31.918)	
Covariates[4]						
MVPA 60 min/day - 7 days	19.3%	13.3%	26.1%	20.3%	14.7%	0.190
OR (95% CI)			2.274 (.474 – 10.901)	1.753 (.351 – 8.763)	1.110 (.230 – 5.356)	
ST ≤2 hrs/day	17.4%	13.3%	11.8%	27.1%	16.7%	0.165
OR (95% CI)			.903 (.175 – 4.652)	2.274 (.458 – 11.293)	1.356 (.279 – 6.586)	

[1]Chi-square or Fisher's exact test for calculating proportions. Logistic regression controlled for gender, MVPA, and ST for comparing between groups ([*]underweight: reference), $P\leq 0.05$. [2] WHO 2007.[49] [3]Variables at risk: BF% (Percentage body fat); WC (Waist circumference); WHtR (Waist-for-height ratio [WC/ht]); TG (Triglycerides); LDL-C (Low density-lipoprotein cholesterol); HDL-C (High density-lipoprotein cholesterol); non-HDL-C (Total cholesterol – HDL-C); TC:HDL-C ratio (TC/HDL-C); Elevated BP (SBP ≥120 and/or DBP ≥80 mmHg, SBP (Systolic blood pressure); DBP (Diastolic blood pressure). [4]Covariates: MVPA (Moderate-to-vigorous physical activity [number of days over past week (7 days) meeting > of 60 min]); ST (screen time). Blood lipids and BP cut-points for children according to the Expert Panel on Integrated Guidelines for Cardiovascular Health and Risk Reduction in Children and Adolescents: Summary Report [89] and Clinical Practice Guideline for Screening and Management of High Blood Pressure in Children and Adolescents. [218]

Table 11 summarizes the children's overall mean food group, macronutrient, and micronutrient intakes, and the differences between weight categories based on ANCOVA with controlling for gender and total kcals. After controlling for total kcals, no statistical difference was found in mean food groups, macronutrients, and micronutrients between weight categories.

Table 11. Mean food group, macronutrient, and micronutrient intakes [1] in Kuwaiti fifth graders by BMI-for-age categories[2]

Nutrition Variables	Overall N=313	Underweight (UW) (≤ -1 SD) *n*=15	Normal Weight (NW) (>-1 to ≤ +1 SD) *n*=95	Overweight (OW) (>+1 to ≤ +2 SD) *n*=70	Obese (OB) (>+2 SD) *n*=133	*P*
Total calories per day	2462.2 ± 52.5	2353.8 ± 219.8	2463.6 ± 74.3	2168.8 ± 106.9	2619 ± 90.7	0.016
	Mean (±SE) food group and nutrient intakes with controlling for total kcals					*P**
Fruit (cup)	2.40 ± .098	2.38 ± .320	2.55 ± .127	2.51 ± .150	2.17 ± .109	0.103
Vegetables (cup)	1.86 ± .066	2.07 ± .215	1.79 ± .085	1.76 ± .10	1.82 ± .073	0.638
Dairy (cup)	1.64 ± .050	1.51 ± .164	1.70 ± .065	1.68 ± .077	1.66 ± .056	0.772
Whole grains (oz)	.624 ± .029	.581 ± .86	.660 ± .034	.632 ± .040	.622 ± .029	0.772
Total fat (g)	92.4 ± 1.09	93.7 ± 3.44	92.9 ± 1.36	90.8± 1.60	92.1 ± 1.16	0.756
Saturated fat (g)	29.2 ± .283	29.2 ± .930	29.4 ± .369	28.7 ± .435	29.3 ± .315	0.586
Trans-fat (g)	8.25 ± .189	8.64 ± .621	8.08 ± .247	8.08 ± .291	8.20 ± .211	0.846
n-6 FAs (g)	19.1 ± .531	19.2 ± 1.74	19.4 ± .692	19.1 ± .815	18.9 ± .591	0.946
n-3 FAs (g)	1.66 ± .026	1.64 ± .085	1.66 ± .034	1.67 ± .040	1.68 ± .029	0.965
Cholesterol (g)	310.6 ± 9.09	327.7 ± 29.8	319.1 ± 11.8	298.3 ± 13.9	297.1 ± 10.1	0.418
Protein (g)	83.9 ± .970	86.3 ± 3.18	83.6 ± 1.26	83.1 ± 1.48	82.8 ± 1.07	0.755
Carbohydrate (g)	334.7 ± 3.11	329.5 ± 9.19	334.2 ± 3.65	339.2 ± 4.29	336.1 ± 3.11	0.729
Total sugar (g)	162.3 ± 3.12	157.9 ± 10.2	160.2 ± 4.07	169.3 ± 4.79	161.8 ± 3.47	0.471
Added sugar (tsp)[3]	21.9 ± .665	20.8 ± 2.18	20.8 ± .867	23.1 ± 1.02	22.8 ± .740	0.225

Table 11 (cont'd)

Fiber (g)	22.3 ± .411	22.8 ± 1.34	22.7 ± .535	22.2 ± .630	21.5 ± .457	0.348
Sodium (mg)	3679.7 ± 43.7	3792.4 ± 143.4	3638.8 ± 57.0	3563.7 ± 67.0	3724.1 ± 48.6	0.196
Potassium (mg)	3052.2 ± 42.4	3150.6 ± 139.1	3074.8 ± 55.2	3047.8 ± 65.0	2935.9 ± 47.1	0.164
Calcium (mg)	953.6 ± 15.7	913.9 ± 51.5	983.5 ± 20.4	960.6 ± 24.0	956.6 ± 17.4	0.562
Magnesium (mg)	334.6 ± 4.36	335.7 ± 14.3	342.6 ± 5.68	335.5 ± 6.69	324.4 ± 4.85	0.108
Vitamin D (IU)[4]	140.6 ± 5.3	136.5 ± 17.3	145.9 ± 6.90	145.7 ± 8.12	134.3 ± 5.89	0.537

[1]ANCOVA (*p**controlled for total calories and gender), data presented as Mean S.E., $P \leq 0.05$. [2] WHO 2007 [49] *n-6* FAs (Omega 6, Linoleic acid); *n-3* FAs (Omega 3, Linolenic acid). [3]One teaspoon equivalent = 4.2 grams of sugar.[261] [4]International Unit (UI), 1 IU of Vitamin D = 0.025 µg.

Table 12 summarizes the proportion of children meeting the US and WHO/FAO nutrition recommendation across weight categories. The overall proportion of children meeting food group recommendations, except fruits, is low (<50%), with saturated fat (~31%), added sugars (17%), fiber (42%), and micronutrients (<42%). We observed that OB children met the WHO/FAO ranges for protein compared to other weight categories. We also observed few differences between weight categories meeting the AMDR for carbohydrates by the UW children. More children in the OW category met sodium recommendations (DRIs) than counterparts in other weight categories.

Table 12. Proportion of Kuwaiti fifth graders meeting the US Dietary Guidelines (DGA), Dietary Reference Intake (DRI), and WHO/FAO (Range/RNI) recommendations by BMI-for-age categories[1]

DGA[2] and WHO/FAO[3] Dietary Guideline Cut points	Overall Proportion N=313	Underweight (UW) [ref] (≤ -1 SD) *n*=15	Normal Weight (NW) (>-1 to ≤ +1 SD) *n*=95	Overweight (OW) (>+1 to ≤ +2 SD) *n*=70	Obese (OB) (>+2 SD) *n*=133	*P-value*
Fruit						
1.5 cups [DGA]	68.9%	60.0%	71.6% $^{p=0.643}$	65.7% $^{p=0.834}$	69.7% $^{p=0.529}$	0.856
400g (1.7 cup) [WHO]	62.2%	60.0%	67.4% $^{p=0.887}$	55.7% $^{p=0.598}$	62.1% $^{p=0.990}$	0.667
Vegetables (cup)						
2-2.5 cup [DGA]	28.8%	33.3%	27.4% $^{p=0.219}$	24.3% $^{p=0.376}$	31.8% $^{p=0.676}$	0.410
met 400g (1.7 cup) [WHO]	46.5%	46.7%	47.4% $^{p=0.991}$	37.1% $^{p=0.455}$	50.8% $^{p=0.836}$	0.354
Dairy (cup)						
2 cups/day	32.7%	26.7%	36.8% $^{p=0.501}$	27.1% $^{p=0.984}$	33.3% $^{p=0.616}$	0.610
Whole grains (ounce)						
3oz [DGA]	0%	0%	0%	0%	0%	-
1oz [WHO]	17%	0%	17.9% $^{p=0.999}$	12.9% $^{p=0.999}$	20.5% $^{p=0.998}$	0.468
Total Calories (kcal)						
1600-2000 [girls], 1800-2200 [boys]	16.7%	20.0%	16.8% $^{p=0.714}$	22.9% $^{p=0.853}$	12.9% $^{p=0.468}$	0.428
Total fat						
25% - 35% [AMDR 4]	65.7%	53.3%	67.4% $^{p=0.371}$	74.3% $^{p=0.162}$	61.4% $^{p=0.634}$	0.296
15% - 30% [WHO]	23.7%	26.7%	21.1% $^{p=0.408}$	35.7% $^{p=0.777}$	18.9% $^{p=0.363}$	0.109
Saturated fat <10%	30.8%	20.0%	27.4% $^{p=0.642}$	40.0% $^{p=0.196}$	29.5% $^{p=0.460}$	0.299

Table 12 (cont'd)

***Trans*-fat** <1%	0%	0%	0%	0%	0%	-
***n-6* FAs**						
5% - 10% [AMDR]	73.4%	73.3%	70.5% $^{p=0.912}$	64.3% $^{p=0.531}$	80.3% $^{p=0.494}$	0.101
5% - 8% [WHO Range]	64.1%	66.7%	60.0% $^{p=0.651}$	58.6% $^{p=0.686}$	69.7% $^{p=0.755}$	0.307
***n*-3 FAs**						
0.6 - 1.2% [AMDR]	47.4%	40.0%	45.3% $^{p=0.654}$	45.7% $^{p=0.605}$	50.8% $^{p=0.406}$	0.782
1 - 2% [WHO Range]	0.3%	0%	0% $^{p=1.000}$	0% $^{p=1.000}$	0.8% $^{p=0.999}$	1.000
Cholesterol <300 mg	54.8%	46.7%	51.6% $^{p=0.624}$	67.1% $^{p=0.170}$	51.5% $^{p=0.633}$	0.281
Protein						
10% - 30% [AMDR]	97.1%	100%	97.9% $^{p=0.999}$	91.4% $^{p=0.999}$	99.2% $^{p=0.999}$	0.046
10% - 15% [WHO]	74.7%	53.3%	76.8% $^{p=0.086}$	62.9% $^{p=0.704}$	81.8% $^{p=0.021}$	0.004
Carbohydrates						
45% - 65% [AMDR]	91.0%	100%	91.6% $^{p=0.999}$	80.0% $^{p=0.999}$	95.5% $^{p=0.999}$	0.008
55% - 75% [WHO Range]	50.3%	33.3%	51.6% $^{p=0.213}$	60.0% $^{p=0.102}$	46.2% $^{p=0.369}$	0.269
Added sugar <10% [5]	17.0%	13.3%	21.1% $^{p=0.643}$	21.4% $^{p=0.555}$	12.1% $^{p=0.879}$	0.423
Fiber 22.4 [girls] - 25.2g [boys]	42.0%	40.0%	45.3% $^{p=0.839}$	35.7% $^{p=0.627}$	43.2% $^{p=0.872}$	0.618

Table 12 (cont'd)

Calcium (1300 mg)	19.9%	13.3%	15.8% $^{p=0.873}$	18.6% $^{p=0.629}$	24.2% $^{p=0.364}$	0.350
Magnesium (350 mg)	41.7%	40.0%	45.3% $^{p=0.725}$	32.9% $^{p=0.605}$	43.9% $^{p=0.803}$	0.447
Potassium (4500mg)	12.8%	26.7%	11.6% $^{p=0.114}$	10.0% $^{p=0.104}$	13.6% $^{p=0.183}$	0.388
Sodium (mg)						
<2200 UL 6	17.3%	20.0%	9.5% $^{p=0.379}$	30.0% $^{p=0.390}$	15.9% $^{p=0.743}$	0.024
<2000 WHO	13.5%	20.0%	8.4% $^{p=0.262}$	20.0% $^{p=0.974}$	12.9% $^{p=0.462}$	0.315
Vitamin D (IU) [7]						
600 RDA 8	0%	0%	0%	0%	0%	-
200 WHO	18.6%	13.3%	20.0% $^{p=0.712}$	17.1% $^{p=0.830}$	18.9% $^{p=0.656}$	0.951

[1]Chi-square or Fisher's exact test for proportions, and logistic regression with controlling for gender, MVPAand ST to compare between weight categories at $P \leq 0.05$.

[2]Dietary Guidelines for Americans 2015–2016 - Eight Edition & DRI (Dietary Reference Intake).[66] [3]The joint WHO/FAO Expert Consultation on diet, nutrition and the prevention of chronic diseases,[22] Public Health Nutrition, 2004. FAO/WHO expert consultation on human vitamin and mineral requirements.[65] [4]AMDR, *n-6* FAs (Omega 6, Linoleic acid), *n-3* FAs (Omega 3, Linolenic acid). [5]One teaspoon equivalent = 4.2 grams of sugar.[261] [6]Upper Limit (UL), Adequate Intake (AI). [7] International Unit (IU), 1 IU of Vitamin D = 0.025 μg. [8]RDA (Recommended dietary allowance).

Discussion

Limited studies have assessed multiple CVD risk factors in Kuwaiti children, particularly non-OB children. In a sample of OB, OW, NW, and UW, the primary objective of the study was to determine the prevalence of CVD risks, and if OB children will have greater risks than non-OB children. Our secondarily objective was determining the proportion of children meeting nutrition recommendations, and whether OB children will be less likely to meet the recommendations than other weight categories. The overall findings indicated more CVD risk factors among OB children; however, contrary to our hypotheses, risks for dyslipidemia were also detected among the non-OB children. On the other hand, the overall proportion of children across weight categories met the nutrition recommendations was low. Also, except for a higher proportion of OB children met protein recommendations, no other differences between weight categories in meeting the recommendations were found, which we were not expecting. Each of the primary outcome variables is discussed below.

With respect to dyslipidemia, no available studies have reported the prevalence of dyslipidemia in Kuwaiti schoolchildren. Moreover, we found higher risks for TG and low HDL in OB children of our study than estimated prevalence of elevated TG (30%) and low HDL (11%) in OW and OB Mexican American children (N=128, 11.9 ± .06 years old).[269] Also, our findings on the prevalence of high risk for low HDL was higher than reported on 8-17 year olds from NHANES 2011-12 which reported prevalences in NW 6.7% and OW 12.5%. [27]

Despite our expectations of higher CVD risks in OB than in non-OB children, we found that the prevalence at risk as well as high risk of elevated TC and LDL did not statistically differ across weight categories, though it was relatively higher in NW children than in OB children. Also OW children had a higher prevalence of LDL levels classified as high risk as compared to

OB children. This indicates that it is important to assess Kuwaiti children for dyslipidemia regardless of weight status. Our findings were not in agreement when contrasted with a study among 7 to 14 years old (N=937) in Salvador. Nutrição et al. (2012) reported a higher prevalence (26.4%) of dyslipidemia (elevated TG [≥130 mg/dL] and TC [≥170 mg/dL]) in OW and OB than NW (20.2%) categories [26] , however this study also indicates that a significant proportion of noNW children had dyslipidemia.[26] Our findings on at risk TG and TC indicated a higher prevalence of in OB (15%) than compared to OW (7.9%) and NW (8.1%) children.

With regard to BP in Kuwaiti children, limited studies report the prevalence of BP beyond 1999. We estimated an overall higher prevalence (25%) of elevated BP than previously reported (5%) in Kuwaiti schoolchildren (6 to 13 years) by Moussa et al. (1999).[67] Also, in contrast with other countries' population of OB children, our findings showed a higher prevalence of BP (37%) compared with NHANES data. The 2017 American Academy of Pediatric Guidelines reclassified BP in 15,647 children aged 5 to 18 years from NHANES (1999 to 2014) and reported an increased prevalence of elevated BP from 11.8% to 14.2% mostly in OW (≥85th centiles, 35.9%) and OB (≥95th centiles, 19.5%) children.[28] In essence, the risk of BP in Kuwaiti children has increased and may be considered among the highest globally.

Our secondary objective was to determine the proportion of Kuwaiti children meeting nutrition recommendations across weight categories, and if there are differences between weight categories. The overall dietary pattern of our study sample across weight categories was characterized as excessive kcals, added sugar, saturated fat, *trans*-fat, *n*-6 FAs, cholesterol, and sodium, while low in vegetables, dairy, whole grains, fiber, *n*-3 FAs, calcium and vitamin D (Tables 1, 2). Moreover, more children in our study were not meeting nutrition recommendations, particularly kcals (80%), when compared with a previous study on Kuwaiti children. Zaghloul et al. (2012) found that around 50% of Kuwaiti school children (9 to 13 years, n=205) exceeded kcals, carbohydrate, and protein intake, while around 80% did not meet micronutrients recommendations including calcium and vitamin D, or *n*-3 FAs and fiber recommendations.[36] Other studies produced similar findings that diet high in kcals is related to an inability to meet the food group and micronutrient recommendations. Petterson et al. (2010) examined dietary energy density with dietary quality in 551 children (mean age 9.6 years, 52% girls) and found an adverse relationship between total food intake including fruit, vegetables, fiber, micronutrient intake, and increased energy density.[242] Also, O'Connor et al. (2013) observed that % total energy from fat, saturated fat and added sugars increased ($P<0.001$) with high energy density, meanwhile, % total protein, fiber, and micronutrient intake decreased among children (N=594, 5 to 12 years). [243]

We hypothesized that OB children would be less likely to meet the recommendations than other weight categories. However, after controlling for covariates (MVPA and ST), we found fewer exceptions with macronutrients. Meeting the WHO/FAO ranges for protein by OB children, while meeting the AMDR for carbohydrates by UW children related to their mean intake level. Likewise, meeting the DRIs recommendations for sodium by the OW category, who had a lower mean sodium intake when compared with other weight categories (Table 13). With respect to using the DGA and DRIs as well as WHO/FAO recommendations, some children in our study met the WHO/FAO cut-points for vegetables (46.5%), whole grains (17%), and vitamin D (18.6%), but did not meet the US cut-points, except for 28% of children meeting the DGA recommendations for vegetables. On the other hand, meeting the AMDR and DRIs for macronutrients and sodium seemed more applicable for Kuwaiti children when compared with WHO/FAO ranges and RNI.

The strengths of the current study included recruiting sufficient sample size of fifth grade boy and girls to determine the prevalence at risk of CVD as well as the proportion meeting the nutrition recommendations. Also, the comparison by weight status controlled for the potential influence of kcals, gender, MVPA, and ST. Data collection was performed by a trained research team according to research protocols, using valid instruments and standardized procedures in pediatric research for assessing CVD risk factors and dietary status in children. [20 89 164] We utilized a valid [248 249] nutritional assessment instrument, Block Kids 2004 FFQ, which was translated (Arabic/English) and modified (cultural food), and retested to facilitate accurate responses by Kuwaiti schoolchildren. Children's dietary status was evaluated based on US Dietary Guidelines and DRIs and WHO/FAO recommendations, using dietary indices such as HEI and FI, which is not available from literature in Kuwait**.** We used valid statistical methods [258] and energy expenditure equations [259] for detecting kcals outliers. However, there were also several potential study limitations. The research was a cross-sectional evaluation of as is true for all cross-sectional studies, no cause and effect inferences can be made from the findings. Our study sample was convenience and may not be a representative sample of all Kuwaiti fifth graders. The sample size for blood lipids was lower than other variables due to being unable to collect a sufficient blood volume to evaluate theblood lipid variables, technical issues with analyzer, or some children opted out of the blood lipid test. Also the UW group sample size was small and all results involving comparisons with this group should be taken with caution. The selected CVD risk factors may be affected by dehydration or medications taken by some children. Literature indicated that children's accuracy in nutrition reporting is difficult to obtain and is related to poor memory or portion estimation or the type and design of the dietary instrument used.[265] For example, children using FFQ may over or underestimate energy intake and some micronutrients related to the length of questions.[266]

Summary and Conclusion

This study determined the prevalence of CVD risk factors, and the proportion meeting nutrition recommendations in a sample of Kuwaiti fifth graders that were categorized by weight status. The overall prevalence of dyslipidemia and BP was higher than reported in similar aged children populations and may be considered among the highest globally. Although the prevalence of at risk TG, TC:HDL, non-HDL, SBP, and DBP was the highest in OB children, risks for elevated TC and LDL were higher in NW and OW than in OB children. With respect to meeting nutrition recommendations, while we expected that OB children would be less likely to meet nutrition recommendations than non-OB children, there were few differences between weight categories and overall the proportion of children meeting nutrition recommendations was poor. These findings warrant CVD risk assessments for Kuwaiti children regardless of weight status, and interventions to improve dietary behaviors.

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CHAPTER 6: SUMMARY AND CONCLUSIONS

This chapter includes is a summary of the of three study aims (from Chapters 3, 4, and 5). and include a brief background and rationale for conducting this work. This is followed by a summary of the results for each aim, and a global summary of the study strengths and weaknesses, conclusion, and future directions.

In Kuwait, there is little published data on the prevalence of children classified at risk for cardiovascular disease (CVD) risk factors, with the exception of OB. Also, limited studies have reported on the proportion of children meeting food group and nutrition recommendations by gender. Moreover, there are no studies that have compared the prevalence of CVD risk factors and the proportion of Kuwaiti children meeting nutrition recommendations between weight status categories (UW, NW, OW, OB).

Using a sample of Kuwaiti fifth graders, the purpose of this dissertation was to: 1) Determine the prevalence of CVD risks for BMI, WC, WHtR, BF%, SBP, DBP, TG, TC, LDL, non-HDL, TC:HDL, and HDL, and whether there were differences in the prevalence of CVD risk factors by gender. Secondarily, determine if there are differences in mean CVD risk factors levels by gender. 2) Determine the proportion of children meeting US Dietary Guidelines (DGA), Dietary Reference Intake (DRI), and WHO/FAO recommendations for food groups (fruit, vegetables, dairy, and whole grains), macronutrients (total calorie, total fat, saturated fat, trans-fat, *n*-6 and *n*-3 fatty acids [FAs], protein, carbohydrates, added sugar, and fiber), selected micronutrients (calcium, potassium, magnesium, sodium, and vitamin D), and two dietary indices (Healthy Eating Index [HEI] and Fiber Index [FI)]), thereby determining whether there are gender differences in dietary intake and meeting nutrition recommendations; 3) in a sample of OB, OW, NW and UW children determine if there are differences between weight categories in: 1) prevalence of CVD risks and determine if risks are greatest in OB children 2) meeting US and WHO/FAO nutrition recommendations and determine if fewer OB children meet the recommendations for food groups , macronutrients, and selected micronutrients.

Aim 1: Prevalence of Cardiovascular Disease Risk Factors in Kuwaiti Schoolchildren, Compared by Gender

This cross-sectional study was conducted to determine the prevalence of CVD risks in Kuwaiti children and whether there are differences in the prevalence and mean levels between genders. Secondarily, determine if there are differences in mean CVD risk factors levels by gender. We anticipated that boys would have a higher prevalence and mean levels of CVD risk factors than girls. Our primary findings indicated a high prevalence of CVD risk factors in Kuwaiti children that are concerning. This includes high rates of OB and OW, elevated resting BP and dyslipidemia. The OB prevalence of 39% indicates the OB rate is increasing in Kuwait when compared to KNSS in 2011- 2012 data Kuwaiti schoolchildren (aged 10 to <15 years (N = 4561) reported a 31% OB rate. Although the prevalence of OW was higher in girls (27.1%) than boys (15.5%), however, the OW prevalence among girls remained similar to the previously reported prevalence of 28%. [1] We estimated an overall prevalence at risk for dyslipidemia and found that our study sample had a greater prevalence of at risk for TC and TG as well as high risk for TG as compared to children from other countries. [26 233 234] With respect to BP, the overall prevalence of elevated BP 23.3% was higher than previously reported in 6 to 13 years Kuwaiti schoolchildren BP 5%) by Moussa et al. (1999). [67] This shows that the risk of BP in Kuwaiti children has increased in the last two decades. Overall CVD risk factor prevalence rates of childen at risk were higher or equal to similar aged populations globally that are considered to have a high prevalence of CVD risks.

We expected boys would have higher rates of CVD risk factors than girls because boys had higher rates of obesity based on the KNSS 2012-13 report. Contrary to our hypotheses, girls were more likely to be at risk of dyslipidemia compared to boys. Girls also had a higher mean TG than boys, also higher than reported in other studies with various childhood age ranges. [13 174 233 235 236] Several studies have reported a higher prevalence of dyslipidemia in girls than boys. [27 233 235] Girls had greater risks for elevated BP, elevated SBP and DBP than boys, also greater risks of BP than previously reported in girls aged between 6 and 13 years old (by Moussa et al. (1999) two decades ago [60] Some studies found that stature was directly related to BP in children. [238-240] We found that %BF and height, which both were relatively higher in girls than boys, were directly (P<0.001) related to the increases in SBP, whereas, body weight was found to be related (P<0.001) to the increases in DBP. The findings of AIM 1 indicate the need for follow-up and lifestyle interventional studies or programs to prevent and manage risks of CVD among children in Kuwait.

Aim 2: Proportion of Kuwait schoolchildren meeting US and WHO/FAO Dietary Recommendations for Food Groups and Nutrient Intakes, compared by Gender

In this cross-sectional study to determine the proportion of children meeting nutrition recommendations and dietary indices (HEI and FI), and whether there are differences by gender. We hypothesized that boys would be less likely to meet nutrition recommendations and would have a poorer quality of diet than girls. Overall, 16.7% of children met kcals, less than 50% met food groups (except fruits), and less than 40% met micronutrients. None of the children had a good HEI (a total score of 80 points or above), and only 1.3% met fiber recommendations

(14g/1000 kcal) for children aged between 9 and 13 years old. The crude and adjusted (calorie, MVPA, and ST) comparison of proportions meeting the recommendations indicated few differences between boys and girls. More boys met the DGA recommendations for fruit than girls (75.7% vs. 62.4%; P=0.037), which we did not anticipate. Other findings supported our hypothesis, as more girls than boys met the DGA and DRI recommendations for vegetables (36.4% vs. 20.3%; P=0.003), sodium (18.2% vs. 8.1%; P=0.022), and cholesterol (64.8% vs. 44.1%; P<0.001).

Our findings are in contrast with a study from 2008-2009, which described the dietary intake and meeting of dietary recommendations of Kuwaiti children between the ages of 9 to 13. The study indicated that 50%, including around 60% of girls and around 40% of boys, exceeded kcals intake, which was lower than our findings. However, the study also indicated that fewer boys than girls exceeded micronutrient recommendations, including vitamin D (0.7% and 0%), calcium (16.4% and 6.7%), and magnesium (48% and 31%), but not sodium (72% and 61%) similar to our findings. [36] Our findings showed a higher mean kcals and macronutrient intakes, but a lower mean micronutrient intake, except for sodium, when contrasted with several similar studies from other countries. [55 174 261 263 270]

With respect to gender differences in dietary indices scores, the boys' and girls' total HEI scores were similar and considered lower than the standard. [191] This was contrary to our hypothesis that boys would have a poorer dietary quality. Furthermore, more children, especially girls, had unexpectedly poorer total HEI scores, while, no participant possessed a good HEI total score (≥80 points). With regard to FI, the overall mean level of FI was nearly identical in boys and girls (overall mean 8.9 ± .11g /1000 kcals).

The current dietary pattern of Kuwaiti children indicates that the majority of children are eating a high caloric low nutrient dense diet and likely contribute to the alarming rates of OB and other CVD risk factors. The findings of aim 2 suggest the need for intervention programs to improve Kuwaiti children's dietary behavior.

Aim 3: Prevalence of Cardiovascular Disease Risk Factors and meeting US and FAO/WHO Dietary Recommendations in Kuwaiti Schoolchildren by Weight Status

This cross-sectional study in a sample of OB, OW, NW, and UW Kuwaiti children determined if there are differences between weight categories in 1) prevalence of CVD risks and determine if risks are greatest in OB children 2) meeting US and WHO/FAO nutrition recommendations and determine if fewer OB children meet the recommendations for food groups, macronutrients, and selected micronutrients.

The overall findings indicated more CVD risk factors among OB children; however, contrary to our hypotheses, risks for dyslipidemia were also detected among the non-OB children. Our findings regarding risks for BP indicated a higher prevalence (25.2%) of elevated BP than previously reported (5%) in Kuwaiti schoolchildren (6 to 13 years) by Moussa et al. (1999). [67] Our findings were also higher than reported in a sample of OW and OB US children that had a prevalence of 14.2% . [28] Overall our findings indicate the risk of elevated BP in Kuwaiti children has increased and appears to be amongst the highest globally. With respect to risks for dyslipidemia, we found higher risks for TG and HDL in OB children as compared to a sample of OW and OB Mexican American children [269] Also, among NW and OW children, our findings on the prevalence of high risk for HDL was higher than reported in US children aged 8 to 17 by NHANES 2011 – 2012. [27]

We hypothesized that OB children would have a greater risk of CVD than non-OB children. The findings of our study indicated a significantly greater prevalence at risk of CVD in OB versus non-OB children, including TG, TC:HDL, HDL, and BP. On the other hand, the prevalence of at risk for TC and LDL was higher than in NW than OB children, but was not statistically different. Additionally, the prevalence of high risk LDL was higher in OW than in OB children. These findings indicate that Kuwaiti children have dyslipidemia regardless of their weight status.

Our secondary objective for Aim 3 was to determine the proportion of Kuwaiti children meeting nutrition recommendations across weight categories, and if there are differences between weight categories. We found that few children across weight categories met the recommendations; 17% for kcal, <50% for food groups, and <40% for micronutrients, except sodium. We observed a higher proportion of children in our study were not meeting kcal recommendations than previously described in a sample of 205 Kuwaitie children 9 to 13 years old. [36] Moreover, our findings indicate a high-energy density and low-nutrient density, which is similar to what was reported by studies from other countries. [242-244 263] Contrary to our hypotheses, a few significant differences between weight categories were detected in meeting recommendations for selected nutrients. Groups that had higher prevalence of meeting included protein by OB, sodium by OW and carbohydrates by UW. These findings warrant CVD risk assessments for Kuwaiti children regardless of weight status, and interventions to improve dietary behaviors.

Strengths and Weaknesses

The strengths of the current study included recruiting a sufficient sample sizes of fifth grade boys and girls to determine their prevalence of at risk CVD, and the proportion meeting the nutrition recommendations. Also, the comparisons by gender and by weight status controlled for the potential influence of kcals, MVPA and ST, and gender. Data collection was performed by a trained research team according to research protocols, using valid instruments and standardized procedures in pediatric research for assessing CVD risk factors and dietary status in children.[20 89 164] We utilized a valid [248 249] nutritional assessment instrument, Block Kids 2004 FFQ, which was translated (Arabic/English) and modified (cultural food), and retested to facilitate accurate responses by Kuwaiti schoolchildren. Children's dietary status was evaluated based on US Dietary Guidelines and DRIs and WHO/FAO recommendations, using dietary indices such as HEI and FI, which is not available from literature in Kuwait**.** We used valid statistical methods [258] and energy expenditure equations [259] for detecting kcals outliers. However, our study encountered several limitations related to the following factors. However, there were also several potential study limitations. The research was a cross-sectional evaluation of as is true for all cross-sectional studies, no cause and effect inferences can be made from the findings. Our study sample was convenience and may not be a representative sample of all Kuwaiti fifth graders. The sample size for blood lipids was lower than other variables due to being unable to collect a sufficient blood volume to evaluate the blood lipid variables, technical issues with analyzer, or some children opted out of the blood lipid test. Also the UW group sample size was small and all results involving comparisons with this group should be taken with caution. The selected CVD risk factors may be affected by dehydration or medications taken by some children. Previous studies have indicated that children's accuracy in nutrition reporting is difficult to obtain and is related to poor memory or portion estimation or the type and design of the dietary instrument used.[265] For example, children using FFQ may over or underestimate energy intake and some micronutrients related to the length of questions.[266]

Conclusion

In summary, Aim 1 determined that the overall prevalence of OB and BP in Kuwaiti schoolchildren was higher than the reported literature. Unexpectedly, boys and girls had similar levels of OB, whereas girls were more likely to be at risk of OW, dyslipidemia, and BP than boys. Aim 2 determined that the overall proportion of children meeting nutrition recommendations and having a good dietary quality was low in Kuwaiti schoolchildren. With respect to gender. We hypothesized more girls would meet dietary recommendations than boys. There were few differences which included more girls met vegetable and sodium intake recommendations, while contrary to our hypothesis, more boys met fruit recommendations. Other unexpected differences were that boys had a higher mean intake of vegetables, dairy, protein, cholesterol, and calcium than girls. Aim 3 determined that OB children had a higher prevalence of CVD risk factors. However, the non-OB children had a higher risk of elevated TC and LDL than OB children, but this was not statistically significant. Regardless of weight category , most of the children were not meeting their nutrition recommendations, and they had a poor quality diet.

Study Significance and Future Directions

This work has provided valuable insights into the prevalence of CVD risk factors and nutritional recommendations among Kuwaiti schoolchildren by gender and weight. Based on the high prevalence of CVD morbidity and mortality in Kuwaiti adults, this study may ultimately help to provide a basis for the development of intervention programs for children to improve their dietary and lifestyle behaviors to prevent CVD risk factor development and reduce premature morbidity. Additionally, we found the rates of OB, and other CVD risk factors , and poor dietary behaviors were high but rates were similar in boys and girls. It is therefore recommended that officials in Kuwait establish strategic plans for the regular assessment and tracking of the schoolchildren for CVD risks. Future studies should include intervention programs to promote healthful dietary and PA behaviors. Furthermore, the investigation of other factors including the role of parental and family support for healthful nutrition and other lifestyle behaviors, the influence of school and community environment on childrens health. Also, biological including genetic factors that may affect a child's nutritional status and health risks should be considered..

APPENDICES

APPENDIX A: Research Study Approvals

MICHIGAN STATE
UNIVERSITY

Initial IRB Application Approval

November 3, 2017

To: Joseph Carlson
Dept of Radiology
Service Rd, 184 Radiolgy Building
Michigan State University, 48824

Re: **IRB#** 17-893 Category: EXPEDITED 2b.,4,7
Approval Date: November 3, 2017
Expiration Date: November 2, 2018

Title: Comparison of Kuwaiti and US (State of Michigan) Children's Nutrition Behavior, Nutrient Intakes, and CVD Risk Factor Status in Contrast with US and WHO/FAO Nutrition Recommendations

The Institutional Review Board has completed their review of your project. I am pleased to advise you that **your project has been approved.**

The committee has found that your research project is appropriate in design, protects the rights and welfare of human subjects, and meets the requirements of MSU's Federal Wide Assurance and the Federal Guidelines (45 CFR 46 and 21 CFR Part 50). The protection of human subjects in research is a partnership between the IRB and the investigators. We look forward to working with you as we both fulfill our responsibilities.

Renewals: IRB approval is valid until the expiration date listed above. If you are continuing your project, you must submit an ***Application for Renewal*** application at least one month before expiration. If the project is completed, please submit an ***Application for Permanent Closure***.

Revisions: The IRB must review any changes in the project, prior to initiation of the change. Please submit an ***Application for Revision*** to have your changes reviewed. If changes are made at the time of renewal, please include an ***Application for Revision*** with the renewal application.

Problems: If issues should arise during the conduct of the research, such as unanticipated problems, adverse events, or any problem that may increase the risk to the human subjects, notify the IRB office promptly. Forms are available to report these issues.

Please use the IRB number listed above on any forms submitted which relate to this project, or on any correspondence with the IRB office.

If we can be of further assistance, please contact us at 517-355-2180 or via email at IRB@msu.edu. Thank you for your cooperation.

Office of Regulatory Affairs
Human Research Protection Programs

Biomedical & Health Institutional Review Board (BIRB)

Community Research Institutional Review Board (CRIRB)

Social Science Behavioral/Education Institutional Review Board (SIRB)

4000 Collins Road
Suite 136
Lansing, MI, 48910
(517) 355-2180
Fax: (517) 432-4503
Email: irb@msu.edu
www.hrpp.msu.edu

State Of Kuwait
Ministry Of Health
Asst. Undersecretary for Planning & Quality

دولة الكويت
وزارة الصحة
وكيل الوزارة المساعد لشئون التخطيط والجودة

كلية التمريض / الوارد
الرقم: ١٥١-٢٠٩٥٠
التاريخ: ٢٠١٧/١٢/١١

الصادر

وارد
٥/٦/٩٩ ٨

٦/١٢/٢٠١٧

التاريخ: ٢٠١٧/١٢/٤
الرقم: ٦١٠

٦١١

السيد الفاضل / د. وكيل الوزارة المحترم

تحية طيبة وبعد،،،،

الموضوع / تسهيل مهمة الباحث/ عبد العزيز خالد الفرحان وآخرون

(رقم البحث 2017/675) لإجراء البحث تحت عنوان:

Comparison of Kuwaiti and US (Michigan) Children's Nutrition Behavior, Nutrient Inteke, and Cardiovascular Status in Contrast to US and WHO/FAO Recommendations

يرجى التفضل بالإحاطة بأن اللجنة الدائمة لتنسيق البحوث الطبية والصحية المشكلة بموجب القرار الوزاري رقم 207 لسنة 2012 قد أوصت باجتماعها الاربعون (9 / 2017) المنعقد يوم الثلاثاء الموافق 28 / 11 /2017 بالموافقة على إجراء البحث رقم (675 / 2017) المقدم من الباحث/ **عبد العزيز خالد الفرحان وآخرون** بتاريخ 2017/10/26 تحت عنوان:

Comparison of Kuwaiti and US (Michigan) Children's Nutrition Behavior, Nutrient Inteke, and Cardiovascular Status in Contrast to US and WHO/FAO Recommendations

وذلك بعد أن قامت اللجنة استنادا للقرار الوزاري رقم 207 لسنة 2012 والتعميم الصادر من السيد / وكيل الوزارة برقم 156 لسنة 2012 باستطلاع آراء الجهات ذات العلاقة بموضوع البحث حيث وافق السيد / الوكيل المساعد للشئون القانونية بالكتاب رقم 196 بتاريخ 19 / 11 / 2017 كما وافق السيد / د. رئيس مجلس أقسام الأطفال بالكتاب رقم 178 بتاريخ 19 / 11 / 2017 .

أ. د. عميد كلية التمريض المحترم
الهيئة العامة للتعليم التطبيقي والتدريب

1

Hassan

للحفظ في ملف بحث عبد العزيز الفرحان
١١/١٢/٢٠١٧

State Of Kuwait
Ministry Of Health
Asst. Undersecretary for Planning & Quality

دولة الكويت
وزارة الصحة
وكيل الوزارة المساعد لشئون التخطيط والجودة

التاريخ : ٤ / ١٢ / ٢٠١٢
الرقم : ٥٦١

ويتم البحث من خلال إستخدام إستبيان لجمع البيانات وقياس الوزن والطول وتقدير كتلة الجسم BMI وإجراء الفحوصات الموضحة ببروتوكول الدراسة لطلاب المدارس الأبتدائية والمتوسطة **(مدة مشروع البحث 6 شهور).**

ولا يتضمن البحث إجراء أي تجارب طبية أو إعطاء أدوية.

برجاء التفضل بالاطلاع والتوجيه بما ترونه مناسباً نحو اعتماد توصية اللجنة والموافقة على مخاطبة الجهات ذات الصلة بموضوع البحث **(السيد / وكيل وزارة التربية / السيد / د. الوكيل المساعد للشئون الفنية / السيدة د. مدير إدارة الصحة المدرسية/ السيد د. رئيس مجلس اقسام الاطفال)** بهذا الشأن للعمل على تسهيل مهمة الباحثين لإجراء البحث.

مع مراعاة التزام الباحثين بالمحافظة على حقوق المشاركين بالبحث بالخصوصية وسرية المعلومات وعدم تداولها خارج إطار البحث والحصول على الإقرار المستنير Informed Consent من الولي القانوني للأطفال المشاركين بالدراسة والتنسيق مع رؤساء الأقسام التي ستجري بها الدراسة وفقا للضوابط المنظمة لذلك.

وتفضلوا بقبول فائق الاحترام،،،،

الدكتور / محمد جاسم الخشتي
الوكيل المساعد لشئون التخطيط والجودة
رئيس اللجنة الدائمة لتنسيق البحوث الطبية والصحية

د/ محمد جاسم الخشتي
وكيل الوزارة المساعد لشئون التخطيط والجودة

١٢/١٢/٢٠١٢

د/ محمد جاسم الخشتي
وكيل وزارة الصحة بالإنابة

2

Khalifa

وزارة التربية
رة العامة لمنطقة مبارك الكبير التعليمية
مكتب مدير إدارة الشؤون التعليمية

الإدارة العامة لمنطقة مبارك الكبير التعليمية

نشرة خاصة
للمرحلة الابتدائية (بنين- بنات)
للعام الدراسي ٢٠١٧/٢٠١٨

السيدات و السادة / مدراء المدارس المحترمين

تحية طيبة وبعد ،،،

الموضوع: تسهيل مهمة

يقوم الباحث/ **عبدالعزيز خالد الفرحان** المسجل على درجة الدكتوراه في جامعة ولاية مشيغان-الولايات المتحدةالامريكية بإجراء بحث ميداني بعنوان"**مقارنة مخاطر الإصابة بأمراض القلب والسلوك الغذائي لدى الأطفال بالكويت مع الولايات**".

فيرجى تسهيل مهمة المذكور أعلاه من خلال **تطبيق الاستبانة +قياس (الوزن-الطول - نسبة الدهون- ضغط الدم - محيط الخصر- مؤشرات مقومات السكر- عينة دهون الدم)**، على طلبة المرحلة الابتدائية بنين-بنات خلال العام الدراسي الحالي ٢٠١٧-٢٠١٨م.

شاكرين لكم حسن تعاونكم ،،،

مدير إدارة الشؤون التعليمية

مدير الشؤون التعليمية بالإنابة

الإدارة العامة لمنطقة مبارك الكبير التعليمية - إدارة الشؤون التعليمية

نسخة لكل من :

- إدارة الشؤون التعليمية .
- ملف
- مريم ١١ /٢٠١٨/١/م

العنوان : ضاحية صباح السالم – قطعة ٢ – شارع ٥ – بجانب مدرسة الرؤية ثنائية اللغة ـ الهاتف : ٢٥٥١٢٦١٦

وزارة التربية
الإدارة العامة لمنطقة حولي التعليمية
إدارة الشئون التعليمية
مكتب المدير

الرقم : ٢٠٣٦٤٠١
التاريخ : ٢٠١٨/١/١١

نشرة عامة

للمرحلة الابتدائية (بنين - بنات)

تحية طيبة وبعد،،

الموضوع / تسهيل مهمة

بالإشارة إلى الموضوع أعلاه وبناء على الكتاب الوارد إلينا من إدارة البحوث التربوية رقم (٢٨) بتاريخ ٢٠١٨/١/١٠م بشأن تسهيل مهمة الباحث/عبد العزيز خالد الفرحان المسجل على درجة الدكتوراه من جامعة ولاية مشيغان - الولايات المتحدة الأمريكية بإجراء بحث ميداني بعنوان "مقارنة مخاطر الإصابة بأمراض القلب والسلوك الغذائي لدى الأطفال بالكويت مع الولايات المتحدة".

فيرجى تسهيل مهمة المذكور أعلاه من خلال تطبيق (استبانة) المختومة صفحاتها من إدارة البحوث التربوية + قياس (الوزن - الطول - ضغط الدم - نسبة الدهون - محيط الخصر - مؤشرات مقومات السكر - عينة دهون الدم) على طلبة المرحلة الابتدائية (بنين - بنات) التابعة لمنطقتكم التعليمية خلال العام الدراسي الحالي ٢٠١٨/٢٠١٧.

مع خالص الشكر والتقدير ،،،

مدير عام منطقة حولي التعليمية

وزارة التربية
منطقة حولي التعليمية

منصور سعود الظفيري
مدير عام منطقة حولي التعليمية

النسخ:
-مراقب التعليم الابتدائي
-الملف زينب

تليفون : ٢٥٦٥٧٤٢١ - فاكس : ٢٥٦٥٧٦٢١ - ص.ب : ١٣٣ حولي - الرمز البريدي ٣٢٠٠١ الكويت

75 / 30 / EA0098065 / 06 / 5000

وزارة التربيـــة
الإدارة العامة لمنطقة الفروانية التعليمية
مكتب مدير إدارة الشئون التعليمية

التاريخ: 11 JAN 2018 ٢٠٠
الرقم : وت / ط ف ل /

نشرة خاصة
لجميع المدارس المرحلة الابتدائية
بنين / بنات

السادة المحترمين مدراء ومديرات مدارس المرحلة الابتدائية

تحية طيبة وبعد،،،

الموضوع : تسهيل مهمة

يقوم الباحث (عبدالعزيز خالد الفرحان) المسجل على درجة الدكتوراه من جامعة ولاية مشيغان /الولايات المتحدة الأمريكية بإجراء بحث ميداني بعنوان((مقارنة مخاطر الإصابة بأمراض القلب والسلوك الغذائي لدى الأطفال بالكويت مع الولايات المتحدة)).

فيرجى التكرم بتسهيل مهمة المذكور أعلاه من خلال تطبيق (الاستبانه) المختومة صفحاتها من إدارة البحوث التربوية + قياس (الوزن/الطول/ضغط الدم/نسبة الدهون/محيط الخصر/مؤشرات مقومات السكر /عينة دهون الدم) على طلبة المرحلة الابتدائية بنين/بنات خلال العام الدراسي الحالي ٢٠١٧/٢٠١٨م

مع خالص شكرنا وتقديرنا ..

مدير إدارة الشؤون التعليمية
مهندس/ [illegible]
مدير إدارة الشئون التعليمية بالإنابة

وزارة التربية
الإدارة العامة لمنطقة الفروانية التعليمية
إدارة الشئون التعليمية

نسخة لكل من :-
المدير العام
مدير الشؤون التعليمية
مراقبي المراحل التعليمية

وزارة التربية
منطقة الجهراء التعليمية
إدارة الأنشطة التربوية
مراقبة الأنشطة المدرسية
قسم الأنشطة الفنية والثقافية

14 JAN 2018

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التاريخ : ٢٠١٨/١/١٤م

نشرة خاصة

لمدارس المرحلة الابتدائية (بنين / بنات)

السادة المحترمون / مديرو ومديرات المدارس

تحية طيبة وبعد,,,,

الموضوع : تسهيل مهمة

بالإشارة إلى الكتاب الوارد إلينا من قطاع البحوث التربوية والمناهج – إدارة البحوث التربوية بتاريخ ٢٠١٨/١/١٠م بشأن الموضوع أعلاه .

يقوم الباحث/ عبدالعزيز خالد الفرحان المسجل على درجة الدكتوراة من جامعه ولاية مشيغان – الولايات المتحدة الأمريكية بإجراء بحث ميداني بعنوان ((مقارنة مخاطر الإصابة بأمراض القلب والسلوك الغذائي لدى الأطفال بالكويت مع الولايات المتحدة))

يرجى تسهيل مهمة المذكور أعلاه من خلال تطبيق أداة البحث (استبانة) المختومة صفحاتها من إدارة البحوث التربوية + قياس (الوزن – الطول نسبة الدهون – ضغط الدم محيط الخصر مؤشرات مقومات السكر – عينة دهون الدم) على طلبة المرحلة الإبتدائية بنين بنات التابعة لمنطقتكم التعليمية خلال العام الدراسي الحالي (٢٠١٧/٢٠١٨) .

مع خالص الشكر,,,,

ملاحظة :

مرفق استبانة .

مدير عام

الإدارة العامة لمنطقة الجهراء التعليمية

نسخة لكل من /
- مدير عام
- مدير إدارة الأنشطة التربوية
- مراقبة الأنشطة المدرسية
- قسم الأنشطة الفنية والثقافية
- للملف / وضحه

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وزارة التربية
الإدارة العامة لمنطقة الأحمدي التعليمية
مكتب المدير العام

التاريخ: الأحد
الموافق: ٢٠١٨/١/١٤
رقم الإشارة: ....

نشرة خاصة لمدارس المرحلة الابتدائية بنين و بنات

السادة والسيدات / مديرو و مديرات مدارس المرحلة الابتدائية المحترمون والمحترمات

تحية طيبة وبعد ،،،

الموضوع: تسهيل مهمة

بالإشارة إلى الموضوع أعلاه، وإلى كتاب مدير إدارة البحوث التربوية رقم ٣١ المؤرخ في ١٠/ ١/ ٢٠١٨م ، بشأن قيام الباحث / عبد العزيز خالد الفرحان المسجل على درجة الدكتوراة من جامعة ولاية مشيغان – الولايات المتحدة الأمريكية بإجراء بحث بعنوان ((مقارنة مخاطر الإصابة بأمراض القلب والسلوك الغذائي لدى الأطفال بالكويت مع الولايات المتحدة))

يرجى تسهيل مهمة المذكور من خلال تطبيق الاستبانة المختومة صفحاتها من إدارة البحوث التربوية + قياس (الوزن – الطول – نسبة الدهون – محيط الخصر – مؤشرات مقومات السكر – عينة دهون الدم على طلاب المرحلة الابتدائية بنين وبنات خلال العام الدراسي ٢٠١٧/ ٢٠١٨م ، دون التأثير على انتظام سير العملية التعليمية، وكذلك مراعاة الإجراءات الاحترازية الوقائية التي تتبعها الإدارات المدرسية في مثل هذه الحالات.

مع خالص التحية،،،

مدير عام
الإدارة العامة لمنطقة الأحمدي التعليمية

وزارة التربية
منطقة الأحمدي التعليمية
وليد عبداللطيف العتيبي
مدير عام منطقة الأحمدي التعليمية

نسخة إلى:
- مدير الشؤون التعليمية.
- مراقب المرحلة الابتدائية .
- الملف

ص.ب : ٥١٢٤٧ الرمز البريدي ٥٣٤٥٣ - الفحيحيل - تلفون : - ٢٣٩٢٣٥٢٣ - ٢٣٩٢٣٥٢٥ - ٢٣٩٢٣٥٢١ - فاكس : ٢٣٩٢٣٥٢٤
البريد الالكتروني : (Email: m.k.sahad@hotmail.com)
: Ahmadi - edu - kw   twitter : ahmadi - edu - kw

وزارة التربية
إدارة العامة لمنطقة العاصمة التعليمية
مكتب المدير العام

MINISTRY OF EDUCATION
CAPITAL EDUCTIONAL AREA
Director Manager Office

الصادر
15 JAN 2018
الرقم: ٥٠٢٩

جع: 037706

Date : 11/1/2018

نشرة خاصة

لمدارس المرحلة الابتدائية

(بنين - بنات)

السادة المحترمون/ مديرو ومديرات المدارس.

تحية طيبة وبعد،،،

الموضوع: تسهيل مهمة الباحث / عبدالعزيز خالد الفرحان

بالإشارة إلى كتاب إدارة البحوث التربوية رقم ٢٦ بتاريخ ٢٠١٨/١/١٠ م والخاص بالموضوع أعلاه.

يرجى التكرم بتسهيل مهمة الباحث / **عبدالعزيز خالد الفرحان** المسجل على درجة الدكتوراه من جامعة ولاية مشيغان بالولايات المتحدة الأمريكية بإجراء بحث ميداني في مدارسكم بعنوان : " **مقارنة مخاطر الاصابة بامراض القلب والسلوك الغذائي لدى الأطفال بالكويت مع الولايات المتحدة** " ويتطلب هذا البحث تطبيق (**استبانة**) المختومة مع قياس كل من (الوزن – الطول – نسبة الدهون – محيط الخصر – مؤشرات مقومات السكر – ضغط الدم - عينة دهون الدم) على طلبتكم وطالباتكم في مدارسكم ، وذلك خلال العام الدراسي الحالي ٢٠١٨/٢٠١٧م.

مع خالص التحية،،،

مدير عام
الإدارة العامة لمنطقة العاصمة التعليمية

وزارة التربية
منطقة العاصمة التعليمية

نسخة لكل من:
- مدير عام المنطقة
- قسم التخطيط والمعلومات
طباعة (خلود)

ت: 24829370 فاكس: 24829372 بدالة: 24829356 - 118/102/101 ص.ب: 2396 الصفاة - الرمز البريدي: 13024 الكويت
www.moe.edu.kw - www.capital-edu-kw

APPENDIX B: Parent concent and child assent

Parent/Guardian *Informed Consent Form*

Dear Parent or Guardian of 5th grade student:

Background/Overview: Your child has been invited to participate in a research project titled "*Comparison of Kuwaiti and US (State of Michigan) Children's Nutrition Behavior, Nutrient Intakes, and CVD Risk Factor Status in Contrast with US and WHO/FAO Recommendations*" sponsored by the Public Authority for Applied Education and Training (PAAET). The research project will investigate cardiovascular disease (CVD) risk factors along with assessing dietary behavior and nutrition intake in children 9 to 11 years in age in the 5th grade who are in the Kuwaiti elementary school, the data will be compared with 5th graders in the state of Michigan, United Sates of America. Mr. Abdulaziz Kh. Alfarhan will be conducting the study for the purpose of PhD degree completion from Michigan State University in the United States of America. The study will be conducted during the school year between the fall of 2017 and spring of 2018. This study will be conducted in school classrooms, during school hours and by administration authorization and supervision. There is no cost to participate. In order for your child to participate in the study, however, we need both your permission (consent) and your child's permission (assent). To help you decide, all program components are summarized below in detail including the parent guardian options.

Research Basis and Purpose: There are several "health" risks that have increased in the Kuwaiti population over the past three decades including overweight and obesity, high blood pressure, type 2 diabetes (elevated blood sugar), and blood cholesterol. CVD, especially coronary heart disease and stroke are major contributors of death in Kuwait. CVD is associated with atherosclerosis (clogging of arteries), which is established during early stages of life. Factors that have contributed to this include decreases in physical activity (PA), increases in screen time and poor dietary/nutrition intake. Importantly, the rates of childhood overweight and obesity is alarming, but there is little data on the prevalence of other CVD risk factors (blood pressure, blood lipids, and type II diabetes.) Additionally there is little data on nutrition behavior and intake among Kuwaiti children. Therefore, the importance of assessing your child's CVD risk factors and nutrition behavior will help provide data for establishing healthy life style programs for children and prevent CVD in Kuwait.

Study/Project Procedures:

The study will be conducted within periods of Fall 2017 and Spring 2018. The study will be led and performed by the researcher, Abdulaziz Alfarhan, and a trained team of second year nursing students from the College of Nursing in Kuwait. The study is based on a standardized measurement procedures and protocols. Your child will be invited to participate voluntarily in a noninvasive health behavior and health status assessments that are commonly done in public health clinics or Doctors' office including:

1. Physical Assessment: Anthropometrics (standing and sitting height, body weight, waist circumference, and body composition (percent body fat) estimated with the same scale that is used to measure weight.
2. Resting blood pressure.
3. A diabetes risk factor test called *Acanthosis Nigricans* (involves observing the back of the neck for skin discoloration), can be an indicator of "insulin resistance" which increases blood sugar levels.
4. Blood lipid levels by collecting a small amount of blood (0.030 ml) via finger prick into a capillary tube.
5. Surveys (food frequency questionnaire and a question about physical activity) for collecting data on nutrition behavior and nutrition intake, and lifestyle of your child.

Expected risks and benefits: Having your child involved as a research participant in this program has little risk. The measurement team (researcher and trained nursing students) will explain the purpose of each assessment to your child before starting any assessment procedure to insure the understanding, comfort, and safety of your child. Maintaining minimal risks during the process of assessing your child is a priority, the nursing students and the school nurse will be ready for any rare *adverse events* that your child might experience these possible adverse events may include feeling faint, sick, upset, stressed, or uncomfortable. For example, having blood drawn involves finger stick with a tiny needle, this will result in a brief stinging feeling in the finger. Blood pressure measurements produce a squeezing feeling on the arm for a few seconds. Also, some children may feel uncomfortable answering questions about what foods they eat, or the amount physical activity and exercise they do. All *adverse events* will be reported to the principal investigator, a designated staff member, and or the school nurse. Your child can choose not to participate in any assessment, or all assessments, at any time, even after your consent and your child's assent.

Confidentiality and voluntary participation: All assessment are done in confidence (for example, weight measures are done behind medical privacy screens and values are written down in the participants file, but not verbalized or shared with anyone but the parents/guardians of the child. Only Key MSU investigators and MSU's Human Research Protection Program (HRPP) will have access to research data. All research data will be stored in a locked office at MSU for a minimum of 3 years following closure of this study. You and your child's confidentiality will be protected to the maximum extent allowable by law. Participation is voluntary. Refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation at any time without penalty or loss of benefits to which you are otherwise entitled.

Contact information for questions or concerns: If you have concerns or questions about this study, such as scientific issues, how to do any part of it, or to report an injury, please contact Abdulaziz Alfarhan Email: alfarha4@msu.edu; address in the US:171B Radiology Building Michigan State University E Lansing, MI 48824; address in Kuwait, the College of Nursing at (+965) 22315707, Fax (+965) 24811923, http://www.paaet.edu.kw/mysite/Default.aspx?alias=www.paaet.edu.kw/mysite/nursing-en Shawikh. You may also contact Dr. Joseph Carlson, Associate Professor, Dept. of Radiology; College of Osteopathic Medicine Division of Sports & Cardiovascular Nutrition (SCVN), Michigan State University; E.Lansing, MI 48824, TEL: 517-884-3346; Joe.Carlson@rad.msu.edu .

While very unlikely if your child is injured as a result of participation in this research study, the Public Authority for Applied Education and Training (PAAET) will assist you in obtaining emergency care, if necessary, for research related injuries. If you have questions or concerns about your child's role and rights as a research participant, and would like to obtain information, offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Public Authority for Applied Education and Training (PAAET), Department of Research at (+965) 2251281, Fax (+965) 22518196, or e-mail http://paaetwp.paaet.edu.kw/ResearchAdmin/?lang=en (research@paaet.edu.kw).

If you wish to <u>have your child participate in the research study</u> please sign below and have your child return the complete form to their 5th grade teacher. *Your signature indicates that you agree to have your child voluntarily participate in this study which includes the following measurements. Your child can decide at any time not to participate in one or all of the measures.*

Parent/Guardian Initials_____

Parent's name	Parent's signature	Today's date
Child's name	**Childs gender**	**Child's birthday**

	Male ☐	Female ☐	__/_______/__
Home Address			
Phone number			
Email			

***WE WILL NOT SHARE YOUR CONTACT INFORMATION** with anyone outside of this project.*

<u>نموذج إقرار بموافقه ولي الأمر لمشاركة الابن / الابنه بدراسه علميه</u>

نبذه عن الموضوع: سوف يتم دعوه أبنكم/ابنتكم لمشاركه تطوعيه بدراسه علميه (رساله دكتوراه) بعنوان " مقارنة مؤشرات الاصابه بأمراض القلب والشرايين والسلوك الغذائي لدى أطفال الصف الخامس بالكويت و الولايات المتحده الامريكيه حسب توصيات منظمة الصحه العالميه و منظمة الصحه الأمريكيه". هذه الدراسه مدعومه و مجازه من الهيئه العامة للتعليم التطبيقي والتدريب و من وزارتي الصحه والتربيه بالكويت وكذلك من جامعة ولاية ميشيغن الأمريكيه. سوف يتم اجراء الدراسه خلال الفصل الدراسي الثاني 2018 من خلال فريق البحث من كليه التمريض باشراف الباحث أ.عبدالعزيز خالد الفرحان وفق المعايير والاجراءات المعتمده للبحث واجراء التقييم في هذا المجال على الاطفال. المشاركه بالدراسه سوف تكون مجانيه ولن يكون هناك مكافآت. و من ذلك, و لأهميه مشاركة ابناءكم بهذه الدراسه المهمه, يحتاج الباحث الى موافقه (إقرار) ولي الأمر والطفل المشارك.

نبذه عن أهميه الدراسه و الهدف منها: هذه الدراسه تسلط الضوء على المخاطر الصحيه المتفشيه والمستمره بالتعاظم مذ ثلاثه عقود أو أكثر لدى سكان الكويت, من ضمنها الزياده فالوزن والاصابه بالسمنه, ارتفاع ضغط الدم, مرض السكر, وارتفاع الكوليسترول في الدم, التي جميعها تعتبر مؤشرات للاصابه بأمراض القلب والشرايين. ان أمراض القلب والشرايين تعتبر اكثر مسبب للوفاه لدى البالغين في دوله الكويت حسب تقارير منظمه الصحه العالميه. المشكله, انه لاتتوافر لدينا معلومات كافيه او حديثه (باستثناء معدلات السمنه) عن معدلات ارتفاع ضغط الدم والكوليسترول لدى الاطفال في الكويت, خصوصا ان هناك دراسات علميه اثبتت ان تلك المؤشرات سالفا الذكر بالاضافه الى انسداد الشرايين تنشأ خلال فتره الطفوله وتمتد الى ما بعد البلوغ. كما ان الزياده فالوزن يفاقم احتماليه حدوث ذلك. كذلك هناك دراسات كثيره تشير الى ان نسبه السمنه والزياده في الوزن لدى الاطفال في الكويت فاقت المعدلات التحذيريه منها الاقليميه والعالميه، ولاتزال مستمره بالتصاعد. و تعتبر التغذيه الغير سليمه و قلت الحركه من ابرز أسباب السمنه والاصابه بأمراض القلب والشرايين. لذلك، فان هذه الدراسه تهدف الى جمع معلومات تتعلق بتقييم مدى تفشي تلك المخاطر الصحيه سالفة الذكر والسلوك الغذائي الغير سليم لدى الأطفال بالكويت. ان مشاركة اطفالكم الراغبين من خلال موافقتكم سيساهم في الحصول على معلومات تمكن من تطوير برامج ودراسات تسهم في تعزيز صحة الاطفال بالكويت.

اجراءات الدراسه: سوف يشارك اطفالكم الراغبين (تطوعا) باجراء فحوصات صحيه اعتياديه (خارج الجسم) عاده ما تجرى بالمستوصفات والعيادات الصحيه من خلال استخدام معدات واجهزه طبيه مألوفه ومعتمده لفحص الاطفال لأخذ معلومات متعلقه بالتالي:

1. الطول و الوزن ومحيط الخصر, و كذلك نسبه الدهون بالجسم.
2. معدلات ضغط الدم (الانقباضي والانبساطي)
3. مؤشر مقاومه الانسولين (مرتبط بالاصابه بمرض السكر) *Acanthosis Nigricans* المتعلق بتغير لون الجلد وشكله (خطوط او طبقات داكنه) خلف الرقبه حيث يتم قياسه.
4. معدلات الكوليستيرول بالدم من خلال فحص مباشر بجهاز CardioCheck, مشابه في عمله لأجهزه قياس السكر بالدم من خلال وخز أحد اصابع اليد للحصول على قطرات دم صغيره جدا (0.040ml) تجمع في انبوب صغير ليتم تحليلها خلال 90 ثانيه.
5. استبيان تغذوي (Food Frequency Questionnaire) بالاضافه الى سؤال استبياني متعلق بمعدل النشاط البدني واستخدام الشاشه.

مدى المخاطر المحتمل حدوثها خلال جمع المعلومات: احتمالات حدوث مخاطر لطفلك من خلال المشاركه بهذه الدراسه سوف تكون ضئيله او نادر حدوثها. لكن هذا لايعني ان بعض الاطفال المشاركين قد يتعرضون للشعور بالاضطراب و عدم الارتياح خصوصا عند وخز الأصبع لأخذ عيّنه الدم أو أثناء قياس ضغط الدم. ولذلك هناك استعداد تام للتعامل مع هذه المواقف من خلال فريق البحث المدرّب و تواجد ممرضات المدرسه، كذلك من خلال الاستعانه بالطبيب المختص المشارك (د. نبيل كمال الدين) اثناء اجراءات التقييم وجمع المعلومات. ***لن يتم القيام باي اجراء حتى يتم شرحه للطفل المشارك, كذلك خيار المشاركه أو الامتناع عن بعض أو كل الاجراءات متروك لقرار الطفل, حتى بعد ان يزودنا بموافقته (اقراره).***

الخصوصيه وسريه جمع المعلومات: جميع اجراءات الفحص وجمع المعلومات المتعلقه بهذه الدراسه سوف تجرى بخصوصيه تامه. مثال, الفحص الجسماني (محيط الخصر) يتم خلف ستائر طبيه. يتم تدوين وحفظ المعلومات الصحيه والاستبيانات للمشاركين بملفات خاصه لكل مشارك ولا يسمح بتناقل او تداول معلوماته بين أعضاء فريق البحث. يتم تسليم كل الملفات للباحث المتواجد للاشراف والتوجيه خلال عمليه جمع المعلومات لضمان سلامة الاجراءات و سلامة المشاركين. تحفظ المعلومات بالحاويه المخصصه (صندوق مقفل) حيث لا يطلع عليها الا الباحث فقط بعد الانتهاء من

نموذج إقرار بموافقه ولى الأمر لمشاركة الابن / الابنه بدراسه علميه

جمع معلومات جميع المشاركين يتم تشفير ملفات المشاركين لتحليل النتائج ونشرها من خلال ورقه علميه. ***سوف يتم تزويد ولي الامر بنسخه من نتائج تقييم الطفل للاطلاع واتخاذ اجراءات صحيه ان لزم الامر من خلال الجهات الصحيه بالدوله.***

في حال وجود استفسار أو سؤال علمي متعلق بالدراسه: يرجى التواصل مع الباحث (أ.عبدالعزيز خالد الفرحان) من خلال البريد الالكتروني alfarha4@msu.edu, أو من خلال الاتصال بكليه التمريض 22315707 أثناء تواجده لاجراء الدراسه بالكويت . وكذلك يمكنكم التواصل مع الدكتور جوزيف كارلسون, المشرف الرئيسي على الدراسه Joe.Carlson@rad.msu.edu .

في حال وجود شكوى لديك متعلقه بمشاركة طفلك في هذه الدراسه: يحق لك تقديمها من خلال موقع اداره البحوث في الهيئه العامه للتعليم التطبيقي و التدريب http://paaetwp.paaet.edu.kw/ResearchAdmin/?lang=en

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اذا كنت ترغب في مشاركة ابنك/ابنتك في هذه الدراسه الموضحه اعلاه, يرجى توقيع النموذج اسفل الصفحه (وملئ باقي البيانات) ثم ارساله (ارجاعه) مع طفلك ليتم تسليمه لمدرس(ة) الفصل .

توقيعك على هذا النموذج يعتبر اثبات بموافقتك على مشاركة طفلك بالدراسه مع حفظ حقه بالامتناع عن المشاركه في احد او كل البنود الخمسه المشروحه اعلاه اذا قرر ذلك قبل او خلال جمع المعلومات.

<table dir="rtl">
<tr><td colspan="3">توقيع ولي اللأمر________________________</td></tr>
<tr><td colspan="2">اسم ولي اللأمر (الثلاثي)</td><td>تاريخ اليوم</td></tr>
<tr><td>اسم الطفل</td><td>الجنس
☐ انثى | ☐ ذكر</td><td>تاريخ ميلاد الطفل
__/_______/___</td></tr>
<tr><td colspan="3">عنوان السكن (اختياري)</td></tr>
<tr><td colspan="3">رقم الهاتف/موبايل (اختياري)</td></tr>
<tr><td colspan="3">البريد الالكتروني (اختياري)</td></tr>
</table>

لن نتداول أو نشارك بمعلومات التواصل الخاصه بك مع أي شخص خارج نطاق البحث

شكرا لاهتمامكم...

Child Assent Form

Dear 5th Grade Student,

The 5th grade classrooms in your school are part of a research study through Michigan State University and the Public Authority for Applied Education and Training (PAAET) in Kuwait. The study is about assessing children's overall health and their eating habits. You have the chance to participate in health measurements. The health measures are like those at a doctor's office or ones you would do in P.E. (gym) class. Being in the study refers to doing the surveys and measures listed below. It is your choice and you can stop at any time.

Please read the list below for details on participation in the study:

- Complete paper pencil survey questions about your eating habits.
- Have your height measured to see how tall you are.
- Step on a scale that will check your body weight and estimate how much fat your body has.
- Measure the size of your waist with a measuring tape (similar to a small belt wrapped around your waist)
  *** The height, weight and waist measures will be done in privacy, so no one can see what your values are.*
- Have your blood pressure measured.
- Have a staff person look at the back of your neck.
- Blood lipids
  ☐I agree to have a small amount of blood taken to measure cholesterol and triglyceride levels (both are types of fats) in your blood. The blood will be collected with a small needle that does a "finger prick" and your blood will be collected in a small tube and tested.

These measures and other information will not be shared with anyone except your parents or guardian.

If you would like to be in the study, please write you name below

__________________________ ________________________ _____/_____/_____

Student name (please print)   Student signature   Today's date

Please list your parents/guardians names: ______________________________________

This assent form was approved by an Institutional Review Board (IRB) at Michigan State University. Approved 11/03/17 - valid through 11/02/2018. This version supersedes all previous versions. IRB # 17-893.

إقرار (موافقه) الطفل للمشاركه في دراسه علميه

عزيزي الطالب، عزيزتي الطالبه (الصف الخامس الابتدائي)

سوف تقام دراسه علميه بمدرستك لطلبه و طالبات الصف الخامس تشتمل على اجراء تقييم صحي وتغذوي. هذه الدراسه معتمده و مجازه من الهيئه العامة للتعليم التطبيقي والتدريب، وكذلك من خلال جامعه ولاية ميشيغن الأمريكيه. لذلك، لديك فرصه للمشاركه بالدراسه لتقييم صحتك من خلال اجراء فحوصات عاديه مماثله للتي يجريها الأطباء بالمستوصفات أو في عيادة المدرسه، بالاضافه الى ملئ استبيان حول سلوكك الغذائي. ان قرار مشاركتك متروك لك، وكذلك يمكنك الامتناع عن اجراء بعض أو جميع الفحوصات حتى بعد تزويدنا بموافقتك.

من فضلك، اقرأ النقاط التاليه لتتعرف على تفاصيل التقييم الصحي والتغذوي من خلال هذه الدراسه:

- تملئ استبيان غذائي، تذكر الاغذيه التي تتناولها بالعاده أو قمت بتناولها خلال فترة اسبوع
- نقوم بقياس طولك.
- تقف فوق ميزان الكتروني ليقوم بقياس وزنك ونسبة الدهون في جسمك.
- نقوم بقياس محيط خصرك (كما يفعل الخياط عندما يلف شريط القياس حول البطن)
  - *سوف نستخدم ستائر طبيه كي نحافظ على خصوصيتك اثناء قياس وزنك ونسبة الدهون و محيط خصرك، ولن يطلع احد على معلوماتك.*
- نقوم بقياس ضغط دمك.
- نقوم بقياس معدلات الكوليسترول والدهون المشبعه بالدم

☐ اوافق على اخذ كمية صغيرة من الدم تجمع في انبوب صغير من خلال وخز أحد أصابع اليد (مشابهه لطريقه قياس السكر بالدم) لقياس وتحليل معدلات الكوليسترول والدهون المشبعه في الدم.

لا يسمح لاحد بالاطلاع على أي من المعلومات المتعلقه بالفحوصات التي ذكرناها ماعدا ولي الامر

اذا كنت ترغب بالمشاركه في هذه الدراسه، املئ البيانات المحدده بالاسفل، ثم اعد (ارجع) هذا الإقرار لمدرس الفصل

اسمك الثلاثي	توقيعك	تاريخ اليوم
اسم ولي الامر:		

This assent form was approved by an Institutional Review Board (IRB) at Michigan State University. Approved 11/03/17 - valid through 11/02/2018. This version supersedes all previous versions. IRB # 17-893.

APPENDIX C: Measurement battery

CARDIOVASCULAR HEALTH RISK ASSESSMENT DATA RECORD

First Name_______________ **ID #**_____**DOB** _________ **Age**______ **Gender** _____

Blood Data (ask the following questions before starting)
Last time you ate? _____*hrs ago. What did you eat/ drink?*___________________________

Have you had a cold or other infection in the last two weeks? ______________________

Total Cholesterol______mg/dL

HDL Cholesterol______mg/dL

Total Chol:HDL Ratio _______

Triglycerides________mg/dL

LDL Cholesterol______mg/dL (calculated)

Non-HDL ________mg/dL

Clinician(s) Full Name _______________________ _______________________

Anthropometrics

Height Meas. 1_____cm 2_____cm 3_____cm
3rd measure required if 2nd measure not w/in 0.4 cm of 1st measure

Sitting ht. (Stool ht._____) Meas. 1_____cm 2_____cm 3_____cm
3rd measure required if 2nd measure not w/in 0.4 cm of 1st measure

Weight Meas. 1_____kg 2_____kg 3_____kg

BIA (BF = body fat) Meas. 1_____%BF 2_____%BF 3_____%BF

Waist Circumference Meas. 1_____cm 2_____cm 3_____cm
3rd measure required if 2nd measure not w/in 0.4 cm of 1st measure

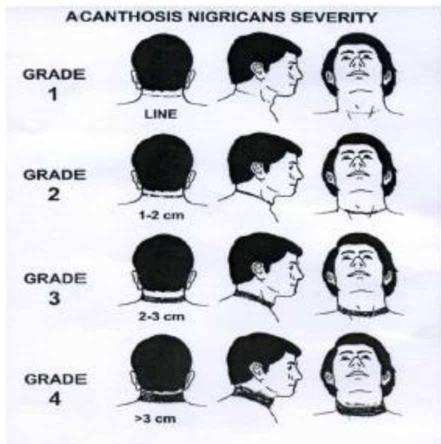
Clinician(s) Full Name _______________________ _______________________

Blood Pressure (systolic/diastolic) **2nd measurement MUST be within 4mm/hg**
Blood Pressure Meas. 1____/___mmHg 2____/____mmHg 3____/____mmHg

Do you have any food allergies? ___ *If yes, please explain*_________________________

Do you take any medication(s)? ___*If yes, please list*_____________________________
Clinician's Full Name ______________________________________ **OVER →**
Acanthosis Nigricans (circle 'none/not present' or the grade of severity below)

NONE/NOT PRESENT



Measurement Clinician(s) ______________________ ______________________

(استبيان نمط الحياة) الأسم:______________________ رقم الهويه:______________________

سوف يتم سؤالك من خلال هذا الاستبيان عن عدد الساعات التي تقضيها في ممارسة الرياضه وكذلك في مشاهدت التلفاز او استخدام الكمبيوتر او الالعاب الالكترونيه. *لا تتردد في طلب المساعده من فريق البحث اذا كان لديك سؤال. شكرا للمشاركة.*

This survey will ask you some questions about exercise and the amount of time you spend watching TV or using the computer. If you have any questions, please ask a staff member for help.

العادات المرتبطه بالنشاط البدني *Physical Activity Related Habits*

1.On a typical day, what time do you go to sleep?	١. متى تذهب للنوم ؟______________________
2.On a typical day, what time do you wake up?	٢. متى تصحوا من النوم ؟______________________
3.How much **television** do you watch on a typical **weekday?** (including video tapes or DVD's)	٣. **خلال الأيام العاديه**، كم من الوقت تقضي في مشاهدت التلفاز أو الفيديو؟ ساعه______________ دقيقه______________
4.How much **television** do you watch on a typical **weekend?** (including video tapes or DVD's)	٤. **خلال نهاية الاسبوع**، كم من الوقت تقضي في مشاهدت التلفاز أو الفيديو؟ ساعه______________ دقيقه______________
5.How much time do you spend on a home **computer or laptop** on a typical **weekday**?	٥. **خلال الأيام العاديه**، كم من الوقت تقضي باستخدام الحاسوب و الانترنت؟ ساعه______________ دقيقه______________
6.How much time do you spend on a home **computer or laptop** on a typical **weekend**?	٦. **خلال نهاية الاسبوع**، كم من الوقت تقضي باستخدام الحاسوب والانترنت؟ ساعه______________ دقيقه______________
7.How much time do you spend **playing video games** on a typical **weekday**?	٧. **خلال الأيام العاديه**، كم من الوقت تقضي بألعاب الحاسوب (play station)؟ ساعه______________ دقيقه______________
8.How much time do you spend **playing video games** on a typical **weekend**?	٨. **خلال نهاية الاسبوع**، كم من الوقت تقضي بألعاب الحاسوب (play station)؟ ساعه______________ دقيقه______________
9.During the past 7 days, how many days were you physically active for a total of at least **60 minutes per day?** *(Add up all the time you spend in any kind of physical activity that increases your heart rate and makes you breathe hard some of the time)*	٩. خلال ال٧ ايام الماضيه، كم عدد الأيام التي مارست فيها أي نوع من الحركه البدنيه (يزيد ضربات القلب و شدت التنفس) لمدة ٦٠ **دقيقه في اليوم الواحد؟** **لا شئ** *0 days* / **يوم** *1 day* / **يومان** *2 days* / **٣ ايام** *3 days* **٤ ايام** *4 days* / **٥ ايام** *5 days* / **٦ ايام** *6 days* / **٧ ايام** *7 days*

التغذية والنشاط البدني للأسره

من فضلك، اختر الاجابه المناسبه حسب ما ينطبق على أسرتك وطفلك من الاسئلة التالية

	دائما	غالبا	احيانا	نادرا / لا
١. يتناول طفلي وجبة الافطار	☐	☐	☐	☐
٢. تتناول أسرتنا الطعام وهي مجتمعه	☐	☐	☐	☐
٣. تشاهد أسرتنا التلفاز اثناء تناول الطعام	☐	☐	☐	☐
٤. تتناول أسرتنا الوجبات السريعه	☐	☐	☐	☐
٥. تستخدم أسرتنا الميكرويف او الأطعمه الجاهزة للتسخين	☐	☐	☐	☐
٦. يتناول طفلي الخضروات والفواكه عند كل وجبه رئيسيه او صغيره	☐	☐	☐	☐
٧. يتناول طفلي المشروبات الغازيه و التي يضاف اليها سكر	☐	☐	☐	☐
٨. يتناول طفلي حليب قليل الدسم عند كل وجبه رئيسيه او صغيره	☐	☐	☐	☐
٩. تتابع الأسره تناول الحلويات والشبس و البسكويت	☐	☐	☐	☐
١٠. تكافئ أسرتنا الطفل بالحلويات	☐	☐	☐	☐
١١. يقضي طفلي أقل من ساعتين يوميا في مشاهدت التلفاز او العاب الفيديو	☐	☐	☐	☐
١٢. تحدد أسرتنا اوقات مشاهدت الطفل للتلفاز	☐	☐	☐	☐
١٣. تسمح أسرتنا للطفل بمشاهدت التلفاز في غرفة نومه	☐	☐	☐	☐
١٤. أسرتنا تمنح الطفل فرص مزاولة النشاط البدني	☐	☐	☐	☐
١٥. أسرتنا تشجع الطفل على مزاولة النشاط البدني يوميا	☐	☐	☐	☐
١٦. تحرص أسرتنا على مزاولة النشاط البدني بشكل جماعي	☐	☐	☐	☐
١٧. يمارس طفلنا النشاط البدني خلال اوقات الفراغ	☐	☐	☐	☐
١٨. طفلنا ملتحق بأنشطه بدنيه او لعبه رياضية مع مدرب	☐	☐	☐	☐
١٩. تتبع أسرتنا روتين يومي لمواعيد نوم الطفل	☐	☐	☐	☐
٢٠. يحصل طفلنا على ٩ ساعات من النوم بالليل	☐	☐	☐	☐

APPENDIX D: Translated – modified Block 2004 Kids food frequency questionnaire (FFQ)

RESPONDENT ID NUMBER
رقم هويّه المشارك

What are kids eating now?
ما يتناولونه الأطفال الآن؟

PLEASE DO NOT WRITE IN THIS AREA

SERIAL #

Your name: الأسم:

Today's date: تاريخ اليوم:

This survey asks about **all of the foods you ate last week.** Remember what you ate at home, at school, from snack machines, or from fast food or restaurants.

هذا الاستبيان يستفسر عن جميع الأطعمه التي قمت بتناولها خلال الأسبوع السابق.
تذكرالأطعمه التي قمت بتناولها في المنزل او في المدرسه او من خلال آلات الأغذيه الجاهزه او من مطاعم الوجبات السريعه.

INSTRUCTIONS: إرشادات:

For each food on the survey, please tell us if you ate it in the last week.
حدد ما قمت بتناوله خلال الاسبوع السابق حسب الأطعمه المتوفره بالاستبيان.

Use a pencil to fill it out.
استخدم قلم رصاص لتعبأة الاستبيان.

We ask two questions for each food on the survey:
هناك سؤالان لكل نوع من الطعام في هذا الاستبيان.

1. *How many days last week did you eat it?*

Mark the bubble that shows the number of days you ate the food last week. In the Example, this person had EGGS two days last week, and MACARONI AND CHEESE on one day last week.

كم عدد الأيام التي تناولت فيها الطعام خلال الاسبوع السابق؟
ظلل الدائره التي توضح عدد الأيام التي تناولت فيها الطعام.
مثال: قام شخص بتناول البيض ليومين خلال الأسبوع السابق و كذلك معكرونة الجبن ليوم واحد خلال الأسبوع السابق.

2. *When you ate it, how much did you have?*

Mark the bubble that shows *how much* of the food you ate in one day. In the Example, this person had one EGG each time, and a B-size bowl of MACARONI AND CHEESE (*use the pictures* for A-B-C-D).

حدد الكميه التي قمت بتناولها؟
ظلل الدائره التي توضح عدد الأيام التي تناولت فيها تلك الكميه.
مثال: شخص تناول بيضه واحده و طبق واحد من معكرونة الجبن في ذلك اليوم.
استخدم الصوره المناسبه (A B C D)

	HOW MANY DAYS LAST WEEK? عدد الأيام خلال الاسبوع السابق؟							HOW MUCH IN ONE DAY? الكميه في اليوم الواحد؟			
	NONE لا شئ	1 DAY يوم واحد	2 DAYS يومان	3-4 DAYS 3-4 ايام	5-6 DAYS 5-6 ايام	EVERY DAY كل يوم		Just a bite قضمه	1 egg بيضه واحده	2 eggs بيضتان	3 eggs بيضات 3
Eggs or breakfast sandwiches like Egg McMuffins بيض او سندويشات البيض مثل	○	○	●	○	○	○	How many eggs do you usually eat in 1 day? كم بيضه تتناول في اليوم الواحد؟	○	●	○	○
Macaroni and cheese معكرونة الجبن	○	●	○	○	○	○	See pictures. How much? حدد الكميه حسب الصور	○ A	● B	○ C	○ D

Think about every time you ate anything in the past week. You can tell us you didn't eat a food at all in the past week, or that you ate it one day last week, two days last week, 3-4 days, 5-6 days, or every day.

هذا الجزء من الاستبيان متعلق بجميع الاوقات التي قمت بتناول أي من الاطعمة المونكوره في الاستبيان خلال الاسبوع السابق. يمكنك ذكر الأطعمة التي لم يتم تناولها خلال الاسبوع السابق, او اذا كنت قد تناولتها خلال يوم او يومان او ثلاثه أيام أو أكثر أو حتى كل يوم.

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant**.

تذكر الأطعمة التي قمت بتناولها في المنزل أو في المدرسه أو من آلآت الأغذية الجاهزه أو من مطاعم الوجبات السريعه

	HOW MANY DAYS LAST WEEK? عدد الأيام خلال الاسبوع السابق؟						**HOW MUCH IN ONE DAY?** الكميه في اليوم الواحد؟	
	NONE لا شئ	1 DAY يوم واحد	2 DAYS يومان	3-4 DAYS 3-4 ايام	5-6 DAYS 5-6 ايام	EVERY DAY كل يوم		
Pancakes, waffles بان كيك , وافل	○	○	○	○	○	○	How many? عدد الكمية؟	○ 1/2 ○ 1 ○ 2 ○ 3
Granola bars, breakfast bars قطع حبوب الافطار (Granola bars, breakfast bars)	○	○	○	○	○	○	How many? عدد الكمية؟	○ 1/2 ○ 1 ○ 2 ○ 3
Eggs or breakfast sandwiches like Egg McMuffins بيض أو سندويشات البيض مثل McMuffins	○	○	○	○	○	○	How many eggs do you usually eat in 1 day? كم بيضه تتناول في اليوم الواحد؟	○ Just a bite قضمه ○ 1 egg بيضه واحده ○ 2 eggs بيضتان ○ 3 eggs بيضات 3
Sausage نقانق / صجق	○	○	○	○	○	○		
Cooked cereal like oatmeal or grits دقيق الشوفان المطبوخ أو جريش وهريس	○	○	○	○	○	○	See pictures. Which bowl? انظر للصورة وحدد حجم الطبق	○ B ○ C ○ D
Cold cereal, like Corn Flakes, Frosted Flakes or any other kinds حبوب أو رقائق الذرة او أي انواع اخرى مماثله	○	○	○	○	○	○	See pictures. Which bowl? انظر للصورة وحدد حجم الطبق	○ B ○ C ○ D

When you ate cereal, which kind did you eat?
(mark the one you ate most of)
ظلل نوع رقائق الحبوب أو الذرة التي غالبا ما تتناولها

- ○ Sweet cereals like Frosted Flakes, Froot Loops — حبوب أو رقائق الذرة المحلاة (بالسكر) مثل (Frosted Flakes, Froot Loops)
- ○ Plain cereals like Corn Flakes, Cheerios, Rice Krispies — حبوب أو رقائق الذرة العادية (Corn Flakes, Cheerios, Rice Krispies)
- ○ Fiber cereals like Raisin Bran, Shredded Wheat — حبوب القمح أو النخالة ذات الألياف الغذائية مثل (Raisin Bran, Shredded Wheat)
- ○ Fortified cereals like Total or Product 19 — حبوب أو رقائق الذرة مثل (Fortifiela cereals)

	NONE	1 DAY	2 DAYS	3-4 DAYS	5-6 DAYS	EVERY DAY		
How often do you have milk on cereal? تناول رقائق الحبوب أو رقائق الذرة مع الحليب؟	○	○	○	○	○	○		
Bananas موز	○	○	○	○	○	○	How many do you usually have in 1 day? كم تتناول باليوم الواحد؟	○ 1/2 ○ 1 ○ 2 ○ 3
Apples or pears تفاح أو كمثرى (أجاص)	○	○	○	○	○	○	How many do you usually have in 1 day? كم تتناول باليوم الواحد؟	○ 1/2 ○ 1 ○ 2 ○ 3
Oranges or Tangerines (Don't count juices) برتقال أو أفندي (لا يشتمل على العصائر)	○	○	○	○	○	○	How many, in one day? كم تتناول باليوم الواحد؟	○ 1/2 ○ 1 ○ 2 ○ 3

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant**.
تذكر الأطعمه التي قمت بتناولها في المنزل أو في المدرسه أو من آلات الأغذيه الجاهزه أو من مطاعم الوجبات السريعه

	HOW MANY DAYS LAST WEEK? عدد الأيام خلال الاسبوع السابق؟							HOW MANY IN ONE DAY? الكميه في اليوم الواحد؟			
	NONE لا شئ	1 DAY يوم واحد	2 DAYS يومان	3-4 DAYS 3-4 ايام	5-6 DAYS 5-6 ايام	EVERY DAY كل يوم					
Strawberries or other berries فراولة أو توت بجميع انواعه	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
Applesauce, fruit cocktail or pineapple slices شرائح الاناناس، فواكه مشكله، صلصة التفاح	○	○	○	○	○	○	**See pictures.** Which bowl? انظر للصورة وحدد حجم الطبق		○ B	○ C	○ D
Any other fruit, like grapes, peaches, watermelon, cantaloupe عنب، خوخ، بطيخ (رقّي)، شمّام	○	○	○	○	○	○	**See pictures.** How much do you usually eat? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
Burgers or cheeseburgers, at home or from a fast food restaurant بيرجر عاديه أو بالجبن (معدة فالمنزل أو من مطاعم الوجبات السريعة)	○	○	○	○	○	○	How much? حدد الكمية؟	○ ½ small burger	○ 1 small burger	○ 1 large burger	○ 2 large burgers
Which kind do you usually eat? أي من النوعين تتناول بالعادة؟	○ Beef burger بيرجر عاديه			○ Cheese burger بيرجر بالجبن							
Hot Pockets, meat ball subs سندويشات جاهزة للتسخين مثل كرات اللحم أو الخضروات أو الجبن	○	○	○	○	○	○					
Roast beef or steak or beef shish kabab روست بيف، ستيك، كباب، شيش طاووق	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D
Beef and noodles, beef stew, beef shawarma نودلز، مرق اللحم	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D
Fried chicken including chicken nuggets, from home or from a restaurant like KFC دجاج مقلي أو قطع دجاج (nuggets) معده في المنزل أو من المطعم	○	○	○	○	○	○	How many pieces? كم عدد القطع؟	○ 1	○ 2 (or 6 nuggets)	○ 3	○ 4
Any other kind of chicken, like roasted chicken, chicken kabab, chicken stew, chicken shawarma دجاج مشوي أو مرق الدجاج	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D
Any kind of fish, like fish sandwich, fish sticks, shrimp or tuna أسماك أو قطع سمك أو سندويشات السمك (تونا)	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant.**

تذكر الأطعمه التي قمت بتناولها في المنزل أو في المدرسه أو من آلات الأغذيه الجاهزه أو من مطاعم الوجبات السريعه

HOW MANY DAYS LAST WEEK? عدد الأيام خلال الاسبوع السابق؟

HOW MUCH IN ONE DAY? الكميه في اليوم الواحد؟

Food	NONE لا شئ	1 DAY يوم واحد	2 DAYS يومان	3-4 DAYS 4-3 ايام	5-6 DAYS 6-5 ايام	EVERY DAY كل يوم	How much in one day?				
Spaghetti, lasagna, pasta with tomato sauce? معكرونات بصلصه الطماطم مثل أسبقياتي، لا زانيا، باستا،	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D
Macaroni and cheese معكرونة الجبن	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D
Pizza, pastries (spinach, meat, cheese), Sambosa بيتزا, فطاير (سبانخ, لحم, جبن, زعتر)، سمبوسك	○	○	○	○	○	○	How many pieces? كم عدد القطع؟	○ 1/2	○ 1	○ 2	○ 3
Refried beans فول مدمس	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D
Vegetable soup, lentil soup, beef soup شوربات (خضار، عدس، لحم، دجاج)	○	○	○	○	○	○	**See pictures.** Which bowl? انظر للصورة وحدد حجم الطبق		○ B	○ C	○ D
Chicken noodle soup شوربة الدجاج والنودلز	○	○	○	○	○	○	**See pictures.** Which bowl? انظر للصورة وحدد حجم الطبق		○ B	○ C	○ D
Biscuits, muffins موفين أو معجنات مشابهه	○	○	○	○	○	○	How many? حدد الكمية؟	○ 1/2	○ 1	○ 2	○ 3
Whole wheat bread, bran, rye, whole grain خبز أسمر بالنخالة، خبز الشعير، خبز كامل الحبوب	○	○	○	○	○	○	How many slices in one day? كم شريحة خلال اليوم الواحد؟	○ 1	○ 2	○ 3-4	○ 5 or more
White bread, toast, bun خبز الدقيق الأبيض توست، صمون	○	○	○	○	○	○	How many slices in one day? كم شريحة خلال اليوم الواحد؟	○ 1	○ 2	○ 3-4	○ 5 or more
Tortillas, pita bread تورتيلا، خبز لبناني	○	○	○	○	○	○	How many? حدد الكمية؟	○ 1	○ 2	○ 3-4	○ 5 or more
Margarine, butter on bread or potatoes زبده او مارجرين (مع الخبز او البطاطا)	○	○	○	○	○	○	How many times each day? عدد المرات كل يوم؟	○ 1	○ 2	○ 3	○ 4
Cheese like cheddar, cooked, spread (Kraft), slices اجبان (شيدر الصفراء، بيضاء، كرافت ، شرائح ، جبن مثلث	○	○	○	○	○	○	How many slices of cheese each day? عدد القطع أو الشرائح ؟	○ 1/2	○ 1	○ 2	○ 3

SERIAL #

PLEASE DO NOT WRITE IN THIS AREA

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant.**

تذكر الأطعمة التي قمت بتناولها في المنزل أو في المدرسه أو من آلات الأغذيه الجاهزه أو من مطاعم الوجبات السريعه

	HOW MANY DAYS LAST WEEK? عدد الأيام خلال الاسبوع السابق؟						HOW MANY IN ONE DAY? الكميه في اليوم الواحد؟				
	NONE لا شئ	1 DAY يوم واحد	2 DAYS يومان	3-4 DAYS 3-4 أيام	5-6 DAYS 5-6 أيام	EVERY DAY كل يوم					
Mayonnaise مايونيز	○	○	○	○	○	○					
Peanut butter sandwich سندويشات زبدة الفول السوداني	○	○	○	○	○	○	How many on those days? العدد خلال تلك الأيام؟	○ ½	○ 1	○ 2	○ 3
Jelly or jam, honey عسل, مربى أو جيلي	○	○	○	○	○	○					
Sunflower seeds, peanuts, or other nuts مكسرات (حب شمسي، فول سوداني) أو أي أنواع أخرى	○	○	○	○	○	○	How much in one day? المقدار خلال اليوم الواحد؟	○ A	○ B	○ C	○ D
Salad with lettuce, green salad سلطه الخس أو سلطه خضراء	○	○	○	○	○	○	**See pictures.** Which bowl? انظر للصورة وحدد حجم الطبق		○ B	○ C	○ D
Salad dressing صلصات السلطه	○	○	○	○	○	○					
Green beans, string beans or peas فاصوليا، لوبيا، بزاليا، فول	○	○	○	○	○	○	**See pictures.** Which bowl? انظر للصورة وحدد حجم الطبق	○ A	○ B	○ C	○ D
Other beans, like chickpeas (cooked) أي انواع أخرى من القبول، مثلا نخي	○	○	○	○	○	○	**See pictures.** Which bowl? انظر للصورة وحدد حجم الطبق	○ A	○ B	○ C	○ D
Corn or corn on the cob ذرة كاملة أو مقطعه	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
Tomatoes including on salad طماطم طازجة أو مع السلطة	○	○	○	○	○	○	How much? حدد الكمية؟	A little ○ طماطم صغيره	tomato ○ ½ طماطم	○ 1	○ 2
Greens like collards, mustard greens or spinach خضروات مثل (ملفوف، ورقيات، سبانخ)	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
Broccoli بروكلي	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D

SERIAL #

PLEASE DO NOT WRITE IN THIS AREA

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant.**

تذكر الأطعمة التي قمت بتناولها في المنزل أو في المدرسه أو من آلات الأغذيه الجاهزه أو من مطاعم الوجبات السريعه

	HOW MANY DAYS LAST WEEK? عدد الأيام خلال الاسبوع السابق؟							HOW MUCH IN ONE DAY? الكميه في اليوم الواحد؟			
	NONE لا شئ	1 DAY يوم واحد	2 DAYS يومان	3-4 DAYS 3-4 أيام	5-6 DAYS 5-6 أيام	EVERY DAY كل يوم					
Carrots, carrot sticks or cooked carrots جزر (مقطّع طازج أو مطبوخ)	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
Sweet potatoes بطاطا حلوه	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
French fries (like McDonald's) بطاطا مقليه (مثل مكدونالدز)	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B صغير	○ C متوسط	○ D كبير
Regular potatoes (baked, broiled or mashed) بطاطا (مطبوخه، بالفرن، أو مهروسه)	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
<u>Any other vegetables</u>, like squash, cauliflower, eggplant, red or green peppers, zucchini, okra أنوع أخرى من الخضروات (قرع، زهره، باذنجان، كوسى، باميه، فلفل اخضر)	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
Rice, including fried rice, cooked rice رز (مقلي، مطبوخ)	○	○	○	○	○	○	**See pictures.** How much? انظر للصور وحدد الكمية	○ A	○ B	○ C	○ D
Ketchup, salsa, or barbecue sauce كاتشب، صوص، صلصة الباربيكيو	○	○	○	○	○	○					
Snack chips like potato chips, tortilla chips, Doritos, popcorn, Bugles, pretzels شبس, فشار (نفيش), رقائق البطاطا، بريتزل	○	○	○	○	○	○	How much in the whole day? الكمية خلال اليوم الواحد؟	○ A	○ B	○ C	○ D
Crackers including Cheez-its, Ritz Bits, Goldfish, TIK, Marie بسكوت مالح، بسكوت ماري أو أنواع أخرى	○	○	○	○	○	○	How much in the whole day? الكمية خلال اليوم الواحد؟	○ A	○ B	○ C	○ D
Nachos with cheese ناتشوز أو ناتشوز مع الجبن	○	○	○	○	○	○	How much? حدد الكمية؟	○ A	○ B	○ C	○ D
Ice cream, ice cream bars or frozen yogurt آيس كريم، بوظة، الزبادي المجمدة	○	○	○	○	○	○	**See pictures.** Which bowl? انظر للصورة وحدد حجم الطبق		○ B	○ C	○ D

Remember what you ate at **home**, at **school**, from **fast food**, or from a **restaurant**.

تذكر الأطعمه التي قمت بتناولها في المنزل أو في المدرسه أو من آلات الأغذيه الجاهزه أو من مطاعم الوجبات السريعه

Food	HOW MANY DAYS LAST WEEK? عدد الأيام خلال الاسبوع السابق؟ NONE لا شئ	1 DAY يوم واحد	2 DAYS يومان	3-4 DAYS 3-4 ايام	5-6 DAYS 5-6 ايام	EVERY DAY كل يوم		HOW MUCH IN ONE DAY? الكميه في اليوم الواحد؟			
Cookies كعك (كوكي)	○	○	○	○	○	○	How many? حدد الكمية؟	○ 1	○ 2-3	○ 4-5	○ 6+
Donuts دونت	○	○	○	○	○	○	How many? حدد الكمية؟	○ 1/2	○ 1	○ 2	○ 3
Cake, cupcakes كيك أو كوب كيك	○	○	○	○	○	○	How many pieces? عدد القطع؟	○ 1/2	○ 1	○ 2	○ 3
Chocolate candy, like candy bars, M&Ms, Snickers, Reese's شوكولاتة (سنيكرز، مارس، أم اند أم) أو أنواع اخرى	○	○	○	○	○	○	How many bars? حدد الكمية؟	○ 1 small صغير	○ 1 med متوسط	○ 1 large كبير	○ 2 large كبير
Any other candy (not chocolate), like Skittles, gum سكاكر، حلوى, علك أو أنواع مماثله (ليست شوكولاته)	○	○	○	○	○	○	How many packages? العدد بالحبة أو بالعلبة؟	○ 1/4	○ 1/2	○ 1	○ 2
Chocolate milk, hot chocolate or cocoa حليب شوكولاتة، هوت تشوكلت	○	○	○	○	○	○	How many glasses or cartons each day? عدد الاكواب او العلب في كل يوم؟	○ 1/2	○ 1	○ 2	○ 3
Milk (not chocolate). (Don't count milk on cereal) حليب فقط	○	○	○	○	○	○	How many glasses or cartons each day? عدد الاكواب او العلب في كل يوم؟	○ 1/2	○ 1	○ 2	○ 3
What kind of milk do you usually drink? ما نوع الحليب الذي تتناوله عادة؟	○ Whole milk كامل الدسم; ○ Skimmed milk خالي الدسم; ○ Soy milk حليب الصويا			○ Reduced-fat (2%) milk قليل الدسم 2%; ○ Lactaid milk خالي من اللاكتوز; ○ Rice milk حليب الأرز			○ Low-fat (1%) milk منخفض الدسم 1%; ○ Don't know لا أعلم				
Sodas like Coke, 7-Up, Pepsi, Sprite, Orange Crush, Fanta (Don't count diet sodas) مشروبات غازيه (بيبسي، سفن آب، سبرايت، فانتا)	○	○	○	○	○	○	How many bottles or cans in 1 day? عدد القنّينات أو العلب خلال اليوم الواحد؟	○ 1	○ 2	○ 3-4	○ 5+
What size soda do you usually drink? ما هو حجم القنينة أو العلبة التي تشربها؟	○ 12-ounce can قنينه عاديه الحجم; ○ 20-ounce bottle بطل متوسط الحجم			○ More than 20 ounces علبه أو بطل ذو حجم كبير							

APPENDIX E: Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ List of Changes to Food Questions

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Standard Block Kids 2004 FFQ	Modified Arabic/English version of Block Kids 2004 FFQ -- Differences highlighted	Questions and Comments
Pancakes, waffles, Pop Tarts	Pancakes, waffles	
Granola bars, breakfast bars	Granola bars, breakfast bars	
Eggs or breakfast sandwiches like Egg McMuffins	Eggs or breakfast sandwiches like Egg McMuffins	
Bacon or sausage	Sausage	
Cooked ceral like oatmeal or grits	Cooked cereal like oatmeal or grits	
Cold cereal, like Corn Flakes, Frosted Flakes or any other kind	Cold cereal, like Corn Flakes, Frosted Flakes or any other kind	
When you ate cereal, which kind did you eat (Mark one)	When you ate cereal, which kind did you eat (Mark one)	
Sweet cereals like Frosted Flakes, Froot Loops	Sweet cereals like Frosted Flakes, Froot Loops	
Plain cereals like Corn Flakes, Cheerios, Rice Krispies	Plain cereals like Corn Flakes, Cheerios, Rice Krispies	
Fiber cereals like Raisin Bran, Shredded Wheat	Fiber cereals like Raisin Bran, Shredded Wheat	
Fortified cereals like Total or Product 19	Fortified cereals like Total or Product 19	
How often do you have milk on cereal?	How often do you have milk on cereal?	
Bananas	Bananas	

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Apples or pears	Apples or pears	
Oranges or tangerines	Oranges or tangerines	
Strawberries or other berries	Strawberries or other berries	
Applesauce, fruit cocktail or pineapplie slices	Applesauce, fruit cocktail or pineapplie slices	
Any other fruit, like grapes, peaches, watermelon, cantaloupe, fruit roll-ups	Any other fruit, like grapes, peaches, watermelon, cantaloupe	
Hamburgers or cheeseburgers, at home or from a fast food restaurant	Burgers or cheeseburgers, at home or from fast food restaurant	
Which kind do you usually eat? Hamburgers / Cheeseburgers	Which kind do you usually eat? Beef burger / Cheeseburger	
Tacos, burritos or enchiladas	***food question deleted***	
Which kind of tacos, burritos, enchiladas do you usually eat? With meat or chicken / Without meat or chicken	***food question deleted***	
Hot Pockets, meat ball subs or Sloppy Joes	Hot Pockets, meat ball subs	
Roast beef, or steak	Roast beef or steak or beef shish kabab	
Hamburger Helper, beef and noodles, beef stew, or any other beef dishes	Beef and noodles, beef stew, beef shawarma	

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Pork chops, ribs, or cooked ham	***food question deleted***	
Fried chicken including chicken nuggets, from home or from a restaurant like KFC	Fried chicken, chicken nuggets, at home or from a restaurant like KFC	
Any other kind of chicken, like roasted chicken, chicken stew, Chicken Helper	Any other kind of chicken, like roasted chicken, chicken kabab, chicken stew, chicken shawarma	
Any kind of fish, like fish sandwich, fish sticks, shrimp or tuna	Any kind of fish, like fish sandwich, fish sticks, shrimp or tuna	
Spaghetti, ravioli, lasagna with tomato sauce?	Spaghetti, lasagna, pasta with tomato sauce	
Macaroni and cheese	Macaroni and cheese	
Pizza or pizza pockets	Pizza, pastries (spinach, meat, cheese), Sambosa	
Hot dogs or corn dogs	***food question deleted***	
Lunch meat like boloney, chicken, sliced ham. Remember sandwiches and Lunchables.	***food question deleted***	
Refried beans	Refried beans	
Vegetable soup, vegetable beef soup, or tomato soup	Vegetable soup, lentil soup, beef soup	
Any other soup like chicken noodle, Cup-a-Soup, ramen noodles, or menudo, posole	Chicken noodle soup	

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Biscuits or muffins	Biscuits or muffins	
Whole wheat bread or whole wheat rolls	Whole wheat bread, bran, rye, whole grain	
White bread, toast or rools, including sandwiches or bagels	White bread, toast, bun	Pita bread might be a better match nutritionally with tortillas. **ok**
Tortillas	Tortillas, pita bread	Do Kuwaiti kids really eat tortillas? **No but some celiac patients might**
Margarine or butter, like on bread or on pancakes or on potatoes	Margarine or butter on bread or potatoes	This question is intended to capture use of margarine or butter on bread, pancakes, or potatoes, but not that used in cooking. Need to add back qualifying statement. **OK**
Cheese. Remember cheese in sandwiches	Cheese, like cheddar, cooked, spread (Kraft), slices	
Mayonnaise or sandwich spread	Mayonnaise	
Peanut butter sandwich	Peanut butter sandwich	
Jelly or jam	Jelly or jam, honey	

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Sunflower seeds, peanuts or other nuts	Sunflower seeds, peanuts or other nuts	
Salad with lettuce, green salad	Salad with lettuce, green salad	
Salad dressing	Salad dressing	
Green beans, string beans or peas	**Green** Beans, string beans or peas	To match with the nutrient database this question must read "**Green beans,** ..." no problem, go green"
Pinto beans, black beans, chili with beans, or bean burritos	Other beans, like chickpeas (cooked)	Are there other beans or lentils that you were thinking about and including with "beans" in question just above? Please **add checkpeas** (cooked)
Corn or corn on the cob	Corn or corn on the cob	
Tomatoes including on salad	Tomatoes including on salad	
Greens like collards, mustard greens or spinach	Greens like collards, mustard greens or spinach	
Broccoli	Broccoli	
Carrots, carrrot sticks or cooked carrots	Carrots, carrrot sticks or cooked carrots	

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Sweet potatoes, or sweet potato pie	Sweet potatoes	
French fries, Tater Tots, hash browns or home fries	French fries (like McDonald's)	
Any other kind of potatoes, like mashed, baked or boiled	Regular potatoes (baked, broiled or mashed)	
Any other vegetables, like squash, cauliflower or green or red peppers	Any other vegetables like squash, cauliflower, **red and green peppers**, eggplant, zucchini, okra	please **restore** red and green peppers
Rice, including fried rice, Spanish rice, rice with beans	Rice, including fried rice, cooked rice	
Ketchup, salsa, or barbecue sauce	Ketchup, salsa, or barbecue sauce	
Snack chips like potato chips, tortilla chips, Doritos, popcorn, Bugles	Snack chips like potato chips, tortilla chips, Doritos, popcorn, Bugles, pretzels	
Crackers, including snack crackers like Cheez-Its, Ritz Bits, Goldfish	Crackers including Cheez-Its, Ritz Bits, Goldfish, TIK, Marie	
Nachos with cheese	Nachos with cheese	
Ice cream, ice cream bars or frozen yogurt	Ice cream, ice cream bars or frozen yogurt	
Cookies	Cookies	
Donuts	Donuts	
Cake, cupcakes, Tasty Cakes, Ho-Ho's, Twinkies	Cake, cupcakes	

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Pie, fruit pie, fruit crisp, cobbler	***food question deleted***	
Chocolate candy, like candy bars, M&Ms, Reese's, Tootse Roll	Chocolate candy, like candy bars, M&Ms, Snickers, Reese's	
Any other candy (not chocolate), like Skittles, Starburst, Lifesavers, gum	Any other candy (not chocolate), like Skittles, gum	We removed "popsicles" here; you also had them with the Slurpees question (below). **Ok**
Chocolate milk, hot chocolate or cocoa	Chocolate milk, hot chocolate or cocoa	
Milk (not chocolate). (Don't count milk on cereal.)	Milk (not chocolate). (Don't count milk on cereal.)	
What kind of milk do you usually drink?	What kind of milk do you usually drink?	
Whole milk	Whole milk	
Reduced-fat (2%) milk	Reduced-fat (2%) milk	
Low-fat (1%) milk	Low-fat (1%) milk	
Non-fat milk	Skimmed milk	
Lactaid milk	Lactaid milk	
Soy milk	Soy milk	
Rice milk	Rice milk	

Don't know	Don't know	
Sodas like Coke, Dr. Pepper, 7-Up, Sprite, Sunkist, Orange Crush (Don't count diet sodas.)	Sodas like Coke, 7-Up, Pepsi, Sprite, Orange Crush, Fanta (Don't count diet sodas.)	
What size soda do you usually drink?	What size soda do you usually drink?	
12 ounce can	12-ounce can	
More than 20 ounces	More than 20 ounces	
20 ounce bottle	20-ounce bottle	
Slurpees, snow cones, popsicles (not ice cream)	Slurpees, snow cones, popsicles (not ice cream)	
Hawaiian Punch, Kool-Aid, Sunny Delight, Gatorade, ice tea, Snapple	Ice tea, Snapple, Gatorade	
Hi-C, Tang, Tampico, Mr. Juicy, Ssips punch	Fruit drinks like Tang	Can you clarify what drinks you are indicating here? Do these have significant amounts of Vitamin C or are they simply sugary drinks? The items on the original questionnaire have added Vitamin C, making them nutritionally different from Gatorade, etc.
Real orange juice. (Don't count Sunkist or other orange sodas)	Real orange juice. (Don't count orange sodas.)	

Addendum A to Cost Proposal for Modified Arabic/English Version of Block Kids 2004 FFQ
List of Changes to Food Questions

Any other real fruit juices like apple juice or grape juice. (Remember juice boxes.)	Any other real fruit juices like apple juice or grape juice. (Remember juice boxes.)	
In the past week, did you take any vitamin pills, like One-a-Day or Flintstones?	In the past week, did you take any vitamins?	
Are you -- Male or Female	Are you -- Male or Female	
How old are you? (age in years)	How old are you? (age in years)	
How tall are you? (feet / inches)	How tall are you? (meters / centimeters)	
How much do you weigh? (pounds)	How much do you weigh? (kilograms)	
Race/ethnicity (6 categories)	***question deleted***	

APPENDIX F: FFQ Kcals Outliers

Table 13. Study participants excluded from analysis based on predictive equation of Schofield-HW and FAO/WHO/UNU for children and adolescents, or Kcal Interquartile Range (Tukey's)

n	Sex	AGE	BMI (kg/m2)	Ht cm	Wt kg	FFQ Total Kcal	[1]REE (Schofield)	[1]REE (Schofield) Kcal Ratio	[1]TEE 1.7 (Schofield)	[1]TEE 1.7 (Schofield) Kcal Ratio	[2]TEE FAO/WHO/UNU	[2]TEE FAO/WHO/UNU Kcal Ratio	[3,4] Kcal Interquartile Range
1	Male	10	15.5	135	28.3	6968.07	1160.60	6.00	1973.01	3.53	1890.96	3.68	1168 – 6487
2	Male	10.6	15.9	135	29	6113.41	1171.97	5.22	1992.35	3.07	1924.72	3.18	1168 – 6487
3	Male	10	29.2	143.5	60.2	5817.13	1690.63	3.44	2874.07	2.02	3167.74	1.84	1168 – 6487
4	Male	10.3	16.3	129	27.2	4837.08	1134.49	4.26	1928.63	2.51	1837.38	2.63	1168 – 6487
5	Male	9.11	14.3	130	24.2	5480.2	1087.11	5.04	1848.09	2.97	1688.04	3.25	1168 – 6487
6	Male	10.6	18.1	135	33	6576.6	1236.97	5.32	2102.85	3.13	2112.69	3.11	1168 – 6487
7	Male	10	16.2	129	26.9	3828.01	1129.61	3.39	1920.34	1.99	1822.66	2.10	1168 – 6487
8	Male	10.11	21.8	134	39.1	408.7	1334.72	0.31	2269.03	0.18	2383.15	0.17	1168 – 6487
9	Male	10.5	23.6	146	50.4	5248.95	1534.81	3.42	2609.18	2.01	2832.46	1.85	1168 – 6487
10	Male	10.9	15.4	130	26	7706.65	1116.36	6.90	1897.81	4.06	1778.21	4.33	1168 – 6487
11	Male	10.3	15.2	139	29.4	5099.9	1183.96	4.31	2012.73	2.53	1943.89	2.62	1168 – 6487
12	Male	10	15.9	131.5	27.5	3845.66	1142.79	3.37	1942.75	1.98	1852.06	2.08	1168 – 6487
13	Male	10.4	15.6	141.6	31.2	6480.54	1216.78	5.33	2068.52	3.13	2029.15	3.19	1168 – 6487
14	Male	10.2	22.2	152	51.3	6806.93	1557.67	4.37	2648.04	2.57	2865.36	2.38	1168 – 6487
15	Male	10.7	16.5	137	31	5309.91	1207.21	4.40	2052.26	2.59	2019.76	2.63	1168 – 6487
16	Male	10	16.7	128	27.3	4631.7	1134.74	4.08	1929.06	2.40	1842.28	2.51	1168 – 6487
17	Male	10.2	23.1	141	45.9	6302.85	1454.83	4.33	2473.21	2.55	2661.58	2.37	1168 – 6487
18	Male	10.3	18.6	141	36.9	4963.45	1308.58	3.79	2224.58	2.23	2287.87	2.17	1168 – 6487
19	Male	10.3	41	145	86.2	6815.59	2115.19	3.22	3595.82	1.90	3812.45	1.79	1168 – 6487
20	Male	10.3	22.2	151.5	51	7400.15	1552.11	4.77	2638.58	2.80	2854.44	2.59	1168 – 6487
21	Male	12	16.5	145.5	35	5480.45	1283.88	4.27	2182.59	2.51	2203.53	2.49	1168 – 6487
22	Male	10	15.5	125.6	24.5	6557.17	1085.95	6.04	1846.11	3.55	1703.18	3.85	1168 – 6487
23	Male	10.7	15.2	139	29.4	4311.86	1183.96	3.64	2012.73	2.14	1943.89	2.22	1168 – 6487
24	Male	10.5	17	145	35.7	5080.17	1294.57	3.92	2200.76	2.31	2234.82	2.27	1168 – 6487
25	Male	10.7	24.4	142	49.3	6326.64	1511.45	4.19	2569.46	2.46	2791.67	2.27	1168 – 6487
26	Male	10	15.7	135	28.6	6610.67	1165.47	5.67	1981.30	3.34	1905.46	3.47	1168 – 6487
1	Female	10	20.5	139	39.7	4468.45	1178.44	3.79	2003.35	2.23	2140.27	2.09	770 – 5782
2	Female	10	25.1	149	55.7	4977.46	1358.78	3.66	2309.93	2.15	2492.08	2.00	770 – 5782
3	Female	10.1	17	133	30	4654.01	1069.40	4.35	1817.98	2.56	1813.80	2.57	770 – 5782
4	Female	10.3	15	138	28.6	3884.37	1080.94	3.59	1837.60	2.11	1759.63	2.21	770 – 5782
5	Female	11	25.4	138	48.3	363.74	1245.73	0.29	2117.74	0.17	2358.26	0.15	770 – 5782
6	Female	10.3	20.9	129	34.8	668	1090.95	0.61	1854.62	0.36	1986.03	0.34	770 – 5782
7	Female	10.8	18	151.5	41.4	5225.45	1250.79	4.18	2126.34	2.46	2188.68	2.39	770 – 5782
8	Female	10.3	23.9	141	47.5	4856.71	1252.99	3.88	2130.08	2.28	2340.81	2.07	770 – 5782
9	Female	9.11	19.6	141	38.9	4800.74	1181.05	4.06	2007.78	2.39	2116.57	2.27	770 – 5782
10	Female	10.4	20.5	139	39.7	6931.58	1178.44	5.88	2003.35	3.46	2140.27	3.24	770 – 5782
11	Female	9.11	21.9	143	44.8	4614.63	1239.70	3.72	2107.49	2.19	2277.64	2.03	770 – 5782
12	Female	10.7	18.9	145	39.7	6126.39	1206.34	5.08	2050.78	2.99	2140.27	2.86	770 – 5782
13	Female	10.4	24.2	140	47.5	5015.53	1248.34	4.02	2122.17	2.36	2340.81	2.14	770 – 5782
14	Female	10.7	19.9	141	39.6	4636.1	1186.90	3.91	2017.74	2.30	2137.34	2.17	770 – 5782

Table 13 (cont'd)

15	**Female**	**10.9**	**29.2**	**150**	**65.6**	**505.53**	**1446.24**	**0.35**	**2458.61**	**0.21**	**2593.35**	**0.19**	**770 - 5782**
16	**Female**	**10.5**	**15.3**	**134**	**27.4**	**4617.09**	**1052.30**	**4.39**	**1788.91**	**2.58**	**1711.77**	**2.70**	**770 - 5782**
17	**Female**	**10.4**	**24**	**142.5**	**48.8**	**5036.72**	**1270.84**	**3.96**	**2160.42**	**2.33**	**2368.87**	**2.13**	**770 - 5782**
18	**Female**	**10.7**	**20.2**	**138**	**38.4**	**5093.99**	**1162.92**	**4.38**	**1976.96**	**2.58**	**2101.47**	**2.42**	**770 - 5782**
19	**Female**	**10**	**14.6**	**129.5**	**24.5**	**4651.73**	**1007.12**	**4.62**	**1712.10**	**2.72**	**1590.74**	**2.92**	**770 - 5782**
20	**Female**	**10**	**17.7**	**134**	**31.7**	**4039.02**	**1088.27**	**3.71**	**1850.06**	**2.18**	**1877.19**	**2.15**	**770 - 5782**
21	**Female**	**10**	**13.9**	**131**	**23.9**	**3491.01**	**1009.07**	**3.46**	**1715.42**	**2.04**	**1564.74**	**2.23**	**770 - 5782**
22	**Female**	**10**	**13.1**	**138.5**	**25.2**	**6931.63**	**1054.82**	**6.57**	**1793.20**	**3.87**	**1620.65**	**4.28**	**770 - 5782**
23	**Female**	**10.3**	**28.3**	**140**	**55.4**	**711.05**	**1314.42**	**0.54**	**2234.52**	**0.32**	**2487.62**	**0.29**	**770 - 5782**
24	**Female**	**10.11**	**12.9**	**140**	**25.3**	**3663**	**1062.63**	**3.45**	**1806.48**	**2.03**	**1624.89**	**2.25**	**770 - 5782**
25	**Female**	**10**	**21.2**	**141**	**42.3**	**8779.29**	**1209.49**	**7.26**	**2056.13**	**4.27**	**2213.25**	**3.97**	**770 - 5782**
26	**Female**	**10.5**	**18.6**	**147.5**	**40.5**	**681.86**	**1224.66**	**0.56**	**2081.92**	**0.33**	**2163.38**	**0.32**	**770 - 5782**
27	**Female**	**10.2**	**17.3**	**138**	**32.9**	**4792.64**	**1116.91**	**4.29**	**1898.74**	**2.52**	**1920.36**	**2.50**	**770 - 5782**
28	**Female**	**10.2**	**13.9**	**134**	**25**	**5399.52**	**1032.23**	**5.23**	**1754.78**	**3.08**	**1612.15**	**3.35**	**770 - 5782**

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APPENDIX G: Reliability Test

Table 14. Reliability (test-retest) of the translated (Arabic/English) and modified (cultural food) Block Kids 2004 FFQ performed on 5th grade boys (n=26) and girls (n=32) in Kuwait

N=116 FFQs Average Measures Crude Data	Intraclass Correlation	95% Confidence Interval		F Test with True Value 0			
		Lower Bound	Upper Bound	Value	df1	df2	Sig
All Variables	.674	.547	.779	8.667	57	2223	.000
Fruit	.679	.458	.810	3.097	57	57	.000
Boys	.843	.651	.929	6.789	25	25	.000
Girls	.369	-.316	.695	1.569	31	31	.108
Vegetables	.751	.581	.852	4.067	57	57	.000
Boys	.858	.684	.936	6.912	25	25	.000
Girls	.532	.059	.769	2.163	31	31	.018
Dairy	.804	.669	.884	5.086	57	57	.000
Boys	.958	.887	.983	29.311	25	25	.000
Girls	.625	.222	.818	2.614	31	31	.005
Whole grains	.551	.248	.733	2.251	57	57	.001
Boys	.593	.111	.816	2.873	25	25	.005
Girls	.536	.042	.774	2.131	31	31	.019
Kcals	.822	.700	.895	5.608	57	57	.000
Boys	.930	.797	.972	18.139	25	25	.000
Girls	.573	.118	.792	2.312	31	31	.011
Protein	.830	.714	.899	5.902	57	57	.000
Boys	.934	.826	.972	18.376	25	25	.000
Girls	.606	.183	.809	2.493	31	31	.007
Total fat	.798	.659	.880	4.926	57	57	.000
Boys	.906	.783	.959	11.848	25	25	.000

Table 14 (cont'd)

Girls	.550	.064	.782	2.184	31	31	.017
***n*-6 fatty acids**	.668	.441	.803	3.018	57	57	.000
Boys	.849	.667	.932	6.762	25	25	.000
Girls	.215	-.644	.621	1.267	31	31	.257
***n*-3 fatty acids**	.795	.655	.879	4.871	57	57	.000
Boys	.904	.771	.958	11.738	25	25	.000
Girls	.569	.105	.791	2.282	31	31	.012
Saturated fat	.814	.687	.890	5.351	57	57	.000
Boys	.909	.777	.961	12.699	25	25	.000
Girls	.653	.286	.831	2.843	31	31	.002
***Trans*-fat**	.799	.662	.881	4.965	57	57	.000
Boys	.867	.697	.941	8.312	25	25	.000
Girls	.633	.244	.821	2.687	31	31	.004
Cholesterol	.812	.684	.889	5.397	57	57	.000
Boys	.844	.607	.933	7.674	25	25	.000
Girls	.740	.467	.873	3.800	31	31	.000
Carbohydrates	.808	.676	.886	5.180	57	57	.000
Boys	.926	.768	.971	18.022	25	25	.000
Girls	.534	.043	.773	2.130	31	31	.019
Added sugar	.798	.659	.881	4.895	57	57	.000
Boys	.924	.768	.970	17.197	25	25	.000
Girls	.487	.003	.743	2.063	31	31	.024
Fiber	.784	.636	.872	4.629	57	57	.000
Boys	.906	.791	.957	10.936	25	25	.000
Girls	.527	.016	.771	2.081	31	31	.023
Calcium	.796	.656	.879	4.901	57	57	.000
Boys	.918	.810	.964	13.327	25	25	.000
Girls	.634	.241	.822	2.678	31	31	.004
Potassium	.813	.685	.889	5.321	57	57	.000
Boys	.938	.849	.973	18.514	25	25	.000
Girls	.554	.073	.784	2.204	31	31	.016

Table 14 (cont'd)

Magnesium	.766	.605	.861	4.279	57	57	.000
Boys	.909	.795	.960	11.934	25	25	.000
Girls	.427	-.196	.723	1.723	31	31	.068
Sodium	.836	.724	.903	6.247	57	57	.000
Boys	.921	.818	.965	13.871	25	25	.000
Girls	.672	.327	.840	3.012	31	31	.001
Vitamin D	.822	.699	.895	5.549	57	57	.000
Boys	.955	.883	.981	26.248	25	25	.000
Girls	.630	.239	.820	2.669	31	31	.004

Intraclass Correlation Coefficient statistics for FFQ baseline test versus follow up (retesting) in boys (1-day interval) and girls (4 weeks interval). Two-way mixed effects model (Absolute agreement) where children effects are random and measures effects are fixed. This estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

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