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Prevalence Of and Factors Associated With Overweight, Obesity and Metabolic Syndrome among School Children and Adolescents in Ras Alkhaimah, United Arab Emirates – 2016-2017

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PREVALENCE OF AND FACTORS ASSOCIATED WITH OVERWEIGHT, OBESITY AND METABOLIC SYNDROME AMONG SCHOOL CHILDREN AND ADOLESCENTS IN RAS Al KHAIMAH, UNITED ARAB EMIRATES – 2016-2017

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This dissertation is submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

Under the Supervision of Dr. Mohamud Sheek-Hussein

May 2018

Declaration of Original Work

I, Mouza Mohammed Eid Al Yahed Al Zaabi, the undersigned, a graduate student at the United Arab Emirates University (UAEU), and the author of this dissertation entitled "*Prevalence of and Factors Associated with Overweight, Obesity and Metabolic Syndrome among School Children and Adolescents in Ras Al Khaimah, United Arab Emirates – 2016-2017*", hereby, solemnly declare that this dissertation is my own original research work that has been done and prepared by me under the supervision of Dr. Mohamud Sheek-Hussein, in the College of Medicine and Health Sciences at UAEU. This work has not previously been presented or published, or formed the basis for the award of any academic degree, diploma or a similar title at this or any other university. Any materials borrowed from other sources (whether published or unpublished) and relied upon or included in my dissertation have been properly cited and acknowledged in accordance with appropriate academic conventions. I further declare that there is no potential conflict of interest with respect to the research, data collection, authorship, presentation and/or publication of this dissertation.

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Abstract

Introduction: The prevalence of childhood obesity is reported to be increasing rapidly in the United Arab Emirates (UAE). Excess adiposity is a key independent risk factor for the future development of cardiometabolic disorders such as metabolic syndrome. Population-based studies using representative samples are required to provide accurate and valid estimates of obesity and metabolic syndrome. Currently, there is a dearth of pediatric obesity research conducted in the emirate of Ras Al Khamimah.

Aims: The aim of this study was to estimate the prevalence and factors associated with obesity and metabolic syndrome among school children in Ras Al Khaimah, UAE.

Method: Using a cross sectional study design, a random representative sample of children (N=1184; 43% males) aged 6-18 years was recruited from government and private schools in Ras Al Khaimah, during the academic year 2016-2017. Participants completed a questionnaire collecting sociodemographic and lifestyle behaviour data. Anthropometric (i.e. height, body mass and waist circumference) and blood pressure measurements were conducted using standard procedures. Body mass index-derived estimates of obesity were calculated using three international cut-offs: Center for Disease Control and Prevention (CDC), the International Obesity Task Force (IOTF), and the World Health Organization (WHO). Participants aged 10-18 year (N=413) provided a fasting venous blood sample to assess fasting blood glucose, lipid levels, and glycated haemoglobin. Metabolic syndrome was classified using the International Diabetes Federation criteria.

Results: The overall prevalence of combined overweight/obesity was 37.2% (CDC), 37.7% (IOTF), and 40.1% (WHO). The prevalence of metabolic syndrome was 6.6%

(11.4% males, females 3.1%, P=0.001). Multivariate logistic regression identified that mother obesity was positively associated with childhood overweight and obesity ($p < 0.05$). Father education, dark vegetables and full fat milk were negatively associated with overweight and obesity ($p < 0.05$).

Significant contributions: This study confirms a high prevalence of overweight and obesity among children and adolescents in Ras Al Khaimah. Mother obesity, Father education, full milk and dark vegetables were identified as correlates of childhood obesity. The prevalence of metabolic syndrome will continue to increase unless school-based obesity interventions are implemented across the UAE.

Gap filled: This is the first study in RAK estimated the prevalence of overweight and obesity since 18 years using 3 international BMI definitions and investigated the associated factors of childhood obesity. Furthermore, it is the first study to estimate the prevalence of metabolic syndrome in the northern emirates.

Keywords: Adiposity, adolescents, children, lifestyle, metabolic syndrome, pediatric obesity, prevalence.

Title and Abstract (in Arabic)

مدى انتشار الوزن الزائد، السمنة ومتلازمة الأيض الغذائي بين الأطفال والمراهقين في مدارس رأس الخيمة-الإمارات العربية المتحدة-2016 – 2017

الملخص

المقدمة: تشير كثير من التقارير البحثية الى تزايد ظاهرة انتشارالسمنة في مرحلة الطفولة في دولة الإمارات العربية المتحدة. ومن المعروف أن السمنة الزائدة هي من عوامل الخطر الرئيسية المستقلة التي تفاقم اضطرابات الأيض المرتبطة بالتمثيل الغذائي والإضطرابات القلبية لدى المرضى مستقبلا. وعليه فهناك حاجة كبيرة للدراسات المسحية لدى السكان، من خلال استخدام عينات تمثيلية لتقدير مدى إنتشار السمنة وارتباطها بمتلازمة التمثيل الغذائي. إذ أن هناك ندرة كبيرة في أبحاث السمنة لدى الأطفال خاصة في إمارة رأس الخيمة.

الأهداف: الهدف الرئيسي من هذه الدراسة هو تقدير مدى إنتشار السمنة والعوامل المرتبطة بها ومدى انتشار متلازمة التمثيل الغذائي لدى أطفال المدارس في إمارة رأس الخيمة، بالإمارات العربية المتحدة.

الطريقة: طريقة الدراسة مقطعية، باستخدام عينة تمثيلية عشوائية من الأطفال (N = 1184)؛ 43% منهم من الذكور (الذين تراوح أعمارهم بين 6-18 سنة) من المدارس الحكومية والخاصة في رأس الخيمة، خلال العام الدراسي (2016-2017). أكمل المشاركون الاستبيانً الخاص بالدراسة، التى اشتملت على جمع بيانات خاصة بالممارسة والسلوك، إضافة الى البيانات الإجتماعية والديموغرافية. كما تم أخذ القياسات الأنثروبومترية (للطول وكتلة الجسم ومحيط الخصر) وقياسات ضغط الدم باستخدام الوسائل القياسية التقليدية. تم حساب تقديرات مؤشر كتلة الجسم من السمنة باستخدام ثلاث معايير دولية: معيار مركز السيطرة على الأمراض والوقاية منها (CDC) ، والمعيار الدولي للسمنة (IOTF) ، ومعيار منظمة الصحة

العالمية (WHO). قدم المشاركون الذين تتراوح أعمارهم بين 10-18 سنة (N = 413) عينة دم وريدي (مع الصيام) لتقييم مستوى السكر في الدم، ومستويات الدهون، والهيموغلوبين. تم تصنيف متلازمة الأيض باستخدام معايير الاتحاد الدولي للسكري (IDF).

النتائج: وجدت الدراسة أن معدل انتشار السمنة الإجمالي قد بلغ 37.2% حسب معايير(CDC)، 37.7% حسب معيار (IOTF)، و 40.1% حسب (WHO). كان انتشار متلازمة التمثيل الغذائي بمعدل (6.6% و 11.4%) لدى الذكور والإناث 3.1%، P = (0.001) باستخدام طريقة الانحدار اللوجستي متعدد المتغيرات. كما وجد أن سمنة الأم مرتبطة إيجابيا مع السمنة في مرحلة الطفوله ($P < 0.05$). كما أوضح التحليل إرتباط تعليم الأب واستهلاك الخضروات الداكنة والحليب كامل الدسم سلبا مع زيادة الوزن والسمنة ($P < 0.05$).

المساهمات الإضافية المميزة للدراسة: تؤكد هذه الدراسة ارتفاع معدل انتشار السمنة والبدانة بين الأطفال والمراهقين في إمارة رأس الخيمة. أثبتت الدراسة علاقة سمنة الأم، وتعليم الأب، واستهلاك الحليب الكامل والخضروات الداكنة بسمنة الأطفال. كما أشارت الدراسة لإرتفاع انتشار متلازمة التمثيل الغذائي طرديا ما لم يتم تنفيذ تدخلات بهدف الحد من السمنة في المدارس في جميع أنحاء الإمارات العربية المتحدة

الفجوات المعرفية التي أغلقتها الدراسة: هذه الدراسة هي الأولى في إمارة رأس الخيمة التي يتم فيها تقدير مدى انتشار فرط الوزن والبدانة منذ 18 عامًا باستخدام 3 معايير دولية لمؤشر كتلة الجسم والتحقيق والعوامل المرتبطة بالبدانة في مرحلة الطفولة. وهي الدراسة الأولى لتقدير مدى انتشار السمنة في الإمارات الشمالية لدولة الإمارات العربية المتحدة.

مفاهيم البحث الرئيسية: السمنة، المراهقين، الأطفال، نمط الحياة، متلازمة التمثيل الغذائي، السمنة عند الأطفال، الانتشار.

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Dedication

To my great mother

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List of Abbreviations

AHA: American Heart Association

ATLS: Arab Teen Lifestyle Study

BMI: Body Mass Index

CDC: Centers for Disease Control and Prevention

Chl: Total Cholesterol

CVDs: Cardiovascular Diseases

DEFF: Design Effect

DM: Diabetes Mellitus

EGIR: European Group for the study of Insulin Resistance

FBS: Fasting Blood Glucose

GDM: Gestational Diabetes Mellitus

HB: Haemoglobin

HBA1c: Glycosylated haemoglobin

HDL: High-Density Lipoprotein

HTN: Hypertension

IDF: International Diabetes Federation

ISCOLE: International Study of Childhood Obesity, Lifestyle and Environment

KSA: Kingdom of Saudi Arabia

LDL: Low Density Lipoprotein

MetS: Metabolic Syndrome

MLR: Multiple Logistic Regression

MOH: Ministry of Heath

NCDs: Non-Communicable Diseases

NCEP: National Cholesterol Education Program

RAK: Ras Al Khaimah

SES: Socio-Economic Status

TG: Triglyceride

UAE: United Arab Emirates

UAEU: United Arab Emirates University

WC: Waist Circumference

WHO: World Health Organization

Chapter 1: Introduction and Literature Review

1.1 Introduction

1.1.1 Definitions of obesity, overweight and Metabolic Syndrome

Overweight and obesity are defined by the World Health Organization (WHO) as abnormal and excessive fat accumulation manifested by abnormal increase in an individual's weight that may impair health. The Body Mass Index (BMI) is the commonly used calculation to quantify the excess body fat. BMI ranges differentiate between the normal, overweight and obese individual [1]. Abnormal fat accumulation can occur in two ways: 1) expansion of the numbers of fat cells (hyperplastic obesity) and 2) expansion of the size of the fat cells (hypertrophic obesity) [2]. The main mechanism for fat deposition in children and adolescents is by hyperplasia, while hypertrophic obesity is the primary mechanism by which adult body fat is stored. Since fat cells can't be eliminated by natural (non-invasive) methods the number of fat cells made during childhood and adolescence is predictor of adult obesity [3, 4].

Metabolic Syndrome (MetS) is a group of metabolic abnormalities that commonly present together, and have been documented in children and adults. MetS is more prevalent among individuals who are obese or overweight, both in adults and children [5, 6, 7]. The metabolic abnormalities that are associated with MetS are: hypertriglyceridemia, elevated fasting blood glucose, high blood pressure, abdominal obesity and low high-density lipoprotein cholesterol, as defined by several authorities such as International Diabetes Federation (IDF), National Cholesterol Education Program (NCEP), the WHO and the European Group for the study of Insulin Resistance (EGIR).

While there is agreement on what the abnormalities are, there is variation between authorities regarding the precise criteria that lead to the diagnosis of MetS, such as the number of metabolic defects needed to make a diagnosis, the cutoff points of the metabolic defects and age groups for which MetS can be diagnosed.

1.1.2 Determinants/ risk factors

Determinants of obesity

Obesity is a result of a long-term disturbance of energy intake and expenditure [8, 9]. This imbalance is influenced by the interaction between complex genetic, environmental and behavioral determinants to which the child is exposed. Exposure to these determinants starts from very early stages of life, even before pregnancy and fetal stages, since maternal health history and status are important. The determinants continue to affect the individual throughout his childhood, adolescence and adulthood. Several factors/ determinants have been identified as increasing the risk for obesity, as summarized in Table 1.1. Although the determinants are described in this section as independent of each other, in reality they are interrelated and concertedly affect the risk of becoming overweight and obese.

Table 1.1: Summary of the determinants of overweight and obesity in children and adolescents

Early life determinants	Environmental and social determinants	Lifestyle determinants
Ethnicity	Socioeconomic status	Skipping breakfast
Obesity of one or both parents	Small family size/ order of the child among the sibling	Consumption of energy dense food and sugar sweetened beverages
Maternal smoking during pregnancy	Urban residential area	Eating outside the home
Gestational diabetes	Obesogenic home and neighborhood environment	Poor sleeping habits
Extremes of birth weight	Unhealthy school environment	Lack of physical activity
Feeding artificial milk		Sedentary behaviors
Early introduction of solid food		

Early life determinants: some of these determinants are strongly linked, either through a shared genetic component, or by a direct or indirect relationship between two or more factors.

a) Ethnicity: Ethnicity can predispose the child to overweight and obesity through its genetic influence. For example, Hispanic and black Americans were shown to have a higher risk of obesity than white non-Hispanic American children [10]. Additionally, ethnicity can affect obesity through its interaction with other obesity determinants. A study on adolescents in Malaysia found a difference in unhealthy food intake patterns in Malay participants as compared with Chinese [11].

b) **Obesity of one or both parents:** When one of the parents is obese the risk of the child to be obese is higher than those with normal weight parents. This risk is further increased if both parents are obese [12]. A recent multicenter study across 12 countries confirmed the positive association between parental obesity and childhood obesity [13].

c) **Maternal smoking:** Direct smoking (and not passive smoking) during pregnancy, especially during 28-32 weeks of gestation, is associated with an increased risk of obesity for that child during the first three years of life [14].

d) **Gestational diabetes (GDM) with/without obesity:** Maternal obesity before pregnancy has been associated with development of GDM. Both pre-pregnancy obesity and GDM are independent risk factors for childhood obesity. Furthermore excessive weight gain during pregnancy has also been associated with a higher risk of childhood obesity [12]. Therefore maternal obesity, even in the absence of GDM, is a risk factor for child obesity. In women with GDM the fetus responds to the high blood glucose levels in the maternal blood by increasing insulin levels. Hyperinsulineamia increases the adiposity and weight of the fetus [15]. A recent study investigating the factors affecting childhood obesity has confirmed a positive association between having a history of maternal GDM and subsequent child obesity [16].

e) **Birth weight:** Extremes of birth weight have been associated with the development of childhood obesity. Babies born with low birth weight (< 2500 grams) who undergo rapid catch up during the first 2 years of life are at a higher risk of developing obesity during childhood [17]. Likewise, babies with high birth weight > 90% for the gestational age have an increased risk for obesity [18].

f) **Artificial milk feeding:** Feeding artificial milk can lead to high and prolonged insulin levels in the infant's blood, thereby initiating the first step of abnormal metabolism [19]. The high insulin in the infant blood promotes the formation of adipose tissue in a very early stage of life. On the other hand exclusive breastfeeding especially in the first six months has been shown to be protective against childhood obesity [20].

g) **Early introduction of solids:** Introduction of solid food (such as pureed fruits, vegetables and cereals) before four months of age is another infant feeding practice that has been shown to increase the risk of obesity [21]. The WHO recommends exclusive breastfeeding for the first 6 months as being optimal for maternal and infant health [22].

Environmental and social determinants: These are the external factors or conditions that affect the child's risk of developing obesity. This group of determinants includes socioeconomic status, family size and child order, residential area, home and neighborhood environment, and school environment.

a) **Socioeconomic status (SES):** Childhood obesity is strongly affected by the SES of the family (as assessed by one or more of the following components: income, parental education and occupation), with the nature of the effect varying in industrialized countries compared with developing countries. Low SES in developed countries predisposes the child to obesity, whereas in developing countries lower SES is associated with lower risk of obesity [23, 24]. Parental education is another important determinant of childhood obesity, and similarly to SES the nature of the effect differs between developed and developing countries. Lower levels of parental education are associated with increased risk of child

obesity in developed countries, and reduced risk of child obesity in developing countries [13].

b) **Family size and child order:** Small families are predisposing factor for childhood obesity [25, 26]. Higher prevalence of overweight and obesity is documented among children who are alone or the youngest in their families. While having a bigger number of younger siblings has been shown to have a protective effect [27]. In big families children tend to have more active playing time and less time spent on sedentary behaviors such as screen time. Families with many children were associated with a lower rate of eating outside and more compliance to home prepared family meals. They also get higher attention and care from their parents or guardians.

c) **Residential address:** Children who live in urban areas are more prone to overweight and obesity compared to those live in rural areas [24, 25]. This was interpreted by the common characteristics of the urban cities such as the high proximity of the building and facilities, crowdedness, limited spaces for walking and cycling safely, limited children play areas which limits the opportunities to engage in physical activities. Urbanization also affected the dietary patterns of the cities residents by the vast availability and easy accessibility of the unhealthy fast food choices [28].

d) **Home and Neighborhood environment:** The home food environment plays a very significant role in creating dietary habits and food intake patterns in children [29]. The unavailability of energy dense unhealthy foods and preparation of food at home are strongly associated with healthy eating habits of the children [30]. In the neighborhood the availability and accessibility to unhealthy food choices

result in predisposing the children to higher risk of obesity. More physical activity opportunities, social support and less electronic media equipment at home are associated with higher physical activity levels among children [31].

e) **School environment:** The school environment has been recognized as being a potential factor that can affect obesity in children. Several studies have explored the effect of various interventions targeting the fat content of school meals and the resulting change in children's weight. Results have varied in magnitude and sustainability [29].

Lifestyle determinants: These include dietary habits and the amount of physical activity.

a) **Skipping breakfast:** Breakfast is an important meal in the day. Children who skip breakfast are at higher risk of being obese compared to their counterparts who have breakfast on a regular basis [24]. A multi-centre study across 12 countries showed that lower body fat percentage and normal BMI were associated with frequent compared to rare or occasional intake of the breakfast meal, among 9-11 year children [32].

b) **Energy dense food, sugar-sweetened beverages:** Consumption of energy dense food, and sugar-sweetened beverages increase the risk of overweight and obesity among children and adolescents [33, 34]. A recent publication by the American Heart Association (AHA) has shown that added sugar in consumed foods and beverages increases the cardiovascular risk factors in children [35].

c) **Eating outside home:** Eating outside the home is now an established determinant of obesity since the food prepared outside is generally higher in calories and lower in nutrients [36, 37].

d) **Sleeping habits:** Sleep duration and sleep hygiene have a clear impact on the development of overweight and obesity among children. According to the Canadian 24-hour movement guideline 5-13 year old children require 9-11 hours of uninterrupted sleep per night. Adolescents between the age of 14-17 years require 8-10 hours per night [38]. Short sleep duration is associated with obesity among children and adolescents [39, 40, 41].

e) **Physical activity:** Physical activity has many health benefits on children and adolescents. A substantial body of evidence supports positive effect of physical activity on preventing and treating childhood obesity, [42] reducing high blood pressure in adolescent [43] and improving insulin sensitivity in diabetic children and adolescents [44]. A study done in the USA comparing Hispanic with white non-Hispanic adolescents found higher obesity in the Hispanics that was partially attributed to differences in physical activity patterns [45]. A significant association was found between lower BMI z-score and meeting Canadian 24-hour movement guidelines [38], which recommend at least 60 minutes of moderate-vigorous physical activity per day [46].

f) **Sedentary behaviors:** "Sedentary behavior" refers to any waking activity characterized by an energy expenditure ≤ 1.5 metabolic equivalents and a sitting or reclining posture" [47]. Sedentary behaviors are associated with higher prevalence of obesity in both adults and children. Long sitting time, as one of the most common sedentary behaviors, independent of the physical activity levels, is

associated with high all-cause mortality in adults [48]. Although it is not possible to extrapolate adult mortality data to the pediatric population, it is reasonable to hypothesize that prolonged sedentary behaviors in children may increase risk of obesity and related health issues in later life.

Determinants of Metabolic Syndrome

MetS is a cluster of cardio-metabolic risk factors (including central obesity, insulin resistance, glucose intolerance, dyslipidemia and increased blood pressure). As such, it is expected that determinants affecting these risk factors will in turn be associated with MetS.

Obesity: is the strongest determinant of MetS among children and adolescents [49]. Furthermore, all the risk factors for obesity are predisposing factors that increase the risk of children developing MetS.

Gender: MetS is more prevalent in male adolescents [50]. This difference has been noted in children as well as adolescents, in whom MetS prevalence is higher in males compared to females [51].

Ethnicity: certain ethnic groups have a unique body fat composition and distribution which predispose them to higher risk of obesity, insulin resistance and then MetS [50]. For example, the prevalence of MetS among the Hispanic adolescents is higher compared to white and black American counterparts [52].

Pubertal stage: the hormonal changes during body maturation increase body fat, which results in insulin resistance. During puberty, the sex hormones and the sex

hormones binding globulin increase leading to further increase in the insulin resistance and reduction of the HDL [53].

Diet and lifestyle: lack of physical activity and the predominance of the sedentary behaviors can cause the MetS in children through two-overlapping mechanisms. An unhealthy lifestyle is a direct established cause of obesity. Low levels of physical activity reduce the sensitivity of the cells to the insulin, which is a major component of the MetS and mediates the cascade of the other metabolic abnormalities. Sleep duration is one of the lifestyle factors that has been shown to be associated with increased prevalence of MetS. Sleep less than 5 hours and longer than 10.5 hours per day is associated with higher prevalence of MetS compared to 7.75 hours of sleep [54].

1.1.3 Methods of assessing obesity and Metabolic Syndrome

Obesity

There is a strong association between obesity in children and adolescents and many adverse physical and psychological health outcomes. Therefore, diagnosis of obesity has become of a great importance. In addition to being valid, accurate, and reliable, the ideal tool should also be as practical and inexpensive as possible. No single tool has been able to fulfill all of these criteria, with each having one or more limitations. Following the discovery that not only total body fat is important, but also the distribution of body fat, body composition and ectopic fat are of clinical significance, clinicians have turned to assessment methods that provide them with this information. Choice of which adiposity assessment tool (or combination of tools) is used depends on what data the clinician or researcher needs, as outlined in

Table 1.2 [55]. Below is a summary of the most important tools that have been used to assess obesity.

Table 1.2: Different tools for assessing adiposity according to the specific diagnostic objectives

Parameter of interest in adiposity assessment	Assessment tool
Total body fat	Body weight Body Mass Index
Distribution of body fat. (Visceral vs. subcutaneous)	Waist Circumference Ratios: Waist to hip Ratio, Waist to height Ratio Sagittal Abdominal Diameter Imaging Methods MRI, CT
Body composition (percent body fat)	Mid-upper arm and Mid-thigh circumferences Skinfold thickness Near-Infrared Interactance NIR Dual-Energy X-ray Absorptiometry Imaging Methods MRI, CT Bioelectrical Impedance
Ectopic fat (heart, liver, pancreas, skeletal muscles)	Magnetic Resonance Spectrometry

Note: Cornier, M., Després, J., Davis, N., Grossniklaus, D. A., Klein, S., Lamarche, B., Poirier, P. (2011, November 01). Assessing Adiposity: A Scientific Statement From the American Heart Association. Retrieved September 14, 2017, from http://circ.ahajournals.org/content/124/18/1996.sho
MRI: Magnetic Resonance Imaging, CT: Computed Tomography Scan.

Body weight: Is defined as "the force due to the effect of the gravity on the body mass" [56], however clinically it has become synonymous with body mass. Although body weight used to be the oldest measure of obesity previously, since the 20th

century its use alone has become obsolete. Body weight is now used in addition to other parameters to assess adiposity [57].

Body Mass Index (BMI): Is a calculation, which is obtained after measuring the weight in kilograms and the height in meters. BMI is equal to the weight divided by the square of the height. BMI is a widely accepted, easy to calculate, valid tool to diagnose human adiposity [58, 59]. BMI is positively related to the amount of body fat and its specificity is good in cutoffs 30 and above in mature adolescents and adults [60], and above the 85th percentile in children [61]. The limitation of the BMI comes from its inability to differentiate between the muscle and fat body mass [62, 63]. For example, it could misclassify a person as normal according to the weight and height, while his/her total body fat mass is very high compared to the lean body mass.

In adults, there are differences in BMI ranges between genders and in some cases ethnicities [64]. In addition to these factors, during childhood there is a continuous change in muscles, bones and body fat resulting in further complication of the development and interpretation of BMI charts in this age group. Indeed, different expert groups have developed different BMI growth charts, with their respective cutoffs, to diagnose and define overweight and obesity in children and adolescents. These cutoffs are both age and sex specific, to parallel the rapidly changing nature of this period of human life. The Center for Disease Control and Prevention (CDC), the International Obesity Task Force (IOTF) and WHO [65, 66, 67] are among the most prominent authorities, whose reference charts are used both in clinical and research settings (Table 1.3).

Table 1.3: Comparison between the reference BMI charts of different authorities

	Year of the most recent update.	Reference population	Ranges and cutoffs	Age ranges the charts developed for	Remarks
CDC	2000	US population. 5 cross sectional surveys 1963-1994	Normal 5^{th}-84^{th} percentile. Overwt. > 85^{th}. Percentile. Obese > 95^{th}. Percentile.		
IOTF	2000	Brazil, Great Britain, Hong Kong, Netherlands, Singapore, US.	Normal 5^{th}-84^{th} percentile. Overwt. > 85^{th}. Percentile. Obese > 95^{th}. Percentile.	2-18 yrs.	Representation from two Far East countries
WHO	2007	Brazil, Ghana, India, Norway, Oman and US.	Normal 5^{th}-84^{th} percentile. Overwt. > 85^{th}. Percentile. Obese > 95^{th}. Percentile.	5-19 yrs.	Representation from two Asian countries

Overwt: overweight

The main reason for the differences in the underlying cutoffs is the reference population the authority used in developing their charts. For example, the development of the CDC charts involved almost exclusively American children, and therefore it is understandable that these charts would be of limited value if they were to be used in other parts in the world e.g. China.

Waist circumference WC: It is a measure of the minimum circumference in the midway between the lower rib and the iliac crest [68]. It is an important and accepted tool for the assessment of abdominal/ central obesity. WC is a simple, easy and inexpensive tool, which is strongly related to cardio-metabolic risk in children [69]. WC is also better than the BMI in predicting the cardiovascular risk in children [70]. The limitation of the WC measurement is due to the lack of standardization of the measurement location, since there are eight measurement sites used to take the WC measurement. The two most recommended sites are those located depending on a bony landmark: the midway between the lower rib and the iliac crest and directly above the iliac crest (National institute of health and Heart, Lung and Blood Institute). The second limitation comes from the lack of ethnicity specific WC cutoffs in children and adolescents worldwide [71].

Waist Height Ratio WHtR: Is a calculation, which is obtained after measuring the waist circumference WC and the height in centimeters. WHtR is equal to the WC divided by the height. It is used mainly to measure abdominal obesity. Among children and adolescents WHtR is considered as a good indicator for cardio-metabolic risk [69]. It is accurate, simple and does not depend on age like the BMI [72]. Several studies have reported that the WHtR is a better predictor for the cardiovascular risk than both WC and the BMI [72]. Although there are many studies

working to validate the cutoff of WHtR in children and adolescents, these are limited to certain parts of the world. The limitation of the WHtR is due to the lack of uniform validated cutoffs in children and adolescents [73].

Hip Circumference HC: Is a measurement of the widest girth of the participant's pelvis. HC circumference is not an indication of obesity unless it is used in combination with the waist circumference to calculate the Waist Hip Ratio WHR. WHR is not recommended for the estimation of body fat distribution or composition among children [74]. Its use is limited to post puberty when the body fat distribution takes the adult physical pattern [75].

Sagittal Abdominal Diameter: Is the abdominal height or the supine vertical anterior-posterior distance of the abdomen [76]. In children and adolescents the sagittal abdominal diameter has been proven to be a reliable indicator for visceral adiposity [77]. Neither the method nor the cutoffs of this measurement have been developed, standardized nor validated both in children and adults.

Imaging Methods: CT scan and MRI are very useful tools to assess body fat distribution. Their superiority compared with WC comes from their ability to differentiate between the visceral fat adiposity and subcutaneous fat adiposity. The limitations of these imaging techniques are due to their cost and impracticality for adults with severe obesity or hyperactive children. Its use is limited for specific clinical cases and research with a relatively small sample size.

Mid-upper arm circumference and Mid-thigh circumference: Is a measurement of the circumference of the limbs in order to assess their muscle mass as a proxy for

body muscle composition and therefore, the other components of body composition like fat.

Skinfold thickness: Skinfold is “a doubling of skin and its underling adherent subcutaneous tissues [78]. Skinfold thickness is measured by pinching the skin at a standard site so that a skinfold forms. The thickness of the double skin is then measured using calibers; from this measurement body fat can be estimated using tables or computer programs. Skinfold thickness measuring is an inexpensive, simple and widely used method to assess body fat composition. The variation between the subcutaneous fat and total body fat in many cases is one of the limitations related to skinfold thickness measurement. The other limitations are related to the importance of good technical skills and high precision in locating the skinfold measurement site.

Other Obesity assessment tools: Near-Infrared Interactance (NIR) and Localized Proton Magnetic Resonance Spectrometry (MRS) are more specialized methods for assessing adiposity. **NIR** is used to obtain the density of the muscle and fat by placing a prop emitting infrared beam on the thigh, biceps, abdomen and the subscapular. The density of the body area being scanned will depend on the amount of light absorbed, which is related to the amount of fat in that area [79].

MRS is the process of determining the molecular structure of certain parts of the body (tissue or organ) in-order to examine the metabolic and cellular activity of that part. It is used to investigate the presence of fat in the liver, pancreas, heart and muscles [80, 81].

The variety of methods for assessing obesity that have been used in different studies, as well as the different cutoffs for each given tool, has made comparison of results between publications difficult.

Metabolic Syndrome

There have been more than 45 definitions used to diagnose MetS in children and adolescents since 2003 [82]. This multitude of definitions is due to the difficulty to assess the component of the MetS in such rapidly developing period of life [83]. From birth to maturation the human body keeps changing while growing. All the components of MetS i.e. blood pressure, lipid profile, anthropometric measurements, glycemic status and insulin sensitivity are changing throughout the years of childhood and adolescence. These changes are affected by sex [51], pubertal stage [84, 85] and ethnicity [86, 87]. These changes in the components of MetS that occur during childhood and adolescence have been a subject of much discussion, which in turn has generated the various definitions of MetS. These factors resulted in the absence of a single nanimously accepted definition unified of MetS in children and adolescents. Table 1.4 summarizes the differences in the definitions of the MetS between two of the most frequently used definitions in the literature.

Table 1.4: Comparisons between the IDF and NCEP definitions of the Metabolic Syndrome in children and adolescents

	Age category years	WC	TG mg/dl	HDL mg/dl	FBS mg/dl	SBP	DBP
IDF central obesity + 2 of 4	6 < 10	Diagnosis of Mets is not recommended, monitoring WC in case of suggestive family history of Mets & type 2 DM					
	10-16	WC ≥ 90th percentile	≥ 150	< 40	> 100	≥ 130 mmHg	≥ 85 mmHg
	> 16	WC ≥ 94 cm males. WC ≥ 80 cm females.	≥ 150	< 40 males. < 50 females	> 100 or known type 2 DM	≥ 130 mmHg	≥ 85 mmHg
NCEP 3 of 5	12-19	WC > 90th percentile	> 110	< 40	> 110	≥ 90th percentile for age, sex and height.	≥ 90th percentile for age, sex and height.

WC: waist circumference, TG: triglyceride, HDL: high-density lipoprotein, FBS: fasting blood sugar, SBP: systolic blood pressure, DBP: diastolic blood pressure, IDF: International Diabetes federation, NCEP: National Cholesterol Education Program. MetS: Metabolic Syndrome

1.2 Literature Review - Obesity

1.2.1 Prevalence of childhood obesity worldwide.

A review of 39 articles published between 2002-2012 to determine the overweight and obesity prevalence among adolescents 10-19 years old presented high worldwide overweight and obesity prevalence among the adolescents. This prevalence exceeded 30% in five countries such as Bahrain, USA, Canada, New Zealand and Portugal. In Europe the higher prevalence of adolescents overweight and obesity were in the southern countries (20-35%) compared to northern countries

(10-20%). In Asia the prevalence varied widely showing the highest prevalence in the Arab peninsula countries 36.4% and the lowest prevalence in China 2.5% [88].

1.2.2 Prevalence of childhood obesity – North America

In the US 16.9% of children and adolescents (2-19 years) were obese as reported in the 2011-2012 National Health and Nutrition Examination Survey (NHNES) [89]. Comparable prevalence was reported in a longitudinal study that included 7738 children who were followed up from1998 to 2007. In children with a mean age of 5.6 years, 12.4% and 14.9% were obese and overweight respectively. Over time, when the same cohort of children was reevaluated at the mean age of 12.4 years the prevalence increased significantly to 20.8% for obesity and 17% for overweight [90]. According to the Canadian Public Health agency the combined overweight and obesity for children between 2-17 years of age in 1979, 2004 and 2007 was 15%, 26% and 34.4% respectively. It started to plateau 2011-2013 to reach 31.4% [91]. In a 2015 publication by the Center for Disease Control and Prevention (CDC) comparing the prevalence and trends of childhood obesity between Canada and USA, prevalence of obesity in the USA was reported to be higher than in Canada among children and adolescents between 3-19 years of age (17.5% vs. 13% respectively) [92].

1.2.3 Prevalence of childhood obesity – Latin America

In a Colombian cross-sectional study involving children and adolescents aged 5-18 years (n=18,265), the combined prevalence of overweight and obesity among males was 8.5%, 10.8% and 14.1% using the IOTF, CDC and WHO classification systems respectively. While in females the combined prevalence was 14.6%, 13.8% and 17.1% using the IOTF, CDC and WHO classification systems respectively [93].

In Brazil, a systematic review included 21 cross-sectional prevalence studies conducted between 2008-2014 among children and adolescents with a total sample of 18,463 participants. The prevalence of obesity was 16.1% and 14.95% among males and females respectively [94]. In Peru in 2015 a cross-sectional analysis of the data from the Young Lives longitudinal study of childhood poverty was conducted to estimate the prevalence of overweight and obesity among 7-8 year- old children. The analysis included 1,737 participants and determined the combined overweight and obesity prevalence to be 32% among males and 23% among females [95].

1.2.4 Prevalence of childhood obesity – Europe

In a Spanish study (2016) the reported prevalence of overweight was 24% and obesity was 12.7% among 8-9 year- old school children [96]. In northern Italy, in 2016 the prevalence of overweight and obesity in second grade school students (7-8.5 years) was 12.5% and 4.7% among boys and 9% and 5.2% among girls [97]. A French cross-sectional (2012) study included two samples of children from two age categories. The 5 to 7 year- old category included 4048 children and had an estimated overweight and obesity prevalence of 9.5% and 2.2% respectively. The older age range (7 to11 years) included 3619 children and estimated a prevalence of 15.6% and 2.9% for obesity and overweight respectively [98]. A multicenter study involving 8 European counties reported very different prevalence rates of childhood overweight and obesity in 8 different counties, ranging from 40% in southern Europe (Italy, Crypts, Spain and Hungary) to 10% in north Europe (Belgium, Sweden, Germany and Estonia) among 18745 (2-9.9 year- old) children [99].

1.2.5 Africa

The 54 countries making up the continent of Africa are extremely diverse in terms of culture, socioeconomic status and other factors that have been implicated in childhood obesity. Many African countries have suffered from famine therefore obesity studies are relatively less than other continents, with the focus being on research related to stunting and malnutrition.

Studies from North African countries have been included under section 1.2.7 (Middle East and North Africa) because those countries share more similarities with the Middle Eastern countries than the rest of the African continent.

In 2010 a cross sectional study in a rural region of South Africa aimed to investigate the prevalence and patterns of stunting, overweight and obesity. The study included a sample of 3511 children and adolescents aged 1-20 years. They found that no prevalence of overweight and obesity existed among boys, while girls had high combined prevalence of overweight and obesity, which increased with age and maturity to reach 20-25% in late adolescence [100]. A second study in Sudan in 2011, included 1138 (10-18 year- old) school children estimated the combined prevalence of overweight and obesity to be 20.5% [101]. A relatively lower combined prevalence of 5.6% was reported in Tanzanian study that involved 466 children aged 6-17 years [102]. In 2013 in Kenya a cross-sectional study included 344 students from 9-14 years. The combined overweight and obesity prevalence was 19%. In all the previous four African studies the overweight and obesity prevalence were higher in girls than boys [103].

1.2.6 Asia

A Chinese cross-sectional study compared overweight and obesity in males aged 14 years and 18 years reported prevalence of overweight as 17.3% and 5.3% and obesity as 3.8% and 2.3% in the younger and older age group respectively [104]. In another Chinese study that included children aged 7-12 years 14% were overweight and obese [105]. In Nepal, a cross-sectional study that included 986 students aged 6-13 years estimated the prevalence of overweight and obesity to be 14.6% and 11.3% respectively [106]. In a study comparing pooling data from 52 studies conducted in 16 of the 28 states in India the author pointed out a differences in prevalence of overweight and obesity between northern and southern parts of the country. The estimated pooled combined overweight and obesity prevalence was 16.3% in (2001-2005), which increased to and 19.3% (2010-2013) [107].

1.2.7 Middle East and North Africa (MENA)

An Iranian systematic review that included 86 studies estimated that 5-13.5% of children and adolescents were overweight as compared with 3.2% to 11.9% who were obese. [108]. In Turkey, studies conducted over one decade (2000-2010) estimated that the prevalence of overweight ranged from10.3 to17.6% and obesity from 1.9 to 7.8% among children and adolescents between 6-16 years of age [109]. The rates of overweight and obesity among Egyptian adolescents between 13-17 years who were included in the Global School-based student Health Survey conducted by the WHO and CDC was 28.2% for overweight of both genders, while obesity was 7.6% and 8.6% for boys and girls respectively [110]. Even higher prevalence for overweight was reported in a 2015 UNICEF publication, with 29.4% for boys and 35% for girls, while prevalence of obesity was 4.9% and 7.8% for boys

and girls respectively aged 15-19 years. In the same publication, when the age bracket is widened to include younger children (5-19 years), the prevalence of both overweight and obesity increased (35% and 36.4% for overweight and 10.5% and 9.5% for boys and girls respectively [111]. In Lebanon, a cross-sectional study involving 868 participants reported the prevalence of overweight and obesity was 34.8% and 13.2% respectively for both sexes among 6-19 year- old children and adolescents [24].

1.2.8 Gulf Cooperation Council countries (GCC)

The GCC includes the six counties of the Arabian Gulf region (Bahrain, Kuwait, Kingdom of Saudi Arabia (KSA), Oman, Qatar and the UAE). These countries close to each other geographically, many of them sharing borders and have similarities in culture and lifestyle. However, the relative size and populations are different (Table 1.5) [112, 113]. The GCC countries collaborate on some health interventions, disease prevention programs and health policies.

Table 1.5: GCC countries populations, and land areas

Country	Total population	Nationals (%) of the total population	Expatriate (%) of the total population	Land area square kilometer
Bahrain	1,314,562	630,744 (48)	683,818 (52)	770
Kuwait	4,294,171	1,316,147 (30.6)	2,978,024 (69.4)	17,820
KSA	30,770,375	20,702,536 (67.3)	10,067,839 (32.7)	2,000,000
Oman	4,419,193	2,412,624 (54.6)	2,006,569 (45.4)	309,500
Qatar	2,404,776	243,019 (10.1)	2,161.757 (89.9)	11,610
UAE	9,154,000	1,052,710 (11.5)	8,101,290 (88.5)	83,600

Note: GCC. (n.d.). Retrieved November 12, 2017, from http://www.gcc-sg.org/en-us/Pages/default.aspx

Childhood obesity is a major public health issue in these countries. Comparing the results of the epidemiological studies that estimated the prevalence overweight and obesity among children and adolescents between the different GCC countries or any other parts in the world is challenging unless the studies use the same methodology, the same age category and the same definition of overweight and obesity. In the following section, the most recent studies in each of the GCC countries were chosen to be included in the literature review. It is important to appreciate the magnitude of the problem when examining the studies from different GCC countries, in the context of the variation in the population, and hence the number of individuals affected.

In Bahrain in 2008 the prevalence of overweight and obesity was 13.5% and 11.9% for males and 9.1% and 12.3% for females among 6-18 year- old school children using the CDC definition [114]. A more recent study in Bahrain used the IOTF definition and included school children between 10-13 years old estimated the prevalence of overweight and obesity by 15.7% to 28.9% in males, and 21.1% to 30.7% in females [115]. Although the methodologies of the studies are different, it is clear that overweight and obesity is a significant health problem in Bahrain. The combined overweight and obesity prevalence in these two Bahraini studies are almost doubling over a 6-year period.

In Kuwait, among school children aged 10-14 years 44.2% and 46.3% of boys and girls respectively were overweight or obese using CDC definition [116]. In 2015 a cross-sectional Kuwaiti study included 6574 school students from 6-18 years, estimated the prevalence of overweight and obesity using three international standards; CDC, IOTF and WHO. Their reported prevalence of overweight was

17.7%, 23.3% and 21.6% respectively. The prevalence of obesity was 33.9%, 28.2% and 30.5% [117]. According to these findings, more than 51% of the children and adolescents in Kuwait are either overweight or obese, by the consensus of the three international obesity-defining standards. Both studies showed that the obesity affected almost half of the pediatrics population.

In KSA the Arab Teen Life Style study (ATLS) 2014 used the IOTF to determine the overweight and obesity prevalence among 14-19 year- old school students [118]. ATLS included a representative sample of 2908 from the three main urban cities in the eastern, middle and western regions of KSA. The estimated prevalence of overweight and obesity among males was 19.5% and 24.1% respectively, while in females 20.8% and 14%. In 2016 another cross-sectional study conducted in the southwestern rural region included 299 children between 10-15 years of age, with the aim of assessing the relation between overweight and obesity and the physical activity among the study population, comparing these outcomes between participants living in high altitudes with those living in low altitudes. Using the WHO references the estimated combined overweight and obesity prevalence ranged between 23.9%-37% in low and high altitudes for boys respectively, while in girls the prevalence was 24.4%- 44.4% in low and high altitudes respectively [119]. From these two studies it can be concluded that more than one third of Saudi children and adolescents above 10 years of age are either overweight or obese, with the urban population appearing to have a higher prevalence.

The studies summarized in this part were the only three studies found from Oman. In 2004 the prevalence of overweight and obesity among a sample of 550 (15-16) years old adolescents was 15.5% and 9.3% in males and 13.3% and 6% in

females based on IOTF standards [120]. In 2013 a retrospective review of the data of 3,657 subjects (0-15 years old) who consulted any of the services of Sultan Qaboos University Hospital over a period of five years (from 2007 to 2011) was conducted. The estimated prevalence of overweight and obesity using the WHO reference was 11.3% and 9.4% respectively- with no significant differences between males and females-. Children between 10-15 years presented a significantly higher prevalence of overweight (12.4%) and obesity (12.9%) compared to the other age groups [121]. The overweight and obesity prevalence estimated by a recent Omani study was 8.7% and 13.8% in males and 10.9% and 11.5% in females in a study involving 701 high school students (mean age 17.3 years) [122].

In 2014 a review article included eight studies on overweight and obesity in the pediatric population in Qatar during the period between 2003-2013 (n=11,289). The results of this review revealed an increase in childhood obesity prevalence throughout the ten-year period [123]. The initial estimation of the combined overweight and obesity prevalence among 6-18 years old children and adolescents by Bener and his team according to the CDC criteria was 30.8% and 20.6% in males and females respectively. Similar values of 30.4% and 22.3% were reported in males and females respectively when using the IOTF definition [124]. In a subsequent 2011 study with a similar population, Bener et al. [125] estimated the prevalence of overweight to be 18.8% and obesity 5.1%, while the combined overweight and obesity prevalence was 23.9% based on the Qatari growth chart developed in 2005. In these two studies the prevalence of obesity was higher among adolescent males than females. Higher overweight and obesity prevalence reported in studies used narrower age ranges or categories. In 2012, Rizk & Yousef [126], studied 315 Qatari

school children aged 6-11. They used the IOTF definition and revealed a higher prevalence of overweight and obesity at 31.7-32.7% in males and females respectively.

The GCC countries are among the highest worldwide with regards prevalence of childhood overweight and obesity [117]. The rates seem to have increased over the past decade reaching alarming figures approaching one third to one half of the pediatric population in Kuwait, Qatar, Bahrain and KSA while Oman was the lowest.

The UAE is one of the GCC countries and shares with them the issue of childhood obesity being an important health concern. The following section gives an overview of all the studies that have been published in the UAE highlighting the major differences. This makes it easier describe the current work in the context of previous studies done of the same country.

1.2.9 UAE

The UAE total land area covers 83, 600 square km, is composed of seven emirates: Abu Dhabi, Dubai, Sharjah, Ajman, Umm AL Quwain, Ras AL Khaimah (RAK) and Fujairah. The total population of the UAE is 9,154,000 according the 2015 census, of which13.3% are children and adolescents (5-19 years). The capital is Abu Dhabi and each of the seven emirates has its local infrastructure under the umbrella of the federal government [127].

RAK is one of the seven emirates, which lies in the northern part of the UAE. RAK constitutes 2.97 percent of the total area of the UAE, and covers 2,468 square km of its total land area. RAK is the fourth largest emirate of the country and occupies a strategic geographic location having the Arabian Gulf on its west. The

total population of RAK is 231,000, out of which 144,000 are male and 87,000 female [128].

The UAE has been an independent federal country since 2nd December 1971. Dramatic economic growth was coupled with accelerated changes in the social structure occurred after independence. The union of the seven emirates and the profitability of the oil and gas industry were behind this rapid economic evolution. This economic growth resulted in parallel changes in the social structure and lifestyle characteristics of the country, which impacted the health status of the population.

Since 2000, eight studies (Figure 1.1) as well as national statistical reports by UAE authorities have been published. Although all the studies indicate that childhood obesity is a problem in the UAE, the actual estimates on the size of the obesity epidemic seem to vary due to the variation in the studies' methodologies, the geographic regions, the number of the emirates included, and the size and composition of the sample included (Table 1.6).

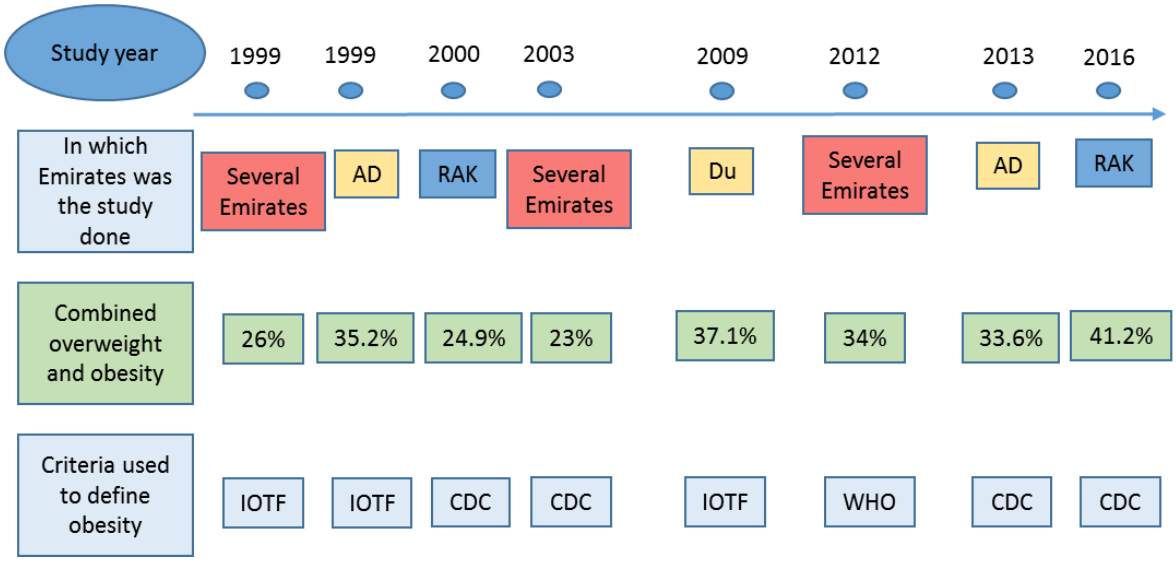

Figure 1.1: Timeline of UAE studies

Al-Haddad et al. [129] report the prevalence of overweight and obesity among 4,075 participants from RAK school children and adolescents (6-16 years) to be 16.5 (males) and 16.9 (females) and 8% (for both sexes) respectively.

Al Hourani et al. [130] study was included 11-18 years old adolescents across 5 emirates on an exclusively female sample of 898 participants in which prevalence of obesity was 9% and overweight 14%.

Al-Haddad's cross sectional analysis (2005) used previous data from the UAE national survey of all the UAE emirates except Fujairah and west area. This analysis included the data of 16391 school students 4-18 years. The prevalence of overweight was 17.1% and 20.1% and obesity 7.7% and 7.1% for males and females respectively [131].

In 2007, Malik & Bakir [132] utilized the UAE national iodine deficiency Survey the data for 4381 (5-17) years old students from Abu Dhabi, Al-Ain and Dubai was used to estimate the prevalence of overweight as 21.5% and obesity as 13.7%. Overweight was higher in girls than boys (22.9% vs. 20.2%).

In Dubai, Bin Zaal et al. [133] conducted a cross-sectional study included 661 school adolescents (12-17 years). The estimated prevalence of overweight was18.5 and 13.1% and obesity 22.2% and 20.5% for males and females respectively.

In 2012, a household cross-sectional study included the seven emirates included 529 children and adolescents. In children (6-10 years) the estimated the prevalence of overweight was 9.1% and 23.6% and obesity15.9% and17.1% for males and females respectively. While adolescents (11-16 years) have higher prevalence of overweight and obesity [134].

Al Junaibi et al. [135] estimated the prevalence of overweight and obesity in Abu Dhabi among 1440 school children (7-18 years) to be 14.7% and 18.9% for overweight and obesity respectively.

In RAK, Al-Blooshi et al. [136] conducted a population based retrospective study of a large cohort of governmental school children (44,900 students) whose ages varied between 3-18 years and over a period of two academic years (2013-2014) and (2014-2015). The estimated prevalence of overweight, obesity and extreme obesity was 41.2%, 24.3% and 5.7% respectively.

All the previous eight studies are summarized in table 1.6. The CDC growth reference was the most frequently used overweight and obesity definition in the UAE studies (4 studies). While the remaining three studies Malik & Bakir [132] and Al-Haddad et al. [131] used the IOTF reference.

The variations in the prevalence reported from the studies in different Emirates may be accounted for by the lack of uniformity in the definitions used to assess obesity, as well as the sampling techniques and the different study designs.

In RAK particularly, there are four studies: two of which reported the overweight and obesity prevalence exclusively for RAK population and the other two reported the prevalence for RAK and other emirates as pooled data. The most recent study was by Al-Blooshi et al. [136] (in which the sample was exclusively from RAK) estimated the highest overweight and obesity prevalence ever reported in RAK and the UAE. The study used a retrospective design that analyzed existing data from students' health records over two phases (academic years 2013-2014 and 2014-2015). Many of the students in the first academic year were included in the second

academic year; subsequently, a certain number of students entered in the analysis twice. The final prevalence data reported was for students in the age category 11-14 years, which is known to have the highest overweight and obesity prevalence due to many factors such as the physiological changes, thereby further magnifying the findings.

Table 1.6: Summary of studies on overweight and obesity in children and adolescences in the UAE

Study	Purpose Aim	Study design	Geographic area & time frame	Population	Sample size	Outcomes measured	Measurements tools	Definition / used	Main results	Remarks
Al-Haddad et al. [129]	Investigate the prevalence of overweight and obesity among UAE school children & adolescents.	Cross-sectional	RAK,	School children & adolescents BOTH sexes 6-16 years	4,075 Boys 1,787 Girls 2,288	BMI	Weight & height	Not specified	Obesity 8% Overweight 16.5-16.9%	Did not examine any determinant. Compared the prevalence with the NHANES of the US.
Al Hourani et al. [130]	Investigate the prevalence of overweight in adolescent females in the UAE.	Cross-sectional	Abu Dhabi, Dubai, Sharja, RAK & Fugairah	11-18 years females only	898 Girls			NHNES reference	Obesity (overwt.) 9% range 7-19 Overweight 14% Range 6-15 (at risk of overwt.)	
Al-Haddad et al. [131]	Assess the national prevalence of obesity among school children (UAE)	UAE national survey analysis Cross-sectional	All UAE. Except Fujairah and west area. 8 educational districts instead of 10 1998-1999	4-18 years. KG 1-grade 12	16391 all UAE nationals	Overwt. & Obesity prevalence Stratified by age and compared to the international standards.		IOTF (Cole et al. [66])	Overwt. 17-20% Obesity 7.7-7.1% Obesity prevalence is age related. The highest from 9-18 yrs. Overwt. 29-27% Obesity 18-11%	Obesity in the UAE is 2-3 times greater than international standards.

Table 1.6: Summary of Studies on overweight and obesity in Children and adolescences in the UAE (Continued)

Study	Purpose Aim	Study design	Geographic area & time frame	Population	Sample size	Outcomes measured	Measurements tools	Definition / used	Main results	Remarks
Malik & Bakir [132]	Determine the prevalence of overwt. & obesity in children in the UAE.	Cross-sectional UAE National Iodine deficiency surveillance study Secondary analysis of the data	1. Abu Dhabi (urban) 2. Al Ain (inland) 3. Dubai rural areas only. 1998-1999	5-17 years	4381 UAE nationals & non-nationals	Overwt. & Obesity prevalence Determinants: Age, gender, nationality/ethnicity, place of birth, area of residence.		IOTF	Overwt. 21.5% Obesity 13.7% Highest in girls than boys. Higher in11-13yrs.	They analyzed the data of the same survey. In the methods it looks like that he generated the data!!
Bin Zaal et al. [133]	Study the association between dietary habits and obesity among adolescents.	Cross-sectional study	Dubai	12-17 years	661 Boys 324 Girls 337	Overwt. & Obesity prevalence Dietary and behavioral habits assessment	Anthropometric measurements Validated questionnaire	WHO	Over weight 18.5% males & 13.1% females obesity 22.2% males & 20.5% females	
Ng et al. [134]	Explore the association between urbanization and wealth and prevalence of overweight and obesity.	Household cross-sectional study	Seven emirates	6-18 years	529 253 (6-10 yrs.) 276 (11-18 yrs.)	Overwt. & Obesity prevalence Sociodemographic, 24-hrs.dietary recall, physical activity.	Anthropometric measurements Validated questionnaire	IOTF	Over weight 9.1% males & 23.6% females obesity15.9% males &17.1% females 6-11 yrs.	

Table 1.6: Summary of Studies on overweight and obesity in Children and adolescences in the UAE (Continued)

Study	Purpose Aim	Study design	Geographic area & time frame	Population	Sample size	Outcomes measured	Measurements tools	Definition / used	Main results	Remarks
Al Junaibi et al. [135]	Estimate prevalence/ determinants of obesity & association with BP.	Cross-sectional	Abu Dhabi 2011	School students 7-18 yrs. Grade 1-12 Gov. schools only	1440 total UAE nationals 1035	Prevalence of underwt. overwt. Obesity Determinants: Diet/lifestyle. Parent BMI socioeconomic variables		CDC	**underwt.** 7.6, 8.3% **overwt.** 14.7, 14.2% **Obesity** 18.9, 19.8% UAE nationals High BMI associated with high BP Higher parental BMI, low diary intake are positive ly associated with high BMI	
Al-Blooshi et al. [136]	Explore the rate/ epidemiology of obesity in large cohort of UAE students	! population based retrospective study	RAK 2013-2015	School students 3-18 years old Gov. schools only	2013-2014 4-12 yrs. **15,500** 2014-2015 **29,400** **44,900**	Prevalence of overweight, obesity& extreme obesity		CDC WHO IOTF	Prevalence of overwt 41.2% Obese24.3% Ext. obese 5.7% By CDC	Private schools not included, method not standardized. Secondary source of data.

1.3 Literature Review-Metabolic Syndrome

The World

The global epidemic of childhood overweight and obesity has been paralleled by an increase in MetS. The overall prevalence of MetS was estimated to range between 0-19% (median of 3.3%) in a systematic review in which Friend and his team presented data from four geographic regions: Europe, the Americas (North, Central and South), Middle East (Tunisia, Turkey, Iran), and the Far East (India, South Korea, China). In overweight and obese children MetS prevalence increased further to reach 11.9% and 29.2% respectively [137]. According to another recent review by Graf and Ferrari, the overall prevalence of MetS among children and adolescents is between 1-23% and increases to reach 60% among obese and overweight [138]. This discrepancy between the prevalence reported in these two reviews may be partly due to the differences in the definition used to diagnose MetS and the different age categories included in the analysis of the various studies since MetS is more prevalent among the adolescents compared to the children. Examining published data on MetS in children in different parts of the world allows us to make comparisons between the prevalence, the factors and the interventions whenever applicable (Table 1.7).

North America

In US the National Health and Nutrition Examination Survey (NHANES) 2001-2006 used the NCEP definition to estimate the prevalence of MetS among a sample of 2456 (12-19 year old) adolescents. The overall prevalence of the MetS was 8.6%, with a higher in males (10.8%) compared with females (6.1%) [52]. This is a

significant increase from earlier data on a similar group, which reported an overall prevalence of 4.2% (males 6.1%, females 2.1%) [139].

Latin America

In Colombia, the prevalence of MetS among 851 adolescents between 10-18 years old was 0.9% by the IDF definition and 11.4% when using de Ferranti definition of MetS in children and adolescents [140]. In Mexico, a cross-sectional study included 225 6-12 year old adolescents and used the IDF criteria to diagnose MetS. They reported a high prevalence of MetS among obese adolescents 44.3% compared to 0.84% in normal weight adolescents [141].

Europe

In Italy, the prevalence of MetS among 439 obese (5-18) year old children and adolescents was estimated to be 17% using the NCEP diagnostic criteria, with higher prevalence among adolescents (21%) compared to children (12%) [142]. The Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) cross-sectional study examined the prevalence of MetS among 1004 (12.5-17) year old adolescents in ten European cities; Vienna, Ghent, Lille, Dortmund, Athens, Heraklion, Pecs, Rome, Zaragoza and Stockholm. The HELENA study used five different definitions to diagnose MetS among children and adolescents. The prevalence was 2.7% using the IDF definition and 3.5% when using the NCEP definition. According the AHA, WHO and Jolliffee and Janssen definitions the prevalence was 2.9%, 1.6% and 3.8% respectively [143]. This is considered to be a big difference in the prevalence of MetS reported in the same study population due to the use of different definitions. This further supports the need to reach a final unified diagnostic criteria for MetS in

children and adolescents to facilitate the comparison between the studies in the same region and worldwide.

Asia

According to the Korean National Health and Nutritional Examination Survey (KNHZNES) the prevalence of MetS was 7.5% in 1998, 9.8% in 2001, 10.9% in 2005 and 6.7% in 2008 among a representative sample of 5652 of 10-18 years children and adolescents in South Korea [144]. This decrease in the MetS prevalence between the KNHZNES III in 2005 and VI in 2008 was due to a national public health intervention related to diet and physical activities at schools. Very similar figures were also reported from China, where the overall prevalence of MetS was 6.6% among a sample of 1844 (7-14) years children and adolescents [145]. The prevalence increases several-fold among overweight and obese children to reach 20.5% and 33.1% respectively

Middle East

Studies exploring the prevalence of MetS among the general pediatric population are few in the MENA region (Table 1.8). In Friend's review, data from the Middle East reported prevalence among children to be 6.8% by IDF definition and 6.5% by NECP definition [133]. In a study conducted among 263 Lebanese adolescents (16-17 years old) the overall prevalence of MetS by IDF criteria was 26.2%. The highest prevalence was observed among obese adolescents (21.2%) compared to overweight and normal weight adolescents, which was 3.8% and 2.1% respectively [146]. In Egypt a case-control study used NCEP definition to evaluate the relationship between obesity and the components of MetS among 7-9 year old children (60 cases vs. 50 controls). The prevalence of MetS among obese children

was 25% [147]. A school base cross-sectional study conducted among 622 female Iranian adolescents (15-17 years old) used the NCEP definition to estimate the prevalence of MetS. The overall prevalence in this exclusively females sample was 6.5%, which increased to 45.1% among obese females [148].

Gulf Cooperation Council countries (GCC)

Studies on MetS in children in GCC countries are limited, and have only been published from 3 of the 6 countries (Kuwait, Saudi Arabia and UAE). A Kuwaiti study included 80 adolescents (40 males); whose mean age was 12.3 years determined the prevalence of MetS 21.3% and 30% using the IDF and NCEP respectively [149]. A recent Saudi cross-sectional study included 509 school adolescents aged between 12-16 years reported prevalence of MetS to be 23.4% [150]. In the UAE, the prevalence of MetS was (13%) according the only study in the country and was limited to the Emirate of Abu Dhabi, which included 1,018 school children and adolescents aged 12 to 18 years. The prevalence was higher in males (21%) compared to females (4%), and increased with body mass index BMI, so that it is more common among overweight and obese children and adolescents [151]. Comparing between MetS prevalence in children and adolescents across different parts in the world is difficult due to the lack of consensus of a unified definition, diagnostic criteria, and the cutoffs values.

Table 1.7: Prevalence of Metabolic Syndrome in children and adolescents in the selected studies for the literature review

	Country / Region	Yr.	Age	MetS. Dx.	Over all prevalence%	Prevalence obese%	Males%	Females%	Sample-size
Cook et al. [139]	US	2003	12-19	NCEP	4.2	OB. 28.7 OW. 6.8	6.1	2.1	2430
Johnson et al. [52]	US	2009	12-19	NCEP	8.6		10.8	6.1	2456
Agudelo et al. [140]	Colombia	2014	10-18	IDF	0.9				851
Guzmán-Guzmán et al. [141]	Mexico	2015	6-12	IDF	0.84	44.3			225
Brufani et al. [142]	Italy	2011	5-18	NCEP		17			439
Vanlancker et al. [143]	Europe	2017	12.5-17	IDF NCEP	2.5 3.5				1004
Chung et al. [144]	South Korea	2012	10-18	NCEP	1998- 7.5 2001- 9.8				5652
Liu et al. [145]	China	2010	7-14	NCEP	6.6	OB. 33.1 OW. 20.5			1844
Nasreddine et al. [146]	Lebanon	2012	16-17	IDF		OB. 21.2 OW. 3.8			263
Zaki et al. [147]	Egypt	2012	7-9	NCEP		OB. 25			60 cases obese 50 controls non
Mirhosseini et al. [148]	Iran	2009	15-17	NCEP	6.5*	OB.45.1*			622 *
Al Boodai et al. [149]	Kuwait	2014	12.3 #	IDF NCEP	21.3 30				80
Al-Daghri et al. [150]	KSA	2016	12-16	NCEP	23.4				509
Al Mehairi et al. [151]	UAE	2013	12-18	IDF	13		21	4	1,018

Yr: year of publication, US: United States of America, KSA: Kingdom of Saudi Arabia, UAE: United Arab Emirates, MetS: Metabolic Syndrome, MetS. Dx: MetS diagnostic criteria or definition, IDF: International Diabetes Federation, NCEP: National Cholesterol Educational Program, AHA: American Heart Association, WHO: World Health Organization, OB.: obese, OV.: overweight, NW.: normal weight.(*) Females only study sample. (#) Mean age of the study sample.

Table 1.8: Summary of studies on Metabolic Syndrome in children in the MENA Region

Studies	Purpose Aim	Year of pub.	Study design	Geographic area & time frame	Population	Sample size	Outcomes measured	Definition/ used	Main results
Al Mehairi et al. [151]	Estimate the prevalence of MetS & its correlates in a sample of adolescents	2013	Cross-sectional School based	UAE AL Ain & Abu Dhabi schools 2010	School students 12-18 years old Gov. schools only	1,018	MS prevalence (lipid profile, bld glucose, BP, wc, ht. wt. BMI.) and questionnaire	IDF	Prevalence of MetS. 13% Boys 21% Girls 4% MetS more in obese over wt. and sitting time.
Boodai et al. [149]	Determine the prevalence of cardiometabolic risk factor abnormalities and MetS(MetS)	2014	Cross-sectional study	Kuwait 2014	Mean age 12.3 yrs.	80 40 males 40 females		IDF & NCEP	The prevalence of MetS 21.3%IDF 30%NCEP
Al-Daghret al. [150]	To assess the relationship between SHBG & MetS	2016	Cross-sectional School based .	Saudia Arabia	Boys 226, girls 283	age 12-16 years	MetS prevalence (lipid profile, bld glucose, BP, wc, ht. wt. BMI.) and SHBG	NCED (ATP III)	23.4% is the prevalence of MetS among Saudi adolescents SHBG associated with MetS in boys not in girls.
Zaki et al. [147]	Assess the association between obesity and different components of MetSin obese children	2012	Case-control study	Egypt 2010	7-9 years children	Case: *obese* 60, (28 boys, 32 girls) Control: non obese 50(25 boys, 25 girls)	(lipid profile, bld glucose, BP, wc, ht. wt. BMI.) Us to measure the subcutaneous & visceral fat	NCED (ATP III) Cook criteria	25% of obese children had MetS MetS strongly associated with abdominal obesity and high IR
Mirhosseini et al. [148]	Determine the prevalence of MetS.	2009	Cross-sectional school based study	Iran	Girls 15-17 years old	622	(lipid profile, bld glucose, BP, wc, ht. wt. BMI.)	NCED (ATP III)	6.5% in general 45.1% in obese subjects. Carb. Rich diet, SES, FHx r strong determinants of MetS.

1.3.1 Association between childhood obesity and Metabolic Syndrome

MetS in children, childhood obesity, MetS in adults, adult obesity, diabetes and cardiovascular diseases are interrelated in different ways (Figure 1.2).

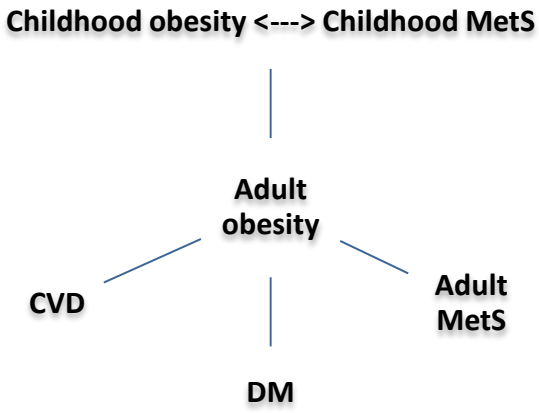

Figure 1.2: Schematic diagram showing relationship between obesity, MetS and NCDs

Childhood obesity is a risk factor for the development of adult obesity. In other words, individuals who are obese as children are at a greater risk of being obese as adults.

Although no direct link has yet been reported between MetS in children and adult metabolic syndrome, the complex relationship leads us to hypothesize childhood MetS may be a significant risk factor for adult cardiovascular diseases and diabetes mellitus. However, MetS is higher in overweight and obese children and adolescents than those with normal weight [152,153].

In adults, strong pathogenic link between obesity, MetS and diabetes mellitus has been clearly identified [154]. Diabetic adults with MetS have double the risk of death from cardiovascular conditions and triple the risk of cardiovascular complications [155, 156].

In children, no direct link has yet been reported. However, MetS is higher in overweight and obese children and adolescents than those with normal weight [151], [152]. Furthermore, childhood obesity is linked to adulthood obesity [157]. Collectively these findings may indicate a possible association between childhood obesity, MetS and development of cardiovascular complications.

1.4 Statement of problem

What we know about childhood obesity?

Several studies have shown overweight and obesity to be a problem among children and adolescents globally and locally. The recently published UAE data indicate that the magnitude of the problem is increasing.

What will the current study add?

Official school health statistics in the UAE indicate that the epidemic of childhood obesity is growing rapidly. Therefore continuous estimation of the magnitude of the problem is required. Although several studies on prevalence of obesity in the UAE have been published, reported values vary, possibly because of the different methodologies used in the studies done prior to our study, such as different definitions of obesity, different sampling frames and sample sizes.

There are many genetic, environmental and lifestyle factors associated with overweight and obesity among pediatrics age group. Worldwide there are well established childhood obesity determinants in terms of their existence and being either positively or negatively association with the high prevalence of children obesity. We know little about how these factors interact in our settings and what patterns of association exist between them and increasing obesity rates among our

children and adolescents. In the current study we focused on a wide range of possible determinants of obesity (mainly modifiable) in a different way than previous studies by using tools (mainly questionnaire) developed and used by the International Study of Childhood Obesity Lifestyle and the Environment (ISCOLE) in 12 different countries in the world [158]. In the original ISCOLE study, none of the Gulf countries were included, where obesity is highest in the world. Therefore generating data from this region would provide valuable information on how to base future interventions. Our region has a unique culture, lifestyle, attitudes and perceptions therefore we need to have reliable data from our setting as a first step towards developing interventional strategies based on in-depth understanding of the culture, lifestyle, attitudes and perceptions.

MetS is a common metabolic complication established among children in a lower extent than in adults. In the UAE there was one study that estimated the prevalence of MetS in children, and that was limited to the emirate of Abu Dhabi. Considering the possible variable results that can be obtained from different regions/emirates on the prevalence of MetS in the UAE, it is worthy to re-estimate the prevalence in one of the northern emirates RAK as the previous study was conducted in the capital southern region.

1.5 Research questions

1. What is the prevalence of obesity and MetS among children and adolescents in RAK, UAE?
2. What are the determinants of obesity and MetS among children and adolescents in RAK, UAE?

1.6 Aims

The first aim of the study is to measure the prevalence of overweight, obesity and MetS among a sample of school children and adolescents in RAK. The second aim is to explore the potential determinants of overweight, obesity and MetS among a sample of school children and adolescents in RAK.

1.7 Objectives

1. To estimate the prevalence of overweight, obesity and to determine the factors associated with overweight and obesity.

2. To estimate the prevalence of MetS and to determine the factors associated with MetS.

3. To explore the difference in prevalence when using three different definitions namely the Center for Disease Control and Prevention (CDC) growth charts, the WHO growth charts and the International Obesity Task Force (IOTF) definition.

1.8 Research significance/expected benefits

Any effective interventional programs should be based on a solid understanding of the factors that are causing the problem. In other countries, intervention programs were developed based on the clear understanding of the obesity determinants in those populations. Here in our setting we need to tailor the intervention, focusing on the most potential factors contributed to the problem of children and adolescent obesity.

Chapter 2: Methods

2.1 Introduction

This chapter describes in detail the methods used in the study. The methods were based on the recent ISCOLE study [158] with adaptation, as will be explained below.

2.2 Research design, setting and subjects

This cross-sectional study was conducted in a sample of government and private schools in the emirate of Ras Al Khaimah (RAK), during the academic year 2016-2017. The subjects were school pupils from grade one to grade twelve (6-18 years old). The inclusion criteria were: student attends either a public or private school in RAK, age between 6-18 years. The exclusion criteria were: students without consent, students beyond the specified age range and students with severe comorbidity i.e. medical conditions that interfere with daily normal life activities of the student such as severe recurrent epileptic attacks or students who use a wheel chair or are unable to stand or walk. This type of information was obtained from the school nurse and/or administration.

2.3 Sample size estimation

A systematic search of the literature describing the prevalence of obesity and MetS in children and adolescents was carried out. The studies revealed the prevalence of obesity and MetS in children and adolescents globally and locally, to help to estimate the sample size of the current study.

Based on a recent study on prevalence of obesity amongst school children Al Junaibi et al. [135], we set the expected prevalence of overweight and obesity to be 33.6%.

We expected the non-response rate to be around 20%. The alpha level was set to 0.05 so that we have a 95% confidence interval. The precision (D) of the confidence interval was set to be 5% so that the width of the 95% CI is at maximum 2*5% = 10%. The design effect (DEFF) is taken to be 2. According to the assumptions above we will need a sample of size n=1200 school students to achieve the desired precision $\frac{1.962p(1-p)(DEFF)}{d^2}$.

2.4 Sampling and randomization

The student population in RAK is diverse, comprised of many different nationalities. They have the option of attending either public schools (which are segregated) or private schools (which are coeducational). There are two categories of public schools: cycle 1(grades 1-5) and cycle 2 (grades 6-12), with independent premises for schools from each cycle. In the private schools grades 1-12 are on the same premises.

Since we wanted to compare the prevalence and determinants of obesity and MetS of different strata of the students (i.e., males vs. females, public vs. private and children vs. adolescents) we used a multi-stage stratified random sampling technique using gender, type of school and grades as units. This type of sampling helped to ensure that the overall study sample had representation from the different subgroups of interest of the study.

Boys and girls attending the government schools in the UAE are separated (single sex schools) because of the cultural traditions, while most private schools are mixed. The government schools are classified according to the educational stages into two types. Cycle 1 schools include the students from grade one to grade five. Cycle 2 schools include the students from grade six to grade twelve. Initially the original RAK Educational Zone schools list was divided into two lists: government and private. In the second stage, the government schools were further divided into two lists. These were the boys' and the girls' schools' lists. In the third stage, both the boys and the girls' schools were separated into cycle one and cycle two. Finally, we extracted five lists of schools (Figure 2.1):

1. The private schools.
2. Government boys' schools cycle one grades1-5.
3. Government boys' schools cycle two grades 6-12.
4. Government girls' schools cycle one grades 1-5.
5. Government girls' schools cycle two grades 6-12.

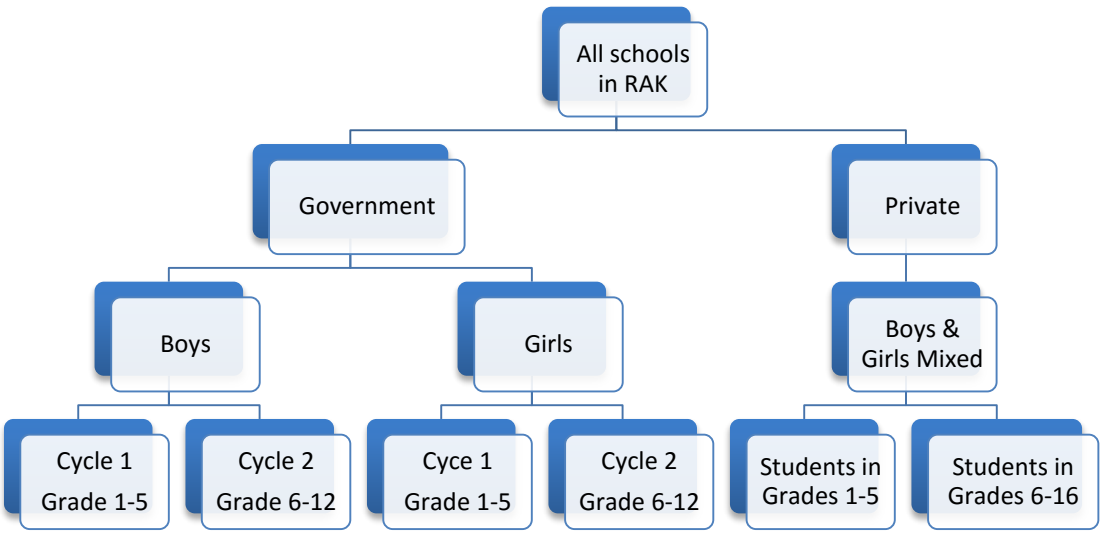

Figure 2.1: Schematic diagram of the multistage stratified sampling technique

The Statistical Package for Social Sciences SPSS version 21 was used to conduct the randomization procedure. Specifically, the five identified lists created from the original RAK Educational Zone schools list, were imported into SPSS separately and then a representative sample of schools was randomly selected. Two private and four government schools (Table 2.1). The first two schools approached were government schools coded A and B (Table 2.2) the study coordinator at each school chose the classes which would be included in the study, as per convenience (i.e. classes had to have an art lesson or a physical education lesson on the study day). However based on the low response rate, the sampling technique was modified for the remaining four schools, such that all divisions of the class were included, and all students attending school were given the study envelopes containing the forms.

The total number of students in the 63 government schools was 32,998. This number was reduced to **29,256** after exclusion of kindergarten (KG) children aged less than six years. The total number of students in the 26 private schools was 24,944 and was reduced to **20,602** after excluding KG children. Fifty nine percent (59%) of RAK school students were enrolled in the government schools and 41% in the private schools. In accordance with these figures we decided to recruit 59% (708) of the 1200 students in the sample from the government schools, and 41% (492) from the private schools. The number of students was selected in proportion to the school size, to ensure a representative sample from each school (Tables 2.2, 2.3).

Table 2.1: Total number of the sample selected in proportion to total population of the school students in RAK

	Governmental schools	Private schools	Total
Total student population	29,256	20,602	49,858
Total percentage of students	59%	41%	100%
The total students no. in the sample	708	492	1200
The total no of the students actually participated in the study	706	503	1209
The no. of the schools selected in the sample	4	2	6
Type of schools	2 males schools 2 females schools	2 mixed schools	6

Table 2.2: Description of the Government schools, sample and data collection details

School #	Code	Name	Type	Grades	Size	%	Sample size	Actual sample	Difference from required sample	Time period spent in each school for data collection from-to		No. of Blood collections
1	A	Al Ofooq	Girls	1-5	627	30%	212	220	+8	9 Oct. 2016	17 Oct. 2016	
2	B	Al Royaa	Girls	6-12	594	29%	205	183	-22	31 Oct. 2016	7 Nov. 2016	112
3	C	Khatt	Boys	6-12	247	12%	86	100	+14	20 Nov. 2016	24 Nov. 2016	100
4	D	Al Mansoor	Boys	1-5	608	29%	205	203	-2	15 Nov. 2016	17 Nov. 2016	
Total					2,076	100%	708	706	-2			212

Table 2.3: Description of the Private schools, sample and data collection details

School #	Code	Name	Type	Grades	Size	%	Sample size	Actual sample	Difference from required sample	Time period spent in each school for data collection from-to		No. of Blood collections
5	E	RAK.M.PS	Mix	1-12	911	47%	231	202	-29	9 Dec. 2016	17 Dec. 2016	98
6	F	ATI.PS	Mix	1-12	1044	53%	261	301	+40	22 Jan. 2017	30 Jan. 2017	110
Total					1955	100%	492	503	+11			208

2.5 Ethical approval

2.5.1 Ethics committee approval

Prior to the pilot and the main study the protocol of the study was reviewed by two Research Ethics Committees: the Al Ain Medical District Human Research Ethics Committee (AAMDHREC) reviews human research proposals from the United Arab Emirates University (UAEU), and granted approval on 16 June 2016 (Approval No ERH-2016-4351_43). And Ministry of Health and Prevention Ethics Committee (MOHPEC) reviews human research proposals from MOHP, and granted approval on 30 June 2016 (Approval No 7) (Appendix 1).

2.5.2 Regulatory approval

In addition to the ethics clearance, research conducted in educational settings in the UAE require approval from the relevant regulatory authority. The related authorities in the current study were RAK Educational Zone and RAK Medical District from which approval was obtained prior to initiation of the study (Appendix 2).

The principals of the six schools that participated in the study were also approached and enlightened about the study.

2.5.3 Privacy and confidentiality

Participants were assigned a code number and the data was kept in a secure locker in the Institute of Public Health, College of Medicine and Health Sciences in the United Arab Emirates University in Al Ain. Confidentiality of the information acquired was ensured by securing in password-protected computer, and all information was coded. The key to the code was saved securely away from the data;

the researcher and the principal investigator accessed the information for research purposes. Each student had a unique ID sticker placed on all his/her forms and the test tubes and results. All the forms were sent home in an envelope with instructions to complete them and return them sealed.

2.6 Data collection

This section is a description of the tool and materials used to collect the data, followed by an explanation of the study procedures.

2.6.1 Data collection tools

Questionnaires

The questionnaires were adapted from the International Study of Childhood Obesity, Lifestyle and Environment (ISCOLE) demographic and family health questionnaire and the ISCOLE diet and lifestyle questionnaire [158].

The ISCOLE is a multi-national and multi-center cross sectional study conducted between 2011-2013 in 12 study sites around the world (Australia, Brazil, Canada, China, Colombia, Finland, India, Kenya, Portugal, South Africa, United Kingdom, and United States). The main objective of ISCOLE was to determine the relationship between lifestyle and obesity. ISCOLE was characterized by its rigorous quality control program and highly standardized measurement protocol. It comprises of four questionnaires; demographic and family health questionnaire, diet and lifestyle questionnaire, neighborhood and home environment questionnaire and school environment questionnaire.

In the current study we used the demographic and family health and the diet and lifestyle questionnaires, because studying the neighborhood and school environments and their effects on obesity was beyond the scope on this study. The English version of the ISCOLE questionnaires was translated to Arabic, and then back translated to English by an independent translator. There were no discrepancies between the initial and the back translations of the questionnaires; all the concepts were equivalent. At that level we realized that the diet and life style questionnaire was long and difficult for children below 10 years (grade 1-5). Since the original ISCOLE questionnaire targeted the students with a mean age of 10 years. A shorter version of diet and life style questionnaire was created for these younger students. This was done by removing the long and difficult questions as summarized in Table 2.5, based on the researcher's experience and interaction with children of the same level.

ISCOLE demographic and family health questionnaire covered ethnicity, socioeconomic status of family, residential address, health history of participant and parents, family structure, age, education, stature and weight of biological parents

ISCOLE diet and lifestyle questionnaire included self-reported daily physical activity, out-door time, television viewing and computer use, physical education, active transport to school, motivation for and attitudes towards physical activity, eating in front of television, frequency of eating breakfast, school lunches and outside the home, emotional eating, sleep duration and quality, self-rated health and well-being [24]. In the current study we adapted the questionnaire by removing a few questions and adding some others. The questions that were culturally sensitive,

beyond the specific aim of the study or not applicable were removed. Table 2.4, 2.5 summarize the modifications of the ISCOLE questionnaires.

Table 2.4: Summary the modifications of the ISCOLE Demographic and Family Health Questionnaire

	Question	Type of modification	Justification/s
Demographic and Family Health Questionnaire	Nearest cross street to home	Removed	Not adding information
	Gender	Removed	Added to the body measurement box, to avoid duplication
	Ethnicity	Removed	Difficult to assess in the UAE
	Nationality	Added	UAE is a multinationals country
	Marital status of the parents	(Never married) removed	This answer option culturally unacceptable
	Family structure	Removed	Not applicable
	Family combined income	Modified	Annual to monthly and income ranges options modified
	Functioning motorized vehicles	Modified	Limited only to cars, motorcycle and moped used for leisure not as transportation mean main.
	Television service	Removed	Not applicable
	Type of internet service	Removed	Not applicable
	No. Of TV.s at home	Added	To evaluate sedentary behaviors/ SES
	Hours per week mother spend outside	Removed	Difficult to evaluate
	Hours per week father spend outside	Removed	Difficult to evaluate
	Is this child is adopted	Removed	Culture sensitive
	Do you have house maid if yes how many	Added	To evaluate sedentary behaviors/ SES
	Father occupation	Added	To evaluate the SES
	Emirates father work	Added	Fathers work in different emirates in many families in RAK
	Mother occupation	Added	To evaluate the SES
	Father and mother education	Modified	The options modified, in some families there are still parents with less than primary school.

Table 2.5: Summary the modifications of the ISCOLE Diet and lifestyle Questionnaire

	Question	Type of modification	Justification/s
Diet and lifestyle Questionnaire	Who prepare food at home	Added	What effect the presence of domestic helper can has
	Time outside before school	Removed	In the UAE schools starts early no chance to spend timeout before the school.
	Transportation to school	Modified	Answer choices modified (walk, car, bus, other…. specify if other)
	Questions from 11 to 21	Removed	Examining the physical activity in details and depth
	FFQ sport drinks	Removed	Too detailed
	Table asking about eating certain food items while watching TV	Removed	
	Food Frequency Questionnaire	Removed from the short Diet and lifestyle Questionnaire	
	Emotional eating (7 questions)		
	Self-rated health and well-being (11 questions)		

Anthropometrics measuring tools

Weight: SECA Robusta 813 electronic flat scale, the lowest precision was 0.01 kg.

Height: SECA 213 portable mobile stadiometer weighing only 2.4 kg the lowest precision is 0.1 cm.

Waist and hip circumference: SECA 203 ergonomic circumference measuring tape was used to measure waist and hip circumferences the lowest precision is 0.1 cm.

Blood pressure apparatus

The Omron M2 Basic is a fully automatic one-touch upper-arm monitor. Blood pressure was measured with participant seated comfortably, back supported, upper arm bared. The participant arm was supported at the heart level. The appropriate cuff size was decided when placing it on the participant arm by

comparing the range markers on the cuff. The range markers should not be overlapped or too short. Three cuffs' sizes were used. The child cuffs for children with arm circumference less than 23 cm. The adult cuffs were used for children with arm circumference less than 33 cm. And the large adult cuffs were used for participants with arm circumference less than 50 cm.

Blood collection equipment

All blood investigations were done through the Medicare Medical Labs (MMLs). MMLs established in RAK-UAE in year 2000 until present date, is a standalone medical laboratory, licensed by MOHAP as a diagnostic center (Appendix 3).

The blood samples required for analysis were collected in two types of tubes. These were the potassium EDTA for hematology, and lithium heparin for routine chemistry.

Cotton, gloves, spirit swaps, plasters, needles, syringes, tourniquets, iceboxes etc. were prepared and kept in the school nurse's room during the blood collection days.

Research team

1. Main data collection team: was a team of four individuals constant throughout the duration of the study in the six schools. The team consisted of the main researcher (Dr. Mouza Al Zaabi) and three nurses (Huda AL Shehhi, Mona Hasan and Aisha Mazen).

Tasks: To explain the study aim and steps to the students directly prior to starting the questionnaire and measurements. To read the questionnaire if required and answer students' inquires. To measure the weight, height, waist and hip circumferences and the blood pressure.

2. The school nurse. Assisted the main team. Dealing directly with the school administration/ teachers to schedule the research team visits to the school. She controlled the students' flow to the four stations during the anthropometric measurements, and to the school clinic during blood collection. She organized and managed the students during the measurement process.

3. Laboratory phlebotomist. Withdrew the blood samples from the students who consented and fasted, and transported the blood to the laboratory within three hours of blood collection.

2.6.2 Training workshop

Anthropometric measurement training workshop was held in the Dental Center conference room in RAK, on the 22nd of September 2016. The aim of the workshop was to standardize the procedure of the anthropometric measurements during data collection for all the students participating in the current study, throughout the six schools. All the research nurses were required to perform the measurements using a standard technique on which they received theoretical and practical training.

The training was done by Mr. Akram Khaled Al Ahmad, assistant director of nursing in Rashid Hospital Dubai, an external trainer who had previous experience with studies using similar procedures. The nurses of the randomly selected six

schools and the data collecting team attended a four-hour workshop. The workshop covered the study protocol, data collection tools and all study procedures. The training included a theoretical and practical session on standardization of anthropometric measurements. A participant was considered to be trained only after successfully completing a competency evaluation.

The **weight** measuring procedure was to weigh the student without shoes and with light clothing. The participant stood looking straight, hands at his side, and in the center of the platform of the scale. The measurement was rounded to the nearest 0.1 kilograms. **Height** was measured for the student without shoes, facing the investigator and his back to the vertical measuring bar. The participant was asked to stand up straight with the heels of both feet together. The vertical stadiometer bar was in contact with the back of the head, shoulder blades and the buttocks. The height was rounded to the nearest 0.1 centimeter. **Waist and hip circumferences** were measured when the participant was standing with feet close together and the weight equally distributed on both legs. The tape was horizontally placed, against the body but not compressing the skin. The measuring tape was placed just above the iliac crest when measuring the waist circumference, and around the widest girth of the participant's pelvis when measuring the hip circumference. The measurement was taken just after exhalation and then rounded to the nearest 0.1 centimeter. In the current study hip measurements were limited to students of grades 11 and 12 (ages 16-18) to ensure they had reached puberty, because assessment of pubertal stage for younger adolescents, in a research setting using the Tanner Scale is culturally sensitive and unacceptable.

2.6.3 Pilot study

The pilot study was conducted from 9 to 13 October 2016, and included 30 students in grades 3 and 4 from school A. The first school was a government cycle 1 girls' school, from which we received the first acceptance of our invitation to start the project. The purpose was to examine the clarity of the questionnaires and feasibility of the implementation of the data collection procedure. There was no need to change any part of the questionnaires and the forms sent to the parents. The results obtained from the pilot sample were included in the main study.

2.6.4 Study conduct and procedure

Step 1: The main researcher visited the study classes in the school and explained the project's aims and steps to the students. Envelopes were sent home to the child's parent(s) containing detailed information sheet about the study, the parental consent form that needed to be signed and returned to the school and also the parent questionnaire. All the forms within the envelope were available in Arabic and English (Appendix 4). The documents were given to the students in the parents' preferred language. This information was obtained from the student and the school representative (teacher or nurse). Parental envelopes were distributed to schools one week prior to the scheduled data collection so that the child's parents had sufficient time to read the information and decide whether or not they would like their child to take part in the study. The contact details of the main researcher, Dr Mouza Al Zaabi, were clearly stated on the parental letter. Parents were able to contact her to discuss any issues or questions they had regarding the study. Parents were required to return the completed forms to school indicating whether or not they agree for their child take part in the study.

Step 2: On the day of data collection, eligible and consented children had the study summarized to them in simple language and were given an opportunity to ask questions. Then the students were invited to provide assent using the assent form (Appendix 4). The school representative was present during the briefing. Children that did not have parental consent and/or did not provide assent participated in a separate classroom activity not related to the study. The eligible and consented students in grades 3 to 12 were asked to read and answer the diet and life style questionnaire. For students in grades 1 and 2 the diet and life style questionnaire was sent home for the mother to complete. The data collection process took place in the nurse's room or in a big conference room depending on the facilities available in each school. The room was divided into four stations for data collection. Screens separated each station to maintain privacy. In each station there was a member of the data collection team measuring the weight, height, waist and hip circumferences and the blood pressure.

All the measurements (weight, height, waist circumference, hip circumference and BP) were taken using the same standardized SECA scales, calipers, tapes and OMRO sphygmomanometers, using the standardized measuring procedure for all participants as described above in the training workshop section. For each student that was enrolled all measurements were taken at the same time by the same research assistant. All measurements were taken for four students at one point of time. Before leaving the examination station the students who consented to give a blood sample were asked to come fasting at least for ten hours the assigned day of the blood collection. Average inter-and intra observer technical errors of measurement for height were 0.23 cm and 0.24, for waist circumference 0.33 and

0.27, and hip circumference 0.23 cm and 0.41 cm respectively (conducted on separate samples).

Step 3: The blood collection procedure took place inside the nurse room in the school. Each participant was asked whether or not he/she was fasting from the previous night before taking any blood sample. A registered phlebotomist (from the Medicare Medical Labs) collected five milliliters of blood from each student. Since the students have been fasted for 12 hours a free meal was given to each student before leaving the nurse's room and going back to their classes. The blood samples were transported to the laboratory within three hours of blood collection to avoid any reduction of plasma glucose concentration and a biased low plasma glucose measurement. Blood investigations included fasting blood glucose (FBS), Glycosylated haemoglobin (HBA1c), high-density lipoprotein (HDL), low-density lipoprotein (LDL), triglyceride (TG), total cholesterol (Chl), haemoglobin (HB), vitamin D and vitamin B12.

The main researcher received and reviewed the blood tests results within one week of the blood collection. Students who wished to receive their results were given a copy of the blood result with brief summary about the findings of the blood investigation. In the current study we decided to assess MetS using the most widely applied definition in research studies and the clinical settings: The International Diabetes Federation (IDF) definition of MetS in children and adolescents [159].

2.7 Variables

2.7.1 Independent variables and dependent (outcome) variables

Independent variables and outcome variables are summarized in Table 2.6.

Table 2.6: Summary of the independent and dependent variables

Variable	Variable type	How it will be measured
a. Demographic variables (child)		
Age	Continuous	Date of birth
Sex	Binary	Male or female
Nationality	Categorical/ Nominal	UAE/non UAE nationals (Arabs, Asians, others)
Family size	Categorical	No. of family member living in the same address
The ages of biological siblings	Discrete	The ages in years
House hold address/ &	Categorical	Rural vs urban
Duration	Discrete	Months/ Years
b. Health history of the child		
Birth weight	Continuous	Kg or grams
Birth length	Continuous	cm
Duration of pregnancy	Discrete/ Continuous	Months or weeks
History of gestational DM With this child	Binary	Yes/no
Breast feeding	Binary	Yes/no
Duration of breast feeding	Continuous	Months/ years
Artificial feeding	Binary	Yes/no
Duration of artificial feeding (age of child when completely stopped it)	Continuous	Months/ years
Maternal smoking during pregnancy with this child	Binary	Yes/no
c. Family demographics and health		
Marital status of child's parents	Nominal	Married/divorced/ widow
Family size	Discrete	No of people living with child
Family income	Categorical	Combines income, to be specified later
SES	Discrete	No. of functioning motorized vehicles
SES	Discrete	No. of TV sets at home
Mother education	Ordinal/ categorical	Less than primary school/Primary school/ High school/ Diploma/ Bachelor degree/Graduate professional degree.
Father education	Ordinal/ categorical	Less than primary school/Primary school/ High school/ Diploma/ Bachelor degree/Graduate professional degree.
Mother age	Continuous	Years
Mother weight	Continuous	Kg

Table 2.6: Summary of the independent and dependent variables (Continued)

Variable	**Variable type**	**How it will be measured**
Mother height	Continuous	Meter/ cm
Mother BMI	Ordinal	Underweight, normal weight, overweight, obese
Mother age at child's birth	Discrete	Years
Father age	Continuous	Years
Father weight	Continuous	Kg
Father height	Continuous	Meter/ cm
Father BMI	Ordinal	Underweight, normal weight, overweight, obese
d. Child's physical activity		
Hours of TV watching at school day/ weekend	Continuous	0-more than 5 hrs/day
Hours of video/computer games at school day/ weekend	Continuous	0-more than 5 hrs/day
Hours spent outside at school day/ weekend	Continuous	0-more than 5 hrs/day
Transportation to school	Nominal	Walk/ bicycle/car/bus/others
Time duration to school	Continuous	From < 5 min. to > 1 hr
e. Child's sleeping		
Start sleep school day/ weekend	Continuous	Time of turnout the light
Getup at school day/ weekend	Continuous	Time of woken up
Self-rating of sleep quality and quantity	Nominal	Very good/fairly good Very bad/fairly bad
TV at child's bed room	Binary	Yes/No
f. Child's dietary habits		
Frequency of eating fruits per week	Discrete	Never-6 days per week OR Once a day / every day more than once
Frequency of eating vegetables per week	Discrete	Never-6 days per week OR Once a day / every day more than once
Frequency of drinking milk & eating milk products per week	Discrete	Never-6 days per week OR Once a day / every day more than once
Frequency of eating sweets/ candy/cakes etc. per week	Discrete	Never-6 days per week OR Once a day / every day more than once
Frequency of drinking fruit juices/energy drinks/cola etc. per week	Discrete	Never-6 days per week OR Once a day / every day more than once
Frequency of having breakfast per week at school days and weekend	Discrete	Never-6 days per week OR Once a day / every day more than once
Eating at school	Discrete	0-5 days per week
Having meals prepared away from home in the past week	Discrete	No of meals
Who prepares meals at home	Nominal	Mother/ chef/house maid/ other specify
g. Emotional eating		
h. Self-rated health		

2.7.2 Potential confounders

Age, sex, ethnicity and socioeconomic status were considered as potential confounders. These were controlled in the analysis by stratification and logistic regression.

2.8 Statistical methods

After the data has been collected any students who have more than 50% missing data were excluded from the analysis

1- Descriptive statistics were used first including the estimation of the prevalence with 95% confidence intervals.

2- The differences in these estimates of prevalence were investigated between males and females, children and adolescents and UAE nationals and non-nationals.[1]

3- One of the objectives was to identify risk factors that increase the likelihood of overweight, obesity or MetS. Multiple logistic regression analysis was used to achieve this objective, where the dependent variable was combined outcome of overweight and obesity or MetS and the independent variable was the list of all potential risk factors. Stepwise methods and Least Absolute Shrinkage and Selection Operator (LASSO) logistic regression were used to identify the set of significant factors in the multiple logistic regression model.

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[1]UAE national: is a person who carries its passport and citizenship according to the UAE low.
Expatriate: person living in the UAE, having a citizen ship other than that of the UAE.
Child: is a person 19 years old or younger.
Adolescent: a person aged 10-19 years.
http://www.who.int/hiv/pub/guidelines/arv2013/intro/keyterms/en/

Chapter 3: Results

3.1 Introduction

In this chapter, results are presented on prevalence of overweight, obesity and combined overweight and obesity of school children and adolescents. Factors associated with the combined outcome of overweight/ obesity are described through univariate and multivariate logistic regression. Finally, prevalence of MetS in a subset of the study sample is reported.

3.2 Description of the study sample

3.2.1 Response rate

Out of 1,793 students who were invited to participate in the study, 1,209 participants provided adequate parental permission and assent. The overall response rate was 67.5%. Students who were outside the age brackets and students who had more than 50% missing data were excluded from the analysis. The final sample included in the analysis for overweight and obesity was 1,184 students. Among them, there were 726 students who were above 10 years and were eligible to carry on to part two of the study. Of these, 420 students fulfilled the consenting process and went on to assess MetS Figure 3.1.

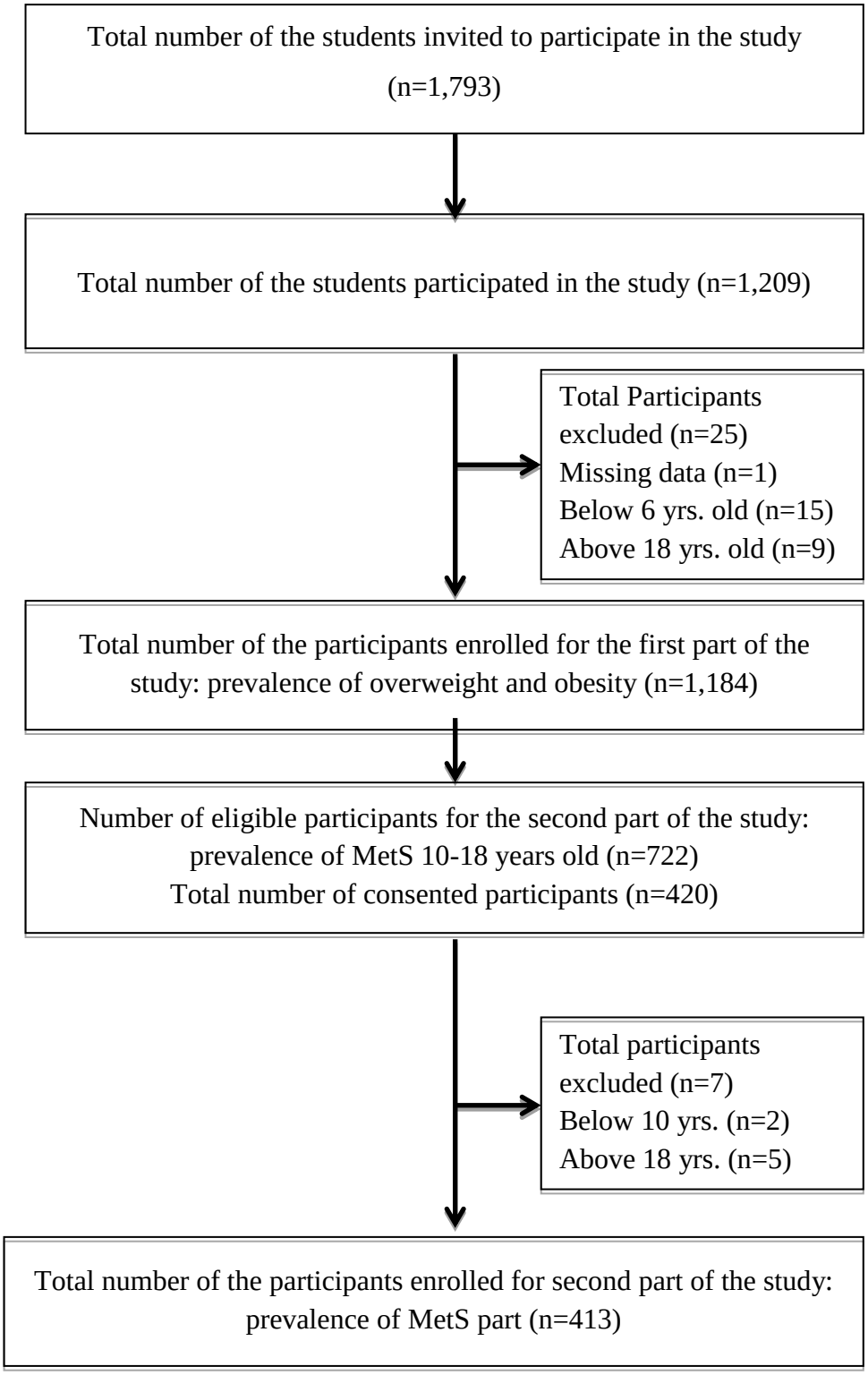

Figure 3.1: Details of the study sample

The most common reason for exclusion of participants from the initial study sample was that they were outside the age range that was described in the protocol.

3.2.2 Descriptive statistics of the study sample

In part one of the study, a total of 1,184 participants aged 6-18 years enrolled to determine overweight and obesity prevalence. Table 3.1 summarizes the child demographic characteristics, child health and maternal pregnancy history. A summary of the family demographic characteristics is presented in Table 3.2. Forty three percent of the participants were males (n=508). Sixty six percent of the participants were Emirati (n=781). The mean age of the participants in the study was 11.3 years, of which 30.6% were 9-11 year old children.

Table 3.1: Descriptive characteristics of the sample in Part 1 of the study. (N=1184)

Demographic Variable	**Total (N=1184)**	**Males (n=508)**	**Females (n=676)**
Participant Nationality n (%)			
Emirati	781 (66.2)	339 (66.7)	442 (65.7)
Expatriate	398 (33.8)	167 (32.9)	231 (34.3)
Mean Age (SD)	11.3 (3.2)	11.1 (3. 4)	11.6 (2. 9)*
Age categories n (%)			
6-8 years	337 (28.5)	185 (36.5)	152 (22.4)**
9-11 years	362 (30.6)	125 (24.6)	237 (35.0)
12-14 years	282 (23.8)	111 (21.8)	171 (25.3)
15-18 years	203 (17.2)	87 (17.1)	116 (17.2)
Mean Birth weight (SD)	3.02 (0.6)	3.08 (0.7)	2.97 (0.6)*
Pregnancy duration n (%)			
Full term ≥ 37 weeks	1023 (94.7)	437 (95.0)	586 (94.5)
Preterm < 37 weeks	57 (5.3)	23 (5)	34 (5.5)
Total	1080	460	620
Maternal smoking during			
No	1114 (99.6)	482 (99.8)	632 (99.4)
Yes	5 (0.4)	1(0.2)	4 (0.6)
Total	1119 (100.0)	483 (100.0)	636 (100.0)
Gestational diabetes during			
No	994 (89.3)	441 (92.1)	553 (87.2)*
Yes	119 (10.7)	38 (7.9)	81 (12.8)
Total	1113 (100.0)	479 (100.0)	634 (100.0)
Age when first fed artificial			
< 6 months	330 (46.8)	199 (64.2)	219 (55.6)**
> 6 months	374 (53.1)	111 (35.8)	175 (44.4)
Total	704 (100.0)	310 (100.0)	394 (100.0)
Age when first solid food			
< 6 months	491 (48.6)	222 (51.2)	269 (46.5)
> 6 months	521 (51.5)	212 (48.8)	309 (53.5)
Total	1012 (100.0)	434 (100.0)	578 (100.0)

n=frequency, SD=standard deviation. Significant differences between males and females are indicated as *P < 0.05, **P < 0.001.

Categorical variables were summarized an n (%). Quantitative variables were presented as means and SD. Chi square test was performed to compare proportion or percentage and unpaired T test was performed to compare means.

Table 3.2: Socio-demographic characteristics of the parents' data, overall and by nationality. (N=1184)

Demographic variable	**Total**	**Emirati**	**Expatriate**
Father current age mean (SD)	43.8 (7.5)	42.4 (7.9)	46.4 (5.9)**
Father age at child's birth mean (SD)	33.1 (12.0)	32.1 (9.4)	35.2
Mother current age mean (SD)	38.5 (5.7)	37.9 (5.7)	39.4 (5.5)
Mother age at child's birth mean (SD)	27.4 (5.1)	27.5 (5)	27.1 (5.1)*
Marital status n (%)			
Married	1028	672 (90.7)	356 (94.9)*
Divorced	59 (5.3)	47 (6.34)	12 (3.20)
Widow	29 (2.6)	22 (2.97)	7 (1.87)
Total	1116 (100)	741 (66.4)	375 (33.6)
Number of siblings			
0-2	288 (25.1)	128 (44.6)	159 (55.4)**
3-5	593 (51.7)	377 (63.9)	213 (36.1)
6-9	230 (20.1)	208 (90.4)	22 (9.6)
10+	36 (3.1)	36 (100)	0 (0)
Total	1,143	749 (65.5)	394 (34.5)
Father educational level n (%)			
Primary or less than primary school	123 (11.2)	111 (15.9)	12 (3.29)**
High school or diploma	562 (51.4)	443 (61.0)	119 (32.6)
Bachelors and post graduate degree	406 (37.4)	172 (23.6)	234 (64.1)
Total	1091 (100)	726 (66.5)	365 (33.5)
Mother educational level n (%)			
Primary or less than primary school	105 (9.4)	86 (11.6)	19 (5.1)**
High school or diploma	568 (51.1)	401 (54.2)	167 (44.9)
Bachelors and post graduate degree	439 (39.5)	253 (34.2)	186 (50.0)
Total	1112 (100)	740 (66.5)	372 (33.5)
Father job			
Armed forces	344 (35.4)	342 (99.7)	1(0.3)
Managers	209 (21.5)	136 (65.7)	71 (34.3)
Professionals	219 (22.5)	43(19.6)	176(80.4)
Other jobs	174 (17.9)	80 (44.5)	97 (55.5)
Retired	26 (2.7)	26 (2.7)	0 (0.0)
Total	972	627 (64.7)	345 (35.3)

Table 3.2: Socio-demographic characteristics of the parents' data, overall and by nationality. (N=1184) (Continued)

Demographic variable	**Total**	**Emirati**	**Expatriate**
RAK	566 (59.3)	272(44.3)	294 (86.2)**
Abu Dhabi, AL Ain, Dubai and outside	312 (32.5)	281(45.8)	31(9.09)
Fujairah, Ajman, Um AlQuwain or	77 (8.0)	61(9.93)	16 (4.7)
Total	955 (100)	614 (64.3)	341(35.7)
Mother job			
Home-makers	774 (70.6)	451 (72.1)	232 (49.4)
Working	322 (29.4)	175 (27.9)	238 (50.6)
Total	1096	626	470
Combined family income AED n (%)			
Less than AED 5000	98 (9.5)	67 (11.5)	31 (6.9)
AED 5000-9999	263 (25.6)	154 (26.5)	109 (24.4)
AED 10000-19999	228 (22.2)	125 (21.5)	103 (23.0)
AED 20000-29999	266 (25.9)	138 (23.8)	128 (28.6)
AED 30000-39999	84 (8.1)	47 (8.1)	37 (8.3)
AED 40000-49999	48 (4.7)	30 (5.2)	18 (4.0)
AED 50000-59999 and above	40 (4.0)	19 (3.3)	21 (4.7)
Total	1027 (100)	580 (56.5)	447 (43.5)
Father BMI			
Normal weight	35 (6.4)	39 (7.4)	14 (4.6)
Overweight	199 (24.1)	131 (25.0)	68 (22.4)
Obese	576 (69.6)	354 (67.6)	222 (73.1)
Total	828	524(63.3)	304 (36.7)
Mother BMI			
Normal weight	253 (28.5)	181(31.4)	72 (23.1)*
Overweight	334(37.6)	215(37.3)	119(38.1)
Obese	302 (33.9)	181(31.4)	121(38.7)
Total	889	577 (64.9)	312 (35.1)

n=frequency, SD=standard deviation. Significant differences between Emirati and Expatriate are indicated as *P < 0.05, **P < 0.001.

Categorical variable was summarized an n (%). Quantitative variables were presented as means and SD. Chi square test was performed to compare proportion or percentage and unpaired T test was performed to compare means.

Around 50% of participants had 3-5 siblings. One quarter of the study sample had 2 or less siblings, and one quarter were in big families with 6 or more siblings. About one tenth of fathers and mothers had a limited education (primary school or less), while more than one third had graduate or postgraduate university degrees. Most of the participants' fathers were working and 26% were retired. Thirty five percent were military staff, 21% were in managerial positions, 22% of the fathers were professionals (in education health and other fields), and 17.9% worked in other jobs categories (marketing jobs skilled and unskilled occupations). The majority of the participants' mothers were home-makers (70.6%). In the mothers' working group, 18.7% were professionals, 3.9% were managers and 6.8% worked in other job categories. Nearly 60% of the fathers were working in the emirate of RAK, 8% worked in the nearby emirates (Fujairah, Ajman, Um Al Quwain and Sharja) and were commuting daily, while 32.5% worked in the further emirates (Abu Dhabi, AL Ain, Dubai and outside UAE) and were commuting weekly. Overweight and obesity were highly prevalent among fathers (24.1% and 69.6% respectively), leaving less than 10% 0f fathers within the normal weight range. Just under three quarters of mothers had excess weight, with 37% of the mothers were overweight and 33.9% were obese. Both parents being either overweight or obese was documented in 45.5% of participants.

Anthropometric characteristics and biochemical parameters stratified by gender

The anthropometric characteristics of male and female study participants are summarized in Table 3.3.

The biochemical parameters of the subsample of 10-18 year old adolescents (who continued to Part 2 of the study) are summarized in Table 3.4.

Table 3.3: Anthropometric characteristics of 6-18 year old school children and adolescents in RAK

Anthropometric characteristics Mean (SD)	**Total N=1,184**	**Males N=508**	**Female N=676**	**P value**
Weight (kg)	44.6 (20.7)	45.2 (24.3)	44.2 (17.6)	0.4
Height (cm)	143.4 (16.8)	143.2 (19.8)	143.6 (14.3)	0.7
WC (cm)	69.5 (15.1)	69.9 (17.6)	69.2 (12.9)	< 0.001
HC (cm)	81.9 (16.5)	(80.2) (17.9)	83.3 (15.2)	0.4
Systolic BP (mm.Hg)	108.5 (27.2)	111.8 (38.1)	106.1 (14.1)	< 0.001
Diastolic BP (mm.Hg)	70.2 (26.1)	71.2 (37.9)	69.5 (10.6)	0.9

SD: standard deviation, WC: waist circumference, HC: hip circumference, BP: blood pressure.

Table 3.4: Biochemical parameters of 10-18 year old school adolescents in RAK

Biochemical parameter Mean (SD)	**Total N=413**	**Males N=180**	**Female N=233**	**P value**
FBS (mg/dl)	91.5 (14.1)	92.0 (9.9)	91.1(16.6)	0.5
CHOL (mg/dl)	163.6 (26.6)	162.6 (30.9)	164.3 (22.8)	0.5
TG (mg/dl)	82.9 (40.2)	89.1 (48.6)	78.1 (31.9)	0.01
HDL (mg/dl)	52.3 (13.2)	48.5 (12.8)	55.2 (12.8)	< 0.001
LDL (mg/dl)	94.7 (22.6)	96.5 (25.5)	93.4 (20.0)	0.3
HBA1C (%)	5.5 (0.4)	5.5 (0.3)	5.5 (0.4)	0.9

SD: standard deviation, FBS: fasting blood sugar, CHOL: cholesterol, TG: triglyceride, HDL: high-density lipoprotein, LDL: low-density lipoprotein, HBA1C: glycosylated haemoglobin.

3.3 Prevalence of overweight and obesity

The prevalence of overweight and obesity among children and adolescents was estimated based on three different definitions CDC, IOTF and WHO, as shown in Table 3.5. Based on the CDC reference, overweight was 13.4% and 15.4% among males and females respectively. One the other hand, significantly more males (25.6%) were obese as compared to females (20.6%). The agreement between the three definitions was tested by kappa (κ) coefficient. The agreement between the three definitions was good with regards to underweight and normal weight κ=0.7 and κ=0.7 respectively. However, moderate (κ=0.5) and fair (κ=0.3) agreement was reported with regards overweight and obesity respectively.

Table 3.5: Prevalence of overweight and obesity stratified by gender and age among 6-18 year old school children and adolescents in RAK, using the CDC, IOTF and WHO growth references

CDC												
	Males				Females				All			
Age (Years)	Overwt No. %	Obesity No. %	Combined No. %	Total No. of males	Overwt No. %	Obesity No. %	Combined No. %	Total No. of Females	Overwt No. %	Obesity No. %	Combined No. %	Net Total
6-8	15 8.1%	28 15.1%	43 23.2%	185	20 13.2%	27 17.8%	47 30.9%	152	35 10.4%	55 16.3%	90 26.7%	337
9-11	20 16%	33 26.4%	53 42.4%	125	32 14%	51 21.5%	83 35%	237	52 14%	84 23.2%	136 37.6%	362
12-14	24 21.6%	31 27.9%	55 49.6%	111	33 19.3%	36 21.1%	69 40.4%	171	57 20.2%	67 23.8%	124 44%	282
15-18	9 10.3%	38 43.7%	47 54%	87	19 16.4%	25 21.6%	44 37.9%	116	28 13.8%	63 31%	91 44.8%	203
Total	68 13.4%	130 25.6%	201 39.6%	508	104 15.4%	139 20.6%	243 36%	676	172 14.5%	269 22.7%	441 37.3%	1184

Table 3.5: Prevalence of overweight and obesity stratified by gender and age among 6-18 year old school children and adolescents in RAK, using the CDC, IOTF and WHO growth references (Continued)

IOTF												
	Males				Females				All			
Age (Years)	Overwt No. %	Obesity No. %	Combined No. %	Total No. of males	Overwt No. %	Obesity No. %	Combined No. %	Total No. of Females	Overwt No. %	Obesity No. %	Combined No. %	Net Total
6-8	15 8.1%	21 11.4%	36 19.5%	185	26 17.1%	23 15.1%	47 30.9%	152	44 13.1%	83 24.6%	127 37.7%	337
9-11	35 28%	17 13.0%	52 41.6%	125	49 21%	41 17.3%	90 38%	237	84 23%	58 16%	142 39%	362
12-14	31 27.9%	25 22.5%	56 50.5%	111	39 22.8%	30 17.5%	69 40.4%	171	70 24.8%	55 19.5%	125 44.3%	282
15-18	17 19.5%	32 36.9%	49 56.3%	87	23 19.8%	23 19.8%	44 37.9%	116	40 19.7%	55 27.1%	95 46.8%	203
Total	98 19.3%	95 18.7%	193 38%	508	137 20.3%	117 17.3%	243 36%	676	235 19.9%	212 17.9%	447 37.8%	1184

Table 3.5: Prevalence of overweight and obesity stratified by gender and age among 6-18 year old school children and adolescents in RAK, using the CDC, IOTF and WHO growth references (Continued)

WHO												
	Males				Females				All			
Age (Years)	Overwt No. %	Obesity No. %	Combined No. %	Total No. of males	Overwt No. %	Obesity No. %	Combined No. %	Total No. of Females	Overwt No. %	Obesity No. %	Combined No. %	Net Total
6-8	18 9.7%	32 17.3%	50 27%	185	17 11.2%	37 24.3%	54 35.5%	152	35 10.4%	69 20.5%	104 30.9%	337
9-11	15 12%	46 36.8%	61 48.8%	125	29 12%	69 29.1%	98 41.4%	237	44 12%	115 31.8%	159 43.9%	362
12-14	12 10.8%	46 41.4%	58 52.3%	111	24 14%	51 29.8%	75 43.9%	171	36 12.8%	97 34.4%	133 47.2%	282
15-18	6 6.9%	43 49.4%	49 56.3%	87	14 12.1%	32 27.6%	46 39.7%	116	20 9.9%	75 37%	95 46.8%	203
Total	51 10.04%	167 32.8%	218 42.9%	508	84 12.4%	189 28%	273 40.4%	676	135 11.4%	356 30.1%	491 41.5%	1184

According to the IOTF standards 19.3% of males and 20.3% of females were overweight, whereas the prevalence of obesity was lower than the overweight figures 18.7% and 17.3% in males and females respectively. Similar to the CDC estimates the highest prevalence of obesity based on the IOTF standards was among 15-18 year old age group (27.1%) and lowest estimate was among 6-8 year old age category (13.1%) (Figure 3.2).

The lowest prevalence of overweight between the three definitions was given by the WHO criteria (10% in males and 12.4% in females). However the WHO gave the highest obesity estimates among both males 32.9% and females 28%. The low overweight estimates (10.39% in 6-8 year olds) and the high obesity estimate (37% among 15-18 year olds) based on the WHO was the same across all age categories. The highest estimate of obesity was among the 15-18 year old age group (37%) and the lowest estimate was among 6-8 year old age category 20.5% (Figure 3.2).

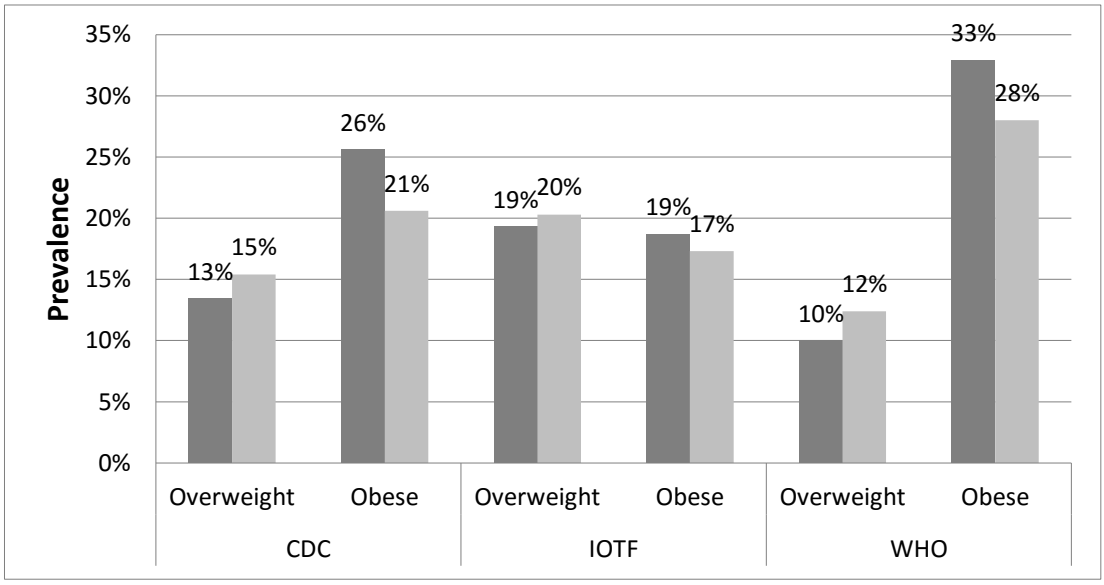

Figure 3.2: Prevalence of overweight and obesity for gender among 6-18 year old school children and adolescents in RAK: Comparison of CDC, IOTF and WHO growth references

The prevalence of overweight and obesity stratified by age-group is shown in Table 3.5. There was a significant increase in both overweight and obesity prevalence with increasing age (P value < 0.001). The highest prevalence was found among 15-18 year-old adolescents (46.8%), while the lowest prevalence was among 6-8 year old children (30.9%) by WHO.

With regards to nationality, there was no significant difference in prevalence of overweight and obesity between Emirati and Expatriate participants, as presented in Table 3.6. The Emirati group included UAE nationals mainly and 9 participants carrying the Comoros citizenships. In the UAE individuals with Comoros nationality are individuals who have been in the UAE for many decades and share the UAE nationals the same culture, however historically they did not have the legal documents to get UAE citizenship. Recently, in a political agreement between the UAE and Comoros, these individuals got Comoros passports, while continuing to live in the UAE. Therefore for the purpose of analysis in this study they have been considered as UAE nationals. The Expatriates group included many nationalities from the eastern Mediterranean region, mainly Arab countries, several Europeans and one African.

Table 3.6: Prevalence of overweight and obesity by nationality (Emirati vs. expatriates) among 6-18 year old school children and adolescents in RAK, using the CDC, IOTF and WHO growth references

CDC												
	Emiratis				Expatriate				All Nationalities			
Age (Years)	Overwt No. %	Obesity No. %	Combined No. %	Total No. of males	Overwt No. %	Obesity No. %	Combined No. %	Total No. of Females	Overwt No. %	Obesity No. %	Combined No. %	Net Total
6-8	28 9.9%	48 16.9%	76 26.8%	284	7 13.7%	7 13.7%	14 27.5%	51	35 10.5%	55 16.4%	90 26.9%	335
9-11	34 15%	57 24.5%	91 39.1%	233	18 14%	27 21.1%	45 35.2%	128	52 14%	84 23.3%	136 37.7%	361
12-14	31 20.4%	34 22.4%	65 42.8%	152	25 19.5%	33 25.8%	58 45.3%	128	56 20%	67 23.9%	123 43.9%	280
15-18	14 12.5%	41 36.6%	55 49.1%	112	14 15.4%	22 24.2%	36 39.6%	91	28 13.8%	63 31%	91 44.8%	203
Total	107 13.7%	180 23.1%	287 36.8%	781	64 16.1%	89 22.4%	153 38.4%	398	171 14.5%	269 22.8%	440 37.3%	1179

Table 3.6: Prevalence of overweight and obesity by nationality (Emirati vs. expatriates) among 6-18 year old school children and adolescents in RAK, using the CDC, IOTF and WHO growth references (Continued)

IOTF												
	Emiratis				Expatriates				All Nationalities			
Age (Years)	Overwt No. %	Obesity No. %	Combined No. %	Total No. of males	Overwt No. %	Obesity No. %	Combined No. %	Total No. of Females	Overwt No. %	Obesity No. %	Combined No. %	Net Total
6-8	33 11.6%	40 14.1%	73 25.7%	284	8 15.7%	4 7.8%	12 23.5%	51	41 12.2%	44 13.1%	85 25.4%	335
9-11	49 21%	44 18.9%	93 39.9%	233	35 27%	14 10.9%	49 38.3%	128	84 23%	58 16.1%	142 39.3%	361
12-14	35 23%	30 19.7%	65 42.8%	152	34 26.6%	25 19.5%	59 46.1%	128	69 24.6%	55 19.6%	124 44.3%	280
15-18	20 17.9%	36 32.1%	56 50%	112	29 31.9%	19 20.9%	48 52.8%	91	49 24.1%	55 27.1%	104 51.2%	203
Total	137 17.5%	150 19.2%	287 36.8%	781	97 24.4%	62 15.6%	159 40%	398	234 19.9%	212 18%	446 37.8%	1179

Table 3.6: Prevalence of overweight and obesity by nationality (Emirati vs. expatriates) among 6-18 year old school children and adolescents in RAK, using the CDC, IOTF and WHO growth references (Continued)

WHO												
	Emiratis				Expatriates				All Nationalities			
Age (Years)	Overwt No. %	Obesity No. %	Combined No. %	Total No. of males	Overwt No. %	Obesity No. %	Combined No. %	Total No. of Females	Overwt No. %	Obesity No. %	Combined No. %	Net Total
6-8	28 9.9%	61 21.5%	89 31.3%	284	7 13.7%	8 15.7%	15 29.4%	51	35 10.5%	69 20.6%	104 31%	335
9-11	29 12%	76 32.6%	105 45.1%	233	15 12%	39 30.5%	54 42.2%	128	44 12%	115 31.86%	159 44%	361
12-14	17 11.2%	53 34.9%	70 46.1%	152	18 14.1%	44 34.4%	62 48.4%	128	35 12.5%	97 34.64%	132 47.1%	280
15-18	8 7.14%	48 42.9%	56 50%	112	12 13.2%	27 29.7%	39 42.9%	91	20 9.9%	75 37%	95 46.8%	203
Total	82 10.5%	238 30.5%	320 41%	781	52 13.1%	118 29.7%	170 42.7%	398	134 11.4%	356 30.2%	490 41.6%	1179

After exploring the differences in the prevalence between the three definitions subsequent analysis into the factors associated with the combined outcome of overweight/ obesity were based on the WHO criteria.

Figure 3.3 shows the differences in the prevalence of the combined overweight and obesity between the six schools that participated in the study, however these differences were not statistically significant (P value > 0.05).

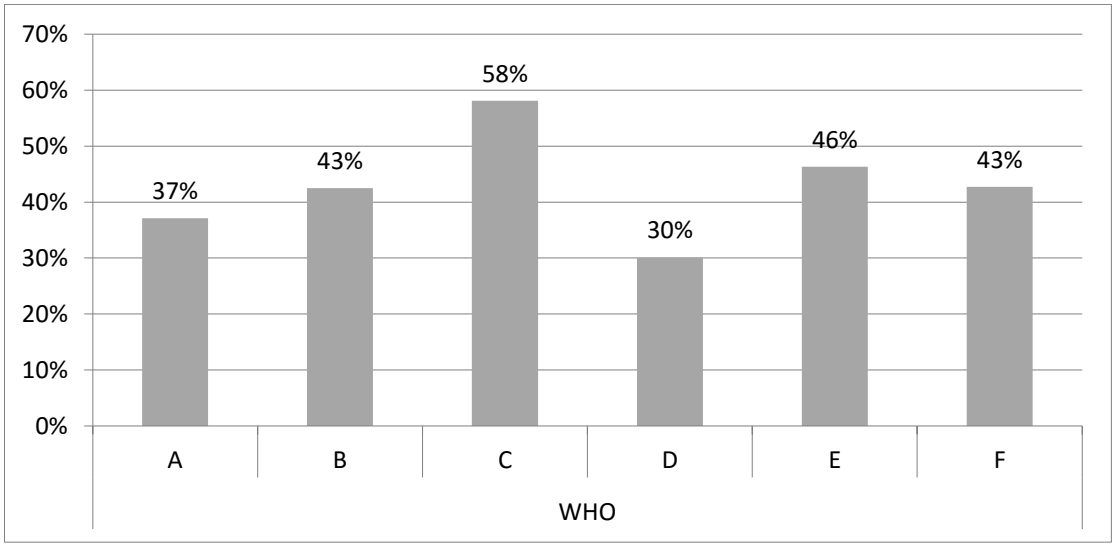

Figure 3.3: Prevalence of the combined overweight and obesity prevalence in the six schools according the WHO criteria

3.4 Factors associated with of overweight and obesity

In this part of the study, selected early life risk factors, socio-demographic factors and lifestyle and behavioral factors were explored to identify those factors that were associated with overweight and obesity in the sample of school children and adolescents in RAK, UAE. Potential factors were analyzed in overweight and obese participants, and were compared with those who were neither obese nor overweight, using the WHO BMI reference. Criteria for logistic regression model were fixed at a level of significance of $P < 0.2$ and 95% confidence interval that does

not include one to avoid early rejection of variable in the logistic regression model. Stepwise regression; backward elimination method was used in order to eliminate the variable with least statistical significance (Tables 3.7, 3.8 and 3.9). At the final multivariable logistic regression model the variable included were the statistically significant variable P < 0.05 (Table 3.10).

Table 3.7: Univariate logistic regression model for independent early life factors associated with the combined overweight and obesity, among 6-18 years old school children and adolescents, RAK, UAE

Variable	**OR**	**95% CI**	**P value**
Early life factors			
Gestational diabetes during pregnancy of this child (No)	1.5	1.1-2.2*	0.03
Smoking during pregnancy	ND		
Birth weight (reference < 2500 grams)			
2500-2999	1.3	0.9-2.1	0.2
3000-3599	1.5	0.9-2.3	0.05
3500-3999	1.7	1.1-2.8*	0.02
≥ 4000	2.1	1.2-3.8**	0.00
Pregnancy duration (Ref < 37 weeks)	1.1	0.6-1.9	0.7
Age of introduction of solid food (Ref < 6 months)	0.9	0.6-1.4	0.8
Age of introduction of artificial milk (Ref < 6 months)	0.9	0.7-1.3	0.8

ND: not done (this analysis was not done) * P value < 0.05, ** P value < 0.001

Table 3.8: Univariate logistic regression model for independent socio-demographic factors associated with the combined overweight and obesity, among 6-18 year old school children and adolescents, RAK, UAE

Variable	**OR**	**95% CI**
Socio-demographic factors		
Gender	0.9	0.7-1.1
Age	1.9	1.3-2.8
School (Ref private)	1.3	0.8-1.8
Nationality (Ref Emirati)	1.1	0.8-1.4
Combined monthly family in come (Ref less than 5000)	1.0	0.6-1.7
Number of siblings (Ref 0-2)	0.9	0.6-1.3
House maid (Ref yes)	0.9	0.7-1.2
Food prepared at home (Ref by maid)		
Mother	1.3	1.0-1.7
Other family member	0.6	0.7-2.7
Father education (Ref less than primary school)	0.3	0.1-0.7*
Mother education (Ref less than primary school)	0.5	0.2-1.0
Father job	0.8	0.3-2.2
Father emirate work (Ref RAK)	0.7	0.5-1.3
Mother job (Ref house maker)	0.9	0.7-1.2
Parent marital status (Ref married)	1.2	0.7-2.0
Father BMI		
Overweight	1.3	0.7-2.5
Obesity	1.9	1.0-3.5
Mother BMI		
Overweight	2.1	1.5-2.9**
Obesity	3.4	0.3-0.5**
Parents BMI		
One parent overweight or obese	1.2	0.5-3.1
Both parents overweight or obese	3.1	1.2-7.2*

* P value < 0.05, ** P value < 0.001

Table 3.9: Univariate logistic regression model for independent diet and lifestyle factors associated with the combined overweight and obesity, among 6-18 years old school children and adolescents, RAK, UAE

Variable	**OR**	**95% CI**	**P value**
Diet and lifestyle factors			
Screen time per day (TV, computer, etc.) (Ref < 2 hours)	1.3	0.7-2.3	0.3
Physical activity class at school (Ref less than 2 classes per week)	1.1	0.8-1.4	0.6
Breakfast (Ref never have breakfast) the results reported for those who have breakfast 5 days or more.	0.5	0.3-0.8**	0.001**
Time spent outside before or after school (Ref less than 1 hour)	1.0	0.8-1.3	0.9
Eating from outside per week (Ref 0-2 times every 2 weeks)	1.1	0.3-3.7	0.9
Fruit intake	0.8	0.3-1.9	0.6
Vegetable intake	0.8	0.4-1.5	0.5
Dark vegetable intake	0.5	0.2-0.8*	0.01*
Sweets intake	0.8	0.4-1.8	0.6
Sugar Sweetened Beverages (soda, juices, energy drinks)	0.9	0.6-1.1	0.7
Bread and pastries in take	0.9	0.7-1.3	0.6
Fish intake	1.8	0.9-3.6	0.08
Milk intake (full)	0.4	0.2-0.5**	0.00**
Other dairy products	0.8	0.5-1.3	0.3
Fried food at home,	0.7	0.4-1.3	0.3
Fast food	0.5	0.3-1.1	0.05
French fries	0.6	0.3-1.2	0.2

The reference in all food items is 0 per week, the reported results are for 5 or more time per week.* P value < 0.05, ** P value < 0.001

Table 3.10: Multivariate logistic regression model for independent factors associated with the combined overweight and obesity, among 6-18 years old school children and adolescents, RAK, UAE

Variable	**OR**	**95% CI**
Gender	0.6	0.4 - 1.1
Age	0.8	0.8 - 1.1
Gestational diabetes Mellitus	1.3	0.5 3.5
Father Education	9.8	1.1-91.2*
Mother BMI		
Overweight	1.6	0.9 -3.1
Obese	2.1	1.1, 3.9*
Intake of dark vegetables		
1-2 time per week	0.9	0.4 - 1.6
3-4 times per week	0.9	0.5 - 1.9
More than 5 times per week	0.3	0.1- 0.7*
Intake of full fresh milk		
1-2 time per week	0.7	0.4 - 1.4
3-4 times per week	1.0	0.5 - 2.1
More than 5 times per week	0.5	0.2 - 0.9*
Intake of French fries		
1-2 time per week	2.6	1.1- 6.2*
3-4 times per week	1.7	0.7- 4.0
More than 5 times per week	2.1	0.7- 5.6
Birth weight	1.1	0.8 -1.6

* P value < 0.05, ** P value < 0.001

3.5 Metabolic Syndrome

Four hundred thirteen participants were enrolled in the second part of the study. The IDF criteria “abdominal obesity and the presence of two or more other clinical features (i.e. elevated triglycerides, low HDL-cholesterol, high blood pressure, increased plasma glucose)” was used to identify students with or without MetS.

The prevalence of MetS and its individual risk factors among the sample are compared between males and females and presented in Table 3.11. The prevalence of MetS in the total sample of 413 participants was 6.6%. The number of males having MetS was more than double the number of females with MetS. Because of a low number of children who have MetS (26), it was not considered to be meaningful to do further statistical analysis and to explore factors associated with MetS. Table 3.12 presents the prevalence of MetS and its individual risk factor across the age categories. From the results, it can be concluded that none of the clinical features involved in MetS is more common than the other in all age categories Table 3.12.

Table 3.11: Prevalence of Metabolic Syndrome and individual risk factors of Metabolic Syndrome among 10 -18 year old school adolescents in RAK stratified by gender. (N=413)

	Total	**Males**	**Females**
MetS n (%)			
Without MetS	368 (93.4)	148 (88.6)	220 (96.9)
With MetS	26 (6.6)	19 (11.4)	7 (3.1)
WC n (%)			
Normal WC	543 (75.5)	187 (66.6)	356 (81.3)
High WC	176 (24.5)	94 (33.5)	82 (18.7)
BP n (%)			
Normal BP	593 (80.9)	217 (75.4)	376 (84.5)
High BP	140 (19.1)	71 (24.6)	69 (15.5)
FBS n (%)			
Normal FBS	373 (90.3)	162 (90)	211 (90.6)
High FBS	40 (9.7)	18 (10)	22 (9.4)
TG n (%)			
Normal TG	380 (92.0)	158 (87.8)	222 (95.3)
High TG	33 (7.9)	22 (12.2)	11 (4.72)
HDL n (%)			
Normal HDL	349 (85.1)	141 (79.2)	208 (89.6)
Low HDL	61 (14.9)	37 (20.8)	24 (10.3)

MetS: metabolic syndrome, WC: waist circumference, BP: blood pressure, FBS: fasting blood sugar, TG: triglyceride, HDL: high-density lipoprotein cholesterol. Chi square test or Fisher exact test was performed to compare proportion or percentage. P values are for tests comparing males and females.

Table 3.12: Prevalence of Metabolic Syndrome and individual risk factor of Metabolic Syndrome among 10 -18 year old school adolescents in RAK by age categories. (N=413)

	All	9-11	12-14	15-18
MetS n (%)				
Without MetS	368 (93.4)	56 (96.6)	182 (95.8)	130 (89.1)
With MetS	26 (6.6)	2 (3.5)	8 (4.2)	16(10.9)
WC n (%)$				
Normal WC	543 (75.5)	189 (80.1)	219 (77.7)	135 (67.2)
High WC	176 (24.5)	47 (19.9)	63 (22.3)	66 (32.8)
BP n (%)*				
Normal BP	593(80.9)	210 (87.1)	237 (84.1)	146 (72.6)
High BP	140 (19.1)	40 (12.9)	45 (15.9)	55 (27.4)
FBS n (%)				
Normal FBS	373 (90.3)	56 (90.2)	175 (88.4)	142 (92.8)
High FBS	40 (9.7)	6 (9.8)	23 (11.6)	11 (7.2)
TG n (%)				
Normal TG	380 (92.0)	57 (91.8)	183 (92.4)	140 (91.5)
High TG	33 (7.9)	5 (8.2)	15 (7.6)	13 (8.5)
HDL n (%)				
Normal HDL	349 (85.1)	54 (91.5)	179 (90.4)	116 (75.8)
Low HDL	61 (14.9)	5 (8.5)	19 (9.6)	37 (24.2)

MetS: metabolic syndrome, WC: waist circumference, BP: blood pressure, FBS: fasting blood sugar, TG: triglyceride, HDL: high-density lipoprotein cholesterol.

*n=733, $n=719.

Chapter 4: Discussion

This study has established the prevalence and associated factors of overweight and obesity among a representative sample of government and private school children and adolescents in RAK, the largest northern emirate in the UAE. Obese children and adolescents are at higher risk of metabolic abnormalities that predispose them in the future to cardiovascular diseases and diabetes mellitus. The prevalence of MetS and its individual components have been estimated among a subsample of the participants to explore the extent of obesity related metabolic disturbance.

4.1 Prevalence of overweight and obesity

4.1.1 Difference in the prevalence when using three different definitions

The prevalence of overweight and obesity was estimated and compared by the three BMI references used internationally, the CDC, IOTF and WHO. These three references presented different prevalence estimates in children and adolescents (aged 6-18) from both sexes. The highest overweight prevalence was by the IOTF (19.7%), while the WHO estimated the lowest overweight prevalence (11.4%). The order was reversed for the outcome of obesity, whereby the WHO gave the highest estimates (30.1%); the lowest obesity prevalence was found when the IOTF criteria were applied (22.7%). The combined overweight and obesity prevalence were similar using CDC and IOTF definitions (37.2% and 37.7% respectively), and higher 41.5% by the WHO definition.

The degree of agreement between the BMI classification systems has varied between studies. In most studies the WHO had the highest estimates of overweight

and obesity compared with other BMI references. For example, findings from a study that explored the agreement between the three BMI classification systems on the outcome of combined overweight and obesity prevalence among 8-14 year old children showed a strong agreement in prevalence reported using the CDC and IOTF criteria, and weaker if compared to the agreement between the IOTF and WHO and between the CDC and the WHO [160]. The lowest overweight and obesity prevalence presented in this study was by the CDC. The WHO criteria gave the highest estimates of overweight and obesity. The IOTF was the most conservative reference, and was recommended by the authors as being the most suitable for the population in that country. The WHO reference also presented higher combined overweight and obesity prevalence in a French study among 4-12 year old children. The study reported weaker agreement between the WHO reference and both the IOTF and the French references, while the agreement between the IOTF and French references was stronger [161]. When overweight and obesity were analyzed as separate outcomes, the highest proportion of children classified as overweight was by the WHO reference, and the lowest proportion was by the French reference. A similar finding was for obesity where the WHO reference gave the highest obesity estimates. Both the French and the IOTF references gave the same obesity prevalence.

Differences in the combined prevalence of overweight and obesity due to the use of different BMI definitions was also noted among 2-17 year old Canadian children, where the WHO presented the highest estimates and the IOTF the lowest, while the CDC was the most moderate [162]. Furthermore, the estimates of each outcome separately (overweight alone and obesity alone) were also highest by the

WHO criteria. The prevalence of overweight estimated by the CDC was higher than the IOTF overweight prevalence. The same findings were for obesity where the IOTF presented the lowest obesity prevalence and the CDC obesity prevalence was much closer to the WHO. Strong agreement (kw ≥ 0.89) between the BMI references was found in a study that involved adolescents with a narrow age range among adolescents (mean age 16.15 years of school students in grade 10) [163]. It appears that the narrower the ranges in the study sample the smaller the variation between the BMI classification systems. In our study it was notable that the differences in overweight and obesity prevalence between the three definitions is more pronounced for ages below 15 years, and less variable in the oldest age group. In the age category from 15-18 years the prevalence of individual and combined outcome overweight and obesity were not significantly different between the three definitions.

In summary, our study used the three BMI definitions covering a wide age range of children and adolescents. The prevalence reported in our study can serve as a benchmark against which new studies are compared, regardless of the BMI definition used. Secondly, we have found that the relation between the three definitions is not the same when the outcome is overweight alone, obesity alone or the combined overweight and obesity prevalence. Finally, the wider the age range of participants included in the study the more significant difference between the three definitions, particularly in the pre-pubertal years (below 15 years).

Trends in prevalence

The differences in the prevalence of overweight and obesity may vary depending on the region/ city/ state or province in a given country. These regional variations may be related to different lifestyle, ethnic background or geographical

factors [118, 164, 165]. The discussion that follows is an analysis of trends in overweight and obesity when RAK is considered in isolation or combined with other emirates, as well as possible gender differences and potential factors associated with these outcomes.

4.1.2 What has happened in RAK only over the last 18 years?

Compared to previously reported data of childhood overweight and obesity in RAK, our findings suggest an increasing prevalence in overweight and obesity among children and adolescents over the past 18 years. Previous data from Al-Haddad et al. [129] reported that 16.8% of 6-16 year-old school children in RAK were either overweight or obese. Sixteen years later, Al-Blooshi et al. [136] estimated that 35.8% of children aged 7-18 years were either overweight or obese, indicating more than a doubling in prevalence. In the present study, the estimates indicate a further increase in the prevalence of combined overweight and obesity to 37.2% among 6-18 year old children and adolescents.

Overweight and obesity prevalence among children and adolescents in RAK has more than doubled over a period of 18 years. This conclusion is obtained from studies done exclusively in the emirate of RAK, involving the same age category (6-18 years) and the same BMI definition (CDC).

4.1.3 Can we extrapolate results from one emirate to another emirate?

An important issue to address is whether we can extrapolate the findings of a single emirate to other emirates, considering that the seven emirates that make up the UAE vary in size, population distribution and development. In other words, to what extent is obesity data from one emirate applicable to other emirates? To answer this

question, publications relating to one or two emirates were examined alongside publications from RAK only, and the trends over time from "RAK only studies" and "other emirates studies" were compared. The trend of overweight and obesity prevalence in the emirates of Abu Dhabi and Dubai has shown a slight increase over the past 6 years. Thirty five percent was the combined overweight and obesity prevalence estimated by Malik & Bakir [132] among 11-17 year-old adolescents in Abu Dhabi and Dubai. This prevalence increased slightly to 37.2% among 12-18 year-old adolescents as estimated by Bin Zaal et al. [133] in Dubai. Al Junaibi et al. [135] reported that 39.8% of 11-18 year old adolescents were either overweight or obese.

Although the three studies above used different definitions, the variation in the prevalence due to different definitions would not be enough to mask a steep increasing trend in overweight and obesity. Hence it can be concluded that although the prevalence of overweight and obesity has increased over a 6 years period in the emirates of Abu Dhabi and Dubai, this increase was not to the same extent as that in the emirate of RAK (20.4% over 18 years). As such, it appears that the data from other emirates cannot be directly applied to RAK. In the past 10 years RAK has gone through major changes towards urbanization, which led to changes in people's lifestyle in ways that have a direct impact on obesity [28]. Since the union of the seven emirates in 1971, and with the discovery of oil in the UAE, there has been a huge economic development. However, this has not been at the same rate for all emirates; the rate of development in Abu Dhabi and Dubai were much faster than RAK, because they are the largest and most populated emirates. RAK was less urbanized at the time when the early studies included RAK were conducted in the

UAE. In the last decade RAK started to catch up by founding new universities and improving the supporting structure, resulting in a marked change in population and lifestyle.

4.1.4 If RAK is included in multi emirate studies do the trends change?

Several multi-emirate studies, that included the emirate of RAK, have been published. In this section we have examined the rate of change in the prevalence of overweight and obesity in such studies, and compared them with RAK only studies. According to what was reported by Al-Haddad et al. [131], the combined overweight and obesity prevalence in the all emirates of the UAE including RAK was 27.95 for 6-18 year old children and adolescents. Ng et al. [116] found that 33.4% of children and adolescents in the seven emirates (including RAK) are overweight or obese. These results suggest that the prevalence is continuing to increase over the years without any plateauing or stability, although the extent of increase seems to be less in studies involving several emirates compared to the magnitude of increase in the prevalence overweight and obesity in studies limited to RAK.

4.1.5 Rate of increase of the combined prevalence for males and females

Males compared with females

The trend of the prevalence of combined overweight and obesity among males (6-18 year- old) was also explored in studies that reported prevalence stratified by sex. The prevalence of overweight and obesity among 6-16 year-old males reported by a study included RAK only was 16.4% (CDC) according to Al-Haddad et al. [129]. The current study found that the prevalence of overweight and obesity among 6-18 year old males is 39% (CDC). The above-described results are

indicating a 22.6% increase in the combined prevalence among adolescent males over the past 18 years. The increase in the obesity prevalence (17.7%) was much larger than the increase in the overweight prevalence (4.9%) among the males.

The trend of the prevalence of combined overweight and obesity among females (6-18 year old) was explored in studies from which this information could be extracted. The prevalence reported in a study that included RAK only was 17.2% in 2000, based on the CDC reference [129].

The current study found that the prevalence of overweight and obesity among 6-18 year old females is 36% (CDC), which amounts to an 18.8% increase over 18 years. The main increase was attributed to the increase in the obesity prevalence (12.7%) as compared to the increase in the overweight prevalence (6.1%). Collectively, these studies seem to indicate that the rate of increase in prevalence of overweight /obesity is higher for boys than girls in the UAE.

Differences between males and females in the patterns of increase of overweight and obesity have been reported in the neighboring GCC countries. Comparison between the estimates of the combined prevalence among males and females in two Bahraini studies over a 6 year period, showed a sharper increase among females (30.4%) than males (19.2%) [114, 115]. In contrast, Kuwaiti studies demonstrated a steeper rise in the prevalence of overweight and obesity in males as compared with females, with an increase of 11.8% and 3.2% in males and females respectively from the years 2009 to 2015. [117, 166]. In the US there were no differences in the trend of change of the overweight and obesity prevalence between males and females over an 8 years period (2003-2012) [89]. It is important to appreciate the additional information that we can get from not pooling or merging the

data, and consider how these details might impact intervention programs targeting male and female children and adolescents.

4.1.6 Are there sex related differences when looking at overweight and obesity separately as outcomes?

While many studies have reported each of these outcomes disjointedly for males and females, others have reported combined overweight and obesity. From these studies we are able to explore possible sex-differences in prevalence when looking at overweight and obesity separately.

Several studies showed that males were higher in both outcomes. Both overweight and obesity were higher in males than females among 15-19 year-old adolescents in Oman [120]. Similarly 6-18 year-old Qatari males were more overweight and obese compared to their female counterparts [124, 125]. Lebanese 12-19 year-old adolescents had higher overweight and obesity prevalence in males compared to females [24]. In Spain both overweight and obesity among 2-14 year-old children were more prevalent among boys than girls. Bulgarian 8-15 year-old boys were more overweight and obese than the girls [167].

On the contrary, in other countries overweight/obesity was higher among females as compared with males. The prevalence of overweight among Egyptian 15-19 year-old female adolescents was 35% compared to 29.4% in males; females had also higher obesity prevalence than males 7.8% compared to 4.9% [111]. Overweight and obesity prevalence was higher among 4-15 year old Norwegian females than males [168]. This is in line with the findings from multicenter European study where both overweight and obesity were higher in girls compared to boys in Germany, Cyprus and Italy. Overweight was higher among Swedish and Hungarian females

than males, but with regards to obesity figures they were either similar or boys were more obese [99].

In some populations the outcome of overweight and obesity varied between the sexes in opposite directions. In the current study females were more overweight than males, while males were more obese than females. This was by the consensus of all three BMI references used to define the participants' weight status. A similar pattern was reported by Al Junaibi et al. [135], who reported higher obesity prevalence in boys and higher overweight prevalence in girls. In contrast, Al-Blooshi et al. [136] found that the prevalence of obesity among 11-18 year-old adolescents is higher in boys than girls according to the three BMI definitions. Higher rates of females' overweight and males' obesity are reported also in children and adolescents by a recent KSA review paper [169]. A Kuwaiti study also reported higher overweight prevalence among females and higher obesity prevalence among males [117].

Although there is still no clear understanding for the reasons underlying the variation of overweight and obesity between males and females, information from published studies and understanding relevant cultural norms could shed some light. The general acceptance of overweight in the Arab region as an indicator of good health could be one of the possible reasons for differences in obesity between the two sexes. In our study, not only was obesity more prevalent in our child/ adolescent sample, but an astounding 93% of fathers were either overweight or obese. Furthermore, males appear to have different weight related beliefs than females; they underestimate their weight, exceed the recommended caloric intake and believe that they don't need to increase their physical activity level. Females have different

weight perceptions than males where they usually overestimate their weight. Furthermore, females are more careful about their weight status and act to reduce their weight before reaching the obesity stage [170]. The sex-specific factors underlying overweight and obesity are not clear, and further research is needed to explore and understand attitudes and perceptions of males and females regarding excess weight. This is in consistent with the results of an Australian study, which explored the sex-differences in the lifestyle behaviours among three age categories. They found that there were no apparent differences between boys and girls below 9 years of age, however females from 10-17 years old were more likely to eat healthier and less likely to be obese compared to males [171]. Dietary habits and eating practices could also vary significantly across sites (urban vs. rural) and age categories, which impact the overweight and obesity prevalence among certain subgroups [172].

4.1.7 Prevalence of overweight and obesity among expatriates in UAE compared with their home countries

The Emirati students had relatively lower combined overweight and obesity prevalence than the expatriate students by the three BMI references (1.7% CDC, 3.2% IOTF, 1.9 WHO). The majority of the expatriate students who participated in the study were from non-Gulf Arab countries (Egypt, Iraq, Jordan, Lebanon, Sudan, Syria). Comparing the prevalence of overweight and obesity estimated in some of these countries among children and adolescents with our results may highlight some difference in the risk of obesity following immigration to other countries.

Prevalence of overweight and obesity was 33% (CDC) among 6-17 year old Jordanian children [173] compared with 38.5% (CDC) of 6-18 years old children in

the current study. The prevalence of overweight and obesity among 7-13 year-old Iraqi children was 7.3%, while the prevalence rate for the expatriate students in our study from 6-14 year-old children was much higher 35.9% (IOTF) [174]. The estimated combined prevalence of overweight and obesity among 14-18 year old adolescents in Sudan was 10.7% (IOTF) [175], which was much lower than the determined combined prevalence of overweight and obesity in the current study (42.8%) using the same BMI reference and across same age group (15-18 year old). In Egypt the combined prevalence of overweight and obesity among 15-19 year old children was 38.5% by the WHO BMI reference compared to 42.9% (WHO) in our expatriate population from the same age category 15-18 years [111]. The estimated combined prevalence for Syrian adolescents aged 15-18 years was 27.5% compared to 42.9% for the expatriate students in the current study from the same age group and by the same BMI standard (WHO) [176]. Expatriate 6-18 year old children and adolescents living in the UAE had lower combined prevalence of overweight and adolescents 42.7% (WHO) compared to their Lebanese counterparts in their home country 48% (WHO) [24].

The nutrition transition and lower physical activity level were the suggested reasons behind such an elevated prevalence among children and adolescents in Lebanon. Acculturation is reported to influence the weight status of children and adolescents in nations with many immigrants or nationalities coming from different cultures and backgrounds and starting to adopt a new lifestyle. Children who have moved to a country other than their own home country reported higher prevalence rates of overweight and obesity compared with natives of that same country. In the US a higher prevalence of overweight and obesity was reported in different

immigrants groups compared to other children due to the effect of acculturation [177, 178]. The home countries of the expatriate are mostly countries affected by poverty, war or the immediate or later effects of wars. In our study the expatriate group consisted of participants from Egypt, Iraq, Jordan, Lebanon, Sudan and Syria. Living conditions in those countries are more challenging due to poverty, ongoing conflict or aftermath of war and destruction [179]. In the current study the extent of acculturation was not assessed. However, considering that there were no significant differences between the Emirati and expatriate group in terms of the socio-demographic factors, it may be suggested that living in the same obesogenic environment and sharing the similar lifestyle factors-diet and low physical activity level- are likely to be behind this rise in the overweight and obesity prevalence among expatriates.

4.1.8 Difference in the prevalence between the schools

We had anticipated a response rate of 80% for all schools, based on studies published in the literature. However, in reality we found the response rate was generally lower than expected. In order to compensate for the lower than expected response rate, and to ensure that our target sample size is met for each school, a larger number of students were invited to participate.

There was significant variation in the response rate between the schools, specifically between public and private institutions. The lowest three-response rates were schools located in suburban regions [180] in the emirate of RAK, where the population was mainly UAE national students from known Emirati tribes [181]. The highest two response rates were from private schools in the city of RAK where the vast majority (more than 90%) were Arab expatriates.

The current study was not designed to explore the reasons underlying differences in response rate, however, since the outcomes we are interested in showed interschool differences, this highlights the importance of ensuring that school-based studies truly reflect the population and not only part of it.

The prevalence of overweight, obesity and combined overweight and obesity rate varied between schools, although this variation did not reach statistical significance. Out of the sites that had secondary schools, schools E and F had relatively lower prevalence of overweight and obesity compared with schools B and C. The former two schools had students from all age categories (6-18 years). To report a single prevalence of overweight/ obesity, covering a wide age-range tends to dampen the age related differences in prevalence, specifically when comparing prevalence between schools. Therefore, when comparing schools, the high variability of the student ages in schools E and F and the homogeneity of the student ages in school B and C should be taken into consideration.

Schools A and D had the lower overweight and obesity prevalence compared to the other schools. The lower prevalence may be due to that the students from these two schools are from the younger age categories (6-9 years).

Accordingly, interventions dealing with excess weight may need to vary between different schools, depending on the age group. At younger ages food choices are probably dominated by the mother, whereas for the older children it is the students themselves making many of the choices.

4.2 Factors associated with overweight and obesity

4.2.1 Early life factors

There is a growing body of evidence supporting the influence of the early life prenatal, antenatal and postnatal environments on a child's weight status and subsequent metabolic disturbance due to childhood obesity [182, 183]. Early life factors associated with childhood overweight and obesity are the first group of exposures that may promote obesity. Identification and understanding of these early life factors is the first step in prevention of the growing epidemic of childhood obesity.

Both gestational diabetes mellitus and high birth weight play a role in overweight and obesity during childhood. Gestational diabetes mellitus alters the intrauterine fetal environment due to hyperinsulineamia, which results in increased birth weight [184, 185]. In our study, gestational diabetes during pregnancy of the child participating in the study had a positive significant association in the univariate analysis, but not in the multivariate analysis. Furthermore there was a clear trend of increasing prevalence of overweight/obesity with birth weight, however this did not reach statistical significance.

Several studies have demonstrated a significant positive association between maternal smoking and subsequent overweight and obesity of the child [1, 14,186]. In the UAE smoking is uncommon and culturally unacceptable among females. The number of smoking mothers during pregnancy in our sample was very small (n=5), which made it difficult to identify any association between maternal smoking and childhood obesity.

It is now well established that one of the many benefits of breastfeeding for the infants is the protection from childhood obesity [187]. By contrast, early introduction of artificial milk and solid food play a role in the etiology of childhood obesity through different mechanisms. All commercial artificial milk and solid food options are known for their high sugar and high-energy content. This can result in energy imbalance as well as promoting unhealthy eating habits from very early stage of infant life [188]. A large population based birth cohort study that included 2611 full term born participants showed that children who were fed solid food earlier than 4 months and were on artificial milk had higher odds of being overweight or obese, which was persistent up to 17 years of age [189]. The same study found that infants who were fed breast milk for 4 months and longer had a lower risk of being overweight or obese than those who were on artificial milk if solid food was introduced for both before 4 months of age. This supports the protective effect of breast-feeding from childhood overweight or obesity and its superiority as a healthy feeding option. Our findings did not show any significant association between the introduction of both artificial milk and solid food at any given period (0-4, 5-6 or > 6 months) and the prevalence of overweight and obesity among 6-18 year-old children and adolescent in RAK [190].

None of the early life factors that were explored in this study appeared to be associated with overweight and obesity to a level of statistical significance. This may be attributed to numerous factors related to the study design and methods.

Data on all the early life risk factors was obtained retrospectively, with mothers being requested to recall information dating back up to 18 years. The accuracy of recall is questionable, since mothers have been shown to overestimate

the breast-feeding period [191, 192]. Information extracted from medical records would be more reliable. The establishment of a child and maternal data base where all the information is stored to retrieve the data of early life factors, would make future studies easier. Accurate data on early life factors that is relevant to our settings is essential to develop interventions integrated into improved mother and child health programs.

In addition, it has been suggested that other factors may interfere with and mask the association of the early life factors [193]. For example, a child may be born with a high birth weight, and later in his childhood other factors such as the diet, physical activity and SES may affect him in way that can reduce his risk of obesity. Therefore children with early life obesity associated factors need to be identified and flagged so that special attention can be paid to the other factors that can reduce their risk for overweight and obesity.

4.2.2 Socio-demographic factors

4.2.2.1 Socioeconomic status

Socioeconomic status is the combined economic and social status, which is evaluated by the parental education, parental occupation and combined family income of child. The SES is considered an important health determinant through its influences on the health outcome of individuals [194]. Childhood obesity is one important negative health outcome, which has been shown to be affected by the SES differently in different populations. Low SES in the developed countries and high SES in the developing countries have been reported to be associated with increased risk of overweight and obesity among children and adolescents [23].

Some researchers have used all the three elements in combination to assess the SES [134] [195], while some looked at each factor in isolation [196], and others used the two approaches together [197]. In the present study combined family monthly income, parental education and parental job were assessed independently. Furthermore, the relationship between other socioeconomic factors such as (number of siblings, presence of fulltime domestic helper, the emirate where the father works (as an indication of the presences or absence from home), mother overweight or obesity, father overweight or obesity, overweight or obesity of both parents) and childhood overweight and obesity were examined. There was a significant negative association between father education and overweight and obesity among children and adolescents in RAK. The other socio-demographic factors did not show any direct relationship with childhood obesity. Our results are in agreement with the study conducted in the KSA that explored the relationship between childhood obesity and SES, which was evaluated by combining effect of father education, father occupation and family income. They found no association between the SES and children overweight and obesity [83]. Similarly, a large longitudinal birth cohort study (Millennium Cohort Study) in the United Kingdom that included around 13,000 children at 7 years of age, investigated whether increased risk of childhood obesity is influenced by low-income and family poverty [84]. No direct association between the income and children weight status was found.

Parental Education

Parental education has a clear impact on children's health outcomes. Various studies reported different associations between father and mother educational level separately or jointly with children obesity in different parts in the world. Parental

education has been shown to have a greater effect compared with family income [198].

Our results revealed a strong association between father education and children overweight and obesity. We found that children and adolescents whose father is educated to at least university level had a lower likelihood of being overweight or obese compared to children and adolescents whose fathers had a lower level of education; mother's education on the other hand had no significant effect on prevalence of obesity.

A lower level of education among Egyptian mothers was positively associated with increased risk of overweight and obesity among 6-14 year old children [199]. A Greek study showed that mother completing high school education is associated with lower level of overweight and obesity among 11-12 year-old children compared with those children whose mothers had lower than high school education [200].

In Bahrain, mother education seemed to have greater impact than father education. Overweight and obesity were more prevalent among 15-18 year-old Bahraini adolescents whose mothers achieved higher levels of education, compared to their counterparts whose mothers had lower education [201]. A Saudi study showed that mother education had greater influence than the father education; with overweight and obesity being more prevalent among children whose mothers had higher educational level [83]. ISCOLE reported different associations across the 12 countries, where mother education was positively associated with children obesity in Kenya and Colombia, and parental education was negatively associated with children obesity in Brazil and US [202].

The influence of education of each parent on obesity seems to vary in different countries, and this could be related to the different roles of each parent in these cultures and how these roles may be affected by education.

4.2.2.2 Other socio-demographic factors

a) Parental overweight and obesity

Mother: Both maternal overweight and obesity were significantly associated with higher odds of overweight and obesity among the children in the univariate analysis. The multivariate analysis showed that mothers' obesity had significant positive relationship with overweight and obesity among 6-18 year-old children and adolescents participating in the current study. Our result is in concurrence with the findings among 9-13 year old Cypriot children, where mother obesity was significantly positively associated with children overweight and obesity [203]. An Iranian study explored the relationship between anthropometric measurements and metabolic risk biomarkers in a sample of 1041 mothers and their daughters [204]. Their findings suggested that both general obesity estimated by the BMI and central obesity estimated by the waist circumference in the mothers were associated with higher prevalence of general and central obesity among their daughters. Genetic, environmental or behavioral factors could contribute to the high prevalence of overweight and obesity among children of obese mothers. Sharing the same home food environment and same eating habits is a possible interpretation of this strong association between mothers and children obesity. Mothers may have direct impact on the building of dietary and physical activity behaviors of their children in a very early stage. The impact of the mother on these two important weight related health behaviors was investigated among 222 preschool Chinese children and their mothers.

They found that the weight related behaviors (dietary habits and eating behaviors, physical activity and inactivity) reported by the children were comparable to their mothers' behaviours, whether those behaviours were healthy or unhealthy [205]. This study highlights the importance of healthy habits formation in such an early period of childhood as well as the influential role of the mother in building the healthy weight related habits of their children.

Both parents/ Father: In contrast, other studies have suggested that obesity of the both parents is associated with a higher prevalence of childhood obesity. A Greek study explored the association between parental weight status and the prevalence of overweight and obesity among their children. The authors reported that overweight and obesity of both parents was associated with significantly higher odds of overweight and obesity among their children as compared to those parents whose children were normal [89]. This is in accordance with the findings among 5000 Chinese children and adolescents aged 6-17 years, where obesity was significantly higher among children and adolescents whose parents were both obese. They also found that fathers' obesity was a strong predictor of obesity among their daughters, while mothers' obesity was a strong predictor of obesity among their sons [206]. An American longitudinal ecological study found that parental overweight and obesity were positively associated with overweight and obesity among 2-5 year-old preschool children [207]. Both parents' obesity was associated with higher obesity prevalence among 11-13 year-old children in UK. Interestingly father obesity had higher significant positive association with obesity among their daughters compared to the sons [208].

While there is a consensus that both parents' obesity is a risk factor for child obesity, there is variation regarding the effect of obesity of one parent.

Number of siblings: Overweight and obesity were reported to be more prevalent among children with no or fewer (0-2) numbers of siblings [25, 26]. Having a bigger number of younger siblings has been shown to be protective from weight gain [27]. This is in contrast to our results, which did not find a relationship between number of sibling and childhood obesity among 6-18 year-old children in RAK. The average number of children is 6 children for Emirati families and 4 children for the expatriate families. The larger family size, the extended family and the family relationships in the UAE are all expected to play a role in affecting obesity risk, probably in ways that are different from countries where families are smaller, nuclear and independent.

b) Role of Domestic Helper

The effect of having a live in domestic helper from a different culture on different aspects of children's growth and development has been a controversial topic covered by the media in the UAE. Sponsorship laws in the UAE make it easier for Emirati national families to have a live in domestic helper. Many of these come from Asian countries (India, Sri Lanka), the Far East (Philippines, Indonesia) and some African countries (commonly Ethiopia, much less Kenya and Zanzibar). Domestic helpers are perceived as having a negative impact on several aspects of children's health and development.

The availability of the domestic helper and its effect on overweight and obesity in children has not been widely explored. A cohort study on Emirati mothers found no significant association between the presence of a full time domestic helper

and mother's decision whether or not breastfeed her infant [209]. In a study among university female students in the UAE obesity was prevalent among non-UAE national students whose mothers were educated and didn't have domestic helper at home [210]. It is possible that more educated mothers are working mothers, which may affect their ability to cook regularly. In this case it could be useful to have a domestic helper with knowledge and training in cooking, to ensure children eat home-cooked meals, indicating that domestic helper may be supportive to better nutrition.

The effect of non-parental childcare in early childhood (< 5 years) was associated with increased risk of obesity later in childhood as reported by a by a review paper on non-parental childcare [211]. In the UAE, although the domestic helper can take part in the childcare process at home from a very early age, there is no evidence as yet that this can be detrimental with regards increasing obesity risk in children. The availability of the domestic helper in such an early stage of the child's life may, under the guidance and instructions of an educated mother, be a supporting factor to better healthy behaviours.

In the current study we investigated the association of 1) the availability of the domestic helper, and 2) whether the domestic helper or any other family member prepared the home meals, with the children overweight and obesity. Our results did not show a relationship between the availability of a living-in domestic helper and children's overweight and obesity. Moreover we did not find an association between the person who prepares the food at home and overweight and obesity. Regardless of whether the food was prepared by the mother, any other family member (such as grandmother) or the domestic helper (who can have cooking responsibilities in our

culture) overweight and obesity did not seem to be affected. This further supports the view that presence of a domestic helper and even her involvement in cooking does not have additional detrimental effect on overweight and obesity. One can hypothesize that the presence of the domestic helper is protective for the children from weight gain because it is increasing the numbers of meals prepared at home and reducing the probability of eating outside home. The domestic helper can work as an assistant for the family members in cooking.

4.2.3 Diet and lifestyle factors

Two main aspects of lifestyle that may impact overweight and obesity were investigated: dietary habits, movement (physical activity, sedentary behaviours and sleeping efficiency).

Dietary habits

Fat accumulation and increased adiposity among children and adolescents is an outcome of the high-energy intake and low energy expenditure [212]. High caloric energy dense unhealthy food is known to have great contribution for this energy imbalance and excess weight gain [213]. Following a healthy diet has been shown to be effective in weight loss and normal weight maintenance [214]. In the current study we asked about the frequency of having breakfast and the number of meals eaten from outside during the previous week. Data about the frequency (but not the portion size) of the consumption of various food items during a typical week was obtained from participants using the food frequency questionnaire. These food items were fruits, vegetables, dark vegetables, fish, sweets, sugar sweetened beverages (SSB, which include soda, juices, energy drinks), bread and pastries, fish,

full milk, low fat milk, cheese and other dairy products, fried food at home, fast food and French fries.

Published literature reported mixed findings related to the dietary habits, dietary patterns and different food items and their association with increased prevalence of overweight and obesity among children and adolescents.

General eating pattern

Breakfast: There is an overwhelming body of evidence associating the breakfast meal with lower obesity prevalence among children and adolescents. A study conducted in Kuwait among 14-19 years old adolescents reported that skipping breakfast was significantly positively associated with overweight and obesity [215]. Skipping breakfast was also among the factors associated with overweight and obesity among Saudi children and adolescents [6]. These results were in accordance with the findings reported recently by a Turkish school-based cross-sectional study, where a significant negative association between daily breakfast consumption and overweight and obesity was found [216].

A large nation-wide Malaysian study that included more than 8000 school students aged 6-17 years, stated that healthier body weight is associated with regular breakfast consumption. A higher prevalence of overweight and obesity prevalence was found among breakfast skippers (0-2 days per week) and irregular breakfast eaters (3-4 days per week) compared to regular breakfast eaters (5 or more days per week) [217]. The ISCOLE study reported that children who consumed breakfast more frequently had lower BMI and body fat percentage, however this finding was not consistent across the 12 countries involved in the study, suggesting regional

variations in the effect [218]. There was no significant association between the frequency of breakfast consumption and obesity prevalence among 9-11 year-old children in Australia, Finland and Kenya. These variations have been interpreted as being due to poverty in Kenya where food is not readily available at home, whereas in Australia and Finland weight reduction plan and not feeling hungry has been suggested to be possible causes. We found those who were having breakfast 5 or more days per week had significantly lower odds of being overweight or obese compared to those who never had breakfast, only in the univariate analysis. No significant association between breakfast consumption and obesity was seen in the multivariate logistic regression. In the UAE there is no shortage of breakfast food, and at the very least would comprise of bread (with or without processed cheese, chocolate spread or jam) and milk or tea. However, the actual foods eaten for breakfast may not be the healthiest choices, thereby dampening the positive effect of breakfast on overweight and obesity.

Eating from outside: Our results showed that eating from outside had no significant association with the increased overweight and obesity prevalence. In our study, around 72% of the study sample ate from outside 2-3 times per week, which included eating outside the home or ordering food to be delivered at home. A review paper from the KSA found that frequency of eating away from home is positively associated with higher rates of overweight and obesity [6]. The availability of restaurants, cafeterias and mobile food venders is an important promoter for children and adolescents to eat from outside. A Mexican study examined the food environment around the school and the effect of the high-density food stores on the students' BMI in several elementary schools. It was found that the higher the number

of the food stores, restaurants, cafeterias, and mobile food venders around the school, the higher the BMI of the children in that school, indicating higher frequency of eating from outside among these children [219]. The sugar content of food bought from outside may be one the factors leading to obesity in consumers of these food. A Greek study found a positive association between the frequencies of eating outside with the amount of sugar intake in the children diet [220].

In the UAE, going to restaurants or ordering foods to be delivered at home are common practices. Food eaten outside or delivered to home is not necessarily fast food; freshly grilled fish, roasted chicken and barbequed lamb or chicken are readily available for home delivery. Hence, eating food cooked outside the home is not always associated with unhealthy eating habits and this could explain why in our study we did not find eating from outside to be a factor associated with obesity.

Dietary contents

Healthy diet is one of the requirements to promote good health and prevent obesity. Research in this field has commonly used the food frequency questionnaire(s) as a tool to collect data on healthy food and non-healthy food which participant consume and to associate this with an outcome (e.g. overweight or obesity) [221]. In general consumption of certain food categories is considered to be healthy whereas consumption other food categories are considered unhealthy.

Healthy dietary contents

Fruits and vegetables including dark vegetables: Worldwide the evidence on the role of fruits and vegetables have on childhood obesity is still inconclusive [222]. There are conflicting results regarding whether or not adequate (size of serving and

frequency of consumption) fruits and vegetables intake, according to the international recommendations, is associated with lower obesity among children. The current study did not find any significant association between fruits and vegetables and overweight and obesity. Higher frequency of intake of dark vegetables was significantly associated with lower prevalence of overweight and obesity among children and adolescents. A Bahraini study among 15-18 year old adolescents showed a significant association between fruits intake for 3 or more times per day and the lower risk of obesity among males but not females. Egyptian 6-14 children (ages 6-14 years) who consume 2 or more servings of fruits and vegetables per day were less likely to be overweight and obese compared to those whose consumption is less frequent or occasional

On the contrary, there was no significant association between fruits and vegetables intake and the weight status among 1-6 year-old [223]. The ISCOLE study reported from the UK found that healthy diet pattern (including fruits and vegetables intake) was associated with increased risk of overweight and obesity among children aged 9-11 years [224]. In the US a study conducted among children aged 1-6 years in rural poor areas included a wide variety of ethnicities and found that having two or more servings of vegetables per day is associated with higher odds of overweight and obesity among these children [225]. Eating one or more serving of vegetables per day was significantly higher among overweight and obese Chinese children [226]. There was no significant relationship between fruits and vegetables consumption and the weight status of 1-6 year old Malaysian children [223]. Information obtained by limiting the question to the amount vegetables consumption, without collecting details about the method of preparation and what it is eaten with,

can be misleading. For example, if the vegetables are fried, or if they are consumed with large amounts of noodles or rice, then the risk for obesity may be more compared with not eating them.

Milk: Our results revealed a significant negative association between the frequent intake of full fat milk and lower prevalence of overweight and obesity among children and adolescents in RAK. This is in agreement with the findings of another UAE study, which showed that lack of dairy products consumption (including milk) was positively associated with overweight and obesity among 6-18 year old school students [135]. In a Turkish school-based cross-sectional study, students who had a higher frequency of milk intake had a lower likelihood of being overweight or obese [227]. Similarly, the results reported by an American study where lower consumption of whole milk was associated with overweight and obesity among children aged 1-6 years [42]. Milk consumption is an old dietary tradition in the UAE; fresh camel milk and goat milk were basic components of the Bedouin diet. While milk remains central to the UAE diet, the organic drink has been replaced by highly processed dairy products, many of which have artificial ingredients added to them.

Unhealthy dietary contents

SSB: Sugar sweetened beverages are a source of added sugar increasing the energy contents and decreasing the nutritional value of the children diet [35]. Increased added sugar is associated with increased adiposity and accumulation of cardio-metabolic risk factors among children [228]. In the current study, no association between the frequency of intake of the sugar sweetened beverages including soft drinks, juices and energy drinks and prevalence of overweight and obesity was found. Our results agree with a Bahraini study among 15-18 year- old adolescents,

that did not find an association between higher frequency of soft drinks and obesity rates [201]. On the other hand, a review paper from KSA found that SSB were positively associated with higher risk of overweight and obesity among Saudi children and adolescents [6]. A Lebanese study that explored the association of different factors with overweight and obesity among children and adolescents aged 6-19 years, found that higher frequency of the consumption of SSB was associated with obesity among their sample [24]. Drinking one or more of the sugar-sweetened beverages per day was significantly higher among overweight and obese Chinese children [43]. The ISCOLE study explored the association between consumption of soft drinks (regular and diet) and obesity among children from 12 countries around the world. Their findings showed a sex difference in the association between the obesity and the soft drinks consumption. A positive association between obesity and regular soft drinks consumption was found among boys only, while the diet soft drinks were positively associated with obesity among girls only [229]. If differences exist in the effect of soft drinks on obesity risk depending on the type of the drink and depending on the sex, then combining all these groups together will likely not show significant results.

Fast food: is defined as "quick, easily prepared and highly processed food by frying, grilling or roasting, cheap and readily available alternatives to home cooked meals and they are also high in calories, saturated fat, sugar and salt" [230]. French fries, pizza, burgers, sandwiches, fried meat or chicken are common types of fast food available in most Arabic countries. Our results showed that having French fries 1-2 times per week was significantly associated with higher odds of being overweight or obese among the studied sample of school children and adolescents in the current

study. The frequency of consuming other fast food types had no significant association with overweight and obesity in multiple logistic regression analysis. Our findings are in agreement with what was reported by Musaiger et al. [201] that intake of fast food was not associated with obesity among Bahraini adolescents. This was attributed to the higher carbohydrate and fat contents in the local food of the GCC countries in general, and Bahrain in particular, as compared to the western fast food. In contrast, children and adolescents aged 6-19 years in a Lebanon were found to have a higher risk of obesity with a higher rate of consumption of fast food. [24]. Higher contents of saturated fat, carbohydrate, salt and sugar reduce the food quality whether it is a local (Middle Eastern) food or westernized fast food. Regular consumption could result in adverse health outcomes, which may be manifested as obesity or any other malnutrition complications.

A number of limitations in studies that had explored the role of diet on weight status of children and adolescents must be taken in to account when interpreting the findings. Self-reported nature of data might be a source of bias. Completion of most food questionnaires requires participants to breakdown each meal into its component, which would difficult for the average person.

Physical activity

The initial plan of the assessment of physical activity in the current study was to measure the school physical activity classes per week in addition to time spent outdoors. However it became apparent that the time spent outdoors is not an accurate indicator, since it is likely be spent in sedentary activity and not necessary actively playing. As a result the school physical activity classes were the only physical activity included in the analysis, which is two lessons per week as set by the UAE

authorities for the all public and private schools in the country. It is not unexpected, therefore that we did not to find any significant association between physical activity and the overweight and obesity prevalence, as 2 hours is not sufficient and well below the recommended physical activity hours per week. Organized physical activity at school was associated with higher fitness levels and lower obesity rates among pre-adolescents aged 8 years [231]. Physical activity has been considered to be one of the main lifestyle behaviours recommended by authorities to reduce the risk of overweight and obesity and CVD [232]. A well-designed school based RCT among 9 year-old children followed for 2 years had shown significant positive effect of physical activity in reducing the blood pressure, total cholesterol and triglyceride in the intervention group compared to the control group [233]. Previously the defined level for school aged children and adolescents to be considered as physically active were to have 60 minutes or more of moderate to vigorous physical activity per day [234]. Since then researchers investigating the relationship between physical activity and childhood overweight and obesity were adherent to this definition to evaluate the physical activity level. The measuring methods used to evaluate the level of physical activity and their associations with overweight and obesity among children and adolescents have a clear impact on the published results. Self-reported recalling questionnaires and activity diaries have their limitations among younger people; physical activity recalling is considered a complicated mental process especially for children [235]. Children also find it difficult to understand the terminology usually used in these questionnaires such as “moderate” “vigorous” “intensity” and “leisure time” [236]. Social desirability and over-reporting are further limiting the accuracy of the self-reported physical activity [237]. Interview based physical activity data collection was compared to the accelerometer data among a group of 92 obese

children aged 5-17 year old. The agreement between the accelerometer and the interview-base level of physical activity information was fair [238]. One could expect that physical activity data reported by the parent would be more accurate and reliable than reported children self-reported data. A study compared the level of physical activity reported by the parents with the objectively measured physical activity by the accelerometer, in order to evaluate parents ability to assess the effect of any proposed future interventions and report physical activity data accurately. They found that the parents overestimate the time spent by the children in the activity [239]. More reliable data and accurate monitoring is obtained from the advanced objective measures of physical activity (e.g. accelerometer), which became more preferable tool for the scientific research [240]. On the other hand, large epidemiological studies cannot use such objective measures, because of their relative high cost and low feasibility. It is not surprising therefore, in view of the limitations mentioned above; that the published studies exploring the association of physical activity with childhood overweight and obesity showed varying results. A UAE study tried to evaluate the level of physical activity among 6-19 year old school children by using the short version of the International Physical Activity Questionnaire, however no association was found between childhood obesity and physical activity due to the self-reported nature of the data collected [135]. There is some evidence suggesting that there are sex-specific differences in the association between the level of physical activity and overweight and obesity among children and adolescents [241]. A Kuwaiti study found that low level of physical activity among males adolescents (but not in females) showed higher contribution on the prevalence of overweight and obesity [242]. While in Bahrain the level of physical activity had no significant association with the weight status among 15-18 year old

adolescents of both sexes. The reported level of physical activity among a sample of 945 Sudanese adolescents was very low (6.8%) and was not associated with the rates of overweight and obesity. A study conducted in the US suggested that the relationship between low rates of obesity and physical activity varied across different age, sex and ethnical groups. Hispanic and white males at the seventh grade who had regular low-intensity physical activity had lower prevalence of overweight and obesity. The ISCOLE study reported that moderate to vigorous physical activity was negatively associated with obesity between both males and females children ages 9-11 in 12 different countries around the world [229]. A recent study found that having more than two hours of outdoor activities on non-school days is associated with lower risk of overweight and obesity among 6-10 years old children compared to two hours and less of outdoor activities on non-school days [243]. The physical activity and the healthy diet showed highly protective effect from overweight and obesity among American children and adolescents. Children who were on unhealthy diet but physical active had lower prevalence of overweight and obesity than those who were on a healthy diet and physically inactive [244]. This superior effect of physical activity was more prominent among younger children 5-7 year-old compared to adolescents, which indicated the importance on building healthy behaviors from younger age. It has been suggested that females in the UAE and the other GCC countries have lower physical activity levels due to cultural restrictions. In our study it seems to be that all the students, regardless of sex, shared the same findings. Although there are many segregated gyms in RAK, there is still a general lack of motivation to engage regularly in adequate physical activity.

Sedentary behaviours: In the current study we asked the students two questions in order to assess sedentary behavior on school days and during weekends: 1) “how many hours did you watch TV?” and 2)“how many hours did you play video or computer games or use a computer for something that was not school work?” during the last week. Participants had five choices, starting from 0 and increasing to 5 or more hours per day, to answer. Although it was expected that many children would spend longer than two hours on the screen, the 95% of the study population that we obtained exceeded our expectations and did not allow comparison with a reference group (less than 2 hours). Several authorities recommended that screen time should be limited to no longer than two hours per day for children [245, 246]. Research has highlighted the association between multiple negative health outcomes and prolonged durations of sedentary activities such as screen time and watching TV. These included increased body fat composition, increased cardio metabolic risk factors scores and a decrease in the level of body fitness [247]. The first cross-sectional study conducted in the UAE and the GCC early in 1998-1999 to investigate the level of inactivity, found that up to 93% of 11-16 year old female school students spend 2-3 hours per day watching TV, only 5% had more than 4 hours of watching TV per day [248]. Although the proportion that are exceeding the recommendations are the same to the proportion reported among our participants, we found that there is a dramatic increase with excessive screen time (5% compared to 72%).

Sedentary behaviors were highly prevalent among Sudanese 14-18 year-old adolescents, but it did not show any significant association with overweight and obesity [175]. The ISCOLE study reported that high TV viewing time is positively associated with obesity among 9-11 year-old children [110]. While another ISCOLE

publication found a positive association between increased sedentary time (including TV viewing) and childhood obesity in 5 of the 12 countries that participated in the study, and reported no significant association for the remaining 7 countries [249]. Twenty two percent of the obese 11-12 year-old Greek children had longer screen hours than their normal or overweight counterpart [38]. The limitations of many studies were that the estimates of TV viewing were self-reported and did not expand to capture the total screen time. Spending more time on watching TV or using other electronic devices (computers, games, smart phones etc.) has become the common trend/norm in the modern life among children and adults. Use of devices with a screen has become a norm in the UAE. Most children activities have a version in the form of application, and these are used by children from a very young age. Finally, similarly to dietary habits, components of movement cannot be assessed independently of one another. For example, a person who regularly has 3 hours of screen time may also engage in one hour of vigorous exercise daily. Therefore, it is only when the components are put together that a more accurate picture of the relationship between obesity and movement will become clear.

Sleeping efficiency: Numerous studies established that sufficient sleeping hours and good sleeping quality have a clear impact on children's general health and weight status [250, 251]. A longitudinal study suggested that 3-12 year old children with shorter sleep duration were more likely to be overweight, which could lead to poor physical health [252]. Short sleep duration was shown to have a stronger association with overweight and obesity than poor dietary habits in inducing overweight and obesity among children and adolescents [111]. Sleep duration and efficiency can influence or be influenced by other lifestyle behaviours, which synergize its health

impact on children and adolescents. The ISCOLE study examined the association between sleep patterns and other lifestyle behaviors such as physical activity, sedentary time, and eating patterns and found variable results across the 12 study sites [253]. One of the interesting findings reported by ISCOLE is that better sleep quality (efficiency and duration) was negatively associated with unhealthy dietary patterns. Childhood obesity is inversely associated with sleeping duration in all childhood stages starting from infancy to adolescence [254]. A review paper of the recently published longitudinal studies among children and adolescents supported the negative association between the overweight and obesity prevalence and the sleep duration across different age categories [255]. Fewer studies supported the same finding across the younger age group but not the older. Short nighttime sleep duration among (0-4 year old) infants and preschool children was associated with increased risk of overweight and obesity. The same study reported that insufficient sleep duration did not associate with subsequent overweight and obesity among the older children 5-13 year old. In our study we intended to evaluate the effect of sleeping time on overweight and obesity among school children and adolescent in RAK. We incorporated two questions in the questionnaire on sleeping time and waking up time, and this was done for the weekdays and weekends. It was noted when filling these questions that there was discussion between the students and their responses appeared to be strongly influenced by peer pressure. Therefore the data was considered to be contaminated and as such was excluded from the analysis. Other recent studies obtained more reliable data on sleeping duration by using the accelerometer for 7 days [256]. Meeting the recommended sleeping hours per day for the school children and adolescent is essential to maintain good general health and for the protection from overweight and obesity and its associated cardio metabolic

complication later in life [257]. Going to bed late is the norm for most adults in the UAE, and it is acceptable in some families for the children as well. Therefore interventions related to improving sleep would have to be culture sensitive and target all age groups.

4.3 Prevalence of Metabolic Syndrome

Out of 726 participants eligible to continue with Part 2 of the study, only 413 agreed, giving a response rate of 56.9%%. We compared characteristics of those who participated in the second part of the study with those who declined, and did not find any significant difference in mean age and sex. Although there were more obese individuals in the group who participated compare to group who refused. The prevalence of MetS among our sample of school adolescents in RAK was 6.6% using the IDF criteria. Higher prevalence has been reported in Al Ain Abu Dhabi emirate; 13% among adolescents aged 12-18 years as reported by Mehairi et al. [151] based on IDF criteria. The prevalence estimated among a sample of exclusively obese school students by Eapen et al. [153] was 44% based on the NCEP. Higher prevalence have been reported in the neighboring GCC countries. In Kuwait 21.3% of among children with mean age of 12.3 years had MetS based on IDF [149]. In the KSA the prevalence of MetS was 23.4% among 12-16 year old adolescents according to the NCEP [150]. The prevalence of MetS among Lebanese adolescents (16-17 years old) was 26.2% by IDF criteria [147]. Our estimated prevalence of MetS is almost the same as the data reported in a review paper from the Middle East, where the MetS prevalence were 6.8% and 6.5% based on IDF and NCEP criteria respectively [137].

MetS prevalence estimated by the current study was higher among males (11.4%) than females (3.1%); all the components of the MetS were also more prevalent in males compared to females. These findings are similar to the findings of Mehairi et al. [151] and Eapen et al. [153]. Al Mehairi et al. [151] found the MetS more prevalent among males than females. In the present study MetS and its individual risk factors increased with age. The highest prevalence of MetS and its components were among the 15-18 year old adolescents compared to the younger age categories.

4.4 Conclusion

This cross-sectional study was designed to determine the prevalence of overweight and obesity and metabolic syndrome among school children and adolescents in RAK, UAE. Early life factors, socio-demographic and diet and lifestyle determinants were investigated with regard their association with overweight and obesity. The prevalence of combined overweight and obesity was high among 6-18 year-old school children and adolescent in RAK. The estimated prevalence of metabolic syndrome was 6.6 among 10-18 year-old adolescents.

Prevalence of excess weight increased with age and there was a clear sex-difference whereby overweight was more common in girls, and higher obesity in boys.

The study found that father education was significantly associated with children overweight and obesity. The role of educated father showed a strong impact on the children weight status. Involving the father in futures interventions related to children weight reduction would be helpful since his role appears to be influential.

Mother obesity was also significantly associated with overweight and obesity among the children. Future interventions need to consider the family health perceptions, behaviors and habits and how these can be transformed from the mother to the child. Milk intake and dark vegetable intake were significantly associated overweight and obesity.

The adjustment of diet and lifestyle factors for children and their parents are of great importance. The protective effect of adequate physical activity, balanced energy intake and healthy eating habits can strongly interfere with the full expression of the pre-existing genetic predispositions and the early life risk factors. The interventions should be focused on the diet and lifestyle factors at this age group (childhood adolescence), because childhood overweight and obesity diet and lifestyle factors are the most reversible and modifiable. In the current study we found that the prevalence of overweight and obesity was lower among the younger age group, but this should not reduce the importance of special interventions directed toward them to help them to build these healthy lifestyle behaviors. Our study is the only study in the Middle East and North Africa to use ISCOLE questionnaire and compare the results with them.

In planning future studies it is important to anticipate the response rate based on local studies and experience, since this can be different from published studies from other countries. Future research looking into overweight and obesity should be based on robust data on causative factors related to these outcomes in addition to an understanding of the cultural issues that no doubt have an impact. In order to understand causative factors, it is necessary to adopt a longitudinal study design in which cohorts are followed prior to becoming obese, for many years. With

longitudinal design, problems related to bias such as recall bias and subjective reporting (e.g. diet and exercise) are avoided. To the extent possible it is better to use objective measures to assess sleep and movement (accelerometer). To understand cultural issues that affect obesity to complement the quantitative with qualitative studies that focus on attitudes and perceptions toward obesity.

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Appendices

Appendix 1 a: Ethical Approval

الإمارات العربية المتحدة
وزارة الصحة و وقاية المجتمع

MOHP RESEARCH ETHICS COMMITTEE
Research and Ethics of Research Committee
COORDINATION LETTER FOR APPROVAL ON THE RESEARCH PRPOSALS

Date:

Dear Sir / Madam

Reference to Research No 7

The MOHP Research and Ethics Committee have approved PI - DR. MOZA MOHAMED AL-ZAABI

as the first step to get approval of his/her Research

Title of the proposed research: Prevalence and Potential Determinants of Obesity and Metabolic Syndrome among School Children and Adolescents in Ras Al Khaimah United Arab Emirates.

APPROVED BY REC MEMBERS:

	NAMES		NAMES
1.	Dr. Abdulla Al-Khayat –CHAIRMAN	7	Dr. Safiya Al-Shamsi
2.	Dr. Suad Hannawi –DEPUTY CHAIRMAN	8	Dr Muna Al-Muttawa
3.	Dr.Sumayya Al-Araj	9	Dr. Sumaya Al-Zarouni
4.	Dr. Salah Al-Badawi	10	Dr. Salem Al-Kaabi
5.	Dr. Ehab Yousef	11	Hala Bin Zaal
6.	Dr. Safwat Mohamed		

The primary concern of the Research Ethics Committee is to guard any infringement on research ethics. Apart from clear violation, the Committee is not deeply involved in the methodology of research as this is the researcher's own responsibility.

Best regards,

Chairman: MOHP-Research Ethics Committee.

Dr. Abdulla Al- Khayat

for **Signature** Dr. Suad Hannawi

30-06-2016

Appendix 1 b: Ethical Approval

UAEU College of Medicine and Health Sciences

جامعة الإمارات العربية المتحدة
United Arab Emirates University

16th June, 2016

Ref: DT/fa/16_43

Dr Mohamud Sheek-Hussein
Public Health Institute
CMHS

Dear Dr Sheek-Hussein

Re: Prevalence and determinants of obesity and metabolic syndrome among school children & adolescences in RAK, UAE ERH-2016-4351 16_43

Thank you for submitting your application to the Ethics Committee. The application has been reviewed by Al Ain Medical District Human Research Ethics Committee (AAMDHREC) and I am pleased to provide you ethical approval of your project. Since this project includes children identified through the schools, it is required that you obtain formal written approval from the relevant school district before commencing your work.

The AAMDHREC is an approved organization of Federal Wide Assurance (FWA) and compliant with ICH/GCP standards.

The Committee must be informed if there is deviation from the approval protocol or if you have any other concerns.

Annual reports plus a terminal report are necessary and the Committee would appreciate receiving copies of abstracts and publications should they arise.

I wish you success with this important study.

With kind regards,

Yours sincerely,

Prof. Dennis Templeton
Chair, Al Ain Medical District Human Research Ethics Committee

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Appendix 2: RAK Medical District Approval

UAEU Faculty of Medicine and Health Sciences

جامعة الإمارات العربية المتحدة
United Arab Emirates University

Date: September 9, 2015

التاريخ: 9 سبتمبر 2015

H.E. Director of Ras Al Khaima Medical District,
RAK Medical District

سعادة مدير منطقة رأس الخيمة الطبية
منطقة رأس الخيمة الطبية
رأس الخيمة

Dear Sir,

تحية طيبة وبعد ، ، ،

Re: ***Data for Students' Project***

الموضوع : معلومات لمشروع بحث طالبي

As part of her research fulfillment our Ph.D. student, **Dr. Moza Mohamed Al Zaabi**, who work under the guidance of **Dr. Mohamud Sheikh Hussein** at the Institute of Public Health of the UAE University, have to conduct a community based study on "**Prevalence of Obesity and Metabolic Syndrome among School Children in RAK, aged 6-18 years**".

نرجو أن نفيدكم علما بأن الدكتورة **موزة محمد** الزعابي، من طلاب برنامج الدكتوراة بكلية الطب والعلوم الصحية بجامعة الإمارات العربية المتحدة. وترغب المذكورة في اجراء دراسة ميدانية عن: "**مدي انتشار السمنة ومتلازمة الأيض لدى أطفال المدارس في الفئة العمرية 6-18 سنة في منطقة رأس الخيمة**".

To do this she would like to distribute a questionnaire (a copy is attached), take anthropometric measurements and to do some medical investigations to a sample of 1200 school students in RAK emirate, during the period from September 2015 to June 2016.

ولتجميع البيانات ترغب المذكورة في توزيع استبيان على الطلاب والطالبات بالمدارس وإجراء القياسات اللازمة للوزن والطول وإجراء بعض التحاليل الطبية لحوالى 1200 طالب وطالبة في رأس الخيمة، وذلك خلال الفترة من سبتمبر الحالي وحتي نهاية يونيو 2016.

I should be most grateful if you could extend to her all possible assistance to carry out her project.

وعليه نرجو منكم التكرم بالإيعاز لمن يلزم بالسماح لها بتوزيع الإستبيان وإجراء القياسات وتجميع المعلومات والبيانات المطلوبة لإنجاز البحث المشار اليه.

Yours faithfully,

وتفضلوا بقبول وافر الشكر والتقدير ، ، ،

Dr. Iain Blair,
Director,
Institute of Public Health,
College of Medicine & Health Sciences,
United Arab Emirates University

د. إيان بلير
رئيس معهد الصحة العامة
كلية الطب والعلوم الصحية
جامعة الإمارات العربية المتحدة

c.c. Asst. Dean for Students Affairs

* نسخة لسعادة العميد المساعد لشؤون الطلاب

التاريخ : 28 – 10 – 2015

السيد / د. عبدالله أحمد النعيمي المحترم ،،،
مدير منطقة رأس الخيمة الطبية ،،،
تحية طيبة وبعد ،،،

الموضوع : بحث الدكتوراة الخاص بالدكتورة موزة الياحد

أرجو من سيادتكم الإيعاز لمن يلزم بمباشرة العمل الميداني لبحثي المرفق تفاصيله في خطاب جامعة الإمارات إليكم .

وتفضلوا بقبول فائق الشكر والإحترام ،،،

الدكتورة / موزة محمد الياحد
كلية الطب والعلوم الصحية
جامعة الإمارات العربية المتحدة

UAEU Faculty of Medicine and Health Sciences

جامعة الإمارات العربية المتحدة
United Arab Emirates University

Date: September 9, 2015

التاريخ: 9 سبتمبر 2015

H.E. Director of Ras Al Khaima Education District,
RAK Education District

سعادة مدير منطقة رأس الخيمة التعليمية
منطقة رأس الخيمة التعليمية
رأس الخيمة

Dear Sir,

تحية طيبة وبعد ، ، ،

Re: ***Data for Students' Project***

الموضوع : معلومات لمشروع بحث طالبي

As part of her research fulfillment our Ph.D. student, **Dr. Moza Mohamed Al Zaabi**, who work under the guidance of **Dr. Mohamud Sheikh Hussein** at the Institute of Public Health of the UAE University, have to conduct a community based study on **"Prevalence of Obesity and Metabolic Syndrome among School Children in RAK, aged 6-18 years"**.

نرجو أن نفيدكم علما بأن الدكتورة **موزة محمد الزعابي**، من طلاب برنامج الدكتوراة بكلية الطب والعلوم الصحية بجامعة الإمارات العربية المتحدة، تحت إشراف **الدكتور محمود شيخ حسين**. وترغب المذكورة فى اجراء دراسة ميدانية عن: **"مدي انتشار السمنة ومتلازمة الأيض لدى أطفال المدارس في الفئة العمرية 6-18 سنة في منطقة رأس الخيمة"**.

To do this she would like to distribute a questionnaire (a copy is attached), take anthropometric measurements and to do some medical examinations to a sample of 1200 school students in RAK emirate, during the period from September 2015 to June 2016.

ولتجميع البيانات ترغب المذكورة فى توزيع استبيان على الطلاب والطالبات بالمدارس وإجراء القياسات اللازمة للوزن والطول مع إجراء بعض التحاليل الطبية لحوالى 1200 طالب وطالبة في رأس الخيمة، وذلك خلال الفترة من سبتمبر الحالي وحتي نهاية يونيو 2016.

I should be most grateful if you could extend to her all possible assistance to carry out her project.

وعليه نرجو منكم التكرم بالإيعاز لمن يلزم بالسماح لها بتوزيع الإستبيان وإجراء القياسات وتجميع المعلومات والبيانات المطلوبة لإنجاز البحث المشار اليه.

Yours faithfully,

وتفضلوا بقبول وافر الشكر والتقدير ، ، ،

Dr. Iain Blair,
Director,
Institute of Public Health,
College of Medicine & Health Sciences,
United Arab Emirates University

د. إيان بلير
رئيس معهد الصحة العامة
كلية الطب والعلوم الصحية
جامعة الإمارات العربية المتحدة

c.c. Asst. Dean for Students Affairs

* نسخة لسعادة العميد المساعد لشؤون الطلاب

Appendix 3: Lab License

Ministry of Health
Licensing Department

وزارة الصحة
إدارة التراخيص الطبية

License Number **5005** رقم الترخيص

Establishment Ref. #	5	5	رقم مرجع المنشأة
Establishment Name	Medicare Medical Laboratory	مختبر ميديكير الطبي	إسم المنشأة
Emirates	Ras Al Khaima	رأس الخيمة	الأمارة
Category Class	• Diagnosis Center	مركز تشخيصي	نوع المنشأة
Date From	15/11/2015	2015/11/15	من تاريخ
Date To	14/11/2016	2016/11/14	إلى تاريخ

EXPO 2020 إكسبو 2020

Appendix 4

Arabic Questionnaires

استبيان: الخصائص السكانية والصحة الأسرية

أ-بيانات عامة:

1. اسم الطفل: _____ 4. عنوان المنزل: _____
2. اسم المدرسة الملتحق بها الطفل: _____ 5. رقم الهاتف: _____
3. اسم الوالد أو ولي الأمر: _____ 6. منذ متى وأنت تعيش في العنوان الحالي: _____أعوام ____ شهور

ب-البيانات الديموغرافية للطفل:

1. تاريخ الميلاد: _____ 2. مكان الميلاد / بلد الميلاد: _____
3. جنسية الطفل: _____ 4. عدد الإخوة والأخوات لدى الطفل: _____
5. أعمار الاخوان والاخوات بالترتيب من الاكبر للأصغر (إن لم يوجد إخوة أو إخوات, يرجى الانتقال إلى السؤال رقم ج)

(1)_____ (2)_____ (3)_____ (4)_____

(5)_____ (6)_____ (7)_____ (8)_____

ج- التاريخ الصحي للطفل:

1. الوزن عند الولادة: _____ كغم
2. الطول عند الولادة: _____ سم
3. مدة الحمل: _____ شهور
4. هل عانت الأم من مرض السكري الحملي أثناء حملها بالطفل؟ ☐ نعم ☐ لا
5. هل كانت الأم تدخن أثناء حملها بالطفل؟ ☐ نعم ☐ لا
6. هل تغذى الطفل على حليب الام؟ إذا كانت الإجابة لا يرجى الانتقال إلى رقم 8 يمكن اعطاء الاجابات تقريبية في حال عدم تذكر الام للبيانات بدقة. مع ذكر كلمة تقريباً ☐ نعم ☐ لا
7. عمر الطفل عندما توقف تماما عن رضاعة حليب الام: _____ شهور
8. عمر الطفل عند بدأ الرضاعة بالحليب الصناعي _____ شهور
9. عمر الطفل عندما توقف تماما من رضاعة الحليب الصناعي _____ شهور
10. في أي عمر بدأ تقديم الطعام الصلب للطفل؟ _____ شهور

د- البيانات الديموغرافية والصحية للأسرة:

1- الحالة الاجتماعية لوالدي الطفل؟
- ☐ متزوجان
- ☐ مطلقان/منفصلان
- ☐ أحدهما متوفى

2- كم عدد الأشخاص الذين يعيشون معك (في هذا العنوان)؟ _____

3- ما هو مجموع الدخل الشهري للأسرة؟ (بالدرهم)
- ☐ أقل من 5.000
- ☐ 30,000 – 20,001
- ☐ 60,000 – 50,001
- ☐ 10,000 – 5,001
- ☐ 40,000 – 30,001
- ☐ 70,000 – 60,001
- ☐ 20,000 – 10,001
- ☐ 50,000 – 40,001
- ☐ 80,001 أو أكثر

4- كم عدد المركبات الآلية المتاحة للإستخدام في المنزل؟
- ☐ عدد ( ) مركبة
- ☐ عدد 5 أو أكثر

5- هل لديكم خادمة بالمنزل؟ ☐ نعم ☐ لا

6- إذا كانت الإجابة على سؤال رقم 5 بنعم، فكم عدد الخادمات؟
- ☐ عدد ( ) خادمة
- ☐ عدد أكثر من 3

7-كم عدد أجهزة التلفاز في المنزل؟
- ☐ عدد ( ) جهاز
- ☐ عدد 5 أو أكثر

8-ما هو مستوى الأم التعليمي؟
- ☐ أقل من المرحلة الإبتدائية
- ☐ المرحلة الثانوية
- ☐ البكالوريوس
- ☐ المرحلة الإبتدائية
- ☐ الدبلوم
- ☐ الدراسات العليا/ المهنية

9- عمل الأم
- ☐ تعمل ، أذكر الوظيفة _____
- ☐ ربة منزل

10- ما هو مستوى الأب التعليمي؟
- ☐ أقل من المرحلة الإبتدائية
- ☐ المرحلة الثانوية
- ☐ البكالوريوس
- ☐ المرحلة الإبتدائية
- ☐ الدبلوم
- ☐ الدراسات العليا/ المهنية

11- عمل الأب _____

12- في أي إمارة يعمل الأب _____

يرجى الإجابة على الأسئلة التالية فيما يتعلق بأم الطفل:

1-عمر الأم الحالي _____ عام

2-عمر الأم عند ولادة الطفل _____ عام

3-طول الأم الحالي _____ سم

4-وزن الأم الحالي _____ كغم

5- لا يمكن تقييم المعلومات الخاصة بالأم أو أنها غير معروفة ☐

يرجى الإجابة على الأسئلة التالية فيما يتعلق بوالد الطفل:

1-عمر الأب الحالي _____ عام

2-عمر الأب عند ولادة الطفل _____ عام

3-طول الأب الحالي _____ سم

4-وزن الأب الحالي _____ كغم

5- لا يمكن تقييم المعلومات الخاصة بالأب أو أنها غير معروفة ☐

استبيان النظام الغذائي ونمط الحياة

يرجى قراءة جميع الأسئلة بعناية. ما هي الإجابات التي ترد إلى ذهنك أولا؟ - اختر المربع المناسب لإجابتك واملأه.

تذكر: هذا ليس اختبار بحيث تكون هناك إجابات صحيحة وأخرى خاطئة. من المهم أن تجيب على جميع الأسئلة وأن نتمكن من رؤية علاماتك بوضوح.

اعلم ان بياناتك سرية للغاية وسيتم استخدامها لأغراض الدراسة فقط وليس النشر فلست مضطرا إلى إطلاع أي شخص على إجاباتك ولن ينظر أي شخص يعرفك على الاستبيان الخاص بك بمجرد انتهائك منه.

فيما يتعلق بالأسئلة المذكورة في هذه الصفحة، يرجى ذكر ما قمت بفعله الأسبوع الماضي:

1- عدد الساعات التي تقضيها امام التلفاز في الأيام الدراسية؟

لم أشاهد التلفاز في الأيام الدراسية ☐

أقل من ساعة ☐ ساعة واحدة ☐ ساعتان ☐ ثلاث ساعات ☐ أربع ساعات ☐ خمس ساعات أو أكثر ☐

2- عدد الساعات التي تقضيها في ممارسة الألعاب الالكترونية أو الفيديو أو استخدام الحاسوب للتصفح لأي غرض غير الدراسة أثناء الأيام الدراسية؟

لم أمارس الألعاب الالكترونية أو الفيديو أو أستخدم الحاسوب لأي غرض غير الدراسة في الأيام الدراسية ☐

أقل من ساعة ☐ ساعة واحدة ☐ ساعتان ☐ ثلاث ساعات ☐ أربع ساعات ☐ خمس ساعات أو أكثر ☐

3- الوقت المستغرق خارج المنزل قبل أو بعد ساعات الدراسة في الأيام الدراسية؟

أقل من ساعة ☐ ساعة واحدة ☐ ساعتان ☐ ثلاث ساعات ☐ أربع ساعات ☐ خمس ساعات أو أكثر ☐

4- عدد الساعات التي تقضيها امام التلفاز في عطلة نهاية الأسبوع؟

لم أشاهد التلفاز اثناء عطلة نهاية الأسبوع ☐

أقل من ساعة ☐ ساعة واحدة ☐ ساعتان ☐ ثلاث ساعات ☐ أربع ساعات ☐ خمس ساعات أو أكثر ☐

5- عدد الساعات التي تقضيها في ممارسة الألعاب الالكترونية أو الفيديو أو استخدام الحاسوب لأي غرض غير الدراسة في عطلة نهاية الأسبوع؟

لم أمارس الألعاب الكترونية أو الفيديو أو أستخدم الحاسوب لأي غرض غير الدراسة في عطلة نهاية الأسبوع ☐

أقل من ساعة ☐ ساعة واحدة ☐ ساعتان ☐ ثلاث ساعات ☐ أربع ساعات ☐ خمس ساعات أو أكثر ☐

6- الوقت المستغرق خارج المنزل في عطلة نهاية الأسبوع؟

أقل من ساعة ☐ ساعة واحدة ☐ ساعتان ☐ ثلاث ساعات ☐ أربع ساعات ☐ خمس ساعات أو أكثر ☐

7- كم عدد الأيام التي ذهبت فيها إلى صفوف التربية البدنية؟

يوم ☐ يوم واحد ☐ يومان ☐ ثلاث أيام ☐ أربعة أيام ☐ خمسة أيام ☐

8- أكثر وسيلة استخدمتها للذهاب إلى المدرسة هي:

المشي، إذا كنت تمشي إلى المدرسة، يرجى الإجابة على السؤال رقم 9 ☐ الحافلة ☐ السيارة ☐ أخرى: أذكرها : _____ ☐

10- متى تذهب للفراش في أيام الدراسة ؟ _____ صباحاً _____ مساءاً

11- متى تستيقظ في الصباح في أيام الدراسة؟ _____ صباحاً _____ مساءاً

12- متى تذهب للفراش في عطلة نهاية الأسبوع؟ _____ صباحاً _____ مساءاً

13- متى تستيقظ في الصباح في عطلة نهاية الأسبوع؟ _____ صباحاً _____ مساءاً

14- كيف تصنف جودة نومك بشكل عام (إلى أي مدى كان نومك جيدا)؟

جيد جداً ☐ جيد إلى حد ما ☐ سيء إلى حد ما ☐ سيء جداً ☐

15- كيف تصنف كمية نومك بشكل عام (اي هل نمت بالقدر الكافي)؟

جيد جداً ☐ جيد إلى حد ما ☐ سيء إلى حد ما ☐ سيء جداً ☐

16- هل تنام بعد المدرسة قبل أن تقوم بعمل واجباتك المدرسية؟ (في السيارة, في الحافلة, في المنزل)؟ نعم ☐ لا ☐

17- هل لديك تلفاز في غرفة نومك ؟ نعم ☐ لا ☐

كم عدد المرات التي تتناول فيها الأطعمة التالية...؟ (يرجى وضع علامة على مربع واحد فقط من كل سطر)

أنواع الطعام	لا آكلها	أقل من مرة في الأسبوع	مرة في الأسبوع	2- 4 أيام في الأسبوع	5- 6 أيام في الأسبوع	مرة كل يوم	أكثر من مرة كل يوم
18- الفواكه	☐	☐	☐	☐	☐	☐	☐
19- الخضروات	☐	☐	☐	☐	☐	☐	☐
20- الحلوى (الحلويات والشوكولاتة)	☐	☐	☐	☐	☐	☐	☐
21- الكولا العادية أو المشروبات الغازية التي تحتوي على سكر	☐	☐	☐	☐	☐	☐	☐
22- الكيك أو المعجنات أو الكعك	☐	☐	☐	☐	☐	☐	☐
23- الكولا الخاصة بالحمية الغذائية أو المشروبات الغازية الخاصة بالحمية الغذائية	☐	☐	☐	☐	☐	☐	☐
24- شرائح البطاطس أو البطاطس المحمرة	☐	☐	☐	☐	☐	☐	☐
25- الخضروات الورقية الداكنة (مثل البروكلي والسبانخ وغيرها) والخضروات البرتقالية (مثل الجزر والقرع والبطاطا الحلوة, وغير ذلك)	☐	☐	☐	☐	☐	☐	☐
26- عصير الفواكه	☐	☐	☐	☐	☐	☐	☐
27- الحليب قليل الدسم (1%, 2%, مقشود)	☐	☐	☐	☐	☐	☐	☐
28- الحليب كامل الدسم (مجنس)	☐	☐	☐	☐	☐	☐	☐

29- الجبن	☐	☐	☐	☐	☐	☐	☐
30- منتجات الألبان الأخرى (الزبادي، حليب الشوكولاتة، البودنغ, الخ)	☐	☐	☐	☐	☐	☐	☐
31- الخبز المصنوع من الحبوب أو البرغل بالكامل (طحين الشوفان, المزلي, الخ)	☐	☐	☐	☐	☐	☐	☐
32- مشروبات الطاقة (ريد بول، باور هورس، الخ)	☐	☐	☐	☐	☐	☐	☐
33- الأسماك	☐	☐	☐	☐	☐	☐	☐
34- الأيس كريم	☐	☐	☐	☐	☐	☐	☐
35- الأطعمة المحمرة مثل أجنحة الدجاج وأصابع لحم الدجاج, الخ, والأطعمة السريعة كالبيتزا والبرجر, الخ	☐	☐	☐	☐	☐	☐	☐
36- والأطعمة السريعة كالبيتزا والبرجر, الخ	☐	☐	☐	☐	☐	☐	☐

37- كم مرة عادة تتناول الإفطار (أكثر من كوب حليب أو عصير فاكهة)؟ - ضع علامة أما مربع لأيام الأسبوع ومربع لعطلة نهاية الأسبوع

أيام الأسبوع:

لا أتناول الإفطار على الإطلاق ☐ أتناوله يوم واحد ☐ يومان ☐ ثلاثة أيام ☐ أربعة أيام ☐ خمسة أيام ☐

عطلة نهاية الأسبوع:

لا أتناول الإفطار على الإطلاق في عطلة نهاية الأسبوع ☐

أتناول الإفطار عادة في يوم واحد من عطلة نهاية الأسبوع (الجمعة أو السبت) ☐ أتناول الإفطار عادة في يومي عطلة نهاية الأسبوع (الجمعة والسبت) ☐

38- ما الذي تأكله عادة في الإفطار؟ _____

39- هل تقدم مدرستك وجبة غداء مدرسية؟ نعم ☐ لا ☐

40- كم مرة تقريبا تناولت فيها وجبة غداء مدرسية؟

0 يوم ☐ يوم واحد ☐ يومان ☐ ثلاث أيام ☐ أربعة أيام ☐ خمسة أيام ☐

41- كم عدد الوجبات (الإفطار، الغداء، العشاء) التي اشتريتها وكانت معدة خارج المنزل في اماكن مثل المطاعم وأماكن إعداد الأطعمة السريعة ومنصات الأطعمة وآلات البيع؟ (لا تذكر الوجبات المقدمة كإفطار مدرسي أو غذاء مدرسي) _____ وجبة

42- من يقوم بإعداد الطعام في المنزل؟

الأم ☐ الخادمة ☐ عضو أخر من أعضاء الأسرة ☐ لا أدرى ☐

إلى أي مدى تصف هذه العبارات حالتك (ضع علامة على المربع المناسب)

	لا / تقريبا لا	أحيانا	عادة / دائما
43- عندما أشعر بالقلق, أتناول الطعام أكثر	☐	☐	☐
44- أتناول الطعام عندما أكون غضبان	☐	☐	☐
45- عندما أؤدي شيء بطريقة جيدة أتناول بعض الطعام	☐	☐	☐
46- عندما أشعر بالحزن, أتناول الطعام أكثر	☐	☐	☐
47- عندما أشعر بالسعادة, أتناول الطعام أكثر	☐	☐	☐
48- عندما أشعر بالملل, أتناول الطعام أكثر	☐	☐	☐
49- أتناول الطعام بين الوجبات حتى لو لم أشعر بالجوع	☐	☐	☐

ضع علامة أمام المربع الذي يصف ما شعرت به

	لا على الإطلاق	قليلا	على نحو متوسط	جدا	للغاية
50- هل تشعر بانك صاحب صحة و لياقة بدنية جيدة؟	☐	☐	☐	☐	☐
51- هل شعرت أنك مفعم بالطاقة؟	☐	☐	☐	☐	☐
52- هل شعرت بالحزن؟	☐	☐	☐	☐	☐
53- هل شعرت بالوحدة؟	☐	☐	☐	☐	☐
54- هل أمضيت وقتا كافيا بمفردك؟	☐	☐	☐	☐	☐
55- هل تمكنت من فعل الاشياء التي أردت أن تفعلها في وقت فراغك؟	☐	☐	☐	☐	☐
56- هل عاملك والديك بشكل جيد؟	☐	☐	☐	☐	☐
57- هل تمتعت بوقت جيد مع اصدقائك؟	☐	☐	☐	☐	☐
58- هل شعرت بالانسجام في المدرسة؟	☐	☐	☐	☐	☐
59- هل كنت قادرا على الانتباه؟	☐	☐	☐	☐	☐

60- كيف ترى صحتك بوجه عام؟

ممتازة ☐ جيدة جدا ☐ جيدة ☐ متوسطة ☐ سيئة ☐

الاسم: _____	العمر: .....-سنوات
الجنس: ذكر □ أنثى □	الإمارة : _____
المدرسة : _____	الصف : _____
الوزن : ..... كغم	الطول : ..... سم
محيط الخصر : ..... سم	محيط الحوض : ..... سم
ضغط الدم الانقباضي : 1._____ مم زئبقي 2._____ مم زئبقي 3._____ مم زئبقي	ضغط الدم الانبساطي : 1._____ مم زئبقي 2._____ مم زئبقي 3._____ مم زئبقي

English Questionnaires

ID#

QUESTIONNAIRE: DEMOGRAPHIC AND FAMILY HEALTH

A. GENERAL INFORMATION

1. Child's Name: .....
2. Name of Child's School: .....
3. Parent's or Guardian's Name: .....
4. Home Address: .....
5. Phone Number: .....
6. How long have you lived at the current address? _____Years _____ Months

B. DEMOGRAPHICS OF CHILD

1. Date of Birth .....
2. In what country was the child born? .....
3. What is the nationality of the child? .....
4. How many biological brothers and sisters does the child have? .....

If no siblings, go to question 5

5. What are the ages of your siblings?

1) _____ **2)** _____ **3)** _____ **4)** _____

5) _____ **6)** _____ **7)** _____ **8)** _____

C. HEALTH HISTORY OF CHILD

1. Birth Weight _____ kg
2. Birth Length _____ cm
3. Length of Pregnancy _____ Weeks ***OR*** _____ Months
4. Did mother develop gestational diabetes during pregnancy with this child 1. Yes ◯ 2. No ◯
5. Was the mother smoking during the pregnancy of this child? 1. Yes ◯ 2. No ◯
6. Fed breast milk? 1. Yes ◯ 2. No ◯

If No, please skip to question 6

7. Age when COMPLETELY stopped being fed breast milk _____ Months
8. Age when FIRST fed formula _____ Months
9. Age when COMPLETELY stopped drinking formula _____ Months
10. At what age solid food was introduced? _____ Months

ID#

D. FAMILY DEMOGRAPHICS AND HEALTH

1. What is the marital status of the child's parents?

☐ Married ☐ Divorced or separated ☐ Widowed parent

2. How many people live in your household (at this address)? _____

3. What is the **COMBINED** monthly income for your family? (AED)

☐ Less than 5,000 ☐ 5,001 – 10,000 ☐ 10,001 – 20,000 ☐ 20,001 – 30,000

☐ 30,001 - 40,000 ☐ 40,001 - 60,000 ☐ 60,001 - 80,000 ☐ 80,001 and above

How many motorized vehicles are available for use at your house?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

4. Do you have house maid at home? ◯ 1. Yes ◯ 2. No

If yes to question 5, then how many maids do you have at home?

☐ 1 ☐ 2 ☐ 3 ☐ More than 3

5. How many television sets are in your household?

☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 or more

6. What is the **MOTHER'S** highest level of education completed?

☐ Less than primary school ☐ Primary School ☐ High school

☐ Diploma ☐ Bachelor's degree ☐ Graduate/professional degree

7. The mother is:

☐ Housewife ☐ Working mother ☐ Specify occupation : _____

8. What is the **FATHER'S** highest level of education completed?

☐ Less than primary school ☐ Primary School ☐ High school

☐ Diploma ☐ Bachelor's degree ☐ Graduate/professional degree

9. What is the **FATHER'S** job? Specify occupation : _____

10. In which emirate he is working?

☐ Abu Dhabi ☐ Dubai ☐ Sharjah

☐ RAK ☐ Fujairah ☐ Um Al Queen

☐ Ajman

ID#

11. Please answer the following questions with regard to the child's **BIOLOGICAL MOTHER**:

☐	1) Current Age	_____ Years
	2) Age at child's birth	_____ Years
	3) Current height	_____ cm
	4) Current weight	_____ kg

☐ Biological Mother's information cannot be estimated or is not known

12. Please answer the following questions with regard to the child's **BIOLOGICAL MOTHER**:

☐	1) Current Age	_____ Years
	2) Age at child's birth	_____ Years
	3) Current height	_____ cm
	4) Current weight	_____ kg

☐ Biological Father's information cannot be estimated or is not known

Diet and Lifestyle Questionnaire

Please read every question carefully. What answer comes to your mind first? Choose the box that fits your answer best and fill it in.
Remember: This is not a test so there are no wrong answers. It is important that you answer all the questions and that we can see your marks clearly.
You do not have to show your answers to anybody. Also, nobody who knows you will look at your questionnaire once you have finished it.

For the questions on this page, please tell about what you did last week.

1) On a school day, how many hours did you watch TV?

☐ I did not watch TV on school days.

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 Or more hours.

2) On a school day, how many hours did you play video or computer games or use a computer for something that was not school work?

☐ I did not play video/computer games or use a computer other than for school work on school days.

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 Or more hours.

3) On a school day how much time did you spend outside **before & after** school?

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 Or more hours.

4) On a weekend day, how many hours did you watch TV?

☐ did not watch TV on weekend days.

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 Or more hours.

5) On a weekend day, how many hours did you play video or computer games or use a computer for something that was not school work?

☐ I did not play video/computer games or use a computer other than for school work on the weekend.

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 Or more hours.

6) On a weekend day, how much time did you spend outside?

☐ < 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 hours ☐ 4 hours ☐ 5 Or more hours.

7) In the last week you were in school, on how many days did you go to physical education (PE) classes?

☐ 0 Days ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days ☐ 5 Days.

8) In the last week you were in school, the **MAIN** part of your journey to school was by :
- Walking, if you walk to school please answer question 9

☐ Bus ☐ Car ☐ Other, Specify : _____

9) In the last week you were in school, **HOW LONG** did it take you to travel to school?

☐ < 5 minutes ☐ 5 - 15 minutes ☐ 16 - 30 minutes ☐ More than 30 minutes.

10) During the past week, what time have you usually turned out the light and gone to sleep on school days?

_____ AM _____ PM

11) During the past week, at what time have you usually woken up in the morning on school days?

_____ AM _____ PM

12) During the past week, what time have you usually turned out the light and gone to sleep on weekend days?

_____ AM _____ PM

14) During the past week, how would you rate your sleep quality overall (how well you sleep)?

☐ Very good ☐ Fairly good ☐ Fairly bad ☐ Very bad.

15) During the past week, how would you rate your sleep quantity overall (how much you sleep)?

☐ Very good ☐ Fairly good ☐ Fairly bad ☐ Very bad.

16) Do you sleep after school before you do your homework? (In car, bus or home) ☐ Yes ☐ No

17) Do you have a television in your bedroom? ☐ Yes ☐ No

How many times do you usually eat . . .? (Please mark only one box for each line)

	Never	< once a week	once a week	days a week	days a week	once a day every day	Every day > once
18) Fruits	☐	☐	☐	☐	☐	☐	☐
19) Vegetables	☐	☐	☐	☐	☐	☐	☐
20) Sweets (candy/chocolate)	☐	☐	☐	☐	☐	☐	☐
21) Regular cola or soft drinks that contain sugar	☐	☐	☐	☐	☐	☐	☐
22) Cake, pastries, or donuts	☐	☐	☐	☐	☐	☐	☐
23) 23 Diet cola or diet soft drinks	☐	☐	☐	☐	☐	☐	☐
24) Potato chips French fries	☐	☐	☐	☐	☐	☐	☐
25) Dark green vegetables (broccoli, spinach, etc.) Orange vegetables (carrots, squash, sweet potato, etc.)	☐	☐	☐	☐	☐	☐	☐
26) Fruit juice	☐	☐	☐	☐	☐	☐	☐
27) Low fat milk (1%,2%, skim)	☐	☐	☐	☐	☐	☐	☐
28) Whole milk (homogenized)	☐	☐	☐	☐	☐	☐	☐
29) Cheese	☐	☐	☐	☐	☐	☐	☐
30) Other milk products (yogurt, chocolate milk, pudding, etc.) Whole grain bread or cereal (oatmeal, muesli, etc.)	☐	☐	☐	☐	☐	☐	☐
31) Whole grain bread or cereal (oatmeal, muesli, etc.)	☐	☐	☐	☐	☐	☐	☐
32) Energy drinks (Red Bull, Power Horse etc.)	☐	☐	☐	☐	☐	☐	☐
33) Fish	☐	☐	☐	☐	☐	☐	☐
34) Ice cream	☐	☐	☐	☐	☐	☐	☐
35) Fried food such as chicken wings, chicken fingers, etc. Fast foods such as pizza, hamburgers, etc.	☐	☐	☐	☐	☐	☐	☐
36) Fast foods such as pizza, hamburgers, etc.	☐	☐	☐	☐	☐	☐	☐

37) How often do you usually have breakfast (more than a glass of milk or fruit juice)? Mark one box for weekdays and one box for weekend.

❖ Weekdays

☐ I never have breakfast on weekdays

☐ One Day ☐ Two Days ☐ Three Days ☐ Four Days ☐ Five Days.

❖ Weekend

☐ I never have breakfast on the weekend

☐ I usually have breakfast on only one day of the weekend (Friday OR Saturday)

☐ I usually have breakfast on both weekend days(Friday AND Saturday)

38) What do you normally eat for breakfast _____

39) Does your school serve school lunches? ☐ Yes ☐ No

40) In the last week you were in school, about how many times a week did you eat a school lunch?

☐ 0 Days ☐ 1 Day ☐ 2 Days ☐ 3 Days ☐ 4 Days ☐ 5 Days.

41) During the past week, how many meals (breakfast, lunch_____ Number of meals or dinner) did you get that were prepared away from home in places such as restaurants, fast food places, food stands, grocery stores or vending machines? (please do not include meals provided as part of school breakfast or school lunch)

42) Who prepare the food at home?

☐ Mother ☐ Maid ☐ Other family member

43) How well do these statements describe you? (Put a mark in the box that best describes how often this happens).

	Never/Almost Never	Sometimes	Usually/Always
44) When I am worried I eat more?	☐	☐	☐
45) I eat when I am mad	☐	☐	☐
46) When I do something well I give myself a food treat	☐	☐	☐
47) When I am sad I eat more	☐	☐	☐
48) When I am happy I eat more	☐	☐	☐
49) When I am bored I eat more	☐	☐	☐
50) I eat between meals even when I am not hungry	☐	☐	☐

Thinking about the last week….. (Put a mark in the box that best describes how you felt)

	Not at all	Slightly	Moderately	Very	Extremely
51) Have you felt fit and well?	☐	☐	☐	☐	☐
52) Have you felt full of energy?	☐	☐	☐	☐	☐
53) Have you felt sad?	☐	☐	☐	☐	☐
54) Have you felt lonely?	☐	☐	☐	☐	☐
55) Have you had enough time for yourself?	☐	☐	☐	☐	☐
56) Have you been able to do the things that you want to do in your free time?	☐	☐	☐	☐	☐
57) Have your parent(s) treated you fairly?	☐	☐	☐	☐	☐
58) Have you had fun with your friends?	☐	☐	☐	☐	☐
59) Have you got on well at school?	☐	☐	☐	☐	☐
60) Have you been able to pay attention?	☐	☐	☐	☐	☐

61) In general how would you say your health is?

☐ **Excellent** ☐ **Very Good** ☐ **Good** ☐ **Fair** ☐ **Poor**

Name	
Age ..... years	Sex : Male ◯ Female ◯
School	Class .....
Height ..... CM	Weight ..... KG
Hip Circumference ..... CM	Waist Circumference ..... CM
Systolic Blood Pressure : **1._____ MMHG 2. _____ MMHG 3. _____ MMHG**	**Diastolic Blood Pressure :** **1._____ MMHG 2. _____ MMHG 3. _____ MMHG**

Consent Forms (English)

Consent Form

TITLE OF STUDY: Prevalence and Potential Determinants of Obesity and Metabolic Syndrome among School Children and Adolescents in Ras Al Khaimah, United Arab Emirate

Principal Investigator: Mouza Mohammed AL Zaabi, PhD
Department: Institute of Public Health
College of Medicine and Health Sciences, UAE University, Al-Ain, UAE
Phone number: + 971 50 22 77 888

Contact cell number: + 971 50 7104194

DECLARATION BY STUDY PARTICIPANT

I am the undersigned participant, confirm that:

1. I have read and understand the attached information sheet for the above study and have had the opportunity to ask questions.
2. I understand that my participation is voluntary and that I am free to withdraw at anytime.
3. I understand that if I withdraw from the study it will not adversely affect my healthcare or employment.
4. I understand that my data will be kept confidential and in a safe place.
5. I agree to take part in the above study

Name of parent	Date	Signature
Name of person taking consent	Date	Signature
Name of witness (if subject unable to read/write)	Date	Signature

Consent Forms (Arabic)

موافقة ولي الامر على المشاركة

عنوان الدراسة: انتشار السمنة ومتلازمة الأيض والعوامل المسببة لذلك بين طلاب المدراس والمراهقين في رأس الخيمة, الإمارات العربية المتحدة.
الباحث: د. موزة محمد الزعابي
الباحث المساعد:
هاتف: 888 77 22 50 971+
متحرك: 7104194 50 971+
الدائرة: معهد الصحة العامة, كلية الطب والعلوم الصحية, جامعة الإمارات العربية المتحدة.

أقر أنا ولي امر الطالب /
برغبتي بالمشاركة في هذا البحث بما يلي:

1. لقد قرأت وفهمت ما جاء في صحيفة المعلومات المرفقة للدراسة أعلاه وقد أتيحت لي الفرصة لطرح الأسئلة والاستفسار عن الدراسة .
2. أعلم بأن مشاركتي طوعية واختيارية ولدي الحرية الكاملة في الانسحاب في أي وقت.
3. في حال الانسحاب من الدراسة في اي وقت ، لن يؤثر سلبا على الرعاية الصحية التي يتلقاها طفلي من قبل ادارة المدرسة فهما امران مختلفان.
4. أعلم بأن البيانات الخاصة بي سوف تبقى سرية ولن يتم تسريب اي معلومات شخصية وسوف يتعاطى معها بكل مصداقية وامانة .
5. لا يحق لي مقاضاة الباحث لأنه لا يوجد ما يستدعي ذلك الا اذا تم نشر المعلومات الخاصة والتي تنقض المتفق عليه .
6. أقر بموافقتي على المشاركة في الدراسة المشار إليها أعلاه .

إسم ولي الامر	التاريخ	التوقيع

اسم المنسق المشارك بالدراسة من قبل ادارة المدرسة . (عند عدم تمكن المشارك من القراءة أو الكتابة)	التاريخ	التوقيع

Information Sheet/English

Information Sheet

TITLE OF STUDY: Prevalence and Potential Determinants of Obesity and Metabolic Syndrome among School Children and Adolescents in Ras Al Khaimah, United Arab Emirates

Principal Investigator: Mouza Mohammed AL Zaabi, PhD
Co-Investigators:
Phone number: + 971 50 22 77 888

Contact cell number: + 971 50 7104194

Department: Institute of Public Health, CMHS, UAE University

Invitation

Dear Participant,

You are being invited to take part in a research study. Before you decide whether to do so, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Purpose
In the United Arab Emirates, obesity became a common problem among children and adolescents. This is a collaborative study that will involve researchers from the College of Medicine, UAE University, the School Health in Ras Al Khaimah, RAK medical district and the RAK Educational Zone.
The study will include a total of 1200 subjects in Ras Al Khaimah, aged 6 -18 years, studying in RAK public and private schools. The participating student will have a good chance to under go comprehensive physical measurements of their weight, height, waist circumference, hip circumferences and blood pressure. Two questionnaires will be answered: the first by the parents and the second by the student. Older students, aged10-18, will do blood test to know their hemoglobin level, lipids levels, blood sugar level and vitamin D level.

Selection
You and your child have been selected to participate in this study because you are part of the RAK society among whom we are interested to know about their weight and health condition. Although your participation is of great importance, it is voluntary.

Do I have to take part?
It is up to you to decide whether or not to take part in this study. If you agree to participate in this study, you will be asked to sign a consent form. However, you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect your child's right as a student in this school.

What will happen to me if I take part?
By signing the attached consent form, you agree to participate in this study that will require you answer a simple questionnaire about the basic child information and family health. Your child will answer another questionnaire at the school with the help of the research assistants if needed. Then the school nurse inside the school clinic and during the physical activity class will measure the child's weight, height, waist circumference, hip circumferences and blood pressure. If your child is above 10 years old he/she will go through the second phase of the study in the next day. These children should come fasting to the school; once they reach the school a small blood sample (3-5 ml) will be taken by a qualified nurse. Directly after that we will supply a free breakfast meal. You will be informed by the results of the physical examination and blood test of your child if you wish so.

Procedure
First, you will have to sign the attached consent letter only after we review with you and provide satisfactory answers to all questions you may have about the study procedures.

- You will fill out the demographic and health history questionnaire at home and send it back to the school with your child the next day.
- Your child will fill out the diet and lifestyle questionnaire in the school with assistance, if required.
- The school nurse will take your child's height, weight, waist and hip circumferences, as well as blood pressure at the school clinic.
- The participation of you and your child will last for not more than 30 minutes in each visit.
- Blood sample will be collected for your child if he/she above 10 years the next day after the examination.

What do the participating student has to do?
He/she will be required to fast overnight (10 hours), there are no dietary restrictions

Risks and Discomforts
None of the above will involve any form of pain, discomfort, and unfavorable experience, other than what you would feel during normal blood collection process.
Benefits
The outcome of this work will most likely contribute to the current national and global efforts to better prevent and reduce obesity.

Confidentiality
All information which are collected about you and your child during the course of the research will be kept strictly confidential under the responsibility of the principal investigator and only the study investigators will have access to the records. Any information about you, your name and address removed so that you cannot be identified.

Outcome
The results of this study are for research purposes only and the outcome will be discussed and shared with you during the study according to your wish. However, the results of this study will be published but no identifying information related to you or your child will be used.

Costs
There is no extra cost to the participants of this study. Any costs that relate to the study will be paid for by the study investigators.

Rights
This is a voluntary participation. Participants are the only one to decide whether or not to participate in this study. Lack of participation will have no adverse affects on the health and educational services the participant usually receives.

Providing answers to your questions
If you have any questions about the study please contact: Mouza Al Zaabi, Telephone No.: +971 50 22 77 888, Email address (moozeheid@hotmail.com). If you have any questions about your rights as a research participant, please contact Research Ethics Committee at Research Ethics Committee, Statistics and Research Department, Ministry of Health, Telephone No.: +971 4 2301 715.

Information Sheet /Arabic

موافقة ولي الامر لمشاركة الابناء استمارة

عنوان الدراسة: انتشار السمنة ,ومتلازمة الأيض والعوامل المسببة لذلك بين اطفال المدراس والمراهقين في رأس الخيمة, الإمارات العربية المتحدة.

الباحث: د. موزة محمد الزعابي

الباحث المساعد:

هاتف: 888 77 22 50 971+

متحرك: 7104194 50 971+

الدائرة: معهد الصحة العامة, كلية الطب والعلوم الصحية, جامعة الإمارات العربية المتحدة.

دعوة

نتشرف بدعوتكم للمشاركة في دراسة بحثية واقعية . لذا يتوجب علينا تنويركم لفهم الاسباب الرئيسية لتنفيذ هذه الدراسة وما تتضمنه من اجراءات وخطوات ومهام . لذا نرجو منكم قراءة المعلومات التالية بعناية تامة واخذ الوقت الكافي لتحديد رغبتكم بالمشاركة او الرفض . كما بإمكانكم توجيه الأسئلة بخصوص الدراسة وآليتها اواذا رغبتم باي توضيح أو لزيادة المعلومات يرجى التواصل على ارقام التواصل المذكورة اعلاه.

الغرض:

أصبحت السمنة من المشاكل الصحية المنتشرة بشكل مخيف بين الأطفال والمراهقين في دولة الإمارات العربية المتحدة ولما لها من مخاطر وخيمة و تهديد لحاضر ومستقبل الابناء والذي يترتب عليه مستقبل البلاد كان هذا البحث الذي نحن بصدده ، فهو دراسة يشارك فيها عدة جهات تتضمن الباحثين من كلية الطب في جامعة الإمارات العربية المتحدة واعضاء من الصحة المدرسية برأس الخيمة وموظفين بمنطقة رأس الخيمة الطبية وموظفين المنطقة التعليمية برأس الخيمة.

تتضمن الدراسة عينة حجمها 2000 طالب و طالبة مأخوذة من المدراس الحكومية والخاصة في رأس الخيمة تتراوح اعمارهم ما بين 6-الى-18 عاما أي الطلبة من الصف 1الى 12 . حيث تنقسم الدراسة الي قسمين الجانب النظري يحتوي استبانتين الاولي لولي الامر والثانية للطالب اما الجانب العملي ايضا ينقسم الي شقين الاول المقاسات الجسمية للطلبة حيث يتم اخذ قياسات الوزن والطول ومحيط الخصر والورك وضغط الدم لجميع الطلبة المستهدفين من الدراسة ، اما الشق الثاني فيكون بأخذ عينات من الدم (معدل الهيموجلوبين و- فيتامين "د"-و الدهون و- سكر الدم) للطلبة الذين تكون اعمارهم من 10 سنوات فما فوق اي من الصف 6 الى 12.

الإختيار

هنيئا لكم فقد تم اختيارك أنت وطفلك للمشاركة في هذه الدراسة لكونكم جزءا فعال في مجتمع رأس الخيمة الذين نهتم بتقييم صحة بنيتهم الجسدية و حالتهم الصحية مجاناً. وبالرغم من أن مشاركتكم تعتبر مشاركة وطنية ولها أهمية كبيرة , إلا أنها تطوعية واختيارية من قبلكم .

هل أنا ملزم بالمشاركة؟

قرار المشاركة يرجع لكم ، فاذا اسعدتنا ودعمتنا بموافقتكم على المشاركة . يرجى منكم توقيع نموذج الموافقة. كما لكم حق الانسحاب في أي وقت ودون إبداء اسباب فقط يرجى ابلاغ ادارة المدرسة ليتم ترشيح طالب اخر لاستكمال العدد . قراركم بعدم المشاركة لن يؤثر اطلاقا على حقوق طفلكم كطالب في هذه المدرسة.

ما يترتب على المشارك في حال الموافقة !

عند الموافقة سيترتب عليك يا سيدي/ سيدتي التوقيع علي نموذج الموافقة , والذي سيتوجب عليك الإجابة على الاستبيان البسيط فيما يخص المعلومات الأساسية لطفلك والحالة الصحية العامة للأسرة . كما نرجو منكم تشجيع طفلكم لاستيفاء الاستبانة الخاصة به في المدرسة بأشراف المساعدين. ومن ثم ستقوم ممرضة المدرسة بالتعاون مع مدرسة / مدرس التربية الرياضية داخل العيادة المدرسية أو صفوف التربية الرياضية بأخذ قياسات الوزن والطول ومحيط الخصر والورك وضغط الدم لدى الطفل. وكما ذكرت سابقا إذا زاد عمر طفلكم عن 10 سنوات, فأنه سيخضع للمرحلة الثانية من الدراسة في اليوم التالي مباشرةً . شرط ان يكون الطالب صائما في اول الصباح عند قدومه إلى المدرسة ويتم أخذ عينة دم صغيرة منه بواسطة إحدى الممرضات المؤهلات لذلك. وسيتم صرف وجبة إفطار مجانية للطفل مباشرةً بعد اخذ العينات . وفي حال رغبتكم في الاطلاع على نتائج الفحص واختبار الدم الخاصة بطفلك يمكننا تزويدكم. فلا تخف عزيزي ولي الامر فأبنائكم أمانة في اعناقنا .

الخطوات المتبعة في المشاركة :-

- توقيع نموذج الموافقة .
- تقوم بملأ الاستبيان الصحي والديموغرافي في المنزل وترسله مع طفلك في اليوم التالي إلى المدرسة.
- يقوم طفلك بملأ استبيان النظام الغذائي ونمط الحياة في المدرسة مع مساعدته عند الضرورة.
- تقوم ممرضة المدرسة بمساعدة مدرس التربية الرياضية بأخذ بقياسات الوزن والطول ومحيط الخصر والورك وضغط الدم للطلبة المشاركين .
- تستمر مشاركتك انت وطفلك لمدة لا تزيد عن 30 دقيقة في كل زيارة.
- يتم تحصيل عينة الدم الخاصة لطفلك إذا زاد عمره عن 10 سنوات في اليوم التالي بعد الفحص.

ما الذي يفعله الطالب المشارك في المرحلة الثانية ؟

ان يحضر الى المدرسة دون تناول الافطار (أي تكون اخر وجبة يأكلها في اليوم الذي يسبقه في الساعة 10 مساءا), ولا توجد أي قيود على التغذية.

المخاطر والمتاعب

لا تتضمن الإجراءات السابقة اي انواع من آلام أو المتاعب أو التجارب السيئة باستثناء ما يمكن أن يشعر به المرء خلال أخذ عينة الدم العادية. ولا توجد مضاعفات او اعراض جانبية من إجراء هذه الدراسة.

الفوائد

ستساهم نتائج هذه الدراسة بشكل كبير في الجهود الوطنية والعالمية للعمل على محاربة السمنة و خفض نسبتها والوقوف علي اسباب انتشارها ووضع بعض الحلول الجذرية لتلافي تزايد اصاباتها ومحاولة تقليص دائرة الانتشار .

السرية

الحفاظ على السرية هو عنوان دراستنا فكل المعلومات التي سيتم الحصول عليها منك و من طفلك تحت مسؤولية الباحث الرئيسي ولن يتم الوصول إلى السجلات إلا بواسطة الباحثين فقط لأغراض الدراسة وليس النشر. كما سيتم مسح أي معلومات عنك وعن اسمك وعنوانك حتى لا يتم التعرف عليك. ولكم حق المقاضاة في حال تسرب بياناتكم .

النتيجة

يتم استخدام نتائج هذه الدراسة في الأغراض البحثية فقط كما سيتم مشاركتها معك خلال الدراسة إذا رغبت في ذلك. و بالرغم من انه سيتم نشرالنتائج العامة لهذه الدراسة و لكن لن يتم استخدام اي معلومات تحديدية تتعلق بك او بطفلك.

التكاليف

يتحمل الباحثون جميع التكاليف بالكامل ولا يتحمل المشاركون في هذه الدراسة أي تكاليف إضافية .

الحقوق

تعتبر المشاركة في هذه الدراسة تطوعية ومن حق المشاركين فقط تحديد قرارهم في المشاركة في الدراسة من عدمها.ولن يؤثر عدم المشاركة على الخدمات الصحية والتعليمية التي يتلقاها المشارك في العادة.

تقديم الإجابات على أسئلتك

اذا كان لديك اي اسئلة حول الدراسة يرجى الاتصال ب:موزة محمد الزعابي، هاتف رقم: 888 77 22 50 971+ و عنوان البريد الاكتروني (moozeheid@hotmail.com). و اذا كان لديك اي اسئلة حول حقوقك كمشارك في البحث يرجى الاتصال بلجنة اخلاقيات البحث في لجنة اخلاقيات البحوث، قسم الاحصاء و البحوث في وزارة الصحة، هاتف رقم: 009714 7152301 .

Child Consent Form (English)

UAEU College of Medicine and Health Sciences

جامعة الإمارات العربية المتحدة
United Arab Emirates University

School Children and their Health in the United Arab Emirates Study

Name of Pupil:_____

Please tick the correct boxes

I have been told about the research study ☐

I want to take part in this research study ☐

I do not want to take part in this research study ☐

I understand that taking part in the study is optional and that I am free to drop out at any time without giving a reason and without affecting me or my school.

Please sign below:

Pupil Signature: _____ Date: _____

Researcher Signature: _____ Date: _____

Child Consent Form (Arabic)

صحة الأطفال في مدارس الإمارات العربية المتحدة

اسم الطالب/ الطالبة .....

ضع علامة صح أمام العبارة المناسبة

لقد شرحوا لي عن البحث ☐

أريد أن أشارك في هذا البحث ☐

لا أريد أن أشارك في هذا البحث ☐

أنا أعلم جيدا أني لست مجبرا على المشاركة في هذا البحث ☐

أنا أعلم جيدا أني أستطيع الخروج من البحث في أي وقت أريده, دون ذكر الأسباب ☐

أنا أعلم أني إذا تركت المشاركة فإن ذلك لن يؤثر على دراستي ☐

أرجو التوقيع هنا:

توقيع الطالب/ الطالبة: ..... التاريخ:.....

توقيع الباحث: ..... التاريخ:.....