ABSTRACT

Title of thesis: The Prevalence and Selected Determinants of Overweight and Obesity Among Children and Adolescent in the City of Al-Ain, UAE

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Background: Obesity is a serious epidemic that is increasing rapidly worldwide, especially in developing countries. The global prevalence of overweight children ages 5 to 17 years is 10%. Obesity is one of the most important health concerns of the United Arab Emirates (UAE) government, with the prevalence of childhood and adolescent obesity becoming a major problem. The prevalence of obesity in the UAE is associated with the rapid increase of wealth and the dramatic impact of economic development during the oil boom in the 1930s. Studies show that adult obesity can be predicted from childhood obesity. Therefore, the increase in childhood and adolescent obesity may play an important role in the increasing occurrence of cardiovascular diseases and diabetes in adults, which are the leading causes of death in the UAE. Consequently, an urgent need exists for health care practitioners and researchers to target the problem of child/adolescent obesity in the UAE.

Objective: the aim of the study is to determine the occurrence of childhood obesity in the city of Al-Ain by comparing two BMI references, Centers for Disease Control and Prevention (CDC) growth cut-offs and the other from the International Obesity Task

Force (IOTF) with various factors associated with overweight and obesity among children and adolescents.

Method: data were obtained by the Nutrition Research and Surveys Program (NRSP) of Al-Ain Health Administration from 10 schools in Al-Ain for both male and female students ages from 8 to 16 years. The total sample size is 1182 children and adolescents, representing 575 girls and 607 boys' schoolchildren. BMI were compared using two different reference standards CDC 2000 and IOTF. Data were analyzed using frequencies, means, chi-square, independent t test, ANOVA, and correlation.

Results: our findings indicate that the prevalences of overweight and obesity when using CDC cut-offs were 12% boys; 12.7% girls and 14% boys ; 13.6% girls, respectively. When using the IOTF cut-offs, the prevalence of overweight is 14.5% boys and 17.6% girls; however, the prevalence of obesity is 9.6% in boys and 12.9% girls. The differences between two references are evident. There were significant differences in IOTF cut offs between boys and girls, but not significant for CDC. BMI was correlated significantly with age. There was no relationship between children's BMI and socioeconomic status in our study.

Conclusion: overweight and obesity are prevalent in Al-Ain city and underweight seems to be another public health problem among schoolchildren. There is no consensus about which cut-offs used for international schoolchildren. Because the IOTF cut-offs average cut-offs from six different countries, it is suggested for Al-Ain schoolchildren until UAE health authorities develop UAE standard.

THE PREVALENCE AND SELECTED DETERMINANTS OF OVERWEIGHT AND OBSEITY AMONG CHILDREN AND ADOLESCENT IN THE CITY OF AL-AIN, UAE

By

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DEDICATION

To my children

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TABLE OF CONTENTS

INTRODUCTION

The prevalence of obesity in children and adolescents is increasing worldwide. According to the report published by the International Obesity Task Force in 2004, a total of 155 million children worldwide or 10 % children 5 to 17 years of age is overweight. About 30-45 million children are classified as obese, which accounts for 2-3% of the world's children and adolescents between the ages of 5-17 years. The results are equally staggering for younger children, with 22 million children under 5 years of age being overweight across the world (49).

Overweight and obesity are considered by clinicians and biomedical researchers to be independent risk factors for increased morbidity and mortality throughout life. For example, being overweight is a predictor of gestational diabetes during pregnancy, which contributes to high birth weight. Excessive birth weight is then also a predictor of overweight and obesity in adulthood (20, 38), and the onset of chronic diseases such as cardiovascular disease, diabetes, hypertension and dyslipidemia, which in turn can lead to increased morbidity and mortality (32).

Several factors contribute to obesity, such as genes, environment, socioeconomic status, urbanization, ethnicity, physical activity, and dietary intake (12, 23). The incidence of overweight and obesity is increasing in developed and developing countries like the United Arab Emirates (UAE). The region faced a sharp nutritional transition after the oil boom in the 1930s, particularly after the establishment of the Federation of United Arab Emirates in 1971. This change in nutrition included "a demographic transition —the shift from a pattern of high fertility and mortality to one of low fertility and mortality" — and an "epidemiological transition — the shift from a pattern of high prevalence of

infectious disease associated with malnutrition, periodic famine, and poor environmental sanitation to one of high prevalence of chronic disease associated with urban industrial lifestyle" (39).

During this period of economic growth, the UAE government utilized oil revenues to provide free social services for UAE citizens. The Federation's health infrastructure began to expand and improve in 1972, and the improved accessibility of health services resulted in a low infant mortality rate of 8.1 per 1000 live births in 2004 (40). Although the UAE has an improved health infrastructure and low infant mortality rate, shifts in diet including higher intakes of fat and added sugar, and lifestyle patterns including sedentary lifestyle due to the wealth of the country, has led to the use of servants in most of the households. Those shifts have led to an increase in chronic diseases including diabetes, obesity, and cardiovascular diseases (20, 32, 38).

Cardiovascular diseases were the leading cause of death for adults in the UAE during the period from 1989 to 1999 (41). Hypercholesterolemia, diabetes mellitus, and hypertension are all risk factors for CVD and have been shown to be present as risk factors for people in the region. For example, in 1995, a community-based study was conducted in UAE to determine the cholesterol levels among adults of different national ethnic groups including Emirati, other Arabs, Asian, Iranians, and Africans (N=834). The study found that Emirati cholesterol levels were 53% higher in comparison to the various other groups (43). Another community based survey among Bedouin-derived Emirati population (42) reported in 1995 that obesity and diabetes were higher in urban areas of Al-Ain, of which 27% of Emirati urban residents ages 20 to 39 were obese (BMI $\geq$30), and 6% were diabetic (including both male and female residents). The incidence of

hypertension within this same group was between 19-25% in both urban and rural areas in Al-Ain (42). Based on theses recent studies, monitoring obesity in children and adolescents in the city of Al-Ain is warranted.

Rationale for the study

The literature review of obesity in Al-Ain suggests that current information about the prevalence of obesity and overweight among Al-Ain children and adolescents is not sufficient to design and develop intervention programs. This paucity of information is due to few studies about the prevalence of obesity in general and in children and adolescents in particular, and to the lack of agreement among professionals about which international reference is deemed the most appropriate for measuring obesity prevalence among youth in Al-Ain. This thesis attempts to provide a comparison-foundation study about measuring obesity and overweight prevalence using CDC and IOTF for children and adolescents in order to provide an indicator of which standard of reference can be used in Al-Ain city in determining obesity prevalence. This thesis is considered the first study to compare CDC with IOTF as measured by body mass index (BMI) in the UAE. The prevalence of overweight and obesity is a very important indicator of health status in any given country and it is critical to have research-based evidence to support the decision to adopt CDC or IOTF standards to determine the prevalence rate of obesity. Comparing the two most common standards of reference will inform decision-makers about their best option for the purpose of policy or public health intervention.

Statement of the problem

There is limited research regarding the appropriate methodology and reference cut-offs for the measurement of the prevalence of obesity and overweight as measured in Al-Ain, especially for children and adolescents. Because of the economic shifts and nutrition transitions in the UAE, non-communicable diseases (NCD) are prevalent in the region in which obesity among children found to be more than thirty percent in 1999.

The lack of information on defining overweight and obesity has an impact on knowing the prevalence of the disease, which prevented health authorities from taking an action towards preventing obesity among children and adolescents are evidenced by lack of any intervention programs in Al-Ain City.

Purpose of the study

The reason of choosing Al-Ain city for this thesis include the following reasons: a) it is the only data set that provides information about overweight and obesity in schoolchildren, b) from a previous study, childhood obesity is prevalent in Al-Ain in 1999, c) Al-Ain is the largest and most developed city after Abu-Dhabi city, d) most UAE citizens live in Al-Ain.

The overall purpose of this study is to describe the prevalence of overweight and obesity among children and adolescents in Al-Ain using the CDC and IOTF reference methods. In addition, this study seeks to examine available factors associated with overweight and obesity prevalence in children and adolescents residing in Al-Ain.

TERMS & DEFENITIONS

Non-communicable Disease (NCD) is a disease that is not infectious, and may result from genetic or lifestyle factors. Examples include hypertension, diabetes, cardiovascular disease, cancer, and mental health problems.

Nutrition Transition is the sequential of changes in dietary patterns and nutrient intake associated with social, cultural, and economic shifts of a country or a region.

Overweight is an excess in body weight

Obesity is an excess of body fat

Body Mass Index (BMI) is an anthropometric measurement to assess excess weight or obesity by dividing weight in kilograms by height in meters squared.

Cut-off is a designed limit beyond which a subject or observation is classified according to a pre-set condition.

Growth Standards define how children should grow and deviations from patterns that describes abnormal growth.

Growth Refrences are comparisions of growth in different populations.

CDC is the Centers of Disease and Control and Prevention in the United States.

IOTF is the International Obesity Task Force Association for the study of obesity.

OBJECTIVES

1- To determine the prevalence of overweight and obesity in children and adolescents ages 8 to 16 in Al-Ain City in the United Arab Emirates.

2- To compare the BMI using CDC and IOTF references among children and adolescents ages 8 to 16 years in Al-Ain City.

3- To identify socioeconomic, nutritional, health status and demographic factors associated with BMI among children and adolescents in Al-Ain City.

RESEARCH QUESTIONS

1. What are the demographic and socioeconomic characteristics of the research sample?
2. Is there a difference in overweight and obesity prevalence if the CDC and IOTF references are compared?
3. Is there an association between BMI (overweight/ obesity) and the socioeconomic, nutritional, health status and demographic characteristcis of children and adolescents in Al-Ain?

LITERATURE REVIEW

The Prevalence of Childhood Obesity in Developing Countries

Over the past two decades there has been an increase in the occurrence of non-communicable diseases such as hypertension, diabetes, cardiovascular disease, cancer, and mental health problems in the developing world. In addition, the prevalence of overweight and obesity has increased in economically developed regions. Changes in the world's food economy have led to increased consumption of processed food, high-fat food, and fast food (20). Not only have dietary patterns changed, but many people in developing countries have also adopted more sedentary lifestyles resulting from countless time- and energy-saving technological advancements and devices that make movement less necessary. Less movement results in a decline in energy expenditure, which leads to obesity and overweight (21).

Obesity and overweight have become global social and health issues that require urgent action (12). In 2003, the World Health Organization (WHO) placed obesity at the top of its agenda as a major risk factor for the onset of non-communicable diseases (22). Several studies have shown that obesity rates have increased significantly in developing countries. For instance, Mercedes et al. conducted a meta-analysis of cross sectional surveys in 79 countries out of a total of 147 developing countries where data were available for analysis. They found that 17.5 million preschool children were overweight in 1995. In the same study, investigators found that overweight among children was highest in Latin America, Africa (eastern, southern, western), and Asia (eastern, southern) (6).

Based on several surveys since 1990, childhood obesity has increased substantially in more developed countries, with approximately 10% of children 5 to 17 years of age being considered to be obese. Survey results also revealed that America has the highest rate of childhood obesity, with greater than 30% of school-age children being overweight or obese. The second highest rate of childhood obesity is in Europe, with 19%, and the third highest rate of childhood obesity is in the Middle East, with 16% (20). A study conducted in the United States in 2005 confirms that overweight and obesity rates increased by 15% from 1988 to 2000 among children and adolescents ages 6 to 19 years (45). Moreover, the Nutrition Examination Surveys (NHANES) of the past two decades confirm the escalating rates of overweight and obese children and teenagers. The 1999-2000 NHANES VI reported that obesity among children increased by 18.8%, compared to the 1988-1994 NHANES III, which reported a 11.3% increase over previous NHANES (1).

The United States is not the only country to experience such a dramatic rise in obesity rates. The prevalence of childhood obesity in England increased between 1974 and 2002-2003, from 1.8% to 6% among boys and from 1.3% to 6.6% among girls (2). In Spain, the trend of obesity for 6- and 7-year-olds rose from 23% to 35% between 1985 and 1995 (3). In Canada, the rate of childhood obesity was tripled in the past 20 years. In 2006, Haque et al. found in a cross-sectional study that 28% among Canadian children ages 6 to 17 in both boys and girls were obese (4).

Urbanization and economic enterprise in developing and developed countries has led to changes in lifestyles and eating habits, thereby compounding the increase in the incidence of being overweight and obese. As a result, the rate of childhood obesity is

rapidly increasing in developing countries to alarming levels, which indicate an urgent need for effective intervention to deter this trend. Because childhood and adolescent obesity tends to worsen with age, it is essential to reverse this trend before it leads to more severe health problems and chronic diseases, which, in turn, could lead to health crises and economic drains on health care systems and increased mortality.

The Prevalence of Childhood Obesity and Overweight in the Eastern Mediterranean Region

The incidence of childhood obesity is increasing in many countries worldwide, including the Eastern Mediterranean region (EMR). According to the World Health Organization (WHO) division of EMR countries, there are 21 countries in the EMR, including Egypt, Iran, Jordan, Morocco, Pakistan, Afghanistan, Somalia, Sudan, Iraq, Yemen, Gulf countries, Syria, Lebanon, Libyan, Tunisia, and Djibouti, that have undergone a rapid epidemiological transition due to their transition from a traditional to a westernized lifestyle. This transition, as described by Omran in 1971, is a "change in patterns of health and disease and on the interactions between these patterns and their demographic, economic and sociologic determinants and consequences" (10, 46). One of the most noteworthy consequences of these countries' transitioning to Western lifestyle is changes in the amount and types of food consumed, which have led to an increase in childhood obesity.

Recent evidence shows a rapid increase in childhood obesity in the EMR. As a matter of fact, 1.2 million out of 1.4 million childhood deaths are concentrated in a few countries of the EMR, including Pakistan, Afghanistan, Egypt, Sudan, Iraq, Yemen, and Somalia (5). A cross-sectional survey taken by Mercedes in parts of the EMR showed

that Egypt and Morocco have the highest occurrence of obesity in preschool children to be 8.6% and 6.8%, respectively, and Oman has the lowest rate at 0.9%(6).

In a cross-sectional survey, the prevalence of overweight among Qatari youths ages 6 to 18 years is 24% in boys and 19% in girls. About 6% of boys and 4% of girls were obese when applying the IOTF growth reference in 2005 (7). In Kuwait, a cross-sectional study among Kuwaiti children ages 6 to 13 years to determine the incidence of childhood obesity by anthropometric measurements and biochemical assessment. The study also found the BMI was significantly higher in Kuwaiti girls than boys. The waist to hip ratio (WHR) was lower in Kuwaiti girls than boys of the same age group, which indicates the prevalent peripheral adiposity in female children and the prevalent central adiposity in male children (9). In other studies done by Musaiger et al, the occurrence of overweight has increased among Bahraini adolescent girls by 38.5% based on BMI and skinfold thickness (TSF) measurements. These studies show that the TSF and age-specific BMI increased by age among Bahraini adolescent girls (8,16). Conversely, in Beirut the prevalence of overweight has increased more among boys ages 6 and 8 than girls of the same age according to IOTF and standard age-specific BMI (17). In Saudi Arabia, a survey was done by El-Hamzi et al. on childhood overweight and obesity among male and female 1 to 18 years of age and was estimated to be 11% of overweight and 13% of obese children. The study results showed that the prevalence of overweight and obesity is higher in girls than boys to be 7% and 6%, respectively. Also, overweight and obesity among Saudi youths is increasing by age between 10 to 18 years (47).

The changes in lifestyle in the EMR leading to childhood and adolescent obesity has become a serious health concern that could lead to deadly results. The findings from

recent studies in this region provide evidence-based data for health professionals and policymakers about the prevalence of childhood obesity in many countries in the EMR. In the last decades, public health organizations have been focusing on malnutrition and micronutrient deficiencies. In addition, these groups need an attention because childhood obesity tracks into adulthood obesity and results in elevated risk of chronic diseases (10).

The Prevalence of Childhood Obesity in the United Arab Emirates

Historical Background

The UAE is a federation of seven independent states located in the southeastern corner of the Arabian Peninsula. It is bordered by the Arabian Gulf to the north, Saudi Arabia to the south and west, and the Sultanate of Oman and the Gulf of Oman to the east. In 1820, the British colonized the UAE before the discovery of oil in the early 1930s, but in 1968, Britain decided to withdraw all of its military forces from the region. In 1971, the UAE became seven fully independent Emirates, including Abu Dhabi, Ajman, Dubai, Al Fujayrah, Ras al Khaymah, Ash-Shariqah, and Umm al Qaywayn, with Abu Dhabi becoming the capital of the federation. The UAE's land size is 77,700 square kilometers and its population is increasing yearly; it reached 3,754,000 in 2002 and 4.3 million in 2004 (13).

Abu Dhabi is the Capital of the UAE and the land surface measures 67, 340 square kilometers, which is about 86.6% of the UAE total land area. However, Al-Ain is 8,195 square kilometers inland city located in the Emirate of Abu Dhabi. Al-Ain considered the Emirate's second largest city and is known as the garden city of the Gulf. Al-Ain is the fourth largest metropolitan area by the population of 348,000 in 2003. There are more nationals live in Al-Ain than other places in the country because Al-Ain

is at the center of the cultural heritage (5500 BC). There are many underground water springs, which explain the populist of nationals in this area.

In the past, life in the UAE was hard and it took extraordinary skills to be able to survive in the harsh terrain and arid climate. People lived in tents and few of them lived in small houses that were built up from mud. Then their extended families usually live together at the same place. Forty years a go, UAE had no infrastructure such as education, health and sanitation, and roads. People used camels for transportation from one place to another. Today, things are easier, but by holding on to their heritage, the people are able to draw upon their confidence in their past to tackle and overcome the challenges of the present and future (48).

The UAE's Cultural and Economic Shift

Forty years ago, the UAE was one of the least developed countries in the world, yet today, it has reached an income level comparable to that of other industrialized nations. Its massive oil revenues have enabled the UAE to short-cut the usually difficult and lengthy process of saving and capital accumulation necessary for economic development, which has allowed it to bypass some of the typical development 'stages' that most industrialized countries seem to have experienced. The rapid increase of wealth during the oil boom in the 1930s has impacted the UAE's economic development greatly, transforming its traditional society to a commercial business society (11).

Furthermore, the UAE has witnessed the creation of a truly modern welfare state with UAE citizens being able to access free health care, education, social services, housing, and safe drinking water. These economic changes have led to a "nutritional transition," which refers to the sequence of changes in dietary patterns and nutrient intake

associated with social, cultural, and economic shifts in UAE demographics (10, 11). This transformation has affected the UAE population's health and lifestyle.

Childhood and Adolescent Overweight and Obesity in UAE

The UAE's rapid economic growth and urbanization has granted its people less physical work, timesaving technology, and mobility through different modes of transportation—all of which have diminished their need for physical activities. At the same time, this economic growth, urbanization, and commercialization have opened the door to fatty, high-preservative fast food. This more sedentary and fattening lifestyle has made childhood overweight and obesity an epidemic, with more than 30% of UAE children being either overweight or obese (14). Several studies show that obesity and overweight are an age and gender related problems. In 1999, Malik and Al-Hddad found that more than 30% of children and adolescents in UAE were obese and overweight; however, the prevalence of obesity increased with age especially in adolescents (14, 15). The increase of obesity in adolescents is an alerting sign of having obesity in adulthood, which might lead to chronic diseases later in life (27).

In fact, several studies performed in the UAE show that obesity and overweight in children and adolescents are more prevalent among girls than boys. The high occurrence of obesity and overweight that has increased disproportionately among female Emirati stems from cultural factors in the UAE. For example, girls usually cannot practice outdoor exercise compared to boys due to religious and cultural restrictions. Most UAE citizens do not have to do housework because they have hired help, so youths typically do not have chores to do. Emirati youth also have numerous electronic devices such as videogames, DVD players, digital music recorders/players, computers, the Internet, cell

phones, and personal data assistants, etc., that require little movement or physical exertion. In addition to the sedentary lifestyle, most Emirati youths consume fast food like, burgers and candies. Canteens and fast food restaurants with delivery options are available in every neighborhood, which makes it very easy to order food over the phone from canteens or restaurants while watching TV or playing games. All these factors further contribute to their sedentary lifestyle, increasing the likelihood of them being overweight and obese, which then may lead to chronic diseases.

It should be noted that childhood overweight and obesity are more prevalent in urban areas and have had little impact in rural areas (14). People in rural areas are Bedouin and still live simple traditional lives. They consume more traditional and less processed food than Emirati citizens who live in urban areas due to the unavailability of processed products and fast food. However, a variety of food found in urban areas, where many kinds of grocery stores that have all kinds of products from all over the world where there a numerous and the availability of fast food restaurants.

A survey has been done in both urban and rural areas in 1999(14). About 38% and 27% of children were overweight whereas for girls and boys, respectively. The prevalence of overweight increased at teens ages 11 to 13 years to be increases with age to be 42% among girls and 37% among boys.

II. Definition of Overweight & Obesity

There is no universally agreed definition, but most people are considered overweight if they are 15-20% greater than their ideal weight as determined by standard or references taking into account age, height, build, and sex. Obesity is an excess of body fat, which refers to the abnormal fat accumulation in adipose tissue (10, 24). The amount of body fat

known as adiposity, which is defined as the amount of fat expressed in absolute fat mass or the percentage of total body mass. Adiposity is assessed by using the body mass index (BMI), and obesity can be assessed by using BMI cut-offs (23). Overweight is defined as an excess in body weight. Overweight and obesity is that caloric intake exceeds energy expenditure (24, 27, 28). Excess weight can put great strains on the body, particularly the joints in the legs and back in addition to leading to more serious health problems. Although there is a connection between overweight and obesity, not all overweight people are obese. Muscle has a higher density than fat, so highly muscular people may be overweight but not obese. Conversely, a sedentary person with normal body weight could have a small muscle mass, large fat stores, and be suffering from obesity (32). In adults, overweight is usually defined as a BMI $\geq$ 25.0 – 29.9 kg/m^2, while obesity is defined as BMI $\geq$ 30 kg/m^2.

Definition of Overweight & Obesity in Children and Adolescents

The simple definition of obesity is an excess body fat. In children and teens, there is no separate definition of overweight/obesity compared to adults. However, in epidemiological and clinical studies, overweight and obesity in children can be assessed by several accurate and direct measures. For instance, underwater weighing is a technique based on flooded the volume of the object in the water, which is used to determine the whole body density including mass and volume then the percent body fat can be calculated from body density. Dual energy X-ray absorptiometry (DXA), which is used for analysis of body composition to determine fat mass and fat free by scanning the whole body in about 30 minutes. Air displacement plethysmography is another type of measurements that is used to determine the body density and percent body fat by entering

objects into a chamber of known volume (19, 20). Anthropometric measurement is appropriate, inexpensive, and universally used method available to assess the shape, size, and composition of human bodies. Anthropometrics include skinfolds, body circumferences, weight and height (28). Skinfold measures the skin thickness of a double skinfold and compressed subcutaneous adipose tissue at different sites of the body, such as the chest, triceps, subscapular, midaxillary, suprailiac, abdomen, thigh, and medial calf. Triceps and subscapular skinfold are used most commonly for assessing body composition in young people 6 to 20 years of age (19, 32). Body circumferences such as waist circumference, measures the central fat distribution that is present in three regions subcutaneous (under the skin), visceral (surrounding the organs), and retroperitoneal (outside of the peritoneal cavity). Waist circumference is measured at the minimum circumference between the iliac crest and the and the rib cage using anthropometric tapes (20, 19). Weight and height are used to calculate the body mass index (BMI) by dividing weight in kilograms by height in meter squared. However, BMI as an index of adiposity is difficult to measure in children compared with adults. In adults, to define overweight and obesity, BMI cut off is 30kg/m^2 for obesity and 25kg/ m^2 for overweight. Those cutoffs cannot apply for children because of the varying growth rates and maturity levels. For that reason, age related cutoff is essential for the youths. There is no specific international standard to define overweight and obesity among children. To define overweight and obesity internationally, age, sex, ethnic group should be considered in order to use appropriate cut off references (23, 25). There are several organizations that use age- and gender-specific references for identifying obesity among the youths, such as

the WHO standard, the CDC standard, and the International Obesity Task Force references.

WHO Standard for Measuring Overweight and Obesity

The World Health Organization has established new growth standard for healthy children 0 to 5 years of age in 2006 that is internationally applicable. The WHO Multicultural Growth Reference Study (MGRS) implemented between 1997 to 2003 from various countries including Brazil, Ghana, India, Norway, Oman, and the USA. The WHO defines children growth by calculating length/height-for-age, weight-for-age, weight-for-length/height, and BMI-for age by using Box-Cox-power-exponential method with curve smoothing by cubic splines for constructing the growth curves followed boys and girls aged 0 to 60 months percentile and z-score curves for length/height-for-age, weight-for-age, weight-for-length/height, and BMI-for age (35).

Center for Disease Control and Prevention (CDC)

Growth charts are an essential screening tool for assessing the nutritional status of infants, children, and adolescents. They can effectively compare statistics among children of the same age and gender to define overweight (31) The CDC uses BMI to define overweight for children and teens between 2 to20 years of age as: BMI = weight (kg) ÷ height (m^2). After calculating the BMI, the CDC method plots this number on the CDC BMI-for-age growth chart for either boys or girls growth charts and then places it into a percentile for a child's or a teen's sex and age (26). The classification of overweight and at risk of overweight are given in the following table:

Weight Status category	Percentile Range
Underweight	< 5th Percentile
Normal	5th - 85th Percentile
At Risk of Overweight	85th - 95th Percentile
Overweight	> 95th Percentile

International Obesity Task Force References (IOTF)

The IOTF defines BMI on the basis of pooled data from six different countries, including Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States (29). Child BMI centiles are linked to the adult BMI cut-offs. A centile cut-off point can be identified as the point of distribution of BMI where the health risk of obesity starts to rise. The IOTF (29) use a statistical method analysis known as the LMS growth method (L=Skewness, M=Median, S=Coefficient). The LMS method were used to construct BMI centile charts. The centile can be drawn from the estimation of LMS curves, which show the parameter changes with age. MS techniques were used to create smoothed percentile BMI curves that passed through the adult cut-off points of 25 kg/m^2 (overweight) and 30 kg/m^2 (obese) for ages 2 to 18 years (23, 29).

There are various available references and cut-off points to classify overweight and obesity. It is difficult to choose the best references or cut-off points to evaluate the nutritional status of children and teens in countries where references do not exist. However, the IOTF cut-off BMI can be an acceptable international definition for overweight and obesity because it is based on pooled international data from various

countries and IOTF Reference BMI cut-off points are commonly used effective guidelines for assessing adiposity status in children and adolescents.

Several studies compare the three approaches to identifying overweight and obesity among children and adolescents. Wang et al. performed a longitudinal study that compares the US-CDC, WHO, and IOTF references to identify overweight and obesity among children and adolescent 6 to18 years of age. The data came from China, the United States, and Russia. The study concludes that the WHO and IOTF references are the best and most useful for identifying overweight and obesity (36).

Abdulbari et al. conducted a cross sectional growth survey in Qatar to analyze the growth patterns among 7660 Qatari children, ages 6 to18 years. The proposed study compared BMIs from the US-CDC standard, the IOFT reference, and the LMS method described by Cole et al. (29) for the Qatari population. The study concludes that there is a slight different between US-CDC and IOTF references (7). Jackson et al. preformed a comparison of the references from the US-CDC, Cole et al., and Must et. Al (WHO). The study gathered data on 922 girls 10 to 19 years of age, of whom 340 were from Egypt, 245 Kuwaiti, and 336 were from Lebanon. The study concludes that there were only slight differences among the three references (37).

Factors Associated with Obesity

There are several factors associated with obesity in children and adolescents, such as socioeconomic factors, environmental factors, psychosocial factors, behavioral factors, and genetics. Behavioral factors include energy consumption compared to energy exertion, physical activity, and sedentary activity (25, 51). Jabre et al. conducted a cross-sectional study in Beirut, Lebanon, in 2004 to determine the prevalence of

overweight/obesity in boys and girls 6 to 8 years of age and some associated characteristics, such as physical activity and energy intake. The study included a total of 131 boys and 103 girls. The BMI of children was calculated according to the IOTF cut-off. The prevalence rate of overweight in boys and girls was 26% and 7%, respectively. The prevalence of obesity in boys was 25% and 6% in girls. After conducting the Spearman correlation coefficient between BMI of children and hours they spent participating in sports per week, the results showed that there is a significant association between overweight/obesity and children exercising less than 3 hours per week ($P<0.05$) (17).

Socioeconomic factors, including location, age, gender, race, ethnicity, education, occupation, and income (52), are also associated with obesity. A cross-sectional study conducted by Stettler et al. (53) in 872 boys and girls with different European ethnic groups in Switzerland 2004. Children who involved in the study were in grades 1, 2, and 3. The aim of the study is to investigate the factors associated with childhood obesity. Researchers conducting this study defined obesity using IOTF cut-off point, and they examined how socioeconomic factors, physical activity, and electronic games affected obesity. The study concluded that obesity slightly high in both boys and girls, but there were no different among ethnic groups. Obesity associated with the time spent playing electronic games and watching TV , which explains the inverse association between physical activity and obesity among Swiss children. The study also examined whether mothers were employed or not as a factor effecting childhood obesity. The results showed that children whos mothers working outside the house were more likely to be obese when compared with children whose mothers stay at home. They conclude of this finding is

that children with working mothers eat large quantities of snacks after school (52). In 2003, Sibia et al. conducted a cross-sectional survey of 2,104 children and teen in Lebanon. The study aimed to determine the prevalence of overweight/obesity and to examine associated covariates among the youth. Investigators applied the WHO standard definition for overweight and obesity for children between the ages of 3 and 10 years using a weight-for-height cut-point greater than 1 and 2 standard deviations. For adolescents ages 10 to 19 years, investigators used the U.S. National Health and Nutrition Examination Survey to define overweight and obesity in the 85^{th} and 95^{th} percentiles, respectively. The study concluded that overweight and obesity is higher in boys 10 years old and older (22.5%) than in girls (16%) of these same ages. Lack of physical activity is associated significantly with obese children whose parents have lower levels of education (54). In Kuwait, a 1999 cross-sectional study survey of 2,400 boys and girls, ages 6 to 13 years, examined the factors associated with childhood obesity including socioeconomic factors such as parental education level, which was categorized as illiterate, primary intermediate, secondary, and university education or above. The study also included the parents' employment status, which was categorized as unemployed, semiskilled, semiprofessional and professional, as well as their social class, which was categorized as low, medium, or high. In that study, obesity was defined according to the National Center of Health statistics at $>90^{th}$ percentile. The BMI mean value of girls was higher than that of boys. The study revealed that the incidence of obesity increased in children whose father and mother had primary intermediate, secondary, and university education or above. In households mothers were unemployed, the incidence of childhood obesity was 69%; Moussa et al explained this finding and suggesting that in Kuwait there is no clear

definition for SES and it does not depend on education and occupation only. Furthermore, the incidence of obesity increased to 36.6% and 56.4% in families categorized as low and medium social classes, respectively, when compared with families categorized in a high social class. The family history of chronic diseases was significant associated with Kuwaiti obese children (55).

MATERIALS & METHODS

I. Data source

Data were obtained from the Nutrition Research and Survey Program of Al-Ain Health Administration from primary schools in 2003. Data were representative for Al-Ain City schoolchildren. The child population between the first through ninth grades in Al-Ain City were 30,625 in 2003 (40). A multi-stage stratified sampling technique was used to select the schools, using grades as strata. Boys and girls in the United Arab Emirates (UAE) are separated in schools because of cultural and traditional beliefs and values, so the data collection took place separately in boys and girls schools. The first stage was to randomly select 5 schools for boys and 5 schools for girls out of the total 117 schools, from which the sample of this study was drawn. Each school was given an identification number written in a small identical in size, shape, and color piece of paper. Then, all the 117 papers were placed on two small non-transparent boxes, one box for boys' schools and the other box for girls' schools. Then, five papers were randomly withdrawn from each box. Therefore, this process resulted in randomly selecting five boys' schools and five girls' schools for this study. The second stage was the selection of 630 boys and 630 girls for the study. The target sample size for each boys and girls was 126. From the five girls schools, the actual total sample for each school was school one was 113, school two was 121, school three is 117, school four was 114, and school five was 106 of girls. For the boys schools the total sample are school one 117, school two 124, school three 124, school four 122, and school five 124 of boys. From each grade (4, 5 and 6 grades) in each school where 42 children were randomly selected, using grade as

the statistical unit used in the sampling procedure. The same process was used for selecting the grades from each school by giving each grade an identification number which was written on a piece of paper and all the boys grades were placed on the boys' grades box. From grades four, five, and six, 196, 189, and 190 of girls were actually selected, respectively. For boys in grade four, five, and six, the total subjects were 202, 205, and 200, respectively. The exclusion criteria for the sample are disabled, non-UAE citizens, and no respondents.

II. Subjects

All children selected for this study had United Arab Emirates (UAE) nationality and were between 8 to 16 years of age. Permission of the Ministries of Health and Education were obtained to collect the data from primary schools. Informed consent forms were sent to the subjects' parents that included a description of the purpose of the study. The Institutional Review Board (IRB) of the University of Maryland College Park approved the study. Out of 1260 schoolchildren, 1180 boys and girls were actually surveyed.

The overall compliances was 94% and the boys compliance was 96% while girls 91%. Seventy-eight subjects withdrew from the study because they either moved to another school, could not participate due to an illness on the day of the study, failed to complete the data.

III. Questionnaires

Two separate questionnaires were developed in Arabic language to assess the parents' health status. The first questionnaire divided in two parts. The first part designed to elicit information about the children's date of birth, name of the school, grade, and

class. However, it is important to mention that some of the schools' name that was involved in this study (2003) have been changed or combined to other schools recently.

The second part of the questionnaire asked information about the socio economic status (SES) of the family. The SES included the educational level for the parents, which was characterized as "illiterate", "read and write", " high school diploma", and " higher education", "mother's employment status". Information was also obtained about the mother and father's history of chronic diseases such as obesity, diabetes, high blood pressure, and cardiovascular diseases.

The second questionnaire was a face-to-face interview to assess the children's lifestyle and health status. Questions included the number of main meals consumed per day representing in three meals per day breakfast, lunch, and supper. Eating while watching TV was also included and answered as "eating", "not eating", and "sometime while watching TV. Participation in daily exercise was also included in the questionnaire. Responses included the following: "yes", "sometime", or "no". Partcipation on sport teams and responses included participants and non-participants.

Researchers took anthropometric measurements, such as weight in kilograms (kg) and height in centimeters (cm) and waist circumference (cm).

IV. Procedures

The research was performed in two stages. The first stage was to ask children to take the first questionnaire to their parents to fill out and bring it back to school. The second stage was research team specialists filled out the second questionnaire by holding face-to-face interviews with the children and taking their anthropometric measurements. In each school, two research teams corresponding to the child's gender in which five

members each team collected the data. The anthropometric measurements were conducted according to the Anthropometry Procedures Manual proposed by the National Health and Nutrition Examination Survey 2002 (50). Weight and height measurements were taken by the research team. For measuring **weight**, each examiner was supplied with weighing scale with height bars attached to it on which weight was measured in kilograms using a standardized procedure (lightly dressed, without shoes). Subjects stood in the center of the scale platform facing the recorder, hands at side, looking straight ahead. The recorder took the measurements to the nearest 0.1 kilograms.

Height was measured by stadiometer in centimeters with subjects asked to stand up straight without shoes and with head pointing straight forward. Subjects were asked to remove any accessories such as jewelry and hejab (covering) from the top of the head in order to properly measure stature. Subjects were asked to stand on the floor with the heels of both feet together and the toes pointed slightly outward at approximately a 60°angle. After making sure that the body weight was evenly distributed with both feet flat on the floor, proper heel position, and the buttocks, shoulder blades, and back of the head in contact with the vertical backboard, the recorder, at eye level of the headboard, took the height to the nearest 0.1 centimeter and this values was converted to meters. **Waist circumference** was measured by placing the measure tap around the trunk in a horizontal plane at the right iliac crest trunk. Making sure that the tape is snug, but not compress the skin and then take the reading to the nearest 0.1 cm.

Determining Body Mass Index

Two references were used to compare and define overweight and obesity. Body Mass Index (BMI) variable was calculated using the following formula:

$$BMI = \text{Weight (kg)} / \text{Height } (m^2)$$

The first cut-off were developed using Center for Disease Control and Prevention (CDC). The BMI values were calculated for each gender and age. After calculating the BMI value, it interpreted by translating it to percentiles by using CDC growth chart BMI –for-age and gender specific. Subjects classified as overweight equal or greater than 95^{th} percentile, who fall between the 85^{th} to less than the 95^{th} percentile classified as at risk of overweight (Table 12 & Table 13). Subjects who falls between 5^{th} percentile to less than the 85^{th} percentile considered normal, and who classified Less than the 5^{th} percentile considered underweight.

The second method of BMI is the International Obesity Task Forec (IOTF) cutt-offs, which were calculated using age and gender specific developed (29, 58). Subjects classified as underweight, normal, overweight and obese according to the IOTF cutt-offs were summrized in Tables 10 and 11.

VI. Data Analysis

Statistical analyses were conducted using the Statistical Package for the Social Sciences Software (SPSS), Version 14.0 for Windows (SPSS, Inc., Chicago, Illinois). Data were obtained from 1182 children and adolescents between the ages 8 to 16 years. Because data were missing for variables, listwise deletion was used to treat the missing causes (56). Although listwise deletion does not result in a substantial decrease in our sample size, since the missing cases were less than 15% of the total sample size.

To address the first research question, descriptive statistics were applied including frequencies and percentages. This was used to report for the analysis variables: age, gender, maternal education, paternal education, and mother employment status.

Comparisons of the prevalence of overweight and obesity using the CDC and the IOTF reference cut points among children and teens were calculated to address the second research question. Descriptive statistics (percentages and frequencies) were preformed using both the CDC and IOTF reference cut-offs for BMI. Chi-square (χ^2) tests were also performed to identify the significant associations of gender and BMI classifications using both references.

Several statistical analyses were performed to address the third research question. BMI and WC were used as continuous variables with some selected variables in Al-Ain data set. hi-square (χ^2) was computed to examine the associations of overweight and obesity and school locations. One-way analysis of variance was applied to assess the

relationship between child BMI and boys and girls school locations. Chi-square was also applied to find out the proportion of overweight, obesity, underweight and SES and breakfast in different school locations.

Spearman's correlation (r) was used to evaluate the strength and direction of relationships between BMI and child's age, parents' education, main meal consumption, exercise, and parental history of chronic diseases among girls and boys. 'Spearman's Rho' correlations were obtained, which is the appropriate statistic when examining relationships between and/or among two or more continuous (scaled) variables and categorical variables. Statistical significance was established at the $p<0.05$ or $p<0.01$ levels.

To determin the relationship between child BMI and SES, several inferential statistics were preformed. Independent t-tests were applied to identify relationships between BMI and mothers' employment status (working vs. not working) and the relationship between BMI and two level of parental education level (illiterate vs. higher diploma) in both girls and boys.

One-way analysis of variance (ANOVA) was also applied to examine mean differences in BMI based on parents' different educational levels including "illiterate", "read and write", "high school diploma", and "higher education".

To evaluate the relationship between BMI and parents' history of chronic diseases (obesity, diabetes, CVD, and hypertension), one-way analysis variances were computed.

Another variable associated with overweight and obesity among schoolchildren was exercise and participation on sport teams. Chi-square (χ^2) tests were used to assess the proportion of overweight and obese children associated with "exercising", "not exercising", or "sometimes exercising". In addition, independent t-tests were preformed for the mean differences among children who were participants and non-participants.

ANOVA was applied to find out the mean differences between the BMI of children and "eating while watching TV", "not eating while watching", or sometime eating while watching TV" at the significant level of 0.05.

Because breakfast is an important meal for children, Independent t-test was performed to estimate the mean differences between child BMI and whether they consumed breakfast or not.

RESULTS

I. Overview

Cases for this study (n= 1182) were randomly selected from subjects between the ages of 8 to 16 years. Six hundred and seven boys and five hundred and seventy five girls

participated in the study. Preliminary data screening revealed that a number of cases were missing for several variables: ninety three cases were missing for father's education level; eighty one cases were missing for mother's education level; one hundred fifty-three) cases were missing for mother's working status; and seventy-five and one hundred cases respectively were missing for individual mother's and father's health condition items. However, because the number of missing cases for the respective variables represented less than 15% of the total sample, listwise deletion was preformed for the proposed missing variables. In addition, descriptive statistics were obtained for continuous variables and reported in means (M) and standard deviation (SD) in Table 1. Variables, such as age, weight (kg), height (m), number of family members per household, number of rooms per household, and BMI, were reported in Table 1 as well. All of the continuous variables reported in Table 1 were normally distributed by displaying a normal curve. Children's ages ranged from 8 to 16 years with a mean age of 10.83 (±1.24) years. Weight (kg) ranged from 17 to 107 kilograms with a mean of 37.02 (±12.71) kilograms, and height ranged from 1.14 to 1.78 meters (m) with mean of 1.40 (±0.09) meters. The BMI mean for children was 18.38 (±4.64) kg/m^2. Frequencies and percentages for parental history of chronic diseases, such as obesity, diabetes, hypertension, and CVD, are indicated in Table 2. Mother's history of chronic diseases were 7.2% (n=79) and 7.7% (n=91) for obesity and diabetes, respectively. However,

father's history of chronic diseases were 16.25 % (n=191) for diabetes, 10.5 % (n=124) for hypertensive, 5.5% (n= 65) for CVD, and 4% (n= 47) for obesity. Table 3 indicates the frequencies and percentages for daily exercise and meal consumption separately for boys and girls of Al-Ain school. About half of the boys were exercising 52.9% (n= 321), 34.6% (n=210) reported exercising sometime, and 12.4% (n= 75) were not exercising. However, girls exercise less than boys 27.3% (n= 157), 39.5% (n=227) sometime, and 32.5% (n= 187) not exercising at all. Most of the schoolchildren consumed three main meals everyday (i.e., breakfast, lunch and supper). Al-Ain schoolchildren consume more lunch and supper than breakfast. About 97% (n= 588) of the boys and 95.7% (n= 550) of the girls consumed lunch everyday. About 95% (n=578) of the boys and 94% (n= 541) of the girls consumed supper everyday. However, 82% (n= 425) of the boys consumed breakfast and 74% (n=425) of the girls consumed breakfast daily.

II. Demographic Characteristics

Descriptive Statistics

The demographic characteristics of the Al-Ain sample are shown in Table 4 and Table 5. Table 4 represents age of child and gender in terms of frequencies (n) and percentages (%). The distribution of children and teens' ages ranged from 8 to 16 years old. The majority of the sample were teens falls between the ages 10 to 13 year and account as 27% (n=320) age ten; 34% (n=403) age eleven; and 17 % (n = 202) age

twelve girls. About half of the sample 51.4 % (n=607) were boys and 48.6 % (n=575) were girls. Table 5 displays parents' educational level and mother's employment status in terms of frequencies (n) and percentages (%).

For father's educational level, 13% (n = 155) of them are illiterate, 18.6% (n = 220) could read and write, 51% (n = 604) had a high school diploma, and 9% (n=110) had higher education degrees. However, in regard to the mother's educational level, 27.7% (n=305) were illiterate, 17% (n=187) could read and write, 50% (n=555) had a high school diploma, and 4.9% (n=54) possessed higher education degrees. In conclusion, the mother's employment status variable was reported in the same table, which showed that 87 % (n=972) of mothers are not working, while 4.8% (n= 57) of them are working.

III. BMI for CDC & IOTF Reference Standards

Descriptive Statistics

To determine BMI using CDC and IOTF, frequencies (n) and percentages (%) of BMI categories were used to detect possible differences. Since the number of boys in the sample ages 8-9, and 14-16 were could avoid uneven frequency distribution and to produce more interpretable inferential analyses. Girls age 14 through 16 were also combined into one category for the same reason; at the other end of the age distribution,

only 9-year-old girls were used in the analysis since there was only one 8-year old girl for both CDC-BMI and IOTF-BMI analyses.

CDC BMI-for-age

Initially, a four-category variable was created utilizing CDC-BMI for boys (n = 607) and for girls (n = 575) in the study sample. The CDC-BMI values were categorized and coded as underweight, normal, at risk of overweight, and overweight for age and gender specific, and are shown in Table 6. The prevalence of children age 8 to 16 years and who are at risk of becoming overweight is 12% for boys and 12.7% for girls. The percentage of children who were overweight is 14% for boys and 13.6% for girls. About half of the sample was considered to have a normal BMI with 56.3% of the boys and 59.7% of the girls. 17.6% of the boys and 14.1% of the girls were underweight.

BMI is age- and gender-specific; therefore, BMI categories for boy and girls between the age of 8 and 16 years are shown individually in Table 5. There were 20% (n=8) of boys at the age 13 years and 26% (n=5) of those between 14 and 16 years of age were overweight. Similarly, the prevalence of girls who were overweight at age 13 and between 14-16 years of age reached 27% (n=7) and 33% (n= 4), respectively. About 20% (n= 8) of boys were considered at risk of overweight at the age of 13 years, while 19 % (n= 5) of girls at the same age were considered to be at risk of being overweight.

The prevalence of underweight cases among girls (24.4%; n= 20) is more likely on girls of 8 and 9 years of age, while in boys, the highest percentage of underweight case was at age 10 and between the ages of 14 and 16, at 20.5% (n= 31) and 21% (n= 4), respectively.

A Chi-Square (χ^2) test was performed to identify the associations between the CDC-BMI classification (i.e., underweight, normal, at risk of overweight, overweight) in boys and girls. No significant association between CDC-BMI classification in boys and girls, was found.

IOTF BMI cut-off

A four-category variable was created using IOTF international cutoff points (29, 58) for males and females in the sample. The previously calculated IOTF BMI was coded as underweight, normal, overweight, and obese. As mentioned previously, the BMI for children is age- and gender-specific and presented in Table 7. It shows the IOTF BMI categories by age and gender for a sample of 1182 Al-Ain schoolchildren.

In girls aged 8 to 16 years (n= 575), the prevalence of overweight cases was 17.6% (n= 101) and was 12.9% (n=74) of obesity. However, 25.6% (n=147) were considered underweight and about 44% (n=253) were considered to have healthy BMI. In boys aged 8 to 16 years (n=607), the prevalence of overweight cases was 14.5% (n=88), and for

obesity, it was 9.6% (n=58). However, 26.2% (n=159) were underweight and about 49.8% (n= 302) have normal BMI.

Obesity was higher at age 13 years to 17.5% (n=7) among boys and increased to 33.3 % (n=4) among girls between the ages of 14 and 16. About 18% (n= 37) of the boys were overweight at the ages 11 and 12 (n=20) years old. Among 10-, 12-, and 13- years old girls, the prevalence of overweight cases was 18% (n= 31), 18% (n=16), and 19% (n=5), respectively. About 42% (n=8) of the boys were underweight at ages 14 to 16 years old. However, in girls, 30.5% (n=25) and 24.6% (n=48) were underweight at the ages 8, 9, and 11 years of age, respectively.

To identify significant association between the categorical IOTF BMI parameters (underweight, normal, overweight, obesity), a Chi-Square (χ^2) test was conducted in boys and girls. The result showed that there were significant differences ($\chi^2 = 9.4$, df = 3, p= 0.02) between boys and girls when using IOTF-BMI classifications.

IV. Determinants Associated with Overweight and Obesity

Inferential statistics

To test the association between BMI of children and selected determinants of overweight and obesity, tests of significance were conducted, including an independent-t test, one-way ANOVA, Chi-square, and correlations.

School locations

This study involves five boys and five girls schools in different locations within the city of Al-Ain. Chi-square test was applied to assess the relationship of overweight and obesity in different school locations for boys and girls between the age 8 to 16 years. The prevalence of overweight and obesity were not significantly affected by school locations in both boys and girls. As shown in Table 14, in boy's schools, overweight was more prevalent in Tawam School 29.5% than other schools, while obesity more common in Tawam (20.7%), Othman Bin Afan (20.7%), and Ibin Khaldoon (20.7). Among girls schools, overweight is widespread in Grayh school (30.7%) and Al-Essra (25.7%) than other schools. However, obesity was more prevalent (29.7%) in Makka School and Amna Bint Wahab School (28.4%) than in other schools (Table 15). ANOVA was also computed to assess the relationship of BMI and different school locations in boys and girls. The mean BMI was significantly differed in girl schools, but not in boy schools. The significant differences were found in Amna Bint Wahab School (M=19.3 ±5.8) and Mezeed School (M=16.2 ±3.8).

Chi-square was performed to assess the relationship between overweight/obesity/underweight and SES (parental educational level, mother employment status) and breakfast. The results showed a significant association between underweight and paternal education in Mezeed school ($\chi^2 = 17.9$, $p < 0.05$). There were

also a significant association between overweight/obese and breakfast consumption in Amna Bin Wahb School ($\chi^2 = 15.8$, $p < 0.05$).

Socioeconomic status (SES)

Socioeconomic status in Al-Ain sample includes parents' educational level and mother employment status. For the parents' educational level, descriptive statistics were preformed including percentages to compare overweight and obese schoolchildren with mothers who were illiterate versus mothers holding high school diploma in boys and girls. There are about 12% (n= 19) overweight and 13% (n=20) obese boys and 16% (n= 24) overweight and 15.5% (n=23) obese girls with illiterate mothers. However, there are about 14% (n=40) overweight and 11% (n= 31) obese boys and 15% (n=40) overweight and 16% (n=43) obese girls with mothers holding high diplomas.

Independent t-tests were computed to examine the mean differences between the BMI of children and two different educational levels of parents (mothers & fathers) including illiterate and higher school diploma for both fathers and mothers in boys and girls. There were no significant differences in BMI in children of illiterate parents or parents holding higher diploma.

One-way analysis of variance tests were computed to assess the relationship between boys and girls BMI and their mother's educational level. This analysis tested for significant mean differences in BMI based on differences in the mothers' levels of

education between children populations of both genders. The results of this analysis showed no significant differences in BMI for either boys or girls based on the level of the mother's education (i.e., illiterate, can read and write, high school diploma, higher education). The same analysis (ANOVA) was computed to examine the relationship between BMI and father's education by gender. Results of this analysis revealed also no significant differences in BMI between boys and girls based on the educational level of the father.

Independent-t tests were preformed to test the research hypothesis that BMI of both girls and boys would differ according to their mother's employment status (i.e., working or not working) at the significance level of 0.05. After applying the t-test, we found that there were no significant differences between boys and girls BMI in terms of their mothers' employment status.

In addition, chi-square test was computed to assess whether the proportion of overweight and obese children was associated with the mothers' employment status (working or not working). This test was not significant in boys or girls in terms of mothers employment status by either using the IOTF or CDC methods.

Spearman correlations were performed to identify the association between the BMI of children and their father and mother educational level and mother employment

status (Table 8). There were no significant associations found between child BMI and SES of their families for both genders.

History of chronic diseases

A one-way analysis of variance was applied to evaluate the relationship between schoolchildren BMI and parents' history of chronic diseases including obesity, diabetes, and CVD in both boys and girls. The dependent variable was child BMI and the independent variable was mothers classification as obese, non-obese, or unknown. The ANOVA was significant in boys, but not in girls. There was a significant differences in the mean of boys BMI between obese (M= 20.0 ± 6.0) and non-obese (M= 18.2 ± 4.5) mothers.

The same analysis test was computed to assess the relationship between youths BMI and diabetic mothers (diabetic, non-diabetic, don't know) for both boys and girls. The were significant differences between the boys BMI and diabetic mothers (M= 20.2 ± 5.2) compared to non-diabetic (M= 18.2 ± 4.6) mothers. There was a significant differences between the mean BMI of girls and diabetic mothers (M= 20.5 ± 4.7) compared to non-diabetic (M= 18.3 ± 4.1) mothers.

Spearman rho correlation analysis was applied to identify the associations between BMI and parent's history of chronic diseases (i.e., obesity, hypertension, diabetes, CVD). In parental history of chronic diseases, significant correlations were

found between BMI, whether the mother was obese (r= 0.109; $p < 0.05$; n= 530) and had diabetes (r= 0.172; $p < 0.05$; n= 459), but no significant association was found with mothers' hypertension or CVD. There were no significant associations between BMI of the children and fathers' obesity, diabetes, hypertension, or CVD in both boys and girls.

Age

Spearman rho correlation was examined to determine out the relationship between children's BMI and children's age in both boys and girls. The BMI was significantly correlated with age in boys (r= 0.3; $p < 0.01$; n= 607), presented in Table 9. In girls, BMI was significantly correlated with age (r= 0.3; $p < 0.01$; n= 575), Table 8. As a result, as age increased, the BMI increased among boys and girls in Al-Ain city.

Main meals

Spearman rho correlations were computed to assess the association between child BMI and their consumption of main meals per day including breakfast, lunch, and supper. Daily breakfast consumption was inversely correlated with BMI for boys (r= - 0.174; $p < 0.01$; n= 607), but no significant correlation was found for lunch or supper, as shown in Table 9. By examining the BMI of the girls and main meals per day (i.e., breakfast, lunch, supper), the results showed inverse association (r= - 0.176; n= 575) between BMI

and consuming breakfast at a significant level of $p < 0.01$, but there were no significant correlations for lunch and supper in girls schoolchildren (Table 8).

Independent t-tests were performed to evaluate the hypothesis that the mean BMI differs between children who consumed breakfast versus those who are not consuming breakfast on a daily basis. This was valid in boys ($t= -4.5$, $p<0.05$, $n= 607$) and girls ($t= -4.6$, $p<0.05$, $n= 575$). Children who consumed ($M=17$, $SD= 4.3$) daily breakfast tend to have lower BMI than those who did not consume breakfast ($M=20$, $SD= 5.3$).

Exercise

A chi-square was conducted to test whether children who were exercising, not exercising, or sometimes exercised were overweight or obese. The proportion of overweight or obese boys were significantly different ($\chi^2 = 3.9$, $df =1$, $p< 0.05$) from those who were exercising ($\chi^2 = 53.8$, $df = 2$, $p= <0.05$) than those who were exercising sometime or not exercising at all when using IOTF, but not significant when using CDC cut offs. The same analysis were conducted for girls and there was no significant differences found in the analysis.

A t-test was performed to assess if the mean BMI differed between participants or non-participants in sports team. The result revealed that there were no significant differences in BMI and participation in sports team in either boys or girls.

Watching TV

One-way ANOVA were computed to evaluate the relationship between children's BMI and whether eating while watching TV, sometime, or not. There were no significant differences found in child BMI and eating while watching TV in both girls and boys.

Underweight

The prevalence of underweight among children ages between 8 to 16 years 26.2% (n=159) in boys and 25.6% (n=147) in girls, when using the IOTF method. However, according to the CDC classification, there were about 17.6% (n= 107) boys and 14% (n=81) girls who were underweight. From Table 6 and 7, one can see that the percentage of underweight was higher in the younger ages in our sample from 11 to 8 years when using CDC and IOTF in both boys and girls.

Independent t-tests were computed to test the hypothesis that the average of child waist circumference differs in underweight versus normal children (IOTF) in boys and girls. The tests ($t= -11.9$, $P <0.05$) in boys ($t= -12.4$, $P <0.05$) and in girls were significant. Underweight boys tend to have lower waist circumference ($M= 54.6 \pm 4.9$) than those who are normal BMI ($M= 60.8 \pm 5.5$) and this was also true for girls. Tests were also preformed using underweight and normal category according to the CDC classification. The results showed there is a significant mean difference in waist circumference between underweight and normal BMI in both boys and girls.

Chi-square tests were applied to assess the relationship between underweight children and SES factors including parental education and mother employment status and boys and girls school locations. The proportion of underweight boys is 43% with illiterate mother compared to the proportion of underweight boys with educated mothers is 56% ($\chi^2 = 53.8$, $p < 0.05$). In addition, there were 35% and 33% boys who were underweight with illiterate and educated fathers, respectively. The proportion of underweight boys with employed mothers was 21.7% compared to none employed mothers 35.7%, this is not statistically significant (Table 16). The same test was preformed to assess the relationship between underweight and SES for girls. The proportion of underweight girls was significantly ($p < 0.05$) lower in illiterate mothers was 31.5% than educated mothers 68.5%. Girls who were underweight with illiterate fathers was 35.0% compared to educated fathers 37%. The proportion of underweight girls with employed mothers was 38.0% compared 37.8% of unemployed mothers; however, the tests were not significant among girls (Table 17).

Among boys schools, underweight was shown to be more prevalent in Omer Bin Al Kahttab School (24.5%) than other schools (Table 14). However, in girl schools, Mezeed was the highest rate of underweight (36.7%) than other schools (Table 15).

DISCUSSION

I. Demographic Characteristics

We collected data of 1,182 children to represent schoolchildren between the age of 8 to 16 years in grades 4, 5, and 6. There was a total of 48,162 boys and girls attended grades 1 through 9 at the time of the study in 2003. The actual ages of schoolchildren in the United Arab Emirates (UAE) in grades 4, 5 and 6 are 9-, 10- and 11-years-old, respectively. The mean age of the sample was 10.83, which is concentrated at grade five. From the age distribution shown in Figure 1, one can see that children of 8, 13, 14, 15 and 16 years of age were included in the study. They account for 3, 20, 66 6, and 5 children, respectively. The reason for those subjects being in grades 4, 5 or 6 is that they repeated the classes several times, quitted the school for some reason such as health conditions or moved to other place. The UAE Ministry of Education allows students to attend school until the age of 18. If a student fails to finish the primary, secondary, and high school before the age of 18, they can convert to evening schools or home schooling. The UAE culture separates students by gender due to religious and traditional reasons. Since boys' and girls' schools are separated; therefore, subjects were collected from separate boys and girls schools. Boys account for 607 and girls for 575 of those who participated in this study.

The socioeconomic status of Al-Ain sample was measured in terms of parents' educational level and mother employment status. In our study, about half of the parents attained a high school diploma. This is due to the nature of the Al-Ain community, where most young males ages 18 to 25 years prefer to join the military and police forces instead of getting higher degrees. Those types of jobs do not require advanced level of education and they are one of the highest paid of jobs in UAE.

The results showed that most of the mothers were not working (87%), which is consistent to the findings of Moussa et al. in Kuwait that more than 67% (n= 914) of mothers were not working in 1996 (55). Similarly, in Saudi, Al Jassir et al. found that, among 4, 812 mothers from different regions in Saudi, about 73% of the mothers were unemployed in a cross-sectional study in 2003 (68). In most gulf countries, and particularly in UAE, women do not work because, in Islam, men are obligated to support the wives and family, so the women do not have to work, and men are required to support their families by the UAE law. Another reason underlying the high percentage of unemployed women is the low level of job opportunities in Al-Ain City as compared to other cities, such as Abu Dhabi or Dubai, where job are more available. The types of job are culturally limited and women tend to prefer working in places where interactions with men are limited, such as girls' schools and universities. In addition, the low educational level that we found in the

study can also be explained by the high number of unemployed women in Al-Ain, since most government and private sector organizations prefer university degree holders.

II. BMI for CDC & IOTF Reference Standards

Measurement of weight and height are important to monitor growth, development, and nutritional status in children and adolescents. Body Mass Index for adults is widely used to define overweight (25kg/m^2) and obesity (30kg/m^2). Because growth in children and adolescents depend upon sexual maturity and growth rates, the BMI cut off is various by age and gender.

It is important to emphasize that there is no "gold standard" that can be used upon internationally for defining overweight and obesity among youth. However there are several standard references excite that can be used to define overweight and obesity in children, such as WHO, CDC, and IOTF (26, 29). The World Health Organization (WHO) reference is based on US national data (NCHS) from the 1970s and it is not ideal for international use because it were based on single population, includes children from age 0 to 3 years only, and the statistical method used to construct them was at that time limited (35). The CDC cut offs are based on well-designed studies in the US including children 2 to 20 years of age and both sexes from different ethnic groups. Also, it is widely used for comparison studies especially in the Gulf countries such as Kuwait, Saudi, and Qatar (7, 37, 47). The IOTF cut points is based on pooled data from six different countries including Brazil, Great Britain, Hong Kong, the Netherlands, Singapore, and the United States for boys and girls age 2 to 18 years. As a result, we

chose CDC and IOTF references as a comparison of BMI among schoolchildren in Al-Ain to define overweight and obesity.

CDC-BMI-for-age

The percentage of schoolchildren aged eight through sixteen who were overweight is 14% for boys and 13.6% for girls and this percentages was not significantly in boys and girls. Our findings clearly show that the prevalence of overweight increased with age are 26%, 20%, 16%, 15.9%, and 8.6% among boys ages 14-16, 13, 12, 11, and 10 years, respectively. Similarly, the prevalence of overweight among girls is 33.3%, 26.9%, 13.3%, 11.85, and 12.4% at the same ages. Our results showed that the amount of overweight cases is slightly higher in boys than girls, at 14% and 13.6%, respectively. Bener et al. has similar findings among Qatari children aged 6 to 18 years, at 11% in boys and 5.6% in girls when using the CDC reference (7). In the same Qatari study, about 19% of boys and 15% of girls were considered at risk of overweight, which is high compared to our finding that 12% of boys and 12.7% of girls were at risk of being overweight. A study conducted by Jackson et al. among adolescents girls in three countries of the Eastern Mediterranean region: Lebanon, Kuwait and Egypt. The prevalence of overweight cases when using CDC reference was 13.5% in Egypt, 14.3% in Kuwait, and

2.7% in Lebanon. Compared to our findings, 13.6% girls aged 8 to 16 years is slightly similar to that of Egyptian and Kuwaiti girls and higher than that of Lebanese girls (37).

The prevalence of overweight cases in American children based on NHANES 2003-2004 data was 18.8% among those 6 to 11 years and 17.4% among those 12 to 19 years, which is considered higher than UAE schoolchildren residing in Al-Ain City at the same year of the study (26).

IOTF BMI-cut off

Our results showed significant differences between boys and girls in overweight (14.5% boys; 17.6% girls) and obesity (9.6% boys; 12.9% girls).

In 1999, Malik et al. performed a study in the UAE among boys and girls from 5 to 17 years of age, using IOTF cut-offs. The study showed a higher percentage of overweight in Al-Ain city—22% girls and 20% boys and 13% of girls and 15% of boys were obese—than our findings (14). In contrast, El-Hazmi et al. found different results among Saudi children one to eighteen years of age between the year of 1994 and 1998, using IOTF cut-off. Their results suggested lower prevalence of overweight cases and obesity compared to our study, with values of 10.7% and 6% in boys, and 12.7% and 6.7% in girls, for overweight and obesity, respectively (47).

Our findings indicate that overweight and obesity was more elevated in girls than boys. In contacts, in Qatar, Bener et al. found higher prevalence of overweight among Qatari boys and girls 6 to 18 years of age (24.3% boys and 18.7% girls) than our study, but lower prevalence of obese children than our findings (6% boys and 3.6% girls) when using IOTF cut-off (7).

Differences between CDC-BMI and IOTF-Cut-Off

In comparing the percentages of boys and girls that are classified as obese by CDC and IOTF cut offs, some important differences are evident, shown in Table 18. To

define overweight and obesity using to both references, different terms have been used for each. For instance, CDC uses the term “at risk of overweight,” which is equivalent to the IOTF term “overweight”. The term “overweight” is used by CDC and it is equivalent to “obesity” that is used by IOTF.

Overweight is more common among girls when using IOTF (17.6%) than CDC (13.6%) references. Similarly, in boys, using IOTF (14.5%) yielded higher values than CDC (12.7%) cut-offs. However, for obesity, the IOTF (9.6%) was lower than CDC (14%) in boys and lower among girls (15.5%) than CDC (13.6%). Overall, our study indicates that there is a difference between CDC and IOTF references. Similarly, Bener et al., in their study of Qatari schoolchildren, found a difference when comparing CDC and IOTF references (7). In addition, Jackson et al. found that there is a slight difference between IOTF and CDC among adolescent girls in three different populations, including Lebanon, Kuwait, and Egypt (37). We expected that there are differences between these two reference cut offs due to several reasons. First, the CDC reference is based on American population, which is documented that overweight and obesity are increasing among U.S. youth. This may explain why high percentages of obese children and teens when using the CDC. These results were consistent with other studies such those by Jackson et al. and Bener and coworkers (7, 37). Second, our results showed significant differences based on the IOTF reference between boys and girls, but not on the CDC

reference. Third, the IOTF cut off is higher than the CDC cut points, which indicate that as the BMI cut offs increased, the percentages of obesity decreased, which is true in our results that the percentages of obesity were less in the IOTF, while increased in the CDC cut offs.

IOTF BMI cutoff is based on a data set that was pooled from averaging six different countries that might yield a sufficient estimate for international populations, in particular, UAE schoolchildren. As a result, IOTF reference is suggested for estimating the BMI of Al-Ain schoolchildren, until UAE develop their own reference.

IV. Determinants Associated with Obesity

We used BMI values and waist circumference values for several analyses as continuous variables. We used BMI and WC to examine the relationship between anthropometric measurements and some selected determinants of childhood overweight and obesity. We chose to use the BMI, but not WC because our second goal of the research was to examine the differences of two BMI methods, thus we use the BMI values to find the relationships between BMI and some available determinants. In addition, BMI and WC act similarly in the prediction of chronic diseases (71), and also BMI was known is highly correlated with WC and waist to hip ratio (70, 71), and it was correlated in our study ($r= 0.8$; $n= 1182$; $P< 0.05$). As a result, we chose BMI as

continuous variable for the determination of overweight and obesity among children for our sample.

School locations

The prevalence of overweight and obesity are higher in schools attended by girls than schools attended by boys. Our results indicate that there were significant differences among girl schools, but not among boys school. The significant differences were found in Mezeed School where girls had lower BMI. Significant differences were also found at Amna Bint Wahab School, but these BMI values were higher compared to other schools.

After finding these results, we explored various SES and dietary factors to ascertain whether these variables were associated with our findings for Mezeed School and Amna Bint Wahab School. Further analysis has been done to determine the reasons of the significant differences in these two schools. We found that low paternal education was associated with underweight in Mezeed School. Mezeed School also had the highest percentages of underweight (36.7%) compared to other girl schools. Skipping breakfast had significantly associated with overweight and obese girls in Amna Bint Wahab School. In addition, the prevalence of overweight and obesity in this school were 22.8% and 28.4%, respectively. In addition, Mezeed School is far from the center of Al-Ain city and might has less influence to the availability of fast food restaurants than Amna Bint

Wahab School. However, we could not explore more about these findings because the data were limited and the data was not designed to answer this question.

It is important to mention that the name of Amna Bint Wahab School has been changed to Al-Ezdehar School and Mezeed converted to high school, recently.

Socioeconomic status (SES)

By using various statistical tests, our findings also showed that there is no significant association between BMI and socioeconomic status (SES), including parental educational level and mother employment variables. In the UAE, a parent's educational level and employment might be insufficient for measuring socio-economic status. To justify that, due to the development of the region and the oil revenue, the UAE government provides free services to citizens, such as free housing, education, and health services. In addition, the UAE per capita is ($49,700), which is considered very high as compared to the educational level of the Al-Ain sample. Again, although some people might have a high-paying job, that does not indicate that they achieved a higher degree of education, such as high school diploma. As a result, educational level is not an appropriate factor to define SES. Income would be more accurate to use income as a factor to define SES in UAE, which was not available in our data set.

In Kuwait, Shah et al. found that "any single measure, such as education or occupation, may not be sufficient to examine the possible effects of SES on various

health indicators". However, to test the association between SES and health, a combination of other indicators should be included in addition to the level of education, such as housing and living conditions, family type, age and sex composition, marital status, economic activities of the men and women, income, and social class distributions (59). Because educational level and employment, as single measurements, are not indicators of SES in UAE, it is difficult to explain the prevalence of overweight and obesity among schoolchildren by means of SES because the UAE population is homogenous in income. It would be appropriate to involve other factors, such as the one indicated in the Kuwaiti study.

History of Chronic Diseases

Recent studies showed that those adolescents who are obese are more likely to be obese in their adulthood, which will contribute to several chronic diseases, such as cardiovascular disease, diabetes, and hypertension (23, 28, 38). Our study showed that children of mother who have chronic diseases had higher BMI than children of mothers who did not have chronic diseases (obesity and diabetes). The International Diabetes Federation classified the United Arab Emirates as ranking number one in the world in the prevalence rate of type 2 diabetes mellitus in 2003 (45). Additionally, in 2003, the year of our study, Al-Maskari et al. found that 86% of male and female adults (n=513) had type 2 diabetes of which 75% were UAE nationals residing in Al-Ain (57). Obesity

among mothers is another factor that correlates with the prevalence of overweight and obesity among children in our study. In 2001, Carter and associates found that the prevalence of overweight and obesity cases was 28% and 35%, respectively, among female Emarati (n=535) with a mean age of 34.3 in the city of Al-Ain (69). From the previous studies in Al-Ain city, one can conclude that obesity and diabetes are prevalent among adults, and obesity is considered a risk factor of diabetes. Our results indicate the there was a relationship between child's BMI and obese/diabetic mothers, which means that children with obese and diabetic mothers have high risk of obesity and diabetes.

Nonetheless, our study tests only relationships and does not predict the causation of overweight and obesity among schoolchildren. Defining BMI of the mother would give realistic percentages for of overweight and obesity among mothers, which was not included in our study and needs further clarification that addresses comparisons of the BMI of mothers and their children.

Age

Our data indicate that BMI is associated positively with children's age. This indicates that BMI increases with age with both references (CDC and IOTF). Our data showed that the prevalence of overweight and obesity among the Al-Ain sample is higher among teens 10 through 16 years of age. Similarly, Malik et al. concluded that, among

UAE children 5 to 17 years of age, the prevalence of overweight and obesity increased with age, but mainly at the ages 11 to 13 years, when applying the IOTF reference (14).

Main Meals

Our results showed that children who missed breakfast at high frequencies had significantly higher BMI values were compare to children who consumed breakfast. Also, children consumed less breakfast than lunch and supper. Breakfast is an important meal for children and adolescents, and is considered the most commonly missed meals (66). In studies with adults, eating more meals per day is associated with lower obesity (60, 61). However, Song et al. found that breakfast consumption is associated with a lower prevalence of overweight and obesity among 4,218 U.S. adults from NHANES 1999-2000(64). Franko et al. reported that increased meal frequency is associated with lower BMI in a longitudinal study of 2,375 white and black girls aged 9 to 19 years (62). In the United States, the trend of consuming breakfast among children and adolescents has declined in the past 25 years (1965-1991). The study also demonstrates that the association of obesity with less frequent breakfast consumption is rising among obese U.S. teens of 15 through 18 years of age (65).

Among 4,370 German preschool children in 2002, Toshake et al. found that an increased meal frequency was inversely related to the prevalence of childhood obesity using IOTF BMI cut-offs (63). The correlation that our study observed between main meals and BMI

underlines the importance of food intake patterns in the etiology of childhood overweight and obesity. The relationship between breakfast and body weight is less understood. However, this could be explained by the claim that children who do not frequently eat breakfast are consuming more lunch and dinner and are significantly more likely to consume snacks between meals (67). It is an interesting observation that children who skip breakfast usually they was snacking between meals. This could be arguable in our finding of the inverse correlation between BMI and breakfast and could be explained by the behavior of consuming more snacks in school or from canteens near their houses. It has been documented previously that skipping breakfast is associated with overweight and obesity, but the type of food consumed in the breakfast meal is another important issue, which is not examined in our study, and further research should be done to assess the type of food consumed by schoolchildren in Al-Ain city.

Exercises

Exercising is another factor that had been explored in this study. Our finding showed that there were no associations between BMI and exercise, whereas several studies (45, 55, 56) showed that there is an inverse association between BMI and physical activity. In our study, 53% of the boys exercise outside of school, while only 27% of girls do so. However, since this data are self-reported, the actual prevalence of physical activity might be under or over estimated. Further studies should be conducted to assess

the relationship of physical activity and the incidence of overweight and obesity among schoolchildren in Al-Ain.

Watching TV

Our results showed that there was no significant association of child BMI and eating while watching. However, our dataset does not provide the time spent in watching TV and it might be a relationship between watching TV and the occurrence of overweight and obesity among schoolchildren in Al-Ain due to the shift and development of the country that change their lifestyle. Further studies should be done and to collect data on daily hours spent on watching TV on Al-Ain children.

Underweight

After calculating the BMI of schoolchildren in both boys and girls in Al-Ain, we were surprised to find that the prevalence of underweight exceed the prevalence of overweight and obesity when applying both references. The rate of underweight was 17.6% in boys and 14.0% in girls when the CDC reference was applied. About 26.0% boys and 25.6% girls, when using the IOTF cutoffs. Our findings did not show any significant differences between underweight and SES. Parental education and mother employment might not be sufficient to evaluate the socioeconomic status for reasons discussed above that is the relatively homogenous and high income of UAE population.

RECOMMENDATIONS

The improvement of health and well-being is immediate goal of addressing the nutritional status of children and teens in the UAE, particularly in Al-Ain city. As a result of our findings, we make the following recommendations:

1. Our research gave an estimate of overweight and obesity among children. Additional studies should be done to explore and address factors associated with overweight/obesity and should include various variables that were not tested in our studysuch as occupation, income, type of housing, number of servants, type of food, number of hours spent watching TV, type and hours of exercise, BMI of the mothers. Also, studies should include ages 2 to 18 years, which were not covered in our data set. Location is an important aspect such as urban and rural areas in UAE.
2. Both CDC and IOTF references gave us an estimate for the prevalence of underweight, overweight, and obesity among schoolchildren. The IOTF would be more suitable for defining underweight, overweight, and obesity, until UAE health authority develop UAE reference.

3. Our findings indicate that the prevalence of underweight is greater among children in Al-Ain and even more than overweight and obesity when using both methods. Thus, studies should be conducted to monitor the problem and find out reasons that cause undernutrition among children that lives in wealthy region.
4. The lack of epidemiological studies in childhood obesity, prevent scientific researcher from monitoring the trends of overweight and obesity among youth in UAE. National surveillance would be vital and essential to monitor the trends of health related problem.
5. It is important that families and children understand the benefit of healthy living. Thus, school-based programs provide an ideal setting for improving dietary patterns and patterns of physical activity among children. These programs include a nutritious breakfast and lunch, health and nutrition basics as part of the school curriculum, and improving the level of physical activity in schools.
6. Polices are needed to control the occurrence of epidemic problems such as overweight and obesity in UAE by developing a committee for youth services that could initiate the policymaking in the UAE.

APPENDICIES

Table 1
Means and Standard Deviations for demographic and socio-economic variables of Al-Ain Schoolchildren

Variable	n	M	±SD
Age/years	1182	10.8	1.24
Weight (kg)	1182	37.0	12.71
Height (m)	1182	1.4	0.09
Number of Family Members	1182	10.2	3.62
Number of Rooms in the home	1182	5.6	2.52
BMI (kg/m^2)	1182	18.38	4.64

Table 2

Frequencies of Chronic Diseases among Parents of Al-Ain Schoolchildren

Variable	n	%
Mother's History of Chronic Disease		
Obesity		
Yes	79	7.2
No	1,007	91.2
Don't Know	18	1.6
Diabetes		
Yes	91	7.7
No	988	83.6
Don't Know	20	1.7
Hypertension		
Yes	82	6.9
No	992	83.9
Don't Know	23	1.9
Cardiovascular Disease		
Yes	13	1.1
No	1,043	88.2
Don't Know	28	2.4
Father's History of Chronic Disease		
Obesity		
Yes	47	4.0
No	1,007	85.2
Don't Know	36	3.0
Diabetes		
Yes	191	16.2
No	877	74.2
Don't Know	22	1.9
Hypertension		
Yes	124	10.5
No	922	78.0
Don't Know	34	2.9
Cardiovascular Disease		
Yes	65	5.5
No	982	83.1
Don't Know	37	3.1

Table 3
Daily Exercise and Meal Consumption Patterns of Al-Ain Schoolchildren

	Boys		Girls	
Variable	***n***	***%***	***n***	***%***
Exercise†				
Yes	321	52.9	157	27.3
Sometimes	210	34.6	227	39.5
No	75	12.4	187	32.5
Total	*607*	*100*	*575*	*100*
Main Meal/ Day				
Breakfast				
Yes	425	81.9	425	73.9
No	110	18.1	150	26.1
Total	*607*	*100*	*575*	*100*
Lunch				
Yes	588	96.9	550	95.7
No	19	3.1	25	4.3
Total	*607*	*100*	*575*	*100*
Supper				
Yes	578	95.2	541	94.1
No	29	4.8	34	5.9
Total	*607*	*100*	*575*	*100*

* 11 causes missing; ** 8 cases missing; † Daily exercising out of the school

Table 4

Age and Gender Distribution of Al-Ain Schoolchildren

Variable	*n*	*%*
Ages		
8	3	0.3
9	157	13.3
10	320	27.1
11	403	34.1
12	202	17.1
13	66	5.6
14	20	1.7
15	6	0.5
16	5	0.4
Total	*1182*	*100%*
Gender		
Boys	607	48.6
Girls	575	51.4
Total	*1182*	*100%*

Table 5

Socioeconomic Status (SES) of Al-Ain Schoolchildren Family

Variable	*n*	*%*
Father's Education*		
Illiterate	155	13.1
Read and Write	220	18.6
High School Diploma	604	51.1
Higher Education	110	9.3
Mother's Education**		
Illiterate	305	25.8
Read and Write	187	15.8
High School Diploma	555	47.0
Higher Education	54	4.6
Mother's Employment Status**		
Not Working	972	87.1
Working	57	4.8

*93 cases missing; **81 cases missing

Table 6
BMI Categories According to the CDC 2000 Reference by Gender and Age*

CDC-BMI	*Boys*		*Girls*	
	N	%	n[a]	%
Underweight <5th Percentile				
Ages 8 – 9	13	16.9	20	24.4
Age 10	31	20.5	18	10.7
Age 11	33	15.9	34	17.4
Age 12	20	17.9	6	6.7
Age 13	6	15.0	2	7.7
Age 14 - 16	4	21.1	1	8.3
Total	*107*		*81*	
Normal 5th-85th Percentile				
Ages 8 - 9	49	63.6	45	54.9
Age 10	93	61.6	108	63.9
Age 11	117	56.3	113	57.9
Age 12	58	51.8	59	65.6
Age 13	18	45.0	12	46.2
Age 14 - 16	7	36.8	5	41.7
Total	*342*		*342*	
At Risk of Overweight 85th to <95th Percentile				
Ages 8 - 9	7	9.1	6	7.3
Age 10	14	9.3	22	13.0
Age 11	25	12.0	25	12.8
Age 12	16	14.3	13	14.4
Age 13	8	20.0	5	19.2
Age 14 - 16	3	15.8	2	16.7
Total	*73*		*73*	
Overweight ≥ 95th Percentile				
Ages 8 - 9	8	10.4	11	13.4
Age 10	13	8.6	21	12.4
Age 11	33	15.9	23	11.8
Age 12	18	16.1	12	13.3
Age 13	8	20.0	7	26.9
Age 14 - 16	5	26.3	4	33.3
Total	*85*		*78*	

Table 7
BMI Categories According to the IOTF Reference by Gender and Age*

IOTF BMI	*Boys*		*Girls*	
	N	%	n[a]	%
Underweight				
Ages 8 - 9	11	14.3	25	30.5
Age 10	31	20.5	36	21.3
Age 11	52	25.0	48	24.6
Age 12	36	32.1	13	14.4
Age 13	11	27.5	3	11.5
Age 14 - 16	8	42.1	2	16.7
Total	*149*		*127*	
Normal				
Ages 8 - 9	50	64.9	41	50.0
Age 10	79	52.3	88	52.1
Age 11	104	50.0	103	52.8
Age 12	48	42.9	53	58.9
Age 13	17	42.5	12	46.2
Age 14 - 16	8	42.1	6	50.0
Total	*306*		*303*	
Overweight				
Ages 8 - 9	6	7.8	9	11.0
Age 10	25	16.6	31	18.3
Age 11	37	17.8	28	14.4
Age 12	20	17.9	16	17.8
Age 13	5	12.5	5	19.2
Age 14 - 16	2	10.5	-	-
Total	*95*		*89*	
Obesity				
Ages 8 - 9	10	13.0	7	8.5
Age 10	16	10.6	14	8.3
Age 11	15	7.2	16	8.2
Age 12	8	7.1	8	8.9
Age 13	7	17.5	6	23.1
Age 14 - 16	1	5.3	4	33.3
Total	*57*		*55*	

Table 8
Correlation of BMI with Selected Health, Dietary, and diseases Determinants among Girls in Al-Ain schoolchildren

Correlations	*r*	*n*	*p*
BMI x Age	**.287****	**575**	**.000**
BMI x father education	- .016	528	.712
BMI x mother education	.024	539	.585
BMI x mother employment	- .091	508	.041
BMI x father obesity	.065	521	.138
BMI x father diabetes	.097*	544	.023
BMI x father hypertension	.010	536	.816
BMI x father CVD	.030	539	.480
BMI x mother obesity	**.109***	**530**	**.012**
BMI x mother diabetes	**.172***	**459**	**.000**
BMI x mother hypertension	.063	546	.141
BMI x mother CVD	.002	539	.539
BMI x breakfast	**- .176 ****	**575**	**.000**
BMI x lunch	- .046	575	.275
BMI x supper	.024	575	.274
BMI x exercise	- .006	571	.890

*** correlation is significant at the 0.05 level (2-tailed)**
**** correlation is significant at the 0.01 level (2-tailed)**

Table 9
Correlation of BMI with Selected Health, Dietary, and diseases Determinants among Boys in Al-Ain schoolchildren

Correlations	*R*	*n*	*p*
BMI x Age	**.281****	**607**	**.000**
BMI x father education	-.017	561	.683
BMI x mother education	-.028	504	.562
BMI x mother employment	.010	521	.814
BMI x father obesity	.035	569	.400
BMI x father diabetes	-.050	546	.248
BMI x father hypertension	-.024	544	.577
BMI x father CVD	.035	545	.410
BMI x mother obesity	.084*	574	.045
BMI x mother diabetes	-.039	550	.366
BMI x mother hypertension	-.011	551	.795
BMI x mother CVD	-.035	545	.420
BMI x breakfast	**-.174 ****	**607**	**.000**
BMI x lunch	-.077	607	.059
BMI x supper	-.007	607	.857
BMI x exercise	-.037	606	.361

*** correlation is significant at the 0.05 level (2-tailed)**
**** correlation is significant at the 0.01 level (2-tailed)**

Table 10
IOTF BMI Cut-off Points for Overweight and Obesity by Gender between 2 and 18 years of Age*

	Overweight		Obese	
	Body mass index 25 kg/m²		Body mass index 30 kg/m²	
Age (years)	Males	Females	Males	Females
2	18.4	18.0	20.1	20.1
2.5	18.1	17.8	19.8	19.5
3	17.9	17.6	19.6	19.4
3.5	17.7	17.4	19.4	19.2
4	17.6	17.3	19.3	19.1
4.5	17.5	17.2	19.3	19.1
5	17.4	17.1	19.3	19.2
5.5	17.5	17.2	19.5	19.3
6	17.6	17.3	19.8	19.7
6.5	17.7	17.5	20.2	20.1
7	17.9	17.8	20.6	20.5
7.5	18.2	18.0	21.1	21.0
8	18.4	18.3	21.6	21.6
8.5	18.8	18.7	22.2	22.2
9	19.1	19.1	22.8	22.8
9.5	19.5	19.5	23.4	23.5
10	19.8	19.9	24.0	24.1
10.5	20.2	20.3	24.6	24.8
11	20.6	20.7	25.1	25.4
11.5	20.9	21.2	25.6	26.1
12	21.2	21.7	26.0	26.7
12.5	21.6	22.1	26.4	27.2
13	21.9	22.6	26.8	27.8
13.5	22.3	23.0	27.2	28.2
14	22.6	23.3	27.6	28.6
14.5	23.0	23.7	28.0	28.9
15	23.3	23.9	28.3	29.1
15.5	23.6	24.2	28.6	29.3
16	23.9	24.4	28.9	29.4
16.5	24.2	24.5	29.1	29.6
17	24.5	24.7	29.4	29.7
17.5	24.7	24.8	29.7	29.8
18	25	25	30	30

* From Cole et al. 2000 (29)

Table11
IOTF BMI Cut-off Points for Thinness by Gender between 2 and 18 years of Age*

Underweight

	Boys			Girls		
Age (years)	16	17	18.5	16	17	18.5
2.0	13.37	14.12	15.14	13.24	13.90	14.83
2.5	13.22	13.94	14.92	13.10	13.74	14.63
3.0	13.09	13.79	14.74	12.98	13.60	14.47
3.5	12.97	13.64	14.57	12.86	13.47	14.32
4.0	12.86	13.52	14.43	12.73	13.34	14.19
4.5	12.76	13.41	14.31	12.61	13.21	14.06
5.0	12.66	13.31	14.21	12.50	13.09	13.94
5.5	12.58	13.22	14.13	12.40	12.99	13.86
6.0	12.50	13.15	14.07	12.32	12.93	13.82
6.5	12.45	13.10	14.04	12.28	12.90	13.82
7.0	12.42	13.08	14.04	12.26	12.91	13.86
7.5	12.41	13.09	14.08	12.27	12.95	13.93
8.0	12.42	13.11	14.15	12.31	13.00	14.02
8.5	12.45	13.17	14.24	12.37	13.08	14.14
9.0	12.50	13.24	14.35	12.44	13.18	14.28
9.5	12.57	13.34	14.49	12.53	13.29	14.43
10.0	12.66	13.45	14.64	12.64	13.43	14.61
10.5	12.77	13.58	14.80	12.78	13.59	14.81
11.0	12.89	13.72	14.97	12.95	13.79	15.05
11.5	13.03	13.87	15.16	13.15	14.01	15.32
12.0	13.18	14.05	15.35	13.39	14.28	15.62
12.5	13.37	14.25	15.58	13.65	14.56	15.93
13.0	13.59	14.48	15.84	13.92	14.85	16.26
13.5	13.83	14.74	16.12	14.20	15.14	16.57
14.0	14.09	15.01	16.41	14.48	15.43	16.88
14.5	14.35	15.28	16.69	14.75	15.72	17.18
15.0	14.60	15.55	16.98	15.01	15.98	17.45
15.5	14.86	15.82	17.26	15.25	16.22	17.69
16.0	15.12	16.08	17.54	15.46	16.44	17.91
16.5	15.36	16.34	17.80	15.63	16.62	18.09
17.0	15.60	16.58	18.05	15.78	16.77	18.25
17.5	15.81	16.80	18.28	15.90	16.89	18.38
18.0	16.00	17.00	18.50	16.00	17.00	18.50

* From Cole et al. 2007 (58)

Table 12
Distribution of CDC 2000 BMI cut offs for Boys between 8 to 16 years of age.

Age (Yeas)	*Overweight (>95th)*	*Risk of Overweight (95th- 85th)*	*Underweight (<5th)*
8	>20	18 – 20	<13.8
9	>21	18.6 – 21	<14
10	>22.1	19.4 – 22.1	<14.2
11	>23.2	20.2 – 23.2	<14.5
12	>24.2	21 – 24.2	<15
13	>25.1	21.8 – 25.1	<15.4
14	>26	22.6 – 26	<16
15	>26.8	23.4 – 26.8	<16.5
16	>27.5	24.2 – 27.5	<17.1

Table 13
Distribution of CDC 2000 BMI cut offs for Boys between 8 to 16 years of age.

Age (Year)	*Overweight (>95th)*	*Risk of Overweight (95th- 85th)*	*Underweight (<5th)*
8	>20.6	18.3 – 20.6	<13.6
9	>21.8	19.1 – 21.8	<13.8
10	>22.9	19.9 – 22.9	<14
11	>24.1	20.8 – 24.1	<14.4
12	>25.2	21.7 – 25.2	<14.8
13	>26.2	22.5 – 26.2	<15.3
14	>27.2	23.3 – 27.2	<15.8
15	>28.1	24 – 28.1	<16.3
16	>28.9	24.8 – 28.9	<16.8

Table 14
The Prevalence of Overweight, Obesity, Underweight by School Locations among Boys 8-16 years of Age

School locations	*Percentages*
Tawam School	
overweight	29.5%
obesity	20.7%
underweight	15.0%
Alyhar North School	
overweight	18.2%
obesity	20.7%
underweight	21.4%
Omer Bin Alkhattab School	
overweight	23.9 %
obesity	17.2%
underweight	24.5%
Othman Bin Afan School	
overweight	12.5%
obesity	20.7%
underweight	22.0%
Bin Khaldoon School	
overweight	15.9%
obesity	20.7%
underweight	17.0%

Table 15
The Prevalence of Overweight, Obesity, Underweight by School Locations among Girls 8-16 years of Age

School locations	*Percentages*
Al-Essra School	
overweight	25.7%
obesity	21.6%
underweight	15.0%
Amena Bint Wahab School	
overweight	**22.8%**
obesity	**28.4%**
underweight	23.1%
Mezeed School	
overweight	10.9 %
obesity	4.1%
underweight	**36.7%**
Gryah School	
overweight	30.7%
obesity	16.2%
underweight	12.9%
Makkah School	
overweight	9.9%
obesity	29.7%
underweight	12.2%

Table 16
The Percentages of Underweight by SES among Boys in Al-Ain

SES variables	*Underweight*
Mother education	
Illiterate	43.8%
High diploma	56.3%
Father education	
Illiterate	35.2%
High diploma	33%
Mother employment status	
Employed	21.7%
Not employed	35.7%

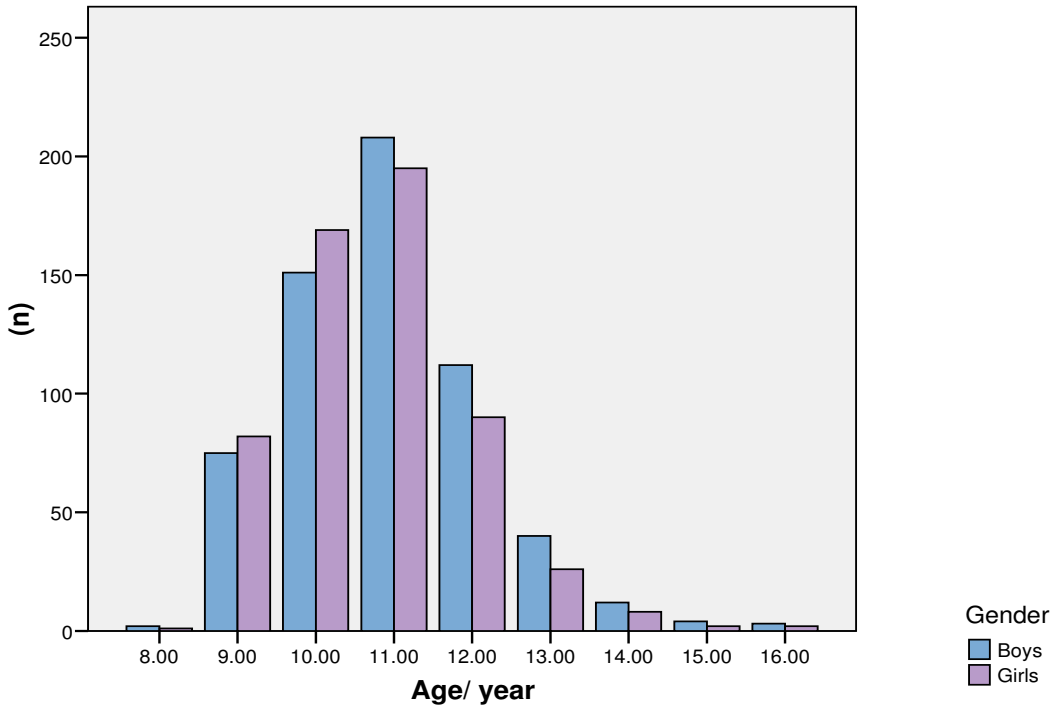
Table 17
The Percentages of Underweight by SES among Boys in Al-Ain

SES variables	*Underweight*
Mother education	
Illiterate	31.5%
High diploma	68.5%
Father education	
Illiterate	35%
High diploma	37%
Mother employment status	
Employed	38%
Not employed	37.8%

Table 18
Comparisons of overweight and obesity Percentages using the CDC and the IOTF cut-offs among Al-Ain schoolchildren**.**

Cut-offs	***Overweight %***	***Obesity %***
CDC		
Boys	12.0	14.0
Girls	12.7	13.6
IOTF		
Boys	14.5	9.6
Girls	17.6	12.9

Figure 1
Age Distribution for Al-Ain Schoolchildren Sample.



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