Chapter 8
Prevalence and Etiology: Middle East and North Africa (MENA) Countries

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Introduction

The increasing prevalence of obesity at an alarming rate in many parts of the world probably has multiple underlying etiologies. Obesity is generally attributed to a combination of genetic and/or environmental factors. In children, genetic, prenatal and perinatal factors have a great effect on individual predisposition, practices and behaviors, contributing to a long-term positive energy balance.

Risk Profile in Developing Countries

It is clear that obesity does not discriminate between geographical location, economic level, sex and age. Emerging data from developing countries indicate that the prevalence of obesity among children and adolescents is escalating more rapidly today than in industrialized countries. This pattern appears to mimic what occurred in the USA between 1980 and 2007 where the percentage of overweight children age 6–11 years more than doubled from 7 to over 15%, while the percentage of overweight adolescents age 12–19 years tripled in the same period from 5 to 15% (Kelishadi 2007; Kuczmarski et al. 2000). In the 1990s, this emerging pattern in developing countries has been largely ignored in health strategies developed at national and international levels (WHO, Geneva 1997) but nowadays research interest and studies in this area are rapidly expanding (http://www.ucsfhealth.org).

The prevalence of chronic or non-communicable disease (NCD) is also increasing more rapidly in developing countries than industrialized countries (Kelishadi 2006), where according to the World Health Organization (WHO) estimates, by 2020, approximately three-quarters of all death in the developing countries will be related to NCD (Onis 2004). Obesity and/or overweight are major risk factors for chronic diseases and play a central role in the "insulin resistance" or "metabolic syndrome", which includes hyperinsulinemia, hypertension, and hyperlipidemia and type-2 diabetes mellitus. It also correlates strongly with increased risk of atherosclerotic cardiovascular disease (Kelishadi 2007;

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Papandreou et al. 2008), stroke, sleep apnoea syndrome (Papandreou et al. 2008), and some forms of cancer (Kelishadi 2006; Papandreou et al. 2008; WHO Geneva 1997; WHO Europe 2005, 2007).

However, little is known about the prevalence of childhood obesity and the pediatric metabolic syndrome in the developing countries because of the limited number of studies (Kelishadi 2007; Papandreou et al. 2008), the variety of definitions and cut-offs used, and the different age groups studied which makes comparisons difficult (Kelishadi 2007). In summary, the rapid progress of urbanization and demographic trends in developing countries is associated with a cluster of NCD and unhealthy lifestyle described as "Lifestyle Syndrome" (Monteiro et al. 2002, 2004). Among developing countries, the prevalence of childhood obesity is highest in the Middle East and Central and Eastern Europe (James 2004).

Overweight Standards

There is no universal consensus on a cut-off point for defining overweight or obesity in children and adolescents; for example, the 85th percentile for children in the US corresponds to the 95th percentile for Brazilian children and the 90th percentile for British children (Abdulbari 2006). Usually, clinical and epidemiological studies are assessed by indicators based on weight and height, such as body mass index (BMI) defined as weight (kg)/height (m^2) (http://www.ucsf-health.org).

For children and teens, BMI ranges are defined so that they can take into account normal differences in body composition related to sex and age. Additionally, these ranges above a normal weight have different labels, for example: "at risk of overweight" and "overweight" (Kelishadi 2007).

In general, overweight and obesity status were defined in the literature by using the following three sets of criteria, all of which were used in studies of childhood obesity in the Middle East North Africa (MENA) region:

- First, the US Centers for Disease Control and Prevention (CDC) defines "overweight" as being at or above the 95th percentile of BMI for age, and "at risk of overweight" as being between the 85th and 95th percentiles of BMI for age (Kuczmarski et al. 2000). US population statistics were used to derive the CDC cut-off values (http://www.cdc.gov/nccdphp/dnpa/obesity/childhood).
- Second, the European Childhood Obesity Group classifies "overweight" as being at or above the 85th percentile of BMI and "obesity" as being at or above the 95th percentile of BMI (Flodmark et al. 2004). European population was used to derive these cut-offs values.
- Finally, the International Obesity Task Force (IOTF), in their definition, used cut-off points of 25 kg/m^2 for adult overweight and 30 kg/m^2 for adult obesity. These cut-off points are based on pooled international data in contrast to the other two definitions given above (Cole et al. 2000).

However, BMI cannot distinguish fat mass from muscle mass, nor can it represent the fat distribution; hence, it may not be the only measure to predict NCD (American Academy of Pediatrics Policy Statement 2003). Though there is no universal cut-off for waist circumference some studies used waist circumference above 75th percentile for age and sex to define abdominal obesity (Katzmarzyk et al. 2004; Moreno et al. 2002).

Risk Profile in the MENA Region

The risk profile in the MENA region appears to be similar to the general risk profile for obesity in developing countries. In the last decades, the Eastern Mediterranean Region (EMR) experienced

a transition from a traditional to a westernized lifestyle accompanied by a similarly rapid epidemiologic transition (Kelishadi 2006). The Middle East, located in this region, has the highest dietary energy surplus of the developing countries (Kelishadi 2006, 2007) as they transition in that direction with large shifts in dietary and physical activity patterns (Abdulbari 2006; Gittelsohn and Kumar 2007; James 2004; Kelishadi 2006, 2007; Lafta et al. 2007; Lasserre et al. 2007; Marsh et al. 2007; Mokhtar et al. 2001; WHO Europe 2005, 2007). As a result, a rise in NCD risk factors is occurring in different age groups (Kelishadi 2006) especially among adolescents (Kelishadi 2007).

Based on the secular trends observed in different countries, it is estimated that by 2010 approximately 41% of children in the EMR (compared to 38% in the European region, 27% in the Western Pacific region and 22% in the Southeast Asian region) will be overweight or obese. In other words, it is estimated that during the next 3–4 years, approximately 1/10 children in the Eastern Mediterranean will be obese; compared to 1/7 for American children (Wang and Lobstein 2006). In Iran, the prevalence of childhood obesity and overweight is reported to be lower than in Arabic countries of the EMR (Kelishadi 2006). Concurrently, many developing countries especially in the MENA region are still grappling with the public health effects of malnutrition and micronutrient deficiencies (Kelishadi 2006; Mokhtar et al. 2001).

Through a qualitative and quantitative systematic review, the present chapter compares and analyzes the results of published research studies on the prevalence of overweight and obesity among children and adolescents living in MENA region. We will use a meta-analysis approach to integrate findings across these publications. We will attempt to outline the factors (geographical, environmental, economic, sex and age) that act separately or jointly as best predictors of the variation of obesity prevalence and etiology in the MENA region.

Geographic Area

The term MENA, for "Middle East and North Africa" covers an extensive region extending from Iran in southwest Asia to Morocco in northwest Africa. It generally includes all the Arab Middle East and North Africa countries, as well as Iran and Israel but not Turkey. The countries of the MENA region can be grouped into three sub-regions (Whitaker and Dietz 1998).

Near East

The Near East is also known as Levant. This sub-region includes: Lebanon, Syria, Palestine, Israel and Jordan but excludes Turkey (http://icf.at/?id=6174).

Gulf Region and Arabian Peninsula

This sub-region includes all the six countries of the Gulf Cooperation Council (GCC): Saudi Arabia, United Arab Emirates (UAE), Kuwait, Bahrain, Qatar and Oman, plus three of their neighbors: Yemen, Iraq and Iran (http://icf.at/?id=6174).

North Africa

This sub-region covers four of the five Maghreb countries (Tunisia, Morocco, Libya, and Algeria) plus Egypt and Sudan (http://icf.at/?id=6174).

Socio-demographic and Economic Characteristics

The MENA region spans an area of 14.8 million km^2, roughly one-tenth of the earth's land surface. It is comprised of 20 countries (Whitaker and Dietz 1998) inhabited by slightly more than 300 million people (WDI, World Bank, 2008). It is the least populated developing region in the world (5% proportion of world population in 2001) with 36.4% below the age of 15 (Levin and Govek 1998). The population of the MENA region comprises 6% of the total world population and is equivalent in number to one third of the population of China Republic, almost equivalent to the population of the European Union, and is one and a quarter times larger than the population of the United States (Whitaker and Dietz 1998). However, the region has the second-highest population growth rate with a 2.2% annual average growth rate between 1990 and 2001, second only to Sub-Saharan Africa (WDI, World Bank 2008). The crude birth rate and the crude death rate in 2006 were 25 and 6‰, respectively (http://www.dcp2.org/pubs/GBD). Infant mortality and under-five mortality rates have declined in recent years and are below the averages for the developing world. Life expectancy at birth in the MENA region in 2006 was 70 years, which is above the developing world average (WDI, World Bank 2008).

The socio-demographic and economic characteristics of the MENA region are summarized in Table 8.1 below.

While rates of extreme poverty in MENA are low, these rates have slightly increased since 1990. Purchasing power parity (Gross National Income (GNI) per capita) was $6,710 in 2006 (WDI, World Bank 2008). Economic growth in the MENA region was the lowest among developing regions in 2006 at 5.1% (WDI, World Bank 2008). The top performers in the region in 2006 were Morocco (8% growth) and Egypt (6.8% growth). But Iran, which accounted for 20% of the region output, grew at 4.6% and Algeria, which accounted for 16% of the region's output, grew by only

Table 8.1 Summary of socio-demographic and economic characteristics

Area	14.8 million km^2
Number of countries	20 countries
Population (in 2008)	>300 million (6% of world population)
Population below the age of 15	36.4%
Growth rate	2.2%
Life expectancy at birth (in 2006)	70 years
Crude birth rate (in 2006)	25 ‰
Crude death rate (in 2006)	6 ‰
Infant mortality and under 5 mortality	Below the averages of the developing world
Mildly underweight	35%
Moderately to severe underweight	21%
Purchasing power parity (in 2006) (Growth National Income (GNI) per capita)	6,710$
Economic growth (in 2006)	5.1%
Sources of economic stability	70% of the world's oil reserves and 46% of the world's natural gas reserves

3% (WDI, World Bank 2008). The MENA region has vast reserves of petroleum (70% of the world's oil reserves) and natural gas (46% of the world's natural gas reserves) that makes it a vital source of global economic stability (Whitaker and Dietz 1998). As of 2007, eight of the twelve OPEC nations are within the MENA region (Whitaker and Dietz 1998).

Methods

A quantitative and qualitative systematic review on the prevalence of overweight and obesity, among children and adolescents living in the MENA region was carried out through an electronic search of the literature from 1996 to 2008 (Medline, PubMed, Google scholar and WHO). Only two reference articles published prior to 1996 were used.

The criteria for inclusion of the studies were

1. Publication in English language
2. Publication date between late 1990s and 2008
3. Study location inside the MENA region
4. Focus on children and adolescents of MENA countries (few studies included adults as well)

The keywords used in this review were "children," "adolescents." "youth," "non communicable diseases," "obesity," "overweight," "BMI," "body composition," "anthropometric measures," "body circumference," "dietary intake," "prevention," "WHO-MENA," "developing countries," "low and middle income countries" "Middle East countries", "North African countries" as well as the names of individual countries.

We identified 51 articles published since 1996. Five studies were in males only (2 children, 2 adolescents and 1 university students), 10 were in females only (6 adolescents and 4 adults) and 36 used mixed sex (10 children, 11 adolescents, 2 children and adolescents, 6 adults, 2 university students and 5 all the population of the country). The articles used in this meta-analysis covered 13 of the 20 countries in the MENA region distributed as follows: 4 in Lebanon, 1 in Syria, 2 in Bahrain, 1 in Iraq, 3 in Kuwait, 11 in Iran, 3 in Qatar, 4 in Saudi Arabia, 2 in UAE, 1 in Northern Africa, 6 in Tunis, 3 in Morocco, 5 in Egypt, 1 in Egypt/Lebanon/Kuwait and 5 in Israel.

A descriptive summary of these studies is provided by the three sub-regions: Near East, Gulf and North Africa in Tables 8.2–8.4, respectively. One study was done in three countries one from each of the three sub-regions is summarized separately in Table 8.5.

The summarized data was supplemented by WHO surveys and reports documenting prevalence and association with demographic, environmental, socio-economic and psychological problems among children and adolescents living in this region. For many parameters, data for the entire MENA region does not exist, and therefore, published data from a number of member countries was integrated in this systematic search.

Prevalence of Overweight and Obesity

The data in Tables 8.2–8.4 are sorted by country within the three main sub-regions of MENA (Near East, Gulf and Arabian peninsula, and North Africa). The first author, year of publication, sample size, key obesity-related parameters and summary of results are presented. The data in Table 8.5 are the summary of two studies comparing the prevalence of overweight and obesity between Egypt and other countries. The first study compared the prevalence between Egypt and Mexico. The second study compared the prevalence between three countries of the MENA region, each from a different sub-region: Egypt (North Africa), Lebanon (Near East) and Kuwait (Gulf and Arabian Peninsula).

Table 8.2 Profile of (childhood) obesity (Ob), overweight (Ow) and underweight (Uw) in countries of the Near East sub-region

Country	Study (no. of subjects)	Age (years)	Prevalence % (obesity, overweight and underweight)	Variables	Outcomes
Lebanon	Sibai et al. (2003) (2,104)	≥3	▪ 3–19 years: Boys: Ob 7.5; Ow 22.5 Girls: Ob 3.2; Ow 16.1 ▪ ≥20 years: Males: Ob 14.3; Ow 57.7 Females: Ob 18.8; Ow 49.4 (WHO criteria)	– BMI – Body fat – Waist circumference	– All variables increased to mid age (40–60 years) and declined thereafter – Significant association between no exercise and children obesity – Adult obesity higher among least educated, family history of obesity and non-smokers – Ob and Ow higher in males, except in females ≥20 years
Lebanon	Jabre et al. (2005) (234)	6–8	Boys: Ob 7.0; Ow 26.0 Girls: Ob 6.0; Ow 25.0 (IOTF criteria)	– Age/sex – Household and family size – Single/2 parent family – Parental education and work – Physical activity – Dietary intake	– High proportion of Ow in 6–8-year-old children in Beirut – Reduced physical activity is the most significant factor associated with childhood overweight
Lebanon	Chakar and Salameh (2006) (12,299)	10–18	Boys / Girls / Total Non-Ob: 61.1 / 76.8 / 68.1 At risk: 28.8 / 19.0 / 24.4 Ob: 10.1 / 4.2 / 7.5 (CDC criteria)	– BMI	– Ob is 2.5 times higher in boys – Risk and prevalence of Ob lower with age in girls but not in boys – Risk of Ob and prevalence of Ob in Lebanese adolescents of private schools are high
Lebanon	Yahia et al. (2008) (220)	20 ± 1.9	Males: Ob 12.5; Ow 37.5; Uw 1.0 Females: Ob 3.2; Ow 13.6; Uw 6.4 (NIH guidelines)	– Age – Weight – Height – BMI – % Body fat – Meal frequency – Dietary intake	– 64.7% of students are normal weight – Females have healthier eating habits: Daily breakfast intake and meal frequency – Intake of colored vegetables and fruits is common among students

Syria "Aleppo"	Maziak et al. (2007) (2,038)	18–65	Males: Ob 28.8 Females: Ob 46.4 Total: Ob 38.2 (WHO criteria)	– Weight – Height – BMI – Blood pressure (BP) – CVD (physician-diagnosed) – Mortality due to CVD in the past 5 years – Smoking (cigarettes or water pipes)	– Prevalence of CVD: 4.8% – CVD mortality 45% of overall in the past 5 years – 49% of CVD deaths before age 65 years, more males than females – Hypertension: 40.6% (47.7% males, 34.9% females) – Smoking: 38.7% (63.6% males, 19.2% females) – Main CVD risk factors: Older age, male sex and low education
Israel, "Jews and Arabs"	Keinan-Boker et al. (2005) (3,246)	25–64	▪ 55–64 years: Males: Ob 22.4 Females: Ob 40.4 ▪ Females education level: Jewish (academic): Ob 13.6 Arab (basic): Ob 57.3 (WHO criteria)	– Weight and height – BMI – Age – Origin – Education level	– High Ob rates (comparable to those in USA), especially among older Arab women (55–64 years) – Ob is more prevalent in females – Ob increased with age – Significant risk factors for Ob: in males: Age in females: age, education, origin – Education level is negatively associated with Ob
Israel	Bar Dayan et al. (2005) (76,732)	17	Males: Ob 4.1 Ow 12.4 Females: Ob 3.3 Ow 11.4 (Criteria used: Low weight <18 kg/m^2 Normal weight 18–25 kg/m^2 Overweight 25–30 kg/m^2 Obesity 30–40 kg/m^2 Morbidly obese >40 kg/m^2)	– Weight and height – Education level – NCD (hypertension, diabetes type 2)	– Low prevalence of Ob but an alarming high prevalence of Ow – Ob is correlated with high prevalence of hypertension, diabetes type 2 and lower education level – A significant difference between sexes in the hypertension and diabetes type 2 prevalence
Israel	Kaluski and Berry (2005) (2,782)	25–64	Total: Ob 22.9 Ow 39.3 (WHO criteria)		– Ow is more common in males – Ob is more prevalent in females – Israeli Arab population is more obese than Jewish one
Israel	Israeli et al. (2006) (560,588)	16.5–19	Males: Ob 3.3 Ow 10.9 Females: Ob 3.2 Ow 11.1 (Ow defined as BMI 25 to ≤30, Ob defined as BMI >30)	– BMI – Systolic blood pressure (SBP) – Diastolic blood pressure (DBP)	– BMI doesn't increase with age – Prevalence of prehypertension is higher in obese subjects – A significant increase in the mean SBP and DBP with age and BMI – Prehypertension is very common among Israeli adolescents

Table 8.3 Profile of (childhood) obesity (Ob), overweight (Ow) and underweight (Uw) in countries of the Gulf and Arabian Peninsula sub-region

Country	Study (no of subjects)	Age (years)	Prevalence % (obesity, overweight and underweight)	Variables	Outcomes
Bahrain	Hamadeh (2000) (61.2% of 620,378)	Bahraini population	(WHO criteria)	– BMI – Physical activity – Daily fruits and vegetables intake	– Prevalence of Ob higher among females in all age groups – Ow is higher among males – Age group 30–79: males are more engaged in PA males and females similar in daily intake of fruits and vegetables
Bahrain	Al-Sendi et al. (2003) (506)	12–17	Males: Ob 21.0 Females: Ob 35.0 (WHO criteria) Males: Ob 15.0 Females: Ob 18.0 (IOTF criteria Must et al. 1991)	– Age – Weight, height – Triceps and subscapular skinfolds	– Higher prevalence in adolescent obesity than was previously reported, especially in girls – Must et al. (1991) and IOTF criteria (Cole et al. 2000) BMI reference values are more practical for use in adolescents surveys than the WHO criteria
Iraq, "Baghdad"	Lafta et al. (2007) (5,361)	7–13	Ob: 4.1 Ow: 12.4 (ITOF criteria)	– Age/sex – BMI – Parental obesity – Physical activity – Watching TV – Eating while watching TV	– Obesity increases with age: a significant linear correlation – Ob and Ow higher in girls – Risk factors: sex, physical activity, parental obesity and family size – Most children watch TV daily and 60% eat while watching
Kuwait	Al-Isa and Moussa (1999) (3,473)	3–5	(NCHS/CDC references)	– Age and birth order – Weight and height – Parental education and work – Family income – Number of servants – Eating habits – Grandparents and number of persons living at home – Number of siblings – SES – Dental status	– Ow and Ob associated with: age, birth order, sex, parents education, region, dental status, eating regular meals and SES – In males, factors are: age, region, eating regular meals, no. of person living at home and SES – In females, factors are: dental status, governorate, number of servants and SES

Kuwait	Moussa et al. (1999) (460 obese)	6–13	(NCHS reference)	– Biochemical variables: serum lipids, lipoproteins, apolipoproteins, insulin – Blood pressure	– Obese children have abnormal biochemical variables and BP – Obesity associated with family history of obesity, diabetes, respiratory and bone diseases – Physical activity and parental social class are not significant
Kuwait	Al-Isa (2004) (14,659)	10–14	Males: Ob 14.7 Ow 30.0 Females: Ob 13.1 Ow 31.8 (NCHS criteria)	– Weight – Height	– No change pattern with age in Ow and Ob in both sexes – Ow was lower in males but Ob was higher compared to females
Iran, "Kerman"	Janghorbani and Parvin (1998) (1,000)	14–21	Girls: very Uw 1.6 Uw 54.6 (Grade 1) Ow 4.6 (Grade 2) Ow 0.7 (Grade 3) Ow 0.0	– Weight, height, BMI – Chest, waist, abdomen, hip and thigh circumference – Criteria used: very Uw <15 Uw 15–19.9 Desirable weight 20–24.9 (Grade 1) Ow 25–29.9 (Grade 2) Ow 30–39.9 (Grade3) Ow ≥40	– Low prevalence of Ow among Iranian young women – Mean BMI: 19.8 – Mean WHR: 0.8 – Mean abdomen-to-hip ratio: 0.8 – Mean chest-to-hip ratio: 0.9
Iran, "Tehran"	Azizi et al. (2001) (421)	10–19	Boys: Ob 5.1 Ow 10.7 Girls: Ob 2.8 Ow 18.4 (BMI cut-offs values for adolescents)	– Total energy intake (TEI) – % of energy derived from protein, carbohydrate and fat – % of energy supplied by each meal and snack	– Diet not different between Ow/Ob and normal weight – In boys: BMI linked to TEI and daily energy distribution – In girls: BMI linked to daily energy distribution only
Iran, "Isfahan"	Kelishadi et al. (2001) (4,500)	2–18	In 1993: Ob 0.2 Ow 4.0 In 1999: Ob 0.35 Ow 8.0	– Serum lipid levels – High density lipoprotein cholesterol (HDL) – Blood pressure – BMI	– Prevalence of obesity is low – Twofold rise in Ow in 5 years, especially in school-aged and adolescent girls – Serum lipid levels higher than standard in both sexes and in all age groups (1993, 1999) – HDL lower than standard – No cases of diabetes mellitus – No difference in hypertension

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Table 8.3 (continued)

Country	Study (no of subjects)	Age (years)	Prevalence % (obesity, overweight and underweight)	Variables	Outcomes
Iran, "Isfahan"	Kelishadi et al. (2003) (2,000)	11–18	Boys: Ob 1.9 Ow 7.4 Girls: Ob 2.9 Ow 10.7 Mean BMI: Urban areas 25.4 Rural areas 23.2 (CDC critera)	– BMI – Physical activity (PA) – Family income – Area of residency – Mother education – Mean total energy intake – Watching TV – Serum lipid levels – Blood pressure	– Ob and Ow higher in girls – Mean BMI is different between rural and urban areas – BMI >85th percentile higher in families with average income and less-educated mothers – Similar mean total energy intake for normal, Ow and Ob – Regular PA is low – Time watching TV is high – BMI: Significant linear association with freq of rice, bread, fast foods, pasta and fat/salty snacks – BMI: Significant correlation with triglyceride, HDL and SBP
Iran, "Tabriz"	Gargari et al. (2004) (1,518)	14–20 Girls only	NHANES I, IOTF Uw 8.0 --- Ob 3.6, 3.9 Ow 11.1, 10.1 Total (Ob and Ow): 14.6, 14	– BMI	– Ob, Ow and Uw are present – Prevalence of Ob and Ow in Tabriz high-school girls higher than in many parts of Iran, but lower than in some neighboring countries such as Saudi Arabia
Iran, "Tehran"	Mohammadpour-Ahranjani et al. (2004) (2,321)	11–16	Total: Ob 7.8 Ow 21.1 Boys: Ow 18.8 Girls: Ow 23.1 (NCHS/CDC)	– Weight, height – BMI	– Ow higher among girls – Risk of Ob is not associated with age for both sexes – Mean BMI higher than in early 1990s in Tehrani adolescents especially among girls
Iran	Kolahdooz et al. (2004) (16,418)	<3	Not reported	– Dietary intake (type and daily/weekly frequency) – Area of residency	– Snacks is the major component of children's diet – Snacks from natural products replaced with industrial and processed products due to industrialization, increased media coverage and lifestyle changes
Iran	Sheikholeslam et al. (2004) (review of 3 national surveys in 1995, 1999 and 2002)	40–69 years	Males: Ob and Ow 50.0 Females: Ob and Ow 66.0	– NCD (CVD, hypertension, diabetes, hyperlipedimia) – Dietary intake – PA	– Fat and CHO are 30 and 40% more than recommended respectively – 80 to 90% of edible oils are hydrogenated – Mean trans fatty acid intake (15.6 to 30 g/day) much higher than recommended amount (<5 g/day) – 70 to 80% are inactive – NCD is a public health problem

Iran, "Islamshahr"	Soutoudeh et al. (2005) (1,003)	10–65 Women only	▪ Adolescent females: Ow (or at risk) 19.0 ▪ Adult females: Ob or Ow 66.8 (IOTF criteria)	– BMI – WHR – Marital status – Occupation – Literacy – Parity – Daily meal and snack consumption	– Highest OW % was in 50–59 years – Ob and Ow are similar in urban and rural areas – Central obesity (WHR ≥85th) is 35.7% in all females – BMI higher in married women and those with <8 years education – WHR higher in women with <8 years of education or >6 parity – Mean BMI and WHR higher in with no daily snack consumption
Iran	Kelishadi et al. (2007) (211,111)	6–18	(CDC criteria)	– BMI – Physical activity – Dietary pattern – Parental education – Parental occupation – History of breastfeeding – History of family obesity and chronic diseases – Birth weight	– PA is higher among boys, in rural than urban, and in intermediate than high school students – PA significantly related to frequency of consumption of all food groups – BMI inversely associated with: frequency of consumption of vegetables and plant proteins (boys) and dairy products, fruits and high PA (girls) – OW significantly related with: boys: low fruit consumption, time spent on PA and energy spent girls: time spent on PA and energy spent
Iran	Kelishadi et al. (2008) (89,532)	>15	Total: Morbid Ob 3.4 Ob 10.8 Ow 28.6 BMI ≥25 kg/m²: Males: 37.0 Females: 48.0 Urban: 46.7 Rural: 35.5 (WHO criteria)	– BMI – Abdominal obesity – Area of residency	– Abdominal Ob prevalence: Males: 9.7 Females: 43.4 Urban: 28.5 Rural: 23.0 – Ow, Ob and abdominal Ob are more prevalent in 45–64 years group
Qatar	Abdulbari et al. (2006) (593)	14–19	Boys: Ow 33.1 (IOTF criteria)	– BMI – Educational level – Living condition – Family size – Frequent dieting	– Extreme dieters: 10.1% – Intermediate dieters: 37.4% – Among the dieters: 34% are Ow – Extreme dieters: more psychological and sleeping problems, always tired and felt like crying – TV (61.7%) is the main source of information on diet

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Table 8.3 (continued)

Country	Study (no of subjects)	Age (years)	Prevalence % (obesity, overweight and underweight)	Variables	Outcomes
Qatar	Abdulbari (2006) (3,923)	12–17	Boys: Ob 7.9 Ow 28.6 Uw 8.6 Girls: Ob 4.7 Ow 18.9 Uw 5.8 (IOTF criteria for obesity and overweight) (CDC criteria for underweight)	– BMI – Parental education – Type of house – No of rooms/house	– Qatari adolescents are at high risk for Ow and Ob – Uw prevalence is highest at 16 years boys: 10.5% and 17 years girls: 8.9% – Ob prevalence is highest at 12 years boys: 11.7% and 13 years girls: 6.4% – The 95th percentile curve is above the IOTF standard curve for boys and below it for girls
Qatar	Abdulbari and Ihab (2006) (566)	14–19	▪ Adolescent females: Ob 1.8 Ow 13.4 ▪ Adult Qatari population: Males: Ob 34.6 Ow 34.4 Females: Ob 45.3 Ow 33.0	– BMI – Hypertension – Smoking status – PA – Medical conditions – Family medical history – Dietary patterns – Living condition – Education level – Frequent dieting – Source of diet information – Psychological factors	– Adolescent female dieters: 39.9% are intermediate and 8.3% are extreme – Dieting is not associated with age but with BMI – Extreme dieting is strongly associated with peer perception and self perception of figure – Diet education sources: TV, magazine and radio – Main source of information for the extreme dieters: TV (43.6%)
Saudi Arabia	Al-Nuaim et al. (1996) (9,061)	6–18	Boys: Ob 15.8 Ow 11.7 (NCHS/CDC standard values)	– Age – Weight and height – BMI – Socio-demographic characteristics – Location of school	– A significant regional variation of Ow and Ob distribution: the highest in Riyadh (18%) and the lowest in Sabea (11.1%) – A high prevalence of childhood Ob is found when compared to NCHS/CDC

Saudi Arabia	El-Hazmi and Warsy (2002) (12,701)	1–18	Boys: Ob 6.0 Ow 10.7 Girls: Ob 6.74 Ow 12.7 (IOTF criteria)	– BMI	– Ow increase with age – Ob: the maximum prevalence for both boys and girls is in the 2–3 years age group, a decrease is found up to 8–13 years age group, and then increase again up to the 18 years age – The highest frequency is in the Eastern Province, the lowest in the Southern Province – The highest Ow: boys (15–16 years)/girls (17–18 years) – The highest Ob: boys and girls (2–3 years) – The lowest Ob: boys (10–11 years)/girls (9–10 years)
Saudi Arabia	Al-Rukban (2003) (894)	12–20	Boys: Ob 20.5 Ow 13.8 (CDC criteria)	– Weight and height – BMI – Socio-demographic characteristics – Dietary and PA history – Obesity-related knowledge and behavior – Family medical history – Past medical history	– Family history and lack of PA are associated with adolescent obesity – 20% of Ow participants did not think they are Ow – Ob is an important public health problem among male adolescents in Riyadh
Saudi Arabia	Al Turki (2007) (701)	≥18 years	Males: Normal 45.8 Ob 23.3 Ow 31.0 (WHO classification)	– Weight and height – BMI	– Changing in eating habits and PA explain the rising prevalence of Ob in Saudi Arabia – Prevention of Ow and Ob among university male students should be planned in early childhood
United Arab Emirates (UAE)	Al-Hourani et al. (2003) (898)	11–18	Adolescent females: Ow 9.0 at risk of Ow 14.0 (NHANES reference data)	– BMI – Triceps skinfold thickness (TSF) – Mid-upper arm circumference	– Mean BMI and TSF at all ages were higher than the 50th percentile (median) of the NHANES reference data – 27% (11 years) and 28% (12 years) are above the TSF 90th percentile and a high prevalence of Ow
United Arab Emirates (UAE)	Al-Haddad et al. (2005) (16,391)	4–18	Males: Ob 7.7 Ow 17.1 Females: Ob 7.1 Ow 20.1 (IOTF criteria)	– BMI	– Ob among UAE youth is 2–3 times greater than the recently published international standards ▪ <9 years: Ob and Ow (among both sexes) are below Cole et al. international standards ▪ 9–18 years: a consistent increase in Ow and Ob (among both sexes)

Table 8.4 Prevalence of (childhood) obesity (Ob), overweight (Ow) and underweight (Uw) in the North African sub-region

Country	Study (no of subjects)	Age (years)	Prevalence % (obesity, overweight and underweight)	Variables	Outcomes
Northern Africa	Mokhtar et al. (2001) Morocco (M: 17,320) Tunisia (T: 2,760)	▪ M: ≥18 ▪ T: 20–60	▪ Morocco: Males: Ob 5.7 Females: Ob 18.0 ▪ Tunisia: Males: Ob 6.7 Females: Ob 22.7 (WHO/NCHS references)	– BMI – Area of residency – Educational level – Daily energy and macronutrient intakes	– Prevalence of Ob: M: 12.2% T: 4.4% – Ob is higher among females than among males in both countries – Ob among females has tripled over the past 20 years – Half of females are Ow or Ob (BMI >25): M: 50.9%, T: 51.3% – Ow increases with age, particularly among girls – Ow and Ob are greater for women in urban areas and with lower educational levels – Obese females consume more calories and CHO than normal weight females – Fat intake is high in T: 31% CHO intake is high in M: 65–67%
Tunis	Ben Mami Ben Miled et al. (2000) (951)	6–12	Total: Ob 5.25	– Weight (wt) and height (ht) – BMI – Birth order – Parental Ob history – Dietary intake	– Wt and ht are more than 3 standard deviations (SD) compared to the normal – 66% have 1 or 2 obese parents – 74% are the oldest or the youngest child in the family – Food intake is rich in sugar and protein – Dietetic troubles are common
Tunis, "Sousse"	Ghannem et al. (2001) (793)	Rural school-children	Total: Ob 4.0 (Criteria used: Ow >25 kg/m² Ob >27 kg/m²)	– Sex – CVD – Lipid serum levels – Blood pressure – Smoking	– Prevalence of hypertension: 11.2%, hypercholesterolemia: 2.9%, hypertriglyceridaemia: 1.0%, HDL: 0.6% and Ob: 4.0%; no significant sex difference – Smoking (4%) has sex difference: boys: 7.3%, girls: 1.2%
Tunis, "Ariana"	Ben Slama et al. (2002) (3,148)	6–10	Total: Ob 3.7	– Weight – Present size of parents – Children life habits	Risk factors of the child Ob are: – Parents' Ob – Short length of sleep (<8 h) – Erosion between meals – Daily consumption of sugary food and sparkling drinks
Tunis, "Sousse"	Laouani Kechrid et al. (2004) (600)	>60	Total: Ob 2 4.2	– Blood pressure (BP) – BMI – NCD (diabetes, hypertension, CVD)	– Prevalence of HBP: 69.3% and diabetes: 23% – 51.7% of hypertension patients are non compliant and uncontrolled

Tunis, "Monastir"	Ben Salem et al. (2006) (3,033)	Infants	▪ 3 months: Ob 6.2 ▪ 9 months: Ob 11.6 Total: wasting and Uw <10% (NCHS reference)	– Weight-for-age – Height-for-age – Weight-for-height – BMI	– Prevalence of growth retardation increased with age – Anthropometrical parameters distribution in Monastir infants is different from NCHS reference curve
Tunis	Blouza-Chabchoub et al. (2006) (1,050)	13–17	Total: Ob 5.1 (NHANES criteria)	– Weight and height – BMI – Food intake – SES – Family history of Ob	– Highest Ob for both sexes is at age 13–14 years – Ob is more important in males of high SES – 51% of obese adolescents have family history of obesity – 96% have abnormal alimentary behavior – 52% have excess caloric intake – 82% have an excess of lipid
Morocco	Benjelloun (2002)	Early childhood	<5 (1997): Uw 10.0 Stunting 23.0 Ow <3 (1987): Ow 3.0 <3 (1997): Ow 9.0 Adults (1984): Ow 26.0 Adults (1998): Ow 36.0 1984 1998 OW Males: 19.0 25.0 Females: 32.0 45.0 Urban: 30.0 40.0 Rural: 20.0 29.0 Ob: 4.0 10.0 (IOTF criteria)	– BMI – Area of residency – Dietary intake – SES – Education level	– Ow is directly associated with SES and inversely with education – Ow is higher among females and among urban than rural – Ow and Ob are major health problems in Morocco – Undernourishment persists among children <5 years – Dietary habits: increased animal products intake, high intake of cereals and sugars (mainly sugar in tea), rise of meat and vegetables consumption accompanied with a steady bread consumption
Morocco, "Urban Sahraoui of South Morocco"	Rguibi and Belahsen (2004) (249)	≥15	Total: Ob 49.0 Ow 30.0 (WHO criteria)	– Weight and height – BMI – Waist circumference (WC) – Hip circumference (HC) – Calorie intake – PA – Marital status – Education level – Desire to lose weight	– Ow and Ob high in younger ages – Abdominal Ob is high and increase with age – 68% with WHR >85th – 76% with WC ≥88 – Ob associated with calorie intake, time spent in walking and in traditional sedentary occupation – Ob higher among married females and not influenced by education – Small % of female population expressed desire to lose weight

(continued)

Table 8.4 (continued)

Country	Study (no of subjects)	Age (years)	Prevalence % (obesity, overweight and underweight)	Variables	Outcomes
Morocco	Rguibi and Belahsen (2007) (Moroccan population)	Adults	Total: ▪ 1984/1985: Ob 4.1 ▪ 1998/1999: Ob 10.3 ▪ 2000: Ob 13.3 Males: Ob 8.0 Females: Ob 22.0 (WHO criteria)	– Weight and height – BMI – Area of residency – Education level	– Ob increased among Moroccan population over the past 15 years, more prevalent in urban areas – Excessive weight is positively associated with age and negatively with education level
Egypt	Bakr et al. (2002) (317)	Medical students at Ain Shams university	Total: Uw 9.5 Normal 41.3 Ob 2.5 Ow 36.9 (CDC criteria)	– Weight and height – BMI – Mid upper arm circumference (MUAC) – Mid arm muscle circumference (MAMC) – Triceps skinfold thickness (TSF) – Lifestyle factors – Food frequency consumption – Family history of obesity	– About half of medical students are Ow and Ob – MUAC and MAMC higher in males – TSF of females is higher – All food group items are consumed fairly – 64% have regular meals – Males practice sports and play computer more than females – Watching TV higher in females – Lifestyle factors responsible for Ob: longer time on computer, eating more during stress and snaking between meals
Egypt, "Cairo and surrounding rural areas"	Jackson et al. (2003) (340)	Adolescent school girls	Ob 13.0 Ow 35.0 (CDC criteria)	– Weight, height and BMI – Waist and hip circumference (WC and HC) – Body image – Areas of residency – SES	– Ow is more prevalent in urban and high SES girls – Girls' perceptions of how their mother viewed their bodies differed from how the girls viewed their own bodies

Egypt, "Alexandria" 2005 (82)	Kharboush et al. (2005) (172 families)		Females: Ob (WHO criteria)	60.0	– Weight and height – Stool, urine and blood analysis – Education level – Occupation – Female to male comparison – Sex ratio of some parameters – Ill health and diseases	– Ill health rate increased with age (36% in girls to 90% in females >45 years) compared to 71% among older males – Females are head of the family in 19.8% of families – Wives participated in family income in 18% families – Female to male sex ratio is low for <6 and >60 years
Egypt (E)	Asfaw (2007)	Mothers	(WHO criteria)		– BMI – Micronutrient deficiency	The odds of Ow/Ob are 80.8% higher for micronutrient deficient mothers than for non-deficient (all other variables constant)

Table 8.5 Comparison of the prevalence of childhood obesity (Ob) and overweight (Ow) between Egypt and Mexico; and between Egypt, Lebanon and Kuwait

Country	Study (no of subjects)	Age (years)	Prevalence % (obesity, overweight and underweight)	Variables	Outcomes
Egypt (E) and Mexico (Me)	Salazar-Martinez et al. (2006) (E = 15,02; Me = 10,537)	11–19	▪ Total: Me E Ob 7.9 6.2 Ow 19.8 12.1 Ob male 11.0 6.0 Ob female 9.0 8.0 Ow male 18.0 7.0 Ow female 21.0 18.0 (CDC criteria)	– BMI – Age – Education level – Area of residency – PA – Vitamin intake – Smoking	– In Me: the most consistent correlates of BMI are age, educational level, smoking, vitamin intake and PA – In E: the most consistent correlates of BMI are age and rural residence
Egypt (E), Lebanon (L) and Kuwait (K)	Jackson et al. (2007) (Total = 922: E = 340 L = 336 K = 245)	10–19 (adolescent girls)	IOTF Must CDC Egypt: Ob 11.2 11.2 13.5 Ow 35.9 35.9 34.4 Lebanon: Ob 2.1 2.7 2.7 Ow 18.8 15.5 16.4 Kuwait: Ob 12.2 13.5 14.3 Ow 33.1 31.0 31.0	– Age – Weight and height – BMI for age with 3 ref.: Must et al. (1991), IOTF criteria and CDC 2000 – Waist circumference (in E and L) – WHR (in E and L) – Daily dietary intake	– Ow and Ob are highest in Kuwait and lowest in Lebanon (height, weight and BMI) – Ow proportion varied by country, reference and age – In E, the mean waist and WHR are higher than in L – Mean energy intake is highest in E and lowest in K – Mean intake of protein and fat is highest in E – Significant correlation between BMI and calorie intake in L and E – The three reference standards differed in estimating Ow more than Ob – IOTF criteria gave the lowest percentage estimate of Ob, while the CDC 2000 gave the highest

Near East Sub-region

Nine studies from three countries of the Near East sub-region are summarized in Table 8.2. Four studies from Lebanon focused on the risk factors (social, biological, demographic, etc.) for obesity, while one study from Syria and four studies from Israel focused on the relationship between obesity and chronic diseases (CVD, hypertension, diabetes). In Lebanon, obesity and overweight were higher in males, except in adult females (≥20 years). Reduced physical activity was the most significant factor associated with childhood overweight. Risk and prevalence of obesity decreased with age in girls but not in boys. Risk and prevalence of obesity in Lebanese adolescents of private schools were high. Females have healthier eating habits: daily breakfast intake and meal frequency. The study done in Aleppo – Syria focused on profiling cigarette smoking, found a high prevalence of obesity (38.2 %) which was a significant risk factor for CVD. In Israel, overweight was more common in males and obesity was more common in females. In addition obesity increased with age and correlates with low education level and origin: Arab females were more obese (57.3%) than Jewish females (13.6%). Pre hypertension was very common among Israeli adolescents.

Gulf and Arabian Peninsula Sub-region

A summary of 26 studies from six countries of this sub-region is presented in Table 8.3.

In Bahrain, the prevalence of adolescent obesity was higher than was previously reported, especially in girls. In general, prevalence of obesity was higher among females in all age groups but overweight was higher among males. Males were more engaged in physical activity and daily intake of fruits and vegetables is similar in both sexes.

In Iraq, the prevalence of obesity and overweight was higher in females. It increased with age and was associated with different risk factors (sex, physical activity, parental obesity and family size). It is important to notice that most children watch TV daily and 60% ate while watching.

Studies done in Kuwait showed that prevalence of overweight was lower but prevalence of obesity was higher in males compared to females. Also, obesity risk factors were different among males and females. Overall, obesity and overweight were positively associated with age, birth order, sex, parental education, region, dental status, eating regular meals, family history and socio-economic status (SES). Conversely, the three studies showed that physical activity and parental social class were not significant.

Iranian studies showed that obesity, overweight and underweight were present but the results may change between the different regions of the same country. The prevalence of overweight, obesity and underweight was higher in urban than rural areas. These studies showed the increasing prevalence of obesity and overweight in the Iranian population with time, which was higher in females than in males, especially in adult females. The analysis of the Iranian lifestyle and food habits demonstrated that there was a significant linear association between BMI and frequency of rice, bread, fast foods, pasta and fat/salty snacks. Time watching TV was high and exercising was low, especially among girls.

Studies in Qatar showed that obesity prevalence was highest among 12-year-old boys (11.7%) and 13-year-old girls (6.4%). Boys were more at risk than girls. Almost, all Qatari adolescents were intermediate to extreme dieters. Extreme dieting was strongly associated with peer perception and self-perception of figure. Diet education sources were TV (followed by 43.6% of extreme dieters), magazine and radio.

In the Kingdom of Saudi Arabia, significant regional variation of overweight and obesity distribution was detected. The highest frequency was in the Eastern Province (Riyadh 18%), the lowest in the Southern Province (Sabea 11.1%). Overweight increased with age (the highest in boys 15–16

years old and in girls 17–18 years old). Conversely, the highest prevalence of obesity for both boys and girls was in the 2–3 years age group, with a decrease up to the 8–13 years age group, followed by an increase up to an age of 18 years. Family history, lack of physical activity and changing in eating habits were associated with adolescent obesity which becomes an important public health problem among male adolescents in Riyadh.

In the UAE, results were compared to NHANES reference data and international standards by the IOTF (Cole et al. 2000). Mean BMI and TSF at all ages were higher than the 50th percentile of the NHANES reference data. On the other hand, obesity among UAE youth was 2–3 times greater than the recently published international standards.

North Africa Sub-region

A summary of 14 studies from three countries of this sub-region is presented in Table 8.4.

The prevalence of obesity in Morocco (12.2%) was higher than in Tunis (4.4%) and higher among females than males in both countries. Half of the females had a BMI >25 (50.9% in Morocco and 51.3% in Tunis) especially those living in urban areas and those having lower educational levels. Fat intake was high in Tunis (31%) and carbohydrates intake was high in Morocco (65–67%). Overweight increased with age, particularly among girls.

In Tunis, prevalence of obesity varied between the areas and increased with time. The highest prevalence for both sexes was observed at age 13–14 years but it was more frequent in males of high SES. 51% of obese adolescents had a family history of obesity. 96% had abnormal alimentary behavior (52% had excess caloric intake and 82% had an excess of fat consumption).

Obesity increased among Moroccan population over the past 15 years and was more prevalent among females and in urban areas. Excessive weight was a major health problem in Morocco and it was positively associated with age and SES but negatively with education level. Dietary habits such as high intake of animal products, cereals and sugars (mainly sugar in tea), increase of meat and vegetables consumption accompanied by steady bread consumption were responsible of increased obesity. However, it was important to underline that undernourishment persists among children below the age of 5 years.

In Egypt, overweight was more prevalent in urban and high SES girls. Body image perception differs between girls and their mothers. An interesting study described the excessive weight among medical students and showed that about half of them were overweight and obese. Although they consumed fairly all food group items and the majority had regular meals (64%) their lifestyle was responsible of obesity (longer time working with the computer, eating more during stress and snacking between meals).

Cross-regional Studies

Two studies compared profiles of obesity in multiple countries not from the same sub-region, and they are summarized in Table 8.5.

The first study compared obesity profiles in Egypt and Mexico. In Egypt, BMI correlated with age and rural area, while in Mexico it correlated with age, educational level, smoking, vitamin intake and physical activity.

The second study compared obesity profiles in Egypt, Lebanon and Kuwait, one country from each sub-region of the MENA region. The prevalence of overweight and obesity was highest in Kuwait and lowest in Lebanon. Mean waist circumference and waist-to-hip ratio (WHR) were

higher in Egypt than in Lebanon. Mean energy intake was highest in Egypt (especially from protein and fat) and lowest in Kuwait. A significant correlation between BMI and calorie intake was found in Lebanon and Egypt. Furthermore, this study showed that using different standard references resulted in wider discrepancies in estimating the prevalence of overweight than the prevalence of obesity. Besides, reference values by the IOTF (Cole et al. 2000) gave the lowest percentage estimate of obesity, while the CDC charts (Kuczmarski et al. 2000) gave the highest.

Overall, the prevalence of overweight among pre-school children varied from near 3% in UAE and Iran to 8.6% in Egypt. Among older children and adolescents (6–18 years), the prevalence of overweight ranged between 6.3% in Bahrain to 31.8% in Kuwait among girls; and between 4.9% in Saudi Arabia to 30% in Kuwait among boys. The prevalence of obesity in the same age groups ranged from near 3% in UAE and Iran to 35.1% in Bahrain among girls; and from 2.1% in Iran to 21% in Bahrain among boys. In almost all MENA countries, obesity and overweight increased with age and became more prevalent among females than males.

Risk Factors Studied

The analysis of 51 representative articles from 13 MENA countries showed an increasing prevalence of overweight and obesity from childhood to adulthood, although rates of early childhood malnutrition remained relatively high.

In this descriptive summary we tracked the socio-demographic and physiological variables of common interest in the published literature from studies in the MENA countries. The results are summarized in Table 8.6.

In this systematic search we found that BMI, dietary and calories intake, educational level and physical activity are the major factors of interest in the MENA countries. However, only six studies measured waist circumference and waist-to-hip ratio; and three studies measured triceps and

Table 8.6 Most common overweight and obesity parameters: a summary

Variables	Countries (*n*)	Number of studies
BMI	All the MENA countries (13)	51
Waist circumference, waist to hip ratio	Lebanon, Iran, Morocco, Egypt (4)	6
Triceps and subscapular skinfolds, mid upper arm circumference	Bahrain, UAE, Egypt (3)	3
Physical activity	Lebanon, Bahrain, Iraq, Iran, Qatar, Morocco, Saudi Arabia, Egypt, Kuwait (8)	11
Dietary and caloric intake	Lebanon, Bahrain, Iraq, Kuwait, Iran, Qatar, Saudi Arabia, Tunis, Morocco (9)	23
Educational level	Lebanon, Iran, Morocco, Israel, Egypt, Kuwait, Tunis (7)	16
Area of residence	Iran, Morocco, Tunis, Egypt (4)	7
SES	Lebanon, Iran, Qatar, Morocco, Saudi Arabia, Egypt, Kuwait, Tunis (8)	7
Family history of obesity	Iraq, Kuwait, Qatar, Saudi Arabia, Tunis, Egypt, Iran (7)	9
Family size	Lebanon, Iraq, Kuwait, Qatar (4)	4
Birth weight, breastfeeding	Iran	2
Frequency and level of dieting	Qatar	2
Order of birth	Kuwait and Tunis	2
Desire to lose weight	Morocco	1

subscapular skinfolds and mid upper arm circumference. These measures should be more integrated into future studies since they explain the fat distribution in the body. Family history of obesity, area of residence, SES and family size are also documented in several studies. Conversely, birth weight, breastfeeding, frequency and level of dieting, order of birth and desire to lose weight were not enough reported. Genetic factors were absent.

Several of the studies summarized above revealed that obese children have less moderate to vigorous physical activity than non-obese children, which in turn is associated with increased TV watching. Increased TV watching was described to coincide with lower consumption of fruits and vegetables and with extra calorie intake from sweets and soft drinks during viewing, especially among 13-year-old boys of lower socioeconomic status. Familial environment and parental habits such as family food culture (eating together), parenting practices and the availability of alternatives (pre-prepared or takeaway food) are likely to mediate the role of TV and food consumption.

An association of obesity with parental education, BMI, SES and obesity in children also emerged in this literature review. A significant inverse relationship was found between the educational level of both parents as well as maternal employment and the prevalence of obesity in children. Also, a direct relationship was observed between the BMI of mothers and food habits of their daughters and boys, while the BMI of fathers was associated with frequency of activities of their sons only.

Obesity is apparently more acceptable in the Arabic values than in western culture, especially among children where obesity is considered a sign of healthiness and high social class. This pattern may have been assisted by increased abundance of fast foods that are generally cheaper, but have high caloric value. Such practices may be attributed to the general inadequacies of health education and awareness about the health risks associated with obesity.

Overall, factors that have been linked to childhood and adolescent obesity in the MENA region are similar to those reported elsewhere in the world and include family lifestyle (smoking, poor eating habits, sedentary lifestyle), environmental factors (increased availability of fast foods, media and advertisement, increased use of the internet and video games and peer influences) and a family history of obesity (http://www.ucsfhealth.org).

These findings emphasize that in addition to community-based lifestyle modification, culturally relevant family-based interventions especially focusing on mother's beliefs and behavior are needed to prevent obesity in children and adolescents and its long-term consequences. Special emphasize should be directed at families with a medical and/or history of obesity.

Conclusions

The prevalence of overweight and obesity among children and adolescents living in the MENA region appears to be increasing in parallel with a changing socio-demographic landscape and the adoption of western-style environmental influences (dietary, lifestyle and economic). Our review showed that the mean GDP was $6,710 in 2006, which is consistent with the finding that the prevalence of obesity increases rapidly when a country's GDP reaches about $5,000 (Lasserre et al. 2007).

Actions are needed at different levels. Short-term intervention and long term prevention efforts are being attempted to varying degrees in some countries of the MENA region through increased awareness, school-based and community-based interventions, as well as family involvement. Efforts to use advertising targeted at children and adolescents to promote healthy food and lifestyle and to replace young people's TV viewing time with alternative activities would offer a sound short term strategy. Prevention of overweight and obesity in early childhood can in the long run, attenuate the high prevalence of excessive weight among older adults in MENA region.

It was difficult to make comparisons of obesity across age groups because published studies used different population age structures and BMI references. Hence, further studies on overweight and

obesity in the MENA region are needed to clarify the most appropriate reference to use to classify overweight and obesity. Additional variables should be studied such as the media impact, body image, peer influence, sources of diet information, socio-psychological factors, different types of cuisine and cultural beliefs and attitudes.

We hope that the results of this descriptive summary would contribute to guiding health planners and administrators to develop proper tools for obesity management in the countries of the MENA region. National Health Accounts (NHA) is one such tool designed for health sector policy makers and managers to aid them in their efforts to improve health system performance (NHA 2003). Many countries in the MENA region (Egypt, Iran, Jordan, Lebanon, Morocco, Tunisia, Yemen, Djibouti, Gulf countries and Syria) are in the process of reforming their health systems to reveal the areas in need of more health care funding and awareness (NHA 2003). Overweight and obesity appears to be gaining steam as a key health issue to be targeted by such plans.

Genetic studies are another area where a significant amount of research in needed in the MENA region. Worldwide studies suggested that pre-disposition to obesity seems to be caused by a complex interaction between over 250 obesity-associated genes and perhaps perinatal factors. Studies that focus on the specific genetic profile pertinent to the peoples of this region would be of great relevance to any plan to combat this emerging health problem.

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