

# Adolescent obesity in Syria: prevalence and associated factors

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Accepted for publication 18 August 2009

## Abstract

**Background** Data on the prevalence of overweight and obesity in Eastern Mediterranean countries remain scarce, particularly for children and adolescents. The objective of this study is to estimate the prevalence of obesity and examine associated factors and covariates amongst school adolescents in Syria.

**Methods** A cross-sectional survey of a representative sample of 776 adolescents (386 males and 390 females), aged 15–18 years, was conducted in six randomly chosen secondary schools in Damascus, the capital city of Syria. Anthropometric measurements and dietary assessment data were collected using standard methods and techniques. Overweight and obesity were defined according to World Health Organization 2007 child growth standards.

**Results** The prevalence rates of overweight and obesity were estimated at 18.9 and 8.6%, respectively. Carbohydrate and saturated fatty acid intakes were significantly higher amongst overweight and obese (250.66 and 32.82 g/day, respectively) as compared with normal weight adolescents (218.12 and 26.10 g/day, respectively). Regression analysis showed that the likelihood of obesity was significantly greater amongst adolescent boys than girls ( $OR = 2.30, P < 0.05$ ) and amongst subjects reporting family history of obesity ( $OR = 2.98, P < 0.05$ ). The odds of obesity increased consistently with increasing educational attainment of both parents and was higher ( $OR = 1.63$ ) amongst adolescents reporting lower crowding index than their counterparts.

**Conclusion** Our findings of a positive association between obesity and socio-economic status measured by parental education and crowding index call for intervention strategies for the promotion of healthy dietary practices not only amongst school adolescents but also parents, targeting families as the unit of intervention. Further studies are needed to examine nutritional habits and food choices amongst families of different socio-economic strata.

## Keywords

Adolescents, body mass index, Damascus, nutrition survey, obesity, overweight, Syria

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## Introduction

The escalating levels of overweight amongst children and adolescents are of particular concern in the western world and several developing countries. In the US for example, data from two National Health Examination Survey (NHANES) surveys showed that the prevalence of obesity in adolescents aged 12–19

years has increased almost 3.5 folds over a period of 24 years (from 5.0% in 1976–1980 to 17.4% in 2003–2004) (Flegal 2005). Studies have consistently demonstrated that the higher the childhood body mass index (BMI), the greater the risk of becoming an overweight adult, with the risk being heightened in the case of adolescent obesity. While an obese 4-year-old child has a 20% chance of becoming an obese adult, the

likelihood that obesity in adolescence would persist into adulthood is increased to 80% (Krebs & Jacobson 2003). Moreover, overweight and obesity in adolescence predict a broad range of adverse health effects in later adulthood including hypertension, type 2 diabetes, insulin resistance, metabolic syndrome, menstrual irregularity, in addition to psychological disturbances such as low self esteem and depression (Ebbeling *et al.* 2002; Krebs & Jacobson 2003). The Harvard Growth Study showed that being overweight during adolescence is a stronger predictor of mortality risk from cardiovascular diseases than being overweight during adulthood (Must *et al.* 1992), and associations are stronger in boys than in girls (Baker *et al.* 2007).

Data on the prevalence of overweight and obesity in the Eastern Mediterranean countries remain scarce, particularly for children and adolescents. Available estimates suggest that the prevalence of overweight and obesity in the region may be higher than that described in industrialized countries, with the highest prevalence of obesity being reported from Bahrain (35.4% amongst girls and 21.3% amongst boys) (Al-Sendi *et al.* 2003). In comparison, obesity prevalence rates amongst adolescents in different European countries range between 1 and 5.3% (Celi *et al.* 2003; Martín *et al.* 2006; Grøholt *et al.* 2008; Marques-Vidal *et al.* 2008; Matthiessen *et al.* 2008). In Syria, a small low-income country of the Eastern Mediterranean Region (total area: 185 180 km<sup>2</sup>; population: 19.3 million), data on the prevalence of overweight and obesity amongst the youth is totally lacking. We report in this paper the prevalence and correlates of overweight and obesity amongst school adolescents (15–18 years) in Damascus, the capital and largest city of the country. We also compare our data with findings from selected countries in the West and in the region.

## Methods

### Study design and subjects

A cross-sectional school-based survey of risk behaviours was conducted in a random sample of adolescents attending secondary classes (grades 9 through 12) in different areas of Damascus. The sampling frame of schools was provided by the Ministry of Education, and a school was considered eligible in the study sample if it were public, if it included grades 9 through 12, and had a minimum enrolment of 100 students in its secondary classes. The sampling frame excluded private schools since education in Syria is mostly state-provided, with the students enrolled in private schools not exceeding 6% (Chen 2005). A two-stage sampling design was implemented: a probability sample of schools proportionate to student popu-

lation size was first undertaken. This was followed by a random sample of four sections within each school representing the four grades. With around 25–35 students per class, the final sample yielded a total of 776 students attending six schools. None of the students refused to participate in the study and written informed consent from parents and from subjects were obtained prior to enrolment in the study. The Institutional Review Board of the American University of Beirut approved the study protocol and the Education Department in each school authority approved and endorsed the study. Fieldwork was carried out, between February and May 2006, by a research nutritionist.

### Data collection: anthropometric measurements and dietary intake

The survey instrument provided information on socio-demographic characteristics, health related variables, and lifestyle. Dietary intake was assessed using an interview-based 24-hour recall. Anthropometric measurements were taken using standardized techniques and calibrated equipments (Jelliffe 1989). Subjects were weighed to the nearest 0.1 kg in light indoor clothing and with bare feet or stockings. Height was measured without shoes and recorded to the nearest 0.5 cm using a stadiometer. BMI was calculated as weight (kg) divided by the height squared (m<sup>2</sup>). Waist circumference was measured, using a calibrated plastic measuring tape, at the level of the umbilicus to the nearest 0.5 cm with the subject standing and following normal expiration. Measurements were taken twice and the average of the two values was considered.

### Definitions of overweight and obesity

The recent WHO 2007 child growth standards were used for the definition of overweight and obesity, based on sex and age-specific 85th and 97th BMI percentiles, respectively, (de Onis *et al.* 2007). In addition, the WHO (1995) and the International Obesity Taskforce (IOTF) (Cole *et al.* 2000) definitions were used for comparative purposes. Following the Adult Treatment Panel (ATP) III criteria for adolescents, subjects with a waist circumference exceeding the 90th percentile for sex and age were considered at higher risk for metabolic diseases than their counterparts (Cook *et al.* 2003).

### Statistical analysis

Frequencies and means ( $\pm$ SD) were used to describe the sample, and differences between boys and girls were examined

using  $\chi^2$  test and *t*-test, for categorical and continuous variables, respectively. For a random sub-sample of around half of the students ( $n = 385$ ), dietary intake data were analysed. Food consumption data were converted to energy and nutrient intake using the Nutritionist IV software (N-squared Computing Nutritionist IV, Silverton, OR: N-squared Computing; 1995) and the Middle-East Food Composition Tables were used to analyse local dishes (Pellet & Shaderevian 1970). Total energy intake and macronutrients were expressed as means ( $\pm$ SD) and results are presented stratified by BMI levels (normal: 5th  $\leq$  BMI < 85th, overweight: 85th  $\leq$  BMI < 97th, and obese: BMI  $\geq$  97th percentiles). Differences in total and percent energy intake contributed by various food groups were examined comparing the overweight and the obese with the normal, as the reference category.

Multivariable logistic regression analysis was carried out, with percent obese (BMI percentiles  $\geq$ 97th) as the dependent variable and a number of baseline characteristics as independent variables. These included age (15–16 and 17–18 years), gender, parent's education, physical exercise, family history of

obesity, crowding index, and dietary intake. Education was considered in three categories: elementary and less, intermediate and secondary, and university level. Crowding index was calculated as number of persons within the household divided by the number of rooms, excluding kitchen and bathrooms. Total energy consumption was divided into tertiles and included in the model as dummy variables with three categories. Energy consumption from carbohydrates was divided according to the acceptable macronutrient distribution range (low if  $\leq$ 45% and high if >45%). Prevalence odds ratios (OR) and their 95% confidence intervals (CIs) were calculated. The Statistical Package for the Social Sciences (SPSS, version 16) was used for all computations and a *P*-value <0.05 was considered significant.

## Results

The sample consisted of 386 boys and 390 girls, with a mean age of 16.8 years (range 15–18 years) (Table 1). The proportion of parents who had attained university level education exceeded 56% amongst fathers and 47% amongst mothers, with the

**Table 1.** Socio-demographic and anthropometric measurements in total study sample and by gender, Syria 2006 ( $n = 776$ )

	Total ( $n = 776$ )	Boys ( $n = 386$ )	Girls ( $n = 390$ )	<i>P</i> -value	
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)		
<b>Socio-demographic</b>					
Age (years), mean $\pm$ SD	16.80 $\pm$ 0.80	16.83 $\pm$ 0.80	16.76 $\pm$ 0.80	0.235	
Father's education					
Elementary and less	123 (15.9)	55 (14.3)	68 (17.4)	0.075	
Intermediate and secondary	218 (28.1)	102 (26.5)	116 (29.7)		
University	434 (56.0)	228 (59.2)	206 (52.8)		
Mother's education					
Elementary and less	217 (28.0)	88 (22.8)	129 (33.1)	<0.001	
Intermediate and secondary	193 (24.9)	93 (24.1)	100 (25.6)		
University	366 (47.2)	205 (53.1)	161 (41.3)		
Crowding index					
$\geq$ 1 person/room	702 (92.6)	330 (88.9)	372 (96.1)	<0.001	
<1 person/room	56 (7.4)	41 (11.1)	15 (3.9)		
Family history of obesity					
No	727 (93.7)	367 (95.1)	360 (92.3)	0.113	
Yes	49 (6.3)	19 (4.9)	30 (7.7)		
<b>Anthropometric measurements</b>					
Weight (kg), mean $\pm$ SD	62.59 $\pm$ 13.39	67.35 $\pm$ 14.18	57.88 $\pm$ 10.66	<0.001	
Height (cm), mean $\pm$ SD	165.90 $\pm$ 8.32	171.44 $\pm$ 6.69	160.41 $\pm$ 5.74	0.000	
BMI (kg/m <sup>2</sup> ), mean $\pm$ SD	22.68 $\pm$ 3.80	22.88 $\pm$ 4.10	22.48 $\pm$ 3.47	0.147	
Underweight (BMI < 5th) <sup>†</sup>					
	21 (2.7)	15 (3.9)	6 (1.5)	0.059	
Normal (5th $\leq$ BMI < 85th) <sup>†</sup>					
	541 (69.7)	254 (65.8)	287 (73.6)		
Overweight (85th $\leq$ BMI < 97th) <sup>†</sup>					
	147 (18.9)	72 (18.7)	75 (19.2)	<0.001	
Obese (BMI $\geq$ 97th) <sup>†</sup>					
	67 (8.6)	45 (11.7)	22 (5.6)	0.000	
Waist (cm), mean $\pm$ SD					
	73.47 $\pm$ 10.52	77.35 $\pm$ 11.68	69.66 $\pm$ 7.51	<0.001	
WC > 90 <sup>th</sup> percentile <sup>‡</sup>					
	26 (3.4)	23 (6.0)	3 (0.8)	0.000	

<sup>†</sup>de Onis and colleagues 2007.

<sup>‡</sup>Cook *et al.* 2003.

**Table 2.** Total energy intake and macronutrients, percent daily energy intake contributed by various food groups according to BMI, Syria 2006 (*n* = 385)

	Normal 5th ≤ BMI < 85th	Overweight 85th ≤ BMI < 97th	Obese BMI ≥ 97th	Overweight and Obese BMI ≥ 85th
		Mean intake ± SD		
Energy (kcal)	1979.92 ± 670.83	2192.12 ± 711.12*	2213.94 ± 820.48*	2199.24 ± 746.35*
Protein (g)	65.29 ± 28.17	71.36 ± 30.12	68.91 ± 29.71	70.56 ± 29.93
Carbohydrate (g)	218.12 ± 85.81	249.03 ± 93.02*	254.04 ± 90.69*	250.66 ± 92.05*
Sugar (g)	52.86 ± 46.80	60.02 ± 46.77	62.07 ± 29.37	60.69 ± 41.83
Fat (g)	97.92 ± 42.83	106.44 ± 51.49	104.94 ± 55.67	105.95 ± 52.74
Saturated Fat	26.10 ± 15.11	33.41 ± 21.72*	31.61 ± 20.21*	32.82 ± 21.20*
Monounsaturated fat	34.52 ± 18.68	36.56 ± 20.51	37.57 ± 22.93	36.89 ± 21.28
Polyunsaturated fat	14.92 ± 10.34	17.44 ± 15.04	17.24 ± 12.10	17.37 ± 14.12
		Mean% Daily Energy Intake ± SE		
Bread and cereals	18.36 ± 13.08	21.75 ± 14.04*	19.20 ± 10.98	20.92 ± 13.15*
Starchy roots	15.74 ± 15.44	15.58 ± 14.63	17.42 ± 15.47	16.18 ± 14.89
Legumes, nuts and seeds	7.60 ± 12.30	5.10 ± 7.98*	5.77 ± 9.17	5.32 ± 8.36*
Milk and milk products	5.18 ± 6.93	4.1 ± 6.74	2.95 ± 5.23*	3.77 ± 6.30*
Meat, poultry, and fish	20.72 ± 15.36	21.99 ± 15.62	18.39 ± 17.13	20.82 ± 16.17
Eggs	1.28 ± 2.77	0.94 ± 2.03	1.04 ± 2.78	0.97 ± 2.30
Oils and fats	6.98 ± 8.29	5.84 ± 7.88	6.68 ± 9.50	6.11 ± 8.42
Sugars and sweets	3.78 ± 5.56	5.50 ± 9.13*	5.98 ± 11.17*	5.66 ± 9.81*
Vegetables	4.33 ± 5.52	4.29 ± 7.16	6.11 ± 8.36	4.88 ± 7.59
Fruits	3.75 ± 5.19	2.28 ± 4.07*	3.68 ± 5.67	2.74 ± 4.68*
Carbonated beverages	2.69 ± 4.06	2.78 ± 3.92	3.12 ± 3.95	2.89 ± 3.92
Chocolate	4.08 ± 7.96	5.22 ± 9.67	4.69 ± 9.00	5.05 ± 9.44
Potato Chips	5.30 ± 8.95	4.54 ± 6.84	4.98 ± 6.30	4.68 ± 6.65

\**P*-values < 0.05, with comparisons being made against the normal group.

proportions being higher amongst parents of boys than those of girls. The majority of adolescents (92.6%) had a crowding index ≥ 1 persons/room. Family history of obesity (6.3%) ranked second amongst family history of disease, after diabetes.

Mean BMI was comparable amongst both genders (22.88 ± 4.10 kg/m<sup>2</sup> for boys; 22.48 ± 3.47 kg/m<sup>2</sup> for girls). Approximately 3% of adolescents were found to be underweight (BMI < 5th percentile), the prevalence of which was higher amongst boys (3.9%) as compared with girls (1.5%). Based on WHO 2007 criteria, 27.5% of the study sample were overweight and obese (BMI ≥ 85th percentile) and 8.6% were obese (BMI ≥ 97th percentile) with boys being two times more likely to be obese compared with girls (11.7% vs. 5.6%, respectively). Amongst boys, prevalence rates for overweight and obesity increased with age, reaching its highest at the age of 17 years. An opposite trend was observed amongst female adolescents (data not shown). The prevalence of elevated waist circumference (WC ≥ 90th percentile) was significantly higher amongst boys (6%) as compared with girls (0.8%).

Overweight and obese adolescents (BMI ≥ 85th percentile) had significantly higher total energy intake (2199.24 Kcal/d) compared with normal weight (5th ≤ BMI < 85th percentile) subjects (1979.92 Kcal/d) (Table 2). Also, carbohydrate and saturated fatty acid intakes were significantly higher amongst

overweight and obese (250.66 and 32.82 g/day, respectively) as compared with normal weight adolescents (218.12 and 26.10 g/day, respectively). Whereas the percent daily energy intake contributed by bread, cereals, sugars, and sweets was significantly higher amongst overweight and obese as compared with normal weight adolescents, energy intake from milk and milk products, legumes, and fruits was found to be significantly higher amongst normal weight subjects (Table 2).

Logistic regression analysis was carried out to examine the association of obesity (BMI ≥ 97th percentile) as the dependent variable with baseline covariates (Table 3). Results showed that boys were 2.3 times significantly more likely to be obese than girls (95% CI: 1.17, 4.50), and obesity was significantly more prevalent amongst subjects reporting positive family history of obesity (OR = 2.98 95% CI: 1.09, 8.11). The odds of obesity increased consistently with increasing educational attainment for both parents and was higher (OR = 1.63) amongst adolescents reporting lower crowding index than their counterparts. Also, obesity was more prevalent amongst adolescents who do not exercise, although this did not reach statistical significance. Energy consumption from carbohydrate contributed significantly to the prevalence of obesity (OR = 1.96, 95% CI: 1.06–3.16) even after controlling for total energy consumption.

**Table 3.** Associations of obesity with baseline co-variables: prevalence odds ratios (ORs) and their 95% confidence intervals (CIs), Syria 2006

Variable	OR (95% CI)
Age (years)	
17–18	1.00
15–16	1.18 (0.64–2.17)
Gender	
Female	1.00
Male	2.30* (1.17–4.50)
Father education	
Elementary and less	1.00
Intermediate & secondary	1.53 (0.74–3.14)
University	1.93 (0.59–6.27)
Mother education	
Elementary and less	1.00
Intermediate & secondary	1.77 (0.74–4.21)
University	1.88 (0.86–4.09)
Family history of obesity	
No	1.00
Yes	2.98* (1.09–8.11)
Crowding index	
≥1 person/room	1.00
<1 person/room	1.63 (0.64–4.17)
Exercise	
Yes	1.00
No	1.57 (0.78–3.17)
Energy consumption (Kcal)	
Low (<1700)	1.00
Moderate (1700–2300)	1.59 (0.73–3.47)
High (≥2300)	1.80 (0.89–3.65)
Energy consumption from CHO (%)	
Low (≤45)	1.00
High: (>45)	1.96* (1.06–3.16)

\**P*-value < 0.05.

## Discussion

Obesity has been long recognized as a public health problem in the western world, and recent evidence suggests that a similar phenomenon is emerging in most developing countries (Popkin & Gordon-Larsen 2004). In a recent study conducted on a representative sample of 2038 adults aged 18–65 years in Aleppo, the second largest city in Syria, the prevalence of obesity amongst adults was estimated at 38.2% (Fouad *et al.* 2006) exceeding that observed in most developed countries (11–25%) (García-Alvarez *et al.* 2007; Donfrancesco *et al.* 2008; Hauner *et al.* 2008). Using WHO 2007 criteria, findings from this study indicate that about 1 in 4 Syrian adolescents is overweight and obese (BMI ≥ 85th percentile) and 8.6% are obese (BMI ≥ 97th percentile) with boys showing notably higher prevalence rates of obesity (11.7%) than girls (5.6%). Syria remains a country with a young demographic profile, where adolescents 15–18 years of age account for 12.93% of the total population, the ratio of males to females being of

1.05 in this age group (ESCWA 2007). Obesity was more prevalent amongst adolescents with high socio-economic status measured by parental education and crowding index, and those who do not exercise, and is associated significantly with family history of obesity.

Adolescent obesity was shown to be associated with increased risk of obesity in adults and to predispose to a wide range of medical and psychological problems (Wiegand *et al.* 2004; Hebebrand & Herpertz-Dahlmann 2009). In our study, estimates for the prevalence of abdominal obesity (3.4%) was significantly higher amongst males (6%) as compared with females (0.8%), and was considerably lower than that reported from Iran, another Middle-Eastern country, using the same ATP III cut-off values (10% amongst 10–19-year-old adolescents) (Esmailzadeh *et al.* 2006). Waist circumference is a key variable correlating with intra-abdominal adipose tissue and is thus a valuable tool for identifying children and adolescents at risk of developing metabolic complications (McCarthy *et al.* 2003). In this study, the lower prevalence of abdominal adiposity amongst girls is consistent with the observed lower prevalence of obesity in females as compared with males and is in agreement with the reported sexual dimorphism of body composition in adolescence (Loomba-Albrecht & Styne 2009). Fat distribution is reported to change during pubertal years with male adolescents assuming a more android body shape and females assuming a more gynecoid type of body fat distribution (Loomba-Albrecht & Styne 2009).

In the absence of previous published data on the prevalence of overweight and obesity amongst adolescents in Syria, it is difficult to investigate changes and trends over time. Nevertheless, to allow comparison with findings reported from other countries, our data were re-analysed according to WHO 1995 and IOTF criteria and compared with selected countries in the region and worldwide (Table 4). Overall, differentials in the prevalence rates across countries are more markedly noted for obesity than overweight, for both genders. Using WHO 1995 criteria, obesity rates amongst secondary school children in Damascus appear to be comparable to estimates from Bahrain (Al-Sendi *et al.* 2003) and Saudi-Arabia (Al-Almaie 2005), but higher than those reported from its neighbouring country Lebanon (Hwalla *et al.* 2005) as well as from Tunisia (Aounallah-Skhiri *et al.* 2008). The IOTF definition yielded higher estimates of obesity in both genders as compared with both WHO 1995 and WHO 2007 criteria. According to the IOTF definition, the prevalence of obesity amongst Syrian adolescents exceeded those estimated in Qatar (Bener 2006) and in European countries such as Norway, Portugal, Italy, and Denmark (Celi *et al.* 2003; Grøholt *et al.* 2008; Marques-Vidal

Country	Study criteria used	Age	Overweight		Obese	
			Boys	Girls	Boys	Girls
Damascus*	WHO 1995	15–18	25.1	20.5	8.8	4.6
	IOTF†	15–18	22.1	20.7	15.1	7.1
Lebanon (Hwalla <i>et al.</i> 2005)	WHO 1995	15–19	26.5	11.6	4.9	1.7
Tunisia (Aounallah-Skhiri <i>et al.</i> 2008)	WHO 1995	15–19	17.4	20.7	4.1	4.4
UAE (Malik & Bakir 2007)	IOTF†	14–17	32.3	34.5	13.3	17.6
Bahrain (Al-Sendi <i>et al.</i> 2003)	WHO 1995	12–17	29.7	38.9	21.3	35.4
Kuwait (Al-Isa 2004)	NCHS 1976–1980‡	10–14	30.0	31.8	14.7	13.1
Qatar (Bener 2006)	IOTF†	12–17	36.5	23.6	7.9	4.7
Saudi Arabia (Al-Almaie 2005)	WHO 1995	14–19	29.5	29.0	19.3	11.8
US (Kuczmarski <i>et al.</i> 2002)	NHANES 1999–2000§	12–19	30.5	30.2	15.5	15.5
Norway (Grøholt <i>et al.</i> 2008)	IOTF†	15–17	17.7	10.7	2.9	1.9
Portugal (Marques-Vidal <i>et al.</i> 2008)	IOTF†	10–18	22.6	24.4	5.3	4.7
Italy (Celi <i>et al.</i> 2003)	IOTF†	15–17	16.5	13.6	4.0	3.3
Denmark (Matthiessen <i>et al.</i> 2008)	IOTF†	15–18	15.8	7.3	1.0	0.9
Australia (Denney-Wilson <i>et al.</i> 2008)	IOTF†	14–17	21.0	15.0	6.6	4.4

\*Current study.

†Cole *et al.* 2000;

‡NCHS 1987;

§Ogden *et al.* 2002.

*et al.* 2008; Matthiessen *et al.* 2008), particularly for adolescent boys. The highest prevalence rates of obesity in the region are observed in oil rich countries, such as the UAE (Malik & Bakir 2007), Bahrain (Al-Sendi *et al.* 2003), Kuwait (Al-Isa 2004), and Saudi Arabia (Al-Almaie 2005) with estimates exceeding, for some countries, those reported by NHANES 1999–2000 (Kuczmarski *et al.* 2002).

Consistent with findings reported elsewhere (Hassapidou *et al.* 2006; Kruger *et al.* 2006), fat and protein intakes in our study did not differ significantly between normal weight and overweight subjects. However, the overweight and obese subjects were found to have a significantly higher energy intake, total and as percentage of RDA, as well as higher intake of carbohydrates. Recent studies show that low carbohydrate non-restricted-calorie diets are more effective in promoting weight loss when compared with low fat energy controlled diets (Shai *et al.* 2008). The type of carbohydrates consumed has also been suggested as an important factor in the development of obesity,

with many high-carbohydrate foods producing a high glycemic response, in a way that may be conducive to body fat gain (Brand-Miller *et al.* 2008).

Obesity in the present study was correlated with specific food choices. Compared with the normal weight, overweight and obese subjects were found to have significantly higher intakes of sugars and sweets, breads and cereals, the consumption of which has been associated with unhealthy weight gain in several other studies (Ludwig *et al.* 2001; Nielsen & Popkin 2004). In contrast, the intake of fruits, legumes, and milk products were found to be significantly lower amongst overweight subjects. Fruits and legumes are important sources of dietary fibre, are more often low glycemic-index foods and have been recently shown to play a role in weight management. Their consumption may decrease energy density, enhance satiety, and decrease energy intake (Howarth *et al.* 2001). As for milk and dairy products, several observational studies have illustrated inverse associations between dairy intake and body weight, both in

**Table 4.** Prevalence (%) of overweight and obesity among adolescents in Syria compared with those in selected neighbouring countries of the Eastern Mediterranean region and worldwide

children (Barba *et al.* 2005) and adults (Pereira *et al.* 2002). A recent trial showed that isocaloric substitution of yogurt for other foods accelerates weight loss in obese subjects and increases abdominal fat loss (Zemel *et al.* 2005). Other studies have found that dietary calcium intake, especially from dairy products; can have a protective effect on overweight and obesity (Skinner *et al.* 2003).

Regression analysis in our study showed that adolescent boys were significantly over two times more likely to be obese than girls. The higher prevalence of obesity amongst boys in this study is in line with previous reports from other countries in the region such as Lebanon, Qatar, Saudi-Arabia, and Greece (Sibai *et al.* 2003; Al-Almaie 2005; Hassapidou *et al.* 2006). This is assumed as possibly resulting from stronger cultural and social pressure on adolescent girls to maintain an acceptable body image in this age group (Sibai *et al.* 2003). Gender differentials may also be explained by differences in dietary patterns and food choices. In this study, the contribution of bread, meat, and sugar to the daily energy intake was significantly higher amongst boys (18.94, 22.92, and 4.39%, respectively) than girls (16.53, 18.60, and 2.33%, respectively) (data not shown). Our finding of a positive and significant association between obesity and family history of obesity in Syrian adolescents (OR = 2.98,  $P < 0.05$ ) corroborates those from other studies and underscores the importance of genetic factors in the aetiology of body fatness (Moussa *et al.* 1999; Oliveira *et al.* 2007).

Regression analysis was also used to examine the relationships between obesity and two socio-economic indicators – crowding index and parental education. It is worth noting that approximately half of the subjects' parents had a university education, which can be explained by the nature of the sample being urban (UNDP 2005) and the fact that university education in Syria is free and state-provided (UNDP 2005; World Bank 2008). A positive, albeit non-significant, association between socio-economic status and obesity has been observed in our study. More specifically, adolescents with university level parents and those living in less crowded households carried, respectively, approximately two-fold and 1.63 times higher risk of obesity than their counterparts. Whereas this is in line with findings reported from Arab countries of the region (Abalkhail *et al.* 2002; Al-Saeed *et al.* 2007), it contradicts findings from developed countries, where a negative association between socio-economic status and adolescent obesity has been reported (Wang 2001; Rees *et al.* 2009). The positive association between socio-economic status and obesity in the Arab region may reflect the traditional culture that values 'plumpness' (Nasser 1986) and where rich food

plays an important role in the daily diet of affluent families (Kandela 1999). Furthermore, recent studies on the relationship between obesity and family socio-economic status suggest that excess weight gain amongst children and adolescents is more prevalent amongst higher income families in less industrialized societies, especially as they move to urban areas, and amongst lower income families in more industrialized societies (Lobstein & Frelut 2003; Discigil *et al.* 2009). For children and adolescents, family income and urbanization may be associated with dietary factors such as increased consumption of energy dense foods and soft drinks instead of fruit and vegetables, and to factors linked with sedentary behaviour such as increased television watching (Ebbeling *et al.* 2002). Adolescents represent the age group that suffers the most from adoption of western lifestyle characterized by long hours of television viewing, computer games and heavy reliance on fast food, all of which are key factors affecting nutritional habits and obesity levels (Poskitt 2009).

Findings of this study should be considered in light of the following limitations. While the study sample was representative of secondary school adolescents in one urban area in Syria, the results cannot be generalized to children in other less urban and rural areas or to adolescents who are not enrolled in schools. The lack of association between physical activity and obesity in our study may be attributed to limitations in the measurement of exercise based on school activities. Furthermore, the dietary assessment using the 24-h recall may not be representative of the usual diet of the study population (Thompson & Byers 1994), and the study lacked sufficient power to detect significant association of obesity with selected characteristics as reflected by the wide CIs around the ORs in the regression analysis.

In spite of the above, this study provides the first attempt to address obesity and its covariates amongst adolescents in Syria and provides a baseline measurement of overweight and obesity for future comparisons. Also, the study used standardized international guidelines for the definition of overweight and obesity in adolescents, which allowed for comparisons with similar reports from other countries. Whereas more studies are needed to further examine the socio-cultural, economic, and behavioural factors associated with overweight and obesity in Syrian youth, now is the time to start implementing multi-component interventions at the societal and individual level, for weight control. Special attention should be given to the promotion of healthy dietary practices and food choices not only amongst children but also amongst parents, with a focus on those of high socio-economic status and family history of obesity.

### Key messages

- This study showed that obesity rates in Syrian adolescents are higher than those estimated in several European countries but lower than those reported from the United States and most Arab oil rich countries.
- Overweight and obesity prevalence rates in secondary school children in Damascus are higher amongst adolescents with high socio-economic status as assessed by parental education and crowding index.
- Obesity was found to be positively correlated with male gender, family history of obesity, and specific food choices such as higher intakes of sugars, sweets, and breads.
- Social, cultural, and nutritional dimensions of paediatric obesity need to be further investigated.
- Multi-component intervention strategies are needed at the societal and individual level, for the promotion of healthy dietary practices and weight control not only amongst children but also amongst parents.

### Acknowledgements

The authors wish to thank the staff of the University of Kalamoon in Syria for their assistance in data collection. This work was conducted partly by M.M. in partial fulfillment of her MSc Degree. M.M. conducted the survey under the supervision of N.H., Director of thesis. N.H. was responsible for design of the study and overseeing data analysis and write up of the manuscript. L.N. drafted the manuscript. A.M-S. provided statistical advice for sample selection and data collection, and was a significant manuscript reviewer. Statistical analysis and interpretation of the data were made by N.A. All authors have approved the manuscript. None of the authors had any conflict of interest.

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