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Prevalence of obesity, central obesity, and associated socio-demographic variables in Syrian women using different anthropometric indicators

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ABSTRACT: The prevalence of overweight and obesity is increasing globally in both developing and developed countries, especially, those with rapid cultural and social changes. The aims of current study were twofold: (a) to examine, for the first time in Syria, the prevalence of overweight, obesity and central obesity in Syrian women and obesity-related socio-demographic determinants, and (b) to establish a base line data about obesity related determinants needed to develop appropriate treatment and prevention strategies. Cross-sectional study with a randomly representative sample of 923 women aged 18–60 years was conducted. Waist (WC) and hip circumference (HC) were measured, and body mass index (BMI) waist-to-hip ratio (WHR) were calculated. Socio-demographic data were collected with a designed questionnaire. The overall prevalence of overweight and obesity in Syrian women as defined by BMI were 31% and 43%, respectively. The overall central obesity as defined by WC and WHR were 53% and 33%, respectively. The prevalence of obesity and central obesity were increased with age. WC and HC were strongly correlated with BMI. The mean BMIs and other anthropometric measurements were significantly higher in married, house wife, less educated, high parity, and low physical activity women. The results of this study indicate an increased rates of overweight, overall, and central obesity in Syrian women. Also, central obesity as defined by WC is higher than BMI derived obesity. In conclusion, WC is more appropriate to be used for obesity assessment, where, BMI underestimates the obesity prevalence among middle-age women. Development of appropriate treatment and prevention strategies are urgently needed to combat with increasing rate of obesity among Syrian women.

KEY WORDS: Body mass index, waist circumference, waist-to-hip ratio, socio-demographic data

Introduction

The prevalence of overweight and obesity is increasing globally in both developing and developed countries, especially, those with rapid cultural and social

changes (WHO 2012; McLaren 2007). According to the World Health Organization (WHO), obesity has become a serious epidemic health problem in many parts of the world, estimated to be the fifth leading cause of mortality at global

level (WHO 2000). Moreover, Obesity is well documented as a major risk factor for many non-communicable diseases (NCDs) and health conditions including hypertension, high lipid concentrations, type-2 diabetes, coronary heart disease, stroke, and certain cancers (Hubert et al. 1983; Calle et al. 2003). Evidence suggests that even a moderate weight loss could be useful in reducing levels of some risk factors for NCDs (WHO 1997–1998).

The WHO has defined obesity as a condition with excessive fat accumulation in the body, to the extent that health is adversely affected (Wagner-Heyward 1999). Also, in 2000 the WHO labeled obesity as the most blatantly visible, but most neglected, public-health problem worldwide (WHO 2000). Obesity is measured by various anthropometric measures such as waist circumference (WC), hip circumference (HC) and indices BMI and waist-to-hip ratio (WHR). BMI is considered the most commonly used method to define overweight and obesity in routine clinical practice and epidemiological studies. While, central obesity is measured mainly by WC or WHR (WHO 2012; Musaiger 2004).

In order to determine the body fat mass, a number of techniques have been used some of which are complex or invasive, and are inapplicable outside of specialized clinical practice including; underwater weighing (hydro densitometry), deuterium oxide dilution, dual energy X-ray absorptiometry (DEXA), air displacement (bod pod), bioelectrical impedance analysis (BIA), computerized tomography (CT) and magnetic resonance imaging (MRI). Most of these techniques have proven their validity in determining body fat (BF), but due to their disadvantages in terms of cost and time, BMI is

regarded as the most suitable indicator for obesity (Alsaif et al. 2002).

The published studies have shown that the prevalence of overweight and obesity vary significantly across the world, ranging between 15–60% among adults. Also, these studies have shown that the prevalence also depends on age and sex. It is usually more common in women than men (Al-Riyami-Afi 2003). Planning, health intervention and preventive strategies require necessary information in field of obesity for different geographical areas. Within the Eastern Mediterranean Region (EMR), existing studies have reported that the prevalence of overweight and obesity has increased significantly during the last decades and that the magnitude of this increase is greatest among women reaching an alarming level. Consequently, the incidence of NCDs is also very high and represents more than 50% of total causes of death in the EMR (Bahrami et al. 2006; WHO 1995). It has been suggested that the main factor leading to this widespread increase in obesity is the westernization of lifestyles including fatty foods and lack of physical activity. Unfortunately, national intervention and preventive strategies to prevent and control obesity in EMR are relatively absent. Additionally, factors associated with the occurrence of obesity have not been well investigated, which in turn relatively affect the impact of any programme to prevent reduce the prevalence of obesity in this region. Obesity Studies of anthropometric measures in the EMR countries have been conducted; however, studies of obesity in women are limited, and the majority of these studies used the BMI as an indicator to assess overweight and obesity prevalence, with a few of them

used other methods such as WC, HC, and WHR (Musaiger 2011).

In Syria, an EMR developing country that is, also experiencing demographic, health and nutritional transitions, very limited information exists on the prevalence of overweight, obesity, and central obesity and associated risk factors in women. The only existing obesity study was previously conducted in Aleppo, the second city in Syria (Fouad et al. 2006). This study has showed that the obesity is a major health problem in Aleppo, especially among women. However, more studies are needed to characterize the magnitude of the prevalence of overweight, obesity and central obesity. Such data are important for quantifying the likely associated burden of obesity related diseases and planning national intervention and prevention strategies.

The aims of current study were two-fold: (a) to examine, for the first time in Syria, the prevalence of overweight, obesity and central obesity in a group of women aged 18–60 years living in Damascus city (the capital city of Syria) using anthropometric measurements (BMI, WC, HC, WHR) and obesity-related socio-demographic determinants, and (b) to establish a base line data about obesity related determinants needed to develop appropriate treatment and prevention strategies.

Materials and methods

Participants

Cross-sectional study with a randomly representative sample of 923 women living in Damascus city, Syria was conducted. The study subjects consisted of healthy weight-stable women (non-pregnant or lactating) aged 18 to 60 years

(mean age 42.29 ± 10.86). The main exclusion criteria were previously known or newly diagnosed diabetes, thyroid, liver or kidney diseases, malignancy, markedly elevated blood pressure, and any medication affecting body composition. The study protocol was approved by the scientific research and the ethical committee of the Atomic Energy Commission of Syria (AECS). Each participant provided informed consent prior to participation after a detailed explanation of the study protocol. All of the measurements were done by the same person with the same equipment during morning hours. The subjects performed no strenuous physical activity for 24 h, arrived in the morning after an overnight fast at the Human Nutrition Unit, health center, AECS. Brief clinical examination was performed by specialized medical doctor. Trained clinical technicians conducted all anthropometric measurements.

Anthropometric measurements

Anthropometric measurements included weight; height, HC, and WC. Body weight was measured to the nearest 0.1 kg using calibrated an electronic scale (Seca, Model: 7671321004; Germany; D=0.05 to 0.1 kg) and height was measured to the nearest 0.1 cm using a well-mounted stadiometer (Seca, Model: 225 1721009; Germany). Subjects were measured barefoot in light underwear. WC was measured in midway between the lateral lower rib margin and the iliac crest. HC was measured at the levels of the trochanters, through the pubic symphysis. Measurements were performed to the nearest millimeter using a non-stretchable tape over the unclothed body. Three measurements were made and the mean

expressed in cm used for analysis. WHR was obtained by dividing WC by HC.

BMI was recognized as the measure of overall obesity. BMI was identified as weight divided by height squared (kg/m^2). Six categories of BMI were identified according to WHO recommendations as follows: Individuals with a BMI ≤ 18.5 kg/m^2 were classified as underweight, individuals with a BMI 18.5–24.9 were classified as normal, overweight BMI 25–29.9, and obese BMI ≥ 30 . Obesity further divided to three classes as follows: obese class 1 BMI 30–34.9, obese class 2 BMI 35–39.9, and obese class 3 BMI ≥ 40 . WC and WHR were used for central obesity measurements. Women with a WC of < 80 , 80–87.9 and ≥ 88 cm were classified as normal weight, overweight and obese, respectively. The cut-off point for central obesity was ≥ 88 cm WC. WHR was obtained by dividing WC by HC. Women with WHR < 0.80 , 0.80 – 0.84 and ≥ 0.85 were classified as normal weight, overweight or obese; respectively. The cutoff point for central obesity was ≥ 0.85 .

Socio-demographic status

The relationships between the anthropometric measurements and indices (BMI, WC, HC, and WHR) and related socio-demographic variables such as marital status, level of education, parity status, employment status, and physical activity were studied. Marital status was categorized into two groups (single and married). Parity status (only parous women) was categorized into two groups (1 child, and more than 1 child). The level of education was categorized into three levels (primary school = L1, secondary school = L2, and university degree = L3). Physical activity was cat-

egorized into three groups (low; house wife, or work site activity, moderate; performing extra activity such as high work site activity, traveling to or from working place, and high; regular fitness, sporting, and fast walking).

Statistical analysis

All analyses were performed by using the Statistical Package for Social Science SPSS (version 17). Means and standard deviations were calculated for all measures of body composition. Multiple regression analysis was performed to detect the relation between the variables; the coefficients of determination (R^2) for each regression model were calculated. Comparison between the different methods of body composition was performed using the statistical analysis of Bland and Altman (Bland-Altman 1986). The level of significance was determined as a p value < 0.05 .

Results

Anthropometric measurements

A total of a random representative sample of 923 women aged 18–60 years were met the inclusion criteria, agreed to participate and provided informed consent. The characteristics of volunteer's sample that enrolled in the study are shown in table 1. However, this sample truly reflects the general population, where, the sample individuals normally distributed in terms of age, height, weight, BMI, WC, and HC as indicated by the suggested reference indicators used in determining the normal distribution of the studied parameters. These reference indicators are presented in Table 1.

Table 1. The main statistical characteristics of the Syrian women sample included in the study

Characteristic	Mean (95% CI)	SD	Median (IQR)
Age (years)	42.29 (41.58;43.00)	10.86	43 (17)
Weight (kg)	73.34 (72.32;74.36)	15.61	72.73 (20.44)
Height (cm)	157.7 (157.34;158.06)	5.49	157.9 (7,37)
BMI (kg/m ²)	29.52 (29.11;29.93)	6.29	28.80 (8.10)
WC (cm)	88.64 (87.81;89.46)	12.66	88.4 (17.3)
HC (cm)	108.25 (107.52;106.98)	11.24	107 (13.58)

IQR – Inter–quartile range; SD – Standards Deviation; CI – Confidence Interval.

The anthropometric measurements were obtained for all participants, these included weight, height, BMI, WC and HC. WHR was calculated. Table 2 shows the anthropometric indices in Syrian women (means, standard deviations, and centiles) by age groups, with values corresponding to the 50th, 85th, and 95th percentiles by the four age groups of 18–30,

31–40, 41–50, and 51–60 years old. All anthropometric measurements except height increased fairly steadily with increasing age until the 51–60 years old age group. The mean age (SD) of women was 42.29(10.86) years. The overall mean BMI of studied group was 29.5 (5.5) kg/m². This mean was increased with increased age, from 24.41 in age

Table 2. Mean anthropometric (standard deviation) variables, percentiles by age groups in Syrian women

Age groups	N	Age (years)	Height (cm)	Weight (kg)	BMI (kg/m ²)	WC (cm)	HC (cm)	WHR
18-30	158 (17%)	25.5 (3.37)	159.0 (5.16) (159.3, 164.5, 167.0)	61.7 (12.2) (60.1, 73.1, 84.7)	24.41 (4.7) (23.9, 28.3, 32.9)	77.7 (9.9) (78.0, 88.0, 93.2)	100.1 (9.1) (99.0, 108.7, 115.2)	0.77 (0.06) (0.77, 0.83, 0.86)
		35.49 (2.95) (35.0, 39.0, 40.0)	158.7 (5.52) (158.9, 163.7, 168.4)	70.8 (14.0) (67.9, 85.1, 96.6)	28.1 (5.3) (27.2, 33.3, 38.2)	85.1 (10.3) (83.8, 96.0, 101.0)	106.6 (9.4) (104.7, 116.8, 122.97)	0.80 (0.05) (0.80, 0.86, 0.89)
41-50	296 (32%)	45.70 (2.81) (46.0, 49.0, 50.0)	158.0 (5.3) (157.8, 163.3, 166.8)	77.0 (15.3) (75.5, 92.7, 105.7)	30.9 (6.0) (30.4, 36.95, 42.3)	91.3 (11.5) (90.5, 103.0, 111.4)	110.3 (11) (109.3, 122.3, 130.3)	0.83 (0.06) (0.82, 0.89, 0.93)
		55.49 (3.33) (55.0, 59.0, 60.0)	155.6 (5.32) (155.5, 161.2, 164.5)	78.7 (15.0) (77.0, 93.5, 107.8)	32.51 (6.0) (31.6, 39.5, 44.1)	95.6 (12.6) (94.5, 109.0, 116.97)	112.3 (11.7) (110.3, 125.3, 133.1)	0.85 (0.07) (0.85, 0.91, 0.95)
All ages	923 (100%)	42.29 (10.86) (43.0, 54.0, 59.0)	157.7 (5.5) (157.8, 163.4, 166.9)	73.3 (15.6) (71.4, 89.6, 102.5)	29.5 (5.5) (28.7, 36.2, 41.2)	88.6 (12.8) (88.2, 101.1, 111.5)	108.2 (11.3) (106.9, 119.6, 129.0)	0.82 (0.06) (0.82, 0.88, 0.92)

(): 50, 85, 95% percentiles.

group 18–30 years to 32.51 in age group 51–60 years. The overall WC, HC, and WHR were 88.6(12.8) cm, 108.2(11.3) cm, 0.82 (0.06), respectively. These indices increased with age.

Prevalence of overweight and obesity

The percentage of participating women in different BMI categories is shown in Table 3. For the total studied group (n=923), 0.9% was underweight, 24% were in normal range, 31% were overweight, and 43% were obese. The majority of obese participants (25%) were in class 1 obesity and (11%) were in class 2 obesity, while 7% were in class 3 obesity. The results show that 74% of women were either overweight or obese. The prevalence of obesity between the age group 18–30 years old and the age group 51–60 years increased by 6.2 fold, as es-

timated by BMI. The percentage of the total group in obesity category increased with increase age. Conversely, in normal category decreased with age. The prevalence of underweight was rare. However, the underweight was demonstrated only in the first two age groups (18–30, 31–40 years) showing ratios of 4% and 0.5%, respectively.

The prevalence of overweight and obesity of Syrian women by age groups as defined by BMI, WC and WHR are shown in Table 4. The three measures of weight status – BMI, WC, and WHR – have shown that 74%, 75%, 63% of Syrian women were either overweight or obese, respectively. The prevalence of obesity increased with age reaching the highest ratio at the age group 51–60 years irrespective of the measurement method used. However, using WC and BMI provided the highest prevalence of obesity

Table 3. Prevalence of overweight and obesity (defined by BMI) in Syrian women by age group

Age group (years)	N (%)	Underweight N (%)	Normal N (%)	Overweight N (%)	Obesity N (%)	Ob1 N (%)	Ob2 N (%)	Ob3 N (%)
18–30	158 (17)	7 (4)	87 (55)	48 (30)	16 (10)	10 (6)	4 (3)	2 (1)
31–40	227 (25)	1 (0.5)	65 (29)	89 (39)	72 (32)	49 (22)	16 (7)	7 (3)
41–50	296 (32)	–	49 (17)	85 (29)	162 (55)	96 (32)	40 (14)	26 (9)
51–60	242 (26)	–	24 (10)	67 (28)	151 (62)	76 (31)	45 (19)	30 (12)
All ages	923 (100)	8 (0.9)	225 (24)	289 (31)	401 (43)	231 (25)	105 (11)	65 (7)

Category definition is based on WHO classification. Underweight = BMI <18.5 kg/m²; Normal = BMI 18.5–24.9 kg/m²; Overweight = BMI 25–29.9 kg/m²; Obesity1 = BMI 30–34.9 kg/m²; Obesity 2 = BMI 35–39.9 kg/m²; Obesity 3 = BMI > 40 kg/m².

Table 4. Prevalence of obesity by BMI, WC, and WHR in Syrian women by age groups

Age group (years)	No of women	BMI (kg/m ²)			WC (cm)			WHR		
		N (%)	OW (%)	O (%)	N (%)	OW (%)	O (%)	N (%)	OW (%)	O (%)
18–30	158	55	30	10	59	25	16	70	19	11
31–40	227	29	39	32	35	27	38	49	30	21
41–50	296	17	29	54	16	21	63	27	37	36
51–60	242	10	28	62	6	17	77	15	30	55
All ages	923	25	31	43	25	22	53	37	30	33

BMI: body mass index, WC: waist circumference, WHR: waist-to-hip ratio.
N: normal, OW: overweight, O: obesity.

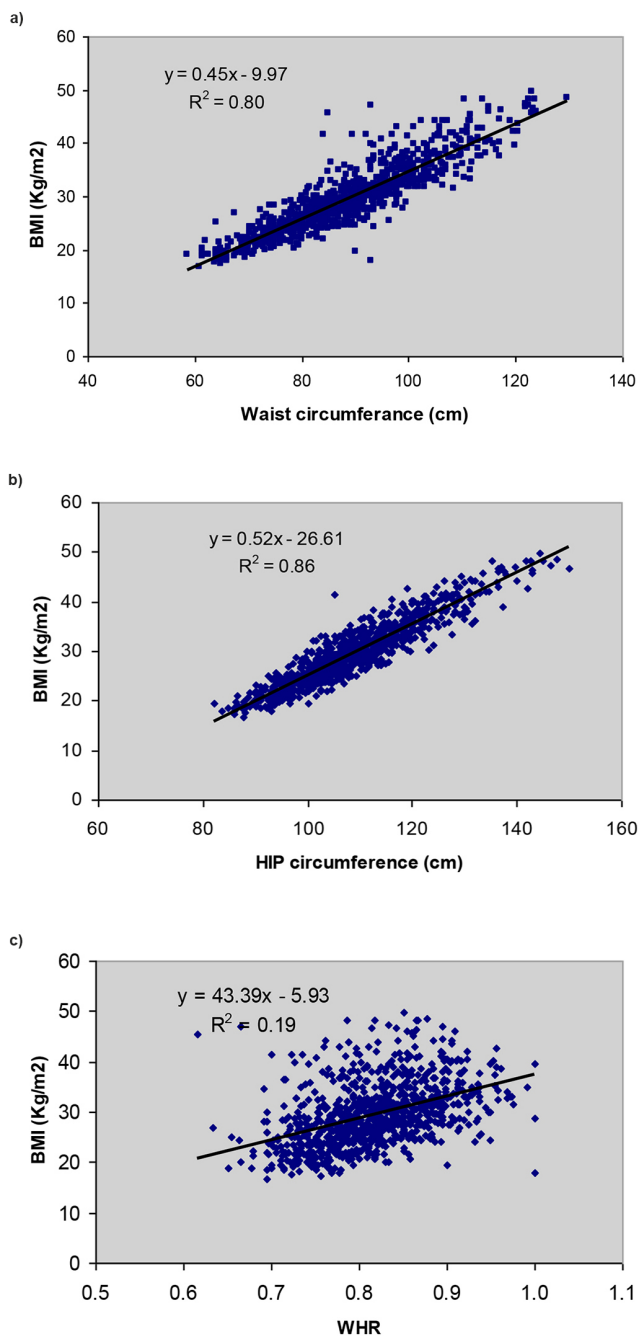


Fig. 1. Scatter plot of body mass index (BMI) against (a) Waist circumference, (b) Hip circumference, and (c) Waist-Hip-Ratio

(77%, 62% of the age group 51–60years, respectively), while WHR provided lowest prevalence in all age groups.

The overall prevalence rates of central obesity as estimated by WC and WHR were 53% and 33%, respectively. As expected, central obesity increased with age, reaching ratios of 77 % (WC), and 55% (WHR) at the age group of 51–60 years. The prevalence of central obesity as estimated by WC and WHR between the age group 18–30 years old and the age group 51–60 years old increased by 4.8 and 5 fold, respectively.

The correlation between the overall obesity (as measured by BMI) and central obesity (as measured by WC, HC, and WHR) was investigated. Figure 1 presents these correlations. As shown, WC and HC were strongly correlated with BMI ($R^2=0.80$, 0.86 , respectively).

A weaker correlation was noted between BMI and WHR ($R^2=0.19$).

Socio-demographic status

The variation in BMI and other anthropometric measurements (WC, HC, and WHR) in relation to the studied socio-demographic variables are shown in Table 5. The mean BMIs and other anthropometric measurements were significantly higher in married, house wife, less educated, higher parity (more than one child), and low physical activity women.

Discussion

The findings of the current study indicating that the overweight and the obesity are major health issues in Syrian women, increasing sharply by age. Our results

Table 5. Anthropometric indicators of weight status in Syrian women in relation to sociodemographic variables

Variable	BMI (kg/m ²) M±SD	WC (cm) M±SD	HC (cm) M±SD	WHR M±SD
Marital status				
Single	25.20 (5.54)*	78.23 (10.28)*	101.3 (9.9)*	0.77 (0.05)*
Married	30.52 (6.05)	91.00 (12.16)	109.86 (10.96)	0.83 (0.06)
Employment status				
House wife	31.24 (6.44)*	92.35 (12.80)*	111.04 (11.70)*	0.83 (0.06)**
Employed	27.84 (5.72)	84.95 (11.79)	105.43 (10.19)	0.80 (0.06)
Level of education				
1 (O level)	32.47 (6.62)*	94.72 (13.94)*	113.49 (12.42)*	0.84 (0.07)**
2 (A level)	30.18 (6.22)**	90.43 (11.92)**	109.85 (10.11)**	0.83 (0.06)**
3 (Uni-degree)	27.87 (5.71)	84.88 (11.73)	109.32 (10.76)	0.80 (0.06)
Number of children				
(1 child)	27.24(4.58)**	84.41(9.09)**	105.11(8.09)**	0.80(0.06)**
(> 1 child)	30.86(6.01)	91.75(11.86)	110.36(10.93)	0.83(0.06)
Physical activity				
Low	31.97(5.93)*	95.45(12.37)*	111.98(10.84)*	0.85(0.06)*
Moderate	29.89(6.50)**	89.55(12.96)**	108.99(11.55)**	0.82(0.07)**
High	28.36(5.68)	85.55(11.98)	105.86(10.35)	0.81(0.06)

M±SD – mean and standard deviation. Statistical significance at * $p<0.05$, ** $p<0.1$.

report an overall prevalence rate of 31% for overweight and 43% for obesity indicating that 74% of Syrian women aged between 18–60 years living in the capital city of Damascus are either overweight or obese. When these rates were applied to 2016 Syrian women population aged between 18–60 years, there were 1.1 and 1.6 million women estimated to be overweight or obese, respectively. The major finding of this study is the alarming prevalence rates of overweight and obesity among Syrian women. This finding indicating that the overweight and the obesity have reached epidemic levels affecting about 74% of Syrian women. Because overweight and obesity are the major risk factor for many NCDs, mainly cardiovascular diseases and type-2 diabetes (Hubert et al. 1983; Calle et al. 2003), these findings suggested that overweight and obesity are major adverse health conditions among Syrian women. This number illustrates the necessity of a great effort to educate the general population, and mainly women, and health professionals to identify and properly control this high rate of obesity various through development of an appropriate intervention and prevention strategies.

Although we have no previous estimates of prevalence of overweight and obesity for comparison, obesity is highly prevalent in Syria when compared to other EMR, Arab, and western countries. However, the only existing obesity study was previously conducted in Aleppo, the second city in Syria. In this study conducted in 2004, Fouad et al reported slightly higher rate of 46.3% (Fouad et al. 2006).

The prevalence rate of obesity in Syrian women (43%), reported in the present study, was higher than in many other Arab, EMR, and western coun-

tries, and relatively comparable to that of the top ranking Arab countries. According to these results, Syria ranks the 3rd among the Arab countries. However, the prevalence of obesity in EMR region as determined using either BMI or WC is one of the highest in the world. The International Obesity Task Force reported that the Middle East is one of the regions that have the highest prevalence rates of obesity worldwide (James et al 2001). According to statistics from the WHO, Kuwait ranks 9th in the world and first amongst Arab countries in women obesity. The rank order in Arab countries for obesity in women is Kuwait (55.2%), Egypt (48%), and UAE (42%), which is higher than all the European countries and about the same as USA (48.3%) and Mexico (41%). These figures in other Arab Countries such as Bahrain, Jordan, Saudi Arabia and Lebanon were (37.9%), (37.9%), (36.4%), and (27.4%), respectively. However, these countries have higher obesity rates in women than UK (26.3%), and Greece (26.4%) (Ono et al. 2005). Much lower obesity rates were reported in many Asian countries such as China, Thai, and Singapore, where, these figures are 1.5%, 8.8%, and 8.5%, respectively (Bell et al. 2001; Aekplakorn et al. 2004).

In the present study, the pattern of obesity has increased by age. The higher prevalence rate of 62% was noted in the age group 51–60 years. However, in the earlier study conducted by Fouad et al (Fouad et al 2006), they reported much higher rate of 81% at similar age group in north of Syria. Similar pattern was observed in other studies (Gallagher et al. 1996; Hesecker and Schmid 2000). In most of the EMR countries, obesity increased as age increased up to 60 years of age. This association can be explained

by physiological factors such as weight gain following menopause, the associated lowering of metabolic consumption, and the decreased level of physical activity with age. Furthermore, age has been considered as a prognostic factor for obesity in many published studies (Kac et al. 2001; Janssen 2007). However, the increase of obesity with age is of great concern in Syrian women, as it has been demonstrated that obese elderly are more likely to present with major health consequence. Moreover, obesity in Syrian women seems to start at a young age; our data show that 10% of women were obese at the ages 18 to 30 years. Therefore, primary intervention and prevention of obesity must start at a young age, particularly for girls.

Central obesity (abdominal obesity, as an indicator of intra-abdominal fat accumulation), reported in the present study, was high in Syrian women (77% and 55% at the age group of 51–60 years as defined by WC and WHR, respectively). In the current study, the prevalence of central obesity as defined by WC was higher than the prevalence of overall obesity defined by BMI. These results indicating that a significant group of Syrian women not classified as obese based on BMI might be at high risk due to increase WC. These findings indicate that prevalence of obesity might be underestimated among middle-aged women. This type of obesity (increased visceral fat which is more metabolically active than subcutaneous fat) has been shown to have more adverse health consequences than overall obesity (Montague-Rahilly 2000). Women with central obesity are more likely to develop many NCDs diseases such as hypertension, type-2 diabetes mellitus, cardiovascular disease, and stroke (Sargeant et al. 2002). Therefore,

and as WC is a simple and inexpensive method of obesity measurement (Pouliot et al. 1994) and significantly related to cardiovascular risk factor levels, and all mortality causes as it has been shown recently, it is more appropriate to be used for obesity assessment of subjects at high risk than BMI (Zhu et al. 2002). Another important value for using WC for obesity prevalence is related to the fact that BMI related obesity is based on a single cutoff for both gender, whereas, gender-specific cutoffs were used for defining the obesity with WC.

The correlations between the overall obesity (as measured by BMI) and central obesity (as measured by WC, HC, and WHR) were also investigated in this study. These correlations are highly suggestive of an association between increased overall obesity as measured by BMI and increased visceral fat as measured by WC, HC, and WHR. These findings suggest that defining obesity on the base of WC, HC, or WHR may be equally valid and useful methods for use in epidemiological research and clinical practice. Our results are in agreement with another study identified a high correlation between WC and BMI and suggested this could imply that WC is not only an indicator of abdominal adiposity but also overall obesity (Reis et al. 2009). However, other studies have suggested that WHR to be a better predictor of CVD risk (Biggaard et al. 2004). Therefore, and as shown in table 4, 53%, 33% of the all studied group and 77%, 55% at the age group of 51–60 years as defined by WC and WHR, respectively are at high risk for CVD which is in agreement with other research results (Dalton et al. 2003).

There are many reasons for high prevalence of obesity in Syrian women. The rapid development over the last decades

or so has brought significant prosperity and easier lifestyles in terms of transport, proliferation of Western style, fast fatty food, and greater opportunities for sedentary lifestyles. These reasons created a suitable environment in many parts of the country for high incidence of overweight and obesity, mainly, among women. Westernization in Syria like many Mediterranean countries has produced many western effects, most notably in the greater availability of fatty food, sugar, and carbohydrates. However, it has been reported, in Syria, that obese people eat more than normal-weight people, regardless of the type of food they eat (Fouad et al. 2006). Also, and according to the Food and Agriculture Organization of the United Nations (Statistics Division), the dietary energy consumption per person in Syria has increased from 2800 kcal/day in the year 1990 to 3050 kcal/day in the year 2007 (FAQ 2010). Many socio-demographic and economic factors have resulted in a large increase in obesity among Syrian women. The relationship between the main socio-demographic factors and women BMIs were assessed in the current study, these are; marital status, number of children, employment status, level of education, and physical activity. Married women are more susceptible to being overweight and obese; in the present study, we reported that married women had statistically a higher mean BMI, 30.52 versus 25.2 in single women ($p < 0.001$). The association of marital status and obesity has been shown in many studies. In a randomized population study in Syria, the prevalence of obesity in married women was 45% (compared to 21% in unmarried women) (Fouad et al. 2006). In Iran, Janghorbani and colleagues (2007) found that mean of BMI for married women (27.1) was

significantly higher than that for single women (24.3). Similar trends in findings were observed in several studies in the EMR region (Veghari et al 2006). The high BMI in married women may be due to their decrease in activity, higher parity, and dietary habits, where, food intake increases after marriage. The relationship between obesity and parity has been, also, investigated in current study. The results showing that women with high parity have higher mean BMI, WC, HC, and WHR. These anthropometric measurements were 27.24 kg/m², 91.18 cm, 105.11cm, and 0.80, in women with one child, respectively. These figures were increased to 30.68 kg/m², 96.81 cm, 110.36cm, and 0.83, in women with more than one child, respectively. It is estimated that nearly 25% of women experience a weight gain of 4.55 kg or more 1 year postpartum, likely due to many factors such as gestational weight gain, decreased physical exercise, and increased food intake (Oson et al. 2003). Employment status is another important factor resulted in an increase in obesity. In this study, we reported that unemployed women have a higher mean BMI compared to employed women; 31.24 (6.44) versus 27.84 (5.72). Similar trends were reported in other anthropometric parameters measurements conducted in this study. In an earlier study, Fouad and colleagues (2006), demonstrated that unemployed women in Syria have a higher rate of obesity (50%) compared to those who are employed (30%). Also, several studies in the EMR region have shown that employment status of women (but not men) is significantly associated with weight gain. In Saudia Arabia, Musaiger and colleagues (2010) found that 55.9% of nonworking women were obese. This can be explain by the fact that the em-

ployed women are generally young, besides, that the exposure of working women to the community during the work make them take care of their weight (Musaiger-Alansari 2003). Education also plays a role in obesity prevalence since there is evidence that illiteracy increases the level of obesity. For example, 51% of illiterate Syrians are obese while 28% of people with a university education are obese. Also, it has been shown that obesity rate in women with low levels of formal education is 63%, while only 11% of women receiving advanced level education were likely to be obese; respectively (Fouad et al. 2006). The association between the level of education and obesity was further assessed in this study. The results have showed that the high education level has been associated with lower BMI. BMIs were 32.47, 30.18, and 27.87 in the three education levels; L1 (low level), L2 (intermediate level), L3 (high level), respectively. However, data from the EMR region suggest that the association between education and obesity is controversial. Several confounding factors may interfere with this association such as age, marital status, and income (Musaiger 2004). Also, the effect of three levels of physical activity was evaluated among Syrian women during this study. BMIs were 31.97, 29.89, and 28.30 in three physical activity levels; low, moderate, and high level, respectively. Cultural restrictions in lifestyle choices available to women in Syria are one reason for increase prevalence of obesity: females have limited access to sporting activities. This may be aggravated by sedentary lifestyle in indigenous women. Nearly half of the women in Syria have a sedentary lifestyle, with TV being the main leisure activity (Fouad et al. 2006). However, Data on physical activity in EMR coun-

tries are very limited. Most of the available data are difficult to interpret due to differences in the way physical activity is measured. In Saudi Arabia, Al-Nozaha *et al.* (Al-Nozha et al. 2007) reported a high prevalence of physical inactivity among women (98.1%) and active individuals exhibit lower values of BMI and WC. Also in Bahrain, a significant negative relationship was seen between walking and obesity (Al-Mahroos- A;-Roomi 2001). Generally, the prevalence of inactivity among most of EMR countries is high. Based on surveys supervised by WHO/EMRO, the proportion of physical inactivity in selected countries in the region ranged from 31% in Syria to 86.8% in Sudan (WHO/EMRO 2009).

Conclusions

We are reporting in this study, for the first time, the prevalence of overweight, overall obesity, and central obesity in Syrian women using the main anthropometrics measurements; BMI, WC, and WHR. The results of this study indicated that this health issue at alarming rate in Syria, as other Arab and EMR countries. The prevalence of central obesity as defined by WC is higher than BMI derived obesity in Syrian women. The mean BMIs and other anthropometric measurements were significantly higher in married and less in educated and unemployed women. Women with high parity have, also, higher mean BMI, WC, HC, and WHR. Therefore, a community-based multiple prevention and intervention strategies should be implemented to combat with increasing level of obesity among Syrian women.

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Authors' contributions

MAB proposed the objectives of the paper, supervised the work, and the major contributor in writing the manuscript; KH participated in performing the anthropometric measurements and collecting the socio-demographic data; LM participated in statistical analysis and computing. All participants read and approved the final manuscript.

Conflict of interest

The Authors declare that they have no competing interests to the present article.

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