

Comparison between different criteria to estimate obesity prevalence and its correlates in female adults residing in central Iran

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Summary. Overweight and obesity are now one of the major health problems, worldwide which can lead to several serious medical conditions. Different criteria have been suggested and are currently used to define abdominal obesity. Our objectives was to investigate the prevalence of overweight and obesity according to different criteria and to compare these criteria examining the several factors in association with obesity derived by these criteria in female teachers. The study was conducted on 844 female teachers who lived in Yazd city in 2015. Height, body weight, waist circumference (WC) and hip circumference were measured using the standard procedures and body mass index (BMI), waist to hip ratio (WHR), and waists to height ratio (WHtR) were calculated. Data on demographics and lifestyle factors were collected by a self-reported questionnaire. The prevalence of general overweight and obesity in 844 females with were 44.5% and 27.5%, respectively using BMI data. The prevalence of abdominal obesity based on WC measurements ranged from 42.2% based on Iranian national criteria to 96.3% based on criteria developed for Chinese women. Prevalence of abdominal obesity using WHR data, ranged from 23% based on criteria developed for Omani women to 93.5% based on Iranian criteria. Considering WHtR, prevalence of abdominal adiposity was from 83.5% to 92.9% based on two different suggested criteria for Iranian females. When comparing different suggested criteria for assessing abdominal obesity in terms of their demographic and lifestyle determinants, Iranian suggested standards showed the highest number of significant associations for abdominal obesity based on WC and WHR, however this was not true for WHtR. The present study revealed that general and abdominal obesity are serious health problems among female teachers residing in central Iran and Iranian definitions might better differentiate these conditions across demographic and lifestyle characteristics of participants compared to other international criteria. Future studies trying to pool anthropometrics data from several parts of the country might lead to more reliable and discriminatory standards for abdominal obesity.

Key words: general obesity, abdominal obesity, waist circumference, waist to hip ratio, waist to height ratio

Introduction

Obesity is now a worldwide epidemic and it is estimated the obesity has affected about 700 million adults worldwide in 2015 (1). Overweight and obesity are mentioned as important risk factors for several serious conditions such as hypertension, dyslipidemia, diabetes mellitus, cardiovascular diseases and some

types of cancer (2). Furthermore, psychological conditions such as depression, decrease of self-confidence and self-efficacy might occur as a results of overweight and obesity, especially in young women (3).

The prevalence of obesity varies significantly across different countries ranging from 15 to 60% among adult populations. It is shown that obesity is more common in women (4). The prevalence of over-

weight, obesity and non-communicable diseases are also increasing in Middle East and this situation influences the economic and social conditions and also total causes of death(5).

Information about the prevalence of overweight and obesity based on age groups, gender, education level and socio-economic status from different populations are important for programming the community based interventions. Body mass index (BMI) is a simple estimate that have been long used to predict general obesity in adults, and commonly used to classify general overweight (BMI 25.0–29.9), obesity (BMI greater than or equal to 30.0), and sever obesity (BMI greater than or equal to 40.0). The majority of studies conducted in Middle East have used BMI to report the prevalence rates for overweight and obesity. For instance, Dastgiri and colleagues reported a prevalence of 45.2% and 24% for overweight and obesity in Tabrizi women (north-west of Iran), respectively (6). In a recent study conducted in Yazd Province, Ghadiri-Anari et al. reported that about 43.9% of female adults were overweight or obese (7).

A number of recent studies have suggested that indices for central adiposity including waist circumference (WC), hip circumference, waist-to-hip ratio (WHR) and waist-to-height ratio (WHtR) might better predictors for obesity-related cardiovascular disease or cancers (8). In Middle Eastern countries, the prevalence rates for obesity and overweight are mostly reported using BMI categories. A limited number of studies have also tried to report the prevalence of central obesity based on WC and WHR measurements among Iranian adults. For instance, Sotoudeh et al showed that that 66.8% of adult females were overweight or obese and central obesity ($WHR \geq 0.85$) was 35.7% in Islamshahr.(9). In the north of Iran, prevalence rate for central obesity using WC criteria in women was reported to be 46.2% for women aged 30-39 years (10).

We are not aware of any study trying to report and compare the prevalence of overweight and obesity based on all these four recommended indices including BMI, WC, WHR and WHtR in Middle East. According to the National Health Survey in Iran (11), women aged 20-40 years old gained weight more and faster than other age groups. Teachers are one of the

highly educated parts of the population that their health status is of great importance because they have important roles in educating the next generation(12). Therefore, In the present study we tried to report and compare the prevalence of overweight and obesity using different indices (BMI, WC, WHR and WHtR) in a large sample of female teachers residing in Yazd, central Iran.

Materials and methods

The current cross-sectional study was carried out in 2015 among female teachers living in Yazd. Multistage cluster random-sampling method was used to select 844 women aged 20-60. They were asked to fill a questionnaire about demographic characteristics, economic status and physical activity and send it back to researchers. Written informed consent was obtained from each participant. This study protocol was approved by the Nutrition and Food Security Research Center, Shahid Sadoughi University of Medical Sciences (registry number: P.17.1.11523).

Assessment of anthropometric measures

Participants were weighed using SECA portable digital scale (model no: 813) to the nearest 0.1 kg, while they were standing on the scale, without help with minimum possible clothes. Height was measured in a standing position using a plastic non-stretchable tape measure fixed on a straight wall to the nearest 0.5 centimeter (cm). To measure height, participants were barefoot and their heads (in Frankfurt position), shoulder blades, buttocks and heels were touching the wall. Waist circumference (WC) was recorded to the nearest 0.5 centimeter using a non-stretchable plastic tape placed midway between iliac crest and lowest rib while participants were in standing position. Measurement for hip circumference was also done over the largest part of the buttocks with the accuracy of 0.5 cm. To reduce the between observer error, all measurements were done by the same trained assistant. Body mass index (BMI), was calculated as weight in kilograms divided by height in meters squared (kg/m^2). Waist to hip ratio (WHR) and waist to height ratio (WHtR) were also calculated.

Definition of General and abdominal overweight and obesity

General overweight and obesity were defined based on BMI categories. Participants with BMI < 25 kg/m² were considered as normal. Those with BMI between 25–29.9 and BMI ≥ 30 were categorized as generally overweight and obese, respectively. Abdominal obesity was defined using different indices including WC, WHR and WHtR. Several cut-off points are suggested to define obesity based on mentioned indices. In the present study, we tried to select cut-offs recommended by the world health organization (13) and criteria developed for females residing in different countries including Middle-East, east Asia and united states (Table 1).

Assessment of other variables

Data on physical activity was obtained by using the Iranian version of short form International Physical Activity Questionnaire (IPAQ) validated to be used in Iranian adults and expressed as metabolic equivalent hours per week (MET-h/wk)(14). Participants were categorized to sedentary and active based on the median of their calculated metabolic equivalents (15).

The economic status was also assessed by using a 9 item questionnaire. The questions were as follow: number of family members, husband's occupation, the head of household (husband/ herself/ other family members), house ownership status (owner/tenant), type of house (apartment/ house), number of bedrooms in the house, car ownership (yes/no), number of cars owned by the family, family income per month. Participants were categorized into low, middle, high economic status according to tertiles of the overall summed scores.

Age (20–50 years/ over 50 years), marital status (single/ married), participants' education (college/ Bachelor degree/ Master degree or higher), husbands' education (high school/ college or Bachelor degree/ Master degree or higher) and numbers of deliveries (none/ one/two/ three or more) the participants experienced in their life were also collected by self-reported questionnaire.

Statistical analysis

Prevalence rates and their corresponding standard errors of general and abdominal overweight/obesity for all study members and also based on participants'

Table 1. Different definitions for abdominal obesity based on WC, WHR and WHtR

WC (cut-off points)		WHR (cut-off points)		WHtR (cut-off points)	
WHO (13)	>80 cm* >88 cm**	WHO (13)	≥0.85 cm		
IDF(Europids) (19, 33)	>80 cm	US Department of Agriculture and US Department of Health and Human Services (34)	≥0.80 cm		
NCEP (32)	>88 cm				
Canadian Clinical Practice Guidelines (35)	>80 cm				
Delavari et al (20)	>90 cm*	Mirmiran et al (16)	0.78–0.92	Hajian-Tilaki et al (10)	0.51
Esteghamati et al (21)	>95 cm**	Sarrafazadegan et al (18)	≥0.86 cm	Sarrafazadegan et al (18)	0.53
Mirmiran et al (16)		Qiao and Nyamdorj (36)		Mirmiran et al (16)	0.50–0.63
		18–34 years	0.82		
		35–54 years	0.87		
		55–74 years	0.91		
China (31)	75–80 cm†	Oman (37)	≥0.91 cm	Turkey (17)	0.59
		White women (USA,UK) (36)	0.83–0.85	Korea (38)	0.51

*Increased Risk of metabolic complications; **Substantially increased Risk of metabolic complications; + Abdominal overweight: those at risk of CVD but requiring only life style change; ++ Abdominal obesity: those at high risk for CVD events, requiring immediate intervention for CVD prevention; † Waist circumference for obesity, diabetes, and CVD risk

age (<50/ ≥50), marital status (single/married), education (high school/bachelor's degree/master's degree), husband's education (high school/bachelor's degree/master's degree), number of deliveries (none, one, two, three or more), physical activity (sedentary/active) and economic status (low income/ middle income/ high income) were calculated and reported. Comparison of continuous and categorical variables across participants' general or abdominal overweight/obesity status was done by the use of independent samples student's t-test and chi-square test, respectively. Data were summarized and analyzed using SPSS version 20 (IBM SPSS, Tokyo, Japan). P-values ≤0.05 were considered as statistically significant.

Results

The prevalence of general overweight and obesity in 844 females with data on anthropometric measurements were 44.5% and 27.5%, respectively. The prevalence of abdominal obesity based on WC measurements was estimated to be 69.4% based on WHO and adult treatment panel (ATPIII) of national cholesterol education program (NCEP), 42.2% based on Iranian national criteria, 91.5% based on international diabetes federation (IDF) and 96.3% based on criteria developed for Chinese women. The prevalence of abdominal obesity, according to WHR was 68.67% (WHO and NCEP criteria), 89.3% (United States department of agriculture: USDA), 93.5% (Iranian criteria developed by Mirmiran et al), 57.2% (Iranian criteria developed by -Sarrafzadegan et al), 50.1% (Qiao and Nyamdorj), 23% (cut-offs developed for Omani females) and 77% (cut-offs suggested for white women) based on different criteria. Considering WHtR, prevalence of abdominal was 90.2% (cut-off points for Korean females and an Iranian criteria developed by Hajian et al), 83.5% (Iranian criteria suggested by Sarrafzadegan et al), 92.9% (IRAN criteria developed by Mirmiran et al) and 51.8% (cutoff points for Turkish females).

Four hundred and fifty female teachers aged 40.60±8.24 years agreed to provide their demographic and lifestyle data. The prevalence of overweight and obesity in 450 women who participated in the second step of the study were 43.3% and 27.3%, respectively. In overall, about 71% of teachers were overweight or obese (Table

2). The lowest prevalence of abdominal obesity based on WC data was 44.0% (based on Iranian criteria for abdominal obesity) and the highest was 96.7% according to China's cutoff point. Prevalence of obesity based on elevated WC according to WHO and NCEP cut-offs was 68.7% (Table 3).

When we used WHR data to assess the prevalence of abdominal obesity, the prevalence was 22.9% based on a cut-off suggested for Omani females and the highest prevalence of obesity based on WHR measurement was shown using a modified version of cut-points suggested for Iran population (16). Based on WHO cut-offs, 65.6% of samples were obese (Table 4).

Prevalence of obesity, according to WHtR ranged from 52% using cut-offs suggested for Turkish females (17) to 82.44% based on a criteria suggested for Iranians (18) (Table 5).

The prevalence of general and abdominal obesity defined using different criteria according to demographic and some lifestyle characteristics of participants are summarized in tables 2 to 5. In total, both general and abdominal obesity were more prevalent in participants aged more than 50 years compared to those who were younger; however the difference was not significant for general overweight or obesity (Table 2).

Among different criteria, general obesity or overweight and also abdominal obesity defined based on IDF (19) and China cut-offs for WC and Iran cutoffs for WHtR were statistically different between single and married participants (Tables 2-5).

General obesity and abdominal obesity defined based on Iranian cutoff points (16, 20, 21) for WC, WHO and white-women definitions for WHR and modified cutoff point for Turkish population for WHtR were inversely associated with physical activity (Table 3). Higher physical activity was related to a decrease prevalence of obesity. (Tables 2-5).

Education level was not associated with general overweight and obesity (Table 2). However, abdominal obesity defined based on IDF and Iran's criteria for WC, Iranian and chinese cut-offs and definition suggested in Omani females for WHR and Turkish cutoff point and Iran cutoff point for WHtR were inversely associated with education level.

Economic status and husband's education did not have relationship with any index or cutoff points of

Table 2. Prevalence of general overweight, obesity and overweight/obesity based on demographic and lifestyle characteristics (n=450).

		Overweight (BMI: 25-29.9 kg/m²)	Obese (BMI≥30 kg/m²)	Overweight or obese (BMI≥25 kg/m²)
Age group	20-50 y	41.58±0.49*	27.37±0.44	68.95±0.46
	Over 50 y	52.17±0.5	27.54±0.44	79.71±0.40
	P value	0.102	0.977	0.071
Marital Status	Single	30.23±0.46	25.58±0.44	55.81±0.50
	Married	44.94±0.49	27.65±0.44	72.59±0.44
	P value	0.064	0.772	0.021
Economic status	Low	40.43±0.49	25.53±0.44	65.96±0.47
	Middle	44.37±0.50	30.46±0.46	74.83±0.43
	High	45.22±0.50	26.11±0.44	71.34±0.45
	P value	0.678	0.580	0.245
Physical activity	Sedentary	41.54±0.49	30.86±0.46	72.40±0.45
	Active	49.06±0.50	16.04±0.37	65.09±0.90
	P value	0.173	0.003	0.149
Education	college	46.59±0.50	29.55±0.46	76.14±0.43
	bachelor's degree	43.04±0.50	27.83±0.45	70.87±0.45
	Master degree or higher	41.18±0.50	21.57±0.41	62.75±0.49
	P value	0.787	0.576	0.245
Husband's education	High school	35.34±0.48	35.34±0.48	70.69±0.46
	College or Bachelor's degree	49.37±0.50	23.21±0.42	72.57±0.45
	Master degree or higher	46.88±0.50	31.25±0.47	78.12±0.41
	P value	0.043	0.046	0.553
Number of deliveries	None	26.92±0.45	11.54±0.32	38.46±0.49
	1 child	43.68±0.50	22.99±0.42	66.67±0.47
	2 children	46.62±0.50	24.87±0.43	72.49±0.45
	3 or more children	42.98±0.50	41.32±0.50	84.30±0.36
	P value	0.068	≥0.001	≥0.001
Total		43.33±0.50	27.33±0.45	70.67±0.46

* Data are presented as Mean± standard error of mean (SE); P values are calculated using chi-square test.

general and abdominal obesity. In contrast, number of deliveries inversely associated with all indices based on different cutoff points. General or abdominal overweight/obesity was more prevalent in those with more deliveries (Tables 2-5).

Discussion

The present study revealed a high prevalence of general and abdominal overweight/obesity in Yazdi

female teachers based on different definitions. According to our finding, prevalence of general overweight and obesity were 44.5% and 27.5%, respectively. Ghadiri-Anari et al (7) reported 36.4% of 40-49 years old women were overweight and 15.5% of 40-49 years old women were obese in Yazd Province between June 2009 to May 2011. In Neyshabur (Eastern Iran) 45.5% of women were overweight and 30.4% were obese (22). In Tehran, 39.5% of women were overweight and 40.3% were obese (23). Prevalence of general overweight and obesity in women who lived in

Table 3. Prevalence of abdominal overweight/obesity based on different criteria suggested for waist circumference measurements (WC) (n=450).

		WHO- NCEP	IDF- CANADA	IRAN (Abdominal overweight)	IRAN (Abdominal obesity)	CHINA
Age group	20-50 y	65.53±0.47*	88.16±0.32	59.74±0.49	41.32±0.49	96.05±0.19
	Over 50 y	85.51±0.35	100±0.00	75.36±0.43	57.97±0.50	100±0.00
	P _{value}	0.01	0.003	0.014	0.01	0.093
Marital Status	Single	60.47±0.49	76.74±0.43	53.49±0.50	44.19±0.50	90.70±0.29
	Married	69.63±0.46	91.36±0.28	63.21±0.48	44.20±0.50	97.28±0.16
	P _{value}	0.218	0.002	0.211	0.999	0.022
Economic status	Low	68.09±0.47	91.49±0.28	58.16±0.49	41.84±0.49	96.45±0.18
	Middle	66.89±0.47	91.39±0.28	62.91±0.48	43.71±0.50	96.03±0.19
	High	71.34±0.45	87.90±0.32	65.61±0.47	46.50±0.50	98.09±0.14
	P _{value}	0.683	0.485	0.409	0.717	0.546
Physical activity	Sedentary	88.10±0.32	90.50±0.30	65.85±0.48	47.18±0.50	96.44±0.18
	Active	85.00±0.36	88.68±0.32	51.89±0.50	33.96±0.47	97.17±0.17
	P _{value}	0.463	0.584	0.011	0.017	0.717
Education	college	76.14±0.43	97.73±0.15	70.45±0.46	59.09±0.49	98.86±0.11
	bachelor's degree	68.61±0.46	87.70±0.33	61.49±0.48	42.39±0.49	96.12±0.19
	Master degree or higher	56.86±0.5	92.16±0.27	54.90±0.50	29.14±0.46	98.04±0.14
	P _{value}	0.061	0.018	0.152	0.002	0.374
Husband's education	High school	76.72±0.42	94.83±0.22	67.24±0.47	53.45±0.50	97.14±0.86
	College or Bachelor's degree	67.93±0.47	90.72±0.29	62.87±0.48	40.51±0.49	96.62±0.18
	Master degree or higher	70.31±0.46	90.63±0.29	62.50±0.49	46.88±0.50	100.0±0.00
	P _{value}	0.233	0.385	0.697	0.068	0.327
Number of deliveries	None	32.69±0.47	69.23±0.47	28.85±0.46	17.31±0.38	84.62±0.36
	1 child	65.52±0.48	89.66±0.30	56.82±0.50	36.78±0.48	97.70±0.15
	2 children	67.20±0.47	90.47±0.29	62.43±0.48	41.80±0.49	97.35±0.16
	3 or more children	88.43±0.32	98.35±0.13	80.17±0.40	63.64±0.48	100.0±0.00
	P _{value}	≥0.001	≥0.001	≥0.001	≥0.001	≥0.001
Total		68.67±0.46	90.00±0.30	62.22±0.48	44.00±0.50	96.67±0.18

some of Middle East counties are reported as follows: Bahrain (31.1% and 40.3%)(24), Kuwait (28.9% and 53%) (25) and Oman (27.2% and 22.3%) (26). As our study shows, the prevalence of general overweight and obesity is close to other parts of Iran.

This is the first study which tried to report and compare the prevalence of overweight and obesity base on different criteria suggested for WC, WHR and WHtR. Previous studies have tried to assess the prevalence of abdominal obesity based on just one or two definitions. For instance, the prevalence of obesity For WHR in our study was 57.2% and 50.1% based on criteria suggested for Iranian females by Mirmiran et al (16) and Sarrafzadegan et al (18); respectively. Another cross-sectional study conducted in 2000, report-

ed that the prevalence of abdominal obesity based on WHR was 16.3% in 50-56 years old women in Yazd (27).

Based on cutoff points for WC which was modified for Iranian populations our results show that prevalence of abdominal obesity was 44% and this rate was about 70% based on NCEP criteria. Results from Yazd Healthy Heart Project published in 2006 (28) also showed that the prevalence of elevated WC considering NCEP cutoff point was 74.3% in women. In north of Iran, Hajian-Tilaki reported that the frequency of inappropriate WC (WC > 88 cm) among 40-49 years old women was 62.2% (10). Frequency of central obesity using definitions based on WHR data was 35.7% in women of Islamshahr (9), 73.3% in Khoram Abad

Table 4. Prevalence of abdominal overweight/obesity based on different criteria suggested for waist to hip ratio (WHR) (n=450).

		WHO	USDA	Iran (Mirmiran et al)	Iran (Sarrafzade- gan et al)	Qiao and Nyamdoj	Oman	White women
Age group	20-50 y	62.11±0.48*	86.58±0.34	92.11±0.27	53.16±0.50	46.05±0.50	19.21±0.39	74.21±0.44
	Over 50 y	84.06±0.37	100.0±0.0	100.0±0.0	79.71±0.40	75.36±0.44	42.03	95.65±0.20
	P value	≥0.001	0.001	0.016	≥0.001	≥0.001	≥0.001	≥0.001
Marital Status	Single	58.14±0.50	88.37±0.32	93.02±0.26	48.84±0.50	41.86±0.50	16.28±0.37	79.07±0.41
	Married	66.17±0.47	88.64±0.32	93.33±0.25	58.27±0.49	51.60±0.50	23.46±0.42	77.28±0.42
	P value	0.292	0.958	0.938	0.234	0.224	0.286	0.79
Economic status	Low	64.57±0.48	90.07±0.30	93.62±0.24	56.03±0.50	48.94±0.50	24.82±0.43	77.30±0.42
	middle	63.58±0.48	86.09±0.35	94.04±0.24	54.30±0.50	50.99±0.50	26.49±0.44	73.51±0.44
	High	68.79±0.46	90.45±0.29	92.36±0.27	61.78±0.49	52.23±0.50	17.83±0.38	82.17±0.38
	P value	0.591	0.411	0.827	0.380	0.849	0.159	0.187
Physical activity	Sedentary	68.25±0.47	88.72±0.32	93.77±0.24	59.64±0.49	52.82±0.50	24.33±0.43	79.82±0.40
	Active	56.60±0.50	88.68±	92.45±0.27	49.06±0.50	42.45±0.50	16.98±0.38	69.81±0.46
	P value	0.028	0.990	0.633	0.055	0.063	0.144	0.032
Education	college	72.73±0.45	93.18±0.25	96.59±0.18	69.32±0.46	62.50±0.49	34.09±0.48	85.23±0.36
	bachelor's degree	65.05±0.48	87.70±0.33	92.23±0.27	55.66±0.50	49.51±0.50	20.71±0.40	76.05±0.43
	Master degree or higher	56.86±0.50	88.24±0.32	94.12±0.24	47.07±0.5	37.25±0.49	17.65±0.38	74.51±0.44
	P value	0.153	0.351	0.343	0.021	0.012	0.020	0.160
Husband's education	High school	68.97±0.46	87.93±0.33	92.24±0.27	65.52±0.48	59.48±0.49	29.31±0.46	80.17±0.40
	College or Bachelor's degree	67.09±0.47	90.30±0.30	94.09±0.24	57.81±0.49	49.37±0.50	21.52±0.41	79.32±0.40
	Master degree or higher	62.50±0.49	87.50±0.33	93.75±0.24	50.00±0.50	46.87±0.50	23.44±0.43	70.31±0.46
	P value	0.675	0.711	0.800	0.116	0.140	0.272	0.250
Number of deliveries	None	40.38±0.49	76.92±0.42	82.69±0.38	34.62±0.48	30.77±0.47	9.62±0.30	57.69±0.50
	1 child	59.77±0.49	87.36±0.34	90.80±0.29	48.28±0.50	40.23±0.49	24.14±0.43	73.56±0.44
	2 children	67.72±0.47	88.36±0.32	94.18±0.23	59.79±0.49	52.38±0.50	20.63±0.40	77.78±0.42
	3 or more children	76.86±0.42	95.04±0.21	98.35±0.13	69.42±0.46	63.64±0.48	30.58±0.46	88.43±0.32
	P value	≥0.001	0.007	0.001	≥0.001	≥0.001	0.019	≥0.001
Total		65.56±0.47	88.67±0.32	93.33±0.25	57.32±0.49	50.67±0.50	22.89±0.42	77.56±0.41

* Data are presented as Mean± standard error of mean (SE); P values are calculated using chi-square test.

(West of Iran)(29); 93.25% of 30-50 year old women of Neyshabur (22) and in 82.1% of women were obese in Tehran (23). Current study revealed that abdominal obesity ranges between 23% to 93.5% based on different criteria.

In the present study Prevalence of obesity according WHtR ranged between 51.8% to 92.9% using dif-

ferent cutoff points; Agha-Alinejad et al reported prevalence 54% for WHtR for women who lived in some urban areas in Iran (30). Therefore, the prevalence of central obesity based on WHtR, is considerably higher in Yazdi femals compared to other urban areas of Iran.

Our study revealed that Chinese cutoff point for abdominal obesity based on WC (31) might not be

Table 5 . Prevalence of abdominal overweight/obesity based on different criteria suggested for waist to height ratio (WHtR) (n=450).

		Iran(Hajian et al) and korea	Iran (Mirmiran et al)	Iran (Sarrafzadegan et al)	Turkey
Age group	20-50 y	88.68±0.32*	92.63±0.26	80.26±0.40	48.95±0.50
	Over 50 y	100.0±0.0	100.0±0.0	94.20±0.23	66.67±0.48
	P _{value}	0.003	0.02	0.005	0.007
Marital Status	Single	81.40±0.39	88.37±0.32	72.09±0.45	41.86±0.50
	Married	91.36±0.28	94.32±0.23	83.70±0.37	53.09±0.50
	P _{value}	0.035	0.125	0.056	0.161
Economic status	Low	91.49±0.28	95.04±0.22	82.98±0.38	46.81±0.50
	Middle	90.73±0.29	94.70±0.22	82.12±0.38	52.98±0.50
	High	89.81±0.30	92.36±0.27	82.80±0.38	55.41±0.50
	P _{value}	0.883	0.563	0.979	0.315
Physical activity	Sedentary	90.80±0.29	94.07±0.24	83.98±0.37	58.16±0.49
	active	89.62±0.30	93.40±0.25	77.36±0.42	32.08±0.47
	P _{value}	0.718	0.802	0.119	≥0.001
Education	college	97.73±0.15	98.86±0.11	88.64±0.32	63.64±0.48
	bachelor's degree	88.35±0.32	92.56±0.26	81.23±0.39	51.78±0.50
	Master degree or higher	92.16±0.27	94.12±0.24	80.39±0.40	33.33±0.48
	P _{value}	0.027	0.090	0.246	0.003
Husband's education	High school	95.96±0.20	96.55±0.18	88.79±0.32	59.48±0.49
	College or Bachelor's degree	90.30±0.30	93.67±0.24	83.54±0.37	50.63±0.50
	Master degree or higher	90.62±0.30	93.75±0.24	79.69±0.40	53.13±0.50
	P _{value}	0.204	0.517	0.233	0.293
Number of deliveries	None	73.08±0.45	80.77±0.40	51.92±0.50	25.00±0.44
	1 child	91.95±0.27	94.25±0.23	81.61±0.39	39.08±0.49
	2 children	88.89±0.31	93.65±0.24	82.01±0.38	49.74±0.50
	3 or more children	99.17±0.09	99.17±0.09	96.69±0.18	75.21±0.43
	P _{value}	≥0.001	≥0.001	≥0.001	≥0.001
Total		90.44±0.29	93.78±0.24	82.44±0.38	51.78±0.50

* Data are presented as Mean± standard error of mean (SE); P_{values} are calculated using chi-square test.

appropriate for Iranian population because estimating the abdominal obesity using this definition resulted in largely different estimates. Iranian cutoff point for abdominal overweight or obesity (16, 20, 21) were partly similar but had some differences with WHO (13) and NCEP (32) cutoff points particularly in discriminating the association between physical activity categories and obesity; therefore, it seems that Iranian cutoffs for WC are more reliable particularly when trying to assess the determinants of abdominal overweight or obesity in an Iranian population.

Also among definitions suggested for abdominal obesity based on WHR, the Iranian definitions could

better reveal the association between demographic and life-style characteristic and obesity. In contrast, our analyses showed that Turkish definition for abdominal obesity based on WHtR data could show the association between more factors and obesity compared to other definitions. Prevalence of overweight and obesity according Iranian cutoff points for WHtR were close together; however, the prevalence rates estimated using Iranian definitions were considerably higher than Turkish cut-point.

It seems cutoffs modified for Iranian population are more appropriate for anthropometric assessment. Future studies with more sample size are needed to

confirm this result. To the best of our knowledge, this is the first study trying to compare different widely used criteria suggested for abdominal obesity in terms of their power to show the determinants of obesity. According to our knowledge this is the first study in Iran that assessed overweight and obesity with all indices for obesity and modified cutoff point for Iranian population.

Our study had a number of limitations that should be considered. First, although we had complete anthropometric data for 844 female teachers we could not encourage all teachers to participate in the second step of study. Second, we did not use direct methods to measure body fat mass.

Our finding indicates that overweight and obesity are serious health problems among female teachers and it seems lifestyle changes and interventions are necessary and Iranian definitions for abdominal overweight and obesity based on WC and WHR measurements can better discriminate these conditions compared to other widely used criteria; however, our study could not confirm this for WHtR. We recommend other large scale studies with the aim to compare the present available criteria to define general and abdominal obesity.

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