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Prevalence of Metabolic Syndrome in Adult Females: Comparison between Iranian National Definition and Currently Used International Criteria

Simin Shahvazi; MSc[1,2], Azadeh Nadjarzadeh; PhD[1,2], Ziba Mehri; BSc[1,2] & Amin Salehi-Abargouei; PhD*[1,2]

[1] *Nutrition and Food Security Research Center, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.*
[2] *Department of Nutrition, School of Public Health, Shahid Sadoughi University of Medical Sciences, Yazd, Iran.*

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Corresponding author:
Department of Nutrition, School of Public Health, Shahid Sadoughi University of Medical Sciences, Shohaday Gomname BLV, Yazd, Iran.
abargouei@hlth.mui.ac.ir
Alternate email:
abargouei@gmail.com

Postal code: 8915173160
Tel: +98 9177173273

ABSTRACT

Background: The prevalence of metabolic syndrome (MetS) is increasing worldwide. Limited data are available trying to compare different definitions suggested to identify MetS. This study aimed to compare the prevalence of MetS and its components based on currently available international and Iranian national definitions. **Methods:** The present cross-sectional study was conducted in 2015 amongfemale teachers residing in Yazd city. Demographic data and information on physical activity, participants, education, economic statusand number of deliveries were gathered using self-administered questionnaires. Anthropometric measurements and serum lipid profile were assessed according to standard procedures. MetS was defined based on international diabetes federation (IDF), national cholesterol education program; adult treatment panel III (NCEP, ATPIII), and Iranian national definition. **Results:** A total number of 450 participants aged 40.60 ± 8.25 y were included in this analysis. Prevalence of MetS based on ATPIII definition, IDF definition, and Iranian modified definition were 39.11%, 40.89%, and 31.11%, respectively. Prevalence of MetS among women aged over 50 y was more than those aged 20-50 y ($P < 0.001$). Based on different definitions, women with higher physical activity had lower prevalence of MetS (base on ATPIII, $P = 0.036$). Prevalence of MetS also was higher in women with more deliveries (for three definitions, $P < 0.001$). **Conclusions:** The prevalence of MetS was high in female teachers living in central province of Iran. It seems that ATPIII and Iranian national criteria can better represent the differences in the prevalence of MetS. Large scale prospective studies are recommended to confirm our results.

Keywords: *Prevalence; Metabolic syndrome definitions; Female teachers; Iran*

Introduction

Metabolic syndrome (MetS) is a cluster of several metabolic abnormalities, including abdominal obesity, hypertension and abnormal serum triacylglycerol, high density lipoprotein cholesterol (HDL-c), and glucose levels. This situation is usually accompanied with some important subclinical characteristics such as low-

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grade inflammation, endothelial dysfunction, plasma hypercoagulability, and atherosclerosis (Hui et al., 2010). MetS is associated with higher risk of diabetes, cardiovascular diseases (CVDs) (Grundy et al., 2005), and thus is estimated to increase risk of mortality by about 46% (Hui *et al.*, 2010).

The prevalence of the MetS is increasing worldwide (Lim et al., 2011). The National Health and Nutrition Examination Survey (NHANES) reportedits prevalence 22.9% in the US in 2010 (Beltrán-Sánchez et al., 2013). Furthermore, prevalence of MetS in Latin American adults varied from 14% to 27% (Escobedo et al., 2009). Additionally, the age-standardized prevalence of the MetS was 14.2% in European women based on world health organization (WHO) definition (Hu et al., 2004). Moreover, in Nepal, 21.9% of women had MetS according to the national cholesterol education program, adult treatment panel III (NCEP, ATPIII) criteria (Sharma et al., 2011) and its prevalence in Canadian woman was 19.5% (Riediger and Clara, 2011). Accordingly, the prevalence of MetS in Saudi females was reported to be 16.1 and 13.6% based on the IDF and ATP III definitions (Al-Qahtani et al., 2006). In the same regard, Gundogan et al., reported the prevalence of 41.8% (based on ATPIII) and 44.0% (based on IDF) in Turkish females (Gundogan et al., 2013). In 2009, it was estimated that more than 11 million Iranians were affected by MetS (Delavari et al., 2009) and the prevalence of MetS rangedfrom9.7% to 62.2% (Barahimi et al., 2009, Sadrbafoghi et al., 2006). In Yazd province (central Iran), the latest report on MetS dates back to a decade ago saying that the prevalence of this syndrome was about 62.2 % in females (Sadrbafoghi et al., 2006).

There are different definitions for MetS, including WHO (Alberti and Zimmet, 1998), NCEP-ATPIII (Program, 2001), the European Group for the study of insulin resistance (Balkau and Charles, 1999), American heart association (AHA)/national health, lung and blood institute (NHLBI) (Grundy et al., 2005), the American Association of Clinical Endocrinologists (AACE) (Einhorn, 2003), and the International Diabetes Federation (IDF) (Alberti et al., 2006). Furthermore, Aziz et al. (Fereidoun Azizi et al., 2010) modified the definition for MetS to be used for Iranian population.

Several factors including life-style, demographic factors, socio-economic status, ethnicity, genetic factors, age, body mass index (BMI), menopause, diet, smoking, alcohol intake, and physical activity have been proposed to be associated with MetS (Athyros et al., 2011, Seneff et al., 2011, Zhu et al., 2004).

There are a limited number of studies trying to compare these widely used criteria to define MetS. Therefore, in the present study, we aimed to investigate the prevalence of MetS and its components according to different international and Iranians' national criteria. We also targeted examining the differences among possible determinants of MetS and their associations in female teachers residing in Yazd city, Iran.

Materials and Methods

Participants and study design: The present cross-sectional study was conducted in 2015 among female teachers residing in Yazd city. Considering at least 20% for the prevalence of MetS, a confidence of 95%, and precision (d) of 4%, the minimum number of participants required for this study was calculated to be 386 participants (Pourhoseingholi et al., 2013). Multistage cluster random-sampling method was used to select 450 women aged 20-60 years from 84 schools of Yazd city. Yazd has two educational regions, from region one 18 elementary schools and 12 guidance or high schools, and from region two 31 elementary schools and 23 non-elementary schools were randomly selected. Each school was used as a cluster and its teachers were invited to participate in the study. The study protocol was approved by the nutrition and food security research center (NFSRC) of Shahid Sadoughi University of Medical Sciences. Written

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informed consent was obtained from each participant eligible to enter the research. Anthropometric assessments were conducted in the first step. After that, data on general characteristics, such as marital status, participants' and their husbands' education levels, economic status, diseases history, family disease history, smoking status, and physical activity were gathered using self-reported questionnaires. The study members were then referred to a laboratory to give blood samples while in a fasted state.

Measurements: Weight was measured to the nearest 100 g using Seca portable digital scale (Germany, Hamburg, Secagmbh & co, model no: 813) with light clothing and without shoes. Height was measured to the nearest 0.5 centimeter in the standing position while the participants'both heels, buttocks, shoulders, and head were rested againstthe wall and their head was maintained in the Frankfurt horizontal plane, using a plastic non-stretchable tape measure fixed on a straight wall (Esteghamati et al., 2009). Waist circumference (WC) was assessed at the level of the umbilicus with the accuracy of 0.5 cm while the measurement was conducted at the end of expiration. BMI was also calculated by dividing weight (kg) to height squared (m^2). All the anthropometric measurements were carried out by a trained nutritionist.

Participants' blood pressure (BP) was measured after resting on a chair for 15 minutes by applying a standard mercury sphygmomanometer (ALP k2-Japan). The systolic blood pressure (SBP) was defined as the appearance of the first sound (Korotkoff phase 1) and the diastolic blood pressure (DBP) was defined as the disappearance of the sound (Korotkoff phase 5) during deflating the cuff. All measurements were taken by a trained nutritionist.

After 12 hours overnight fast, venous blood samples were drawn. Plasma was separated immediately by centrifugation. Fasting blood glucose (FBG), serum concentrations of high density lipoprotein cholesterol (HDL-c), and triglycerides (TG) were then measured by Technicon auto-analyzer (USA, New York, model: RA1000) automatic analyzer and Pars Azma kits (Pars Azma, Iran, Tehran). The inter-assay CV for FBG, TG, and HDL-c kits were 3%, 1.6%, and 1.8%, respectively.

Definition of MetS: Several definitions are proposed for MetS (**Table 1**). Criteria defined by NCEP ATP-III and IDF are well known and currently used by many researchers to assess the MetS. According to different ethnicity, genetic, and demographic factors some countries such as Iran has redefined MetS' definition (Fereidoun Azizi et al., 2010). Therefore, we tried to assess and compare the prevalence of MetS and its determinants defined based on NCEP, IDF, and Iranians'' national criteria (**Table 1**).

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Table 1. Criteria for metabolic syndrome definitions in female adults

	WHO (Alberti and Zimmet, 1998)	EGIR (Balkau and Charles, 1999)	NCEP (Program, 2001)	AACE (Einhorn, 2003)	IDF (Alberti et al., 2006)	AHA/NHLBI (Grundy et al., 2005)	IRAN-Azizi et al (Fereidoun Azizi et al., 2010)
Required	DM, IFG, IGT, IR and the following:≥2	Insulin resistance And ≥2 or more:	3 or more risk factors	IGT and ≥ 2 or more risk factors	Elevated WC and ≥ 2 or more of :	3 or more risk factors	3 or more risk factors
Fasting blood glucose (mg/dl)	≥110	≥110	≥100	≥110	≥100	≥100	≥100
Triglyceride (mg/dl)	≥150	≥178	≥150	≥150	≥150	≥150	≥150 Or drug usage for hyperTG
HDL cholesterol(mg /dl)	<39	≤39	<50	<50	<50	<50	<50 Or use of drug for reduced HDL
Blood Pressure (mmHg)	140/90 or greater	140/90 or greater	130/85 or greater	130/85 or greater	130/85 or greater	130/85 or greater	130/85 or Greater
Obesity	WHR > 0.85 Or BMI > 30	WC ≥ 80 cm	WC > 88 cm	BMI ≥ 25	WC >80 cm or BMI > 30	WC ≥ 88 cm	>95 cm
Other	Urinary albumin excretion rate ≥20g/min or albumin:creatinine ratio ≥30mg/g						

IGT: Impaired glucose tolerance;IFG: impaired fasting glucose; IR: insulin resistance (defined as hyperinsulinaemia—top 25% of fasting insulin values amongthe non-diabetic population); DM: diabetes mellitus; WC: waist circumference; BMI: body mass index; and WHR: waist to hip ratio

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Economic status: The assessment of economic status was conducted by using 9 self-administered questions. The questionnaire items included: number of family members, husband's occupation, the head of household (husband/ herself/other family members), house ownership (owner/tenant), house type (apartment/house), number of bedrooms in the house, car ownership (yes/no), number of cars owned by the family, and family income per month. Participants were categorized into low, middle, and high economic status based on tertiles of the overall summed score.

Physical activity: Data on physical activity was obtained by using International Physical Activity Questionnaire (IPAQ) (short format). The information gathered from this questionnaire was converted to metabolic equivalent hours per week (MET-h/wk) (Ainsworth et al., 2000) and participants were placed in two the categories of sedentary and active.

Assessment of other variables: Some other variables were also collected by administration of a self-administered questionnaire. The questionnaire included the following factors; age (20-50 y/ over 50 y), 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),number of deliveries (none/one/two/ three or more), menstruation status (yes/no), family history of cardiovascular diseases (yes/no), family history of diabetes (yes/no),medication use, and disease or medical condition.

Data analysis: Prevalence rates and their corresponding standard errors (SEs) of MetS and its components were calculated for all participants. Other information such as age (< 50/ ≥ 50), marital status (single/married), economic status (low income/middle income/high income), education (high school/bachelor's degree/master's degree), number of deliveries (none, one, two, three or more), physical activity (sedentary/active), husband's education (high school/bachelor's degree/master's degree), menstruation (yes/no), family history of diabetes mellitus (DM) (yes/no), and family history of cardiovascular diseases (CVDs) (yes/no) were also reported. SPSS version 20 (IBM SPSS, Tokyo, Japan) was used for all statistical analyses. Categorical variables were compared by applying chi-square *test* and the statistical significance level was considered as the P-value ≤0.05.

Results

Four hundred fifty female teachers aged 40.60 ± 8.25 y participated in the current analysis. 90% of the participants were married, 16% were menopause, 31.2% had the family history of CVDs, and 40.7% of them had family history of DM. Furthermore, about 23.6% had an active lifestyle. About 11.6% of women had no children and 27% of them had 3 or more successful deliveries.

The prevalence of MetS components based on participants' characteristics are summarized in **Table 2**. Elevated WC based on NCEP and IDF were the most prevalent MetS components (72.22% and 90.0%, respectively). Reduced HDL-c was the most prevalent lipid profile disorder (48.7%, n = 219). The prevalence of elevated FBG and BP were the same (31.78).

Age was significantly associated with all components of MetS. According to NCEP definition, 34.7% of women aged 20-49 y suffered from MetS while this prevalence in women aged over 50 y was 62.3%.

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Table 2. Prevalence (%) of metabolic syndrome components in all participants (n = 450).

Variables		High FBG	High BP	High TG	Low HDLc	WC-NCEP	WC-IDF	WC-Iran
Age group (year)	20-50	29.21	27.11	30.0	50.53	69.21	88.16	41.32
	Over 50	46.38	56.52	62.32	37.68	88.41	100.0	57.97
	P-value	0.005	≥0.001	≥0.001	0.050	0.001	0.003	0.010
Marital Status	Single	30.23	30.23	37.21	37.21	60.47	76.74	44.19
	Married	31.85	32.10	34.81	49.63	73.58	91.36	44.20
	P-value	0.828	0.803	0.754	0.121	0.068	0.002	0.999
Economic status	Low	27.66	24.82	31.21	51.06	70.92	91.49	41.84
	Middle	31.79	35.76	33.77	49.01	70.86	91.39	43.71
	High	35.67	34.39	39.49	45.86	75.16	87.90	46.50
	P-value	0.334	0.093	0.304	0.662	0.628	0.485	0.717
Physical activity	Sedentary	33.83	33.83	35.61	47.18	73.59	90.50	47.18
	Active	24.53	26.42	30.19	52.83	68.87	88.68	33.96
	P-value	0.072	0.154	0.305	0.310	0.342	0.584	0.017
Education	College	39.77	37.50	48.86	48.86	79.55	97.73	59.09
	Bachelor degree	30.74	30.42	32.36	49.84	72.49	87.70	42.39
	master degree or higher	23.53	29.41	27.45	41.18	58.82	92.16	29.41
	P-value	0.114	0.422	0.008	0.518	0.031	0.018	0.002
Husband's education	High school	37.93	44.83	39.66	48.28	81.03	94.83	53.45
	College or Bachelor degree	28.65	27.85	34.18	50.63	72.15	90.72	40.51
	master degree or higher	31.25	26.56	29.69	50.0	71.88	90.62	46.88
	P-value	0.215	0.003	0.374	0.917	0.171	0.385	0.068
Number of delivery	None	17.31	15.38	17.31	44.23	36.54	69.33	17.31
	1 child	26.44	25.29	26.44	44.83	68.97	89.66	36.78
	2 children	30.16	28.57	34.92	50.26	70.90	90.48	41.80
	3 or more children	43.80	47.93	47.93	51.24	91.74	98.35	63.64
	P-value	0.002	≥0.001	≥0.001	0.697	≥0.001	≥0.001	≥0.001
Menstruation	Yes	28.04	26.72	29.89	50.0	68.52	88.10	61.11
	No	51.39	58.33	61.11	41.67	91.67	100.00	40.74
	P-value	≥0.001	≥0.001	≥0.001	0.195	≥0.001	0.002	0.001
Family history of CVDs	Yes	40.0	40.71	35.71	40.0	80.71	92.14	48.57
	No	27.36	27.70	33.78	51.01	67.57	89.19	41.22
	P-value	0.022	0.025	0.238	0.022	0.014	0.540	0.186
Family history of DM	Yes	36.07	31.15	37.70	46.99	75.96	90.16	48.09
	No	28.40	32.40	34.40	48.40	69.20	90.0	40.80
	P-value	0.168	0.139	0.178	0.704	0.426	0.967	0.258
	Total	31.78	31.78	34.89	48.67	72.22	90.0	44.0

FBG: fasting blood glucose; BP: blood pressure; HDLc: high density lipoprotein cholesterol; WC: waist circumference; NCEP: national cholesterol education program; DM: diabetes mellitus; IDF: international diabetes federation

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Marital status was also significantly related with elevated WC (IDF) (P = 0.002) however, it was not associated with other components. Physical activity was only related to elevated WC (Iranian definition) (P = 0.017). Education level was linked to elevated TG (P = 0.008) and elevated WC based on all definitions (NCEP, P = 0.031; IDF, P = 0.018 and Iranian definition, P = .002). Husband's education was also related to elevated BP (P = 0.003). Though, number of deliveries and menstruation were not related to reduced HDL-c, they had a significant association with other MetS components. Family history of CVDs had relationship with elevated FBG (P = 0.022), elevated BP (P = 0.025), elevated WC (NECP) (P = 0.014), and reduced HDL-c (P = 0.022). Family history of diabetes and economic status was not associated with MetS components. Low HDL-c as well as elevated WC and TG were the most common components in our study.

For more analysis, we removed participants with history of chronic diseases, then analyzed the same associations without any previous/current disease or medical condition (n = 255) (**Table 3**). In the second analysis still 25.1% of participants were affected by hyperglycemia. High FBG was not associated with participant's characteristics. High BP (22.35 ± 0.42 mmHg) was related to increased age (P = 0.001), more deliveries (P = 0.002), and menopause (P = 0.001). Also, the prevalence of high serum TG was 25.1% which was associated with older ages (P = 0.02) and menopause (P = 0.022). The most prevalent component was reduced HDL-c, 49.41%. For elevated WC the prevalence rates were as follows: NCEP: 65.88%, IDF: 87.84% and Iran's national criteria: 36.47%. Number of deliveries was significantly associated with high WC based on all mentioned definitions (P < 0.001), and also menopause (NCEP: P = 0.014, IDF: P = 0.05 and Iran criteria: P = 0.033). Higher level of education was related to lower prevalence of elevated WC (NCEP: P = 0.032 and Iran criteria: P = 0.007). IDF criteria for WC was associated with age (P = 0.027) and marital status (P > 0.001).

The prevalence of MetS was 39.1% (n = 176) based on NCEP definition, 40.9% (n = 184) according to IDF, and 31.1% (n = 140) based on Iranian redefined definition. The prevalence rates shown by different definitions were not statistically significant (P > 0.05).

Table 4 shows the prevalence of MetS based on three definitions. According to NCEP definition 39.1% of participants had MetS and these rates were 31.1% and 40.9%, based on Iranian and IDF definitions, respectively.

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Table 3. Prevalence (%) of metabolic syndrome components in participants without history of chronic diseases (n=255).

Variables		High FBG	High BP	High TG	Low HDL	WC-NCEP	WC-IDF	WC-Iran
Age groups (year)	20-50	24.66	18.83	21.97	50.67	63.68	86.10	34.53
	Over50	29.03	45.16	48.39	38.71	80.65	100.0	48.39
	P-value	0.600	0.001	0.020	0.212	0.062	0.027	0.133
Marital Status	Single	25.93	29.63	33.33	37.04	51.85	66.67	33.33
	Married	25.11	21.59	24.23	50.66	67.87	90.31	37.00
	P-value	0.926	0.344	0.303	0.181	0.097	≥0.001	0.708
Economic status	Low	23.53	20.00	25.88	56.47	64.71	91.76	35.29
	Middle	25.61	20.73	18.29	50.00	67.07	90.24	39.02
	High	26.44	26.44	31.03	41.38	66.67	82.76	35.63
	P-value	0.903	0.542	0.160	0.139	0.941	0.147	0.858
Physical activity	Sedentary	27.42	23.12	24.19	47.58	66.13	87.10	39.78
	Active	18.75	20.31	25.00	53.12	67.19	90.62	28.13
	P-value	0.168	0.642	0.897	0.467	0.877	0.454	0.095
Education	College	25.00	18.18	36.36	50.00	70.54	97.73	47.73
	Bachelor degree	24.72	23.03	24.16	50.56	68.54	85.96	38.20
	master degree or higher	25.81	22.58	16.13	41.94	45.16	87.10	12.90
	P-value	0.992	0.784	0.113	0.673	0.032	0.095	0.007
Husband's education	High school	23.73	27.12	18.64	45.76	74.58	94.92	47.46
	College or Bachelor degree	22.79	21.32	27.21	52.94	65.44	88.24	33.09
	master degree or higher	32.43	16.22	18.92	54.05	70.27	91.89	37.84
	P-value	0.475	0.436	0.329	0.612	0.437	0.327	0.163
Number of delivery	None	18.42	15.79	18.42	42.11	34.21	65.79	13.16
	1 child	25.93	16.67	22.22	50.00	64.81	88.89	29.63
	2 children	23.42	18.02	26.13	48.65	66.67	90.09	36.04
	3 or more children	32.69	42.31	30.77	55.77	88.46	98.08	61.54
	P-value	0.443	0.002	0.554	0.640	≥0.001	≥0.001	≥0.001
Menstruation	Yes	32.00	48.00	44.00	40.00	88.00	100.00	56.0
	No	24.35	19.57	23.04	50.43	63.48	86.52	34.35
	P-value	0.402	0.001	0.022	0.322	0.014	0.050	0.033
Family history of CVD	Yes	32.88	24.66	26.03	42.47	76.71	91.78	37.73
	No	21.26	21.26	23.56	50.57	60.92	86.78	35.63
	P-value	0.094	0.760	0.221	0.103	0.058	0.283	0.824
Family history of DM	Yes	26.60	17.02	26.60	48.94	68.09	86.17	37.23
	No	23.49	25.50	26.17	49.99	64.43	89.26	36.26
	P-value	0.836	0.146	0.411	0.924	0.812	0.664	0.976
Total		25.10	22.35	25.10	49.41	65.88	87.84	36.47

FBG: fasting blood glucose; BP: blood pressure; HDLc: high density lipoprotein cholesterol; WC: waist circumference; NCEP: national cholesterol education program; DM: diabetes mellitus; IDF: international diabetes federation

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Table 4. Prevalence (%) of metabolic syndrome according to three different definitions.

Variables		MetS-NCEP	MetS-IDF	MetS-Iran	P-value
Age group (year)	20-50	34.74	36.32	27.37	0.020
	Over 50	62.33	65.22	50.72	0.186
	P-value	<0.001	<0.001	<0.001	
Marital Status	Single	39.53	37.21	37.21	0.968
	Married	39.01	41.23	30.62	0.004
	P-value	0.947	0.610	0.375	
Economic status	Low	34.75	37.59	27.66	0.190
	Middle	39.74	40.40	31.79	0.227
	High	42.68	44.59	33.76	0.113
	P-value	0.371	0.464	0.515	
Physical activity	Sedentary	41.54	42.43	32.64	0.016
	Active	30.19	34.91	24.53	0.255
	P-value	0.036	0.169	0.114	
Education	college	47.73	51.14	42.05	0.475
	Bachelor degree	38.51	39.81	29.77	0.018
	master degree or higher	27.45	29.41	21.57	0.644
	P-value	0.058	0.034	0.026	
Husband's education	High school	49.14	50.0	42.24	0.431
	College or Bachelor degree	37.13	40.08	26.58	0.005
	master degree or higher	31.25	32.81	28.12	0.843
	P-value	0.032	0.060	0.010	
Number of delivery	None	13.46	13.46	11.54	0.944
	1 child	34.48	37.93	20.69	0.034
	2 children	35.45	37.57	27.51	0.092
	3 or more children	58.68	59.50	52.07	0.441
	P-value	<0.001	<0.001	<0.001	
Menstruation	Yes	62.50	63.89	54.17	0.01
	No	34.66	36.51	26.72	0.436
	P-value	<0.001	<0.001	<0.001	
Family history of CVDs	Yes	42.86	44.29	35.71	0.02
	No	34.49	38.51	28.38	0.295
	P-value	0.166	0.222	0.181	
Family history of DM	Yes	43.72	44.81	32.24	0.164
	No	36.40	38.80	30.80	0.025
	P-value	0.124	0.165	0.356	
Total		39.11	40.89	31.11	0.866

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Prevalence of MetS among women aged over 50 y was more than women aged 20-50 y ($P < 0.001$), however these prevalence rates were significantly different based on various definitions in women under 50 y old ($P = 0.020$). Based on Iranian national definition, unlike the other definitions, prevalence of MetS among married women was lowerthan single women however this relationship was not significant. The prevalence of MetS was also significantly different between different criteria among married women ($P = 0.004$)

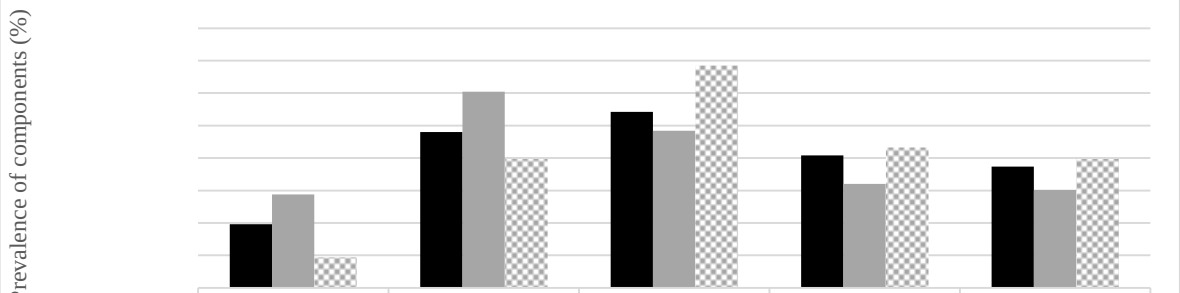
Prevalence of MetS in highest tertile of economic status was higher than the lowest tertile. There was no difference between definitions in different economic status levels. Based on different definitions, women with higher physical activity had lower prevalence of MetS (base on NCEP ATPIII, $P = 0.036$), while significant differences were represented among different definitionsin women with sedentary life style ($P = 0.016$).

Prevalence of MetS was lower in women who were highly educated or had husbands with higher education ($P < 0.05$). Moreover, prevalence of MetS was increased in women with more deliveries (for three definitions, $P < 0.001$). Differences among definitions in women with one delivery was significant ($P = 0.034$).

Postmenopausal women had more MetS based on all definitions (for three definition, $P < 0.001$), and the relationships between these prevalence rates were reported as significant ($P = 0.01$).

In women with family history of DM and CVDs, prevalence of MetS was higher than those without family history. According to these definitions, different prevalence rates of MetS in women with family history of CVDs ($P = 0.02$) and without history of DM ($P = 0.025$) were significant.

The prevalence distribution of components' number is shows in **Figure 1**. According to NCEP and Iran definitions, 9.8% and 14.4% of participants did not meet any criteria of MetS respectively. But it is considerable that 27.1% (NCEP) and 24.2% (Iran) had two components of MetS.



	0 components	1 component	2 components	3 components	4 or 5 components
MetS-NCEP	9.80%	24%	27.10%	20.40%	18.70%
MetS-Iran	14.40%	30.20%	24.20%	16.00%	15.10%
MetS-IDF	4.70%	19.80%	34.20%	21.60%	19.80%

Figure 1. Number of metabolic syndrome components among female teachers based on different criteria (n = 450).

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Discussion

This study was conducted with the aim of investigating the prevalence of MetS and its components in female teachers according to ATP III, IDF, and Iran modified criteria.Our findings showed a high prevalence of MetS based on NCEP (39.11), IDF (40.89), and Iranians' national criteria (31.11). These prevalence rates are similar to those found in the last study conducted in Yazd. Sadrbafoghi et al., reported that one third of Yazd population had MetS according to NCEP criteria (Sadrbafoghi et al., 2006).

Prevalence of MetS varies in the other studies in Iran, but most researchers reported higher prevalence of MetS in women compared to men. Ghorbani et al., reported 38.7% and 44.1% of women who lived in Semnan province (central Iran) were affected by MetS based on NCEP and IDF, respectively (Ghorbani et al., 2012).Two other studies reported the prevalence of 35.9% (Fakhrzadeh et al., 2006) and 41.1% (Hadaeqh et al., 2007) based on NCEP criteria. On the other hand, 9.7% (Barahimi et al., 2009) of women in Barahimi et al. study had MetS. In Turkey and Pakistan, neighbors to Iran, 45% (Onat et al., 2002) and 49% (Iqbal Hydrie et al., 2009)of women had MetS according to NCEP. It is worth noting that rate of MetS prevalence is highly associated with diagnostic criteria. Because of differences between cutoff points for WC, usually prevalence of MetS based on IDF is higher which is similar to our result. The cutoff point for WC that Azizi et al., (Fereidoun Azizi et al., 2010) reported for diagnosis of MetS in Iranian population washigher than other cutoff points, therefore, the rate of MetS using this criteria was lower than the others. In the present study, although a slight difference was shown in prevalence of metabolic syndrome based on different criteria, this was not approved by statistical tests.

In the current research, the most common component of MetS was low HDL-c and increased WC. These findings are in line with the previously conducted studies in Iran (Azizi *et al.*, 2003, Esmailzadehha *et al.*, 2013, Kaykhaei *et al.*, 2012, Marjani *et al.*, 2012, Zabetian *et al.*, 2007). After removing participants who reported previous or current disease, most common components were still the same. Low HDL-c could be attributed to changes in lifestyle (industrialization), unhealthy diet, insufficient physical activity, increased prevalence of hypertriglyceridemia, overweight, and obesity (Azizi et al., 2003). Additional factor that must be considered is genetic polymorphisms that has been suggested by family and twin studies (Austin *et al.*, 1987, Bucher *et al.*, 1988, Heller *et al.*, 1993).

Our results clarified that at least 24.2% (modified definition for Iran) of participants had two components of MetS according to different definitions (but did not meet all criteria for MetS). This finding can be useful for designing some interventions to prevent MetS, DM, CVDs, and the other medical conditions. It is simply understandable that these women can be the future patients and it seems necessary to educate them favorable lifestyle and dietary changes to reduce the risk of MetS and its consequences. On the other hand, from theclinical point of view or any of the aforementioned three definitions i.e., NCEP, IDF, or modified criteria for Iranian population, every physician can diagnose MetS with clinical examination and simple blood test in routine checkup. Thus, the importance of MetS, its prevention, and treatment should be considered in the health system.

This was the first study conducted in central part of Iran which tried to compare the prevalence of MetS according to different definitions. Our study though had several limitations: the nature of cross-sectional methodology was one of the limitations. We just investigated female teachers while men were not included in the study. However, this should be noted that Iranian females are more prone to MetS because of their lower physical activity, consequently, overweight and obesity (general or abdominal) are more common among them (Mirmiran et al., 2001). Furthermore, our sample may not be a good representative of MetS for all women residing in Yazd province because it did not target at general female population. The

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MetS and overweight or obesity have been linked with an increased risk of DM, CVDs, morbidity, and mortality (Gu et al., 2005), that causes in a huge economic burden to society (Jamali et al., 2014).

Conclusions

Without more emphasis on the prevention and control of obesity and MetS, these health problems and their consequences will increase in the near future. We suggest future community-based interventions targeting at MetS control, particularly among teachers. Large scale prospective studies are highly required to confirm our results.

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Author contributions

Nadjarzadeh A participated to conception and design of study, managing the project and drafting the manuscript. Shahvazi S and Mehri Z participated to acquisition of data, data analysis and drafting the manuscript. Salehi-Abargouei A participated to data analysis and drafting the manuscript. All authors read manuscript and they finally verified it.

Conflicts of Interest

Authors declare that they had no conflict of interest.

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