Review Article

Prevalence and Incidence of Metabolic Syndrome in Iran: A Systematic Review and Meta-Analysis

Abstract

Metabolic syndrome (MetS) is a predictor of several diseases such as cardiovascular diseases, diabetes, dyslipidemia, stroke, osteoarthritis, certain cancers, and death leading to public health concern in most societies. We aimed to estimate the pooled prevalence and incidence of MetS in Iranian population through a meta-analysis study. We included cross-sectional and cohort studies to estimate the overall prevalence and incidence rates of MetS in Iran National databases including MagIran, Science Information Database, IranMedex, and international databases including Medline, Web of Sciences, and Scopus were searched up to October 2017. Finally, 125 studies were included. The total sample size was 472,401 with a mean age of 38 ± 7.8 years. The overall pooled prevalence and incidence rate among the general population of Iran was 0.26 (95% CI: 0.26, 0.29) and 97.96 (95% CI: 75.98, 131.48), respectively. The pooled prevalence of MetS was higher in females and in urban areas. The highest and lowest prevalence of MetS was obtained by the Iranian definition criteria (0.43) and the NHANES III (0.12). The highest and lowest incidence rates of MetS were obtained by IDF (144.07 per 1000) and the JIS (89.73 per 1000). The prevalence of MetS was higher in women and those living in urban areas. Furthermore, the prevalence of MetS increased with increasing age in both genders.

Keywords: *Incidence, Iran, meta-analysis, metabolic syndrome, prevalence, review*

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Introduction

Metabolic syndrome (MetS) or X syndrome is defined as a set of metabolic and nonmetabolic disorders, including high fasting blood glucose, hypertriglyceridemia, high blood pressure, low HDL, and obesity.[1] People who have three symptoms or more simultaneously are diagnosed as cases of metabolic syndrome.[1]

MetS is a predictor of several diseases such as cardiovascular diseases, diabetes, dyslipidemia, stroke, osteoarthritis, certain cancers, and death leading to public health concern in most societies.[2-4] Moreover, MetS imposes high costs on the health system and generally reduces the quality of life.[5,6]

The prevalence of metabolic syndrome in the United States is estimated at 34%.[7] In Iran, based on the Tehran Lipid and Glucose Study (TLGS), the prevalence of metabolic syndrome was 42% in men and 24% in women in adult adolescents.[8] Further, the overall incidence of metabolic syndrome in adults aged 20 years and above was reported at 550.9 per 10,000; in men, it was 794.2 per 10,000, and in women, it was reported at 443.5 per 10,000.[9]

According to statistics in Iran, the prevalence of MetS among adolescents is more than 30%, which is higher than in most developed countries such as the United States. In general, there has been an increase in the prevalence of this syndrome in the Iranian society.

MetS is known as a multifactorial disorder. Numerous studies[5,8-13] have shown that several factors are involved in the etiology of metabolic syndromes such as abdominal obesity, insulin resistance, impaired glucose tolerance, hypertension, low level of physical actively, genetic factors, psychosocial stress, and nutritional factors.

Given the high prevalence of metabolic syndrome and its important role in the development of cardiovascular diseases and diabetes, several studies[10,14-16] have been conducted in Iran. However, due to errors in repeated sampling, the measurements of the prevalence of MetS have been controversial and imprecise.

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In meta-analyses the sample size is large and a combination of various studies is examined, thus providing a precise result and reducing the confidence intervals of estimates. Therefore, we aimed to estimate the pooled prevalence and incidence of MetS in the Iranian population through a meta-analysis study.

Methods

Eligibility criteria

In this systematic review, we included cross-sectional and cohort studies to estimate the overall prevalence and incidence rates of metabolic syndrome in Iran. The study population in this review was the general population of Iran regardless of gender, age, and ethnicity. There were no restrictions on the time, location, and language of the studies. The outcome of interest was syndrome metabolic that is a clustering of at least three of the five following medical conditions: central obesity, high blood pressure, high blood sugar, high serum triglycerides, and low serum high-density lipoprotein (HDL).

Search strategy

The following keywords were used to design a search strategy: Metabolic syndrome, MetS, Iran, prevalence and incidence. National databases including MagIran (from January 2001), Science Information Database (SID) (from January 2004), and IranMedex (from January 2001), and international databases including Medline (From January 1950), Web of Sciences (January 1945), and Scopus (January 1973) were searched up to October 2017.

Two investigators (A.F. and Z.Ch.) were independently responsible for the screening of the titles and abstracts of the retrieved studies. In case of any disagreement, it was resolved upon discussion and judgment of a third investigator. In addition, the kappa index was calculated to evaluate the agreement of the two investigators. The inter-authors reliability based on kappa statistics was 84%. In the next step, the full texts of the selected studies were reviewed to assess the eligibility criteria. Finally, the studies that met the inclusion criteria were selected.

Data extraction

The following data were extracted using a predesigned datasheet from the studies that met the inclusion criteria: the first author's name, year of publication, location of study, the scale used for the diagnosis of metabolic syndrome, the mean age of the participants in each study, gender, sample size, and number of participants with metabolic syndrome. In case of missing data in the included studies, we contacted the authors.

Risk of bias assessment

The quality of the included studies was assessed using the STROBE checklist.[17] The following items were used for quality assessment: (1) sample size calculation; (2) defining the outcome and method of measuring it; (3) the participants' eligibility criteria; (4) reporting precision for the outcome (95% CI or standard deviation); (5) describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection.

Assessment of heterogeneity

The statistical heterogeneity was evaluated using the Chi-square test at 10% significance level. In addition, we quantified the heterogeneity using I^2. The between-study variance was estimated using tau-square (Ta^2).

We used the following approaches to deal with the heterogeneity: (1) recheck the extracted data; (2) meta-regression to identify the source of heterogeneity, and (3) subgroup analysis.

Data analysis

The Stata 11 (Stata Corp, College Station, TX, USA) was used for data analysis. We calculated the prevalence in each study by dividing the number of participants by the sample size. In addition, the standard error of prevalence was calculated as follows:

$$\sqrt{\frac{P\times(1-P)}{n}}$$

In this formula, P and n are prevalence and sample size, respectively. In cohort studies, we calculate the standard error by $\sqrt{\frac{1}{\mathrm{d}}}$ the logarithmic scale. In this formula, d is the number of new cases of metabolic syndrome. For studies that had not been reported, the number of new cases, we calculated the standard error by a 95% confidence interval using this formula $\frac{\text{Upper limit - Lower limit}}{2\times1.96}$

The inverse variance method was used to obtain pooled prevalence and incidence. In the studies in which prevalence was close to zero or one, we calculated the 95% CI using the exact method, and the "meta prob" module was used for data analysis. The random-effects model was used for reporting the results at 95% CI.

Results

In this review, 2528 articles were retrieved through searching electronic databases and 1038 were excluded because of duplication. In the next stage, 1320 articles were excluded upon checking the titles and abstracts and another 45 were excluded upon checking the full texts as they did not meet the eligibility criteria.

Finally, 125[13,18-140] studies remained in the final analysis, of which 105 were cross-sectional studies (that assessed the prevalence of metabolic syndrome) and 20 cohort studies (that assessed the incidence of metabolic syndrome), involving 138,182 and 434,219 individuals in the cohort

and cross-sectional studies, respectively [Figure 1]. The mean (SD) age of the participants was 38 ± 7.8 years.

In cross-sectional studies (105 studies), 63.80% of studies (67 studies) used the NCEP/ATP III criteria, 16.19% of studies (17 studies) used the IDF criteria, 7.61% of studies (8 studies) used the WHO criteria, and remaining studies (12.3%) used the other criteria for definition of metabolic syndrome. Further, in cohort studies (25 studies), 56% of studies (14 studies) used the NCEP/ATP III criteria, 12% of studies (3 studies) used the IDF criteria, 8% of studies (2 studies) used the AHA criteria, and 4% of studies (1 study) used the NHANES criteria for defining metabolic syndrome.

Data gathering and validity assessment of studies

Two investigators (Z.Ch. and A.F.) read the retrieved publications simultaneously and independently to select the studies that would meet the inclusion criteria. The investigators were not blinded to the authors' names, the journals' names, and abstracts and results. Any disagreements were resolved by adjudication with a third investigator (A.D.I.). The kappa index (an index for interrater reliability) was 0.906. Also, we appraised the risk of bias (quality) of the included publications using the STROBE checklist. The same investigators (Z.Ch. and A.D.I.) appraised the studies independently. Based on the recommended items of the STROBE checklist, we classified the cross-sectional studies into categories of high-quality (77.4%), intermediate-quality (20.7%), and low-quality (1.90%). Similarly, the cohort studies were also classified into high-quality (92.3%) and intermediate-quality (7.9%) [Figure 2].

To reduce the heterogeneity, we divided the studies into subgroups by gender, habitat, and criteria of diagnosis of MetS to achieve homogeneity. However, homogeneity was not achieved.

Estimated prevalence and incidence

We considered all the studies (cohort and cross-sectional) that had addressed MetS in them. As mentioned earlier, 105 cross-sectional studies had estimated the prevalence of MetS in healthy Iranian population. The overall prevalence of MetS based on the random-effects model was 0.26 (95% CI: 26, 0.29. I^2 = 99.6%) [Table 1]. Also, 20 cohort studies had estimated the incidence of

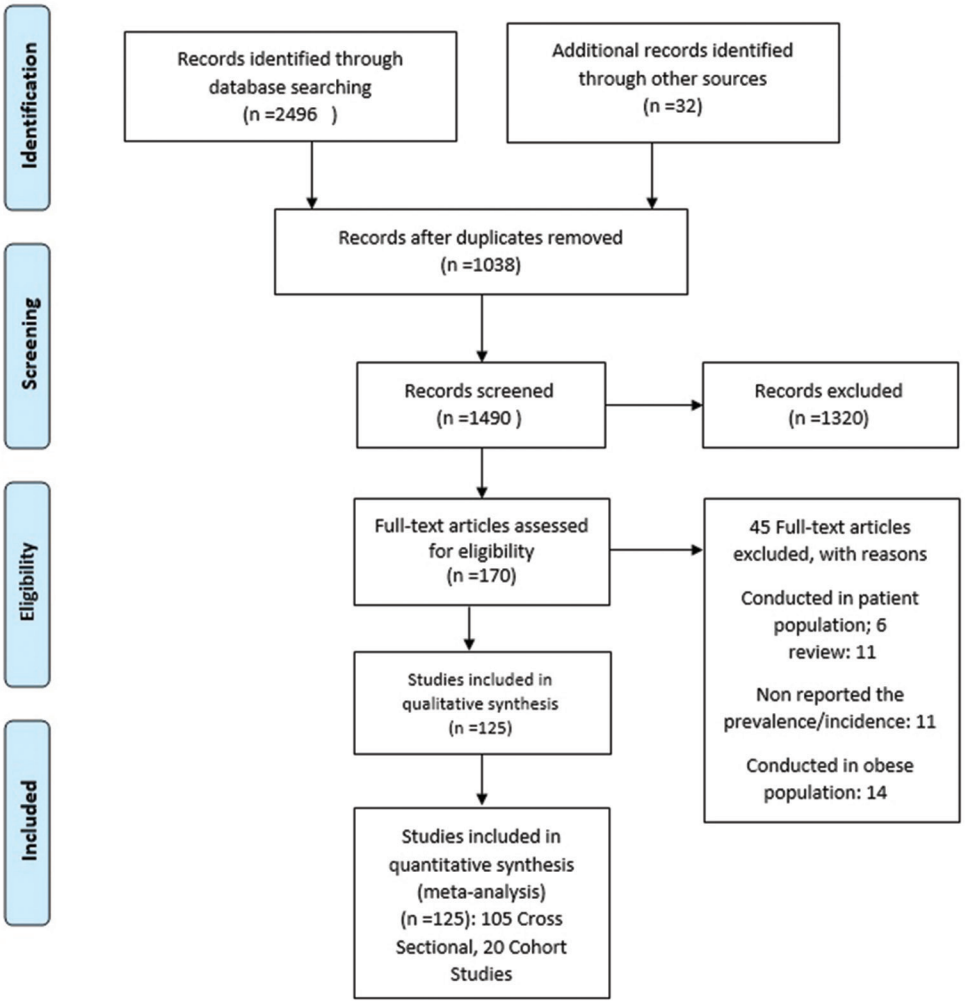

Figure 1: A flow diagram depicting the phases of retrieving articles, checking eligibility criteria, and including the articles into the meta-analysis

Mets. The overall incidence rate of MetS based on the random-effects model was 97.96 (95% CI: 75.98, 131.48. I^2 = 99.7%) [Figure 3].

Subgroup analysis

Since the studies included in this systematic review had used different diagnostic criteria for the detection of metabolic syndrome, we intended to report the pooled prevalence and incidence of MetS based on the criteria for diagnosis of MetS. The overall prevalence of MetS, based on WHO, IDF, JIS, AHA/NHLBI, ATP III, the Iranian Definition, NHANES III, EGIR, and AACE, were 0.19 (0.95 CI: 0.15, 0.23. I^2 = 99.7%), 0.27 (0.95 CI: 0.21, 0.33. I^2 = 99.8%), 0.43 (0.95 CI: 0.35, 0.5. I^2 = 98.4%), 0.22 (0.95 CI: 0.08, 0.36. I^2 = 99.8%), 0.27 (0.95 CI: 0.24, 0.29. I^2 = 99.7%), 0.44 (0.95 CI: 0.17, 0.53. I^2 = 99.8%), 0.12 (0.95 CI: 0.02, 0.21. I^2 = 98.5%), 0.17 (0.95 CI: 0.01, 0.34. I^2 = 98.8%), and 0.26 (0.95 CI: 0.24, 0.29. I^2 = 98.9%), respectively. Therefore, the highest and lowest prevalence of MetS was obtained by the Iranian definition criteria and the NHANES III (0.43 vs. 0.12). [Table 1]. The highest and lowest incidence rates of MetS were obtained by the IDF and JIS (144.07 per 1000 vs. 89.73 per 1000) [Figure 3]. The pooled prevalence of MetS was higher in females (0.34 vs. 0.22) [Table 1 and Appendix 1]. The overall pooled prevalence of MetS was higher in urban areas compared to rural areas (0.39 vs. 0.26) [Table 1]. Pooled estimates of the incidence rate of metabolic syndrome were not possible based on gender and habitat, as only one study had reported incidence by gender, and no other study had reported it by habitat (urban/rural).

Heterogeneity

For quantitative and qualitative heterogeneity, I^2 and Chi-square (at a significance level of 0.05) tests were used. Also, the tau-squared test was used to estimate the variances among the studies. In all the subgroups of the analysis (gender, habitat, and diagnostic criteria of MetS), considerable heterogeneity (over 90%) was observed. These inconsistencies were also found to be significant with the Cochrane test (P < 0.001). These results have been observed both in the cross-sectional and cohort studies [Tables 2 and 3].

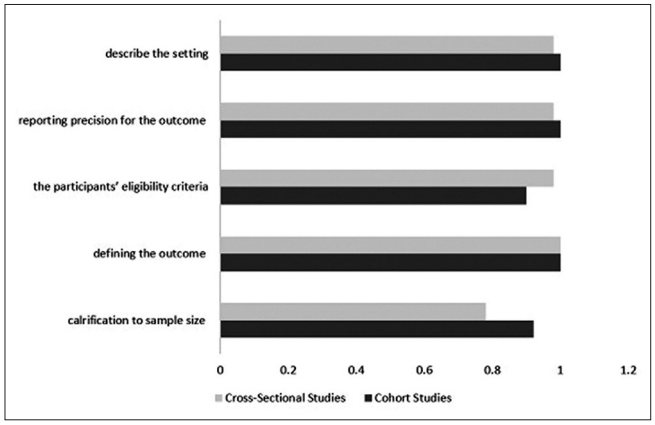

Figure 2: The quality assessment of studies

Discussion

In this systematic review, 125 studies were included in the final analysis. The total sample size was 472,401. Based on our results, the overall pooled prevalence and incidence rate among the general population of Iran were/was 0.26% and 97.96 per 1000, respectively. Moreover, the pooled prevalence of MetS was higher in

Table 1: The prevalence of metabolic syndrome in Iranian general population

Variables	Category	Prevalence (%)	[95% CI]	Weight %
Gender	Male	0·22	[0·21,0·24]	44·01
	Female	0·34	[0·31,0·37]	55·99
	Both Genders	0·26	[0·24,0·29]	0·26
Habitat	Urban	0·39	[0·21,0·33]	84·36
	Rural	0·26	[0·27,0·3]	15·64
Criteria	WHO	0·19	[0·15,0·23]	5·26
	IDF	0·27	[0·21,0·33]	16·42
	JIS	0·43	[0·35,0·5]	3·91
	AHA/NHLBI	0·22	[0·08,0·36]	3·93
	NCEP/ATP III	0·27	[0·24,0·29]	64·57
	Iranian Definition	0·44	[0·17,0·53]	1·30
	NHANES III	0·12	[0·02,0·21]	1·98
	EGIR	0·17	[0·01,0·34]	1·31
	AACE	0·21	[0·03,0·4]	1·31

Table 2: The results of heterogeneity test of prevalence of metabolic syndrome in cross-sectional studies

Subgroups	Category	Chi²	*P*	I^2	τ^2
Gender	Female	12938·10	<0·001	99·1	0·01
	Male	40324·10	<0·001	99·1	0·03
	Total	57619·27	<0·001	99·6	0·02
Criteria	WHO	539·19	<0·001	98·70	0·0031
	IDF	14936·96	<0·001	99·80	0·0257
	JIS	310·15	<0·001	98·40	0·0083
	AHA/NHLBI	2174·96	<0·001	99·80	0·0316
	NCEP/ATPIII	31008·93	<0·001	99·70	0·0172
	Iranian definition	553·91	<0·001	99·80	0·1894
	NHANE III	136·19	<0·001	98·50	0·0064
	EGIR	84·21	<0·001	98·80	0·0139
	AACE	90·38	<0·001	98·90	0·017
Habitat	Urban	12147·94	<0·001	99·80	0·0256
	Rural	21·36	<0·001	81·30	0·0002

Table 3: The results of heterogeneity test of incidence rate of metabolic syndrome in cohort studies

Subgroups	Category	Chi²	*P*	I^2	τ^2
Criteria	IDF	647·21	<0·001	99·70	0·788
	NCEP/ATPIII	2526·57	<0·001	99·50	0·9131
	JIS	878·91	<0·001	99·90	3·5147

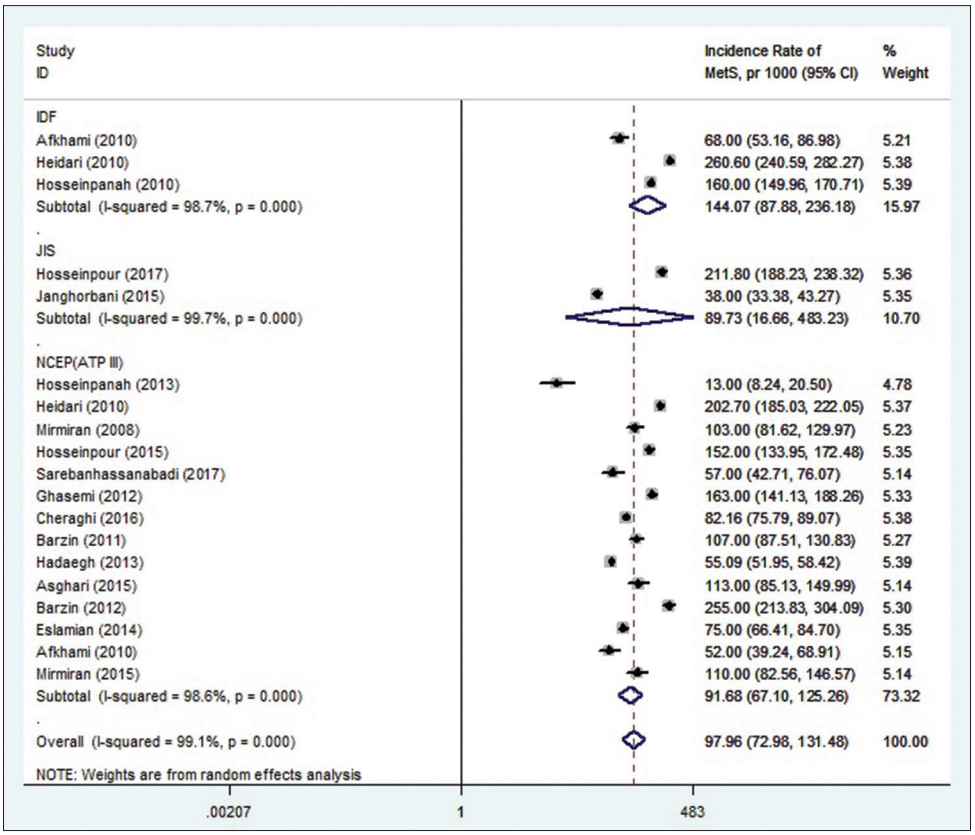

Figure 3: A forest plot for the incidence of Metabolic Syndrome (MetS) by criteria for diagnosis of MetS

females (0.34 vs. 0.22) and in urban areas (0.39 vs. 0.26). The highest and lowest prevalence of MetS was obtained by the Iranian definition criteria and the NHANES III (0.43 vs. 0.12). On the other hand, the highest and lowest incidence rates of MetS were obtained by IDF and the JIS (144.07 per 1000 vs. 89.73 per 1000). Pooled estimates of the incidence rate of metabolic syndrome were not possible based on gender and habitat, as only one study reported incidence by gender, and no study had reported it by habitat (urban/rural). Considerable heterogeneity (over 90%) was observed, both in cross-sectional and cohort studies. These inconsistencies were also found to be significant with the Cochrane test. Heterogeneity remained even after subgroup analysis (by gender, criteria, and habitat).

The highest prevalence of MetS among 105 cross-sectional studies was 91%, which was reported by Bayani (2016).[35] In this study, the mean age of the participants was 68.5 years. The lowest prevalence was 0.9%, which was reported by Mehrdad (2006); this study was conducted on children aged 6–9 years. Upon assessing the rank of prevalence in other studies, it is clear that there is a direct relationship between increasing age and the prevalence of MetS. We also observed that with increasing age, BMI (as one of the major determinants of metabolic syndrome) increased in both sexes. In Aguilar's study, more than 50% of people aged 60 years and older had metabolic syndrome.[141]

In the present study, the pooled prevalence of MetS was significantly higher in women (34% vs. 22% in men). It is noteworthy that the highest difference of prevalence of MetS has been reported in older age groups. This finding is consistent with this important point, that the risk of cardiovascular disease after menopause is higher in women than in men.[142] On the other hand, there are common risk factors for cardiovascular diseases and MetS (such as obesity, high blood pressure, diabetes, and high blood lipids).[141,142]

Furthermore, in a meta-analysis study,[143] MetS has been mentioned as a strong risk factor for cardiovascular disease and mortality. Therefore, the detection, prevention, and treatment of the underlying risk factors for MetS should be an important approach in reducing the burden of cardiovascular disease in societies.

In the present review, the prevalence of MetS was 27% based on the IDF criteria and the ATP III criteria. Sayehmiri (2014) conducted a review study[144] on 26 studies (total sample size was 60,635 with an age range of 3–90 years); the results indicated that the prevalence of MetS based on the IDF and ATP III criteria were, 36% and 27%, respectively. Upon comparison, our results are consistent with the second criteria. In Delvand's (2015)[39] review, that was conducted on 32 cross-sectional studies with a total sample size of 7444, the overall prevalence of MetS was 32%. In the present study, the overall prevalence was lower, i.e., 26%.

Finally, according to the results of this review, the prevalence of MetS was higher in the urban areas. One of the main reasons behind this finding may be the difference in lifestyles of people living in the city and the countryside. Based on the results of previous studies,[12,145] the prevalence of common risk factors of MetS such as cardiovascular disease, obesity, and hypertension in people living in urban areas is significantly higher than in rural areas.

Strengths and limitations of the study

In this study, a significant number of eligible studies[124] were included. In the previous reviews,[15,16,143] less than 40 publications had been studied. This may add to the generalizability of the results.

In the current review, we could not conduct certain subgroup analysis (e.g., the incidence rates of MetS based on gender and habitat) in the cohort studies, since the number of cohort studies were not sufficient (only one study reported incidence by gender and no studies were based on their habitat). Furthermore, we could not estimate the role of important risk factors on MetS such as physical activity and diet, since the studies included had not measured the effects of these factors.

Conclusions

In Iran, the prevalence of metabolic syndrome was 0.26 and the incidence was 97.96 per 1000. The prevalence of MetS was higher in women and those living in urban areas. Furthermore, the prevalence of MetS increased with increasing age in both genders. The findings of this study indicate a high prevalence of metabolic syndrome, hence the need to pay more attention to target populations

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Conflicts of interest

There are no conflicts of interest.

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References

1. Alberti K, Zimmet P, Shaw J. Metabolic syndrome—A new world-wide definition. A consensus statement from the International Diabetes Federation. Diabetic Med 2006;23:469-80.
2. Ford ES. Risks for all-cause mortality, cardiovascular disease, and diabetes associated with the metabolic syndrome: A summary of the evidence. Diabetes Care 2005;28:1769-78.
3. Sattar N, Gaw A, Scherbakova O, Ford I, O'Reilly DS, Haffner SM, *et al*. Metabolic syndrome with and without C-reactive protein as a predictor of coronary heart disease and diabetes in the West of Scotland Coronary Prevention Study. Circulation 2003;108:414-9.
4. Bonora E, Targher G, Formentini G, Calcaterra F, Lombardi S, Marini F, *et al*. The metabolic syndrome is an independent predictor of cardiovascular disease in type 2 diabetic subjects. Prospective data from the verona diabetes complications study. Diabetic Medi 2004;21:52-8.
5. Williams MA, Haskell WL, Ades PA, Amsterdam EA, Bittner V, Franklin BA, *et al*. Resistance exercise in individuals with and without cardiovascular disease: 2007 update: A scientific statement from the American Heart Association council on clinical cardiology and council on nutrition, physical activity, and metabolism. Circulation 2007;116:572-84.
6. Schlenk EA, Erlen JA, Dunbar-Jacob J, McDowell J, Engberg S, Sereika SM, *et al*. Health-related quality of life in chronic disorders: A comparison across studies using the MOS SF-36. Qual Life Res 1997;7:57-65.
7. Ford ES, Mokdad AH, Giles WH, Brown DW. The metabolic syndrome and antioxidant concentrations findings from the third national health and nutrition examination survey. Diabetes 2003;52:2346-52.
8. Ghotbodin MS, Mirmiran P, Bahadoran Z, Mehrabi Y, Azizi F. The association between dairy intake with metabolic syndrome and its components in adolescents: Tehran Lipid and Glucose Study. IJEM 2014;16:270-82.
9. Bagry HS, Raghavendran S, Carli F. Metabolic syndrome and insulin resistance: Perioperative considerations. Anesthesiology 2008;108:506-23.
10. Kazemi S, Koosha A, Sharifi F, Moosavi-Nasab S, Mellati A. Metabolic syndrome prevalence in 17-21 years old population of Zanjan: A new definition for waist circumference in Iranians in comparison with ATPIII and World Diabetes Association. Iran Diabetes Lipid J 2008;7:393-8.
11. Jalalzadeh M, Mohammadi R, Mirzamohammadi F, Ghadiani MH. Prevalence of metabolic syndrome in a hemodialysis population. Iran J Kidney Dis 2011;5:248-54.
12. Khezeli M. Study on the prevalence of hypertension and its associated factors in the elderly population. Rev Prat 2012;62:1225-8.
13. Hadaegh F, Hasheminia M, Lotfaliany M, Mohebi R, Azizi F, Tohidi M. Incidence of metabolic syndrome over 9 years follow-up; the importance of sex differences in the role of insulin resistance and other risk factors. PloS one 2013;8:e76304.
14. Haghparast F, Norooz-Zadeh J. Metabolic syndrome prevalence in urban adult population of the south of Iran. Iranian Nutrition Congress. Tabriz; 2006.
15. Maleki F, Sayehmiri F, Kiani F, Nasiri S. Metabolic syndrome prevalence in Iran: A systematic review and meta-analysis. J Kermanshah Univ Med Sci 2014;18:242-50.
16. Dalvand S, Niksima SH, Meshkani R, Gheshlagh RG, Sadegh-Nejadi S, Kooti W, *et al*. Prevalence of metabolic syndrome among iranian population: A systematic review and meta-analysis. Iran J Public Health 2017;46:456-67.
17. Knottnerus A, Tugwell P. STROBE–A checklist to strengthen the reporting of observational studies in epidemiology. J Clin Epidemiol 2008;61:323.
18. Afarideh M, Behdadnia A, Noshad S, Mirmiranpour H, Mousavizadeh M, Khajeh E, *et al*. Association of peripheral 5-hydroxyindole-3-acetic acid, a serotonin derivative, with

metabolic syndrome and low-grade inflammation. Endocr Pract 2015;21:711-8.

19. Afkhami-Ardekani M, Zahedi-Asl S, Rashidi M, Atifah M, Hosseinpanah F, Azizi F. Incidence and trend of a metabolic syndrome phenotype among Tehranian adolescents: Findings from the Tehran Lipid and Glucose Study, 1998-2001 to 2003-2006. Diabetes Care 2010;33:2110-2.
20. Afrand M, Khalilzadeh SH, Shojaoddiny-Ardekani A, Afkhami-Ardekani M, Ariaeinejad A. High frequency of metabolic syndrome in adult Zoroastrians in Yazd, Iran: A cross-sectional study. Med J Islam Repub Iran 2016;30:370.
21. Ahmadi A, Gharipour M, Nouri F, Kelishadi R, Sadeghi M, Sarrafzadegan N. Association between adolescence obesity and metabolic syndrome: Evidence from Isfahan Healthy Heart Program. Indian J Endocrinol Metab 2014;18:569-73.
22. Ainy E, Mirmiran P, Asl SZ, Azizi F. Prevalence of metabolic syndrome during menopausal transition Tehranian women: Tehran Lipid and Glucose Study (TLGS). Maturitas 2007;58:150-5.
23. Alavi SS, Makarem J, Mehrdad R, Abbasi M. Metabolic syndrome: A common problem among office workers. Int J Occup Environ Med 2015;6:34-40.
24. Amiri A, Hakimi A. The study of prevalence of metabolic syndrome among nurses of Shahid Mohammadi Hospital of Bandar Abbas city, Iran. J Clin Nurs Midwifery 2017;6:1-8.
25. Ansari R, Kahbazi M, Abdar EM. Determining the prevalence of metabolic syndrome phenotypes among heypertensive patients in Isfahan and Markazi provinces in Iran 2007.
26. Asghari G, Yuzbashian E, Mirmiran P, Mahmoodi B, Azizi F. Fast food intake increases the incidence of metabolic syndrome in children and adolescents: Tehran Lipid and Glucose Study. PLoS One 2015;10:e0139641.
27. Azimi-Nezhad M, Herbeth B, Siest G, Dadé S, Ndiaye NC, Esmaily H, *et al*. High prevalence of metabolic syndrome in Iran in comparison with France: What are the components that explain this? Metab Syndr Relat Disord 2012;10:181-8.
28. Azizi F, Mirmiran P, Momenan AA, Hadaegh F, Habibi Moeini A, Hosseini F, *et al*. The effect of community-based education for lifestyle intervention on the prevalence of metabolic syndrome and its components: Tehran Lipid and Glucose Study. Int J Endocrinol Metabol 2013;11:145-53.
29. Azizi F, Salehi P, Etemadi A, Zahedi-Asl S. Prevalence of metabolic syndrome in an urban population: Tehran Lipid and Glucose Study. Diabetes Res Clin Pract 2003;61:29-37.
30. Bagherniya M, Khayyatzadeh S, Avan A, Safarian M, Nematy M, Ferns G, *et al*. Metabolic syndrome and its components are related to psychological disorders: A population based study. Diabetes Metab Syndr 2017;11:S561-6.
31. Bahrani R, Chan YM, Khor GL, Rahman HA, Esmailzadeh A, Wong TW. The relationship between metabolic syndrome and its components with socio-economic status among adolescents in Shiraz, Southern Iran. Southeast Asian J Trop Med Public Health 2016;47:263-76.
32. Barzin M, Asghari G, Hosseinpanah F, Mirmiran P, Azizi F. The association of anthropometric indices in adolescence with the occurrence of the metabolic syndrome in early adulthood: Tehran Lipid and Glucose Study (TLGS). Pediatr Obes 2013;8:170-7.
33. Barzin M, Hosseinpanah F, Fekri S, Azizi F. Predictive value of body mass index and waist circumference for metabolic syndrome in 6-12-year-olds. Acta paediatrica (Oslo, Norway: 1992) 2011;100:722-7.
34. Barzin M, Hosseinpanah F, Saber H, Sarbakhsh P, Nakhoda K, Azizi F. Gender differences time trends for metabolic syndrome and its components among tehranian children and adolescents. Cholesterol 2012;2012:804643.
35. Bayani MA, Yazdani E, Karkhah A, Moodi S, Bijani A, Hosseini SR. Prevalence of metabolic syndrome and its components in the Iranian elderly people: Results from AHAP study. Int J Adv Biotechnol Res 2016;7:2235-42.
36. Chiti H, Hosseinpanah F, Mehrabi Y, Azizi F. The prevalence of metabolic syndrome in adolescents with varying degrees of body weight: Tehran Lipid and Glucose Study (TLGS). Iran J Endocrinology Metab 2010;11:625-37.
37. Chiti H, Shakibi E, Soltani Z, Mazloomzadeh S, Mousavinasab S. Prevalence of metabolic syndrome and cardiovascular risk factors among physicians of Zanjan City. ZUMS J 2016;24:10-20.
38. Deihim T, Amiri P, Taherian R, Tohidi M, Ghasemi A, Cheraghi L, *et al*. Which insulin resistance-based definition of metabolic syndrome has superior diagnostic value in detection of poor health-related quality of life? Cross-sectional findings from Tehran Lipid and Glucose Study. Health Qual Life Outcomes 2015;13:194.
39. Delavar MA, Lye MS, Khor GL, Hanachi P, Hassan S. Prevalence of metabolic syndrome among middle aged women in babol, Iran. Southeast Asian J Trop Med Public Health 2009;40:612-28.
40. Delvarianzadeh M, Abbasian M, Khosravi F, Ebrahimi H, Ebrahimi MH, Fazli M. Appropriate anthropometric indices of obesity and overweight for diagnosis of metabolic syndrome and its relationship with oxidative stress. Diabetes Metab Syndr 2017;11(Suppl 2):S907-S11.
41. Ebrahimi H, Emamian MH, Shariati M, Hashemi H, Fotouhi A. Metabolic syndrome and its risk factors among middle aged population of Iran, a population based study. Diabetes Metab Syndr 2016;10:19-22.
42. Ebrahimi MH, Delvarianzadeh M, Saadat S. Prevalence of metabolic syndrome among Iranian occupational drivers. Diabetes Metab Syndr 2016;10 (1 Suppl 1):S46-51.
43. Ebrahimpour P, Fakhrzadeh H, Heshmat R, Bandarian F, Larijani B. Serum uric acid levels and risk of metabolic syndrome in healthy adults. Endocr Pract 2008;14:298-304.
44. Ebrahimpour P, Fakhrzadeh H, Heshmat R, Ghodsi M, Bandarian F, Larijani B. Metabolic syndrome and menopause: A population-based study. Diabetes Metab Syndr 2010;4:5-9.
45. Ejtahed HS, Bahadoran Z, Mirmiran P, Azizi F. Sugar-sweetened beverage consumption is associated with metabolic syndrome in Iranian adults: Tehran Lipid and Glucose Study. Endocrinol Metab (Seoul, Korea) 2015;30:334-42.
46. Eshtiaghi R, Esteghamati A, Nakhjavani M. Menopause is an independent predictor of metabolic syndrome in Iranian women. Maturitas 2010;65:262-6.
47. Eslamian G, Mirmiran P, Asghari G, Hosseini-Esfahani F, Yuzbashian E, Azizi F. Low carbohydrate diet score does not predict metabolic syndrome in children and adolescents: Tehran Lipid and Glucose Study. Arch Iran Med 2014;17:417-22.
48. Esmaillzadeh A, Mirmiran P, Azadbakht L, Etemadi A, Azizi F. High prevalence of the metabolic syndrome in Iranian adolescents. Obesity (Silver Spring, Md) 2006;14:377-82.
49. Esmailnasab N, Moradi G, Delaveri A. Risk factors of non-communicable diseases and metabolic syndrome. Iran J Public Health 2012;41:77-85.
50. Esmailzadehha N, Ziaee A, Kazemifar A, Ghorbani A, Oveisi S. Prevalence of metabolic syndrome in Qazvin Metabolic Diseases Study (QMDS), Iran: A comparative analysis of six definitions. Endocr Regul 2013;47:111-20.
51. Esteghamati A, Ashraf H, Rashidi A, Meysamie A. Waist

circumference cut-off points for the diagnosis of metabolic syndrome in Iranian adults. Diabetes Res Clin Pract 2008;82:104-7.
52. Esteghamati A, Khalilzadeh O, Anvari M, Ahadi MS, Abbasi M, Rashidi A. Metabolic syndrome and insulin resistance significantly correlate with body mass index. Arch Med Res 2008;39:803-8.
53. Fakhrzadeh H, Ebrahimpour P, Pourebrahim R, Heshmat R, Larijani B. Homocysteine levels and its correlation to metabolic syndrome in 25-64 years old residents of the Tehran Medical University Population Lab. Iranian J of Diabetes and Metabolism 2004;4:71-8. [in Persian].
54. Fakhrzadeh H, Ebrahimpour P, Pourebrahim R, Heshmat R, Larijani B. Metabolic syndrome and its associated risk factors in healthy adults: A population-based study in Iran. Metab Syndr Relat Disord 2006;4:28-34.
55. Frootan M, Mahdavi R, Moradi T, Mobasseri M, Farrin N. Prevalence of metabolic syndrome in an elderly population of Tabriz, Iran. Endocrinol Metabol Syndrome S 2011;1:S1:003.
56. Gharipour M, Baghaie AM, Boshtam M, Rabeie K. Prevalence of metabolic syndrome in an Iranian adult population. ARYA Atherosclerosis 2010;1:188-92.
57. GhariPour M, Baghei A, Boshtam M, Rabiei K. Prevalence of metabolic syndrome among the adults of central of areas of Iran (as part of" Isfahan Healthy Heart Study"). J Birjand Univ Med Sci 2006;13:9-15.
58. Ghasemi A, Zahediasl S, Azizi F. Nitric oxide and clustering of metabolic syndrome components in pediatrics. Eur J Epidemiol 2010;25:45-53.
59. Ghasemi A, Zahediasl S, Azizi F. High serum nitric oxide metabolites and incident metabolic syndrome. Scand J Clin Lab Invest 2012;72:523-30.
60. Ghorbani R, Abtahi Naeini B, Eskandarian R, Rashidy-Pour A, Khamseh ME, Malek M. Prevalence of metabolic syndrome according to ATPIII and IDF criteria in the Iranian population. Koomesh 2012;14:65-75.
61. Ghotboddin Mohammadi S, Mirmiran P, Bahadoran Z, Mehrabi Y, Azizi F. The association of dairy intake with metabolic syndrome and its components in adolescents: Tehran Lipid and Glucose Study. Int J Endocrinol Metab 2015;13:e25201.
62. Hadaegh F, Zabetian A, Azizi F. Prevalence of metabolic syndrome in Iranian adult population, concordance between the IDF with the ATPIII and the WHO definitions. Iran J Diabetes Lipid Disord 2007;6:59-67+E44.
63. Hajian-Tilaki K, Heidari B, Firouzjahi A, Bagherzadeh M, Hajian-Tilaki A, Halalkhor S. Prevalence of metabolic syndrome and the association with socio-demographic characteristics and physical activity in urban population of Iranian adults: A population-based study. Diabetes Metab Syndr 2014;8:170-6.
64. Heidari R, Sadeghi M, Talaei M, Rabiei K, Mohammadifard N, Sarrafzadegan N. Metabolic syndrome in menopausal transition: Isfahan Healthy Heart Program, a population based study. Diabetol Metab Syndr 2010;2:59.
65. Heidari Z, Hosseinpanah F, Mehrabi Y, Safarkhani M, Azizi F. Predictive power of the components of metabolic syndrome in its development: A 6.5-year follow-up in the Tehran Lipid and Glucose Study (TLGS). Eur J Clin Nutr 2010;64:1207-14.
66. Hosseini M, Sarrafzadegan N, Kelishadi R, Monajemi M, Asgary S, Vardanjani HM. Population-based metabolic syndrome risk score and its determinants: The Isfahan Healthy Heart Program. J Res Med Sci 2014;19:1167-74.
67. Hosseini N, Talaei M, Dianatkhah M, Sadeghi M, Oveisgharan S, Sarrafzadegan N. Determinants of incident metabolic syndrome in a middle eastern population: Isfahan Cohort Study. Metab Syndr Relat Disord 2017;15:354-62.
68. Hossein-Nezhad A, Nikoo MK, Maghbooli Z, Karimi F, Mirzaei K, Hosseini A, *et al*. Relationship between serum Vitamin D concentration and metabolic syndrome among Iranian adults population. Daru 2009;17:1-5.
69. Hosseinpanah F, Asghari G, Barzin M, Ghareh S, Azizi F. Adolescence metabolic syndrome or adiposity and early adult metabolic syndrome. J Pediatr 2013;163:1663-9.e1.
70. Hosseinpanah F, Barzin M, Mirmiran P, Azizi F. Effect of changes in waist circumference on metabolic syndrome over a 6.6-year follow-up in Tehran. Eur J Clin Nutr 2010;64:879-86.
71. Hosseinpanah F, Borzooei S, Barzin M, Farshadi M, Sarvghadi F, Azizi F. Diagnostic values of metabolic syndrome definitions for detection of insulin resistance: Tehran Lipid and Glucose Study (TLGS). Arch Iran Med 2012;15:606-10.
72. Hosseinpanah F, Salehpour M, Asghari G, Barzin M, Mirmiran P, Hatami H, *et al*. Adolescent metabolic phenotypes and early adult metabolic syndrome: Tehran lipid and glucose study. Diabetes Res Clin Pract 2015;109:287-92.
73. Hosseinpour-Niazi S, Hosseini S, Mirmiran P, Azizi F. Prospective study of nut consumption and incidence of metabolic syndrome: Tehran Lipid and Glucose Study. Nutrients 2017;9. doi: 10.3390/nu9101056.
74. Hosseinpour-Niazi S, Mirmiran P, Mirzaei S, Azizi F. Cereal, fruit and vegetable fibre intake and the risk of the metabolic syndrome: A prospective study in the Tehran Lipid and Glucose Study. J Hum Nutr Diet 2015;28:236-45.
75. Jalali R, Vasheghani M, Dabbaghmanesh MH, Ranjbar Omrani G. Prevalence of metabolic syndrome among adults in a rural area. Iran J Endocrinology Metab 2009;11:405-14+77.
76. Jalilolghadr S, Javadi A, Mahram M, Farshidgohar M, Javadi M. Prevalence of metabolic syndrome and insulin resistance in children and adolescent of Qazvin, Iran. Malays J Med Sci 2015;22:32-9.
77. Janghorbani M, Amini M. Glycated hemoglobin as a predictor for metabolic syndrome in an Iranian population with normal glucose tolerance. Metab Syndr Relat Disord 2012;10:430-6.
78. Janghorbani M, Amini M. Low-density lipoprotein cholesterol and metabolic syndrome in an Iranian high-risk population. Diabetes Metab Syndr 2015;9:91-7.
79. Jouyandeh Z, Nayebzadeh F, Qorbani M, Asadi M. Metabolic syndrome and menopause. J Diabetes Metab Disord 2013;12:1.
80. Karandish M, Hosseinpour M, Rashidi H, Latifi SM, Aleali AM. Prevalence of metabolic syndrome in normal weight children and adolescents in Ahvaz, Iran. J Am Coll Cardiol 2016;68:C69-C.
81. Karimi F, Jahandideh D, Dabbaghmanesh M, Fattahi M, Omrani GR. The prevalence of metabolic syndrome and its components among adults in a rural community, Fars, Iran. Int Cardiovasc Res J 2015;9:94-9.
82. Kaykhaei M, Hashemi M, Narouie B, Shikhzadeh A, Jahantigh M, Shirzaei E, *et al*. Prevalence of metabolic syndrome in adult population from Zahedan, Southeast Iran. Iran J Public Health 2012;41:70-6.
83. Kelishadi R, Ardalan G, Adeli K, Motaghian M, Majdzadeh R, Mahmood-Arabi MS, *et al*. Factor analysis of cardiovascular risk clustering in pediatric metabolic syndrome: CASPIAN study. Ann Nutr Metab 2007;51:208-15.
84. Khosravi-Boroujeni H, Ahmed F, Sadeghi M, Roohafza H, Talaei M, Dianatkhah M, *et al*. Does the impact of metabolic syndrome on cardiovascular events vary by using different definitions? BMC Public Health 2015;15:1313.
85. Khosravi-Boroujeni H, Sarrafzadegan N, Sadeghi M,

Roohafza H, Talaei M, Ng SK, *et al*. Secular trend of metabolic syndrome and its components in a cohort of Iranian adults from 2001 to 2013. Metab Syndr Relat Disord 2017;15:137-44.

86. Maharlouei N, Bellissimo N, Ahmadi SM, Lankarani KB. Prevalence of metabolic syndrome in pre- and postmenopausal Iranian women. Climacteric 2013;16:561-7.
87. Mahjoub S, Ahmadi MH, Faramarzi M, Ghorbani H, Moazezi Z. The prevalence of metabolic syndrome according to the Iranian Committee of Obesity and ATP III criteria in Babol, North of Iran. Caspian J Int Med 2012;3:410-6.
88. Maleki R, Mostafazadeh M, Nazari Sharif H, Rahim Nejad S, Gorgani-Firuzjaee S. The prevalence of metabolic syndrome in Air Guard Forces of Iran Army. Paramed Sci Mil Health 2016;11:8-16.
89. Marjani A, Hezarkhani S, Shahini N. Prevalence of metabolic syndrome among fars ethnic women in North East of Iran. World J Med Sci 2012;7:17-22.
90. Marjani A, Moghasemi S. The metabolic syndrome among postmenopausal women in Gorgan. Int J Endocrinol 2012;2012:953627.
91. Mehrdad M, Hosseinpanah F, Azizi F. Prevalence of metabolic syndrome among 3-9 years old children inTehran Lipid and Glucose Study. Res Med 2006;30:337-47.
92. Mehrkash M, Mohammadian S, Qorbani M, Eshghinia S, Shafa N. Prevalency of metabolic syndrome among adolescents aged 15 to 17 years in Gorgan, Northern Iran (2009). J Gorgan Univ Med Sci 2011;13.
93. Mirhosseini NZ, Yusoff NA, Shahar S, Parizadeh SM, Mobarhen MG, Shakery MT. Prevalence of the metabolic syndrome and its influencing factors among adolescent girls in Mashhad, Iran. Asia Pac J Clin Nutr 2009;18:131-6.
94. Mirmiran P, Noori N, Azizi F. A prospective study of determinants of the metabolic syndrome in adults. Nutr Metab Cardiovasc Dis 2008;18:567-73.
95. Mirmiran P, Sherafat-Kazemzadeh R, Farahani SJ, Asghari G, Niroomand M, Momenan A, *et al*. Performance of different definitions of metabolic syndrome for children and adolescents in a 6-year follow-up: Tehran Lipid and Glucose Study (TLGS). Diabetes Res Clin Pract 2010;89:327-33.
96. Mirmiran P, Yuzbashian E, Asghari G, Hosseinpour-Niazi S, Azizi F. Consumption of sugar sweetened beverage is associated with incidence of metabolic syndrome in Tehranian children and adolescents. Nutr Metab 2015;12:25.
97. Mohammadbeigi R, Fatholapour A, Khodaverdi S, Delpisheh A, Khodaverdi M, Afkhamzadeh A. Epidemiology of metabolic syndrome among women of reproductive age in Abhar City in Western Iran. Pak J Med Sci 2011;27:1116-20.
98. Mohebbi I, Saadat S, Aghassi M, Shekari M, Matinkhah M, Sehat S. Prevalence of metabolic syndrome in Iranian professional drivers: Results from a population based study of 12,138 men. PLoS One 2012;7:e31790.
99. Moradi S, Zamani F, Pishgar F, Ordookhani S, Nateghi N, Salehi F. Parity, duration of lactation and prevalence of maternal metabolic syndrome: A cross-sectional study. Eur J Obstet Gynecol Reprod Biol 2016;201:70-4.
100. Motamed N, Razmjou S, Hemmasi G, Maadi M, Zamani F. Lipid accumulation product and metabolic syndrome: A population-based study in northern Iran, Amol. J Endocrinol Invest 2016;39:375-82.
101. Mousavi A, Biglari A, Reyhanian M. Prevalence of metabolic syndrome and its related criteria in health network personnel in Babolsar, 2012. J Mazandaran Univ Med Sci 2015;24:379-83.
102. Mousavi E, Gharipour M, Tavassoli A, Sadri GH, Sarrafzadegan N. Multiparity and risk of metabolic syndrome: Isfahan Healthy Heart Program. Metab Syndr Relat Disord 2009;7:519-24.
103. Nabipour I, Amiri M, Imami SR, Jahfari SM, Shafeiae E, Nosrati A, *et al*. The metabolic syndrome and nonfatal ischemic heart disease; a population-based study. Int J Cardiol 2007;118:48-53.
104. Najafian J, Toghianifar N, Mohammadifard N, Nouri F. Association between sleep duration and metabolic syndrome in a population-based study: Isfahan Healthy Heart Program. J Res Med Sci 2011;16:801-6.
105. Ostovaneh MR, Zamani F, Sharafkhah M, Ansari-Moghaddam A, Akhavan Khaleghi N, Saeedian FS, *et al*. Prevalence of metabolic syndrome in Amol and Zahedan, Iran: A population based study. Arch Iranian Med 2014;17:477-82.
106. Pasdar Y, Nazari LH, Rezaei M, Barzegar A, Darbandi M, Niazi P. Which factors predict metabolic syndrome? A cross sectional study in Kermanshah, Iran. Ann Trop Med Public Health 2017;10:993-8.
107. Payab M, Hasani-Ranjbar S, Merati Y, Esteghamati A, Qorbani M, Hematabadi M, *et al*. The prevalence of metabolic syndrome and different obesity phenotype in Iranian male military personnel. Am J Mens Health 2017;11:404-13.
108. Rafraf M, Hasanabad SK, Jafarabadi MA. Vitamin D status and its relationship with metabolic syndrome risk factors among adolescent girls in Boukan, Iran. Public Health Nutr 2014;17:803-9.
109. Rahmanian K, Shojaie M. Prevalence of metabolic syndrome in an adult urban population in the South of Iran. Iran J Diabetes Obesity 2011;3:77-82.
110. Rashidi AA, Parastouei K, Aarabi MH, Taghadosi M, Khandan A. Prevalence of metabolic syndrome among students of Kashan University of Medical Sciences in 2008. KAUMS J (FEYZ) 2010;13:307-12.
111. Rashidi H, Payami SP, Latifi SM, Karandish M, Moravej Aleali A, Aminzadeh M, *et al*. Prevalence of metabolic syndrome and its correlated factors among children and adolescents of Ahvaz aged 10-19. J Diabetes Metab Disord 2014;13:53.
112. Rezaei Kheirabadi M, Asghari G, Mirmiran P, Mehrabi Y, Azizi F. Comparison of body fat percentage with anthropometric indices for identification of metabolic syndrome in Tehranian adolescents. J Babol Univ Med Sci 2014;16:25-34.
113. Saberi HR, Moravveji AR, Fakharian E, Kashani MM, Dehdashti AR. Prevalence of metabolic syndrome in bus and truck drivers in Kashan, Iran. Diabetol Metab Syndr 2011;3:8.
114. Sadeghi M, Roohafza H, Shirani S, Baghaei A, Golshadi I, Aghdak P. Relationship between hematological factors and metabolic syndrome in an Iranian Population Isfahan Healthy Heart Program. J Rafsanjan Univ Med Sci 2006;5:109-16.
115. Sadrbafoghi S, Salari M, Rafiee M, Namayandeh S, Abdoli A, Karimi M. Prevalence and criteria of metabolic syndrome in an urban population: Yazd Healthy Heart Project. Tehran Univ Med J 2006;64:90-6.
116. Salem Z, Vazirinejad R. Prevalence of obesity and metabolic syndrome in adolescent girls in South East of Iran. Pak J Med Sci 2009;25:196-200.
117. Sanjari M, Khodashahi M, Gholamhoseinian A, Shokoohi M. Association of adiponectin and metabolic syndrome in women. J Res Med Sci 2011;16:1532-40.
118. Saraei M, Heidarbagi E, Najafi A. Prevalence of metabolic syndrome and risk factors of obstructive sleep apnea among locomotive drivers. J Sleep Res 2016;25:347.
119. Sarebanhassanabadi M, Mirhosseini SJ, Mirzaei M,

Namayandeh SM, Soltani MH, Pedarzadeh A, *et al*. The incidence of metabolic syndrome and the most powerful components as predictors of metabolic syndrome in central Iran: A 10-year follow-up in a cohort study. Iran Red Crescent Med J 2017;19:10.

120. Sarrafzadegan N, Gharipour M, Ramezani MA, Rabiei K, Zolfaghar B, Tavassoli AA, *et al*. Metabolic syndrome and health-related quality of life in Iranian population. J Res Med Sci 2011;16:254-61.
121. Sarrafzadegan N, Kelishadi R, Baghaei A, Hussein Sadri G, Malekafzali H, Mohammadifard N, *et al*. Metabolic syndrome: An emerging public health problem in Iranian women: Isfahan healthy heart program. Int J Cardiol 2008;131:90-6.
122. Schwandt P, Kelishadi R, Haas GM. Ethnic disparities of the metabolic syndrome in population-based samples of German and Iranian adolescents. Metab Syndr Relat Disord 2010;8:189-92.
123. Schwandt P, Kelishadi R, Ribeiro RQ, Haas GM, Poursafa P. A three-country study on the components of the metabolic syndrome in youths: The BIG study. Int J Pediatr Obes 2010;5:334-41.
124. Sh GM, Mirmiran P, Bahadoran Z, Mehrabi Y, Azizi F. The association between dairy intake with metabolic syndrome and its components in adolescents: Tehran lipid and glucose study. Iran J Endocrinol Metab 2014;16:270-82.
125. Shahbazian H, Latifi SM, Jalali MT, Shahbazian H, Amani R, Nikhoo A, *et al*. Metabolic syndrome and its correlated factors in an urban population in South West of Iran. J Diabetes Metab Disord 2013;12:11.
126. Shahini N, Shahini I, Marjani A. Prevalence of metabolic syndrome in turkmen ethnic groups in gorgan. J Clin Diagn Res 2013;7:1849-51.
127. Sharifi F, Mousavinasab SN, Saeini M, Dinmohammadi M. Prevalence of metabolic syndrome in an adult urban population of the west of Iran. Exp Diabetes Res 2009;2009:136501.
128. Shirani F, Esmaillzadeh A, Keshteli AH, Adibi P, Azadbakht L. Low-carbohydrate-diet score and metabolic syndrome: An epidemiologic study among Iranian women. Nutrition 2015;31:1124-30.
129. Soltani Z, Khamse M, Chiti H, Valizadeh M, Mazloomzadeh S. Plasma 25 (OH) vitamin-D level and metabolic syndrome risk factors among physicians of Zanjan. J Zanjan Univ Med Sci Health Serv 2015;23:64-73.
130. Sourinejad H, Moghaddam BL, Niyati S. The metabolic syndrome and its components in mid-pregnancy in Tehran, 2013-14. J Urmia Nurs Midwifery Fac 2016;14:465-73.
131. Tabari MG, Naseri F, Paad E, Majidi F, Marjani A. Prevalence of metabolic syndrome in baluch women in Chabahar. Int J Osteoporosis Metab Disord 2015;8:27-34.
132. Tabatabaie AH, Shafiekhani M, Nasihatkon AA, Rastani IH, Tabatabaie M, Borzoo AR, *et al*. Prevalence of metabolic syndrome in adult population in Shiraz, Southern Iran. Diabetes Metab Syndr 2015;9:153-6.
133. Veghari G, Sedaghat M, Banihashem S, Moharloei P, Angizeh A, Tazik E, *et al*. The prevalence of metabolic syndrome in the north of Iran. An epidemiologic comparative study. J Cardiovasc Dis Res 2015;6:172-5.
134. Yousefzadeh G, Sheikhvatan M. Age and gender differences in the clustering of metabolic syndrome combinations: A prospective cohort research from the Kerman Coronary Artery Disease Risk Study (KERCADRS). Diabetes Metab Syndr 2015;9:337-42.
135. Zabetian A, Hadaegh F, Azizi F. Prevalence of metabolic syndrome in Iranian adult population, concordance between the IDF with the ATPIII and the WHO definitions. Diabetes Res Clin Pract 2007;77:251-7.
136. Zabetian A, Hadaegh F, Sarbakhsh P, Azizi F. Weight change and incident metabolic syndrome in Iranian men and women; a 3 year follow-up study. BMC Public Health 2009;9:138.
137. Zabetian A, Hadaegh F, Tohidi M, Sheikholeslami F, Azizi F. Prevalence of metabolic syndrome by the ATPIII, IDF and WHO definitions and their association to coronary heart disease in Iranian elderly population. Iran J Diabetes Metab 2007;7:91-101.
138. Zardast M, Namakin K, Chahkandi T, Taheri F, Kazemi T, Bijari B. Prevalence of metabolic syndrome in elementary school children in East of Iran. J Cardiovasc Thorac Res 2015;7:158-63.
139. Zaribaf F, Falahi E, Barak F, Heidari M, Keshteli AH, Yazdannik A, *et al*. Fish consumption is inversely associated with the metabolic syndrome. Eur J Clin Nutr 2014;68:474-80.
140. Ziaee A, Esmailzadehha N, Ghorbani A, Asefzadeh S. Association between uric acid and metabolic syndrome in qazvin metabolic diseases study (QMDS), Iran. Glob J Health Sci 2013;5:155-65.
141. Aguilar M, Bhuket T, Torres S, Liu B, Wong RJ. Prevalence of the metabolic syndrome in the United States, 2003-2012. Jama 2015;313:1973-4.
142. Bhupathiraju SN, Stampfer MJ. Menopausal hormone therapy and cardiovascular disease: Unraveling the role of age and time since menopause onset. Clin Chem 2018;64:861-2.
143. Galassi A, Reynolds K, He J. Metabolic syndrome and risk of cardiovascular disease: A meta-analysis. Am J Med 2006;119:812-9.
144. Sayehmiri F. Metabolic syndrome prevalence in Iran: A systematic review and meta-analysis. J Kermanshah Univ Med 2014;18:242-50. [in Persian].
145. Abdul-Rahim HF, Husseini A, Bjertness E, Giacaman R, Gordon NH, Jervell J. The metabolic syndrome in the West Bank population: An urban-rural comparison. Diabetes Care 2001;24:275-9.