Study of Metabolic Syndrome Criteria among Apparent Healthy Population in Sana'a, Yemen

Abstract

Background: The metabolic syndrome is characterized by several cardiovascular risk factors and is associated with an increased incidence of diabetes, cardiovascular events and mortality. The prevalence of metabolic syndrome is increasing in epidemic proportions worldwide. The present study aimed to investigate the prevalence of MS and its components in healthy populations in Sana'a, Yemen.

Methods: This study was a cross-sectional study conducted from February 2019 to April 2019. A total of 120 healthy populations (>= 40 years old) were selected.The study protocol was approved by the institutional ethical committee and informed consent was obtained from all the enrolled study patients for their inclusion in the screening and participation in the research. In the present study, the diagnosis of metabolic syndromebased on the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) and to a joint statement from several large organizations.In the current study, the presence of more than or equal to any three of the above mentioned factors is required for the diagnosis of metabolic syndrome.

Results: The total prevalence of MS among the study subjectswas40.0% (*P< 0.001*)and 62.5%of them werewithin 40-49 years old. In the present study, there was not statically significant difference between the khat chewing and the metabolic syndrome. According the distribution of metabolic syndrome criteria among subjects with metabolic syndrome, the prevalence of fasting blood glucose (FBG) was the highest (85%).

Conclusions: The prevalence of metabolic syndrome among healthy Yemeni populations was very high and it is associated with increased morbidity and mortality. This emphasizes the need for more attention to investigate this condition to decreasing the prevalence of cardiovascular morbidity and mortality in thesesubjects.

***Keywords**: Criteria, Metabolic Syndrome, Prevalence*

1. Introduction:

Metabolic syndrome was first recognized during the late 1980s and was characterized by the clustering of abdominal obesity, elevated blood pressure, hyperglycemia, and dyslipidemia[(1)].Subjects with metabolic syndrome are at increased risk for coronaryartery disease (CAD), and the presence of metabolicsyndrome alone can predict approximately 25% of allnew-onset cardiovascular disease (CVD) [(2)]. In addition,metabolic syndrome is associated with an increased riskof death from coronary heart diseases, cardiovascular diseases, and all other causes[(3)].

Metabolic syndromeincreases the risk of type 2 diabetes mellitus by a 5-fold and 2-fold of cardiovascular disease (CVD) over the next 5 to 10 years [(4)]. Recently, the prevalence of metabolic syndrome has been reported tobe between 10% and 84% worldwide according to theage, sex, and ethnicity of the population[(5)].

Nearly one-quarter of adults in the U.S. have the metabolic syndrome[(6)].

The prevalence of metabolic syndromein the Middle East and North African (MENA) region is known for its high,where it has been reported to be 45.5% and24.3% in Tunisia, using the International Diabetes Federation (IDF) criteria and Adult Treatment Panel (ATP III)definition, respectively[(7)]. The prevalence of metabolicsyndrome in Gulf countries, as part of the Middle East, has shown ranges from 17% in Oman [(8)]to 40.5% in the United Arab Emirates (UAE) [(9)], accordingto the ATP III and IDF criteria, respectively.

The prevalence of metabolic syndrome in Saudi Arabia according toAl-Rubeaan et al. [10]reported it to be 39.8% and 31.6% in 2018 according to the ATP III and IDF criteria.The metabolic syndrome has become a serious public-health problem. Due to changes in the social environment, the numbers of individuals with metabolic syndrome have been increased over the past years. Therefore, the main aim of the current study was toestimate the prevalence of metabolic syndrome and its risk factors among the adult Yemeni population in comparison to other countries.

2. Methods:

This study was a cross-sectional study conducted from February 2019 to May 2019. A total of 120 of healthy populations were selected.The study protocol was approved by the institutional ethical committee and informed consent was obtained from all the enrolled study patients for their inclusion in the screening and participation in the research.

In the effort to introduce the metabolic syndromeinto clinical practice, several scientific organizations have attempted to formulate working definition of the syndrome. In the present study, the diagnosis of metabolic syndromebased on the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) and to a joint statement from several large organizations[11]. The patients must meet at least three of the following criteria for diagnosis of metabolic syndrome:

- Increased waist circumference (40 inches [102 cm] or greater in men and 35 inches [89 cm] or greater in women).
- Triglycerides of 150 mg/dL (1.70 mmol/L) or greater.
- Low high-density lipoprotein (HDL) cholesterol (less than 40 mg/dL [1.03 mmol/L] in men and less than 50 mg/dL[1.29 mmol/L] in women).
- Systolic blood pressure (BP) of 130 mm Hg or greater, diastolic BP of 85 mm Hg or greater.
- Fasting blood glucose of 100 mg/dL (5.6 mmol/L) or greater.

In the current study, the presence of more than or equal to any three of the above mentioned factors is required for the diagnosis of MS. Populations with established chronic diseases were excluded to homogenize the study subjects.

All the study subjects were personally interviewed by the trained interviewers. The following variables were evaluated: age, sex, waist circumference, HDL cholesterol, triglycerides, fasting glucose, and blood pressure. Statistical analysis wasdone by SPSS software version 21.0 by using Pearson's Chi-squaretest. *P-value*of less than 0.05 was considered significant.

3. Results:

The overall prevalence of metabolic syndrome was 40% (*P-value < 0.001*), and was significatilly higher in women than in men (52.9% vs 30.4%, respectively; *P-value = 0.01*).Out of 69 males, 21 (30.4%) had Metabolic Syndrome and 27 (52.9%) of femaleshadmetabolic syndrome (table 2).

Table 1. Prevalence of metabolic syndrome among the study populations

Variable	Level of variable	N	%	*P-value*
Metabolic Syndrome	**Yes**	48	40.0	0.001
	No	72	60.0	
	Total	120	100.0	

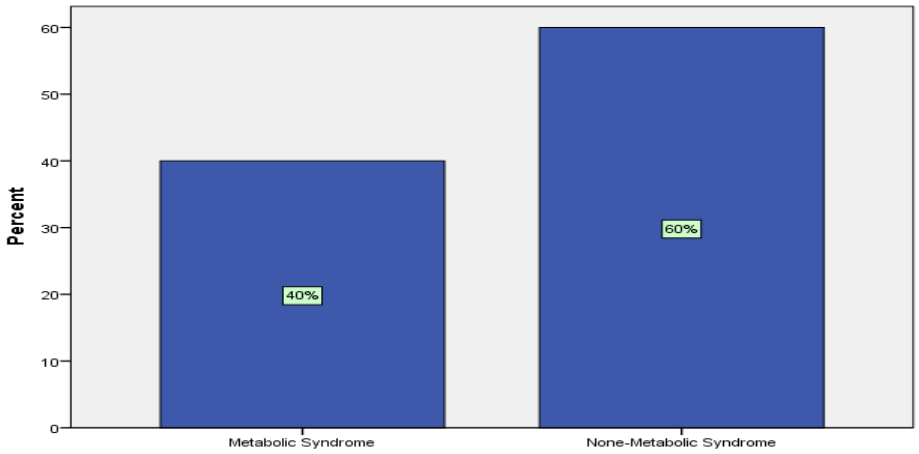

Figure 1. Prevalence of Metabolic Syndrome among the Study Sample

Table 2. The prevalence of Metabolic Syndrome among gender

Variable		Metabolic Syndrome		Total	*P-value*
		Yes	No		
Gender	Male	21 (30%.4)	48	69	0.013
	Female	27 (52.9%)	24	51	
	Total	48	72	120	

There was significantly relationship between the prevalence of waist circumference and metabolic syndrome (*P-value*< 0.001).26 of patients with increased waist circumference had metabolic syndrome, in comparison, 22 of patients withmetabolic syndrome did not have increased waist circumference.

Table 3. The prevalence of waist circumference among Subjects with Metabolic Syndrome

Variable		Metabolic Syndrome		Total	*P*-value
		Yes	No		
Waist circumference (WC)	No	22	60	82	**0.001**
	Yes	26	12	38	
	Total	48	72	168	

Table 4 showed the distribution of metabolic syndrome by Triglyceride. Results in this table indicated that the relationship between metabolic syndrome and prevalence of triglyceride was high significant (*P-value*< 0.001). In addition, out of 48subjects with metabolic syndrome, 31 of them had high triglyceride.

Table 4. The prevalence of Triglyceride (TG) among Subjects with Metabolic Syndrome

Variable		Metabolic Syndrome		Total	*P-value*
		No	Yes		
Triglyceride	No	52	17	69	**0.001**
	Yes	20	31	51	
	Total	72	48	120	

The relationship between metabolic syndrome and HDL cholesterol level was statistically significant (*P-value*< 0.001). According to the study findings, 37(77.1%) of subjects with metabolic syndrome had low HDL (<40 mg/dL in male or <50 in

female). However, 11 of subjects with metabolic syndrome had normal HDL cholesterol level.

Table 5. The prevalence of HDL- Cholesterol among Subjects with Metabolic Syndrome

Variable		Metabolic Syndrome		Total	*P-value*
		Yes	No		
HDL-Cholesterol	**Yes**	37	32	69	**0.001**
	No	11	40	51	
	Total	48	72	120	

The association between metabolic syndrome and blood pressure was analyzed in the table6. Results in this table showed high significantly relationship (*P-value*<0.001). Based on the study results, 25 (52.1%) of subjects with metabolic syndrome hadhigh blood pressure.

Table 6. The prevalence of Blood Pressure among Subjects with Metabolic Syndrome

Variable		Metabolic Syndrome		Total	*P-value*
		No	Yes		
Blood Pressure (BP)	**No**	58	23	81	**0.001**
	Yes	14	25	39	
	Total	72	48	120	

In the current study, the relationship between metabolic syndrome and fasting blood glucose (FBG) was statistically significant (*P-value*< 0.001). In addition, 41 (85.4%) of subjects with metabolic syndrome had high FBG.

Table 7. The prevalence of Fasting Blood Glucose (FBG) among Subjects with Metabolic Syndrome

Variable		Metabolic Syndrome		Total	*P-value*
		No	Yes		
Fasting Blood Glucose (FBG)	**No**	39	7	46	**0.001**
	Yes	33	41	74	
	Total	72	48	120	

In this study, the relationship between metabolic syndrome and age group was not statistically significant (*P-value* = 0.113).Similarly, there was not any relationship between metabolic syndrome and Khat chewingor smoking (*P-value* = 0.124; 0.420, respectively).

Table8 . The distribution of age group, smoking, andkhat chewing among patients with metabolic syndrome

Variable		Metabolic Syndrome		Total	*P-value*
		Yes	No		
Age group	40-49	30	47	77	0.113
	50-59	10	21	31	
	60 or greater	8	4	12	
Smoking	Yes	18	22	40	0.429
	No	30	50	80	
Khat chewing	Yes	34	14	48	0.124
	No	41	31	72	

The study results reported a high prevalence of metabolic syndrome criteria among subjects with metabolic syndrome. The most frequently observed component of metabolic syndrome was found to be Fasting Blood Glucose (FBG), followed by HDL-C (table 9).

Table 9. Distribution of metabolic syndromecriteria among subjectswithmetabolic syndrome

Variable		Metabolic Syndrome		%
		Yes	No	
Waist Circumference	No	22	60	54.2%
	Yes	**26**	12	
Triglyceride	No	17	52	67.6%
	Yes	**31**	20	
HDL-C	Yes	37	32	77.1%
	No	11	40	
Blood Pressure	No	23	58	52.1%
	Yes	25	14	
Fasting Blood Glucose	No	7	39	85%
	Yes	41	33	

According to the study findings, HDL-C had significant relationship between men and women (*P-value*<0.001). However, there was not statistically significant between men and women in other metabolic syndrome criteria (table 10).

Table 10. Distribution of Metabolic Syndrome Criteria according to Gender

Variable		Gender		Total	*P-value*
		Male	Female		
TG	<150 mg/dl	41	28	69	0.621
	150 mg/dL or greater	28	23	51	
HDL-C	<40 mg/dl in men or <50 in women	30	39	69	0.001
	40 mg/dL or greater in men or = 50 or greater in women	39	12	51	

Waist circumference	**<89 cm in women or <102 cm in men**	51	31	82	**0.13**
	89 cm in women or greater or 102 cm or greater in men	18 (26.1%)	20 (39.2%)	38	
Fasting Blood Glucose	**<100 mg/dL**	28	18	46	**0.56**
	100 mg/dL or greater	41	33	74	
Blood pressure	**<130/85 mm**	43	38	81	**0.16**
	130/85 mm Hg or greater	26	13	39	

There were not statistically significant between the khat chewing and metabolic criteria. In addition, there were not statistically significant between the metabolic syndrome and khat chewing.

Table 11. Distribution of metabolic syndrome criteria among subjectswith khat chewing

Variable		**Khat chewing**		***P-value***
		Yes	**No**	
Waist Circumference	**No**	51	31	0.92
	Yes	**24**	14	
Triglyceride	**No**	39	30	0.12
	Yes	**36**	15	
HDL-C	**Yes**	41	28	0.42
	No	34	17	
Blood Pressure	**No**	46	35	0.062
	Yes	29	39	
Fasting Blood Glucose	**Yes**	48	26	0.50
	No	27	19	

4. Discussion:

Metabolic syndrome has become a public health problem and its prevalence increasing globally. To our knowledge, this is the first Yemeni study that focuses on the estimation of the prevalence of metabolic syndrome in the general population by using the American Heart Association/National Heart, Lung, and Blood Institute (AHA/NHLBI) and to a joint statement from several large organizations.According to the study results, the prevalence of metabolic syndrome was seen in 40 % of the study subjects. This result is consistent with results from other studies, where the prevalence of metabolic syndrome was 38.5% among Americans [(12)]and of 33.5% in the population of India[(13)].However; it is high compared to prevalence in the South African population [(14)](25.5%) and lower than that of the population of Nepal [(15)] (61.7%).These differences in the prevalence can be explained by the interaction of genetic and environmental factors, which have long been known to play a key role in the pathophysiology of metabolic syndrome[(16)].Furthermore, analysis of the variation in prevalence of metabolic syndrome according to sex showed a significantly higher prevalence in females (52.9%) %) compared to males (30.4%). This result is consistent with many studies [(17, 18)]. However, it differs from others where the prevalence is similar between both sexes[(19)]Factors such as weight gain after pregnancy, gestational diabetes mellitus, preeclampsia, polycystic ovary syndrome, use of hormonal contraceptives, and menopause may increase the risk of metabolic syndrome in females[(20)]. In addition, we observed a variation in the prevalence of

metabolic syndrome according to age with a maximum at the fourth decade among the study sample (62.5%).This may be related to the most study subjects within this age group (64.2%).A decline is observed in the prevalence of metabolic syndrome in patients aged over 60 years.This may be related to the increase of the mortality in people with metabolic syndrome of >= 60 years old. Moreover,the association between premature mortality and the presence of metabolic syndrome has been described in many studies[17, 21].Also the lack of consensus on metabolic syndromes definitions and the cutoff points used for its components, especially regarding waist circumference, has resulted in these differences.The comparisons between Yemen and other countries must be made with caution. Because in Yemen and most of other studies were conducted in a small area or a city, they cannot be representative of the entire country. Therefore, generalizing the study results to a country is a point of concern[22].Also the differences between peoplemight to genetic differences that couldeffecton metabolic syndrome criteria[23].

In terms of individual criteria, the major factors contributing to metabolic syndromewere fasting blood glucose (85%), followed by HDL-c and triglyceride (77.1% and 67.6%; respectively).These findings could be associated with the high prevalence of insulin resistanceand the propensity for elevated triglyceride levels in patients with metabolic syndrome.Furthermore, about 34.2% of participants in the sample survey were unaware of pre-existing diabetes of. After evaluation, 85% in this group were eventually diagnosed with metabolic syndrome. In a study conducted by Delavari et al.[24], greater waist circumference values and lower HDL cholesterol have also been reported in Iranian communities than in Western populations, which support the idea of an ethnic predisposition of the Iranian community to metabolic syndrome.
In the current study, there were not statistically significant between the khat chewing and metabolic criteria or the prevalence of metabolic syndrome.This might due to other classical cardiovascular risk factors, such as smoking, dietary salt intake, physical inactivity, and other habits along with Khat may modify the extent of association between Khat chewing and metabolic criteria.
In contrast to previous studies, which reported that Khat chewing has an important effect on carbohydrate metabolism through a reduced insulin secretion and insulin resistance and induced upregulation of resistin expression [25, 26]and cathinone-induced catecholamines secretion; which would increase blood glucose levels [27].
A study conducted to evaluate the effect of khat chewing on the blood glucose level of normal chewers in comparison to the effects of two antidiabetic drugs in diabetic patients showed that the rate of sugar decrease in healthy khat chewers was significantly higher than the effect of the two antidiabetic drugs[28].
Recently, a study conducted by Murray et al. [29] showed chewing khat significantly decrease the feelings of hunger and increase the sensation of fullness.
Moreover, one of its uses is in the control of obesity, which indirectly would reduce the risk of diabetes. High plasma levels leptin, have been found 4 h after a heavy khat chewing session (400g). This hormone may attribute to the decreased of appetite and body weight that observed in khat chewers[30].

Conclusions

The prevalence of metabolic syndrome among healthy Yemeni populations was very high (40%) and it is associated with increased morbidity and mortality. The risk factors for metabolic syndromein Yemeni society were similar to those reportedinternationally. In addition, women were at a greater risk ofhaving metabolic syndrome. This emphasizes the need for more attention to investigate this condition to

decreasing the prevalence of cardiovascular morbidity and mortality in thesesubjects.Furthermore, inorder to prevent metabolic syndrome, policy makersshould consider the promotion of a healthy diet andphysical activity in the future strategies of health careof Yemeni population.

Conflict of Interest:

The authors declare that they have no competing interests.

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