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RESEARCH ARTICLE

EVALUATION OF METABOLIC SYNDROME IN HEALTHY YEMENI POPULATIONS

Gamil Alrubaiee[1], Ali Alyahawi[2*]
[1]*Depatment of Applied Medical Sciences, Al-Razi University,Yemen.*
[2]*Depatment of Pharmacy, Al-Razi University, Yemen.*

ABSTRACT
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 metabolic syndrome and its components in healthy populations in Sana'a, Yemen. 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 syndrome based 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.
The total prevalence of metabolic syndrome among the study subjects was 40.0% (P<0.001) and 62.5% of them were within 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%). 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 these subjects.
Keywords: Criteria, metabolic syndrome, prevalence, Yemen.

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Address for Correspondence:
Dr. Ali Alyahawi, Depatment of Pharmacy, Al-Razi University, Yemen. Tel: 00967-775957401, E-mail: *alyahawipharm@yahoo.com*

INTRODUCTION
Metabolic syndrome was first identified 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 coronary artery disease (CAD), and the present of metabolic syndrome can increase the risk of all new-onset cardiovascular disease (CVD) by 25 %[2]. In addition, metabolic syndrome is associated with an increased risk of death from coronary heart diseases, cardiovascular diseases, and all other causes[3].
Metabolic syndrome increases the risk of type 2 diabetes mellitus and cardiovascular disease (CVD) by a 5-fold and 2-fold, respectively during the next 5 to 10 years[4]. Recently, the prevalence of metabolic syndrome has been reported to be between 10% and 84% globally according to the age, sex, and races of the population[5]. About twenty-five percent of adults in the U.S. have the metabolic syndrome[6]. The prevalence of metabolic syndrome in the Middle East and North African (MENA) region is known for its high, where it has been reported to be 45.5% and 24.3% in Tunisia, using the International Diabetes Federation (IDF) criteria and Adult Treatment Panel (ATP III) definition, respectively[7]. The prevalence of metabolic syndrome 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], according to the ATP III and IDF criteria, respectively.
According to Al-Rubeaan *et al.*, the prevalence of metabolic syndrome in Saudi Arabia was 39.8% and 31.6% in 2018, depending on the ATP III and IDF criteria[10]. The metabolic syndrome is recognized as a significant public-health problem. Due to changes in the social environment, the numbers of people with

metabolic syndrome have been increased during the past years. Therefore, the main aim of the current study was to estimate the prevalence of metabolic syndrome and its risk factors among the adult Yemeni population in comparison to other countries.

METHODS

This study was a cross-sectional study conducted from February 2019 to May 2019. A total of 120 of healthy populations (40 years≤ old) were selected. Full ethical clearance was obtained from the qualified authorities who approved the study design and the informed consent was obtained from all the study subjects for their inclusion in the screening and participation in the research.

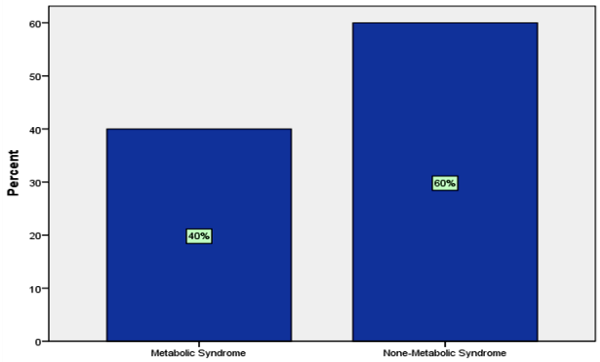

Figure 1: Prevalence of metabolic syndrome among the study sample among gender and waist circumference

To institute the metabolic syndrome into clinical practice, several scientific organizations have attempted to introduce definition of the syndrome. In the present study, the diagnosis of metabolic syndrome based 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.

Table 1: Prevalence of metabolic syndrome among the study populations

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

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. Populations with established chronic diseases were excluded to homogenize the study subjects.

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	
Waist	No	22	60	82	0.001
circumf	Yes	26	12	38	
erence	Total	48	72	168	
(WC)					

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 was done by SPSS software version 21.0 by using Pearson's Chi-square test. Categorical variables were expressed as percentages. P-value of less than 0.05 was considered significant.

Table 3: The prevalence of different variables among subjects with metabolic syndrome

Variable		Metabolic Syndrome		Total	P-value
		No	Yes		
Triglyceride	No	52	17	69	
	Yes	20	31	51	0.001
	Total	72	48	120	
HDL-Cholesterol	Yes	37	32	69	
	No	11	40	51	0.001
	Total	48	72	120	
Blood Pressure (BP)	No	58	23	81	
	Yes	14	25	39	0.001
	Total	72	48	120	
Fasting Blood Glucose (FBG)	No	39	7	46	
	Yes	33	41	74	0.001
	Total	72	48	120	

RESULTS

The overall prevalence of metabolic syndrome was 40% (P-value < *0.001*), and was significantly 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 females had metabolic syndrome (Table 2).

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 with metabolic syndrome did not have increased waist circumference.

Table 3 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 48 subjects with metabolic syndrome, 31 of them had high triglyceride.

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 4: The distribution of age group, smoking, and khat chewing among patients with metabolic syndrome

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

The association between metabolic syndrome and blood pressure was analyzed in the Table 7. 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 had high blood pressure. 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. 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 chewing or smoking (P-value=0.124; 0.420, respectively).

Table 5: Distribution of metabolic syndrome criteria among subjects with metabolic syndrome

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

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 5). 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 6). 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.

DISCUSSION

Metabolic syndrome is a serious 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 (61.7%)[15]. 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, the study of the metabolic syndrome prevalence according to sex showed a significantly higher prevalence in females (52.9%) %) compared to males (30.4%). This result is similar to many studies[17,18]. However, it was in consistent with others where the prevalence is similar between both sexes[19]. Factors such as weight gain after pregnancy, diabetes mellitus during pregnancy, polycystic ovary syndrome, preeclampsia, use of hormonal contraceptives, and menopause may increase the risk of metabolic syndrome in women[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 was 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 whole country. Therefore, generalizing the study results to all population is a point of concern[22]. Also the differences between people might to genetic variations that could effect on metabolic syndrome criteria[23].

In terms of individual criteria, the major factors contributing to metabolic syndrome were 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 resistance and 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.

Table 6: Distribution of metabolic syndrome criteria according to gender

Variable		Gender		Total	P-value
		Male	Female		
TG	<150 mg/dl	41	28	69	
	150 mg/dL or greater	28	23	51	0.621
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	

Table 7: Distribution of metabolic syndrome criteria among subjects with 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	

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, Khat chewing had a significant effect on carbohydrate metabolism by a reduced insulin secretion, insulin resistance[25,26] and cathinone-induced catecholamines secretion; which would raise blood glucose levels[27].

A study conducted to investigate 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 percentage of sugar decrease in khat chewers without diabetes was significantly higher than the effect of the two antidiabetic drugs[28]. Recently, a study done by Murray *et al.* reported that khat chewing significantly decreased the sensation of hunger and increase the feelings of fullness[29].

Moreover, it was found one of khat uses is in the control of obesity, which indirectly would decrease the risk of diabetes. High plasma levels leptin, have been found 4 hours 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].

CONCLUSION

In conclusion, this study places Yemen as one of the countries with the highest prevalence of metabolic syndrome. The risk factors for metabolic syndrome in Yemeni populations were similar to those reported internationally. In addition, women were at a greater risk of having metabolic syndrome. The major causes of metabolic syndrome are unhealthy lifestyles and eating habits.

This emphasizes the need for more attention to evaluate this condition to decreasing the prevalence of cardiovascular morbidity and mortality in these subjects. Furthermore, in order to prevent metabolic syndrome, policy makers should consider the promotion of a healthy diet and physical activity in the future strategies of health care of Yemeni population.

AUTHOR'S CONTRIBUTION

The manuscript was carried out, written, and approved in collaboration with all authors.

COMPETING INTERESTS

The authors declare that they have no competing interests.

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