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Prevalence and Risk Factors of Metabolic Syndrome Among Patients With Hypertension

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Abstract

Background: Metabolic syndrome (MetS) is a serious public health and clinical concern since its prevalence has been rising over the past few decades and is now approaching epidemic levels.

Objective: To estimate the prevalence and risk factors of MetS in Jordanian adults with confirmed diagnoses of hypertension.

Method: This is a hospital-based cross-sectional study conducted among Jordanian patients with hypertension who were followed at outpatient clinics at King Hussien Medical Center. Metabolic syndrome was diagnosed based on International Diabetes Federation (IDF) criteria. Data on socio-demographic, clinical, and anthropometric characteristics were collected from 336 hypertensive patients from June to October 2023. Descriptive analysis was utilized to assess the prevalence of MetS, and binary logistic regression analysis was used to determine independent risk factors for MetS.

Result: The overall prevalence of MetS was 33.6% (33.6% in males and 66.4% in females). Advanced age (OR = 2.006, 95% CI: 1.280 - 2.913), increased waist circumference (OR = 2.864, 95% CI: 1.534 - 4.322), increased systolic blood pressure (OR = 1.073, 95% CI: 1.041 - 1.105), overweight (OR = 5.522, 95% CI: 1.371 - 7.422), and obesity (OR = 7.521, 95% CI: 4.520 - 9.016) were associated factors that increased the risk of Mets (P<0.05). Meanwhile, high physical activity (OR = 0.321, 95% CI: 0.107–0.961) decreased the risk of MetS (P<0.05).

Conclusion: One-third of the hypertensive patients had MetS, thus highlighting the necessity of early screening and vigorous treatment of all hypertensive individuals to reduce the occurrence of cardiovascular events.

Keywords: hypertension, prevalence, metabolic syndrome, risk factors

Introduction

Nearly a third of deaths around the globe in 2021 were caused by cardiovascular diseases (CVD), with an estimated 20.5 million deaths (1). A recent report for the World Health Organization (WHO) about silent killers reported that hypertension doubled between 1990 and 2019, escalating from 650 million to 1.3 billion (2). The prevalence of these non-communicable chronic illnesses (NCDs) is increasing globally, particularly in developing countries where population growth rates are high (3). In line with the worldwide trend, Jordan is experiencing an epidemiological shift toward non-communicable diseases (NCDs), which currently account for 78% of all deaths (4). Of these NCDs, Metabolic syndrome (MetS) which is characterized by a variety of cardiovascular risk factors, including diabetes, elevated fasting plasma glucose, central obesity, dyslipidemia, and increased blood pressure (5-7). High blood pressure is associated with increased insulin resistance and insulin levels (8). In as much as 40–50% of cases, insulin resistance has been shown to have a role in the pathogenesis of primary hypertension (9).

Metabolic syndrome is prevalent in hypertensive patients and ranges from 30% to 50% (10-12). This not only subjected them to an elevated susceptibility to target organ damage but also augmented the occurrence of cardiovascular problems (9). Moreover, multiple metabolic risk factors often coexist with hypertension.

The greatest opportunity for more aggressive treatment, including lifestyle and dietary modification, weight management, and treatment of comorbid factors, can be achieved by identifying high-risk groups and developing an understanding of the modifiable lifestyle determinants and risk factors of MetS, particularly among hypertensive patients. Thus, this study aimed to determine the prevalence of MetS and its related risk factors in the Jordanian population.

Methods

This is a hospital-based cross-sectional study conducted among patients with hypertension who are followed at outpatient clinics at King Hussien Medical Center. The study's eligibility criteria included all hypertension patients older than 18 who had routine follow-up at outpatient clinics. The study excluded those with known cardiac or renal failures, lipid-altering drug users, long-term users of pharmaceuticals that cause dyslipidemia, such as beta-blockers and steroids, pregnant women, or those who have already been diagnosed with diabetes.

Metabolic syndrome was identified, according to the International Diabetes Federation (IDF) (13). The metabolic syndrome was diagnosed if the patient had three or more of the following conditions: Central obesity (defined as a waist circumference >90 cm for males and >80 cm for females), Raised triglycerides (≥150 mg/dL (1.7 mmol/L) or specific treatment for this lipid abnormality), reduced HDL cholesterol (<40 mg/dL (1.03 mmol/L) in males, <50 mg/dL (1.29 mmol/L) in females, or specific treatment for this lipid abnormality), Raised blood pressure (systolic BP ≥130 or diastolic BP ≥85 mm Hg or treatment of previously diagnosed hypertension), raised fasting plasma glucose (FPG ≥100 mg/dL (5.6 mmol/L), or previously diagnosed type 2 diabetes).

Data were collected via a socio-demographic sheet (including age, gender, educational level, and employment status), lifestyle behaviors (including smoking status and physical activity level), physical and anthropometric examination (including blood pressure, body weight and height, body mass index, and waist circumference), and patient family history of chronic diseases. The calculation and categorization of body mass index (BMI) were conducted in accordance with the guidelines provided by the World Health Organization (WHO) (14). The waist circumference (WC) was assessed by measuring the distance between the iliac crest and the lower edge of the ribs during the end of the expiratory phase. The blood pressure (BP) of the subject was assessed while in a seated position, following a minimum of 10 minutes of rest, with an aneroid sphygmomanometer.

Physical activity (PA) was assessed using the Arabic version of the Global Physical Activity Questionnaire (GPAQ) (15). The GPAQ comprises 16 questions that asked participants about the intensity, frequency, and duration of PA across 3 major domains, namely PA at work, PA during travel or transport, and PA during recreation or leisure time, in addition to an extra question that collected data on sedentary behavior and time in minutes/day. A metabolic equivalent task (MET) value of 4 was designated as moderate intensity PA, while a value of 8 was assigned as vigorous intensity PA. These values of MET were subsequently multiplied by the number of days per week of PA and the duration on a typical day for each PA domain to tabulate the total PA (MET-minutes per week). The MET minutes per week spent on each domain were subsequently computed to yield the overall PA level. High PA level was defined as vigorous-intensity activity on at least 3 days with at least 1500 MET-minutes/week or 7 days or more on any combination of walking, moderate, or vigorous-intensity activities of at least 3000 MET-minutes/week. Moderate PA level was defined as 3 or more days of vigorous-intensity activity of at least 20 min/day, 5 or more days of moderate-intensity activity or walking of at least 30 min/day, or 5 or more days of any combination of walking, moderate- or vigorous-intensity activities that achieved a minimum of at least 600 MET-minutes/week. Participants who neither met nor exceeded any of the previous two criteria were classified as having a low PA level.

Laboratory assessments included fasting blood sugar (FBS) (mg/dL), high-density lipoprotein cholesterol (HDL-c) (mg/dL) and triglycerides (TGs) (mg/dL).

The Ethics Review Board at Royal Medical Services approved this study. Each subject read the study information sheet and signed an informed consent form prior to participation. The confidentiality of patient data was strictly maintained, and the analysis of the data was conducted in an anonymous manner using patient identification numbers.

The statistical analyses were carried out using SPSS v25.0 (SPSS Inc., Chicago, IL, USA). The sample characteristics, lifestyle behaviors, physical and anthropometric measurements, and laboratory results were presented using descriptive analysis. Patients were divided into two groups: those with hypertension and MetS, and those without MetS. The student t test, chi square test, or Ficher exact test, as appropriate, were utilized to compare the groups regarding continuous and categorical variables. Utilizing binary logistic regression analysis, the groups' independent risk variables for MetS were investigated.

Results

The study enrolled 336 patients who had been diagnosed with hypertension; their average age was 50.59 years (SD = 16.20). As determined by the IDF criteria, 33.6% of the hypertensive study participants had MetS. 66.4% of those patients with MetS were female. Most of the study participants had a secondary degree as their level of education (37.2%), and they were employed (59.5%). Patients with MetS had a significantly higher mean age compared to those who didn’t have MetS (P = 0.042). No significant difference was found between hypertensive patients who had MetS and those who didn’t with regard to the other demographic characteristics (P > 0.05). Demographic characteristics are presented in Table 1

Compared to hypertensive patients without MetS, hypertensive patients with MetS had significantly higher proportions of those who had low levels of physical activity (61.9% vs. 43%) and lower proportions of those who had moderate (28.3% vs. 36.3%) and high levels of physical activity (9.7% vs. 20.6%) (P < 0.05). The majority of hypertension patients without MetS exhibited a normal BMI at a rate of 63.7%. Conversely, a significant proportion of hypertensive patients with MetS were classified as overweight, accounting for 50.4% of this group. A significant difference was seen across the groups in relation to BMI (P = 0.001). Hypertensive patients with MetS had a significantly higher mean waist circumference (96.90 ± 12.71) compared to those without MetS (85.28 ± 8.22) (P = 0.001). Systolic and diastolic blood pressure were significantly higher in hypertensive patients with MetS compared to those without MetS (146.83±12.49 vs. 138.92±9.58 and 92.88±11.55 vs. 84.97±7.55, respectively) (P = 0.001). There was no significant difference between the groups regarding smoking and family history (P > 0.05). Life style behaviors, physical and anthropometric parameters and medical history of hypertensive patients are presented in Table 2

In terms of laboratory parameters, hypertensive patients with MetS had significantly higher levels of fasting blood sugar compared to those without MetS (118.71±32.21 vs. 101.48±28.61), a higher level of triglyceride (182.28±43.13 vs. 162.64±32.62), and a lower level of high-density lipoprotein (45.30±8.27 vs. 48.37±8.38) (P < 0.05). Laboratory parameters of hypertensive patients are presented in Table 3

Binary logistic regression showed that increasing age (OR = 2.006, 95% CI: 1.280 - 2.913, P = 0.037), increasing waist circumference (OR = 2.864, 95% CI: 1.534 – 4.322, P = 0.003), increasing systolic blood pressure (OR = 1.073, 95% CI: 1.041 – 1.105, P = 0.001), and being overweight (OR = 5.522, 95% CI: 1.371 – 7.422, P = 0.025) or obesity (OR = 7.521, 95% CI: 4.520 – 9.016, P = 0.002) increased the risk of MetS, whereas having a high level of physical activity decreased the risk of MetS (OR = 0.321, 95% CI: 0.107 – 0.961, P = 0.042). Factors associated with metabolic syndrome in hypertensive patients are presented in Table 4

Table 1. Demographic characteristics’ of hypertensive patients (N=336)

Variables	**Total (n=336)**	**Metabolic syndrome**		**t/*X***	***P*-value**
		No = 223 (66.4)	Yes = 113 (33.6)		
Age, years (mean ± SD)	50.59±16.20	49.42±16.38	53.91±15.64	1.87	0.042
Sex, no (%)					
Male	122 (36.3)	84 (37.7)	38 (33.6)	0.529	0.467
Female	214 (63.7)	139 (62.3)	75 (66.4)		
Education, no (%)					
Elementary school	86 (25.6)	61 (27.4)	25 (22.1)	5.78	0.216
Secondary school	125 (37.2)	80 (35.9)	45 (39.1)		
Diploma	44 (13.1)	33 (14.8)	11 (9.7)		
Bachelor's degree	71 (21.1)	41 (18.4)	30 (26.5)		
Postgraduate studies	10 (3.0)	8 (3.6)	2 (1.8)		
Employment, no (%)					

Employed	200 (59.5)	130 (58.3)	70 (61.9)	0.415	0.519
Not employed	136 (40.5)	93 (41.7)	43 (38.1)		

t: Independent t test; *X*: chi square test

Table 2. Life style behaviors, physical and anthropometric parameters and medical history of hypertensive patients (N=336).

Variables	**Total (n=336)**	**Metabolic syndrome**		**t/*X***	***P*-value**
		No = 223 (66.4)	Yes = 113 (33.6)		
Smoking, no (%)					
No	218 (64.9)	141 (63.2)	77 (68.1)	0.794	0.373
Yes	118 (35.1)	82 (36.8)	36 (31.9)		
Physical activity, no (%)					
Low	166 (49.4)	96 (43)	70 (61.9)	12.09	0.002
Moderate	113 (33.6)	81 (36.3)	32 (28.3)		
High	57 (17.0)	46 (20.6)	11 (9.7)		
BMI, kg/m^2, no (%)					
Underweight	19 (5.7)	18 (8.1)	1 (0.9)	77.38	0.001
Normal weight	172 (51.2)	142 (63.7)	30 (26.5)		
Overweight	117 (34.8)	60 (26.9)	57 (50.4)		
Obese	28 (8.3)	3 (1.3)	25 (22.1)		
Waist circumference, cm Mean ± SD	89.19 ± 11.36	85.28 ± 8.22	96.90 ± 12.71	10.09	0.001
SBP, mmHg (mean ± SD)	141.58±11.27	138.92±9.58	146.83±12.49	6.43	0.001
DBP, mmHg (mean ± SD)	87.63±9.28	84.97±7.55	92.88±11.55	7.52	0.001
Family history, no (%)					
No	225 (67)	156 (70)	69 (61.1)	2.68	0.102
Yes	111 (33)	67 (30)	44 (38.9)		

t: Independent t test; *X*: chi square test; BMI: body mass index; SBP: Systolic blood pressure; DPB: diastolic blood pressure

Table 3. Laboratory parameters of hypertensive patients (N=336)

Variables	**Total** (n=336)	**Metabolic syndrome**		**t**	***P*-value**
		No = 223 (66.4)	Yes = 113 (33.6)		
FBS, mg/dL (mean ± SD)	107.27±30.92	101.48±28.61	118.71±32.21	4.99	0.001
HDL, mg/dL (mean ± SD)	47.33±8.46	48.37±8.38	45.30±8.27	3.18	0.002
TGs, mg/dL (mean ± SD)	169.25±37.6	162.64±32.62	182.28±43.13	4.66	0.001

t: Independent t test; FBS; fasting blood sugar; HDL; high-density lipoprotein; TGs; triglycerides

Table 4. Factors associated with metabolic syndrome in hypertensive patients (n=336)

Variables	**OR**	**95% CI**	***P*-value**
Age, years	2.006	1.280 - 2.913	0.037
Sex			
Male	1.00		
Female	1.444	0.737 - 2.830	0.285
Education			
Elementary school	1.00		
Secondary school	1.793	0.794 - 4.050	0.160
Diploma	0.721	0.240 – 2.163	0.559

Bachelor's degree	1.827	0.731 – 4.566	0.197
Postgraduate studies	1.140	0.177 – 7.322	0.890
Employment			
Employed	1.00		
Not employed	0.663	0.315 – 1.395	0.279
Smoking			
No	1.00		
Yes	0.957	0.492 – 1.860	0.896
Physical activity			
Low	1.00		
Moderate	0.588	0.276 – 1.251	0.168
High	0.321	0.107 – 0.961	0.042
Waist Circumference, cm	2.864	1.534 – 4.322	0.003
SBP, mmHg	1.073	1.041 – 1.105	0.001
DBP, mmHg	1.014	0.974 – 1.056	0.496
Family history			
No	1.00		
Yes	1.507	0.753 – 3.015	0.247
BMI, kg/m^2			
Underweight	1.00		
Normal weight	0.823	0.653 – 1.776	0.113
Overweight	5.522	1.371 – 7.422	0.025
Obese	7.521	4.520 – 9.016	0.002

BMI: body mass index; SBP: Systolic blood pressure; DPB: diastolic blood pressure; FBS; fasting blood sugar; HDL; high-density lipoprotein; TGs; triglycerides; OR: odd ratio; CI: confidence interval

Discussion

In the present investigation, we evaluated the prevalence and risk factors of metabolic syndrome among Jordanian patients diagnosed with hypertension. According to IDF criteria, the overall prevalence of MetS was 33.6%, with a higher proportion observed in females (66.4%) compared to males (33.6%). One possible explanation for the gender gap in MetS prevalence is that women in this region tend to lead less active lifestyles than men do. The fact that women are more likely than men to be obese, as well as cultural and societal norms that discourage physical activity, could have an impact on this (16). The adoption of fast urbanization has led to less exercise and more food consumption, which is a major health concern. Previous studies conducted in Jordan reported a varied range of MetS prevalence, and this variation may be due to the adoption of different criteria for the diagnosis of MetS. Obeidat et al. reported the prevalence of MetS as 51% based on IDF criteria (17). Using Third Adult Treatment Panel III criteria (ATP III) (18), Al-Shami et al. reported the prevalence of MetS as 42.5% (19). Meanwhile, the prevalence of MetS according to the WHO criteria was 26.9% among Jordanian patients (20). Most of the aforementioned studies reported higher prevalence in females than males (18, 19), with the exception of the Yasein et al. study, which reported similarity between males and females (20). Contrary to this, the Haverinen et al. study reported a higher prevalence of MetS in males than females according to three different definitions (21). Akintunde et al. compared the frequency of occurrence of metabolic syndrome in Nigerian population using three international definitions, and the highest prevalence reported for those diagnosed via IDF criteria (22). This highlights the need for consistent terminology so that findings may be compared across nations, throughout time, and even in the same country over time.

Globally, several international studies have shown varying rates of MetS in adult hypertensive patients, like in Ethiopia (48.7%), Nigeria (47.2%), Northeast China (50.1%), Iran (42.8%), and Finland (33.3%) (10, 21-24). Genetic differences between populations, ethnicity, sociodemographic traits, lifestyle, duration of hypertension, and experiences with anti-hypertensive medication are some of the hypotheses that might account for the variance, in addition to the diagnostic criteria adopted.

In this study, hypertensive patients with MetS showed a higher mean age, lower physical activity, higher waist circumference, higher systolic blood pressure, and higher proportions of overweight and obesity than

those patients without MetS. Several studies have shown that the prevalence of MetS increases steadily with age (11, 23, 24). This is consistent with the fact that aging impacts all stages of pathogenesis. Many factors contribute to the development of MetS, including insulin resistance, changes in hormone levels, and an increase in visceral adipose tissue, all of which are linked to aging (25). However, Ulasi et al. contended that the drop in MetS rate in the oldest groups may be due to age-related loss of body fat (26).
Among hypertension patients, obesity was the predominant cardiovascular risk factor. Obesity has been proposed as the primary underlying risk factor responsible for the development of metabolic syndrome. Research on obesity, specifically central obesity, has revealed that adipose tissue is an endocrine organ that releases adipocytokines, which are bioactive substances with various functions in the body. These include leptin, TNF-α, IL-6, angiotensinogen, and non-esterified fatty acids (NEFA). Arterial hypertension is a significant consequence of adipocytokines (27). Furthermore, elevated blood pressure is a result of an active renin-angiotensin system and a positive feedback interaction with the sympathetic nervous system in obese individuals (28). In this study, demographic characteristics are similar among hypertensive patients in both groups except in terms of age, physical activity, and indicators of obesity, both in terms of waist circumference and BMI. Therefore, it may be deduced that obesity is significantly related to the occurrence of MetS in hypertensive patients. Moreover, obesity as a risk factor for MetS development was responsible for increasing the risk by 7.5 times in the present study.
Waist circumference was another risk factor for MetS development in our study, which increased the risk by 2.86 times. A previous cross-sectional study carried out in Jordan also confirmed this result (20). The Lopez-Lopez. study demonstrated a stronger correlation between a higher MetS score and WC than BMI (29). Waist circumference, rather than BMI, is a more robust predictor of serious cardiovascular events like myocardial infarction and stroke among Latin American and Chinese populations (30, 31).
Nevertheless, it is crucial to acknowledge that a significant proportion of patients with hypertension can be identified as having the cardiometabolic syndrome, which is a concern of great importance for public health. This already puts them at increased risk for cardiovascular disease and events. Hence, it is imperative to commence endeavors aimed at implementing appropriate public health measures for the early identification of those prone to cardiovascular disease. Moreover, implementing a national health intervention strategy that targets obese individuals, those with hyperlipidemia, and those with a family history of cardiovascular disease can enhance cardiovascular care and ultimately decrease the overall burden of cardiovascular risk in the population.

Limitations

The main limitation of our study was that it was limited to a single center in Amman, Jordan, which was an urban region in Jordan. The data was collected by a team of five researchers, which raises the possibility of reporting bias. Important data regarding hypertension disease duration and types of antihypertensive drugs were not reported in the present study. The inability of the participants to recollect every detail pertaining to lifestyle, physical activity and medical information constituted an additional limitation.

Conclusion

The prevalence of metabolic syndrome among hypertensive patients is high, which accounts for one-third of those patients with low HDL, high TGs, and high fasting blood sugar. Hypertensive patients with metabolic syndrome have significantly higher ages and lower physical activity. Increased age, a higher BMI, a higher waist circumference, and a higher systolic blood pressure were found to be risk factors for the development of metabolic syndrome.

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