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Prevalence, Clinical Characteristics, and Predictors of Metabolic Syndrome in a Hospital-Based Adult Population

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Abstract

Background: Metabolic syndrome (MetS) is a cluster of metabolic abnormalities including central obesity, hypertension, dyslipidemia, and impaired glucose metabolism that significantly increase the risk of cardiovascular disease and type 2 diabetes. The prevalence of MetS has risen worldwide due to sedentary lifestyles, urbanization, and dietary changes. Early identification of its clinical characteristics and predictors in hospital-based populations is important for effective prevention, timely diagnosis, and appropriate management of associated health complications. ***Objectives:*** To determine the prevalence, clinical characteristics, and predictors of metabolic syndrome among adults attending a hospital-based healthcare facility. ***Methods:*** This hospital-based cross-sectional study was conducted at Ibn Sina Diagnostic & Consultation Center, Uttara, from June 2018 to May 2019. A total of 226 adult participants were included. Data were collected using structured questionnaires, clinical measurements, and laboratory records. Variables included age, gender, BMI, blood pressure, and biochemical parameters. Data were analyzed using Statistical Package for the Social Sciences (SPSS) with descriptive statistics and Chi-square tests; $p<0.05$ was considered significant. ***Results:*** Among 226 participants, the mean age was 42.6 ± 11.8 years, with 56.6% males. Metabolic syndrome was present in 86 (38.1%) individuals. The highest prevalence occurred in the 41–50 years group (30.2%). Overweight and obesity were observed in 40.7% and 24.8% respectively. Hypertension affected 51.3% participants. Abdominal obesity (46.0%) and low HDL (41.6%) were common components. Smoking (30.1%) and physical inactivity (68.1%) were notable lifestyle risk factors. ***Conclusion:*** Metabolic syndrome showed high prevalence, strongly associated with obesity, hypertension, smoking, and inactivity, emphasizing the need for early detection and prevention.

Keywords: Metabolic Syndrome, Prevalence, Obesity, Hypertension, Dyslipidemia.

INTRODUCTION

Metabolic syndrome (MetS) represents a constellation of interconnected physiological, biochemical, clinical, and metabolic factors that directly increase the risk of cardiovascular disease, type 2 diabetes mellitus, and all-cause mortality [1]. This cluster of abnormalities comprising central obesity, hypertension, dyslipidemia (elevated triglycerides and reduced high-density lipoprotein cholesterol), and hyperglycemia has emerged as one of the most significant public health challenges of the twenty-first century [2]. The syndrome's pathogenesis is complex, involving interactions between genetic predisposition, environmental factors, and lifestyle behaviors, with insulin resistance and visceral adiposity serving as central pathophysiological drivers [3]. Globally, the prevalence of metabolic syndrome has reached alarming proportions, affecting approximately 20-25% of the adult population, with substantial geographic and demographic variations [4]. In the United States, studies have reported prevalence estimates ranging from 22.5% to 34% among adults, with higher rates observed among specific ethnic groups and socioeconomically disadvantaged populations [5]. A large-scale meta-analysis from mainland China demonstrated a pooled prevalence of 24.5%, with significant variations by age, sex, and urban versus rural residence [4]. Similarly, European investigations have documented prevalence rates between 15% and 30%, depending on the

diagnostic criteria applied and the population characteristics [6]. The clinical significance of metabolic syndrome extends beyond its individual components, as the clustering of these abnormalities exerts synergistic effects on cardiovascular risk [7]. Individuals with MetS have a five-fold increased risk of developing type 2 diabetes and two- to three-fold increased risk of atherosclerotic cardiovascular disease [8]. Furthermore, MetS has been associated with numerous other chronic conditions, including non-alcoholic fatty liver disease, chronic kidney disease, polycystic ovary syndrome, obstructive sleep apnea, and certain malignancies [9]. The economic burden is substantial, with healthcare costs for individuals with MetS estimated to be 1.6 times higher than those without the syndrome [10]. Hospital-based populations represent a particularly important group for metabolic syndrome research, as they often have higher comorbidity burdens and may demonstrate different clinical characteristics compared to community-dwelling adults [11]. Patients attending hospital outpatient departments frequently present with multiple risk factors and established chronic diseases, making them a high-risk population deserving of targeted screening and intervention [12]. However, much of the existing literature has focused on community-based epidemiological studies, leaving gaps in our understanding of MetS prevalence and characteristics within healthcare settings [13]. Identification of predictors for metabolic syndrome in hospital-based populations is crucial for developing effective screening strategies and risk stratification tools [14]. Demographic factors such as age, sex, and socioeconomic status, along with clinical parameters including body mass index, waist circumference, and family history, have been variably associated with MetS risk [15].

OBJECTIVES OF THE STUDY

General Objective: To determine the prevalence, clinical characteristics, and predictors of metabolic syndrome among adults attending a hospital-based healthcare facility.

Specific Objectives:

- To determine the prevalence of metabolic syndrome among the adult study population.
- To assess the socio-demographic characteristics (such as age, gender, and occupation) of the study participants.
- To evaluate the clinical characteristics of participants including body mass index (BMI) and blood pressure.

METHOD AND MATERIALS

Study Design:

This was a hospital-based cross-sectional study conducted at Ibn Sina Diagnostic & Consultation Center, a well-established private healthcare facility that provides diagnostic and consultation services. The study was carried out over a 12-month period from June 2018 to May 2019. The study population consisted of adult patients attending the outpatient department and diagnostic services of the clinic during the study period. A total of 226 adult participants who met the eligibility criteria were included in the study to assess the prevalence, clinical characteristics, and predictors of metabolic syndrome.

Sampling Formula: The sample size was calculated using the standard formula for prevalence studies:

$$n = \frac{Z^2 \times p \times q}{d^2}$$

n = required sample size

Z = standard normal deviate at 95% confidence interval (1.96)

p = estimated prevalence of metabolic syndrome from previous studies

q = (1 − p)

d = acceptable margin of error (precision), usually set at 5%

Data Collection and Study Procedure:

Data were collected using a structured questionnaire and clinical assessment form. Sociodemographic information including age, gender, and occupation was obtained through direct interviews with the participants. Clinical parameters such as body mass index (BMI), blood pressure, and waist circumference were measured using standard procedures. Laboratory investigations including fasting blood glucose, triglycerides, and HDL cholesterol levels were obtained from diagnostic records of the participants. All measurements and data collection procedures were conducted by trained personnel to ensure accuracy and consistency.

Inclusion Criteria:

The study included adult patients aged 18 years and above who attended the outpatient or diagnostic services of the clinic during the study period and who consented to participate in the research. Participants who had undergone relevant clinical and laboratory investigations required for diagnosing metabolic syndrome were considered eligible for inclusion in the study.

Exclusion Criteria:

Patients who were pregnant, severely ill, or unwilling to participate in the study were excluded. Additionally, individuals with incomplete clinical or laboratory data required for the assessment of metabolic syndrome components were not included in the analysis.

Statistical Analysis:

All collected data were checked, coded, and entered into statistical software for analysis, commonly using the Statistical Package for the Social Sciences (SPSS). Descriptive statistics such as frequency, percentage, mean, and standard deviation were used to summarize the data. Associations between variables and metabolic syndrome were assessed using the Chi-square

test, and a p-value of less than 0.05 was considered statistically significant.

Ethical Consideration:

Ethical approval for the study was obtained from the appropriate institutional authority prior to the commencement of data collection. Participants were informed about the purpose and procedures of the study, and informed consent was obtained from each participant before enrollment. Confidentiality and privacy of all participants were strictly maintained throughout the study, and the collected data were used solely for research purposes.

RESULT

Table 1: Socio-Demographic Characteristics of the Study Population (n = 226)

Variables	Frequency (n)	Percentage (%)
Age Group (years)		
18–30	48	21.2
31–40	62	27.4
41–50	56	24.8
51–60	38	16.8
>60	22	9.7
Mean Age ± SD	42.6 ± 11.8	
Gender		
Male	128	56.6
Female	98	43.4
Occupation		
Service holder	72	31.9
Business	46	20.4
Housewife	58	25.7
Farmer	28	12.4
Others	22	9.7

Table 1 shows the socio-demographic characteristics of the study participants. Among the 226 respondents, the largest proportion (27.4%) belonged to the 31–40 years age group followed by 24.8% in the 41–50 years group. The mean age of the participants was 42.6 ± 11.8 years. Males constituted the majority of the study population (56.6%), while females represented 43.4%. Regarding occupation, service holders were the largest group (31.9%), followed by housewives (25.7%) and business professionals (20.4%).

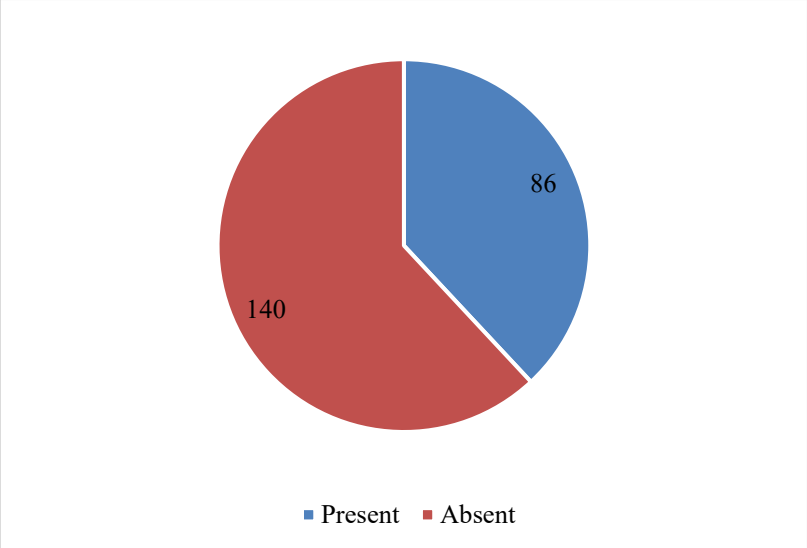

Figure 1: Prevalence of Metabolic Syndrome among Study Participants

Figure 1 presents the prevalence of metabolic syndrome among the participants. Out of 226 adults, 86 individuals (38.1%) were found to have metabolic syndrome, while 140 individuals (61.9%) did not meet the diagnostic criteria. This indicates a considerable burden of metabolic syndrome in the hospital-based adult population.

Table 2: Distribution of Metabolic Syndrome According to Age Group (n = 226)

Age Group	Metabolic Syndrome Present n (%)	Metabolic Syndrome Absent n (%)
18–30	10 (11.6)	38 (27.1)
31–40	18 (20.9)	44 (31.4)
41–50	26 (30.2)	30 (21.4)
51–60	20 (23.3)	18 (12.9)
>60	12 (14.0)	10 (7.1)
Total	**86 (100)**	**140 (100)**

Table 2 shows the age-wise distribution of metabolic syndrome. The highest proportion of metabolic syndrome was observed in the 41–50 years age group (30.2%), followed by 51–60 years (23.3%). Younger participants (18–30 years) showed the lowest prevalence (11.6%). These findings indicate that the occurrence of metabolic syndrome increases with age.

Table 3: Distribution of Metabolic Syndrome According to Gender (n = 226)

Gender	Metabolic Syndrome Present n (%)	Metabolic Syndrome Absent n (%)
Male	52 (60.5)	76 (54.3)
Female	34 (39.5)	64 (45.7)
Total	**86 (100)**	**140 (100)**

Table 3 demonstrates the distribution of metabolic syndrome according to gender. Among the participants with metabolic syndrome, 60.5% were males and 39.5% were females. This suggests that metabolic syndrome was relatively more common among males compared to females in the study population.

Table 4: Clinical Characteristics of Study Participants (n = 226)

Clinical Variables	Frequency (n)	Percentage (%)	p-value
Body Mass Index (BMI)			
Normal	78	34.5	0.002
Overweight	92	40.7	
Obese	56	24.8	
Blood Pressure			
Normal	110	48.7	0.001
Hypertensive	116	51.3	

Table 4 presents the clinical characteristics of the study participants and their association with metabolic syndrome. Regarding body mass index, 34.5% of respondents had normal BMI, while 40.7% were overweight and 24.8% were obese. The association between BMI categories and metabolic syndrome was statistically significant ($p = 0.002$). Regarding blood pressure status, 51.3% of participants were hypertensive and 48.7% had normal blood pressure. A significant association was also observed between hypertension and metabolic syndrome ($p = 0.001$).

Table 5: Distribution of Individual Components of Metabolic Syndrome (n = 226)

Components	Frequency (n)	Percentage (%)	p-value
Abdominal obesity	104	46.0	0.003
Elevated blood pressure	116	51.3	0.001
High fasting blood glucose	88	38.9	0.002
High triglycerides	72	31.9	0.004
Low HDL cholesterol	94	41.6	0.003

Table 5 presents the distribution of the individual components of metabolic syndrome among the study participants and their statistical association with metabolic syndrome. Elevated blood pressure was the most common component, affecting 51.3% of the respondents, followed by abdominal obesity (46.0%) and low HDL cholesterol (41.6%). High fasting blood glucose and elevated triglycerides were observed in 38.9% and 31.9% of participants respectively. Statistical analysis showed that all components had a significant association with metabolic syndrome ($p < 0.05$), indicating that these factors contribute significantly to the development of metabolic syndrome among the study population.

Table 6: Lifestyle Factors of Study Participants (n = 226)

Lifestyle Factors	Frequency (n)	Percentage (%)
Smoking Status		
Smoker	68	30.1
Non-smoker	158	69.9
Physical Activity		
Regular exercise	72	31.9
Irregular / none	154	68.1

Table 6 shows the lifestyle characteristics of the participants. Approximately 30.1% of respondents were smokers, whereas 69.9% were non-smokers. In terms of physical activity, only 31.9% reported regular exercise, while a large majority (68.1%) reported irregular or no physical activity, which may contribute to metabolic syndrome risk.

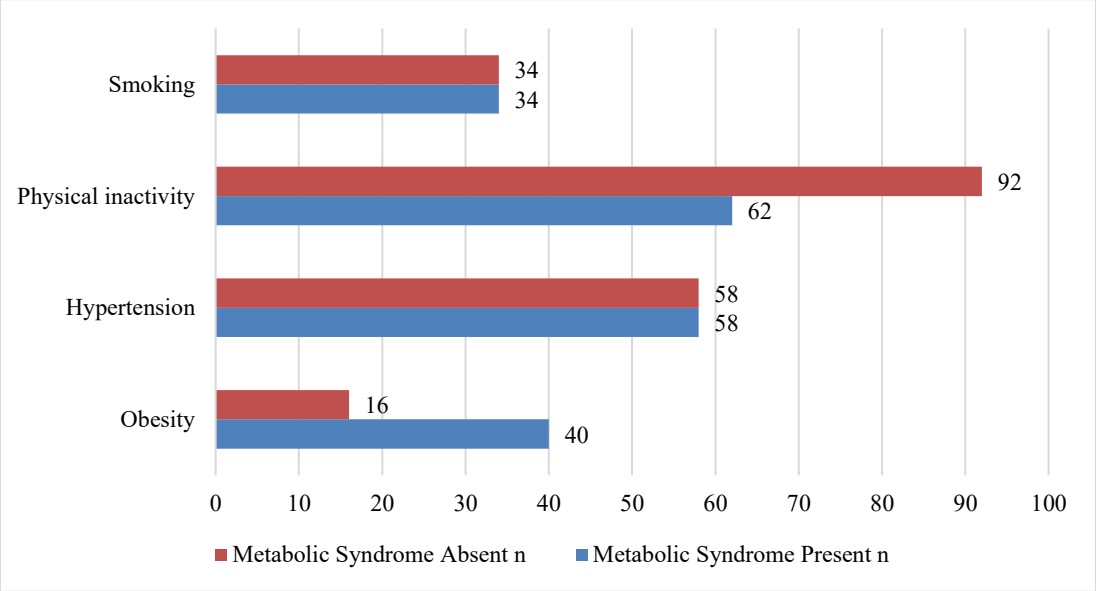

Figure 2: Predictors of Metabolic Syndrome among Study Participants

Figure 2 highlights the potential predictors of metabolic syndrome among the study participants. Obesity was strongly associated with metabolic syndrome, with 46.5% of affected individuals being obese. Hypertension was also highly prevalent (67.4%) among those with metabolic syndrome. Physical inactivity and smoking were more common among individuals with metabolic syndrome compared to those without it, suggesting their role as important contributing risk factors.

DISCUSSION

The present study revealed a metabolic syndrome prevalence of 38.1% among the hospital-based adult population. This finding is notably higher than the prevalence rates reported in several community-based studies from the same period. Mahabaleshwarkar *et al.,* documented a prevalence of approximately 22.5% among adults receiving care in a large integrated health care system in North Carolina [15]. The higher prevalence observed in our study population may be attributed to the hospital-based setting, where individuals typically present with greater comorbidity burdens compared to community-dwelling adults. The mean age of participants was 42.6 ± 11.8 years, with the highest proportion of metabolic syndrome observed in the 41-50 years age group (30.2%), followed by the 51-60 years group (23.3%). This age-related increase in metabolic syndrome prevalence aligns with findings from a Russian population-based study conducted among 25-45-year-old Novosibirsk dwellers, which demonstrated a clear increase in metabolic syndrome prevalence with advancing age [16]. Similarly, a large-scale US study using NHANES data from 2011-2016 reported that metabolic syndrome prevalence increased significantly from 19.5% among those aged 20-39 years to 48.6% among those aged 60 years and older [17]. The physiological changes accompanying aging, including increased visceral adiposity, declining insulin sensitivity, and alterations in hormonal regulation, likely contribute to this age-related trend. Regarding gender distribution, metabolic syndrome was more common among males (60.5%) compared to females (39.5%) in our study population. This male predominance is consistent with findings from the Novosibirsk study, where metabolic syndrome was more frequently recorded in men than women regardless of the diagnostic criteria applied [16]. However, some studies have

reported conflicting findings. A study among patients with psychiatric disorders in Saudi Arabia found no significant gender difference in metabolic syndrome prevalence, while the NHANES analysis demonstrated comparable prevalence between men and women (35.1% vs. 34.3%) [18]. These discrepancies may reflect regional variations in lifestyle factors, dietary patterns, and healthcare-seeking behaviors. Analysis of individual metabolic syndrome components revealed that elevated blood pressure was the most common component (51.3%), followed by abdominal obesity (46.0%) and low HDL cholesterol (41.6%). The high prevalence of hypertension in our study population is particularly noteworthy. Duarte et al., studying an urban population in Ecuador aged 55-65 years, reported that 65.8% of participants had increased waist circumference and 45% were diagnosed with metabolic syndrome, with hypertriglyceridemia being most prevalent in males and low HDL cholesterol more common in females [19]. The high frequency of low HDL cholesterol observed in our study (41.6%) mirrors findings from China, where a large-scale investigation reported that half of the participants with metabolic syndrome had low HDL cholesterol [20]. The significant association between body mass index categories and metabolic syndrome ($p = 0.002$) observed in our study underscores the central role of adiposity in metabolic syndrome pathogenesis. Data from a large cross-sectional study published in Nature demonstrated that individuals with metabolic syndrome had significantly higher waist circumference, blood pressure, triglyceride levels, and fasting glucose compared to those without the syndrome [21]. Obesity, present in 46.5% of affected individuals in our study, represents a key modifiable risk factor that should be targeted in prevention strategies. Lifestyle factors emerged as important contributors to metabolic syndrome risk in our population. Physical inactivity was reported by 68.1% of participants, and smoking by 30.1%. A study among Qatari women of reproductive age identified a "High Risk" lifestyle pattern characterized by fast food consumption, sugar-sweetened beverages, physical inactivity, and smoking, which was associated with 2.5 times higher odds of metabolic syndrome 22]. Similarly, research among Chilean adolescents demonstrated that physical inactivity significantly increased metabolic syndrome risk in males (OR = 2.9) [23]. These findings highlight the importance of lifestyle modification programs in clinical settings. The clinical implications of our findings are substantial. With 38.1% prevalence of metabolic syndrome in this hospital-based population, there is an urgent need for systematic screening protocols in outpatient settings.

CONCLUSION

This study demonstrates a high prevalence (38.1%) of metabolic syndrome among adults attending a hospital-based outpatient population, with significant variations across age groups and gender. The highest burden was observed in middle-aged adults (41-50 years), and metabolic syndrome was more prevalent among males compared to females. Elevated blood pressure emerged as the most common individual component, followed by abdominal obesity and low HDL cholesterol, highlighting the complex interplay of metabolic abnormalities in this population. The significant associations between metabolic syndrome and modifiable risk factors including obesity, hypertension, physical inactivity, and smoking provide actionable targets for clinical intervention.

Limitations of the Study:

Several limitations should be considered when interpreting the findings of this study. First, the cross-sectional design precludes establishing causal relationships between the identified predictors and metabolic syndrome, as the temporal sequence of exposure and outcome cannot be determined. Second, the study was conducted at a single hospital, which may limit the generalizability of findings to other healthcare settings or community-based populations with different demographic and clinical characteristics.

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