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Prevalence of Metabolic Syndrome among Patients with Acute Myocardial Infarction at Al-Ramadi Teaching Hospital, Ramadi City, Iraq

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ABSTRACT

Background: Acute myocardial infarction (AMI) and metabolic syndrome (MeS) are two major health problems worldwide. In recent years, MeS has been introduced as a significant risk factor for AMI.
Objectives: To estimate the prevalence of MeS and its components among patients with AMI.
Materials and methods: This was a cross-sectional study conducted at Al-Ramadi Teaching Hospital during a period from January to December 2022, including a total of 100 patients with AMI. The definition of MeS was established based on the criteria of the modified National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III).
Results: The mean age of patients was 58.6 ± 7.1 (range: 41–81 years). Males represented 55% of the studied group. Clustering of MeS components among cases revealed that 57% had less than three components while 43% had 3 or more criteria for MeS diagnosis, giving a prevalence rate of 43% for MeS. Only 5 cases had none of these components. MeS was relatively more prevalent in younger age groups and females. The mean values of all components of MeS were significantly higher in the MeS group than in the non-MeS group (P-value < 0.05).
Conclusion: MeS was an important risk factor for AMI. The study revealed a high prevalence of MeS among individuals with AMI and it was higher among women than men.
Keywords: Acute myocardial infarction; Metabolic syndrome; Prevalence.

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INTRODUCTION

Globally, cardiovascular diseases (CVDs) are the most common cause of mortality. Among CVDs, coronary heart diseases (CHDs) are the leading cause of morbidity and mortality. Acute myocardial infarction (AMI) is the most common form of CHDs. If AMI is not treated promptly, it leads to tissue damage due to occlusion of the blood flow to heart tissues [1, 2].

Understanding the epidemiology, pathogenesis, and risk factors of AMI is crucial for developing effective prevention and treatment strategies [1, 2]. AMI has a high incidence and prevalence worldwide, and the incidence rate varies by gender and age. Additionally, different modifiable and non-modifiable risk factors contribute to the incidence of AMI, family history, hypertension, diabetes, smoking, dyslipidemia, obesity, sedentary lifestyle, and stress factors. In addition, the environmental factors are associated with a higher likelihood of developing AMI [3, 4]. In a previous study by Yusuf et al., they assessed the effect of potentially modifiable risk factors on AMI in 52 countries and found that modifiable risk factors, including smoking, high blood pressure, and high cholesterol, account for a significant proportion of the risk for AMI [5].

Metabolic syndrome (MeS) is a clustering of clinical conditions that occur together more often than would be expected. A higher risk of developing CVD has shown associated with the presence of MeS which also increases the risk of stroke and type II diabetes. Currently, MeS, is a global health problem affecting both developed and developing countries. The prevalence varies depending on geographical location, ethnicity, and age group. According to the International Diabetes Federation (IDF) and the Center of Disease and Prevention (CDC), there has been an increase in the prevalence of MeS since its appearance in the 1980s. The incidence of MeS matches the prevalence of obesity and type II diabetes mellitus. It is estimated that almost 85% of type II diabetic patients have MeS, and they are at increased risk of heart diseases. However, the prevalence of MeS varies with age,

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sex, race, and ethnicity [6–9].

The pathophysiology of MeS is not well understood, several complicated mechanisms are encountered and yet need to be clarified. However, the role of these mechanisms in MeS is still under debate, with an emerging question of whether the components of MeS themselves form separate pathologies or share a common process of pathogenesis. From other points of view, genetic factors, lifestyle, and environmental factors are all important contributors to the development of MeS [10]. Insulin resistance is one of the crucial pathogenic factors that commonly contribute to the mechanism of MeS development where the body is unable to use insulin effectively, moreover, inflammatory factors and neurohormonal function appear to play an important role in the progression of MeS and its sequel to CVD [9, 11–13]. According to the clinical guidelines, MeS can be diagnosed when at least three of five criteria are clustered; these criteria include elevated blood glucose, hypertension, elevated triglycerides, central obesity, and low levels of high-density lipoprotein (HDL) [10].

Understanding the epidemiology, diagnostic criteria, components, and risk factors of MeS is crucial for both the diagnosis and prevention of this condition for reducing or preventing its adverse consequences, particularly CVDs.

Iraq, like other Middle Eastern countries, has seen significant changes in lifestyle and dietary habits in recent decades, increasing the prevalence of MeS and its risk factors of noncommunicable diseases. However, Iraqi studies regarding the association between MeS and AMI are scarce, and there has been no recent study in this field, particularly about the prevalence of MeS among AMI Iraqi patients.

Globally, several studies assessed the risk of AMI in patients with MeS. Almost all these studies found some degree of association between the presence of MeS and a higher incidence of AMI, in addition to the adverse outcomes of hospitalized patients with AMI and MeS. Hence, there is strong evidence that patients with MeS have a higher risk and higher incidence rate of AMI and complications [14].

However, metabolic risk factors are considered the leading risk factors for AMI and mortality, but the underlying mechanisms linking MeS to AMI are complex and not well clarified due to the involvement of many correlated factors that lead to vascular consequences, endothelial dysfunction, atherosclerosis, and other complications [15].

Therefore, we aimed to assess the association between MeS and AMI by estimating the prevalence of MeS and its components among patients with AMI.

MATERIALS AND METHODS

This was a cross-sectional study conducted during the period from January to December 2022 at Al-Ramadi Teaching Hospital. It included 100 patients with AMI who were admitted and followed up in the Internal Medicine Department and Outpatient Clinic.

The study included patients of both genders who had indications of CVD and experienced AMI. The research was approved by the Ethical Approval Committee of the Anbar Health Directorate, Anbar, Iraq, under reference number 38091 on December 12, 2023. Informed consent was obtained from every patient. While those patients who declined to participate were excluded from the study. The final diagnosis of AMI came from the patient's medical history, the presence of biochemical markers that showed cardiac necrosis, common symptoms like central chest pain, and changes seen on an electrocardiogram. For the case definition, ST elevation MI was considered when the patients had ST segment elevation on their initial ECG upon admission, namely, STEMI while those without such findings were called non-STEMI.

The diagnostic criteria for MeS involved the application of the Modified NCEP-ATPIII criteria [16]. These criteria included the presence of clusters of three of the following factors: central obesity, elevated triglycerides, low HDL, high blood pressure, and high fasting blood glucose (FBG). Risky waist circumference that indicates central obesity is $\geq$ 102 cm in men and $\geq$ 88 in women. Risky triglyceride levels are over 150 mg/dl, risky blood pressure is over 130/85 mmHg, and risky FBG is $\geq$ 100 mg/dl, and the risky HDL is less than 40 mg/dl in men and less than 50 mg/dl in women.

Hypertension is characterized by systolic blood pressure 130 mm Hg and/or diastolic blood pressure values $\geq$ 85 mmHg or when patients are already on antihypertensive treatment.

Data were collected through medical history taking, encompassing previous occurrences of diabetes mellitus, hypertension, tobacco use, and alcohol intake. In addition, a thorough physical examination was performed for the evaluation of resting blood pressure, waist circumference, height, and weight. Waist circumference was measured while the subject stood, and a measuring tape was placed around the abdomen at the marked point.

After fasting overnight, venous blood samples were collected from each patient in the morning under an aseptic technique and standard procedures. All blood samples were referred to the lab and investigated, and then the results were reported.

Additional investigations and examinations were also performed accordingly, such as electrocardiogram, echocardiography, imaging, and cardiac enzymes The collected data were entered, managed, processed, and analyzed using the statistical package for social sciences (SPSS) version 28 for Windows. Descriptive statistics are presented as mean $\pm$ standard deviation for continuous variables and frequencies or percentages for categorical variables. All scale variables were checked for a statistically normal distribution using the statistical method. A one-Sample Kolmogorov-Smirnov test was applied and revealed that all of these variables followed the statistically normal distribution, therefore, we used the student's t-test as a parametric statistical test to compare the means of these variables in the MeS *vs.* non-MeS groups. To compare MeS *vs.* non-MS group in the categorical variables, we used the Chi-square test. All statistical tests were applied under the assumption of a two-tailed level of significance (P-value) of $<$ 0.05 to be considered a statistically significant difference.

RESULTS

A total of 100 patients were recruited for this study. The age of patients ranged between 41 and 81 years with a mean of 58.6 $\pm$ 7.1 years. Male patients represented 55% of the studied group, with a male to female ratio of almost 1.2/1. The majority (81%) of the studied group were of urban origin. Smoker patients were 22% of the participants. The commonest comorbidity was hypertension (32%), as shown in Table 1.

MeS was encountered in 43 cases (Figure 1). The distribution of components of MeS among the AMI cases is shown in Table 2. The commonest MeS component was hypertension (54%).

The clustering of these components revealed that only 5

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Table 1. Baseline characteristics of the 100 patients.*

Variable		Number	Percent
Age (year)	≤ 50	17	17.0
	> 50	83	83.0
Mean age ± SD	58.6 ± 7.1	-	-
Sex	Male	55	55.0
	Female	45	45.0
Residency	Urban	81	81.0
	Rural	19	19.0
Smoking	Yes	22	22.0
	No	78	78.0
Comorbidities	Hypertension	32	32.0
	Diabetes mellitus	22	22.0
	Renal diseases	3	3.0
	Stroke	3	3.0
	Others*	4	5.0

* SD: standard deviation.
Others*: Rheumatoid arthritis, Knee osteoartheritis, Chronic obstructive pulmonary disease, Osteoporosis.

cases had none of these components. The highest combination of components was two components 33% (Table 3).

As expected, it was also found that all of the MeS components were more common in the MeS group than in the non-MS cases; the Chi-square test showed this was statistically significant difference with a P-value of less than 0.05 (Table 4).

The distribution of MeS according to age and gender of AMI cases showed that MeS was relatively more prevalent in cases at age ≤ 50 years and in females; however, the difference was neither significant in age nor gender (P-value > 0.05), as shown in Table 5.

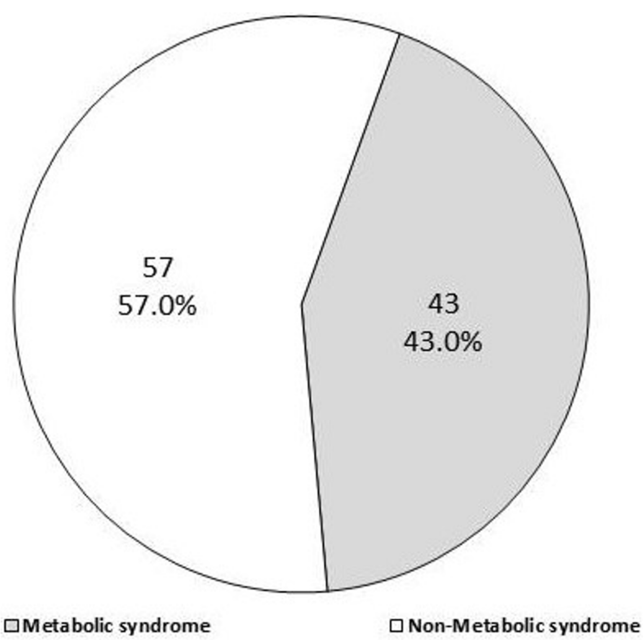

Figure 1. Prevalence of metabolic syndrome among 100 cases of acute myocardial infarction.

Table 2. Distribution of components of metabolic syndrome (MeS) among 100 acute myocardial infarction (AMI) cases.*

MeS components	No.	%
Risky waist circumference (WC)	48	48.0
Triglyceride ≥ 150 mg/dl	46	46.0
Low high density lipoprotein (HDL)	42	42.0
Hypertension	54	54.0
Fasting blood glucose (≥ 110 mg/dl)	38	38.0

* Risky WC in males > 102 cm, in females > 88 cm. Risky low HDL < 40 in males and < 50 mg/dl in females.
Some patients had combined more than one component.

Table 3. Number of total collected components of metabolic syndrome among 100 acute myocardial infarction patients.

Number of risk factors	No.	%
None	5	5.0
One	19	19.0
Two	33	33.0
Three	24	24.0
Four	11	11.0
Five	8	8.0
Total	100	100.0

Also, when the average values of the MeS components as scale variables were compared between the MeS and non-MeS groups, they showed significantly higher average values for both male and female waist circumference, systolic and diastolic blood pressure, and fasting blood glucose (P-value < 0.05). As shown in Table 6, people with MeS had higher levels of triglycerides and lower levels of HDL compared to people who did not have MeS. However, the differences were not statistically significant in either of these variables (P-value > 0.05).

DISCUSSION

MeS is a group of clinical signs and abnormal laboratory determinations that, when present, constitute risk factors for the development of vascular disease. They refer to the presence of central obesity, hypertriglyceridemia, decreased HDL cholesterol (atherogenic lipid disorders), hyperglycemia or decreased glucose tolerance, and hypertension. Central obesity and insulin resistance play a major role in its pathogenesis. MeS is recognized when at least three of the aforementioned criteria are present [17]. However, no consensus currently supports a single criterion to define MeS. Since the appearance of the first official definition, prepared by the WHO Working Group in 1998, different proposals have emerged [16], targeting identifying individuals who have the syndrome; nonetheless, the definition of MeS has been the subject of debate; and yet there is no unique definition.

The interest in MeS lies mainly in the fact that it is associated with a higher prevalence of CVD. The prevalence of MeS in the general population is widely investigated worldwide. It has been shown that the prevalence of MeS is higher in patients with cardiovascular events compared to that in the general population. Moreover, all components of MeS represent individual risk factors for CVDs. Although not all of these components have the same impact, their effects can be

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Table 4. Distribution of components of metabolic syndrome (MeS) among 100 cases with acute myocardial infarction.*

Risk factors		MeS (n = 43)		Non-MeS (n = 57)		Total (n =100)	P-value*
		No.	%	No.	%		
Risky WC	Yes	32	74.4	16	28.1	48	0.001
	No	11	25.6	41	71.9	52	
TG $\geq$ 150 mg/dl	Yes	26	60.5	20	35.1	46	0.001
	No	17	39.5	37	64.9	54	
Low HDL	Yes	29	67.4	17	29.8	46	0.001
	No	14	32.6	40	70.2	54	
Blood pressure($\geq$130/ $\geq$85 mm Hg)	Yes	35	81.4	19	33.3	54	0.001
	No	8	18.6	38	66.7	46	
Fasting glucose ($\geq$ 110 mg/dl)	Yes	25	58.1	13	22.8	38	0.001
	No	18	41.9	44	77.2	62	

* Chi square test was used in all comparisons; WC = waist circumference; TG = triglyceride; HDL = high density lipoprotein.

Table 5. Distribution of metabolic syndrome (MeS) according to age and gender of 100 acute myocardial infarction cases.*

Variable	MeS		Non-MeS		Total		P-value*
	No.	%	No.	%	No.	%	
Age (year)							
$\leq$ 50	10	45.5	12	54.5	22	22.0	
> 50	33	42.3	45	57.7	78	78.0	0.792
Total	43	43.0	57	57.0	100	100.0	
Mean (SD)	58.2 (6.7)	–	57.6 (7.4)	–	–	–	0.703
Gender							
Male	20	36.4	35	63.6	55	55.0	
Female	23	51.1	22	48.9	45	45.0	0.138
Total	43	43.0	57	57.0	100	100.0	

* Chi-square test used in comparison of age groups and gender.
Student's t–test used in comparison of mean age.

Table 6. Comparison of mean values of components of metabolic syndrome (MeS) as scale variables.

Variable	Metabolic syndrome		No Metabolic syndrome		P-value
	Mean	SD	Mean	SD	
Waist circumference (cm) (Males)	106.9	5.8	94.3	6.4	0.001
Waist circumference (cm) (Females)	92.6	4.9	81.2	5.3	0.001
Systolic blood pressure (mmHg)	132.2	14.2	121.9	13.4	0.001
Diastolic blood pressure (mmHg)	81.3	9.2	79.4	11.8	0.382
Triglycerides (mg/dL)	142.3	22.1	139.2	20.5	0.470
HDL cholesterol (mg/dL) (Males)	43.1	8.6	45.6	7.1	0.115
HDL cholesterol (mg/dL) (Females)	39.6	9.0	42.4	7.7	0.097
Fasting glucose (mg/dL)	126.4	13.6	95.6	11.8	0.001

added up, so when the correlation analysis was performed, a direct proportional relationship was observed between the risk of AMI and the number of MeS components [18]. From another point of view, patients with AMI have been shown to have a higher prevalence of MeS, which supports the idea of an inter-correlation between these two disorders and the fact that MeS shares the same risk factors as CVDs that can appear simultaneously or sequentially in the same individual and have a common pathophysiological link.

In Iraq, some studies have been conducted in this field; however, the results of these studies are conflicting due to using different definition criteria. Additionally, in our province, Anbar, no previous study has been conducted to assess the prevalence of MeS among patients with AMI; hence, in our study, we tried to fill part of this gap, and our findings may be added to the growing body of literature in this field. Hence, we included 100 patients who were admitted for AMI during the study period and investigated them for having one or more of the components of MeS then categorized them to have or not have MeS according to the NECP-ATPIII criteria [16].

The baseline and demographic information about the people in the study, such as their age, gender, where they lived, if they smoked, and if they had any other health problems, matched what other research has said about AMI cases. The majority of our patients were older than 50 years and of urban origin, with a relatively high predominance of males. On the other hand, the smoking rate was higher than national records

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of the smoking rate among the Iraqi population. Hypertension and diabetes mellitus are reported in a higher proportion compared to the general population; this was not unexpected due to the fact that hypertension, diabetes mellitus, and smoking are significant risk factors for AMI in both men and women [19].

The clustering and the total number of individual components of MeS revealed that 43% of the AMI cases had at least three risky components included in the definition of MeS; hence, we observed that the prevalence of MeS among the studied group was 43%. Additionally, only 5% of cases had none, while 52% had only one or two criteria; therefore, these cases did not meet the definition of MeS and were considered as non-MeS group when used as a comparative group to those with MeS.

We found that all the components of MeS were significantly more frequent in the MeS group than in the non-MeS group. We did not find a significant difference in the age of AMI patients between the two groups; this could be attributed to the fact that the majority of cases were older and most of AMI cases were within close age ranges.

In the current study, the MeS was slightly more prevalent in males than females; however, the difference did not reach statistical significance. This could be attributed to the small sample size; however, it is still clinically significant.

Several studies investigated the prevalence of MeS in AMI or CVD patients employing various criteria, such as the NCEP ATP III, as well as those established by the IDF and WHO [16].

In our study, the overall prevalence of MeS reported among our AMI cases according to NCEP-ATPIII criteria was 43%, and it was comparable to a previous Iraq study conducted by Al- Mohanna et al. [20], in which they found a prevalence of 43.8% of MeS among AMI cases. An Indian study conducted by Ramachandran et al. documented a prevalence rate of 41.1% [21]. In contrast to Pandey et al. from Nepal [22], who discovered a rate of 26.19% among 84 AMI cases, our study revealed a higher prevalence rate. The prevalence reported in our study was lower than that reported in a previous Iraqi study conducted at Ibn Al-Bitar Hospital, where Hussain et al. [23] found an overall prevalence of MeS of 69.3%, and it was much higher (83%) among patients with than those without IHD. In Qatar, Al-Aqeedi et al. found the prevalence of MS among patients with AMI was (69.4%) [24] which is higher than our finding.

A large scale multiethnic case-control study from 52 countries included about 27000 subjects, documented that MeS associated with a higher risk of AMI [25]. As mentioned earlier, MeS was more frequent in AMI and CVD cases than in the general population.

A higher prevalence among women was demonstrated in the present study than in male cases, which is consistent with other studies from Iraq [23], USA [26], and Spain [18]. This might be attributed to the differences in the diagnostic criteria between men and women; waist circumference, and HDL. Additionally, in the present study, women with AMI were presented with a higher prevalence of obesity, hyperglycemia, and dyslipidemia. An Iranian study concluded that the MeS by the NCEP/ATPIII definition is a major determinant of ischemic heart disease in the middle-aged Iranian population, especially among smokers [27]. Egyptian study reached the same conclusion [28].

In the present study, there was no significant difference in age found across MeS group; however, the prevalence was higher in older AMI cases. This might be attributed to the increasing risk factors with the advancing age like obesity, hypertension, diabetes, and dyslipidemia, and the atherosclerotic changes that occur with advancing age; additionally, glucose intolerance is an important part of MeS and increases with age [29, 30].

The strength of this study are that it will add to the growing database in this discipline and could be beneficial to other researchers. One the limitations of this study was the cross-sectional nature where the temporal relationship cannot be proved.

CONCLUSION

The study revealed that the prevalence of MeS among individuals with AMI was high. Furthermore, MeS was higher among older adults and females. Further studies are highly suggested, particularly multi center studies on a national level.

ETHICAL DECLARATIONS

Acknoweldgements

None.

Ethics Approval and Consent to Participate

Written approval was obtained from the Ethical Approval Committee of the Anbar Health Directorate, Anbar, Iraq under the Reference number 38091 on 12 December 2023. Study data/information was used for research purposes only. Informed consent was obtained from each participant.

Consent for Publication

No personal data are included.

Availability of Data and Material

The datasets produced and/or analysed during the present study can be obtained from the corresponding author upon reasonable request.

Competing Interests

The author declares that there is no conflict of interest.

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Authors' Contributions

Hussein AJ has made significant, direct, and intellectual contributions to the work and has approved it for publication.

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