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Unrecognized diabetes mellitus among acute coronary syndrome patients in Basra, Iraq – A cross-sectional study

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ABSTRACT

INTRODUCTION: Diabetes mellitus (DM) is one of the most prevalent modifiable risk factors for acute coronary syndrome (ACS). Patients with DM constitute approximately 25%–30% of those admitted with ACS. However, data on the prevalence of unrecognized DM among patients with ACS in Iraq is generally limited.
MATERIAL AND METHODS: This cross-sectional study was conducted on patients admitted with ACS to Al Sadir Teaching Hospital, Basra Teaching Hospital, and Basra Specialized Cardiac Center in Basra. Patients with known diabetes or conditions affecting glucose or hemoglobin A1c (HbA1c) levels were excluded. This was a consecutive sampling of eligible patients. All patients admitted during the study period who met the inclusion criteria were approached and invited to participate. Those who consented were enrolled until the desired sample size was achieved. Data were collected through direct interviews and a structured questionnaire, with anthropometric measurements and laboratory investigations, including fasting blood sugar (FBS), random blood sugar (RBS), HbA1c, and lipid profile. Patients were classified as normal, prediabetes, or newly diagnosed diabetes.
RESULTS: A total of 275 ACS patients were included (mean age: 56.6 ± 12.5 years; 72% male). Screening revealed that 15.3% had unrecognized diabetes and 11.6% had prediabetes. Newly diagnosed diabetes was significantly associated with younger age (P = 0.007), smoking (P = 0.013), higher BMI (P = 0.01), dyslipidemia (P = 0.001), family history of diabetes (P < 0.001), and STEMI presentation (P = 0.047).
CONCLUSIONS: Unrecognized DM causes a significant burden among ACS patients. Effective screening for DM would aid in early detection and proper management, particularly among younger ACS patients, those with a family history of DM, smokers, and obese patients.

KEYWORDS

diabetes mellitus, screening, prediabetic state, acute coronary syndrome, cardiovascular risk factors, Iraq

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INTRODUCTION

Cardiovascular diseases (CVDs) are the leading cause of death worldwide. It is estimated that more than 75% of deaths related to CVDs mainly occur in low- and middle-income countries [1]. Acute coronary syndrome (ACS) is a group of clinical conditions characterized by reduced blood flow to the coronary myocardium that includes ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (non-STEMI), and unstable angina [2].

Community-based studies regarding the prevalence of ACS among the Iraqi population are limited. However, a study conducted in Kurdistan revealed that nearly 31% of patients who were undergoing coronary angiography were diagnosed with premature coronary artery disease before the age of 45 years. This indicates that there is a high burden of early-onset cardiovascular risk [3].

Diabetes mellitus (DM) is a chronic metabolic disease with a complex pathogenesis. It is characterized by hyperglycemia, or high blood glucose levels, which results from abnormal insulin secretion, insulin action, or both [4]. The prevalence of type 2 DM has been increasing globally over the last 40 years, especially in Asia, the Middle East, and North Africa. This could be explained by the sedentary lifestyle and the high prevalence of overweight and obesity [5].

Nearly 1.4 million Iraqis have diabetes and the prevalence of type 2 DM in Iraq ranges from 8.5% to 13.9% [6]. A study conducted in 2014 in Basra reported an age-adjusted prevalence of 19.7% among individuals aged 19 to 94 years [7].

In 2021, the global prevalence of undiagnosed DM reached 44.7% of all diabetic patients [8]. To identify patients with unrecognized or undiagnosed DM, a screening test must be conducted. The American Diabetes Association (ADA) has listed criteria for screening among asymptomatic adults. This includes screening for adults aged 45 and over, those with prediabetes, and women with prior gestational diabetes. For overweight or obese adults, screening is recommended if additional risk factors such as family history, hypertension, and polycystic ovary syndrome are present [9].

Patients with DM have significantly higher risks of cardiovascular events, including acute myocardial infarction, with a prevalence 3 to 5 times higher than that observed in the general population [10]. Moreover, patients with DM constitute a substantial portion of those admitted with ACS, approximately 25%–30% [11]. Diabetes is associated with a 2- to 4-fold increase in the risk of death from a CVD. More than 70% of diabetic patients over the age of 65 years will die from causes related to heart disease or stroke [12]. Despite advancements in treatment, mortality rates from coronary artery disease in patients with DM remain relatively high compared to non-diabetics, who have shown remarkable improvement in their mortality rates [13].

Thus, unrecognized DM is common and may adversely affect outcomes if left undetected. Identifying the prevalence and associated factors of unrecognized DM in ACS patients can help in early diagnosis and targeted management. To address this gap, we conducted a hospital-based screening of ACS patients in Basra to determine the prevalence of unrecognized DM and its association with demographic and clinical characteristics, providing locally relevant evidence for prevention and care.

The aim of this study was to estimate the prevalence of unrecognized DM among patients with ACS and to estimate its association among this population with demographic and clinical characteristics such as age, sex, body mass index (BMI), family history of DM, smoking status, hypertension, and dyslipidemia.

MATERIAL AND METHODS

This cross-sectional, observational study was conducted on patients admitted with ACS from January 1 to June 15, 2024 to coronary care units (CCUs) in three centers in Basra, Iraq: Al Sadir Teaching Hospital, Al Basra Teaching Hospital, and Basra Specialized Cardiac Center. The study was approved by the scientific council of the Arab Board of Health Specializations, the Ministry of Health and Environment, and the Basra Health Directorate.

The sample size estimation was based on a previous cross-sectional study conducted in Qatar by Abdullatef et al. [14], in which the prevalence of unrecognized DM among patients with ACS was 21.1%. The minimum sample size was determined according to the formula $n = (Z^2 \times p \times (1 - p)) / d^2$, where n is the sample size, Z is 1.96 at a 95% confidence interval, and the desired margin of error d is 0.05. The total number of participants was 275 patients, thus exceeding the minimal calculated sample size of 254 participants.

In this study, consecutive sampling of eligible patients was performed. All patients diagnosed with ACS, based on history, clinical examination, and assays (electrocardiogram and cardiac biomarkers), were subjected to the inclusion and exclusion criteria specific to this study. All patients admitted during the study period who met the inclusion criteria were approached and invited to participate. Those who consented were enrolled until the desired sample size was achieved. The inclusion criteria called for patients admitted to a CCU who were diagnosed with ACS during the study period who had given informed consent to participate. Known cases of DM and patients with conditions that could affect hemoglobin A1c

(HbA1c) or blood sugar readings – such as hemoglobinopathies, hemolytic anemia, pregnancy, chronic kidney disease, chronic liver disease, thyroid dysfunction, or steroid use – were excluded (Figure 1).

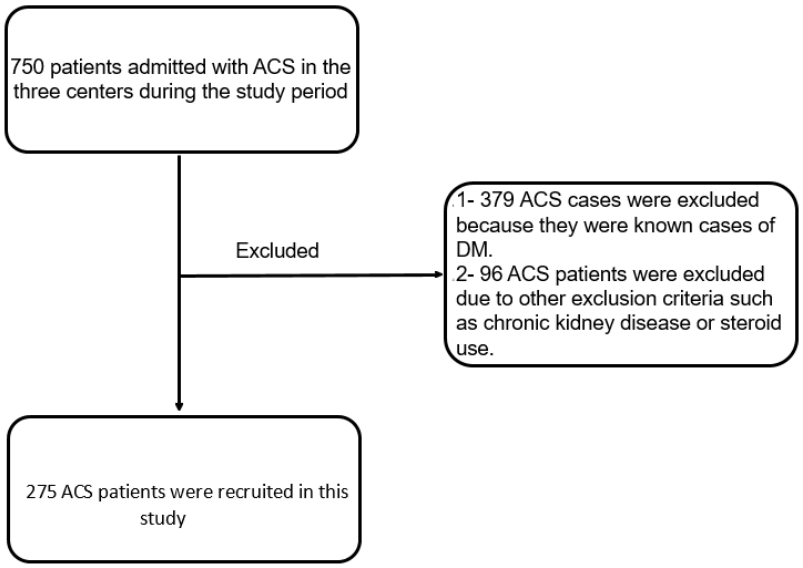

Fig. 1. Flowchart of the study. ACS – acute coronary syndrome; DM – diabetes mellitus.

The data was collected by direct interviews with the patients using a questionnaire. The questionnaire used in this study was developed by the research team based on a thorough review of the relevant literature and clinical guidelines related to ACS and DM screening. To ensure validity and clarity, the questionnaire was reviewed by experts in cardiology and endocrinology. A pilot study was conducted with a small group of patients to test its reliability. The questionnaire consisted of sections covering demographic information (age, sex, education level, and residence), clinical history (smoking status and family history of diabetes, hypertension, and dyslipidemia), and details relevant to ACS and diabetes risk factors.

Anthropometric measurements were taken using standardized methods: weight was measured with a calibrated digital scale, and height was measured using a stadiometer. Patients were measured without shoes and wearing light clothing to ensure accuracy. This was followed by calculating the BMI, which was categorized into four groups according to the World Health Organization (WHO) classification criteria (underweight: < 18.5; normal: 18.5–24.9; overweight: 25–29.9; and obese: ≥ 30 kg/m²) [15].

The investigations included DM screening using fasting blood sugar (FBS), random blood sugar (RBS), HbA1c, and lipid profile testing. Dyslipidemia was defined as abnormalities in any of the lipid profile parameters. Based on the results of the diabetes screening, the patients were classified into three categories using the ADA criteria for diagnosis (normal: both FBS and HbA1c were within normal ranges; prediabetes [pre-DM]: either FBS of 100––125 mg/dL or HbA1c of 5.7%–6.4%; newly diagnosed DM [new-DM]: either FBS ≥ 126 mg/dL or HbA1c ≥ 6.5%) [9]. The reference ranges for laboratory tests were based on the American Board of Internal Medicine laboratory test reference ranges published in January 2024.

The statistical analysis was conducted using Statistical Package for the Social Sciences version 26. Descriptive statistics, including frequency and percentage, were used for categorical variables. For quantitative data, the means and standard deviation were reported. The chi-square test was used to describe the association between categorical variables. A one-way ANOVA test was performed to compare the means of quantitative data of more than two sets. The Shapiro–Wilk test was used to test the normality of distribution. Statistical significance was defined as a P-value of less than 0.05.

RESULTS

In this study, 275 patients with ACS who fulfilled the inclusion and exclusion criteria specified for this study were recruited. The study population had a mean age of 56.60 ± 12.48 years. The majority of participants were male (72.0%). Regarding the education levels, the highest percentages had a primary (25.1%) or secondary (25.8%) education. Nearly 59% were active smokers. The mean weight of the patients was 84.78 ± 13.58 kg, and the mean height was 170.38 ± 7.86 cm. The mean BMI was 29.26 ± 4.33, ranging from 18.51

to 43.90. Among the study population, only 41 (14.9%) fell into the normal BMI category; 112 participants (40.7%) were overweight and 122 (44.4%) were obese. Hypertension was observed in 54.9% (n = 151) of the participants. Regarding lipid profiles, 128 subjects (46.5%) were identified as having dyslipidemia. Among the participants, 129 (46.9%) reported a positive family history of DM among their first-degree relatives.

STEMI was the most common subtype of ACS, occurring in 141 patients (51.3%). Non-STEMI was found in 88 participants (32.0%), while unstable angina was present in 46 participants (16.7%), as presented in Table I.

The screening indicates that 15.3% of the 275 individuals surveyed were newly diagnosed with DM, which represents the prevalence of unrecognized DM among ACS patients admitted to a CCU in the three centers in Basra. Normal results were found in 201 participants (73.1%), while 32 (11.6%) were identified with prediabetes (Figure 2).

There was a statistically significant difference in the mean age between the three groups (P = 0.007). Prediabetic patients and those who were newly diagnosed with DM were significantly younger than the non-diabetics.

Table I. Sociodemographic and clinical characteristics of the study group

Variable	Categories	Frequency	Percentage (%)
Age (years)	Mean ± SD	56.60 ± 12.48	–
Sex	Male	198	72.0
	Female	77	28.0
Education	Illiterate	23	8.4
	Literate	16	5.8
	Primary	69	25.1
	Intermediate	59	21.5
	Secondary	71	25.8
	Higher	37	13.4
Smoking	Smoker	163	59.3
	Non-smoker	96	34.9
	Ex-smoker	16	5.8
BMI	Normal	41	14.9
	Overweight	112	40.7
	Obese	122	44.4
Hypertension	Hypertensive	151	54.9
	Non-hypertensive	124	45.1
Lipid profile	Dyslipidemia	128	46.5
	Normal	147	53.5
Family history of DM	Positive	129	46.9
	Negative	146	53.1
ACS type	STEMI	141	51.3
	Non-STEMI	88	32.0
	Unstable angina	46	16.7
Total		**275**	**100.0%**

BMI – body mass index; DM – diabetes mellitus; ACS – acute coronary syndrome; STEMI – ST-segment elevation myocardial infarction.

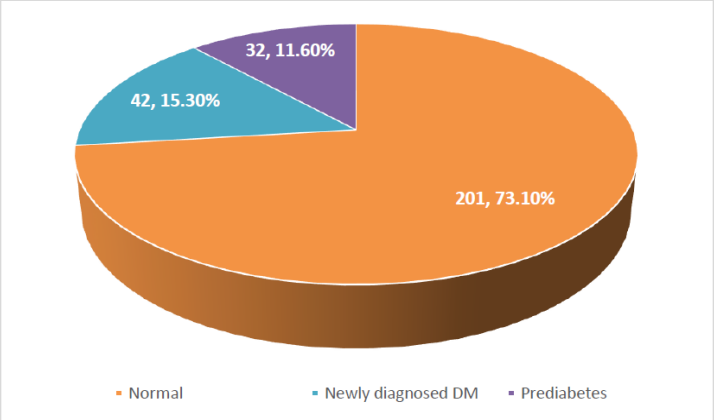

Fig. 2. Distribution of the study group according to diabetes mellitus (DM) screening results.

A significant association was found between smoking and DM (P = 0.013). Nearly two thirds of the newly diagnosed diabetic patients were active smokers. The mean BMI was significantly higher among new-DM and pre-DM patients compared to those with normal screening results (P = 0.01).

Moreover, the new-DM and pre-DM groups were more likely to be overweight or obese (P = 0.024). Dyslipidemia was significantly more prevalent among these groups as well (P = 0.001). A family history of DM was more likely among the pre-DM patients and to a lesser extent among the new-DM ones (P < 0.001).

A significant association between DM screening and ACS subtype was found (P = 0.047). The new-DM group had a higher percentage of STEMI (71.4%) compared to the pre-DM and normal groups (46.9% and 47.8%, respectively).

There was no statistically significant association between DM screening results and sex, educational level, place of residence, or hypertension (P > 0.05), as seen in Table II.

Table II. Comparison of the sociodemographic and clinical characteristics across the diabetes mellitus (DM) screening groups

Variable	Categories	Normal (n = 201)	New-DM (n = 42)	Pre-DM (n = 32)	P-value
Age (years)	Mean ± SD	57.90 ± 13.40	54.69 ± 8.43	50.94 ± 8.61	**0.007****
Sex	Male	149 (74.1%)	29 (69.0%)	20 (62.5%)	0.356*
	Female	52 (25.9%)	13 (31.0%)	12 (37.5%)	
Education	Illiterate	17 (8.5%)	2 (4.8%)	4 (12.5%)	0.201*
	Literate	13 (6.5%)	2 (4.8%)	1 (3.1%)	
	Primary	48 (23.9%)	9 (21.4%)	12 (37.5%)	
	Intermediate	34 (16.9%)	17 (40.5%)	8 (25.0%)	
	Secondary	54 (26.9%)	10 (23.8%)	7 (21.9%)	
	Higher	35 (17.4%)	2 (4.8%)	0 (0.0%)	
Smoking	Smoker	121 (60.2%)	28 (66.7%)	14 (43.8%)	**0.013***
	Non-smoker	69 (34.3%)	9 (21.4%)	18 (56.3%)	
	Ex-smoker	11 (5.5%)	5 (11.9%)	0 (0.0%)	
BMI	Mean ± SD	28.78 ± 4.35	30.71 ± 4.05	30.34 ± 4.05	**0.010****
	Normal	36 (17.9%)	3 (7.1%)	2 (6.3%)	**0.024***
	Overweight	87 (43.3%)	13 (31.0%)	12 (37.5%)	
	Obese	78 (38.8%)	26 (61.9%)	18 (56.3%)	
Hypertension	Hypertensive	112 (55.7%)	23 (54.8%)	16 (50.0%)	0.833*
	Non-hypertensive	89 (44.3%)	19 (45.2%)	16 (50.0%)	
Lipid profile	Dyslipidemia	80 (39.8%)	26 (61.9%)	22 (68.8%)	**0.001***
	Normal	121 (60.2%)	16 (38.1%)	10 (31.3%)	
Family history of DM	Positive	79 (39.3%)	24 (57.1%)	26 (81.3%)	**0.000***
	Negative	122 (60.7%)	18 (42.9%)	6 (18.8%)	
ACS subtype	STEMI	96 (47.8%)	30 (71.4%)	15 (46.9%)	**0.047***
	Non-STEMI	66 (32.8%)	10 (23.8%)	12 (37.5%)	
	Unstable Angina	39 (19.4%)	2 (4.8%)	5 (15.6%)	

*Chi-square test was used; **One-way ANOVA test was used; new-DM – newly diagnosed diabetes mellitus; pre-DM – prediabetes mellitus; BMI – body mass index; ACS – acute coronary syndrome; STEMI – ST-segment elevation myocardial infarction.

DISCUSSION

DM is recognized as a global public health concern. The WHO has ranked DM as the eighth leading cause of death in 2021, based on the global projections of causes of death [16]. The Middle East and North Africa region comes second among the International Diabetes Federation regions, with a prevalence of DM of 9.2% [17].

In a pooled analysis to measure the worldwide trends of DM, it is estimated that the prevalence of DM in Iraq in 2014 was approximately 17.5% [18]. Data from a population-based study conducted in Basra in 2014 found that 11% of individuals screened for DM were identified to have undiagnosed DM and 29.1% were found to have prediabetes [7].

In this study, the prevalence of unrecognized DM among ACS patients during the study period was 15.3%. This finding was comparable to that of a study conducted in India by Ashraf et al. [19], in which 14.7% of ACS patients were newly diagnosed with diabetes. Notably, this group had a mortality rate that was double that of the normal and pre-diabetic groups.

Across countries, the prevalence rates of undiagnosed DM in ACS patients were highly variable. Starting as low as 5.3% in Macedonia [20] or 7.4% in Pakistan [21], they reach up to 21.1% in Qatar [15], 22% in India [22], and as high as 24.5% in Egypt [23]. The relatively lower prevalence in our study compared to other

countries might reflect the widespread accessibility to healthcare services in Iraq as well as the screening programs established in primary health center settings [6]. Furthermore, this variation between different studies is also linked to the demographic and geographic characteristics of the populations, the diagnostic criteria applied, the choice of laboratory tests (HbA1c, FBS, RBS, and oral glucose tolerance test), and the methodologies used [24].

The study revealed that 11.6% of patients were found to be prediabetic. This was slightly lower than in studies by Kumar et al. [22] and Abdullatef et al. [14], where pre-DM patients represented 14% of ACS patients.

In the current study, the mean age of the patients with newly diagnosed DM was 54.69 ± 8.43 years, which was significantly lower than the mean age of the non--diabetic group (57.90 ± 13.40 years). This was in line with a study conducted in Pakistan in 2024 by Khan et al. [25], which found that both undiagnosed DM and pre-DM groups were significantly younger than the non-diabetic group. The accelerated atherosclerosis, oxidative stress, and increased inflammation caused by DM can promote the progression of atherosclerotic changes at earlier ages compared to non-diabetic individuals [26].

In the study, ACS patients who had newly diagnosed DM and pre-DM had significantly higher BMI and dyslipidemia rates compared to the non-diabetic patients. Dyslipidemia was prevalent among nearly 62% of the newly diagnosed DM patients. This was comparable to two studies, by Filisa-Kaphamtengo et al. [27] in Malawi and by Yadegar et al. [28] in Iran. Both studies found that approximately 70% of DM patients had dyslipidemia and that it acts as a predictor of the risk of atherosclerotic cardiovascular diseases.

Filisa-Kaphamtengo et al. [27] also revealed that dyslipidemia among diabetic patients was associated with being overweight and obese. Both obesity and dyslipidemia are associated with reduced levels of serum adiponectin, a hormone that is integral to glucose regulation and lipid metabolism. Obesity among patients with DM is also associated with elevated levels of leptin, a hormone that plays a role in appetite regulation. Elevated leptin levels contribute to endothelial dysfunction, a key mechanism in the pathogenesis of atherosclerotic cardiovascular diseases [29].

In the current study, newly diagnosed DM patients had a mean BMI of 30.71 ± 4.05, which was significantly higher than the BMI among the normoglycemic group (28.78 ± 4.35). This was in line with a study by Mansour et al. [7] in Basra, who found that diabetic patients had significantly higher BMI than non-diabetics (28.3 ± 5.6 and 26.8 ± 6.6, respectively).

The current study revealed that 81.3% of pre-DM patients and 57.1% of new-DM ones had a family history of DM. Likewise, a study in Pakistan found a similar association, where 45% of newly diagnosed DM patients had a family history of DM [21]. A family history of DM among first-degree relatives results in a 3-fold higher risk of developing DM [30].

In this study, approximately 67% of the newly diagnosed DM patients were active smokers, which was higher than a study in China, which reported that 50.8% of ACS male patients with undiagnosed DM were smokers [31]. According to the European Society of Cardiology, smoking increases the risk of type 2 diabetes, cardiovascular disease, and premature death [32].

The study found no association between DM screening results and hypertension. More than half of patients with newly diagnosed DM were also hypertensive. This disagrees with the findings of Mansour et al. [7] in a study from Basra in which hypertension rates were significantly higher among DM and pre-DM individuals.

In the study, patients with unrecognized DM had a significantly higher frequency of STEMI (71.4%) compared to the pre-DM (46.9%) and non-diabetic groups (47.8%). The prevalence of STEMI was higher than that reported in Pakastani studies by Kazim et al. [21] and Khan et al. [25], in which STEMI was seen in 50% and 37% of undiagnosed DM patients, respectively, and no significant association was revealed. In contrast to our results, a study by Zhou et al. [31] in China found significantly higher rates of both non-STEMI and unstable angina among ACS cases with DM. The variation in these results is likely due to differences in study design and sample size, inclusion criteria, and diagnostic methods. Undiagnosed diabetes affects the development of ACS through various mechanisms, such as endothelial dysfunction, inflammation, hypercoagulability, and accelerated atherosclerosis. The presence of hyperglycemia causes an increase in oxidative stress and impairment of endothelial function. This leads to a greater risk of plaque destabilization and rupture, which are key factors in ACS [24].

This study is limited by its hospital-based sample, which may restrict the generalizability of the findings to the broader population. Patients in hospital settings may differ from those in the community or primary care settings in terms of disease severity, access to healthcare, and other factors. Additionally, the cross--sectional design estimates the prevalence at a specific point in time. Future research should consider including patients from diverse healthcare settings to improve external validity and ensure a more comprehensive understanding of the findings.

CONCLUSIONS

This study demonstrates a substantial burden of unrecognized DM among ACS patients and it is strongly associated with cardiovascular risk factors such as smoking, high BMI, dyslipidemia, family history of DM, and younger age at presentation, as well as higher rates of STEMI. These findings highlight the need for routine diabetes screening in all ACS patients, with particular focus on high-risk individuals. Integrating targeted interventions, including smoking cessation programs, weight management, dyslipidemia control, and public health education on healthy lifestyles at both primary healthcare centers and through media campaigns should be prioritized in order to reduce the impact of diabetes and cardiovascular disease in this population.

Authors' contribution

Study design – M.Q.M. Ali, N.R. Shiaa
Data collection – Z.Q.M. Ali
Data interpretation – A.A. Al-Rubaye
Statistical analysis – A.A. Al-Rubaye
Manuscript preparation – Z.Q.M. Ali, A.A. Al-Rubaye
Literature research – Z.Q.M. Ali, M.Q.M. Ali, N.R. Shiaa, A.A. Al-Rubaye

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