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Prevalence of diabetes mellitus among traumatic patients admitted to Aseer Central Hospital, Aseer Region, Abha, Saudi Arabia: cross-sectional study

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Abstract

Background Traumatic injuries among patients with diabetes mellitus (DM) are associated with extended hospital stays and higher mortality rates.

Objectives This study aimed to estimate the prevalence of DM among traumatic patients admitted to Aseer Central Hospital, Aseer Region, Saudi Arabia.

Methods A cross-sectional design was conducted among trauma casualties aged 18 years and older admitted to the Trauma Center of Asser Central Hospital, Abha, Saudi Arabia, for six months from July 1 to December 31, 2024. Data were collected using an interviewer-administered questionnaire. The questionnaire covered various aspects, including demographic information, smoking status, presence of chronic diseases, previous diabetes diagnoses, details of any accidents, diabetes diagnosis during the accident, and self-care practices.

Results Three hundred and eleven trauma casualties were included with a mean age of 46.7 ± 12.9. Of them, 60.8% were men. The study found that the prevalence of diabetes among trauma casualties was 8.7%, with 48.2% incidentally discovered during the current trauma. Among diagnosed patients, 33.3% had glycated hemoglobin (HbA1c) levels between 7.51–8.5%, 11.1% between 8.51–9.5%, and 22.2% exceeded 9.5%. The predictors of diabetes diagnosis included smoking (OR = 6.39, 95% CI = 2.08–19.63), lower levels of education levels (OR = 0.75, 95% CI = 0.58–0.96), and a positive family history (OR = 24.9, CI = 7.96–78.36).

Conclusions The study found an 8.7% prevalence of diabetes among trauma casualties, with nearly half discovered during the event. Factors like smoking, education, and family history of diabetes were associated with diagnosis. Routine diabetes screening is crucial for early detection and management. Targeted interventions, such as multidisciplinary care teams and telemedicine, can improve diabetes management. Further research is needed to address cultural and socioeconomic factors.

Keywords Opportunistic screening, Saudi Arabia, HbA1 C, Glycaemic control

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Introduction

Diabetes mellitus (DM) is a major global health problem, affecting about 537 million adults aged 20 to 79 years, which is approximately one in ten people; with about 90% classified as type 2 diabetes. This number is expected to rise to 643 million by 2030 and a staggering 783 million by 2045 [1]. Alarmingly, over 75% of adults with DM live in low- and middle-income countries, highlighting the unequal burden of the disease. DM has a significant impact beyond its prevalence, causing 6.7 million deaths in 2021, which is equivalent to a life lost every 5 s [2]. Furthermore, diabetes adversely affects quality of life, overall well-being, and an individual's sense of self-efficacy, specifically among those with poor glycemic control [3, 4].

In the Eastern Mediterranean Region, 16.2% of adults are estimated to have DM [5]. Saudi Arabia ranks seventh worldwide in the prevalence of DM. It is estimated that over seven million people in Saudi Arabia have DM, and nearly three million have pre-diabetes [6]. Household health surveys conducted across Saudi Arabia's 13 administrative regions estimated that 8.5% of individuals aged 15 years and above have diabetes [7]. In 2021, the International Diabetes Federation (IDF) estimated the diabetes prevalence in Saudi Arabia to be 17.7% among adults [2]. However, in 2024, there has been a notable increase in the prevalence of DM, reaching 36.1%, with a significant rate of 28.3% for pre-diabetes [8]. Saudi Arabia has a high prevalence of diabetes due to various factors such as urbanization, sedentary lifestyles, obesity, changing dietary habits, and increased life expectancy [9, 10].

Undiagnosed diabetes is a significant public health problem, and almost half of adults (20–79 years old) with diabetes are unaware of their condition [2]. Early detection of diabetes is crucial as the duration of high blood sugar levels predicts adverse outcomes, and there are effective interventions to reduce the risk of complications [11, 12]. Laboratory techniques for diabetes testing include fasting plasma glucose (FPG) levels or a two-hour oral glucose tolerance test (OGTT). Additionally, the World Health Organization (WHO) and the American Diabetes Association recommend using glycated hemoglobin A1c (HbA1c) alone (≥ 6.5% or 48 mmol/mol) for diagnosis and monitoring of people with diabetes [13, 14].

Many people with risk factors for diabetes do not have access to primary care and can be referred to the emergency department (ED). The ED plays a vital role in providing medical care to people with limited access to screening and preventive interventions, making it a potential location for opportunistic screening for diabetes. Blood glucose levels are routinely tested in the ED, particularly for high-risk individuals, further supporting the value of conducting diabetes screening in this setting [15, 16].

Traumatic injuries among individuals with DM often lead to longer hospital stays and higher mortality rates, particularly if people are undiagnosed or have poorly controlled diabetes. Motor vehicle crashes and falls are common causes of traumatic injuries and fatalities, posing significant concerns for diabetics. Research suggests that reduced mobility, cognitive impairment, and visual deficits are notable risk factors for these injuries in patients with diabetes. Similarly, diabetes complications such as reduced peripheral nerve function, impaired vision, and renal dysfunction contribute to these injuries. Moreover, these risk factors are primarily associated with hypoglycemic conditions resulting from DM itself and antidiabetic therapy [17, 18]. The complex nature of diabetes comorbidities leads to poorer outcomes in post-traumatic injury. Detecting DM in trauma patients is crucial due to the complex medical needs and increased risks they face. Prioritizing diabetes detection in this population not only enhances individual care but also optimizes resource allocation within healthcare settings [19].

Trauma patients, especially those from low-income communities, are more prone to missed diagnoses of DM due to their circumstances [20]. Given this higher probability of missed diagnoses among trauma patients, trauma centers have the potential to identify people who require better glucose management [21]. However, little is known about the current burden of DM in this specific population in Saudi Arabia. Therefore, this study aims to estimate the prevalence of DM among traumatic patients admitted to Aseer Central Hospital in the Aseer Region, Abha, Saudi Arabia.

Methods

Study design, setting, and population

A cross-sectional design was conducted among trauma casualties aged 18 years and above admitted to the Trauma Center, Asser Central Hospital, Abha, Saudi Arabia for six months (July 1 to December 31, 2024). Trauma causalities with disturbed levels of consciousness and those with incomplete or missing data relevant to the study objectives were excluded from the study.

Sampling technique and sample size

Participants were recruited using the convenience sampling method. The sample size was calculated using a Roasoft online calculator, with an alpha error of 0.05, a confidence level of 95%, a diabetes prevalence among trauma patients set at 17.3% [20], and a non-response rate of 20%. Consequently, the calculated minimum sample size was 262. However, a total of 311 samples were ultimately collected.

Data collection

The researchers developed the questionnaire after reviewing different studies [16–18, 20]. This questionnaire was completed by the researcher while interviewing trauma casualties. To ensure its validity, four professors were solicited to review and assess its clarity and relevance. The questionnaire comprises different sections. The first part of the questionnaire includes demographic data such as age, sex, marital status, monthly income, occupation, employment in the healthcare field, education level, and health insurance status. Additional details such as smoking status, the presence of chronic diseases, and previous diabetes diagnosis were also collected. The questionnaire then explores the specifics of any accidents experienced by the participants, covering previous accident history, location, severity, and general health assessment before and after the accident. It inquires about the diagnosis of diabetes during the accident. In addition, it investigates diabetes related history, including self-reported diabetes, family history of diabetes and the symptoms experienced. HbA1c testing was also performed. WHO and IDF recommend an HbA1c $\geq$6.5% cutoff point for diabetes diagnosis [13, 14]. For assessing clinical diabetes control, an HbA1c threshold of 7.5% or more to define uncontrolled diabetes, which aligns with the guidance provided by the National Institute for Health and Care Excellence (NICE) for managing type 2 diabetes in adults. According to NICE guidelines, intensification of therapy is recommended when HbA1c levels exceed 7.5% (58 mmol/mol), which we adopted to categorize individuals as having uncontrolled diabetes [22]. Finally, the questionnaire explores details related to self-care, including following a diet, physical activity levels, regular testing, access to healthcare services, and receiving health education or training.

Before data collection, a pilot study was conducted in a small sample of trauma survivors to assess clarity, feasibility, applicability, and completion time of the questionnaire. Adjustments and enhancements were implemented based on the findings of the pilot study before the final data collection. The participants involved in the pilot study were not included in the final analysis.

Data analysis

Statistical Package for the Social Sciences (IBM SPSS) Statistics for Windows (Version 27.0 was used for data entry and analysis. We excluded incomplete and inconsistent participant data from the analysis. Categorical data were presented as numbers and percentages, where mean and standard deviation (SD) were used to present quantitative variables. Binary logistic regression analysis was performed to assess predictors of diabetes among the studied participants, with the Odds Ratio (OR) indicating the strength of association and the Confidence Interval (CI) providing the range of certainty for the OR.To ensure the appropriateness and reliability of the logistic regression model, we performed the Hosmer–Lemeshow goodness-of-fit test ($p > 0.05$ indicates a good fit) and calculated Nagelkerke R^2, which explains the proportion of variance explained by the model. A p-value less than 0.05 was considered statistically significant.

Ethical considerations

The approval for this study was obtained from the Ethics Committee of the Saudi Ministry of Health (IRB: H-06-B-091). The research followed the international ethical guidelines of the Helsinki Guidelines and their subsequent amendments. Participants were provided with an explanation of the study's objectives and goals before conducting it. They were informed that their participation was voluntary. Patient confidentiality and privacy will be maintained throughout the study. Consent was taken from the participants confirming their approval of participation in the study. To maintain confidentiality, all responses were stored on a password-protected computer, accessible only to the principal investigator, guaranteeing the privacy and security of participant data.

Results

The initial sample comprised 326 trauma casualties admitted to the Trauma Center, Asser Central Hospital, Abha, Saudi Arabia, for six months from July 1 to December 31, 2024. However, we excluded the responses of 15 causalities with incomplete medical records or missing data relevant to the study objectives were excluded from the study.

Table 1 illustrates the general characteristics of trauma casualties. The mean age of the patients was 46.7 ± 12.9 years, 60.8% were males, 85.5% were married, 78.8% resided in urban areas, 20.9% had an income less than 5000 SR, 46.9% had a university education, 43.7% were employed in the governmental sector, 90.7% were not health workers, and 73.6% did not have health insurance.

Table 2 shows the health-related profile of trauma casualties. Among the study participants, 11.6% were smokers, 10.9% had a history of trauma, over one third (35%) described their health as excellent, and 91.3% reported having no chronic disease. Regarding the current accident, 70.7% of them experienced the accident at home, and 57.9% described their injury as moderate.

Table 3 represents the history of diabetes related to trauma among trauma casualties. Only 5.8% experienced symptoms of polydipsia and polyuria. A positive family history of diabetes was recorded among 6.4% of the studied participants. Analyzing the results of HbA1c revealed

Table 1 General characteristics of trauma casualties

Variables		(*n* = 311)	%
Age (Years)	**Mean ± SD**	**46.7 ± 12.9**	
Sex	Male	189	60.8
	Female	122	39.2
Marital status	Married	266	85.5
	Widow	8	2.6
	Divorced	3	1.0
	Single	34	10.9
Residence	Urban	245	78.8
	Rural	66	21.2
Income	Not specified	20	6.5
	Less than 5000 Saudi Riyal	65	20.9
	5000–15000 Saudi Riyal	109	35.0
	15,000–20000 Saudi Riyal	85	27.3
	> 20,000 Saudi Riyal	32	10.3
Education level	Illiterate	9	2.9
	Read and write	10	3.2
	Primary/Preparatory	29	9.4
	Secondary	89	28.6
	University	146	46.9
	Postgraduate	28	9.0
Employment	Governmental sector	136	43.7
	Private sector	24	7.7
	Retired	72	23.2
	Un employed	79	25.4
Health worker	No	282	90.7
	Yes	29	9.3
Health insurance	Governmental insurance	44	14.1
	Private insurance	38	12.2
	No insurance	229	73.6

Table 2 Health-related profile of trauma casualties

Variables			%
Smoking	Non-smokers	275	88.4
	Smokers	36	11.6
History of previous trauma Such as traffic accidents, falls, work injury…..etc.)	No	277	89.1
	Yes	34	10.9
Current accident place	Home	220	70.7
	Public place	81	26.0
	Work	10	3.2
Current accident severity	Mild	109	35.0
	Moderate	180	57.9
	Severe	22	7.1
Self-rating of general health before the accident	Excellent	104	33.4
	Very good	74	23.8
	Good	47	15.1
	Fair	40	12.9
	Poor	46	14.8
Chronic disease	No	284	91.3
	Diabetes	14	4.5
	Others*	10	2.6

* Others include hypertension, heart disease, and thyroid disease

Table 3 Diabetes-related history among trauma casualties

Variables		n	%
Symptoms of polydipsia and polyuria	Yes	18	5.8
	No	293	94.2
Family history of diabetes	Positive	20	6.4
	Negative	291	93.6
HbA1c results	Not diabetic < 6.5	284	91.3
	Diabetic ≥ 6.5	27	8.7%
Glycaemic control among diabetics	HbA1c (6.5- < 7.5)	9	33.3%
	HbA1c (≥ 7.5)	18	66.7%
If HbA1c > 6.5	Diagnosed previously	14	51.8
	Diagnosed accidentally	13	48.2
Follow a healthy diet regimen	Yes	13	4.2
	No	298	95.8
Regular physical activity	Yes	22	7.1
	No	289	92.9
Regularly screen for diabetes	Yes	29	9.3
	No	282	90.7
Accessibility to healthcare	Yes	36	11.6
	No	275	88.4
Receiving health education regarding diabetes mellitus	Yes	36	11.6
	No	275	88.4

that 8.7% of them were diabetics, and of them, 48.2% were accidentally discovered during the current trauma, and 66.7% were uncontrolled (HbA1c ≥7.5). Regarding self-care activities, 9.3% had regular diabetes screening and 11.6% had access to health care.

Table 4 presents a logistic regression of the presence of diagnosed diabetes among trauma casualties. Smoking is a predictor of diagnosis of DM among trauma casualties (OR =6.39, 95%CI =2.08 −19.63). Being a smoker increased the probability of having DM among trauma patients six times. Additionally, people with higher education have a lower likelihood of diagnosis of DM among trauma casualties (OR =0.75, 95%CI =0.58–0.96). Furthermore, a positive family history of diabetes greatly increases the odds of the diagnosis of DM among trauma casualties. (OR =42.9, 95%CI =7.96–78.36). However, age and sex were not significant predictors of diabetes diagnosis among trauma casualties. The Hosmer–Lemeshow test indicated a good fit (p =0.880), and the model

Table 4 Logistic regression of the presence of diabetes among trauma casualties

Predictors	B	S.E	Wald	P	OR	95% CI	
						Lower	Upper
Age	0.01	0.01	0.29	0.588	1.01	0.97	1.04
Female sex	−0.32	0.60	0.29	0.585	0.72	0.22	2.33
Being smoker	1.85	0.57	10.47	0.001*	6.38	2.07	19.62
University and postgraduate education	−0.282	0.12	4.87	0.027*	0.75	0.58	0.96
Positive family history of diabetes	3.21	0.58	30.46	0.0001*	24.99	7.96	78.36
Constant	−11.64	2.71	18.39	0.0001*			
Hosmer–Lemeshow test $p = 0.880$							
Nagelkerke $R^2 = 0.339$							

* Statistically significant ($p < 0.05$)

explained 33.9% of the variance in diabetes status (Nagelkerke $R^2 = 0.339$).

Discussion

The prevalence of DM among trauma casualties in the present study, as determined by HbA1c results, was 8.7%; of them, 48.2% were accidentally discovered during the current trauma. On the other hand, Massey et al. [20] recorded that 17.3% of the trauma patients were diabetic; of them, 30% were undiagnosed or had poorly controlled DM. In another study, when ED records of an urban Australian public hospital were analyzed, 38.4% of patients were recorded as diabetics. Among those with diabetes, 32.2% were previously undiagnosed [15]. Variations in the prevalence of diabetes among trauma patients in different studies can be attributed to factors such as differences in study populations, diagnostic criteria, healthcare access, geographical variability, and sampling methods. Demographics, diagnostic methods, awareness of healthcare, regional disparities, and study designs play a role in the reported prevalence rates. These findings highlight the importance of screening for diabetes as a routine clinical practice among trauma patients.

HbA1c is a widely used indicator for assessing long-term glycemic control in individuals with diabetes. Clinical control in patients with diabetes is considered suboptimal if the HbA1c level is ≥7.5% [22, 23]. The present study revealed that among previously and accidentally diagnosed diabetic patients, 66.7% had HbA1c levels ≥7.5. Similarly, other studies reported that nearly two-thirds of diabetes cases had uncontrolled glycaemia [24, 25]. According to the American Diabetes Association (ADA) [26], HbA1c levels below 7% are generally recommended for most adults with diabetes to reduce the risk of complications. The results of this study indicate that a considerable proportion of diabetic patients may have HbA1c levels above the recommended target range. Poor glycemic control is associated with an increased risk of diabetes-related microvascular and macrovascular complications [27, 28] Hence, it is crucial to address and optimize glycemic control in diabetic trauma patients.

Multifaceted interventions, encompassing lifestyle modifications and health education, have been extensively studied and proven effective in both preventing the occurrence of diabetes and managing the disease among individuals already diagnosed. These interventions play a crucial role in lowering HbA1c levels and reducing the risk of complications among diabetic patients [29]. However, similar to other reports [30], the present study revealed a low practice of these activities among the participants. This finding suggests a gap in the implementation of lifestyle modifications and health education interventions in the population studied. It highlights the importance of developing and implementing targeted interventions to promote and support these activities among individuals who have experienced trauma, particularly diabetics.

The study found that a small percentage (5.8%) of trauma casualties experienced symptoms of polydipsia and polyuria, which are common symptoms of diabetes. This indicates that the presence of these symptoms alone may not be sufficient to detect DM in trauma patients. In agreement, Pawar et al. [31] reported that the diagnostic accuracy of the presence of these classical diabetes symptoms is limited.

The study identified several factors associated with the diagnosis of diabetes among trauma casualties. Smoking was found to be positively associated with diabetes diagnosis. This finding is consistent with previous research linking smoking with an increased risk of trauma [32]. Furthermore, people with higher levels of education had a lower probability of diagnosis of diabetes, indicating that education can play a role in the prevention and treatment of diabetes [33]. The presence of a positive family

history of diabetes significantly increased the odds of diabetes diagnosis among trauma casualties. Additionally, a positive family history of diabetes was recorded in 6.4% of participants. This finding underscores the importance of considering family history as a risk factor for diabetes and supports the need for targeted screening in individuals with a family history of the disease [34].

This study possesses several strengths, including its relevance to public health by focusing on the early detection of DM among trauma patients, a group that often lacks regular access to primary care and screening. The comprehensive data collection through interviewer-administered questionnaires ensures detailed demographic, lifestyle, and medical information, enhancing the robustness of the analysis. The study's emphasis on opportunistic screening in emergency departments highlights a critical intervention point for high-risk populations. However, the study also has limitations, such as its cross-sectional design, which limits causal inferences, and the use of convenience sampling, which may introduce selection bias. The single-center nature of the study restricts the generalizability of the results and reliance on self-reported data can lead to inaccuracies. Despite these limitations, the study offers significant information on the prevalence and predictors of diabetes among trauma patients, providing a foundation for future research and public health interventions. To overcome limitations, future research should shift to longitudinal designs for causal insights, opt for random sampling over convenience sampling to mitigate bias, conduct multicenter studies for broader applicability, and blend self-reported data with objective measures for accuracy.

Conclusions

In conclusion, the study revealed an 8.7% prevalence of diabetes among trauma casualties, with nearly half of the cases being incidentally discovered during the trauma event. The study highlighted suboptimal glycemic control among patients with diagnosed diabetic trauma and identified a low practice of healthy lifestyle modifications. Factors such as smoking, higher education levels, and a positive family history of diabetes were associated with the diagnosis of diabetes among trauma casualties. This study emphasizes the importance of routine diabetes screening among trauma patients to ensure early detection and prompt management. Addressing suboptimal glycemic control is crucial to reduce the risk of diabetes-related complications in this population. The study underscores the need for targeted interventions to promote healthy lifestyle modifications. Implementing evidence-based interventions like multidisciplinary care teams, structured diabetes education programs, nutrition counseling, physical activity initiatives, support groups, and telemedicine can significantly improve diabetes management among trauma patients. By integrating these strategies into trauma care settings, healthcare providers can provide comprehensive support, empower patients with self-management skills, promote healthy lifestyle choices, and ensure ongoing monitoring and follow-up after injury. In addition, more research is warranted to develop tailored approaches that address the specific needs of trauma patients with diabetes, taking into account cultural and socioeconomic factors.

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Authors' contributions
M.M.A Conceptualization, B.A.A Methodology, A.M.A Project administration, M.M.M Supervision, A.S.Al Visualization, and H.M.Al Validation, T.A.Al Writing – original draft, Writing – review & editing, A.Mo.Al Visualization, A.I.M.I Validation. All authors contributed to data analysis, drafting, or revising the article, gave final approval of the version to be published, agreed to the submitted journal, and agreed to be accountable for all aspects of the work.

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Data availability
All data are available upon request from the corresponding author.

Declarations

Ethics approval and consent to participate
The approval for this study was obtained from the Ethics Committee of the Saudi Ministry of Health (IRB: H- 06-B-091). Written informed consent was obtained from all the participants to confirm their approval of participation in the study.

Consent for publication
Not Applicable.

Competing interests
The authors declare no competing interests.

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