Prevalence, Diagnosis, and Associated Factors of Diabetes among Primary Healthcare Center Attendees in Saudi Arabia: A Screening Cross-Sectional Study

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Abstract

Background: Diabetes is a widespread chronic condition, with rising cases due to aging, lifestyle, and dietary shifts. Diagnosis relies on blood glucose tests, and early detection is vital for preventing complications. Key factors include genetics, obesity, poor diet and inactivity. Targeted interventions addressing these can help reduce diabetes rates and improve outcomes.

Aim: The main aim is to determine the prevalence of diabetes, improve diagnostic accuracy, and identify associated key factors.

Methods: This cross-sectional study assessed diabetes prevalence, diagnostic accuracy, and associated factors. A representative sample was surveyed on demographics, lifestyle, and medical history, with BMI measurements and blood glucose tests for diagnosis. Statistical analysis was used to identify key factors linked to diabetes.

Results: A total of 964 attendees at primary healthcare centers participated, with a mean age of 47.6 years (± 17.1) and a gender distribution of 50.4% female. Initial screenings found that 32.6% were diagnosed with diabetes, 12.9% were pre-diabetic, and 54.6% had normal glucose levels. A follow-up screening showed 36.8% were diagnosed with diabetes, 12.9% pre-diabetic, and 50.3% normal. Among 312 confirmed diabetes cases, 30.1% had Type 2 diabetes and 2.3% had Type 1. Factors linked to a diabetes diagnosis included age (higher odds for those over 50), male gender, obesity (6.5 times higher odds), hypertension (3.1 times), and dyslipidemia (3.8 times).

Conclusion: The study reveals a high prevalence of type 2 diabetes in Saudi Arabia's middle-aged and elderly population, with one-third diagnosed. Risk factors include age, obesity, and hypertension. Undiagnosed cases pose serious complications, burdening the healthcare system and requiring enhanced preventive efforts.

Keywords:
Diabetes screening, Prevalence of diabetes, Type of diabetes, Risk factor, Saudi Arabia

Introduction

Globally, the prevalence of diabetes is steadily rising in both high- and low-income nations, making it a serious global health concern [1]. According to the International Diabetes Federation (IDF), 537 million adults between the ages of 20 and 79 had diabetes in 2023; if current trends continue, this number is expected to increase to 783 million by 2045 [2]. While Type 1 diabetes (T1D) and gestational diabetes continue to have a substantial global burden, Type 2 diabetes (T2D) makes up the majority of cases. The Western Pacific, North Africa, and the Middle East have the highest prevalence rates [2, 3]. Aging populations, urbanization, dietary changes, and increased physical inactivity are some of the factors contributing to this rising prevalence [4, 5]. The COVID-19 pandemic has further exacerbated diabetes-related complications, highlighting the urgent need for comprehensive public health strategies to mitigate the impact of diabetes worldwide [6]. The growing burden of diabetes is placing substantial strain on healthcare systems, with costs associated with care and management increasing rapidly [7].

In recent years, there has been a significant increase in the prevalence of diabetes in Saudi Arabia, aligning with global trends of urbanization, lifestyle changes, and rising obesity rates [8-10]. Current estimates indicate that approximately 18.5% of the adult population in Saudi Arabia has diabetes, with Type 2 diabetes (T2D) making up the majority of these cases [9, 10]. Over the past decade, the prevalence of diabetes among Saudi adults has risen by nearly 2% per year, reflecting a substantial rise compared to previous years. Obesity, a major risk factor for Type 2 diabetes, affects nearly 35% of adults in the country and serves as a significant contributor to this alarming trend [11]. Additionally, sedentary lifestyles, unhealthy eating habits, and rapid urbanization are further exacerbating the increasing rates of diabetes. A national survey conducted in 2021 found that nearly 30% of individuals aged 45 to 64 were living with diabetes, with the highest prevalence observed in those over 65 years of age [12, 13].

For early intervention and better health outcomes, screening for diabetes-related complications such as cardiovascular disease, nephropathy, neuropathy, and retinopathy is essential [14]. Healthcare professionals can identify high-risk patients and promptly implement treatment plans when screening protocols are effective. This strategy lowers diabetes-related morbidity and mortality [15]. Furthermore, comorbid conditions like obesity, dyslipidemia, and hypertension make managing diabetes more difficult and put a greater strain on medical resources [16]. People with diabetes frequently have comorbid conditions, which makes treatment adherence and clinical outcomes even more difficult [17]. The current study aimed to assess the prevalence, types, and risk factors of diabetes among screened primary healthcare attendants in Saudi Arabia.

Methodology

A screening study was conducted for attendants of primary health care centers where persons coming for regular follow-up, or those for screening, were included after explaining the purpose of the study. Those aged 18 years or more, not previously diagnosed with diabetes were invited to participate in the study. After giving their consent, participants were directly interviewed using a pre-structured questionnaire covering their demographic data, weight, height, medical history, and laboratory findings mainly fasting blood glucose level (FBS) and HbA1c. For the initial screening test, persons were categorized into normal, pre-diabetic, and diabetic persons. Then, FBS and HBA1c tests were repeated if the initial HbA1C was ≥6.5% or FBS ≥126 mg%) to confirm the diagnosis (see the attached pathway plan (Figure 1)). Finally, screened persons were confirmed to be diabetic or not, and diabetics were classified into type I and type II diabetes.

Data analysis

The data were collected, reviewed, and then fed into Statistical Package for Social Sciences version 26 (Released 2019. Armonk, NY: IBM Corp). All statistical methods used were two-tailed with an alpha level of 0.05 considering significance if P value is less than or equal to 0.05. Descriptive analysis for categorical data was done using frequencies and percentages, whereas numerical data were presented as mean with standard deviation. The participants' data were tabulated while the diabetes category and type were graphed. Also, participants' laboratory findings were compared by their diabetes category. Cross tabulation was done showing factors associated with diabetes diagnosis using crude and adjusted odds ratio and its 95% confidence interval based using Pearson Chi-Square test and logistic regression models.

Results

A total of 964 eligible attendants to the primary health care centers were included in the screening. Attendants' ages ranged from 18 to 68 years with a mean age of 47.6 ± 17.1 years old. Exactly 486 (50.4%) participants were females. The vast majority came for follow-up (95.1%; 917) while 47 (4.9%) came for screening. As for initial screening results, 314 (32.6%) were diagnosed as diabetic, 124 (12.9%) were pre-diabetic and 526 (54.6%) were normal. At the repeated screening, 355 (36.8%) were categorized as diabetic, 124 (12.9%) as pre-diabetic, and 485 as normal. The assessed mean FBS among study participants was 121.9 ± 59.5 mg/dl and the average HbA1c was 7.7 ± 1.9% (Table 1).

Figure 1. Prevalence and type of diabetes among screened study attendants of primary health care centers. Exactly 312 (32.4%) were confirmed to have DM, where 290 (30.1%) had type II DM and 22 (2.3%) had type I DM.

Table 2 presents factors associated with a confirmed diagnosis of diabetes among primary healthcare center attendees. As for age, the likelihood of having a confirmed diabetes diagnosis increased with age, with individuals aged 51-60 and over 60 years exhibiting the highest odds of having diabetes (ORA= 1.3, 95% CI 1.01–2.0; p-value = 0.001). Also, males had higher odds of having diabetes compared to females (ORA= 1.6, 95% CI 1.2–2.2; p = 0.017). As for obesity, it was strongly associated with diabetes diagnosis, as individuals with obesity were 6.5 times more likely to be diagnosed with diabetes (ORA= 6.5, 95% CI 4.2–10.3; p = 0.001). Likewise, patients with hypertension had 3.1 times the odds of being diagnosed with diabetes compared to those without hypertension (ORA= 3.1, 95% CI 1.9–6.3; p-value= 0.001). Finally, dyslipidemia was also strongly associated with diabetes, with individuals having dyslipidemia being 3.8 times more likely to have a confirmed diabetes diagnosis (ORA= 3.8, 95% CI 2.3–6.3; p = 0.001).

Table 3 illustrates laboratory findings among study participants by their diabetes category. Regarding Fasting Blood Sugar (FBS), Normal group: The average FBS level in individuals with normal glucose metabolism was 92.9 mg/dL (SD = 15.4), which is within the normal range (typically 70-100 mg/dL). T1DM group: The average FBS in individuals with Type 1 diabetes (T1DM) was 218.2 mg/dL (SD = 103.4), significantly higher than that in the normal group. This is consistent with the typical hyperglycemia observed in uncontrolled Type 1 diabetes. T2DM group: The average FBS in individuals with Type 2 diabetes (T2DM) was 182.6 mg/dL (SD = 67.0), also elevated compared to normal, but generally lower than that observed in the T1DM group. All these differences were statistically significant (P<0.001). As for HbA1c (%), Normal group: The mean HbA1c for individuals with normal glucose metabolism was 6.1% (SD = 0.5), which is within the normal range (typically < 5.7% for healthy individuals). T1DM group: The mean HbA1c for individuals with Type 1 diabetes (T1DM) was significantly higher at 9.2% (SD = 2.6), reflecting poor long-term glucose control, which is common in Type 1 diabetes patients, especially if they have difficulty managing insulin therapy. T2DM group: The mean HbA1c in Type 2 diabetes (T2DM) was 8.3% (SD = 1.9), which was lower than that in T1DM.

Table 1. Personal characteristics of study participants who have undergone diabetes screening, in Saudi Arabia (n=964)

Data	No	%
Age in years		
18-30	188	19.5%
31-40	143	14.8%
41-50	174	18.0%
51-60	211	21.9%
> 60	248	25.7%
Mean ± SD	47.6 ± 17.1	
Gender		
Male	478	49.6%
Female	486	50.4%
Type of Visit		
Follow up	917	95.1%
Screening for diabetes	47	4.9%
HbA1C/FBS Category		
Normal	526	54.6%
Prediabetes	124	12.9%
DM	314	32.6%
Repeated HbA1C/FBS Category		
Normal	485	50.3%
Prediabetes	124	12.9%
DM	355	36.8%

Figure 1. Prevalence and type of diabetes among screened study attendants of primary health care centers (n=964)

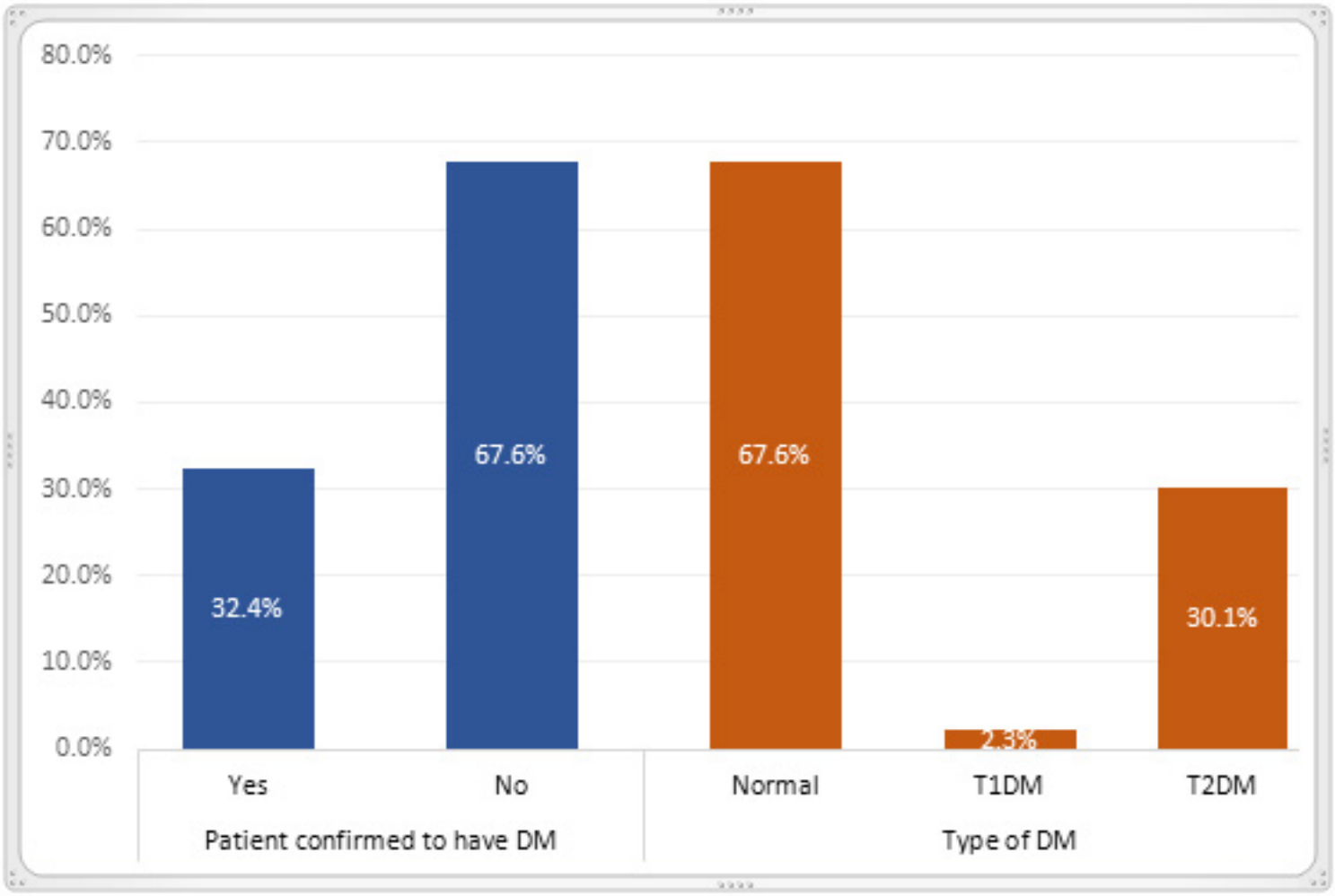

Table 2. Factors associated with a confirmed diagnosis of diabetes among screened study attendants of primary health care centers (n=964)

Factor	The patient confirmed to have DM				p-value	OR_C (95% CI)	OR_A (95% CI)
	Yes		No				
	No	%	No	%			
Age in years							
18-30	19	10.1%	169	89.9%			
31-40	20	14.0%	123	86.0%			
41-50	46	26.4%	128	73.6%	.001*	1.8 (1.6-2.1)	1.3 (1.01-2.0)
51-60	102	48.3%	109	51.7%			
> 60	125	50.4%	123	49.6%			
Gender							
Male	172	36.0%	306	64.0%	.017*	1.4 (1.1-1.8)	1.6 (1.2-2.2)
Female	140	28.8%	346	71.2%		1	1
Obesity							
Yes	138	71.9%	54	28.1%	.001*	8.7 (6.1-12.6)	6.5 (4.2-10.3)
No	174	22.5%	598	77.5%		1	1
HTN							
Yes	109	63.4%	63	36.6%	.001*	5.0 (3.5-7.1)	3.1 (1.9-6.3)
No	203	25.6%	589	74.4%		1	1
Dyslipidemia							
Yes	132	73.7%	47	26.3%	.001*	9.4 (6.5-13.6)	3.8 (2.3-6.3)
No	180	22.9%	605	77.1%		1	1

P: Pearson X^2 test *ORC: Crude odds ratio* *ORA: Adjusted odds ratio* ** P < 0.05 (significant)*

Table 3. Laboratory findings among screened study attendants of primary health care centers by their diabetes category

Lab tests	Type of DM						p-value
	Normal		T1DM		T2DM		
	Mean	SD	Mean	SD	Mean	SD	
FBS	92.9	15.4	218.2	103.4	182.6	67.0	.001*
HbA1C (%)	6.1	0.5	9.2	2.6	8.3	1.9	.001*

P: One Way ANOVA
* P < 0.05 (significant)

Discussion

The study sample features a diverse age distribution, with the largest group (25.7%) over 60 years old, followed by age 51-60. Notably, 19.5% of participants were aged 18-30, which is high for a diabetes screening study. Research from other regions, such as the U.S. and Europe, shows similar trends, with a greater proportion of diabetes screenings occurring among middle-aged and older individuals. This pattern reflects the increased risk of diabetes associated with age. For instance, a study by Gerstein et al. [18] in the United States reported that the prevalence of Type 2 diabetes rises significantly after the age of 45, which is consistent with the findings of this study. Similarly, a study by Moller et al. [19] in Europe highlighted that diabetes screenings are more frequently targeted at individuals aged 45 and older, due to the elevated risk of both prediabetes and diabetes in these age groups. Overall, both studies emphasize that diabetes screenings are more common in middle-aged and elderly populations because of their higher susceptibility to the disease.

The current study found that about one-third of participants in primary health care centers had diabetes mellitus (DM), with type II diabetes mellitus accounting for the majority of cases and type I diabetes mellitus (T1DM) accounting for a smaller percentage. These results are consistent with a larger regional and global trend in which T2DM is significantly more prevalent than T1DM, primarily as a result of lifestyle factors like dietary habits, physical inactivity, and rising obesity rates, particularly in urban areas. A national survey conducted in Saudi Arabia found that the overall prevalence of diabetes was approximately 28.8%, with T2DM as the predominant form consistent with the current study findings [20]. A more recent nationwide survey, the Saudi Diabetes Survey in 2019, assessed the prevalence of Type 2 diabetes (T2D) among adults in Saudi Arabia to be nearly 25.5% [21]. The survey revealed that approximately 30% of individuals with diabetes are undiagnosed, highlighting the crucial need for regular screening and early detection. This high rate of undiagnosed cases indicates that many people with diabetes may not be receiving adequate care, which increases their risk of complications such as cardiovascular disease, kidney failure, and neuropathy. A study conducted by Al-Daghri et al. [22] highlighted the significant burden of diabetes in Saudi Arabia, revealing that approximately 30% of the adult population suffers from prediabetes. The authors emphasized that prediabetes is a major risk factor for the progression to Type 2 diabetes, making early screening and intervention essential for preventing the full onset of the disease.

Saudi Arabia has one of the highest rates of diabetes worldwide when comparing its prevalence to that of other regions. The International Diabetes Federation (IDF) Global Diabetes Atlas (2021) states that the prevalence of diabetes in adults worldwide is approximately 9.3%, whereas rates are much higher in the Middle East and North Africa (MENA) region, which includes Saudi Arabia [23]. The prevalence is almost twice as high in Saudi Arabia as it is worldwide, which puts a significant burden on the healthcare system. Research conducted in the U.S. and Europe indicates a rising trend of diabetes prevalence with increasing age, particularly among individuals aged 45 and older, as highlighted in studies by Gerstein et al. [24] and Moller et al. [19]. In the USA, it was reported that diabetes prevalence among adults is around 10.5%, with T2DM constituting the majority [25].

The prevalence of Type 1 Diabetes Mellitus (T1DM) among adults in this study is 2.3%, which aligns with international statistics indicating that T1DM typically accounts for 5-10% of all diabetes cases [26]. Unlike Type 2 Diabetes, T1DM is less affected by lifestyle factors; it is primarily caused by the autoimmune destruction of pancreatic beta cells. Regional and global studies show that while the overall prevalence of T1DM is nearly stable, it is increasing among younger age groups in high-income countries. This trend highlights the importance of ongoing monitoring and the implementation of prevention strategies for that type which starts early in life, with more burden on diagnosed patients [27].

Regarding the risk factors, this study highlights several significant factors associated with a confirmed diagnosis of diabetes. Age, gender, obesity, hypertension, and dyslipidemia all emerged as significant predictors of diabetes diagnosis. The likelihood of being diagnosed with diabetes increased with age, particularly among individuals aged 51-60 years and those over 60 years, reflecting findings from previous studies such as those by Gerstein et al. [28], which show that diabetes risk escalates with age. Additionally, males were found to have higher odds of diabetes diagnosis compared to females, a gender difference also reported in other studies like that of Al-Daghri et al. [22], suggesting that men may be at greater risk due to factors like abdominal fat distribution and lifestyle behaviors. Obesity was the strongest predictor, with obese individuals being 6.5 times more likely to be diagnosed with diabetes, which is consistent with many previous studies [29-31]. Hypertension and dyslipidemia were also strongly

associated with diabetes which is consistent with findings from the National Health and Nutrition Examination Survey (NHANES) and many other studies [32-35]. These findings underscore the importance of early screening for individuals with these risk factors, particularly in regions like Saudi Arabia, where the burden of diabetes is rapidly increasing.

Conclusions and Recommendations

This study reveals a high prevalence of diabetes, particularly type 2 diabetes mellitus (T2DM), among middle-aged and elderly populations in Saudi Arabia, with roughly one-third of participants diagnosed. These were in line with global trends, as diabetes screenings are more common in older adults due to increased risk. Many cases remain undiagnosed, risking serious complications like cardiovascular disease and kidney failure. The main risk factors, including age, obesity, and hypertension, further highlight the vulnerability of this population. Given the high diabetes rates in Saudi Arabia compared to global averages, there is a significant burden on the healthcare system, necessitating enhanced preventive efforts. So, regular nationwide diabetes screening programs targeting middle-aged and elderly populations, especially those with identified risk factors, should be prioritized to improve early detection and management. Also, the conducting of periodic public health campaigns focused on educating individuals about diabetes risk factors and promoting lifestyle changes that can prevent or delay the onset of T2DM, such as healthy eating, regular physical activity, and weight management.

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