

Diabetes Outcomes in Saudi Arabia: A Nationwide Assessment of Glycemic Control and Complications in Primary Health Centers

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Abstract

Background: Diabetes mellitus poses a significant public health challenge in Saudi Arabia, with rising prevalence and complications burden. Primary health-care centers (PHCs) serve as frontline providers, yet data on diabetes outcomes in these settings remains limited.

Objective: This study aimed to evaluate glycemic control status, complication patterns, and predictors of poor outcomes among diabetic patients attending PHCs in Saudi Arabia.

Methods: A cross-sectional study was conducted among 312 diabetic patients (T1DM=22; T2DM=290) across Saudi PHCs. Data on demographic characteristics, glycemic control (HbA1c <7% as controlled), and complications (dyslipidemia, retinopathy, neuropathy, etc.) were collected through medical records and clinical assessments. Logistic regression identified predictors of complications.

Results: The study found that only 30.4% of patients achieved adequate glycemic control, with no significant difference between those with type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM) (27.3% vs. 30.7%, $p=0.737$). Dyslipidemia emerged as the most prevalent complication, affecting 42.3% of the overall cohort, and was significantly more common among T2DM patients compared to those with T1DM (45.2% vs. 4.5%, $p=0.001$). Retinopathy was observed in 13.4% of T2DM patients, while no cases were reported among those with T1DM ($p=0.049$). Furthermore, obesity (OR=4.74), hypertension (OR=5.21), and poor glycemic control (OR=4.35) were found to be strong predictors of diabetes-related complications, all with statistically significant associations ($p=0.001$). **Conclusion:** The study reveals alarmingly poor glycemic control and high complication rates in Saudi PHCs, driven by modifiable risk factors. Urgent interventions targeting obesity, hypertension, and glucose management are needed to improve diabetes outcomes.

Keywords

Diabetes mellitus, complications, glycemic control, primary healthcare, Saudi Arabia

Introduction

Diabetes mellitus has become one of the most pressing public health challenges of the 21st century, with its global prevalence rising to epidemic levels [1]. The disease featured by chronic hyperglycemia resulting from defects in insulin secretion, action, or both, leads to serious damage to multiple organ systems over time [2]. The World Health Organization estimates that diabetes directly caused 1.5 million deaths worldwide in 2019, with the Eastern Mediterranean region experiencing particularly rapid increases in disease burden [3, 4]. Saudi Arabia has been disproportionately affected, with age-adjusted prevalence rates among adults reaching 18.3%, nearly double the global average, according to recent International Diabetes Federation reports [5]. This metabolic disorder exists in two primary forms: type 1 diabetes (T1DM), an autoimmune condition typically diagnosed in childhood, and type 2 diabetes (T2DM), which accounts for 90-95% of cases and is strongly associated with obesity and lifestyle factors [6].

The progressive nature of diabetes frequently leads to devastating complications that significantly reduce quality of life and increase mortality. Chronic hyperglycemia triggers pathological changes in both microvascular and macrovascular systems, resulting in retinopathy, nephropathy, neuropathy, and accelerated cardiovascular disease [7]. Microvascular complications particularly affect the eyes, kidneys, and nerves, with diabetic retinopathy the leading cause of blindness in working-age adults globally [8]. Macrovascular complications manifest as atherosclerotic changes, increasing risks of coronary artery disease, stroke, and peripheral vascular disease by two- to four-fold [9]. Alarming, recent Saudi national data indicates that approximately 40-50% of diabetic patients already show evidence of complications at diagnosis, highlighting the need for earlier detection and intervention [10]. Within the Saudi healthcare system, primary health care centers (PHCs) serve as the first line of defense against diabetes and its complications. This study aims to broadly evaluate diabetes-related outcomes among patients attending primary healthcare centers (PHCs) in Saudi Arabia.

Methodology

A cross-sectional study was conducted to assess diabetes-related outcomes and associated factors among diabetic patients attending primary health care centers in Saudi Arabia. The study included adult patients aged 18 years and above with a confirmed diagnosis of type 1 or type 2 diabetes mellitus who were attending scheduled follow-up visits. Patients with gestational diabetes or incomplete medical records were excluded. A total of 312 patients were recruited using a consecutive sampling technique. Data collection was performed through structured interviews and a review of patients' medical records. Information was gathered on sociodemographic characteristics, clinical factors (type of diabetes mellitus, presence of hypertension, obesity status, and type of visit), diabetes-related complications (including dyslipidemia, peripheral neuropathy, retinopathy, proteinuria, diabetic foot, and other complications), and blood glucose control status. Blood glucose control status was determined based on the latest available HbA1c results. The primary outcomes assessed were the presence of diabetes-related complications, while secondary outcomes included blood glucose control status and referral status to specialized care. Ethical approval for the study was obtained and written informed consent was secured from all participants. Confidentiality and anonymity were maintained throughout the study period.

Data analysis

The data were collected, reviewed, and then fed into Statistical Package for Social Sciences version 26 (Released 2019, Armonk, NY: IBM Corp). Descriptive statistics were used to summarize the demographic and clinical characteristics of the participants. For categorical variables, Pearson's chi-square (χ^2) test was used to assess differences in proportions between groups, with exact probability tests applied when necessary. For continuous variables, such as age, comparisons between groups were made using independent t-tests, with the significance level set at $p < 0.05$. To identify potential predictors of complications among diabetic patients, logistic regression analysis was conducted. This model included factors such as age, gender, type of diabetes, obesity, hypertension, and glycemic control. The odds ratios (ORs) and 95% confidence intervals (CIs) were calculated to estimate the strength and direction of associations, and statistical significance was determined based on p-values less than 0.05. All statistical analyses were performed using statistical software, and results were considered statistically significant if $p < 0.05$.

Results

Among the total study population of 312 diabetic patients, the majority were diagnosed with type 2 diabetes mellitus (T2DM) (n = 290, 93.0%), while only a small proportion had type 1 diabetes mellitus (T1DM) (n = 22, 7.1%). Age distribution showed a statistically significant difference between the two groups (p = .001). Most T1DM patients (86.4%) were between 18–30 years, while T2DM patients were predominantly older, with 35.2% aged 51–60 years and 43.1% above 60 years. The mean age for T1DM patients was 24.4 ± 4.7 years compared to 58.7 ± 11.8 years for T2DM. Regarding gender, males represented a slightly higher proportion overall (55.1%), with similar distributions in both T1DM (50.0%) and T2DM (55.5%) groups (p = .616). Obesity was reported in 44.2% of participants, affecting 36.4% of those with T1DM and 44.8% with T2DM, with no significant difference (p = .441). Hypertension (HTN) showed a statistically significant association with diabetes type (p = .002), being more prevalent in the T2DM group (37.2%) and rare among T1DM patients (4.5%). All patients (100%) were attending follow-up visits at the time of data collection.

Table 1. Sociodemographic and Clinical Characteristics of Diabetic Patients by Type of Diabetes Mellitus (N=312)

Data	Total (N=312)		Type of DM				p-value
			T1DM (N=22)		T2DM (N=290)		
	No	%	No	%	No	%	
Age in years							
18-30	19	6.1%	19	86.4%	0	0.0%	.001*^
31-40	20	6.4%	3	13.6%	17	5.9%	
41-50	46	14.7%	0	0.0%	46	15.9%	
51-60	102	32.7%	0	0.0%	102	35.2%	
> 60	125	40.1%	0	0.0%	125	43.1%	
Mean ± SD	56.2 ± 14.5		24.4 ± 4.7		58.7 ± 11.8		
Gender							
Male	172	55.1%	11	50.0%	161	55.5%	.616
Female	140	44.9%	11	50.0%	129	44.5%	
Obesity							
Yes	138	44.2%	8	36.4%	130	44.8%	.441
No	174	55.8%	14	63.6%	160	55.2%	
HTN							
Yes	109	34.9%	1	4.5%	108	37.2%	.002*
No	203	65.1%	21	95.5%	182	62.8%	
Type of Visit							
Follow up	312	100.0%	22	100.0%	290	100.0%	-

P: Pearson X2 test

^: Exact probability test

* P < 0.05 (significant)

Figure 1 illustrates blood glucose control status between patients with type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). Overall, 30.4% (n = 95) of the total 312 patients had controlled blood glucose levels, while 69.6% (n = 217) had uncontrolled levels. Among T1DM patients, only 27.3% (n = 6) had controlled glucose levels compared to 30.7% (n = 89) in the T2DM group. The majority of both T1DM (72.7%, n = 16) and T2DM (69.3%, n = 201) patients had uncontrolled blood glucose (P=.737).

Figure 1. Blood Glucose Control Status by Type of Diabetes Mellitus among Study Patients (N=312)

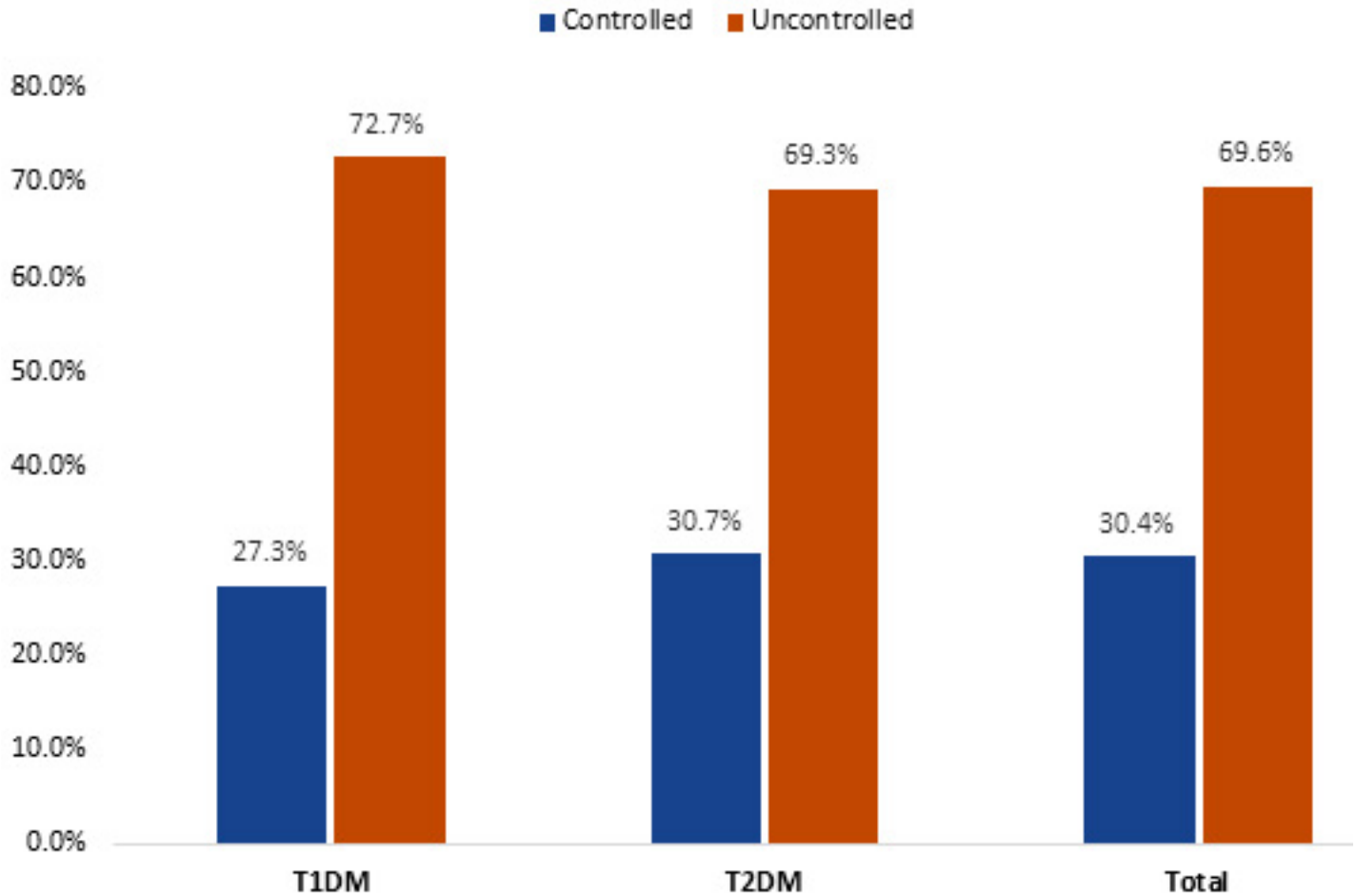


Table 2 presents diabetes-related outcomes among patients with type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM). Overall, dyslipidemia was the most common complication, observed in 42.3% of patients, and was significantly more prevalent in the T2DM group (45.2%) compared to only 4.5% in the T1DM group ($p = .001$). Retinopathy was also significantly associated with T2DM (13.4%) and was absent among T1DM patients ($p = .049$). Other complications such as peripheral neuropathy (15.7%), proteinuria (9.9%), diabetic foot (17.0%), and other unspecified complications (1.3%) showed no statistically significant differences between the two groups. Notably, proteinuria appeared more frequently in T1DM patients (18.2%) than in T2DM (9.3%), though this difference did not reach statistical significance ($p = .180$). These findings highlight the higher burden of certain complications, particularly dyslipidemia and retinopathy, among patients with T2DM.

Table 2. Diabetes-Related Outcomes by Type of Diabetes Mellitus among Study Patients (N=312)

Complications	Total (N=312)		Type of DM				p-value
			T1DM (N=22)		T2DM (N=290)		
	No	%	No	%	No	%	
Dyslipidemia	132	42.3%	1	4.5%	131	45.2%	.001*
Peripheral Neuropathy	49	15.7%	2	9.1%	47	16.2%	.376^
Retinopathy	39	12.5%	0	0.0%	39	13.4%	.049*^
Proteinuria	31	9.9%	4	18.2%	27	9.3%	.180
Diabetic Foot	53	17.0%	2	9.1%	51	17.6%	.306
Other complications	4	1.3%	0	0.0%	4	1.4%	.579^

P: Pearson X2 test

^: Exact probability test

* $P < 0.05$ (significant)

Figure 2 shows the referral status of patients based on the type of diabetes mellitus. Among the total sample, the vast majority (98.7%, $n = 308$) were not referred to secondary or tertiary care centers, while only 1.3% ($n = 4$) of patients were referred. All patients with type 1 diabetes mellitus (T1DM) (100%, $n = 22$) were managed without referral, whereas a small proportion of type 2 diabetes mellitus (T2DM) patients (1.4%, $n = 4$) required referral.

Figure 2. Referral Status of Diabetic Patients by Type of Diabetes Mellitus (N=312)

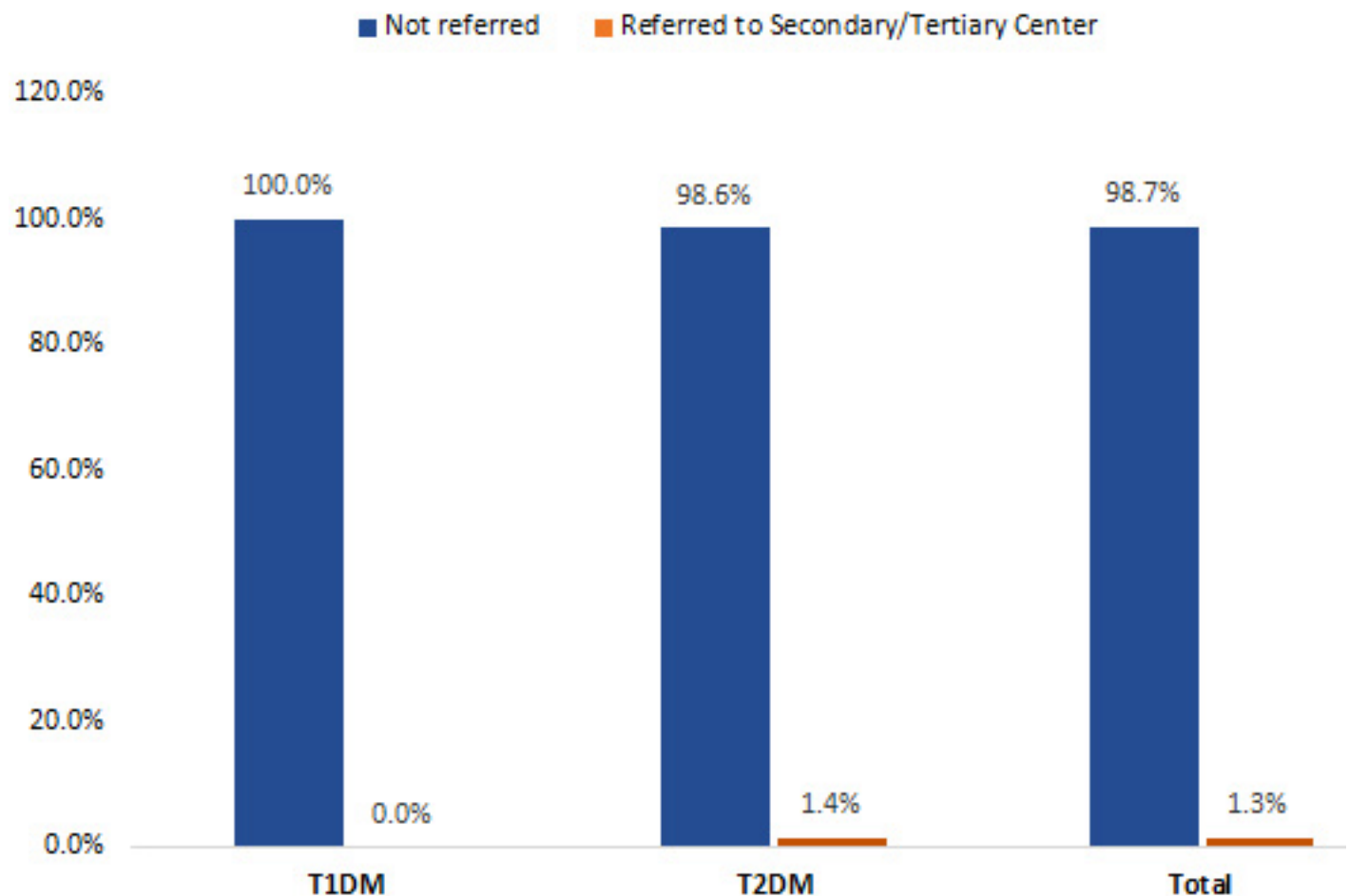


Table 3 outlines the results of the logistic regression analysis for predictors of complications among diabetic patients. Several factors were found to significantly predict complications. Obesity, hypertension (HTN), and uncontrolled diabetes mellitus (DM) all had strong associations with an increased likelihood of complications. Obesity [ORA = 4.74, $p = .001$], HTN (ORA = 5.21, $p = .001$), and uncontrolled DM (ORA = 4.35, $p = .001$) were identified as significant predictors, with ORAs indicating a substantially higher risk of complications in these groups. Age, gender, and type of diabetes (T1DM vs. T2DM) were not statistically significant.

Table 3. Logistic regression analysis for predictors of complications among diabetic patients

Factors	Sig.	OR _A	95% CI	
			Lower	Upper
Age in years	.973	1.10	.74	1.99
Male gender	.239	1.38	.81	2.34
Type II DM	.181	2.45	.66	9.15
Obesity	.001*	4.74	2.55	8.81
HTN	.001*	5.21	2.75	9.89
Uncontrolled DM	.001*	4.35	2.21	8.55

ORA: Adjusted odds ratio

CI: Confidence interval

* $P < 0.05$ (significant)

Discussion

The study assessed diabetes-related outcomes and complications among patients at PHCs in Saudi Arabia. The clear age difference between T1DM and T2DM patients supports established evidence regarding their distinct etiologies, T1DM typically appearing in younger individuals due to its autoimmune origin, while T2DM is more prevalent in older adults. Also, gender distribution showed no significant differences, separating from some regional studies that report a higher prevalence of T2DM among Saudi males [11]. However, this matches the global trends suggesting a narrowing gender gap in diabetes prevalence as lifestyle risk factors become more evenly distributed between sexes [12]. The similar obesity rates across T1DM and T2DM groups challenge traditional associations of obesity with T2DM alone and may reflect increasing obesity levels in Saudi Arabia, even among the youth, which is a growing concern [13, 14]. Likewise, the strong correlation between hypertension and T2DM in this study is consistent with existing literature highlighting the main role of metabolic syndrome in T2DM progression [15, 16]. On the other hand, the low prevalence of hypertension in T1DM patients may be attributed to the younger age group's relatively better cardiovascular profiles, though this may change with time, warranting ongoing monitoring. The universal adherence to follow-up visits in our cohort is notable and differs from the lower retention rates reported in other settings [17]. This could reflect improved patient engagement in Saudi PHCs, possibly driven by the Saudi Vision 2030 health initiatives that emphasize enhanced chronic disease care and patient-centered primary health services [18].

Regarding diabetes control, our study reveals considerable challenges in achieving glycemic control among diabetic patients in Saudi PHCs, with most cases showing uncontrolled blood glucose levels and no significant difference observed between T1DM and T2DM patients. This reflects previous Saudi findings, such as Al-Rubeaan's (2015) national survey showing only 30% of patients reaching HbA1c targets [19]. Interestingly, the similar rates of poor control between T1DM and T2DM differ from international studies like Foster et al. (2019), which reported worse control in T1DM due to insulin management complexities [20], but align with regional data from Alqurashi et al. (2011) [21]. Several factors may explain these patterns. Challenges within the Saudi healthcare system, such as fragmented services and insufficient patient education, have been documented by Alotaibi et al. (2017) [14]. Additionally, cultural and lifestyle factors, including high-calorie diets and sedentary behavior, remain significant contributors according to the IDF Diabetes Atlas (2021) [22]. The lack of difference in control rates across diabetes types suggests the need for both universal and tailored interventions. For T1DM patients, enhancing insulin management and improving carbohydrate-counting skills is critical, as highlighted by Alaqeel et al. (2019) [23]. For T2DM patients, strengthening medication adherence and lifestyle interventions is vital, consistent with American Diabetes Association (2023) recommendations [24].

Also, our study reveals critical patterns in diabetes-related complications among patients attending primary healthcare centers in Saudi Arabia, with notable differences between T1DM and T2DM populations. The significantly higher prevalence of dyslipidemia in T2DM patients is similar to the metabolic profile of type 2 diabetes and reflects findings from the SAUDI-DM study, which identified dyslipidemia as the most common comorbidity in Saudi diabetic patients [19]. This strong association indicates the importance of regular lipid monitoring and management in T2DM care protocols within primary health settings. The complete absence of retinopathy in our T1DM cohort contrasted with its significant presence in T2DM patients may reflect differences in disease duration and glycemic control patterns between the groups, consistent with observations by Al Hayek et al. in Saudi populations [25]. The relatively high prevalence of peripheral neuropathy and diabetic foot complications across both diabetes types, without significant intergroup differences, suggests these outcomes may be more related to long-term glycemic control than to diabetes etiology itself. This finding supports the American Diabetes Association's emphasis on comprehensive foot care for all diabetic patients regardless of type [24]. The trend toward higher proteinuria in T1DM patients, though not statistically significant, warrants attention as it may indicate early renal involvement in younger patients, a pattern noted in some regional studies [26] but requiring further investigation.

The logistic regression analysis indicates that modifiable risk factors, specifically obesity, hypertension, and uncontrolled diabetes, are the strongest predictors of complications among diabetic patients. These findings highlight that metabolic and comorbid conditions have a greater impact on complication risk than demographic factors like age or diabetes type, aligning with the International Diabetes Federation's focus on managing cardiovascular risk factors but differing from studies that identified age as a predictor [24, 27].

Conclusions and Recommendations

In conclusion, the current study showed significant challenges in diabetes management and complications among patients in Saudi primary healthcare centers. The high prevalence of uncontrolled blood glucose and frequent diabetes-related complications, particularly dyslipidemia and retinopathy in T2DM patients, underlines gaps in current care approaches. The strong association between modifiable risk factors (obesity, hypertension, and poor glycemic control) and complications emphasizes the need for targeted interventions. Key recommendations include: (1) implementing regular complication screening protocols in PHCs, especially for retinopathy and dyslipidemia; (2) developing intensive lifestyle and medication programs targeting obesity and hypertension; (3) enhancing diabetes education to improve glycemic control; and (4) establishing standardized monitoring systems for high-risk patients. These measures should be integrated into Saudi Arabia's primary care diabetes programs to reduce complications and improve long-term outcomes.

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