ORIGINAL RESEARCH



The prevalence of erectile dysfunction and its associated factors among diabetic patients in the Southwestern Region of Saudi Arabia analytical cross-sectional study

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Abstract

Background: Erectile dysfunction (ED) is a common condition among diabetic patients, significantly affecting their quality of life. This study examines the prevalence of ED and the factors contributing to its occurrence among diabetic patients in the southwestern region of Saudi Arabia. Methods: This analytical cross-sectional study was conducted in randomly selected Primary Healthcare Centers (PHCCs) across the Asir region. The sample included 398 married male Saudi nationals aged 18 years and older, diagnosed with diabetes and attending PHCCs. Data collection involved a standardized questionnaire that included the International Index of Erectile Function (IIEF-5) to measure ED severity and explore related factors. Statistical analysis was performed using SPSS v22, with descriptive statistics including Chi-square tests, independent ttests, analysis of variance (ANOVA) and multiple regression. Results: Most participants were aged 41-60 years (51.5%), with 55.5% having completed high school or bachelor's education and 67.8% earning an income of $\leq 10,000$ SR. Most participants (82.9%) have Type 2 diabetes and 21.9% reported smoking. Clinical findings revealed a mean body mass index (BMI) of 28.53, glycemic control was poor, with only 29.1% achieving controlled hemoglobin A1C (HbA1C), while 18.3% had severely uncontrolled levels. In terms of ED severity, mild to moderate dysfunction was most common (29.6%), followed by mild dysfunction (25.1%) and moderate dysfunction (20.4%). Severe dysfunction affected 13.1%, while 11.8% reported no dysfunction. Significant correlations were observed between ED severity and factors such as age, education level, income, duration of diabetes and HbA1C levels (p < 0.05). Smoking status was also significantly associated with ED severity (p = 0.0116), while BMI showed no significant correlation (p= 0.791). Conclusions: Erectile dysfunction is prevalent among diabetic patients in the Asir region, with its severity influenced by demographic and clinical factors. Younger age, higher education, and better glycemic control were associated with reduced ED severity.

Keywords

Erectile dysfunction; Diabetes; Prevalence; Predictors; Saudi Arabia; Glycemic control

1. Introduction

Erectile dysfunction is one of the world's most prevalent health issues, and it affects men with chronic diseases even more [1]. Among all these conditions, diabetes mellitus stands out as one of the most common diseases with a strong correlation to erectile dysfunction [2]. The consistent inability to attain or sustain a satisfactory erection for sexual intercourse, known as impotence, affects millions of men but often goes undiagnosed due to the psychosocial aspects of sexual dysfunction. Despite the widespread perception of ED as a sexual problem, studies reveal that it is a systemic issue, particularly among males with diabetes [3]. Diabetes is a well-established risk factor for ED, and the link between them has been extensively researched in attempts to determine the various factors of different populations affected by diabetes. This is especially true given the rising incidence of diabetes, particularly in the southwestern part of Saudi Arabia, and the cultural taboos that surround discussions about sexual health [4].

Diabetes mellitus is a global metabolic illness that causes chronic hyperglycemia in the body due to insulin resistance or a lack of insulin production [5]. The two main categories include Type 1 and Type 2 diabetes; both conditions implicate different mechanisms affecting the body's usual erectile systems, which are vascular, neuronal and hormonal [5]. Nonetheless, diabetes is in the process of becoming a significant public health issue in Saudi Arabia especially in the southwest, due partly to changes in diet, encroaching urbanization and other genetic factors [6, 7]. Mechanisms underlying erectile dysfunction in diabetic patients in this region align with current global trends; local factors like poor diet, insufficient exercise, and high obesity rates could potentially exacerbate the condition. These factors only compound the existing challenge of managing erectile dysfunction in this group of people [8].

Current literature shows that erectile dysfunction is more common in diabetic males than in non-diabetic males and this trend is also evident in Saudi Arabia [9]. A number of studies from various regions of the country indicate that 35– 75% of diabetic men are likely to experience some cases of erectile dysfunction, exceeding the global statistic of 20–80% among diabetic males [10]. The development of ED in diabetes patients occurs at a significantly earlier age than in patients without diabetes, sometimes even 10 years earlier [11]. This region's culture, genetics, and lifestyle may contribute to diabetic patients' increased susceptibility to erectile dysfunction.

The following factors contribute to a higher prevalence of erectile dysfunction among diabetic patients in Saudi Arabia's southwestern region: These parameters include prolonged diabetes, a poor glycemic control status, and diabetic complications such as diabetic neuropathy, cardiovascular disease and obesity, to name but a few [12]. Besides these physiological factors, other psychological problems like low self-esteem, depression, and anxiety that prevail in many patients with chronic diseases act as catalysts for the problem. Social beliefs about sexuality might also dissuade many men from seeking treatment, which could contribute to the underdiagnosis of ED and appropriate treatment in the region [13].

This study addresses the rising incidence of erectile dysfunction (ED) among diabetic men in southwestern Saudi Arabia, a region with unique cultural, genetic and lifestyle factors. The region's growing diabetes rates are linked to dietary changes, urbanization and genetics. Despite the significance, there is limited research on diabetes-related ED in this area. The study aims to fill this gap by exploring how factors like culture, healthcare access and health-seeking behavior contribute to ED. It will provide valuable data to guide public health strategies, improve awareness and promote better diabetes and ED management. The study emphasizes the importance of lifestyle changes and integrating sexual health screening into diabetes care for improved patient outcomes.

2. Methodology

2.1 Study design

The design used in this study was analytical cross-sectional because it aimed at determining the prevalence of ED and associated factors among diabetic patients in the southwestern region of Saudi Arabia. The cross-sectional design was suitable for estimating the proportion of participants experiencing ED at a given moment. It enabled an investigation of potential relationships between diabetes and levels of erectile dysfunction in the target sample.

2.2 Study setting

The study was carried out in randomly selected Primary Healthcare Centers in the southwestern region of Saudi Arabia known as Asir region. The region was divided into five parts: north, south, east, west, and central Primary Healthcare Centers were selected from each of the five regions. This geographic segmentation made it possible to take a sample that was in some way a representation of the overall population of the region.

2.3 Study duration and recruitment process

The study ran from 08 June 2024 to 09 September 2024. Recruitment began at the start of the study and continued throughout the duration. Participants were contacted through online ads and healthcare partnerships, with follow-ups to ensure timely enrollment. Data collection concluded by 09 September 2024.

2.4 Study population

2.4.1 Inclusion criteria

- 1. Diabetic patients (both Type 1 and Type 2 diabetes).
- 2. Saudi nationals.
- 3. Married men.

4. Male patients aged 18 years and above who were attending chronic disease clinics.

2.4.2 Exclusion criteria

1. Patients with organic disorders affecting sexual function, such as penile abnormalities or primary vascular conditions.

2. Patients with chronic renal failure, due to its independent association with ED.

3. Illiterate patients, as they may not have been able to complete self-reported assessments reliably.

2.5 Sample size calculation

The required sample size for the study was calculated using several key assumptions. These include the variation in the prevalence of erectile dysfunction among Saudi diabetic populations, as reported in previous studies. Additionally, an effect size of 0.5 was considered, with a statistical power of 95% and an alpha error margin set at 0.05. These parameters were used to ensure that the sample size would be sufficient to detect significant results with a high degree of confidence. This calculation resulted in a required sample size of 398 participants. This number ensured sufficient power to detect statistically significant associations between diabetes and erectile dysfunction.

2.6 Sampling technique

A multistage sampling method was used to ensure a representative sample from the study population. The following steps were as follows: 1. The Asir region was divided into five geographic clusters: north, south, east, west and center.

2. An equal number of PHCCs were randomly selected from each cluster.

3. In each selected PHCC, diabetic patients attending chronic disease clinics were systematically sampled. A systematic random sampling technique was employed, where every third patient who met the inclusion criteria was selected for the study.

4. Data collection took place through a standardized, interviewer-administered questionnaire or self-administered using a custom barcode provided to patients.

2.7 Data collection tools

Data were collected using a validated questionnaire designed to assess erectile dysfunction levels and related factors. The International Index of Erectile Function (IIEF-5) questionnaire was used to determine the severity of ED. The questionnaire also gathered information on demographic factors (age, duration of marriage, education), medical history (diabetes duration, glycemic control, medication use) and lifestyle factors (smoking, physical activity, obesity).

2.8 Data management

All collected data were:

1. Checked for completeness and accuracy at the point of data entry.

2. Stored securely in a password-protected personal computer.

3. Edited and coded prior to entry into the statistical software to ensure quality and consistency.

2.9 Statistical analysis

Data were analyzed using SPSS for IBM version22 (IBM Corp., Armonk, NY, USA). Statistical analysis will involve the use of several tests to examine the relationships between erectile dysfunction (ED) severity and various demographic, clinical and behavioral factors. Descriptive statistics will be used to summarize the distribution of categorical variables (such as age, education level, income, diabetes type and HbA1C) and continuous variables (such as BMI, weight and HbA1C). Chisquare tests will be applied to explore associations between categorical variables and ED severity. Independent samples t-tests will compare mean ED scores between two groups (e.g., diabetes type and smoking status). At the same time, one-way ANOVA will assess differences in ED scores across multiple groups (e.g., age groups, education levels and income brackets). Finally, multiple linear regression will be conducted to identify significant predictors of ED severity among the participants.

3. Results

3.1 Demographics

Table 1 shows that the majority of participants are aged between 41–60 years (51.5%), followed by those aged 61–80 years (34.7%). In terms of education, most have either a Bachelor's degree (28.1%) or a high school diploma (27.4%), with fewer having elementary or postgraduate education. Regarding income, a significant portion of participants earn 5000 SR or less (33.9%) or between 5001–10,000 SR (33.9%), while fewer earn higher incomes. The data highlights that the participants are predominantly middle-aged, with a relatively even distribution of educational backgrounds and a tendency toward lower income levels.

Variable	Frequency (F)	Percentage (%)
Age Group		
21–40 yr	46	11.6
41–60 yr	205	51.5
61–80 yr	138	34.7
More Than 80 yr	9	2.3
Education		
Elementary School	93	23.4
Middle School	60	15.1
High School	109	27.4
Bachelor Degree	112	28.1
Postgraduate	24	6.0
Income		
5000 SR or less	135	33.9
From 5001-10,000 SR	135	33.9
From 10,001-20,000 SR	93	23.4
More than 20,000 SR	35	8.8

3.2 Diabetes characteristics

In Table 2, majority of participants (82.9%, F = 330) have Type 2 diabetes, while a smaller portion (17.1%, F = 68) are diagnosed with Type 1 diabetes. In terms of the duration of diabetes, most have been living with the condition for 1–9 years (50.5%, F = 201), followed by those with 10–19 years (29.9%, F = 119) and 20–29 years (17.3%, F = 69). A minority have had diabetes for 30–39 years (1.8%, F = 7) or 40–49 years (0.5%, F = 2). Regarding smoking habits, 78.1% (F = 311) of participants do not smoke, while 21.9% (F = 87) are smokers.

TABLE 2. Diabetes charac	cteristics.
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Variable	Frequency (F)	Percentage (%)
Type of Diabetes		
Type 1	68	17.1
Type 2	330	82.9
Duration of Diabe	tes	
1 yr–9 yr	201	50.5
10 yr–19 yr	119	29.9
20 yr–29 yr	69	17.3
30 yr–39 yr	7	1.8
40 yr–49 yr	2	0.5
Smoking		
No	311	78.1
Yes	87	21.9

3.3 Clinical characteristics

Table 3 shows that participants' weight ranged from 53.00 kg to 150.00 kg (mean 80.65 kg), and height varied between 149.00 cm and 190.00 cm (mean 168.16 cm). The BMI averaged 28.53, ranging from 17.60 to 49.50.

The study analyzed BMI and HbA1C levels among participants as shown in Table 4. Regarding BMI, 0.5% were underweight (BMI <18.5), 22.9% had normal weight (BMI 18.5–24.9), 41.2% were overweight (BMI \geq 25.0) and 35.4% were classified as obese (BMI \geq 30.0). For HbA1C levels, 29.1% had controlled HbA1C, 52.5% were mild to moderately uncontrolled (HbA1C 7–9) and 18.3% were severely uncontrolled (HbA1C \geq 9).

3.4 Questionnaire response

Table 5 explained the participants' confidence in getting and maintaining an erection, with the largest group (38.4%) indicating moderate confidence. Smaller proportions reported very low (21.9%), low (17.6%), high (16.1%) and very high (6.0%) confidence. Regarding erections hard enough for penetration, 25.6% said it occurred sometimes, 22.9% reported a few times and 21.4% stated most times. Maintaining an erection happened sometimes for 29.4%, a few times for 25.4% and most times for 17.8%. Difficulty maintaining an erection to complete intercourse was slightly difficult for 23.1% of participants, and sexual satisfaction occurred sometimes for 24.6%, with 22.1% reporting satisfaction a few times.

3.5 Erectile dysfunction score

In Table 6, Participants were assessed for erectile dysfunction severity, with the largest proportion (29.6%, F = 118) falling into the mild to moderate dysfunction category, followed by 25.1% (F = 100) who experienced mild dysfunction. A smaller group (20.4%, F = 81) had moderate dysfunction, while 13.1% (F = 52) were categorized as having severe dysfunction. Lastly, 11.8% (F = 47) showed no dysfunction. This distribution highlights that the majority of participants faced varying degrees of erectile dysfunction, with only a small portion experiencing no issues.

3.6 Comparison of mean erectile dysfunction score

In Table 7, the age group, education level, income, duration of diabetes, smoking status, and HbA1C levels showed statistically significant associations with ED (p = 0.001), indicating robust relationships. Age group and education level demonstrated significant variability, with younger age groups and higher education correlating with better outcomes. Income also significantly influenced health indicators, with higher in-

come groups showing improved metrics. The type of diabetes (p = 0.035) and HbA1C levels revealed significant associations, underlining their clinical importance. In contrast, BMI categories did not show a statistically significant association (p = 0.929), suggesting limited correlation in this sample.

3.7 Chi square test of significance

The analysis shown in Table 8 examined the associations between score groups (ranging from severe dysfunction to no dysfunction) and various demographic, clinical and lifestyle variables, focusing on significant *p*-values. Age group, education level, income, duration of diabetes and HbA1C levels all demonstrated statistically significant associations (p = 0.001), suggesting that these factors are strongly related to the degree of dysfunction. Younger age groups and higher education levels were associated with lower dysfunction scores, while longer diabetes duration correlated with increased dysfunction severity. Smoking status also showed a significant association (p = 0.0116), with smokers generally experiencing worse outcomes. BMI, however, did not show a statistically significant relationship with dysfunction scores (p = 0.791), indicating limited influence in this sample.

3.8 Multiple linear regression results

Table 9 explained that age has emerged as a critical factor, with a negative and significant association (p = 0.025), indicating that ED severity increases with age. BMI also showed a significant negative relationship (p = 0.008), reflecting its impact as a modifiable risk factor for ED, likely due to its association with metabolic and vascular health. HbA1c, another significant predictor (p = 0.021), underscores the role of glycemic control in influencing ED severity, with poorer control associated with worse outcomes. Other variables, including education, income, diabetes type and smoking status, were not statistically significant, suggesting limited direct influence in this model. Among all factors, age was the most substantial contributor, followed by BMI and HbA1c.

4. Discussion

The findings of this study provide important insights into the prevalence and associated factors of erectile dysfunction (ED) among diabetic men in the southwestern region of Saudi Arabia [14, 15]. The results are consistent with global trends, where diabetic patients show a significantly higher prevalence of ED compared to the general population [15]. However, it is important to place these findings within the context of other studies conducted in different regions, both locally and internationally, to better understand the broader implications and nuances of ED in diabetic populations.

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Variable	Minimum	Maximum	Mean	Std. Deviation
Weight	53.00	150.00	80.6508	14.66373
Height	149.00	190.00	168.1583	6.82805

TABLE 3. Clinical characteristics.

Std. Deviation: Standard deviation.

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Variable	F	%		
BMI				
BMI <18.5: underweight	2	0.5		
BMI 18.5-24.9: normal weight	91	22.9		
BMI \geq 25.0: overweight	164	41.2		
BMI \geq 30.0: Obesity	141	35.4		
HbA1C				
Controlled	116	29.1		
Mild to moderate uncontrolled 7–9	209	52.5		
Severely uncontrolled 9 and above	73	18.3		

TABLE 4. BMI and HBA1C levels.

F: Frequency; %: Percentage; BMI: Body Mass Index; HbA1C: Hemoglobin A1C.

	TABLE	5.	Ouestionnaire	response
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Question	Frequency	Percentage
How do you rate your confidence that you could get and	keep an erection?	
- Very low	87	21.9
- Low	70	17.6
- Moderate	153	38.4
- High	64	16.1
- Very high	24	6.0
When you had erections with sexual stimulation, how off	en were your erections hard eno	ugh for penetration?
- Almost never/never	65	16.3
- A few times (much less than half the time)	91	22.9
- Sometimes (about half the time)	102	25.6
- Most times (much more than half the time)	85	21.4
- Almost always/always	55	13.8
During sexual intercourse, how often were you able to m	aintain your erection after you h	ad penetrated (entered) your partner?
- Almost never/never	64	16.1
- A few times (much less than half the time)	101	25.4
- Sometimes (about half the time)	117	29.4
- Most times (much more than half the time)	71	17.8
- Almost always/always	45	11.3
During sexual intercourse, how difficult was it to maintai	n your erection to completion of	f intercourse?
- Extremely difficult	78	19.6
- Very difficult	66	16.6
- Difficult	80	20.1
- Slightly difficult	92	23.1
- Not difficult	82	20.6
When you attempted sexual intercourse, how often was it	t satisfactory for you?	
- Almost never/never	74	18.6
- A few times (much less than half the time)	88	22.1
- Sometimes (about half the time)	98	24.6
- Most times (much more than half the time)	78	19.6
- Almost always/always	60	15.1

TABLE 6. Erectile dysfunction score.

Score	Frequency	Percentage
Severe (5–7)	52	13.1
Moderate (8–11)	81	20.4
Mild to Moderate (12–16)	118	29.6
Mild (17–21)	100	25.1
No Dysfunction (22–25)	47	11.8

· ·	TABLE 7. Comparison	of mean crectile dysf	unction score.	
Variable	Frequency(F)	Mean	Std. Deviation	p Value
Age Group				
21–30 yr	6	21.0000	4.60435	
31–40 yr	40	17.9750	5.20595	
41–50 yr	82	17.3659	4.47631	
51–60 yr	123	14.9512	5.41984	0.001
61–70 yr	98	12.1429	4.56793	0.001
71–80 yr	40	8.9500	3.76182	
81–90 yr	8	9.3750	4.10357	
More Than 90 yr	1	9.0000		
Education				
Bachelor Degree	112	17.5268	5.21253	
Elementary School	93	10.7742	5.11207	
High School	109	14.7615	4.29879	0.001
Middle School	60	11.9500	4.95890	
Postgraduate	24	18.7083	4.70411	
Income				
5000 SR or less	135	12.0370	5.02888	
From 10,001-20,000 SR	93	17.0000	5.08621	0.001
From 5001-10,000 SR	135	13.8370	5.41447	0.001
More than 20,000 SR	35	19.0286	4.34190	
Type of Diabetes				
Type 1	68	13.5294	5.52463	0.025
Type 2	330	14.6061	5.62311	0.035
Duration of Diabetes				
1 yr–9 yr	201	16.5274	5.43144	
10 yr–19 yr	119	12.9496	4.94178	
20 yr–29 yr	69	11.1884	4.76283	0.001
30 yr–39 yr	7	12.5714	5.76938	
40 yr–49 yr	2	8.5000	4.94975	
Smoking				
No	311	14.2926	5.49732	0.001
Yes	87	14.8851	6.02403	0.001
HbA1C				
Controlled	116	16.0345	5.31762	
Mild to moderate uncon- trolled 7–9	209	14.4450	5.38499	0.001
Severely uncontrolled 9 and above	73	11.7945	5.80220	
BMI				
BMI <18.5: underweight	2	11.5000	9.19239	
BMI 18.5–24.9: normal	91	14.5495	6.02820	
weight				0.929
BMI \geq 25.0: overweight	164	14.3415	5.27808	
BMI \geq 30.0: obesity	141	14.4752	5.73035	

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BMI: Body Mass Index; HbA1C: Hemoglobin A1C; Std. Deviation: Standard deviation.

			Score Gro	oup		
	Severe (5–7)	Moderate (8–11)	Mild to Moderate (12–16)	Mild (17–21)	No Dysfunction (22–25)	<i>p</i> value
Age Group						
21–40 yr	2 (4.3%)	3 (6.5%)	10 (21.7%)	18 (39.1%)	13 (28.3%)	
41–60 yr	14 (6.8%)	33 (16.1%)	59 (28.8%)	67 (32.7%)	32 (15.6%)	0.001
61–80 yr	33 (23.9%)	43 (31.2%)	45 (32.6%)	15 (10.9%)	2 (1.4%)	0.001
More Than 80 yr	3 (33.3%)	2 (22.2%)	4 (44.4%)	0 (0.0%)	0 (0.0%)	
Education						
Elementary School	30 (57.7%)	26 (32.1%)	24 (20.3%)	10 (10.0%)	3 (6.4%)	
Middle School	11 (21.2%)	18 (22.2%)	20 (16.9%)	8 (8.0%)	3 (6.4%)	
High School	4 (7.7%)	24 (29.6%)	48 (40.7%)	25 (25.0%)	8 (17.0%)	0.001
Bachelor Degree	7 (13.5%)	10 (12.3%)	22 (18.6%)	46 (46.0%)	27 (57.4%)	
Postgraduate	0 (0.0%	3 (3.7%)	4 (3.4%)	11 (11.0%)	6 (12.8%)	
Income						
5000 SR or less	28 (20.7%)	35 (25.9%)	51 (37.8%)	15 (11.1%)	6 (4.4%)	
From 10,001–20,000 SR	5 (5.4%)	8 (8.6%)	29 (31.2%)	31 (33.3%)	20 (21.5%)	0.001
From 5001–10,000 SR	18 (13.3%)	36 (26.7%)	35 (25.9%)	35 (25.9%)	11 (8.1%)	0.001
More than 20,000 SR	1 (2.9%)	2 (5.7%)	3 (8.6%)	19 (54.3%)	10 (28.6%)	
Duration of Diabetes						
1 yr–9 yr	14 (7.0%)	29 (14.4%)	49 (24.4%)	68 (33.8%)	41 (20.4%)	
10 yr–19 yr	20 (16.8%)	26 (21.8%)	47 (39.5%)	22 (18.5%)	4 (3.4%)	
20 yr-29 yr	17 (24.6%)	22 (31.9%)	20 (29.0%)	9 (13.0%)	1 (1.4%)	0.001
30 yr-39 yr	0 (0.0%)	4 (57.1%)	1 (14.3%)	1 (14.3%)	1 (14.3%)	
40 yr-49 yr	1 (50.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	
Smoking Status						
No	42 (13.5%)	60 (19.3%)	99 (31.8%)	79 (25.4%)	31 (10.0%)	0.0116
Yes	10 (11.5%)	21 (24.1%)	19 (21.8%)	21 (24.1%)	16 (18.4%)	0.0110
BMI Group						
BMI <18.5: underweight	1 (1.9%)	0 (0.0%)	0 (0.0%)	1 (1.0%)	0 (0.0%)	
BMI 18.5–24.9: normal weight	12 (23.1%)	21 (25.9%)	22 (18.6%)	24 (24.0%)	12 (25.5%)	0.791
BMI \geq 25.0: overweight	19 (36.5%)	35 (43.2%)	51 (43.2%)	43 (43.0%)	16 (34.0%)	
BMI \geq 30.0: obesity	20 (38.5%)	25 (30.9%)	45 (38.1%)	32 (32.0%)	19 (40.4%)	
HbA1C						
Controlled	8 (15.4%)	16 (19.8%)	35 (29.7%)	39 (39.0%)	18 (38.3%)	
Mild to moderate uncon- trolled 7–9	23 (44.2%)	43 (53.1%)	69 (58.5%)	51 (51.0%)	23 (48.9%)	0.001
Severely uncontrolled 9 and above	21 (40.4%)	22 (27.2%)	14 (11.9%)	10 (10.0%)	6 (12.8%)	

TABLE 8. Chi square test of significance for erectile dysfunction.

BMI: Body Mass Index; HbA1C: Hemoglobin A1C.

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Variable	Coefficient	Standard Error	<i>t</i> -value	<i>p</i> -value	95% Confidence Interval (C.I)
Intercept	23.9468	1.959	12.226	0.007	[15.519, 32.374]
Age	-0.1799	0.029	-6.213	0.025	[-0.305, -0.055]
Education	0.0741	0.485	0.153	0.893	[-2.014, 2.163]
Income	-0.6214	0.736	-0.844	0.488	[-3.789, 2.546]
Diabetes Type	1.8943	2.374	0.798	0.509	[-8.322, 12.110]
Smoking Status	-1.0536	2.082	-0.506	0.663	[-10.014, 7.907]
BMI	-0.2150	0.065	-3.308	0.008	[-0.405, -0.025]
HbA1c	-1.4325	0.531	-2.698	0.021	[-2.567, -0.298]

TABLE 9. Multiple linear regression results.

The prevalence of erectile dysfunction in our study was notably high, with 88.2% of diabetic men reporting some degree of ED. This aligns with other studies conducted in China [16] and Saudi Arabia [17]. However, our study's prevalence is slightly higher than reported by a study conducted in Egypt among diabetic men [18]. This variation may be due to regional differences in diabetes management, healthcare access and cultural factors. In Western populations, such as in the United States and Europe, the prevalence of ED among diabetic men has been reported to range between 35% and 75%, lower than the figures reported in Saudi Arabia and other Middle Eastern countries [19]. These discrepancies could be attributed to variations in healthcare systems, lifestyle factors, and early interventions available in developed countries compared to the Middle East.

Our study demonstrated a strong association between age and ED severity (p = 0.001), with the highest prevalence observed in men aged 51-60 years. This finding is consistent with global literature, where older age is a well-established risk factor for ED due to age-related vascular changes, declining testosterone levels, and increased comorbidities such as cardiovascular disease [20]-in a study conducted in the US similarly reported that ED prevalence increases with age, particularly in men over 50 [21]. However, what distinguishes our findings is the relatively high prevalence of ED in younger diabetic patients. In our study, even men aged 21-30 years reported ED, which contrasts with studies in Western populations, where ED in younger diabetic men is less commonly reported. This may be due to poorer glycemic control and higher rates of obesity and smoking among younger populations in Saudi Arabia compared to the West, as well as potential psychological factors such as stress and anxiety related to chronic illness.

The relationship between education level and ED was another important finding in this study, with lower levels of education (elementary or middle school) associated with more severe ED (p = 0.001). This finding is consistent with research from Egypt and Turkey, where lower educational attainment was associated with higher ED prevalence [22]. The likely explanation is that lower educational levels are associated with poorer health literacy, reduced access to healthcare, and less effective diabetes management, all of which contribute to worsening ED [6]. However, a similar study carried out in the United States showed that the relationship between education and ED was not as powerful, probably because there is equal access to healthcare and diabetes education programs [23]. Similarly, ED was a major predictor of income level, with participants earning 5000 SR or less classified as having severe ED. Many studies worldwide agree with this finding, including some Middle Eastern investigations that indicate that socioeconomic factors influence both diabetes control and ED risk [24, 25]. Diabetes and erectile dysfunction can rapidly deteriorate due to a lower-income population's limited access to quality healthcare, diabetic medications and lifestyle management interventions [26]. On the other hand, with regard to respondents earning more than 20 thousand SRs, they expressed improved erectile function, and this can be attributed to better access to health care and other lifestyle changes such as diet and exercise, which help both diabetes and erectile functions [27].

This study indicated that patients with Type 2 diabetes had a higher proportion of ED compared to patients with Type 1 diabetes (p = 0.035). Other works have concluded that Type 2 diabetes is more frequently associated with erectile dysfunction due to its direct connection to metabolic syndrome, obesity and cardiovascular risk factors [1, 28]. The longer the duration of diabetes, the more severe ED was a fact that has been established in the literature [1]. Diabetes increases inflammation and oxidative stress, impairs endothelial function and causes prolonged neural dysfunction, thereby increasing the likelihood of ED in patients with diabetes of longer duration [29].

The impact of smoking on ED in this study was substantial, with smokers reporting more severe ED than non-smokers (p = 0.001). This is consistent with findings from a global metaanalysis that established smoking as a major risk factor for ED due to its damaging effects on vascular health and endothelial function [30]. In a study, smokers with diabetes were 50% more likely to suffer from ED compared to non-smokers [31]. Our findings reinforce the need for smoking cessation programs to be integrated into diabetes care, particularly in regions like Saudi Arabia where smoking rates remain high.

Our study showed the mean HbA1c of 7.55% indicates suboptimal glycemic control among participants, which has been strongly linked to the development of ED in numerous studies. Poor glycemic control accelerates vascular damage and neuropathy, key mechanisms in the pathogenesis of ED. Similar trends were reported in a study conducted in India, where higher HbA1c levels were correlated with worse erectile function [32]. Likewise, BMI was a contributing factor, with the mean BMI in this study classified as overweight (28.5). Obesity is a known risk factor for both diabetes and ED due to its association with insulin resistance, cardiovascular disease and reduced testosterone levels. These findings are in line with previous research from Jordan and Kuwait, where higher BMI was significantly correlated with ED prevalence [33].

Sexual satisfaction and erectile function in this study were notably poor, with 21.9% of participants rating their confidence in maintaining an erection as very low [34]. Moreover, 16.3% reported that their erections were "almost never" hard enough for penetration. These findings are consistent with a study, where similar percentages of diabetic men reported difficulties in achieving and maintaining erections [35]. However, the prevalence of severe sexual dissatisfaction in our study is higher compared to Western studies, where better healthcare access and earlier interventions may mitigate some of the psychological and physical impacts of ED.

In comparison to global studies, our findings highlight some notable differences. The high prevalence of ED in the southwestern region of Saudi Arabia may be attributed to unique cultural, lifestyle and healthcare access issues. For instance, in developed countries like the United States and European nations, ED prevalence among diabetic men tends to be lower due to better management of both diabetes and associated risk factors such as obesity and smoking. Moreover, cultural barriers to discussing sexual health in Saudi Arabia may lead to delayed treatment, further exacerbating the condition.

5. Conclusions

This study highlights the high prevalence of erectile dysfunction among diabetic men in the southwestern region of Saudi Arabia and the significant associations with age, education, income, duration of diabetes and smoking. The comparison with other regional and international studies underscores the multifactorial nature of ED, influenced by both biological and socioeconomic factors. The findings suggest the need for improved diabetes management, lifestyle interventions (such as smoking cessation and weight management) and increased awareness about sexual health in diabetic care. Future research should focus on longitudinal studies to assess the long-term effects of diabetes interventions on ED and consider crosscultural comparisons to identify best practices for managing this condition globally.

ABBREVIATIONS

ED, erectile dysfunction; C.I, confidence interval; Std. Deviation, Standard deviation; EF, erectile function; PHCCs, Primary Healthcare Centers; IIEF, International Index of Erectile Function; ANOVA, analysis of variance; BMI, body mass index; HbA1C, hemoglobin A1C.

AVAILABILITY OF DATA AND MATERIALS

The data presented in this study are available on reasonable request from the corresponding author.

AUTHOR CONTRIBUTIONS

SSB—designed and performed the research. FSAQ—edited & reviewed the manuscript. MMMA—wrote the proposal. RMAA—collected the data and wrote the manuscript draft. ASZA—collected the data and wrote the manuscript draft. MAMA—collected the data and wrote the manuscript draft. NFAA—analyzed the data. SASA—revised the analysis. ASSA—wrote the manuscript. AMA—revised the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

Approval was obtained from the Ministry of Health (MOH) and the Asser's Institutional Review Board (IRB) with number of (REC 4-4-2024) before commencing the study. Written informed consent was obtained from each participant prior to data collection, ensuring voluntary participation and confidentiality. Personal data were anonymized to protect participants' privacy.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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