PLOS ONE

RESEARCH ARTICLE

Prevalence and determinants of erectile dysfunction among type 2 diabetes mellitus patients at selected government hospitals in gurage zone: A cross-sectional study

Seid Abrar Abdlshikure[1]*, Aklilu Getachew Mamo[2], Bisrat Fikadu[1], Abdulber Seid[3]

1 Department of Medical Laboratory Sciences, College of Medicine and Health Sciences, Wolkite University, Wolkite, Ethiopia, **2** School of Medical Laboratory Science, Faculty of Health Sciences, Institute of Health, Jimma University, Jimma, Ethiopia, **3** Department of Educational Planning & Management, College of Education & Behavioral Sciences, Wolkite University, Wolkite, Ethiopia

* seyaabfl@gmail.com

Check for updates

OPEN ACCESS

Citation: Abdlshikure S, Getachew Mamo A, Seid A, Fikadu B (2025) Prevalence and determinants of erectile dysfunction among type 2 diabetes mellitus patients at selected government hospitals in gurage zone: A cross-sectional study. PLoS ONE 20(4): e0318908. https://doi.org/10.1371/journal.pone.0318908

Editor: Kamal Sharma, UN Mehta Institute of Cardiology and Research Center, INDIA

Received: August 10, 2024

Accepted: January 23, 2025

Published: April 21, 2025

Peer Review History: PLOS recognizes the benefits of transparency in the peer review process; therefore, we enable the publication of all of the content of peer review and author responses alongside final, published articles. The editorial history of this article is available here: https://doi.org/10.1371/journal.pone.0318908

Copyright: © 2025 Abdlshikure et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Abstract

Background

Erectile dysfunction (ED) is often not recognized in men with type 2 diabetes mellitus (T2DM), despite the prevalence of the disease. Early diagnosis of ED in T2DM is very important for effective treatment and prevention of serious complications such as cardiovascular events.This study investigates the prevalence and determinants of ED among T2DM patients at selected government hospitals in the Gurage Zone.

Methods

We conducted a study in three public hospitals from September 1 to December 30, 2020. 204 diabetic men were selected using consecutive sampling. ED was evaluated utilizing the International Index of ED-5. Glycated hemoglobin (HbA1c) and lipid levels were analyzed utilizing a Cobas 600 clinical chemistry analyzer. The data was analyzed using the Statistical Package for Social Sciences-20.

Results

ED was observed in 156 (76.5%) diabetic males. Independent predictors of ED included age above 40 years, alcohol consumption, khat chewing, overweight [Body mass index (BMI) ≥ 25 kg/m^2], obesity (BMI ≥ 30 kg/m^2), a diabetes duration of more than 5 years, uncontrolled diabetes (HbA1c > 7%), elevated low-density lipoprotein (LDL), and high total cholesterol levels ($P < 0.05$).

Conclusion

The study confirmed a high prevalence of ED among males with T2DM in the study settings. Consequently, clinicians should adopt preventive measures and focus on identifying the factors associated with ED in these patients.

Data availability statement: All relevant data are within the paper and its Supporting Information files.

Funding: The author(s) received no specific funding for this work.

Competing interests: Author have declared that no competing interest.

Introduction

Diabetes mellitus (DM) is a global health concern, with approximately 629 million people projected to develop the disease by the year 2045, the majority being in developing countries [1]. Ethiopia ranks among the highest in Africa, with an estimated 1.3 million people living with diabetes [2].

Erectile dysfunction (ED) is defined as the inability to achieve and/or maintain an erection of sufficient rigidity and duration to permit satisfactory sexual performance [3]. Generally, ED is categorized into organic and psychogenic subtypes [4], with the organic subdivision being frequently induced by a number of causes such as diabetes mellitus (DM), hypertension, cardiovascular illnesses, and hyperlipidemia [4].

Globally, individuals with diabetes are the largest group at risk for ED, with over 422 million cases worldwide [5]. Studies indicate that diabetic men have nearly a threefold higher likelihood of developing ED compared to non-diabetic men and experience its onset 10–15 years earlier [6,7]. The prevalence of ED in men with type 2 diabetes mellitus (T2DM) is reported to be around 50%, with higher rates (e.g., 94.7% in Nigeria) documented in certain populations [8].

ED is attributed to a variety of controllable and unmodifiable causes. Age is one of the most prominent association variables for an increased incidence of various ED domains, and the condition is typically found among aged men with diabetes [9]. According to studies, the age-adjusted association factor of ED was twice as high in diabetic males as in those without diabetes [10]. Similarly, comorbid illnesses, such as hypertension, increase the risk of developing ED; an estimated 40–80% of diabetic patients with hypertension were found to have ED due to the illness itself, drug side effects, and the psychological impact of chronic diseases [11,12].

Furthermore, patients with microvascular and macrovascular diabetes problems are more likely to develop ED [13,14]. Studies have demonstrated that ED is a strong indicator of poor quality of life in patients with T2DM [15–19]. Indeed, ED has been demonstrated to be a sign of subclinical cardiovascular disease and general health, and physicians should refer these men to cardiologists, urologists, and other specialists as soon as possible to provide comprehensive care and better outcomes [9]. Despite the profound impact of ED on the lives of diabetes patients, discussing sexual health issues remains taboo in Ethiopia. As a result, sexual disorders are often overlooked and insufficiently addressed in the country [20].

Although ED is a frequently observed complication of diabetes, there is a paucity of studies on the risk of ED in T2DM in central Ethiopia [21,22]. This study was, therefore, conducted to assess the prevalence of ED among T2DM men, and to identify factors associated with ED, including their perceptions and practices regarding ED management. The findings of the study will positively influence the local decision makers to mitigate the problem through working on the identified responsible factors that contribute to ED.

Methods and materials

Study design, setting, and period

A hospital-based cross-sectional study was conducted from September 1 to December 30, 2020, at hospitals in the Gurage zone of central Ethiopia, 158 km south of Addis Ababa. The Gurage zone has three primary hospitals and one general hospital, all with chronic follow-up clinics for diabetes and hypertension. This study took place at the diabetic clinics of Butajira General Hospital (200 beds), Wolkite University Comprehensive Specialized Hospital (150 beds), and Attat Hospital (180 beds). These hospitals were selected due to their diverse patient populations from densely populated urban and rural areas, along with their available

resources and support. During the study, the monthly male patients diagnosed with T2DM were highest at BH (26), followed by WKUSH (15) and AH (10). A total of 104 T2DM patients were recruited from BH, 60 from WKUSH, and 40 from AH over the four months.

Study participants

Adult male with T2DM who had a active heterosexual activity, regardless of their relationship status in the last 6 months at the time of interview and willingness to participate in the study were included in the study. Patients with ED secondary to non-diabetes-related endocrine or neurological conditions, such as hypogonadism or Parkinson's disease, and were not sexually active not because of ED for the previous 6 months prior to the study were excluded from the study (Fig 1).

Sample size and sampling technique

The sample size for this study was determined by using a single population proportion formula. There were two previous studies conducted in Ethiopia; we have utilized the prevalence studied in the Bale zone (prevalence of 84.39%) [23], with a 5% margin of error and a standard Z score of 1.96 corresponding to 95% CI.. The sample size was computed as n = (Z) 2 p (1-p)/ d2; n = $[(1.96)^2 * 0.8439 * (1–0.8439)]/ (0.05)^2 = 204$. The calculated sample size was 204, and, by adding a 10% non-response rate, the final sample size became 211. Among them, 3 were excluded due to non-eligibility while the remaining 4 did not give consent. Eligible male patients with T2DM attending their routine follow-up appointments at selected government hospitals were approached by investigators during the data collection period. A consecutive sampling technique was used to select all diabetic male patients who fulfill the inclusion criteria until the desired sample size is attained.

Variables

Dependent variable. ED (Yes/No)

Independent variable.Socio-demographic factors. Age, marital status, occupational status, educational status, etc.

Behavioral and lifestyle factors. Alcohol, smoking, body mass index, khat chewing, etc.

Medical conditions. Comorbid illness, lipid profile, etc.

Data collection

Data were collected through face-to-face interviews using a questionnaire. Participants were informed about the study's objective, and verbal and written consent was obtained.

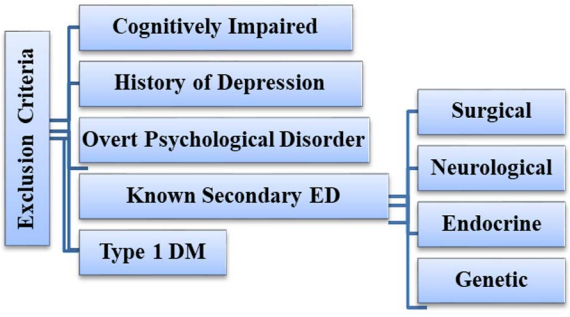


Fig 1. A figure that shows exclusion criteria of study subjects attending selected governmental hospitals, Gurage Zone, central Ethiopia, and September 1 to December 30, 2020.

https://doi.org/10.1371/journal.pone.0318908.g001

Information collected included age, blood pressure, HbA1c, height, weight, duration of DM, hypertension, other medical conditions, smoking, alcohol use, ED treatment sought, and IIEF-5 scores. Three trained male nurses conducted the interviews on working days. The IIEF-5 questionnaire screened for ED, while biochemical measurements were taken with a COBAS 600 analyzer. A structured questionnaire assessed participants' awareness and attitudes toward ED treatments, including perceived medication effectiveness and sexual counseling. Data collection took place in a separate, quiet room. Patients identified with ED were informed of their condition and advised to consult their physician.

Operational definition

Glycemic control: The level of glycemic control was assessed by obtaining HbA1C values. Participants were grouped into normal glycemic control (i.e., HbA1C ≤ 7) and poor control (i.e., HbA1C > 7) [24].

Alcoholic: The daily alcohol amount that respondents consume was calculated considering the average alcohol percent (%/ml) of each drink multiplied by the volume (ml) of the drink and volumetric mass density (which is 0.8 g/ml). Accordingly, participants were explained to be alcoholic if they drank more than 12g of ethanol of alcohol per day in the past six months of the survey [25].

Cigarette smoking: those who smoke any tobacco products daily will be considered tobacco users [26].

Physical inactivity: Those respondents who will not achieve WHO recommendations of total physical activity (level less than 600 METs-minute/week) or reported practicing no physical activities will be classified as inactive. Whereas those who meet this criterion (> 600 METs-minutes/week) will be classified as physically active [27]

Khat chewer: if the patient reported khat chewing (kata adulis forsik)

Comorbidity: any medical condition concomitantly occurring with diabetes mellitus. Example: hypertension [28].

Diabetic complications: the existence of macrovascular diabetic complications, microvascular diabetic complications (retinopathy, neuropathy, and nephropathy), and diabetic foot ulcer.

Body mass index (BMI): a person's weight in kilograms (kg) divided by his or her height in meters squared (m2). Based on WHO's 2004 BMI classification, participants who have a BMI (kg/m^2) < 18.5, 18.5–24.9, 25–29.9, and > 30 kg/m^2 will be classified as underweight, normal range, overweight, and obese, respectively [29].

ED is the outcome variable for this study. It was assessed using the International Index of Erectile Function (IIEF) questionnaire. This questionnaire consists of five questions, each with Likert scale alternative responses. The greatest possible score is 25, which is the score for people who never had an erection problem, and the lowest score is 5. The sum of the ordinal replies to the 5 items determines the IIEF-5 score. The ED was categorized into two depending on the IIEF score. Those who score 22 and above were classified as having no ED, and those who score 21 and below were classified as having ED. More specifically, those who have a score of 17–21, 12–16, 8–11, and 5–7 are subcategorized as having mild, mild to moderate, moderate, and severe ED, respectively [30].

Data processing, analysis and quality assurance

The questionnaire and checklist were reviewed by experts and translated into Amharic, followed by back-translation for consistency. To ensure data quality, facilitators and data collectors were trained, and the tool was pretested on 10% of participants. Data collection occurred in a private room, with daily supervision of data collectors by investigators.

Data were collected using the Amharic version, checked for consistency, errors, completeness, accuracy, and clarity before being entered into Epi-data version 3.1. The data were then exported to SPSS version 20 for recoding, cleaning, and analysis. All continuous independent variables were categorized.

The outcome variable was dichotomized and coded as '0' and '1', representing those who have no and have ED, respectively. Continuous data were checked for normality with the Shapiro–Wilk test and were found not to be normally distributed. Descriptive statistics like frequency, percentage, and measure of central tendency with their corresponding measure of dispersion were used to describe demographic and other variables. Tables', graphs, and texts were used to present the findings.

Furthermore, the binary logistic regression analysis was applied to identify factors associated with ED. Those variables with a p-value ≤0.25 in the bi-variable analysis were entered into the multi-variable logistic regression model to control the possible effects of confounder/s and to identify the significant factors. According to the Hosmer and Lemeshow test, the model was found to be adequate. Likewise, prior to identifying the significant factors, the presence of mul-ticollinearity problem was examined using the Variance Inflation Factor (VIF), and no variable was found to have that problem.

Ethical consideration

Ethical clearance to conduct the study was obtained from the institutional health research ethical review committee of Jimma University. This ethical clearance was taken to the AH, BH, and WKUCSH clinical director office, and a permission letter to conduct the study was taken from the clinical director office to the AH, BH, and WKUCSH diabetic clinic to conduct the study. The objective of the study was explained to each study participant. Verbal and written informed consent was obtained from each respondent before the interview. The consent was taken after participants were informed about the risk, benefit, and their right to withdraw from the study at any time during the interview process. Those volunteers who signed on the consent form were involved in the study. Moreover, all information taken from the respondents was kept confidential, and the entire data collected was only used for the purpose of this study.

Results

Socio-demographic and clinical characteristics of participants

A total of 204 participants were enrolled study making a response rate of 96.68%. The mean (±standard deviation (SD)) age of the respondent was 44.09(±13.04) years. The majority of participants, specifically 73.53%, were married. Almost more than half of them, i.e., 52.94%, were from families with a monthly income of more than 2000 Ethiopian Birr (equivalent to 50.8 USD). The study also revealed that 32.84% of participants were smokers, 43.6% were alcohol consumers, and more than half (52.94%) were khat chewers (Table 1).

Table 2 shows, 43.1% of the study participants had diabetes for 5–10 years, and 68.6% of them used tablets for treatment. Most of the participants (65.2%) had uncontrolled diabetes, that is, their A1c levels were higher than 7. About 34.8% of them were found to be obese. The total cholesterol level (>200 mg/dl) was abnormal in more than half of the patients.

Prevalence of ED among the study participants

As Fig 2 shows, the prevalence rate of ED among T2DM was 76.5% (156 out of 204).

Table 1. Socio-demographic characteristics among T2DM attending selected governmental hospitals, Gurage zone, central Ethiopia, and September 1 to December 30, 2020. (n = 204).

Socio-Demographic Variables	Category	Frequency(%)
Age Group	<40 Years	73(35.79%)
	40–50 Years	72(35.29%)
	>50 Years	59(28.92%)
Marital Status	Single	41(20.10%)
	Married	150(73.53%)
	Separated	12(5.88%)
	Divorced	1(0.49%)
Educational Status	No Formal Education	48(23.53%)
	Primary	47(23.04%)
	Secondary	37(18.14%)
	Diploma	34(16.67%)
	Degree And Above	38(18.62%)
Occupational Status	Farmer	50(24.51%)
	Merchant	57(27.94%)
	Government Employee	58(28.43%)
	Non Employed	39(19.12%)
Monthly Income (Ethiopian Birr)	<1000	35(17.16%)
	1000–2000	61(29.90%)
	>2000	108(52.94%)
Physical Activity	Yes	83(40.69%)
	No	121(59.31%)
Alcohol Drink	Yes	89(43.63%)
	No	115(56.37%)
Smoking	Yes	67(32.84%)
	No	137(67.16%)
Khat Chewing	Yes	108(52.94%)
	No	96(47.06%)

https://doi.org/10.1371/journal.pone.0318908.t001

ED acceptance and treatment-seeking rate

The results presented in Table 3 align with the study's aim by providing insights into participants' perceptions of ED treatments, which are essential for understanding the barriers to seeking care and improving management practices.

Most of the patients who were included in the study (94.12%) were not screened or managed for ED. A significant number, 23 (11.27%), of study participants think that drugs are effective in treating ED cases. In the same manner, only 37 (18.14%) of the study participants think that sexual counseling is effective in the treatment and prevention of ED (Table 3**).**

Factors associated with ED

In multi-variable analysis variables such as older age, long duration of diagnosed with DM, alcohol drink,khat chewing,high BMI, poor glycemic control, and dyslipedemia (elevated LDL), and high TC levels) have shown an independent association with ED (Table 4).

The association between ED and participant demographics along with clinical characteristics. ED was associated with 73.7% of participants 40 and above years ($p < 0.001$), alcohol consumption ($p < 0.001$), and chat consumption ($p < 0.001$). Participants with a higher

Table 2. Participants' clinical characteristics among T2DM men attending selected governmental hospitals, september 1 to december 30, 2020. (n = 204).

Clinical variables	Category	Frequency(%)
BMI	Normal	49(24.02%)
	Over weight	84(41.18%)
	obese	71(34.80%)
Duration of diabetes	<5yrs	79(38.73%)
	5–10yrs	88(43.13%)
	>10yrs	37(18.14%)
Diabetes complication	Yes	58(28.43%)
	No	146(72.57%)
Co-existing hypertension	Yes	92(45.10%)
	No	112(54.90%)
On hypertensive drug	Yes	67(32.84%)
	No	137(67.16%)
Glycemic control	Good	71(34.80%)
	Poor	133(65.20%)
HDL	Normal(≥40 Mg/Dl)	104(50.98%)
	Abnormal(<40mg/Dl)	100(49.02%)
LDL	Normal(≤100mg/Dl)	113(55.39%)
	Abnormal(>100mg/Dl)	91(44.61%)
TC	Normal (≤200mg/Dl)	84(41.18%)
	Abnormal (>200mg/Dl)	120(58.82%)
TG	Normal (≤150mg/Dl)	92(45.10%)
	Abnormal (>150mg/Dl	112(54.90%)

NOTE: BMI: Body Mass Index, DM: Diabetes Mellitus, HDL (High Density Lipoprotein), LDL (Low Density Lipoprotein), TC (Total Cholesterol), TG (Triglyceride)

https://doi.org/10.1371/journal.pone.0318908.t002

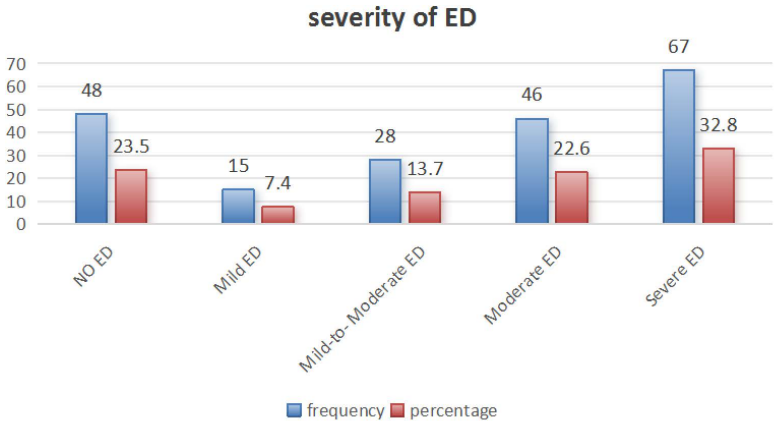


Fig 2. Erectile function scores of T2DM men attending selected governmental hospitals, Gurage zone, central Ethiopia, and September 1 to December 30, 2020. (n = 204).

https://doi.org/10.1371/journal.pone.0318908.g002

BMI (≥25 kg/m²) were more likely to experience ED ($p < 0.001$). In addition, abnormal HDL, abnormal LDL, and high TC levels were associated with ED ($p < 0.001$). Furthermore, 91.6% of participants who had diabetes for 5 years or more experienced ED ($p = 0.002$). As

Table 3. Acceptance and treatment-seeking rate for ED among T2DM men attending selected governmental hospitals, Gurage zone, central Ethiopia, and September 1 to December 30, 2020. (n = 204).

Acceptance and treatment-seeking rate for ED	ED	No ED	Total Frequency(%)
History of seeking medical help			
Yes	12(100.0%)	0	12(5.88%)
No	144(75.0%)	48(25.0%)	192(94.12%)
Treated for sexual problem			
no	145(75.1%)	48(24.9%)	193(94.61%)
yes	11(100.0%)	0	11(5.39%)
Thinking of drug are effective			
Yes	14(60.9%)	9(39.1%)	23(11.27%)
No	142(78.5%)	39(21.5%)	181(88.73%)
Thinking of sexual counseling is effective			
Yes	17(45.9%)	20(54.1%)	37(18.14%)
No	139(83.2%)	28(16.8%)	167(81.86%)

https://doi.org/10.1371/journal.pone.0318908.t003

mentioned above, there was no significant association between ED and marital status, occupation, monthly income, physical activity, smoking status, hypertensive drug use, educational status, abnormal triglyceride level, coexisting hypertension, and diabetes complications(S Table 1).

Discussions

ED has been reported to be an important cause of decreased quality of life in men [3]. As socio-cultural changes can veil the prevalence and determinants of ED, in this regard, many studies have investigated the prevalence and determinants of ED as the interest in the disease increased. However, little has been done in Sub-Saharan Africa and Ethiopia on this issue. To the best of our knowledge, information concerning contributing factors of ED among T2DM patients was uncommon.

The prevalence of ED among patients with T2DM was found to be 76.5% in the present study. This is in line with studies conducted in different parts of the world ranging between 35 and 90%. Moreover, the study finding coincides with the pooled results from India, 68.7% [31] and Africa, 71.45% [32]. However, there is some discrepancy with the study conducted in Ethiopia, 54.3% [33]. The reason for these discrepancies in prevalence rates across studies is not scientifically explained, though some authors do provide possibilities. Factors such as population sizes, demographic characteristics, duration and severity of diabetes, and the presence of other comorbidities may account for these divergent rates.

A consistent risk factor for ED includes increasing age, in both the diabetic and general populations [34]. However, in men with diabetes, ED is more frequent than in men of the same age who do not have diabetes [35]. The onset of ED also occurs 10–15 years earlier in men with diabetes than it does in those without diabetes [36].n our study, the odds of having ED were 5.8 and 6.9 times higher among participants who were aged 40–50 and >50 years than in younger participants, respectively. The advancing age of diabetes has been consistently documented to increase the probability of having ED, which is a finding that is confirmed by the work of Tridiantari et al. and Ghanem et al. [18,37].

There are some controversial results in another study where increasing age is not an independent determinant of ED in diabetes [38]. Increasing age poses the chance of having ED due to physiological changes of atherosclerosis and the consequently reduced blood flow to the sex organs [39]. Although the aging process is inevitable, preventive measures such as

Table 4. Independent predictors of ED among T2DM men attending selected governmental hospitals, Gurage zone, central Ethiopia, and September 1 to December 30, 2020. (n = 204).

Variable	Category	ED status		AOR (Lower-Upper)	P-value
		NO	YES		
Age group	< 40 Years	32(66.67%)	32(20.51%)	1	1
	40–50 Years	14(29.17%)	46(29.49%)	5.80 (2.08–16.76)	0.000*
	>50 Years	2(4.16%)	110(70.51%)	6.90 (1.79–11.98)	0.000*
Marital Status	Single	5(31.25%)	26(16.67%)	1	1
	Married	30(62.50%)	120(76.92%)	0.60 (0.14–2.52)	0.482
	Separated	3(6.25%)	10(6.41%)	1.01 (0.12–8.52)	0.991
Occupational Status	Farmer	10(20.83%)	40(25.64%)	1	1
	Merchant	12(25.00%)	45(28.85%)	0.74 (0.15–3.83)	0.724
	Government	12(25.00%)	46(29.49%)	0.93 (0.21–4.06)	0.918
	Non Employed	14(29.17%)	25(16.03%)	0.51 (0.09–2.87)	0.442
Monthly Income (Birr)	<1000	12(25.00%)	23(14.74%)	1	1
	1000–2000	16(33.33%)	45(28.85%)	1.41(.270–7.368)	0.683
	>2000	20(41.67%)	88(56.41%)	1.75 (0.29–10.72)	0.542
Alcohol drink	Yes	10(20.83%)	79(50.64%)	12.68 (2.96–54.40)	0.001*
	No	38(79.17%)	77(49.36%)	1	1
Smoking	Yes	11(22.92%)	56(35.90%)	1.51 (0.47–4.84)	.492
	No	37(77.08%)	100(64.10%)	1	1
Khat Chewing	Yes	15(31.25%)	93(59.62%)	5.29 (1.62–17.28)	0.006*
	No	33(68.75%)	63(40.38%)	1	1
BMI	Normal	25(52.08%)	24(15.38%)	1	1
	Over Weight	10(20.83%)	74(47.44%)	8.49 (2.33–30.88)	0.001*
	Obese	13(27.08%)	58(37.18%)	5.85 (1.54–22.27)	0.010*
Duration of diabetes	<5yrs	29(60.41%)	50(32.05%)	1	1
	≥5yrs	19(39.59%)	106(67.95%)	3.28 (1.06–10.19)	0.039*
Glycemic control	Good	29(60.42%)	42(26.92%)	1	1
	Poor	19(39.58%)	114(73.08%)	4.23 (1.36–13.14)	0.013*
HDL	Normal(≥40 Mg/Dl)	36(75.00%)	68(43.59%)	1	1
	Abnormal(<40mg/Dl)	12(25.00%)	88(56.41%)	2.22 (0.71–6.96)	0.171
LDL	Normal(≤100mg/Dl)	40(83.33%)	73(46.79%)	1	1
	Abnormal(>100mg/Dl)	8 (16.67%)	83(53.21%)	4.59 (1.32–15.92)	0.016*
TC	Normal (≤200mg/Dl)	35(72.92%)	49(31.41%)	1	1
	Abnormal(>200mg/Dl)	13 (27.08%)	107(68.59%)	4.16 (1.35–12.81)	0.013*

NOTE: AOR: Adjusted Odds Ratio BMI: Body Mass Index, CI: Confidence Interval DM: Diabetes Mellitus, HDL: High-Density Lipoprotein, LDL: Low-Density Lipoprotein, TC: Total Cholesterol 1: Reference category,

*: significant p < 0.005, Hosmer and Lemshow goodness of fit (p-value = 0.44), Multicollinearity test (VIF) = 1.36

https://doi.org/10.1371/journal.pone.0318908.t004

adopting a healthy lifestyle and eating habits can reduce the future burden of this problem [40]. Seeking doctors' help and early treatment measures may also help to mitigate the onset of ED.

A meta-analysis of population-based cross-sectional studies has found significantly decreased odds of ED among alcohol consumers [41]. In the present study, the odds of having ED among alcohol consumers were 12.6 times higher than among non-alcohol consumers. This result is similar to the study conducted in Gabon and India [42,43]. One possible

explanation for the increase in ED following alcohol consumption could be that alcohol triggers the RhoA/Rho-kinase pathway, causes increased oxidative stress, and increases the penis' reactivity to the constrictor effects of endothelin-1. Endothelin-1 (ET-1) is a potent vasoconstrictor in the penis, and its vasoconstriction is linked to the RhoA/Rho-kinase pathway, which reduces the production of nitric oxide (NO) by suppressing endothelial nitric oxide synthase (eNOS) [44].

Although the effect of smoking has also been shown as the cause for ED in T2DM [45], this was not observed in our study. Our findings are in line with other reports where smoking habit was not related to the prevalence of ED [46,47]. The lower number of respondents who identified as smokers could explain why the findings do not align with those of previous studies.

Furthermore, the probability of having ED among Khat chewers was 5.3 times higher than non-Khat chewers. The possible reason for the high chance of ED among Khat chewers compared to non-Khat chewers may be due to Khat chewing affecting male sexual potency by inhibiting spermatogenesis and reducing testosterone levels [48]. However, the work of Asefa et al. and Nassar et al. failed to show chewing khat as an independent predictor for ED in diabetes [49,50]. Further research is needed to determine whether chewing khat contributes to the morbidity of ED.

Previous research findings indicate that diabetic patients tend to have significantly higher BMI and waist circumference compared to non-diabetic individuals [51]. It is well-known that obesity is a risk factor for ED in diabetic patients [52].In our study, we found that excess weight is strongly associated with a higher likelihood of developing ED, showing an 8.5-fold increase. Similarly, obesity is linked to a 5.8-fold increase in the chance of experiencing ED. Studies in the past have shown similar findings and have shown a direct relationship between obesity and ED [8,16]. Subclinical inflammation and oxidative stress in obesity lead to leptin resistance that results in low LH and low testosterone, which is one of the causes of ED [53]. Insulin resistance in obesity elevates oxidative stress and inflammatory cytokines, such as TNF-α and IL-6, in endothelial cells, which decreases nitric oxide bioavailability and induces endothelial dysfunction [54].

The duration of diabetes is the most significant factor associated with the occurrence of ED in T2DM patients. If the duration of diabetes is greater than 5 years, the risk of association with ED triples. This is in line with the findings of previous studies conducted in Sri Lanka and Gabon [43,55].

In our study, dyslipidemia characterized by showed higher levels of total cholesterol and abnormal lipoprotein levels. The probability of having ED was 5.2 and 5.6 times higher in participants with high serum TC and LDL levels than in those who had normal serum TC and LDL levels, respectively. This finding is in line with a previous study conducted by Fedele et al. in Italy [56]. This result was also noted by Azad et al.; it was observed that there is a correlation between abnormal LDL, high TC, and ED [57].

In addition, the probability of having ED was 5.2 times higher in men with poor blood sugar compared to those with well-controlled blood sugar. This finding highlights the critical role of maintaining optimal blood glucose levels in reducing the chance of ED and improving overall health outcomes.This finding is consistent with studies conducted in India and Saudi Arabia [42,58].

The study also presented no significant relationship between any of the sexual domains with hypertension, hyperlipidemia, and high TG in men with T2DM. These findings were consistent with Sharifi's study, which found that men with T2DM had no significant association with blood pressure and levels of triglycerides [59].

When considering the medications, no significant association between being on antihypertensive drugs and ED was noted. This finding is congruent with a study conducted in Nigeria [60]. However, this data was contradicted with the study in Zimbabwe [61]. Also, on the contrary to our outcome, recently published articles in Ethiopia revealed that diabetic

complications (AOR=2.05,95% CI: 1.18–3.58, P=0.01) were significantly associated with sexual dysfunction among diabetes patients [49].

In this research, it was noteworthy that a significant percentage (94.12%) of participants had not addressed the issue or pursued medical treatment for ED from a physician, including those dealing with DM. This concerning pattern has been reported in Asia [62], where a majority of patients had neither sought nor received treatment for ED (fewer than 10% had undergone treatment). The low rate of seeking treatment may be attributed to patient-related obstacles, such as feelings of shame or embarrassment, culturally unsuitable services, and a lack of awareness [63].

This study didn't find a link between smoking, income, education, occupation, physical activity, diabetes complications, hypertension medication, high triglyceride levels, low HDL, and ED, possibly due to cultural factors. The study highlights the high prevalence of ED among T2DM patients and identifies several determinants. It calls for awareness campaigns for patients, the public, and the government.

Strength and limitation of the study

This study utilized standard tools, such as IIEF, but may have experienced over-reporting of cases due to participants hoping for better management. Despite efforts to minimize bias, including male interviewers and private settings, social desirability bias may still have influenced responses due to the sensitive nature of the topics discussed. Additionally, the inability to measure participants' testosterone levels limits the analysis of diabetes' impact on men's sexuality. We also lacked a control group to compare the prevalence of ED between the general population and T2DM patients. The cross-sectional design precludes causal inferences about the risk factors for ED in the studied population. Future research should consider using continuous variable values to enhance the robustness of the analysis.

Conclusion

In conclusion, the prevalence of erectile dysfunction among adult T2DM is nearly eight out of ten. ED health-seeking behavior was poor, with only a minority of patients seeking and receiving care. To manage men with T2DM, we recommend objective ED screening with standard brief instruments, early glycemic goal achievement through lifestyle interventions, culturally appropriate ED-related conversations in private, and referral to an ED clinic for urological input. The Ethiopian Ministry of Health should incorporate ED management into diabetes guidelines. Future studies on ED among diabetics should consider using self-administered questionnaires or digital survey tools to gather data.

Supporting information

S1 Table. Association between variables among T2DM.
(DOCX)

S1 File. Questionnaire.
(DOCX)

Acknowledgments

Special thanks to the BH, WKUSH, and AH staffs for their intensive cooperation in sample analysis. Finally, we would like to appreciate to all the study participants to provide their valuable time and data for the research.

Author contributions

Conceptualization: Seid Abdlshikure.

Data curation: Bisrat Fikadu.

Formal analysis: Abdulber Seid.

Investigation: Bisrat Fikadu.

Supervision: Aklilu Getachew Mamo.

Visualization: Seid Abdlshikure.

Writing – original draft: Seid Abdlshikure.

Writing – review & editing: Seid Abdlshikure.

References

1. Federation ID. IDF Diabetes Atlas. 8th Edition. 2017.
2. Atlas D. International diabetes federation. IDF Diabetes Atlas. 7th edn. Brussels, Belgium: International Diabetes Federation; 2015.
3. Consensus N. NIH Consensus Conference. Impotence. NIH consensus development panel on impotence. JAMA. 1993;270(1):83–90. https://doi.org/10.1001/jama.1993.03510010089036 PMID: 8510302
4. Lue TF. Erectile dysfunction. N Engl J Med. 2000;342(24):1802–13. https://doi.org/10.1056/NEJM200006153422407 PMID: 10853004
5. Mathers CD, Loncar D. Projections of global mortality and burden of disease from 2002 to 2030. PLoS Med. 2006;3(11):e442. https://doi.org/10.1371/journal.pmed.0030442 PMID: 17132052
6. Feldman HA, Goldstein I, Hatzichristou DG, Krane RJ, McKinlay JB. Impotence and its medical and psychosocial correlates: results of the massachusetts male aging study. J Urol. 1994;151(1):54–61. https://doi.org/10.1016/s0022-5347(17)34871-1 PMID: 8254833
7. Laumann EO, Paik A, Rosen RC. Sexual dysfunction in the United States: prevalence and predictors. JAMA. 1999;281(6):537–44. https://doi.org/10.1001/jama.281.6.537 PMID: 10022110
8. Ugwumba FO, Okafor CI, Nnabugwu II, Udeh EI, Echetabu KN, Okoh AD, et al. Prevalence of, and risk factors for erectile dysfunction in male type 2 diabetic outpatient attendees in Enugu, South East Nigeria. Ann Afr Med. 2018;17(4):215–20. https://doi.org/10.4103/aam.aam_3_18 PMID: 30588936
9. Johannes CB, Araujo AB, Feldman HA, Derby CA, Kleinman KP, McKinlay JB. Incidence of erectile dysfunction in men 40 to 69 years old: longitudinal results from the Massachusetts male aging study. J Urol. 2000;163(2):460–3. https://doi.org/10.1016/s0022-5347(05)67900-1 PMID: 10647654
10. Selvin E, Burnett AL, Platz EA. Prevalence and risk factors for erectile dysfunction in the US. Am J Med. 2007;120(2):151–7. https://doi.org/10.1016/j.amjmed.2006.06.010 PMID: 17275456
11. Giuliano FA, Leriche A, Jaudinot EO, de Gendre AS. Prevalence of erectile dysfunction among 7689 patients with diabetes or hypertension, or both. Urology. 2004;64(6):1196–201. https://doi.org/10.1016/j.urology.2004.08.059 PMID: 15596196
12. Ramanathan RS. Correlation of duration, hypertension and glycemic control with microvascular complications of diabetes mellitus at a tertiary care hospital. J Neurol Exp Neural Sci. 2017;4(1):1–4.
13. Vinik AI, Maser RE, Mitchell BD, Freeman R. Diabetic autonomic neuropathy. Diabetes Care. 2003;26(5):1553–79. https://doi.org/10.2337/diacare.26.5.1553 PMID: 12716821
14. Al-Hunayan A, Al-Mutar M, Kehinde EO, Thalib L, Al-Ghorory M. The prevalence and predictors of erectile dysfunction in men with newly diagnosed with type 2 diabetes mellitus. BJU Int. 2007;99(1):130–4. https://doi.org/10.1111/j.1464-410X.2006.06550.x PMID: 17026597
15. Malavige L, Jayaratne S, Kathriarachchi S, Sivayogan S, Ranasinghe P, Levy J. Erectile dysfunction is a strong predictor of poor quality of life in men with Type 2 diabetes mellitus. Diabet Med. 2014;31(6):699–706. https://doi.org/10.1111/dme.12412 PMID: 24533738
16. Sayilan S. Erectile dysfunction and associated factors in men with type 2 diabetes mellitus. Sex Disabil. 2024;42(1):189–200. https://doi.org/10.1007/s11195-023-09831-w
17. Parmar RS, Verma S, Pathak VK, Bhadoria AS. Prevalence of erectile dysfunction in Type 2 diabetes mellitus (T2DM) and its predictors among diabetic men. J Family Med Prim Care. 2022;11(7):3875–9. https://doi.org/10.4103/jfmpc.jfmpc_1130_21 PMID: 36387626

18. Ghanem YM, Zahran ARM, Younan DN, Zeitoun MH, El Feky AY. Prevalence of erectile dysfunction among Egyptian male patients with type 2 diabetes mellitus. Diabetes & Metabolic Syndrome: Clin Res Rev. 2021;15(3):949-53.
19. Gupta M, Tiwari A, Chandra K, Awasthi R, Chaudhary S, Gupta N, et al. Assessment of erectile dysfunction and other sexual dysfunction in men with type 2 diabetes mellitus: a multicenter observational study in North India. Clin Epidemiol Glob Health. 2022;18:101136. https://doi.org/10.1016/j.cegh.2022.101136
20. Weldesenbet AB, Kebede SA, Tusa BS. Prevalence of erectile dysfunction and its associated factors among patients with diabetes in Ethiopia: a systematic review and meta-analysis. J Int Med Res. 2021;49(2):300060521993318. https://doi.org/10.1177/0300060521993318 PMID: 33583238
21. Seid A, Gerensea H, Tarko S, Zenebe Y, Mezemir R. Prevalence and determinants of erectile dysfunction among diabetic patients attending in hospitals of central and northwestern zone of Tigray, northern Ethiopia: a cross-sectional study. BMC Endocr Disord. 2017;17(1):16. https://doi.org/10.1186/s12902-017-0167-5 PMID: 28298205
22. Walle B, Lebeta KR, Fita YD, Abdissa HG. Prevalence of erectile dysfunction and associated factors among diabetic men attending the diabetic clinic at Felege Hiwot Referral Hospital, Bahir Dar, North West Ethiopia, 2016. BMC Res Notes. 2018;11(1):130. https://doi.org/10.1186/s13104-018-3211-2 PMID: 29448969
23. Mesfin T, Tekalegn Y, Adem A, Seyoum K, Geta G, Sahiledengle B, et al. Magnitude of erectile dysfunction and associated factors among adult diabetic men on follow-up at Goba and Robe hospitals, Bale Zone, South East Ethiopia: Hospital-based cross-sectional study. BMC Endocr Disord. 2023;23(1):236. https://doi.org/10.1186/s12902-023-01489-x PMID: 37880632
24. Association GoAD. Standards of medical care in diabetes--2015: summary of revisions. Diabetes Care. 2015;38:S4. https://doi.org/10.2337/dc15-S003 PMID: 25537706
25. Muturi N. Alcohol consumption and reproductive health risks in rural Central Kenya. Sex Reprod Healthc. 2014;5(2):41–6. https://doi.org/10.1016/j.srhc.2014.01.002 PMID: 24814437
26. Organization WH. WHO toblabnet official method SOP 01. Standard operating procedure for intense smoking of cigarettes. https://appswhoint/iris/bitstream/handle/10665/75261/9789241503891_engpdf. 2012.
27. Shazwani N, Suzana S, Hanis Mastura Y, Lim C, Teh S, Mohd Fauzee M, et al. Assessment of physical activity level among individuals with type 2 diabetes mellitus at cheras health clinic, Kuala Lumpur. Malays J Nutr. 2010;16(1):101–12. PMID: 22691857
28. Hurisa AD, Negera GZ. Erectile dysfunction among diabetic patients in a tertiary hospital of southwest Ethiopia. TOPHJ. 2020;13(1):240–5. https://doi.org/10.2174/1874944502013010240
29. Consultation W. Obesity: preventing and managing the global epidemic. Report of a WHO consultation. World Health Organ Tech Rep Ser. 2000;894:i–xii, 1–253. PMID: 11234459
30. Rosen R. International Index of Erectile Function (LIEF): a multidimensional scale for assessment of erectile dysfunction. Urology. 1997;14:1–28.
31. Parvthaneni A, Kodithyala PK, Karangula S. Prevalence and risk factors of erectile dysfunction among patients with type II diabetes mellitus at a tertiary care centre in Hyderabad. MRIMS J Health Sci. 2023;11(1):65–9. https://doi.org/10.4103/mjhs.mjhs_33_22
32. Kouidrat Y, Pizzol D, Cosco T, Thompson T, Carnaghi M, Bertoldo A, et al. High prevalence of erectile dysfunction in diabetes: a systematic review and meta-analysis of 145 studies. Diabet Med. 2017;34(9):1185–92. https://doi.org/10.1111/dme.13403 PMID: 28722225
33. Malavige LS, Levy JC. Erectile dysfunction in diabetes mellitus. J Sex Med. 2009;6(5):1232–47. https://doi.org/10.1111/j.1743-6109.2008.01168.x PMID: 19210706
34. Jakka NR, Ramesh J. A study of various factors associated with sexual dysfunction in males with type 2 diabetes mellitus. Int J Adv Med. 2017;4(4):1083–7.
35. Balde N, Diallo A, Balde M, Kake A, Diallo M, Diallo M, et al. (Editors). Erectile dysfunction and diabetes in Conakry (Guinea): Frequency and clinical characteristics from 187 diabetic patients. Annales d'endocrinologie. 2006.
36. Chu NV, Edelman SV. Diabetes and erectile dysfunction. Clin Diabetes. 2001;19(1):45–7. https://doi.org/10.2337/diaclin.19.1.45
37. Tridiantari DK, Saraswati LD, Udiyono A. Epidemiology of erectile dysfunction in men with diabetes mellitus: a study in a primary health care center in Indonesia. Med J Indones. 2020;29(1):82–7. https://doi.org/10.13181/mji.oa.192070

38. Ugwu T, Ezeani I, Onung S, Kolawole B, Ikem R. Predictors of erectile dysfunction in men with type 2 diabetes mellitus referred to a tertiary healthcare centre. Adv Endocrinol. 2016;2016:1–8. https://doi.org/10.1155/2016/9753154

39. Wang JC, Bennett M. Aging and atherosclerosis: Mechanisms, functional consequences, and potential therapeutics for cellular senescence. Circ Res. 2012;111(2):245–59. https://doi.org/10.1161/CIRCRESAHA.111.261388 PMID: 22773427

40. Simon RM, Howard L, Zapata D, Frank J, Freedland SJ, Vidal AC. The association of exercise with both erectile and sexual function in black and white men. J Sex Med. 2015;12(5):1202–10. https://doi.org/10.1111/jsm.12869 PMID: 25801073

41. Cheng J, Ng E, Chen R, Ko J. Alcohol consumption and erectile dysfunction: meta-analysis of population-based studies. Int J Impot Res. 2007;19(4):343–52. https://doi.org/10.1038/sj.ijir.3901556 PMID: 17538641

42. Nutalapati S, Ghagane SC, Nerli R, Jali M, Dixit NS. Association of erectile dysfunction and type II diabetes mellitus at a tertiary care centre of south India. Diabetes Metab Syndr. 2020;14(4):649–53. https://doi.org/10.1016/j.dsx.2020.04.039 PMID: 32438327

43. Ndang Ngou Milama S, Mougougou A, Olagui SG, Mbethe D, Nsame D, Boundama HG, et al. Analysis of the factors associated with ED in type 2 diabetics at the University Hospital of Libreville. Sex Med. 2022;10(6):100564. https://doi.org/10.1016/j.esxm.2022.100564 PMID: 36126588

44. Giugliano F, Maiorino M, Bellastella G, Gicchino M, Giugliano D, Esposito K. Determinants of erectile dysfunction in type 2 diabetes. Int J Impot Res. 2010;22(3):204–9. https://doi.org/10.1038/ijir.2010.1 PMID: 20147958

45. Hackett GI. Erectile dysfunction, diabetes and cardiovascular risk. Br J Diabetes. 2016;16(2):52. https://doi.org/10.15277/bjd.2016.076

46. Ugwu T, Ezeani I, Onung S, Kolawole B, Ikem R. Predictors of erectile dysfunction in men with type 2 diabetes mellitus referred to a tertiary healthcare centre. Adv Endocrinol. 2016;2016:1–8. https://doi.org/10.1155/2016/9753154

47. Omar SM, Musa IR, Idrees MB, Abdelbagi O, Adam I. Prevalence and associated factors of erectile dysfunction in men with type 2 diabetes mellitus in eastern Sudan. BMC Endocr Disord. 2022;22(1):141. https://doi.org/10.1186/s12902-022-01060-0 PMID: 35643513

48. Kimani ST, Nyongesa AW. Effects of single daily khat (Catha edulis) extract on spatial learning and memory in CBA mice. Behav Brain Res. 2008;195(1):192–7. https://doi.org/10.1016/j.bbr.2008.05.022 PMID: 18588917

49. Asefa A, Nigussie T, Henok A, Mamo Y. Prevalence of sexual dysfunction and related factors among diabetes mellitus patients in Southwest Ethiopia. BMC Endocr Disord. 2019;19(1):141. https://doi.org/10.1186/s12902-019-0473-1 PMID: 31852461

50. Nassar OH, Aklan HM. Erectile dysfunction among yemenis: does chewing khat play a role?. Eurasian J Med. 2014;46(2):69–73. https://doi.org/10.5152/eajm.2014.18 PMID: 25610301

51. Kumar R, Kumar U, Trivedi S. Comparison of risk factors for erectile dysfunction (ED) in type 2 diabetics and nondiabetics: a retrospective observational study. Cureus. 2023;15(9):e44576. https://doi.org/10.7759/cureus.44576 PMID: 37790032

52. Ryan JG, Gajraj J. Erectile dysfunction and its association with metabolic syndrome and endothelial function among patients with type 2 diabetes mellitus. J Diabetes Complications. 2012;26(2):141–7. https://doi.org/10.1016/j.jdiacomp.2011.12.001 PMID: 22437118

53. Moon KH, Park SY, Kim YW. Obesity and erectile dysfunction: from bench to clinical implication. World J Mens Health. 2019;37(2):138–47. https://doi.org/10.5534/wjmh.180026 PMID: 30079640

54. Pierce GL, Lesniewski LA, Lawson BR, Beske SD, Seals DR. Nuclear factor-{kappa}B activation contributes to vascular endothelial dysfunction via oxidative stress in overweight/obese middle-aged and older humans. Circulation. 2009;119(9):1284–92. https://doi.org/10.1161/CIRCULATIONAHA.108.804294 PMID: 19237660

55. Nisahan B, Kumanan T, Rajeshkannan N, Perananthara jah T, Aravinthan M. Erectile dysfunction and associated factors among men with diabetes mellitus from a tertiary diabetic center in Northern Sri Lanka. BMC Res Notes. 2019;12(1):210. https://doi.org/10.1186/s13104-019-4244-x PMID: 30953562

56. Fedele D, Bortolotti A, Coscelli C, Santeusanio F, Chatenoud L, Colli E, et al. Erectile dysfunction in type 1 and type 2 diabetics in Italy. On behalf of Gruppo Italiano Studio Deficit Erettile nei Diabetici. Int J Epidemiol. 2000;29(3):524–31. https://doi.org/10.1093/ije/29.3.524 PMID: 10869326

57. Azad AK, Setunge S, Selim S, Chowdhury SH, Rahaman MF, Chowdhury MAJ, et al. Dyslipidaemia as a risk factor for erectile dysfunction in type 2 diabetes mellitus patients. Diabetes Metab Syndr. 2019;13(1):748–53. https://doi.org/10.1016/j.dsx.2018.11.052 PMID: 30641801

58. Almigbal TH. Erectile dysfunction in men with type 2 diabetes: Is it associated with poor glycemic control?. J Men's Health. 2019;15(1):e12–22. https://doi.org/10.22374/jomh.v15i1.104

59. Sharifi F, Asghari M, Jaberi Y, Salehi O, Mirzamohammadi F. Independent predictors of erectile dysfunction in type 2 Diabetes mellitus: Is it true what they say about risk factors?. Int Schol Res Not. 2012;2012.

60. Ezeude CM, Ezeude AM, Young EE, Oguejiofor OC, Bakari AG. Correlates of erectile dysfunction in nigerian men with type 2 diabetes mellitus: experience from a tertiary health center. JDM. 2020;10(03):182–201. https://doi.org/10.4236/jdm.2020.103015

61. Machingura VPI, Chikwasha V. Erectile dysfunction among diabetic patients at parirenyatwa group of hospitals in Zimbabwe. TIJPH. 2018;6(2):69–73. https://doi.org/10.21522/tijph.2013.06.02.art009

62. Tan H-M, Low WY, Ng CJ, Chen K-K, Sugita M, Ishii N, et al. Prevalence and correlates of erectile dysfunction (ED) and treatment seeking for ED in Asian Men: The Asian men's attitudes to life events and sexuality (MALES) study. J Sex Med. 2007;4(6):1582–92. https://doi.org/10.1111/j.1743-6109.2007.00602.x PMID: 17908233

63. Lo WH, Fu SN, Wong CKH, Chen ES. Prevalence, correlates, attitude and treatment seeking of erectile dysfunction among type 2 diabetic Chinese men attending primary care outpatient clinics. Asian J Androl. 2014;16(5):755–60. https://doi.org/10.4103/1008-682X.127823 PMID: 24759587