BMJ Open

Predictive factors of sexual dysfunction and quality of life among type 2 diabetes outpatients in southern Iran: a cross-sectional survey

Vahid Keshtkar [ORCID] ,[1] Mina Zarmehrparirouy [ORCID] ,[2] Mohammad Ali Izadi,[3] Mohammad Hossein Sharifi[4,5]

Correspondence to
Associate Professor Mohammad Hossein Sharifi;
mhsharifi1350@gmail.com

ABSTRACT

Objectives This study was conducted to determine the predictors of sexual dysfunction and quality of life (QOL) in patients with type 2 diabetes (T2D). Sexual dysfunction is a long-term consequence of diabetes that is widely ignored in personal management, even though it can have an adverse effect on QOL.

Design This research was designed as a cross-sectional study.

Setting 12 diabetes centres and clinics in Shiraz, south of Iran.

Participants 390 male patients with T2D mellitus participated in this project. The inclusion criteria were being 30–65 years, having a history of diabetes of at least 1 year, having fasting blood sugar and glycosylated haemoglobin tests and being willing to participate in the study. Patients with medication treatment for mental disorders, a history of heart disease and renal failure were excluded.

Primary outcome measures QOL and erectile dysfunction (ED). The questionnaires were the Audit of Diabetes-Dependent QOL (ADDQOL) and the International Index of Erectile Function (IIEF-15). Data were reported using descriptive and analytical statistics methods.

Result The participants' mean age was 48.35±9.27 years. The average weighted impact (AWI) score of ADDQOL for the participants was −3.01, indicating the negative influence of diabetes on their QOL. The mean value of the total score of sexual dysfunction was 42.79±22.75, and the rates of mild, mild to moderate, moderate and severe ED were 19%, 17.7%, 17.2% and 24.6%, respectively. Sexual dysfunction was significantly related to age (OR=1.06; 95% CI: 1.02 to 1.09), diabetes duration (OR=1.04, 95% CI: 1.01 to 1.07), HbA1c (OR=1.45, 95% CI: 1.07 to 1.95), BMI (OR=1.10, 95% CI: 1.03 to 1.16), marital status (married: OR=2.30, 95% CI: 1.40 to 3.77), without diabetes complication (OR=0.17, 95% CI: 0.08 to 0.31) and insulin therapy (OR=2.86, 95% CI: 1.67 to 4.92). ADDQOL was significantly related to age (OR=1.049), HbA1c (OR=2.192), marital status (married: OR=2.089), educational level (high school certificate: OR=0.337, university degree: OR=0.295), diabetes complication (no complication: OR=0.372) and insulin therapy (OR=3.82). AWI was correlated with the total score of IIEF-15 (r=0.78, p value <0.001).

STRENGTHS AND LIMITATIONS OF THIS STUDY

⇒ The study design was a population-based study with a good sample size.

⇒ Accurate statistical models were used to determine the predictors of the outcomes.

⇒ Using validated and accurate tools, including the Audit of Diabetes-Dependent Quality of Life and International Index of Erectile Function.

⇒ There was a lack of measurement of serum biomarkers such as vitamin D status, zinc level, testosterone level and insulin level.

⇒ Cross-sectional studies cannot establish causal relationships between exposure and outcome.

Conclusion To improve the QOL of diabetic patients, it is suggested that all the predictors of sexual dysfunction, such as glycaemic control, obesity, diabetes complications and duration, should be considered in diabetic management guidelines.

INTRODUCTION

Sexual dysfunction is a long-term consequence of diabetes that is widely ignored in patient management, even though it has an adverse effect on quality of life (QOL).[1][2] Millions of men suffer from sexual dysfunction, yet most prefer not to report it, as talking about sex is taboo in some societies.[2] Previous research revealed that the prevalence of sexual dysfunction was 20–85%.[2] In the recent decade, the issue of diabetes complications has received considerable critical attention. Sexual dysfunction may be a significant determinant of QOL in type 2 diabetes (T2D) mellitus (T2DM) and a predictor of sexual dysfunction and QOL in ongoing research gaps. This study seeks to obtain detailed data that will help to improve diabetes management in patients with T2DM. Although sexual dysfunction and QOL have been evaluated separately in other studies in patients with T2D, few studies have simultaneously

evaluated the predictive factors of sexual dysfunction and QOL. In addition, the published studies on predictors of sexual dysfunction were limited to local surveys.

The inability to achieve or maintain a sufficiently firm erection during a sexual relationship is known as erectile dysfunction (ED).[3] It is the primary type of sexual health problem, according to the World Association for Sexual Health,[4 5] and sexual dysfunction is defined as a change in one of the stages of sexual function, such as desire, arousal or orgasm.[4 5] However, the pathophysiology of the sexual function problem is highly complex. The pathophysiology of ED can be organic, psychological or a disease complication such as arterial and venous disorders, diabetes, chronic hepatitis, cirrhosis, chronic renal failure and coronary bypass graft.[6] As a result, determining the factors related to sexual health in people with diabetes may help to promote sexual health.[7]

Decision-makers have identified QOL as the primary goal of all health interventions, as well as an essential and measurable outcome for determining the effectiveness of healthcare. There are few general questionnaires (36-Item Short Form Survey (SF-36), Health-Related Quality of Life (HRQOL)) for measuring the QOL in diabetes patients. There are few published studies on QOL using specific questionnaires (Audit of Diabetes-Dependent QOL (ADDQOL)).[8 9] A previous study indicated that T2DM negatively impacted QOL in 36.7% of the participants, and diabetes had the most negative average weighted impact (AWI) on 'freedom to eat' and 'family life'.[8]

With the global increase in diabetes in developing and developed countries, a thorough understanding of diabetes complications such as sexual dysfunction could improve healthcare services in diabetes clinics. Although sexual dysfunction and QOL have been evaluated separately in other studies in patients with T2D, a few studies have simultaneously evaluated the predictive factors of sexual dysfunction and QOL using two specific questionnaires. In addition, the published studies on predictors of sexual dysfunction were limited to local surveys. This investigation aimed to identify the predictors of sexual dysfunction and diabetes-dependent QOL in patients with T2D. In addition, although much is known about the prevalence of ED, relatively little is known about its association with men's QOL. In this regard, the following research hypotheses are posed:

H_1: clinical characteristics can predict diabetes-dependent QOL in patients with T2D.

H_2: clinical characteristics can predict sexual dysfunction in patients with T2D.

H_3: the diabetes-dependent QOL has a direct association with sexual dysfunction.

METHODS

Study design and participants
We performed a cross-sectional study design from August to October 2021 in Shiraz, south of Iran. Participants included 390 male patients with T2DM who were referred to diabetes centres and clinics. This study used the convenience sampling method. The inclusion criteria were patients being aged 30–65 years with a history of diabetes for at least 1 year, having fasting blood sugar and glycosylated haemoglobin test and being willing to participate in the study. Mental disorder treatment history, heart disease history and renal failure were all considered exclusion criteria. We calculated the minimum sample size based on the prevalence of ED in Iranian men with T2D (35%), a precision of 5%, and a 95% CI as follows.[10] Therefore, the sample size was estimated at 350 samples, and 390 samples were collected.

$$n = \frac{Z^2 P(1-P)}{d^2}$$
$$Z = 1.96, P = 0.35, 1 - P = 0.65, d = 0.05$$

Data collection
We collected information about participants using three questionnaires. The questionnaires included demographic information, an ADDQOL and a 15-item International Index of Erectile Function (IIEF-15) questionnaire.

Demographic questionnaire
The demographic information included questions such as age, job, marital status, educational level and income level. The clinical characteristics were Body Mass Index (BMI), Fast Blood Sugar (FBS), HbA1c, smoking status, alcohol consumption, diabetes complication, complication type, medication and duration of diabetes.

International Index of Erectile Function
This tool was used to assess the sexual dysfunction of men. It consists of 15 items in the form of five areas as follows: (1) erectile function (items=1-2-3-4-5-15), (2) orgasmic function (items=9–10), (3) sexual desire (items=11–12), (4) intercourse satisfaction (items=6-7-8) and (5) overall satisfaction (items=13–14). Six-point and five-point Likert-type scales from 0 to 5 (for items 1–10) and 1 to 5 (for items 11–15) were used for item scaling. The maximum acceptable score is 75, which reflects a better sexual function. Furthermore, according to previous studies, the severity of dysfunction is classified as 'severe sexual dysfunction' (score=0–10), 'moderate' (score=11–16), 'moderate to mild' (score=17–21), 'mild' (score=22–25) and 'lack of sexual dysfunction' (score=26–30).[11] According to the results of Rosen's study, the reliability coefficient (Cronbach's alpha) of this tool was in the range of 0.73–0.99.[12] In this study, Cronbach's alpha was obtained at 0.99. According to the study by Rezaei et al, the IIEF-15 Persian version was valid and reliable (Cronbach's alpha=0.893) for evaluating male sexual function.[13]

Audit of Diabetes-Dependent QOL
The ADDQOL questionnaire includes two sections: the overview items and 19 domains related to the impact of diabetes on specific aspects of QOL. The overview items have two questions: (1) my present QOL and (2) if I did not have diabetes, my QOL would be… The 19-domain

section is as follows: leisure activities, working life, journeys, holidays, physical health, family life, friendships and social life, personal relationships, sex life, physical appearance, self-confidence, motivation, people's reactions, feelings about the future, financial situation, living conditions, dependence on others, freedom to eat and freedom to drink. For the 19-domain section, the scoring system ranges from −3 to +1 for the 'impacting rate' and 0 to +3 for attributed importance (importance rating). The weighted impact score (ranging from −9 to +3) for each domain is calculated as an impacting rate (−3 to +1) multiplied by an importance rating (0 to +3). The weighted impact scores were divided by the number of functional domains to obtain the AWI score (ranging from −9 to +3). More negative scores reflect a more negative impact of diabetes and poorer QOL. Based on the study by Chung et al, the overall reliability of this tool (Cronbach's alpha) was 0.96,[14] and it was achieved as 0.95 for this study. According to the study by Ghazanfari et al, the Persian version of the ADDQOL was a valid and reliable instrument (Cronbach's alpha=0.931) for assessing how diabetes affects the QOL in Iranian contexts.[15]

Ethics

This survey was related to the participants' problems. Consequently, after receiving written informed consent, the participants did not mention their identities at the beginning of the questionnaire or on the demographic information page to protect their privacy. The study was reviewed and approved by the ethics committee of Shiraz University of Medical Sciences (Code=IR.SUMS.MED.RED.1399.284).

Statistical analysis

The normality assumptions were tested using the Kolmogorov-Smirnov test and skewness and kurtosis values. Missing values were not observed in any of the study variables. Descriptive statistics were represented as frequency (percentage) for categorical variables or by mean±SD and median (min, max) for continuous variables. The Mann-Whitney U test and Kruskal-Wallis test compared the dependent variable (AWI) between independent variable groups. The Spearman correlation coefficient test was also used to assess the potential relationship between the dependent variable and continuous demographic and clinical characteristics (age, BMI, diabetes duration, FBS and HbA1c).

We used the backward stepwise logistic regression model to identify the influence of the participants' demographic and clinical characteristics on their QOL. The participants were categorised into two groups based on the lower quartiles of the ADDQOL score. Thus, the dependent variable was a poorer QOL (lower AWI vs higher AWI).[14] The predictors of sexual dysfunction were determined by performing the ordinal logistic regression analysis (univariate and multivariable). Finally, the Spearman correlation coefficient test assessed the relationship between the AWI score and the total IIEF-15

score. The correlation matrix and multicollinearity via VIF (Variance Inflation Factor) were used to check the association between variables and choose the predictors of regression models. Correlation coefficients >0.80 and VIF >5 indicate strong correlations and multicollinearity. The statistical analyses were carried out using R software (version 3.3.1). A p value<0.05 was set as the statistical significance level.

Patient and public involvement

Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

RESULTS

Demographic and clinical characteristics

Table 1 represents the demographic and clinical characteristics of the study population based on the AWI (score of ADDQOL). 390 men with T2DM aged 48.35±9.27 years participated in this study. The majority of the participants were employed (58.2%) and single (62.1%) and had high school certificates (46.9%). The income level of 55.9 per cent (n=218) of the participants was equal to expenses. Diabetes duration was 10.2±7.67 years. Alcohol consumption status in patients was never (n=177, 45.4%), sometimes (n=160, 41%) and regular (n=53, 13.6%). 69% of the patients (n=267) did not have complications of diabetes. Most participants had diabetic foot complications (n=41, 10.5%). The medication methods for patients were oral antidiabetic therapy (n=109, 27.9%), insulin therapy (n=224, 57.4%) and 'oral antidiabetic+insulin' therapy (n=57, 14.6%).

ADDQOL-19 score

The moderate weighted impact (AWI) score of ADDQOL for the participants was −3.01, which indicated the negative influence of diabetes on their QOL. There was a significant difference between job levels (p value <0.001), educational levels (p value <0.05), income levels (p value <0.05), complication types (p value <0.001) and medication levels (p value <0.001) about AWI score. AWI score was significantly lower in married patients (−3.67±2.49) and patients with diabetes complications (−5.02±1.99) than in single patients and patients with non-complicated diabetes. Age (r=−0.33, p value <0.001), BMI (r=−0.24, p value <0.001), diabetes duration (r=−0.47, p value <0.001), FBS (r=−0.69, p value <0.001) and HbA1c (r=−0.73, p value <0.001) were significantly negatively associated with AWI (table 1).

Pie charts of the two overview items of QOL in the participants' study are presented in the online supplemental figure. The patient's QOL rate at good, very good and excellent levels was 41%. In addition, 59% of patients believed that their QOL would have been very much better if they did not have diabetes, while 21% thought that would have been about the same (online supplemental figure).

Table 1 Demographic and clinical characteristics of the study population (n=390) based on AWI score of ADDQOL

Variable	Value	AWI score		P value
		Mean±SD	Median (min, max)	
Gender (male)	390 (100)	−3.01±2.27	−2.68 (−8.68, 0)	−
Age	48.35±9.27	−0.33†		<0.001***
Job				
Employed	227 (58.2)	−2.32±1.92	−1.95 (−8.53, 0)	<0.001***‡
Retired	85 (21.8)	−4.15±2.31	−4.84 (−8.68, 0)	
Unemployed	78 (20)	−3.79±2.47	−3.63 (−8.21, −0.16)	
Marital status				
Single	242 (62.1)	−2.61±2.04	−2.24 (−8.68, 0)	<0.001***§
Married	148 (37.9)	−3.67±2.49	−3.52 (−8.53, 0)	
Educational level				
Primary/secondary education	97 (24.9)	−3.47±2.18	−3.37 (−8.21, 0)	0.043*‡
High school certificate	183 (46.9)	−2.93±2.36	−2.47 (−8.68, 0)	
College or university degree	110 (28.2)	−2.75±2.17	−2.26 (−8.37, 0)	
Income level				
Less than expenses	98 (25.1)	−3.60±2.43	−3.18 (−8.68, −0.16)	0.01*‡
Equal to expenses	218 (55.9)	−2.94±2.27	−2.58 (−8.53, 0)	
More than expenses	74 (19)	−2.45±1.92	−2.15 (−6.79, −0.05)	
BMI	24.43±4.01	−0.24†		<0.001***
Diabetes duration (years)	10.2±7.67	−0.47†		<0.001***
FBS	200.63±62.68	−0.69†		<0.001***
HbA1c	8.71±1.94	−0.73†		<0.001***
Smoking status				
Never	197 (50.5)	−3.04±2.34	−2.79 (−8.68, 0)	0.57‡
Sometimes	170 (43.6)	−2.93±2.22	−2.59 (−8.53, 0)	
Regular	23 (5.9)	−3.39±2.22	−3.52 (−8.21, −0.42)	
Alcohol consumption				
Never	177 (45.4)	−3.10±2.34	−2.68 (−8.68, 0)	0.23‡
Sometimes	160 (41)	−2.80±2.20	−2.52 (−8.53, 0)	
Regular	53 (13.6)	−3.36±2.25	−3.21 (−8.21, 0)	
Diabetes complications				
Yes	123 (31.5)	−5.02±1.99	−5.42 (−8.68, −0.05)	<0.001***§
No	267 (68.5)	−2.08±1.74	−1.79 (−7.79, 0)	
Complication type				
Retinopathy	5 (1.3)	−4.83±1.11	−4.84 (−6.21, −3.21)	<0.001***‡
Nephropathy	36 (9.2)	−5.19±2.08	−5.55 (−8.53, −0.05)	
Neuropathy	33 (8.5)	−5.05±2.00	−5.42 (−8.68, −0.16)	
Hypertension	8 (2.1)	−4.57±2.91	−5.13 (−7.89, −0.21)	
Diabetic foot	41 (10.5)	−4.96±1.87	−5.05 (−8.37, −0.53)	
Medication				
Oral antidiabetic therapy	109 (27.9)	−1.25±1.18	−0.89 (−5.11, 0)	<0.001***‡
Insulin therapy	224 (57.4)	−3.31±2.12	−3.21 (−8.53, 0)	
Oral+insulin	57 (14.6)	−5.21±2.04	−5.57 (−8.68, −0.26)	

Data are presented as n (%), median (min, max) or mean±SD.
−, no p-value for gender (male).
*p<0.05 and ***p<0.001.
†Bivariate correlation coefficients for relationship between continues variables and AWI.
‡Kruskal-Wallis test.
§Mann-Whitney U test.
ADDQOL, Audit of Diabetes-Dependent Quality of Life; AWI, average weighted impact.

Table 2 Distribution of response by impact and importance ratings together with the weighted impact score of ADDQOL

Domain	Impact rating (mean±SD)	Importance rating (mean±SD)	Weighted impact score (mean±SD)
Leisure activities	−1.45±1.01	1.86±0.81	−2.78±2.49
Working life	−1.27±1.09	2.03±0.76	−2.77±2.67
Journeys	−1.37±1.06	1/.73±0.77	−2.55±2.47
Holidays	−1.33±0.95	1.80±0.84	−2.66±2.54
Physical health	−1.53±1.04	2.11±0.78	−3.42±2.87
Family life	−1.13±1.02	2.05±0.78	−2.47±2.61
Friendship and social life	−1.21±1.08	1.96±0.77	−2.51±2.60
Personal relationship	−1.18±1.07	1.92±0.72	−2.49±2.69
Sex life	−1.40±1.08	2.15±0.77	−3.17±2.87
Physical appearance	−1.17±1.02	2.16±0.77	−2.75±2.77
Self-confidence	−1.54±1.05	2.27±0.77	−3.71±3.06
Motivation	−1.58±1.06	2.28±0.76	−3.79±3.05
People's reactions	−1.10±1.00	2.08±0.66	−2.48±2.62
Feelings about future	−1.25±1.02	2.16±0.68	−2.93±2.74
Financial situation	−0.82±1.00	2.16±0.79	**−1.89±2.50**
Living conditions	−1.39±1.00	2.19±0.069	−3.29±2.81
Dependence on others	−1.41±1.04	2.19±0.69	−3.33±2.91
Freedom to eat	−1.71±0.92	2.20±0.73	−3.95±2.75
Freedom to drink	−1.89±0.86	2.18±0.73	**−4.30±2.67**

Impact rating (without diabetes conditions): −3, very much better; −2, much better; −1, a little better; 0, the same and +1, worse. Importance rating: 0, not at all important; 1, somewhat important; 2, important and 3, very important.
Weighted impact score=¼impact rating (−3 to +1)×importance rating (0–3)=(−9 maximum negative impact of diabetes) to +3 (maximum positive impact of diabetes).
The lowest and highest negative weighted impact scores are highlighted in bold.
ADDQOL, Audit of Diabetes-Dependent Quality of Life.

Table 2 presents the distribution of responses by impact and importance rating, together with the weighted impact score of ADDQOL for the participants. Diabetes had the highest impact on domains including 'freedom to drink' (impact rating=−1.89±0.86) and 'freedom to eat' (impact rating=−1.71±0.92) and had the lowest impact on the 'financial situation' domain (impact rating=−0.82±1.00). 'Motivation' (2.28±0.76) and 'journeys' (1.73±0.77) domains had the most and the least essential ratings, respectively. In addition, all of the 19 ADDQOL domains had negative weighted impact scores. The lowest and highest negative weighted impact scores were the financial situation (−1.89±2.50) and freedom to drink environment (−4.30±2.67), respectively. The lower the scores, the worse the QOL related to each domain (table 2).

Table 3 shows the results of backward stepwise logistic regression analysis to determine the predictors of ADDQOL. The practical and significant predictors of the dependent variable (lower QOL vs higher QOL) remained in the final model. Lower QOL was significantly related to age (OR=1.049, p value=0.008), HbA1c (OR=2.192, p value <0.001), marital status (married: OR=2.089, p value=0.023), educational level (high school: OR=0.337, university degree: OR=0.295; p value=0.002),

diabetes complication (no complication: OR=0.372, p value=0.011) and medication (insulin: OR=3.82, p value=0.001; oral+insulin: OR=4.763, p value=0.016). No significant relationship was observed between QOL and other predictors.

IIEF-15 score
According to the IIEF-15 questionnaire results, the mean value of the total score of sexual function for participants was 42.79±22.75. The mean±SD scores of five subscales included erectile function (17.12±9.57), orgasmic function (5.59±3.21), sexual desire (5.93±2.67), intercourse satisfaction (8.07±4.71) and overall satisfaction (6.07±2.91). 21.5% (n=84) of the participants had a normal sexual dysfunction, but the rates of severe sexual dysfunction were 24.60% (n=96), moderate sexual dysfunction 17.20% (n=67), mild to moderate sexual dysfunction 17.70% (n=69) and mild sexual dysfunction 19% (n=74). In other words, 79.5% of the participants experienced varying degrees of sexual dysfunction.

Table 4 presents the result of ordinal logistic regression to describe the predictors of sexual dysfunction. The multivariable model showed that the most effective predictors of sexual dysfunction were age, diabetes duration,

Table 3 Predictors of low ADDQOL using logistic regression analysis

Variable		Full model		Final model†		
		OR	95% CI	OR	95% CI	P value
Age (years)		1.041	0.994 to 1.090	1.049	1.012 to 1.086	0.008*
Diabetes duration (years)		1.030	0.980 to 1.083	–		
HbA1c		2.060	1.352 to 3.137	2.192	1.731 to 2.775	<0.001***
FBS		1.004	0.990 to 1.017	–		
BMI		0.954	0.877 to 1.038	–		
Job	Employed (ref)	1		–		
	Retired	1.176	0.445 to 3.112			
	Unemployed	2.425	0.880 to 6.680			
Marital status	Single (ref)	1	–	1		
	Married	1.642	0.790 to 3.416	2.089	1.106 to 3.945	0.023*
Educational level	Primary/secondary education (ref)	1		1		
	High school certificate	0.279	0.132 to 0.590	0.337	0.167 to 0.677	0.002*
	University degree	0.222	0.089 to 0.550	0.295	0.135 to 0.644	0.002*
Income level	Less than expenses (ref)	1		–		
	Equal to expenses	1.446	0.628 to 3.325			
	More than expenses	2.365	0.794 to 7.044			
Smoking status	Never (ref)	1		–		
	Sometimes	1.065	0.395 to 2.875			
	Regular	0.550	0.112 to 2.700			
Alcohol consumption	Never (ref)	1		–		
	Sometimes	1.357	0.481 to 3.830			
	Regular	2.878	0.919 to 9.017			
Diabetes complications	Yes (ref)	1		1		
	No	0.341	0.149 to 0.780	0.372	0.174 to 0.796	0.011*
Medication	Oral antidiabetic therapy (ref)	1		1		
	Insulin therapy	3.885	1.733 to 8.707	3.820	1.760 to 8.289	0.001*
	Oral+insulin	4.765	1.153 to 19.699	4.763	1.332 to 17.030	0.016*

–, the variables not determined as predictors in backward stepwise logistic regression model.
Dependent variable=average weighted impact (AWI).
*p<0.05 and ***p<0.001.
†Backward stepwise logistic regression model.
ADDQOL, Audit of Diabetes-Dependent Quality of Life; ref, reference category for predictor variables.

HbA1c, FBS and BMI. With increasing age (OR=1.06, p value <0.001), diabetes duration (OR=1.04, p value=0.04), HbA1c (OR=1.45, p value=0.02), FBS (OR=1.02, p value=0.02) and BMI (OR=1.10, p value=0.03) the probability of severe sexual dysfunction enhanced to 1.06, 1.04, 1.45, 1.02 and 1.10, respectively. Married participants were 2.30 times more likely than single ones to have severe sexual dysfunction (p value=0.01). The odds of severe sexual dysfunction in participants without diabetes complications was 0.83 (1-OR=1–0.17, p value <0.001)) less than those with difficulties. Participants treated with insulin (OR=2.86, p value <0.001) and oral+insulin (OR=2.75, p value=0.04) were 2.86 and 2.75 times more likely to have severe sexual dysfunction than the oral anti-diabetic therapy group, respectively.

Relationship between ADDQOL and IIEF-15
Figure 1 demonstrates the relationship between total QOL scores and sexual dysfunction for diabetic patients using the Spearman correlation test. AWI was positively significantly correlated with the total score of IIEF-15 (r=0.78, p value<0.001).

DISCUSSION
Despite extensive research, diabetes remains a noncommunicable disease with a significant burden in developed and developing countries. There is a clear need for research into all aspects of diabetes. QOL and sexual dysfunction are two essential aspects of diabetes that were investigated concurrently in this study. The main

Table 4 Predictors of sexual dysfunction according to the IIEF-15 using ordinal logistic regression

Variable		Univariate model		Multivariable model	
		OR (95% CI)	P value	OR (95% CI)	P value
Age (years)		1.11 (1.08 to 1.14)	<0.001***	1.06 (1.02 to 1.09)	<0.001***
Diabetes duration (years)		1.15 (1.12 to 1.18)	<0.001***	1.04 (1.01 to 1.07)	0.04*
HbA1c		3.04 (2.61 to 3.54)	<0.001***	1.45 (1.07 to 1.95)	0.02*
FBS		1.04 (1.03 to 1.041)	<0.001***	1.02 (1.01 to 1.03)	0.02*
BMI		1.17 (1.12 to 1.23)	<0.001***	1.10 (1.03 to 1.16)	0.03*
Job	Employed (ref)	–		–	
	Retired	6.40 (3.94 to 10.40)	<0.001***		
	Unemployed	3.89 (2.43 to 6.25)	<0.001***		
Marital status	Single (ref)	–		–	
	Married	2.51 (1.72 to 3.65)	<0.001***	2.30 (1.40 to 3.77)	0.01*
Educational level	Primary/secondary education (ref)	–		–	
	High school certificate	0.84 (0.55 to 1.29)	0.43		
	College or university degree	0.56 (0.34 to 0.91)	0.02*		
Income level	Less than expenses (ref)	–		–	
	Equal to expenses	0.55 (0.34 to 0.83)	0.01*		
	More than expenses	0.29 (0.17 to 0.49)	<0.001***		
Smoking status	Never (ref)	–		–	
	Sometimes	0.78 (0.55 to 1.13)	0.19		
	Regular	1.61 (0.70 to 3.68)	0.26		
Alcohol consumption	Never (ref)	–		–	
	Sometimes	0.66 (0.45 to 0.96)	0.03*		
	Regular	1.07 (0.63 to 1.84)	0.79		
Diabetes complications	Yes (ref)	–		–	
	No	0.04 (0.02 to 0.07)	<0.001***	0.17 (0.08 to 0.31)	<0.001***
Medication	Oral antidiabetic therapy (ref)	–		–	
	Insulin therapy	8.80 (5.51 to 14.05)	<0.001***	2.86 (1.67 to 4.92)	<0.001***
	Oral+insulin	71.91 (34.06 to 150.11)	<0.001***	2.75 (1.03 to 7.30)	0.04*

Dependent variable=sexual dysfunction (1=severe, 2=moderate, 3=mild to moderate, 4=mild and 5=normal).
–, the variables not determined as predictors in the ordinal logistic regression model.
*p<0.05 and ***p<0.001.
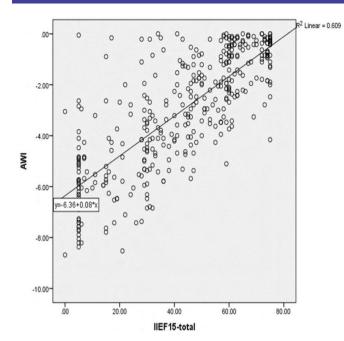IIEF-15, International Index of Erectile Function; ref, reference category for predictor variables.

Figure 1 Correlation between average weighted impact (AWI) score of Audit of Diabetes-Dependent Quality of Life and the total score of erectile dysfunction using International Index of Erectile Function (IIEF-15) (r=0.78, p<0.001) (0<R²<1 is the goodness of fit index for model [r=0.78]²=0.609).

finding of the present study showed that the frequency of sexual dysfunction was notable (79.5% of the participants experienced varying degrees of sexual dysfunction), and the AWI of the QOL was correlated with the total score of sexual dysfunction (r=0.77). The analysis showed that QOL was significantly related to age, HbA1c, marital status, educational level, diabetes complications and medication. In addition, sexual dysfunction is associated dramatically with age, diabetes duration, HbA1c, FBS, BMI, marital status, diabetes complications and type of medication.

Diabetes, as a chronic disease, can impact QOL; however, determining its detailed factors may be necessary for enhancing diabetes management. About 60% of patients in the current study believed that their QOL would be much better with no diabetes. The highest negative weighted impact scores were associated with the freedom to drink domain (−4.30±2.67), freedom to eat (−3.95±2.75), motivation (−3.79±3.05) and self-confidence (−3.71±3.06), respectively. This finding is consistent with the results of the study by Papazafiropoulou et al, which found that the highest negative weighted impact scores were freedom to eat (−3.95±2.75), freedom to drink (2.5±2.9) and self-confidence (2.9±3.1).[16] Furthermore, the current study found that the highest negative weighted impact scores were associated with the financial situation (−1.89±2.50).

In contrast, previous studies found that the negative weighted impact scores of the financial situation were mild to moderate (2.2±3.8).[17] One possible explanation for this is socioeconomic and cultural differences. In other words, different countries have different socioeconomic and cultural differences that can affect various aspects of QOL. In sum, diabetes had a negative weighted impact score on almost every QOL item, but this effect varied depending on socioeconomic and cultural status. Identifying predictors of QOL among patients with T2D could help to deepen understanding of the factors related to diabetes and improve diabetic management. QOL was found to be significantly linked to age, HbA1c, marital status, educational level, diabetes complications and insulin therapy in the current study. In this respect, increased HbA1C and diabetes duration increase the likelihood of lower QOL by 2.2 and 2.1 times, respectively. In the current study, much evidence indicated that QOL was inversely associated with HbA1c.[17–19] In addition, the likelihood of having a low QOL decreased by 70% with a higher educational level (university level). The study by Alshayban and Joseph revealed a significant distinction in QOL between academic levels.[19 20] This finding could be explained by the fact that participants with a high level of education had high coping mechanisms with acceptance of disease and complications.

Furthermore, without a diabetes complication, the likelihood of having a low QOL decreased by 63%. Also, the possibility of lower QOL was 3.9 times higher with insulin therapy compared with oral medication therapy. This finding is in line with a previous study that demonstrated the association between insulin treatment and QOL.[21] One explanation for this result is that the diabetic patient who received insulin therapy had a long disease duration.[22] Identifying predictors of sexual dysfunction among patients with T2D could help to deepen understanding of the complications of diabetes and improve diabetic management. The current study revealed that sexual dysfunction was significantly related to age, diabetes duration, HbA1c, marital status, diabetes complications and type of medication. One of the key findings of this study was that every unit increase in HbA1C increased the likelihood of sexual dysfunction by 45%. Previous studies found that men with poor glycaemic control are more susceptible to sexual dysfunction than those with reasonable control.[23 24] Vitamin D status and HbA1C may be related through a mechanism that affects endothelial dysfunction and raises the risk of sexual dysfunction.[25–28]

ED may be associated with low testosterone, but the current study did not assess this.[24] People who do not have diabetes complications have an 83% lower risk of developing ED. Based on a previous study, one of the predictors of ED was diabetes complications.[1 27] A previous study found a link between ED and microvascular issues such as diabetic nephropathy (OR=1.33) and diabetic neuropathy (OR=1.32).[26] Due to the high prevalence of ED in diabetic patients, we recommend that all healthcare facilities provide individualised ED consultations to all diabetic patients. Insulin users had a 2.9-fold increased risk of developing ED in this study. This result can partly be explained by the fact that the diabetic patient who received insulin therapy had a chronic illness. QOL and

ED are two essential aspects of diabetes that were investigated concurrently in this study. The main finding of the present study showed that QOL was strongly correlated with the ED (r=0.77). In other words, this study showed that increased sexual function increased QOL. According to a recent systematic review of six high-quality studies, diabetes-related ED negatively impacted the QOL, with a higher ED severity associated with a lower rate of life.[29 30]

This study had several limitations; serum biomarkers associated with ED were not measured, such as vitamin D status, zinc level, testosterone level and insulin level. Furthermore, our findings are not able to illuminate a causal relationship because the data is cross-sectional. We used the convenience sampling method in all diabetes clinics. Although convenience sampling inhibits the generalisability of the study, it is still an acceptable sampling technique. As a result, additional research is required.

In conclusion, our finding of QOL predictors among patients with T2D adds to the knowledge of associated diabetes-related factors and enhances diabetic management. Our results showed that diabetes adversely affected the patients' QOL in most domains of life, including sexual dysfunction. The prevalence of ED is substantial, and it would be helpful to understand its predictors in patients with T2D to better manage their condition. However, because our study was cross-sectional, additional prospective studies are required to confirm our findings. To improve the patient's QOL, we recommend developing and implementing individual consultation strategies and interventions for patients with diabetes.

Author affiliations
[1]Department of Community Medicine, Shiraz University of Medical Sciences, Shiraz, Iran (the Islamic Republic of)
[2]Department of Biostatistics, School of Allied Medical Sciences, Shahid Beheshti University of Medical Sciences, Tehran, Iran (the Islamic Republic of)
[3]Shiraz University of Medical Sciences, Shiraz, Iran (the Islamic Republic of)
[4]Research Center for Traditional Medicine and History of Medicine, Shiraz University of Medical Sciences, Shiraz, Iran (the Islamic Republic of)
[5]Non-Communicable Diseases Research Center, Shiraz University of Medical Sciences, Shiraz, Iran (the Islamic Republic of)

ORCID iDs
Vahid Keshtkar http://orcid.org/0000-0001-5293-724X
Mina Zarmehrparirouy http://orcid.org/0000-0002-4226-7331

REFERENCES

1 Kouidrat Y, Pizzol D, Cosco T, et al. High prevalence of erectile dysfunction in diabetes: a systematic review and meta-analysis of 145 studies. *Diabet Med* 2017;34:1185–92.
2 Anwar Z, Sinha V, Mitra S, et al. Erectile Dysfunction: An Underestimated Presentation in Patients with Diabetes Mellitus. *Indian J Psychol Med* 2017;39:600–4.
3 Salvio G, Ciarloni A, Cutini M, et al. Hyperhomocysteinemia: Focus on Endothelial Damage as a Cause of Erectile Dysfunction. *Int J Mol Sci* 2021;22:418.
4 Gutiérrez-Valverde JM, Portillo PF, Guevara-Valtier MC, et al. Sexual Dysfunction, Depression and Quality of Life in Individuals with Diabetes Mellitus Type 2. *IJN* 2016;3:9–19.
5 Peixoto MM, Lopes J, Rodrigues AL. Quality of Life, Sexual Functioning and Chronic Disease: A Comparative Study with Portuguese Women without Chronic Disease, and Women with Diabetes Type 1 and 2, and Arterial Hypertension. *Int J Sex Health* 2022;34:209–20.
6 Rew KT, Heidelbaugh JJ. Erectile Dysfunction. *Am Fam Physician* 2016;94:820–7.
7 Ford JV, Ivankovich MB, Douglas JM Jr, et al. The Need to Promote Sexual Health in America: A New Vision for Public Health Action. *Sex Transm Dis* 2017;44:579–85.
8 Levterova BA, Orbetzova M, Levterov G, et al. Assessment of the impact of type 2 diabetes on the quality of life by Audit of Diabetes-Dependent Quality-of-Life (ADDQoL-19). *Biotechnology & Biotechnological Equipment* 2018;32:1627–34.
9 Zurita-Cruz JN, Manuel-Apolinar L, Arellano-Flores ML, et al. Health and quality of life outcomes impairment of quality of life in type 2 diabetes mellitus: a cross-sectional study. *Health Qual Life Outcomes* 2018;16:94.
10 Mofid A, et al. Prevalence and risk factors of erectile dysfunction in Iranian diabetic men. *Acta Med Iran* 2009;309–14.
11 Jafari Torkamani Z, Dolatian M, Omani-Samani R, et al. Relationship between sexual function and type 2 diabetes in infertile men referred to Royan institute. *J Renal Inj Prev* 2020;10:e33.
12 Rosen R, O'Leary M, Altwein J, et al. Luts and male sexual dysfunction: The multi-national survey of the aging male (MSAM-7). *European Urology Supplements* 2003;2:S25:94:.
13 Rezaei N, Sharifi N, Fathnezhad-Kazemi A, et al. Evaluation of Psychometric Properties of the Persian Version of Brief Male Sexual Function Inventory: A Cross-Sectional Study. *Sex Med* 2021;9:100409.
14 Chung JO, Cho DH, Chung DJ, et al. Assessment of Factors Associated with the Quality of Life in Korean Type 2 Diabetic Patients. *Intern Med* 2013;52:179–85.
15 Ghazanfari Z, Naghizadeh MM, Hadavi M, et al. Translation and psychometric properties of the Persian version of the Audit of

Diabetes Dependent Quality of Life (IR-ADDQoL). *Health Qual Life Outcomes* 2022;20:156.
16 Papazafiropoulou AK, Bakomitrou F, Trikallinou A, *et al*. Diabetes-dependent quality of life (ADDQOL) and affecting factors in patients with diabetes mellitus type 2 in Greece. *BMC Res Notes* 2015;8:786.
17 Stahl-Pehe A, Landwehr S, Lange KS, *et al*. Impact of quality of life (QoL) on glycemic control (HbA1c) among adolescents and emerging adults with long-duration type 1 diabetes: A prospective cohort-study. *Pediatr Diabetes* 2017;18:808–16.
18 Al-Taie N, Maftei D, Kautzky-Willer A, *et al*. Assessing the quality of life among patients with diabetes in Austria and the correlation between glycemic control and the quality of life. *Prim Care Diabetes* 2020;14:133–8.
19 ALSharit BA, Alhalal EA. Effects of health literacy on type 2 diabetic patients' glycemic control, self-management, and quality of life. *Saudi Med J* 2022;43:465–72.
20 Alshayban D, Joseph R. Health-related quality of life among patients with type 2 diabetes mellitus in Eastern Province, Saudi Arabia: A cross-sectional study. *PLoS One* 2020;15:e0227573.
21 Arditi C, Zanchi A, Peytremann-Bridevaux I. Health status and quality of life in patients with diabetes in Switzerland. *Prim Care Diabetes* 2019;13:233–41.
22 Boels AM, Rutten G, Cleveringa F, *et al*. Insulin Therapy in Type 2 Diabetes Is Associated With Barriers to Activity and Worse Health Status: A Cross-Sectional Study in Primary Care. *Front Endocrinol (Lausanne)* 2021;12:573235.
23 Binmoammar TA, Hassounah S, Alsaad S, *et al*. The impact of poor glycaemic control on the prevalence of erectile dysfunction in men with type 2 diabetes mellitus: a systematic review. *JRSM Open* 2016;7.
24 Ugwu T, Ezeani I, Onung S, *et al*. Predictors of Erectile Dysfunction in Men with Type 2 Diabetes Mellitus Referred to a Tertiary Healthcare Centre. *Advances in Endocrinology* 2016;2016:1–8.
25 Arıman A, Merder E, Çulha MG, *et al*. Relation of glycated hemoglobin and vitamin D deficiency with erectile dysfunction in patients with type 2 diabetes mellitus. *Andrologia* 2021;53:e14076.
26 Kumsar Ş, Ciğerli Ö, Hasırcı E, *et al*. The relationship between serum irisin levels and erectile dysfunction in diabetic men (irisin and erectile dysfunction in diabetic patients). *Andrologia* 2021;53:e13959.
27 Ryan JG, Gajraj J. Erectile dysfunction and its association with metabolic syndrome and endothelial function among patients with type 2 diabetes mellitus. *J Diabetes Complicat* 2012;26:141–7.
28 Castela Â, Costa C. Molecular mechanisms associated with diabetic endothelial-erectile dysfunction. *Nat Rev Urol* 2016;13:266–74.
29 Thongtang P, Seesawang J. Erectile dysfunction and quality of life among diabetic men: a systematic review of quantitative studies. *Nursing Science Journal of Thailand* 2020;38:4–18.
30 Thongtang P, Fongkaew W, Lojanapiwat B, *et al*. Prevalence and Factors Associated with Quality of Life among Diabetic Men Living with Erectile Dysfunction. *Walailak J Sci & Tech* 2020;17:947–57.