

Predictors of Erectile Dysfunction in Type 2 Diabetes Mellitus

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Abstract

The aim of the study was to determine the frequency of erectile dysfunction among type 2 diabetes (T2DM) mellitus and to determine the predictive risk factors of erectile dysfunction in men with T2DM. A cross-sectional study was conducted on 184 men with T2DM from patients attending the internal medicine diabetic outpatient clinic of Tanta university hospital, Gharbia Governorate, Egypt. The results revealed that 42.93% of study group suffered from erectile dysfunction. Glycated hemoglobin, age in years, systolic and diastolic blood pressure, smoking condition and high total cholesterol are considered significant predictors for erectile dysfunction among T2DM patients. The study concluded that the prevalence of erectile dysfunction was high in men with T2DM and glycated hemoglobin, age in years, systolic and diastolic blood pressure, smoking condition and high total cholesterol are considered significant predictive risk factors for erectile dysfunction among diabetic patients that let us recommend certain measures to prevent, early detection and management of these risk factors.

Key words: Predictor, erectile dysfunction, T2DM.

Introduction

Erectile dysfunction (ED) is described as a persistent inability (more than 6 months) to attain and maintain an erection enough to have a satisfactory sexual performance.⁽¹⁾ Erectile dysfunction (ED) is a common complication in diabetes mellitus (DM). About two fifths to three fourths of diabetic men suffer from ED. ED often occurs 10–15 years earlier and is more severe among diabetic than non-diabetic men.⁽²⁾ The causes of diabetic erectile dysfunction in men are complex and involve impairments in blood vessels, muscle, and nerve function.⁽³⁾ Hyperglycemia may lead to smooth muscle dysfunction by the oxidation of

low density lipoprotein and increased production of free-oxygen radical species.⁽⁴⁾

ED is associated with a reduced quality of life.⁽⁵⁻⁸⁾ The overall cost for the treatment of patients suffering from ED in the United States is around 400 million Dollars.⁽⁹⁾ Prediction of the risk factors associated with ED in diabetic patients is important for better prevention and management of the disease. So, the aim of the present study was to determine the frequency of ED among type 2 diabetes mellitus (T2DM) and the predictive risk factors of ED in men with T2DM.

Materials and Methods

In this cross-sectional study, all the subjects recruited from men with T2DM were attending the internal medicine diabetic outpatient clinic of Tanta university hospital, Gharbia Governorate, Egypt. Participants gave a written informed consent. The study population consisted of 184 men with T2DM, enrolled between first of January 2013 and the end of May 2013.

Inclusion criteria:

The inclusion criteria for participation were married men attending the outpatient diabetic clinic with T2DM and aged more than 30 years.

Exclusion criteria:

The exclusion criteria included patients with major depressive disorder, history of spinal or prostate surgery, and patients with secondary causes of impotency (such as hostility, guilt, anger, or shame). Also, patients had history of hypertension under treatment of beta blockers, ≤ 30 years of life or unmarried patients were excluded.

Study sample

The total sample size was calculated using Minitab statistical program version 16 and it was 198 diabetic patients. The minimal sample size for diabetic erectile dysfunction (single proportion) was 180 putting into consideration that comparison probability was 57.0%⁽¹⁰⁾, hypothesis probability from pretest was 45% (9 out of 20 diabetic patients) and power of 90.0%. Ten percent were added for dropout cases. The response rate was found to be 92.92% (184 out of 198). Our study sample constituted 198 type 2

diabetic men (16.5%) out of the total study population (1200) diabetic men who attended the diabetic clinic during study period.

Recruitment:

Recruitment of type 2 diabetic patients was random from daily registered cases (simple random) where every type 2 diabetic patient represented by card with blind selection of one of them. About five cases per day were chosen, two days per week for about five months. Blind selections of other cards were done when the patients were excluded due to exclusion criteria (29 cases; 20 type 1 diabetes, 5 less than 30 years, 3 suffered from hypertension under beta blockers and 1 case suffered from secondary cause of impotence.

Definition of type 2 DM:

T2DM is defined as noninsulin-dependent DM or adult-onset diabetes. DM is associated with recurrent or persistent hyperglycemia, and is diagnosed by demonstrating any one of the following: (1) fasting plasma glucose level ≥ 7.0 mmol/l (126 mg/dl); (2) symptoms of hyperglycemia and casual plasma glucose ≥ 11.1 mmol/l (200 mg/dl) 2 h after a 75 g oral glucose load (post prandial) as in a glucose tolerance test; AND (3) glycated hemoglobin (HbA1C) $\geq 6.5\%$.⁽¹¹⁾

Definition of erectile dysfunction:

Erectile dysfunction (ED) is described as a persistent inability (more than 6 months) to attain and maintain an erection sufficient to have satisfactory sexual performance.⁽¹⁾

All patients subjected to predesign closed ended questionnaire sheet containing data about biomedical data as age, educational level, smoking status, history of diabetes and whether it juvenile or adult onset, insulin or non-insulin dependent, history of hypertension and if the patient treated with beta blockers or not. Also the questionnaire data included 4 questions related to secondary causes of impotence (anger, hostility, guilt or shame). Patients eligible for inclusion criteria were determined (target group participants).

The target group participants were interviewed face to face using a standardized questionnaire (international index of erectile function (IIEF)-5)⁽¹²⁾ to diagnose ED. The questionnaire evaluates five parameters of sexual function including, erectile function, orgasmic function, sexual desire, intercourse satisfaction, and overall satisfaction. Each item was rated on a 5-point scale. Thus, a response of 0 for a question was considered the least functional, whereas a response of 5 was considered the most functional. Men with a total score of ≤ 21 were considered to have ED. The diagnosis was confirmed by internal medicine specialist presented at diabetic clinic.

IIEF-5 questionnaire is the gold standard to quantify erectile dysfunction. A score of 5 – 7 is regarded as severe; 8- 11 as moderate; 12 – 16 as mild to moderate; 17 – 21 as mild and 22 – 25 as no erectile dysfunction.⁽¹³⁾ Translations of the IIEF have been validated and conducted into several languages including German, and are widely used to evaluate the outcome of pharmacological studies on ED or the outcome of treatment of patients.⁽¹⁴⁻¹⁸⁾

After the interview, the participant's body weight and height was assessed using weight and height scales. The body mass index was calculated by dividing body weight in kilogram by square height in meter where less than 18 was considered underweight, 18 to 25 was considered average, above 25 to less than 30 was considered overweight, 30 to less than 35 was considered mild obese, from 35 to less than 40 was considered as moderate obesity and 40 and above was considered massive obesity.⁽¹⁹⁾ Also, the participant's blood pressure was assessed by using a standard mercury sphygmomanometer after the subject had been seated for at least 5 minutes. Two readings were taken with 5 minutes interval and their mean was recorded. Hypertension was diagnosed when systolic blood pressure ≥ 140 mmHg and diastolic blood pressure ≥ 90 mmHg.⁽²⁰⁾

For biochemical investigations, a venous blood sample was taken (throughout clinical pathology department of Tanta university hospital) in the morning after a twelve hours fasting for the determination of total cholesterol, high-density lipoprotein concentrations (HDL), fasting blood sugar and HbA1c. Dyslipidemia was diagnosed when total cholesterol level was more than 200 mg/dl, and high- density lipoprotein was less than 40 mg/dL in men.⁽²¹⁾ Diabetes mellitus was diagnosed when fasting blood glucose level ≥ 126 mg/dl.⁽¹⁹⁾ HbA1c percentage was determined by ion-exchange method. An HbA1c of 6.5% is recommended as the cut off point for diagnosing diabetes.⁽²²⁾ All measurements were made under standard conditions by one technician and with the same device.

Data Analysis

All questionnaires were coded and entered into an electronic database. Data analysis was carried out using Statistical Package for Social Sciences (SPSS) version 20. Frequency of distributions with numbers and percentages as well as mean and standard deviation for qualitative and quantitative data respectively of all variables produced. Risk analysis were done using odds ratio for study independent variables in relation with diabetic patients suffered from erectile dysfunction and patients with normal erectile function. The independent variables considered were age, educational level, smoking condition, physical activity, body mass index, systolic and diastolic blood pressure, fasting blood sugar, high density lipoprotein, total serum cholesterol and glycated hemoglobin (HbA1C). Multivariate analysis was done using stepwise linear regression analysis for erectile function score with all independent variables. Linear correlation was done between erectile function score and other independent variables.

Ethical Considerations

Verbal consent was taken from all participants in line with the Ethics protocol of medical research. Raw data treated with strict confidentiality and used only for research purposes.

Results

The majority (64.1%) of our target group were aged more than 50 years old and low educated (illiterate and literate) constituted 63.6%. About two thirds of the participants were overweight & obese and most of them (88.6%) not

practiced any type of sport respectively. On the other hand, 10.3%, 33.7%, 20.2 and 6% of our sample were cigarette smokers, hypertensive, hypercholesterolemic and had low level of HDL respectively (table1).

The mean age of our study group was 50.25 ± 9.44 years. The mean systolic blood pressure was found to be 129.37 ± 14.71 mmHg and mean diastolic blood pressure was 84.37 ± 9.83 mmHg. The mean fasting blood sugar, total cholesterol, HDL and Hb A1C found to be 167.93 ± 28.53 mg/dL, 205.89 ± 42.49 , 48.88 ± 7.71 mg/dL and 7.68 ± 1.06 mg/dL respectively. On the other hand, the mean erectile function score was found to be 19.47 ± 5.99 with range between 7 and 25 (table 1).

All diabetic patients aged ≤ 50 years had normal erectile function while 66.9% of patients more than 50 years suffered from erectile dysfunction and the association was statistically significant. On the other hand, educational level had non-significant risk for erectile dysfunction ($p > 0.05$ & odds ratio = 0.569). 89.5% of smokers had erectile dysfunction with statistically significant risk compared to 37.6% among non-smokers ($p < 0.05$ & odds ratio= 14.12). Overweight and obese patients suffered from higher frequency of erectile dysfunction (63.1%) than patients with average body weight (3.2%) with significant odds of 51.33 ($p < 0.05$). Hypertensive patients suffered from higher frequency of erectile dysfunction (96.8%) than normotensive patients (15.6%) with significant odds of 162.63 ($p < 0.05$). Patient suffered from hypercholesterolemia suffered from higher frequency of erectile dysfunction (97.3%) than patients with normal total

serum cholesterol level (29.3%) with significant odds of 87.07 ($p < 0.05$). Patient suffered from lower HDL suffered from higher frequency of erectile dysfunction (72.7%) than patients with normal HDL level (41.0%) with in-significant odds ratio of 3.83 ($p > 0.05$) (table 2).

Table (3) revealed that high glycated hemoglobin (HbA1C), old age, high blood pressure, smoking condition and high total cholesterol were considered significant predictors for erectile dysfunction among diabetic patients while educational levels, body mass index, fasting blood sugar level, HDL and sport practice were excluded variables. Glycosylated hemoglobin effect was found to be the most effective predictors for erectile dysfunction among diabetic patients with overall effect of 97.3% for all significant predictors.

Table (4) revealed a significant negative correlation between erectile function score from one side and systolic blood pressure, diastolic blood pressure, total serum cholesterol, and age in years from the other side while significant positive correlation was found with HDL. There was no significant correlation between erectile function score and fasting blood sugar.

Our study revealed that 42.93% of study group suffered from erectile dysfunction. Severe, moderate, mild to moderate and mild erectile dysfunction constituted 6.34%, 48.10%, 43.03% and 2.53% respectively (figure 1 & 2).

Discussion

The prevalence of erectile dysfunction among diabetic men varies between 35 and 90%.⁽²³⁾ Erectile dysfunction was detected in over 50% of men with diabetes in the U.S and in 41% of diabetic men in the Netherlands.^(24&25) Studies from Saudi diabetic patients reported ED among 80 to 90% of the patients.^(26&27) Sexual dysfunction was detected in 77% of diabetic men in Isfahan province of Iran.⁽²⁸⁾

The majority of our target group aged more than 50 years, low educated (illiterate and literate), overweight & obese and not practiced any type of sport respectively. On the other hand, 10.3%, 33.7%, 20.2 and 6% of our sample were cigarette smokers, hypertensive, hypercholesterolemic and had low level of HDL respectively (table1). Niciane et al., (2013) found nearly the same results.⁽²⁹⁾ In the Framingham Heart Study, 13% of men with diabetes mellitus had increased total plasma cholesterol levels. Also the study found that the prevalence of high LDL cholesterol levels in men with diabetes mellitus was 9%.⁽³⁰⁾ The previous results may explained based that low level of education lead to unsound eating behavior as well as unsound life style related to physical inactivity which lead to obesity, hypertension, hypercholesterolemia and diabetes.

The mean age of study group was 50.25 ± 9.44 years. Similar study by Romeo et al., (2000) found that the mean age for diabetic subjects was 62.0 ± 12.3 years.⁽²⁵⁾ The difference between our results and Romeo et al study may be due to difference of socioeconomic level and life style. The mean fasting blood sugar, total cholesterol and HDL found to be

167.93 ± 28.53 mg/dL, 205.89 ± 42.49 and 48.88 ± 7.71 mg/dL respectively. The mean level of HbA1C in our study was 7.68 ± 1.06 and the mean erectile function score was 19.47 ± 5.99 in our study. Romeo et al., (2000) found the mean HA1C was 8.1% ± 1.9% and mean erectile function score was 16.6 ± 5.9 (range 5 to 23).⁽³¹⁾ The results of our study indicate uncontrolled diabetes and associated hypercholesterolemia according to their definition^(19,21,22) the difference between our study results regarding erectile score and other study was attributed to difference in socioeconomic profile, life style and associated risk factors.

All diabetic patients age ≤ 50 years had normal erectile function while 66.9% of patients more than 50 years suffered from erectile dysfunction with statistical significant difference between normal and erectile dysfunction according to age (table 3). Fonseca et al., (2004) found higher percentages of men in age groups of 50-59 years than those from 60-69 years, suffering from severe ED; indicated that severity increased with advancing age (p= 0.007).⁽³²⁾ Our study revealed that patient suffered from overweight and obesity suffered from higher frequency of erectile dysfunction (63.1%) than patients with average body weight (3.2%) with significant odds ratio of 51.33. However, Fonseca et al., (2004) found that BMI did not influence the occurrence of erectile function.⁽³²⁾

The present study found that most of smokers had erectile dysfunction with statistically significant risk compared to nonsmokers (41.5%) (odds ratio = 1.56). Similarly, Fedele et al, in Italy, have established an association between tobacco smokers and occurrence of

erectile dysfunction. They found that smoking potentiates the effects of chronic conditions favoring the development of endothelial dysfunction.⁽³³⁾

Patient suffering from hypertension had higher frequency of erectile dysfunction (96.8%) than normotensives (15.6%) with significant odds ratio of 162.63. Martin-Morales et al., (2001) demonstrated that high blood pressure (odds ratio = 1.58), tobacco use (odds ratio = 2.5) were significantly associated with erectile dysfunction.⁽³⁴⁾ Also, Arvind et al., (2013) found that 57.1% of the subjects with severe ED had associated Hypertension, whereas about 36.7% subjects with no ED had hypertension.⁽³⁵⁾

Patient suffering from hypercholesterolemia had higher frequency of erectile dysfunction (97.3%) than patients with normal total serum cholesterol level (29.3%) with significant odds ratio of 87.07. Patient suffering from lower HDL had higher frequency of erectile dysfunction (72.7%) than patients with normal HDL level (41.0%) with in-significant odds ratio of 3.83 (table 3). The same result attained by Fedele et al., (2000) in Italy. He explained this association due to the occurrence of endothelial dysfunction in hyperlipidemia.⁽³³⁾ Some studies demonstrated that erectile function was significantly damaged in hyperlipidemic conditions because of some structural change of penile vessels.^(36&37)

Predictors of ED among T2DM:

Stepwise linear regression analysis demonstrated that glycated hemoglobin, old age, high blood pressure, current cigarette smoking and high total

cholesterol were considered significant predictors for erectile dysfunction among diabetic patients. Glycosylated hemoglobin effect found to be the most prominent predictors for erectile dysfunction among diabetic patients. Romeo et al., (2000) found through Multivariate analysis that HbA1C was an independent predictor of erectile function score ($p < 0.001$).⁽³¹⁾

Our study revealed that more than two fifths of study group suffered from erectile dysfunction. Among our study group, severe, moderate, mild to moderate and mild erectile dysfunction constituted 6.34%, 48.10%, 43.03% and 2.53% respectively. In Pakistan, Ahmed et al., (2013) found that only 28% of diabetic patients was not suffered from erectile dysfunction while 17.1%, 37.8%, 21.7% and 20.7% had mild, mild to moderate; moderate; and severe erectile dysfunction respectively.⁽³⁸⁾

Giugliano et al., (2010) found that about 60% of diabetic men had varying degrees of erectile dysfunction (mild 9%, mild to moderate 11.2%, moderate 16.9% and severe 22.9%).⁽³⁹⁾

There were significant negative correlations between erectile function score from one side and systolic blood pressure, diastolic blood pressure, total serum cholesterol, and age in years from the other side while significant positive correlation was found with HDL. There was no significant correlation between erectile function score and fasting blood sugar (table 5). A negative significant correlation found between potency score and HbA1c, fasting blood glucose (FPG) and systolic blood pressure (SBP) but not between other risk factors such as lipid profile and BMI.⁽⁴⁰⁾ There was a

direct correlation between degrees of glycemic control status, as was assessed by HbA1c and degree of ED which were assessed by IIEF-5.⁽³⁵⁾

Limitations of the study

In spite of the study excluded patients with secondary causes of impotency (such as hostility, guilt, anger, or shame); it is still in need for in-depth study related to psychological risk factors of ED as it is not enough to ask about sensations.

Conclusion

In conclusion, we found that ED prevalence was high in men with T2DM compared with non-diabetics (from literature). Abnormal high glycated hemoglobin, old age, hypertensive, cigarettes smokers and high total cholesterol are considered significant predictive risk factors for erectile dysfunction among diabetic patients that let us to recommend a certain measures to prevent and early detection and management of these risk factors.

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Table (1a): Distribution of biomedical variable among study group.

Biomedical variables	Categories	No. (%)
Age groups	30-40	39 (21.2)
	41-50	27 (14.7)
	51-60	104 (56.5)
	>60	14 (7.6)
Educational levels	illiterate	13 (7.1)
	literate	104 (56.5)
	secondary	63 (34.2)
	university	4 (2.2)
BMI	Average	62 (33.7)
	overweight	37 (20.1)
	mild obesity	15 (8.2)
	moderate obesity	67 (36.4)
	sever obesity	3 (1.6)
Smoking condition	non	75 (40.8)
	passive	88 (47.8)
	ex-smoker	2 (1.0)
	current	19 (10.3)
Sport practice	No	163 (88.6)
	Imperfect	16 (8.7)
	accepted	3 (1.6)
	perfect	2 (1.1)
Blood pressure	Normal	122 (66.3)
	Hypertensive	62 (33.7)
Total cholesterol	Normal	147 (79.8)
	hypercholesterolemia	37 (20.2)
HDL	Normal	173 (94.0)
	Low	11 (6.0)

Table (1b): Distribution of biomedical variable among study group.

Biomedical variables	N	Minimum	Maximum	Mean	Std. Deviation
Age in years	184	26.00	68.00	50.2500	9.44310
Systolic blood pressure mmHg	184	110.00	170.00	129.3750	14.71090
Diastolic blood pressure in mmHg	184	70.00	100.00	84.3750	9.83557
Fasting blood glucose mg/dL	184	130.00	290.00	167.9348	28.53578
Total blood cholesterol mg/dL	184	170.00	290.00	205.8967	42.49893
High density lipoprotein mg/dL	184	33.00	55.00	48.8859	4.71633
Hb A1C	184	6.50	11.20	7.6880	1.06805
Erectile function score	184	7.00	25.00	19.4728	5.99538

Table (2): Biomedical Risks of erectile dysfunction among study group.

Biomedical data	categories	Erectile function			Odds ratio	Confidence I (95%)	
		Normal	dysfunction	Total		lower	upper
Age groups	<50 years	66 (100.0)	0 (0.0)	66 (100.0)	X ² =77.43*		
	>50years	39 (33.1)	79 (66.9)	118 (100.0)			
educational	Illiterate and literate	61 (52.1)	56 (47.9)	117 (100.0)	0.569	0.30	1.06
	2ry and university	44 (65.7)	23 (34.3)	67 (100.0)			
Smoking condition	Non smokers	103 (62.4)	62 (37.6)	165 (100.0)	14.12*	3.15	63.2
	smokers	2 (10.5)	17 (89.5)	19 (100.0)			
BMI	normal	60 (96.8)	2 (3.2)	62 (100.0)	51.33*	11.96	220.16
	Overweight and obese	45 (36.9)	77 (63.1)	122(100.0)			
blood pressure	normal	103 (84.4)	19 (15.6)	122 (100.0)	162.63*	36.60	722.61
	Hypertensive	2 (3.2)	60 (96.8)	62 (100.0)			
Total cholesterol	normal	104 (70.7)	43 (29.3)	147 (100.0)	87.07*	11.56	655.39
	high	1 (2.7)	36 (97.3)	37 (100.0)			
HDL	normal	102 (59.0)	71 (41.0)	173 (100.0)	3.83	0.98	14.94
	low	3 (27.3)	8 (72.7)	11 (100.0)			

NB. X2 was calculated in age group as Odd's ratio cannot calculated due to the presence of zero value.

*Statistically significant.

Table (3): predictors of erectile dysfunction among target group (step wise linear regression analysis)

Predictors	Unstandardized Coefficients		Standardized Coefficients	t	P
	B	Std. Error	Beta		
(Constant)	58.867	.840		70.092	.000
Hb A1C	-4.145	.165	-.738	-25.109	.000
Smoking condition	-.995	.151	-.148	-6.603	.000
Age in years	-.059	.015	-.093	-4.004	.000
cholesterol	-.013	.004	-.095	-3.623	.000

Effect = 97.3

F test = 791.10

P = 0.000

Table (4): Linear correlation between erectile function score and some study biomedical data.

Linear correlation	Systolic blood pressure	Diastolic blood pressure	Fasting blood glucose	Total cholesterol	High density lipoprotein	Age in years	Hb A1C
r	-.865**	-.826**	-.094	-.764**	.303**	-.690**	-.957**
p	.000	.000	.205	.000	.000	.000	.000

*Statistically significant

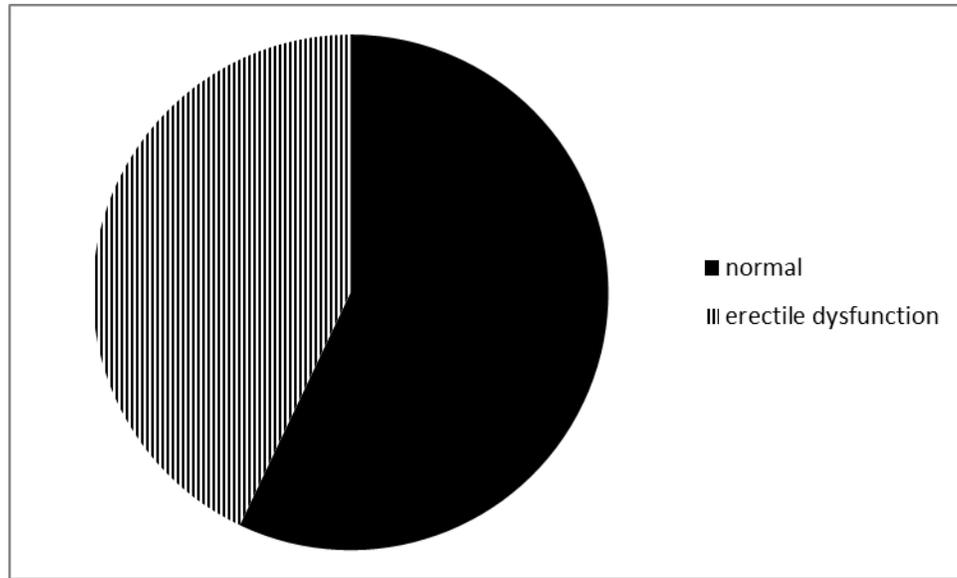


Figure (1): frequency of erectile dysfunction among study group.

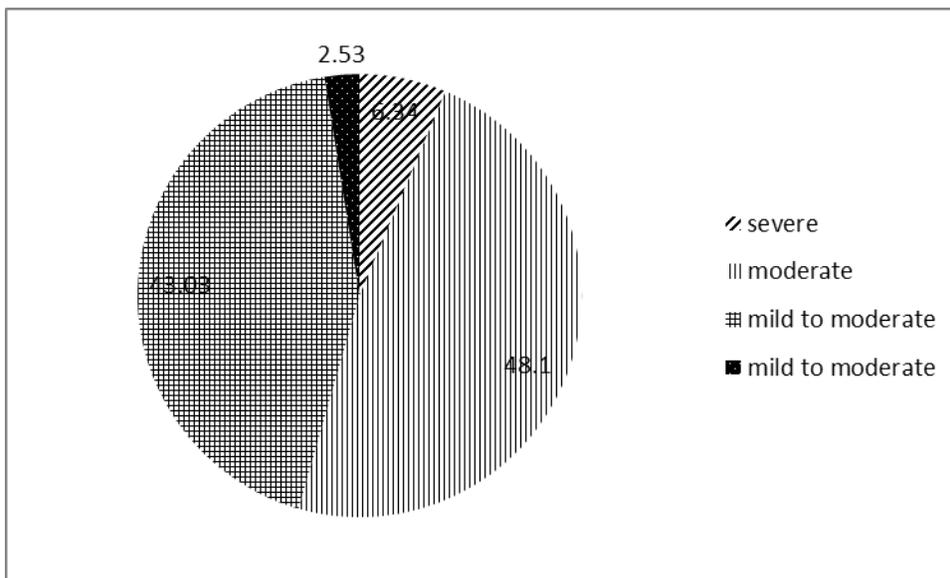


Figure (2): Distribution of erectile dysfunction grades