Prevalence and Determinant of Erectile Dysfunction in Type II Diabetes Mellitus and Healthy Men

Dorcas Serwaa [1*], Folasade Adenike Bello [2, 3], Kayode O. Osungbade [4], Charles Nkansah [5, 6]

[1] Reproductive Biology Unit, Pan African University of Life and Earth Sciences Institute, University of Ibadan, Ibadan, Oyo State, Nigeria.

[2] Department of Obstetrics and Gynaecology, University College Hospital, Ibadan, Oyo State, Nigeria.

[3] Department of Obstetrics and Gynaecology, University of Ibadan, Ibadan, Oyo State, Nigeria.

[4] Community Medicine, College of Medicine, University College Hospital, Oyo State, Nigeria.

[5] Clinical Laboratory Department, Nkenkaasu District Hospital, Nkenkaasu, Ghana.

[6] Department of Medical Diagnostic, Faculty of Allied Health Sciences, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana.

Abstract

Erectile dysfunction is currently a growing health concern and one of the most prevalent sexual dysfunctions in men worldwide. Diabetes mellitus is considered a risk factor for developing ED. Therefore, this SHIM study was designed to assess the prevalence, severity and determinant of erectile dysfunction in type II diabetes mellitus patients and healthy men. This hospital-based cross-sectional study was conducted on 132 diabetic male patients and 66 healthy men at the Nkenkaasu hospital, Offinso North, Ghana between January-June, 2019. A pre-structured questionnaire and patients' medical records were used to document relevant information. Erectile function was assessed using Sexual health inventory for men questionnaire. Data were analyzed using SPSS version 22.0. Chi-square test, binary and multivariable logistic regression analysis were used appropriately. The mean age of study participants was 57.94 ± 9.79 years. The overall mean score on the SHIM test was 12.42 ± 8.15 (range: 1–25), mean of 9.59 ± 7.83 for the type II diabetics and 18.08 ± 5.39 for non-diabetic men. The total erectile dysfunction (ED) prevalence was 81.8% (95% CI: 0.757, 0.869). ED was common in diabetics (70.4%) compared with healthy men (29.6%). Severe ED was 93.7% and 6.3% in the diabetic and non-diabetic men respectively. Multivariate logistic regression revealed that diabetic men with poor health-related quality of life had 3.48 times likelihood of having ED compared to their non-diabetic counterparts (AOR= 3.48, 95% CI; 1.284, 9.453). Very high erectile dysfunction was observed in our study participants. This is worrisome owing to the profound negative impact of ED on the quality of life and fertility of men. It is recommended that periodic assessment of erectile function should form part of routine diabetes care, focusing attention on the modifiable risk factors in preventing, delaying progression, or reversing established ED in persons.

Keywords: Prevalence; Determinants; Erectile Dysfunction; Type II Diabetes Mellitus.

1. Introduction

Penile erection must be maintained for sexual intercourse to occur. Achieving and maintaining a penile erection is mediated multi-factorially: psychological, neurovascular and hormonal factors [1]. Erectile Dysfunction (ED) is

defined as the inability to achieve and maintain an erection sufficient to permit satisfactory sexual intercourse. The symptoms of ED depend on the aetiology and it is often classified into organic (that is, endocrine, neurological, vascular, fibro proliferative or medication-induced) and psychogenic aetiologies. However, both aetiologies are usually interlinked and difficult to distinguish [2]. ED is currently a growing health concern. Worldwide projection indicates that by 2025 about 322 million men will be affected with ED, an increment from a 152 million estimate in 1995 [3].

Risk factors associated with the development of ED are reported in literature. Many drugs including histamine H 2-receptor antagonist known as cimetidine, estrogens and drugs with antiandrogenic action, like ketoconazole and cyproterone acetate have been reported to cause ED in men [4]. Lifestyle factors like chronic alcoholism, tobacco use, obesity, and sedentary lifestyle are known to be associated with ED [5, 6]. Additionally, chronic diseases, such as diabetes mellitus (DM) and hypertension, are considered risk factors for developing ED [7, 8].

The prevalence of diabetes mellitus (DM) has increased overwhelmingly over the past two decades [9]. Type II diabetes mellitus still remains the commonest type of DM, affecting more than 135 million worldwide [10]. Diabetes-associated male fertility impairment, sexual and erectile dysfunction are major clinical complications which have had limited therapeutic options [11, 12]. Although ED is present in many non-diabetic men, ED may be considered as an early diabetic complication [13]. In Africa, the prevalence of diabetes-associated ED has largely varied, a prevalence of 67.9% has been reported in patients with DM in Ghana [14], 57.4% in Nigeria [15], and 75% in Benin [16].

As the debate about the mechanism of ED among diabetic patients is on-going, evidence suggests that it is often related to a complex mechanism involving several factors including arterial impairment, poor glycemic control, neurologic damage, autonomic neuropathy, and hormone imbalance [17].

Even though ED is a highly preventive challenge, it presents highly significant impact on the quality of life of men. Patients with ED are more prone to DM, hypertension, premature ejaculation, benign prostatic hypertrophy, and overactive bladder compared with the general male population [18, 19]. Patients with ED oftentimes suffer from anxiety when sexual ability declines, mutual mistrust, general unhappiness, and fear of losing support from their partner rises [20]. A study reported a greater prevalence of dementia amongst men with long-standing ED (2.5%) compared to controls (1.5%) and that men with ED are 1.68-times more likely to develop dementia [7]. Moore et al., (2014) also found that men with ED had poorer cognitive function compared to those without ED [8].

This humiliating and disturbing ailment does not only affect the men but also their intimate partner. It adversely affects the social and psychological well-being of both partners and contributes to marital tension [21]. It should also be noted that, ED is the most treatable complication of diabetes; over 95% of cases can be successfully treated, however, owing to its embarrassing nature and the shame felt by sufferers, diagnosing and treatment of ED is more challenging [22].

In the Ghanaian community, a man's self-image and identity are associated with his sexual virility. As such, Ghanaian men desire to stay sexually virile throughout their life [23]. Research has been found that medical practitioners do not often take sexual history in males with diabetes and the clients feel insecure and shy to report their current sexual inabilities with healthcare givers [24]. Also healthy men with the problem rarely discuss about the condition or seek help from their fellow men due to the associated stigma [3].

Despite the increasing demand for clinical services and the possible impact of ED and other sexual dysfunctions on interpersonal relationships and quality of life, epidemiological data are relatively limited [25]. This Sexual health inventory for men (SHIM) study was designed to assess the prevalence, severity and associated factors of erectile dysfunction in type II diabetes mellitus patients and healthy men to supplement existing literature. The findings would enhance awareness amongst persons with this condition and also amongst the primary care physicians attending to ED patients.

2. Subjects and Methods

2.1. Study Site

This study was conducted at the diabetic clinic at Nkenkaasu district hospital in the Offinso North district, Ashanti region of Ghana. The hospital serves about 120,585 people and is a referral centre for twelve (12) different health facilities in the Municipality. Offinso North district is one of the twenty-seven (27) districts in the Ashanti Region of Ghana, carved out of Offinso Municipality to facilitate rapid development of the area. The total land area of the District is about 945.9 square kilometers and it lies between longitudes 10 60W and 10 45E and as well as latitudes 70 20N and 60 50S. Offinso North is a peri-urban area with a heterogeneous population with varied religious beliefs, varied political ideas, occupations and education levels [23].

2.2. Target/study Population

The clinical material for this present study comprised a total of 198 subjects. The study group consisted of men with type II diabetes mellitus, while the control group consisted of apparently healthy non-diabetic men. The type II diabetic group were patients who were diagnosed according to the current WHO diagnostic criteria of FBS $\geqslant$ 7.0 mmol/l, [24] and had been referred for management at the hospital. The non-diabetic group consisted of apparently healthy men who visited the hospital to visit their relatives, blood donation or for routine check-up during the period of data collection. The criteria for type II diabetes exclusion among the healthy group were based on measurement of baseline fasting blood sugar and laboratory assessments confirmed through a physician's diagnosis.

2.3. Study Design

This comparative cross-sectional study involved 132 type II diabetic men between 40-70 years registered at the diabetic clinic of Nkenkaasu Government Hospital and 66 healthy men of the same age range. This study excluded patients on androgens, steroids medications, patients with history of chronic renal failure, prostate cancer, prostatectomy and castrated men.

2.4. Administration of Questionnaire

A pre-structured questionnaire and patients' medical records were used to document relevant demographic, lifestyle practices and clinical information like age, level of education, marital status, and cigarette smoking history, height, weight, glucose levels and quality of life.

2.5. Variables Measurements

Body mass index (BMI)

Participants were weighed using an electronic weighing scale, while wearing light clothing, to the nearest 0.1 kg. Height was measured using height rod to the nearest cm, without the subjects wearing shoes. BMI was computed by dividing the body weight (kg) by the square of the height in meters (m^2), BMI was categorized as: <18.5 (underweight); 18.5 to 24.9 (normal weight); 25 to 29.9 (overweight); and $\geqslant$ 30 (obese).

Physical activities

Leisure-time physical activity was measured based on alternatives to the question "How physically active are you during your leisure time?". Subjects were characterized as having; sedentary leisure time if they perform activities related to watching television, or other sedentary activity; light leisure-time physical activity if subjects engage in some walking, cycling, or other physical activity at least four hours per week; Moderate leisure-time physical activity if they perform any of the following activities running, , aerobic, heavier gardening, or similar physical activity during at least 2 hours a week; and lastly, Heavy leisure-time physical activity if engaged in heavy training or competitions in running, walking for a long distance, swimming, football, etc., which is performed regularly and several times a week [25].

Health-related quality of life questionnaire (EuroQoL group / EQ-5D questionnaire)

A basic health-related quality of life (HRQoL) questionnaire was completed by all subjects. Five questions were asked on mobility, self-care, usual activity, pain/discomfort and anxiety/depression, with three options each were provided for each item. [26] The overall score a participant could obtain ranged from 0 to 15. The median score was 9, hence those scoring greater than or equal to the median were considered to have good HRQoL and those scoring below the median mark were considered to have poor HRQoL. This questionnaire was chosen for its brevity and simplicity.

Sexual health inventory for men (SHIM) questionnaire

SHIM questionnaire is a basic 5-point questionnaire used to assess erectile dysfunction status. Each answer was graded from 0 (no sexual activity or attempts at intercourse) to 5 (very good sexual function). The maximum score patients could obtain was be 25, the minimum was 1. Based on the SHIM questionnaire patients were divided into groups has having: Severe ED=0-7; Moderate ED= 8-11; Mild to Moderate ED =12-16; Mild ED=17-21; and No ED=>22. This questionnaire was completed by all participants.
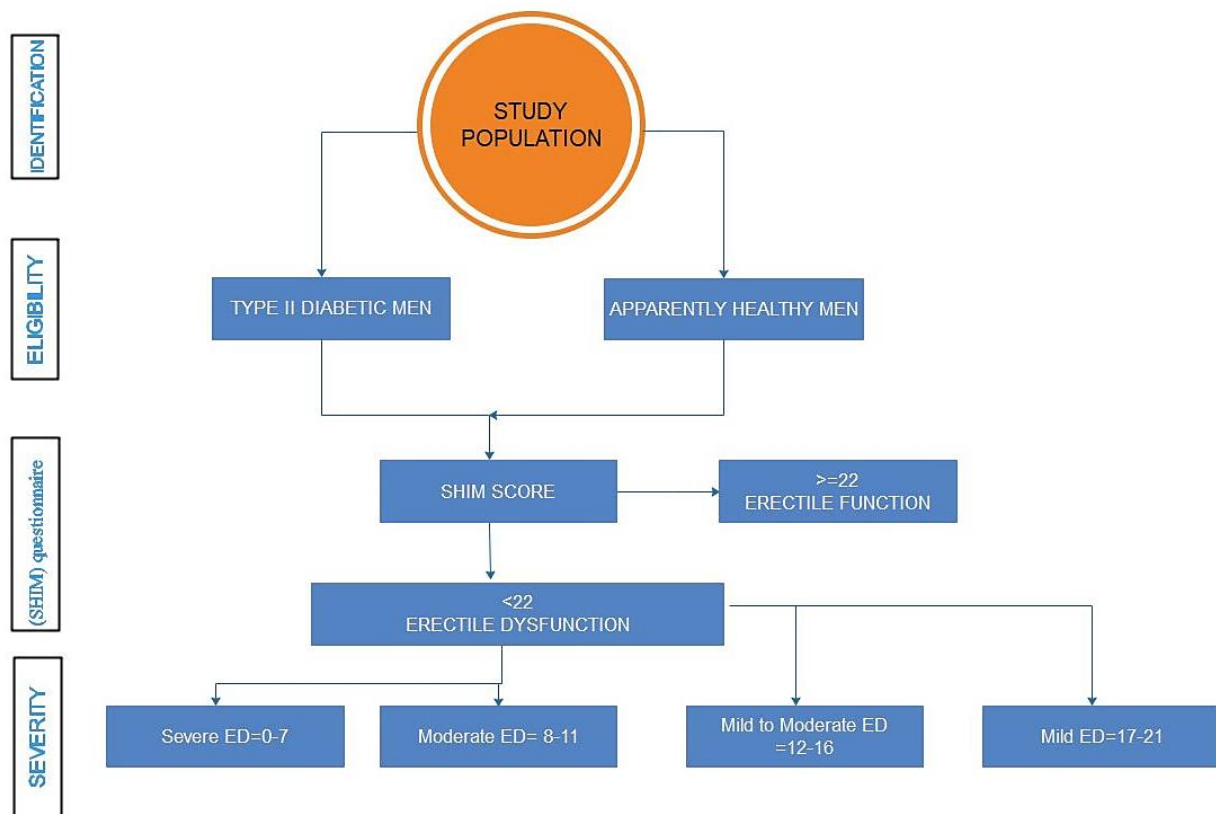
Figure 1. Flow chart of the Research Methodology

2.6. Statistical Analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS), version 22.0. Test for normality was done with box plot and Kolmogorov-Smirnoff test. Parametric data were presented as means ± standard deviation. Frequencies and percentages were calculated to enable comparison of characteristics between type II diabetes mellitus subjects and the healthy men. The Chi square ($\chi 2$) or Fishers exact test was used appropriately to test the descriptive statistics for the categorical variables. To establish the determinants of erectile dysfunction in the type II diabetic men and the non-diabetic men, binary logistic regression analysis was performed. All independent variables at $p<0.20$ were taken to multivariable logistic regression analysis. The statistical significance of variables at the final model was set at $p<0.05$ and 95% confidence level for the adjusted odds ratio. The Hosmer and Lemeshow statistics and deviance coefficient were used to check the goodness of fit of the model.

2.7. Ethical Consideration and Informed Consent

This study was conducted based on the Helsinki Declaration and study protocol, consent forms and participant information material were reviewed and approved by University of Ibadan/University Collage Hospital Ethics Committee (UI/EC/18/0621).

Written informed consent of individual participants was sought after the aims and objectives of the study had been thoroughly explained to them. Participants either signed or thumb-printed to give their consent, before the commencement of the study and they assured of the confidentiality of their data.

3. Results

A total of 198 male volunteers participated in this research study. The ratio of type II diabetics to healthy non-diabetic men was 2:1. There was a statistically significant difference between the type II diabetic and non-diabetic groups when categorized by occupation (p=0.004), Health-related quality of Life (HRQoL) (p<0.001) and leisure time activity (p=0.017). With reference to occupation, a statistically significant difference was observed between type II diabetic and non-diabetic subjects in relation to unemployment and farming. HRQoL was significantly different between both group. There was a significant difference between the type II diabetics men and non-diabetics men with respect to leisure time activities (Table 1).

Table 1. General and lifestyle characteristics of study subjects (N=198)

Characteristics	Diabetics N (%)	Non-Diabetics N (%)	P value
Age (57.94 ± 9.79[a] years)	**58.62±9.88[a]**	**56.59±9.54[a]**	
40-49	30 (22.7)	21 (38.1)	
50-59	28 (21.2)	19 (28.8)	0.086
60+	74 (56.1)	26 (39.4)	
Marital status			
Single (never married)	13 (9.8)	7 (10.6)	0.868
Married	119 (90.2)	59 (89.4)	
Occupation			
Farming	51 (38.6)	43 (65.2)	
Civil servant	30 (22.7)	8 (12.1)	
Trade/sales	18 (13.6)	8 (12.1)	0.003*
Others	12 (9.1)	5 (7.6)	
Unemployed	21 (15.9)	2 (3.0)	
Educational status			
No formal education	27 (20.5)	23 (34.8)	
Primary	24 (18.2)	12 (18.2)	0.101
Secondary	65 (49.2)	22(33.3)	
Tertiary	16 (12.1)	9 (13.6)	
BMI	**24.51±4.02[a]**	**23.64±4.69[a]**	
Under weight	4 (3.0)	3 (4.6)	
Normal	72 (54.5)	42 (46.6)	0.313[b]
Over weight	45(34.1)	14 (21.5)	
Obese	11 (8.3)	6 (9.2)	
HRQoL	**8.31±2.08[a]**	**9.42±1.29[a]**	
Good	81 (61.4)	57 (86.4)	<0.001*
Poor	51 (38.6)	9 (13.6)	
Leisure Time Activity			
Sedentary	46 (38.8)	9 (13.6)	
Light	30 (22.7)	19 (28.8)	0.017*
Moderate	43 (32.6)	31 (47.0)	
Heavy	13 (9.8)	7 (10.6)	
Alcohol consumption			
YES	11 (8.3)	10 (15.2)	0.142
NO	121 (91.7)	56 (84.8)	
Smoking			
Yes	22 (16.7)	12 (18.2)	0.790
No	110 (83.3)	54 (81.8)	
Duration of diabetes (yrs)			
<5	83 (62.9)		
5-10	29 (22.0)		
≥10	20 (15.1)		

[a] Mean±SD; [b] Fisher's exact

The overall mean score on the five-item version of Sexual Health Inventory for Men (SHIM) was 12.42 ± 8.15 (range: 1–25). The mean SHIM scores for the type II diabetics men and non-diabetics men was 9.59±7.83 and 18.08±5.39 (t= -8.92, p<0.001) respectively. The overall prevalence of erectile dysfunction in our study population was found to be 81.8% (95% CI: 0.757, 0.869). Erectile dysfunction was common among type II diabetic men than healthy men (70.4% vs. 29.6%: χ^2 =5.50, p=0.019). Severe erectile dysfunction was commonnest among type II diabetics (59/144, 93.7%) compared with 6.3% (4/48) of healthy men. The level of severity of erectile dysfunction was significantly associated with diabetes (χ^2 =70.66, p<0.001) (Table 2).

Table 2. Prevalence and severity of erectile dysfunction in by diabetes status

		Status		t/χ^2	P-value
		Diabetic	**Non Diabetic**		
		9.59±7.83*	18.08±5.39*	-8.92[a]	<0.001[b]
ED status	Normal erectile function	18 (50.0)	18 (50.0)	5.50	0.019
	ED	114 (70.4)	48 (29.6)		
Severity of ED	Mild	5 (16.1)	26 (83.9)	70.66	<0.001
	Mild to Moderate	29 (61.7)	18 (38.3)		
	Moderate	21 (100)	0 (0.0)		
	Severe	59 (93.7)	4 (6.3)		

[a] t-test statistic;   [b] t-test significance; * SHIM mean score

Nine and three independent variables were entered into the bivariate logistic regression (first model) and the multivariate logistic regression (second model) respectively. After controlling for confounders in the second model, only health-related quality of life was found to be significantly associated with erectile dysfunction in the study participants. Diabetic men with poor health-related quality of life between had 3.48 times likelihood of having erectile dysfunction compared to their non-diabetic counterparts (AOR= 3.48, 95% CI; 1.284, 9.453) (Table 3).

Table 3. Binary and multivariable logistic regression about determinants of ED among the study participants

Variable	Diabetic N(%)	Non-diabetic N(%)	COR [95% CI]	p-value	AOR [95% CI]	p-value
Age						
40-49	19 (63.3)	11 (36.7)	1		1	
50-59	22 (62.9)	13 (37.1)	0.98 [0.357,2.692]	0.968	-	-
60+	73 (75.3)	24 (24.7)	1.76 [0.735,4.221]	0.205	-	-
Marital status						
Single (ever married)	13 (72.2)	5 (27.8)	1		1	
Married	101 (70.1)	43 (29.9)	0.903 [0.303,2.691]	0.855	-	-
Occupation						
Unemployed	21 (91.3)	2(8.7)	1		1	
Farming	44 (61.1)	28 (38.9)	0.15 [0.033,0.688]	0.015*	0.24 [0.045,1.316]	0.101
Civil servant	22 (73.3)	8 (26.7)	0.26 [0.050,1.379]	0.114*	0.36 [0.060,2.196]	0.269
Trade/sales	17 (70.8)	7 (29.2)	0.23 [0.042,1.262]	0.091*	0.28 [0.047,1.700]	0.167
Others	10 (76.9)	3 (23.1)	0.32 [0.046,2.212]	0.247	0.63 [0.080,5.045]	0.667
Educational status						
No formal education	27(65.9)	14 (34.1)	1		1	
Primary	21 (70.0)	9 (30.0)	1.21 [0.439,3.332]	0.712	-	-
Secondary	52 (75.4)	17 (24.6)	1.59 [0.680,3.698]	0.286	-	-
Tertiary	14 (63.6)	8 (29.6)	0.91 [0.307,2.678]	0.860	-	-
BMI						
Under weight	4 (57.1)	3 (42.9)	1		1	
Normal	61 (66.3)	31 (33.7)	1.48 [0.311,7.010]	0.624	1.33 [0.229,7.712]	0.752
Over weight	38 (82.6)	8 (17.4)	3.56 [0.664,19.113]	0.138*	4.92 [0.773,31.270]	0.092
Obese	11 (68.8)	5 (31.3)	1.65 [0.264,10.313]	0.592	2.15 [0.290,15.990]	0.454
HRQoL						
Good	66 (61.7)	41 (38.3)	1		1	
Poor	48 (87.3)	7 (12.7)	4.26 [1.761,10.307]	0.001*	3.48 [1.284,9.453]	**0.014***
Leisure Time Activity						
Heavy	10 (76.9)	3 (23.1)	1		1	
Moderate	32 (58.2)	23 (41.8)	0.42 [0.103,1.688]	0.220	-	-
Light	29 (67.4)	14 (32.6)	0.62 [0.147,2.621]	0.517	-	-
Sedentary	43 (84.3)	8 (15.7)	1.61 [0.362,7.189]	0.531	-	-
Alcohol consumption						
YES	10 (58.8)	7 (41.2)	1		1	
NO	104 (71.7)	41 (28.3)	1.78 [0.633,4.980]	0.275	-	-
Smoking						
Yes	20 (66.7)	10 (33.3)	1		1	
No	94 (71.2)	38 (28.8)	1.24 [0.530,2.886]		-	-

COR: Crude odds ratio; AOR: Adjusted odds ratio; * for p<0.20 at bivariate analysis; *and bold for p<0.05 at multivariable analysis

4. Discussions

In this study, the mean age of the diabetic men was 58.62±9.88 years. Similar to epidemiological study from Finland suggests that, high exposure to unemployment double the risk of type II diabetes among men [27], most unemployed men in this study belonged to the type II diabetes group. The plausible explanation could be the detrimental effect of complications like retinopathy, nephropathy, stroke, hypertension and depression on job performance.

Hu et al., (2001) reported that, overweight is the single most important determinant of type II diabetes, therefore, it was not surprising to observe that more of the diabetic men were overweight compared to the healthy men. Majority of the diabetic men had poor quality of life compared with the healthy men and this finding is supported by a study that observed prolonged stress and anxiety being causally linked to the onset of type II diabetes due to the over activity of hypothalamo–pituitary–adrenal (HPA) axis, cortisol production and behavioral factors [27, 29].

About half of the diabetic men had a sedentary lifestyle, increased time spent in sedentary behaviour and decreased time spent in moderate-to-vigorous–intensity physical activities have been reported to be independently associated with type II diabetes [30, 31]. Moderate alcohol consumption is linked with a decreased risk of type II diabetes [28], similarly, we found that more of the healthy men were consumers of alcoholic beverages compared the diabetic men.

It was surprising that compared to the type II diabetic men, the healthy men recorded the highest number of smokers. Although, cigarette smoking is associated with a small increase in the risk of type II diabetes [28], our study assessed current smoking habits, it is therefore likely that health education given to DM patients encourage them to give up cigarette smoking and excess alcohol consumption.

Diabetes has a strong and well established relationship with ED. About 50 percent of men with chronic diabetes mellitus have erectile dysfunction [1]. Diabetes either affects internal pudendal artery that supplies the majority of the blood flow to the penis through the cavernosal branches or the cavernous nerve terminals and endothelial cells, resulting in a deficiency of neurotransmitters like nitric oxide and intracellular cyclic guanosine monophosphate [32].

The present study showed that, ED was more common in the type II diabetics men than the healthy men. A hospital-based cross-sectional study conducted on male diabetic patients on follow-up at the diabetic clinic of Jimma Medical Center (JMC), Southwest Ethiopia, observed that, the majority, 212 (60.4%) of the diabetic patients had varying degrees of ED [22]. These findings are in accordance with other studies which recorded higher prevalence of ED in type II diabetic men ranging from 44-83% [19, 33]. The overall prevalence of erectile dysfunction in our study population was found to be 81.8%, higher than the prevalence from the aforementioned these studies. The plausible explanation for that disparity may be because of the population-specific composition and the method applied for ED assessment. This study further assessed the severity of ED among the participants. It was observed that more than half of the diabetic subjects had severe ED. A previous study by Sondhi et al., (2018) reported that 21.4% of the diabetic males had no ED, 12.3% had mild ED, and 30.9% had mild to moderate ED. The implications of these findings are clear and that this study outcome should inform health care professionals to increase patient awareness about diabetes associated ED.

The current study revealed that health-related quality of life of participants is associated with high erectile dysfunction. Diabetic men with poor health had greater chance of having ED relative to the non-diabetic men. Similarly, a systematic review carried out by Thongtag and Seesawang, 2020 to assess the erectile dysfunction and quality of life among diabetic men revealed that, erectile dysfunction had a negative impact on QoL, with increased severity of ED correlating with a lower QoL [26]. ED results in a decline of QoL because of difficulty in intimate relationships, causing men to lose their self-esteem and self-efficacy. In addition, one study revealed that DED has a significant association with psychological, social relationships, and environmental domains of WHO-QoL-BREF [27].

This finding indicates that a more detailed health-related quality of life assessment should be incorporated in the routine evaluation of ED in diabetic men. Screening of such a high risk population may also help classify those who will benefit the most from interventions and improvements in their Health. A review of previous studies has shown that certain aspects of the demographic, environment and lifestyle, such as age, occupation, BMI, alcohol consumption, smoking and leisure time activities are important predictors of erectile dysfunction [34, 35]. However, this our study found no association between these variable and erectile dysfunctions, likely due to the cross-sectional nature of the survey, difference in sample sizes and discrepancy of methodology data collection tool.

For instance, Seid et al. (2017) carried out amongst diabetic patients attending in hospitals of central and northwestern zone of Tigray, northern Ethiopia and observed that age, longer duration of diabetes and lower monthly income were independent predictors of ED. But their study had no control group and the researchers utilized chart, erectile function was assessed using abridged 5-item version of the International Index of Erectile Function (IIEF-5) and in-person interviews to probe further the responses elicited from some participants and this may have identified extra cases of ED and associated factors.

Also, cigarette smoking is one of the well-recognized risk factors of ED in diabetic patients by accelerating atherosclerosis which is the main pathophysiologic pathway for vasculogenic ED [22]. However, our study failed to show such an association with smoking. This might be related to the relatively small number of participants who had ever smoked cigarette actively in our study population. This lower proportion of smokers might be due to a significant reduction in the number of smokers owing to continual campaign against smoking as part of lifestyle modification education programs in the diabetic clinics. Moreover, the use of questionnaires to assess smoking status may have a social desirability issue diminishing response rate.

It is also probable that individuals with prevalent erectile dysfunction and diabetes might have modified this lifestyle behaviour compared with the healthy men. Some studies have revealed that about one-third of men with ED display improvement in sexual function based on lifestyle interventions, such as diet, exercise, and weight loss, discontinuance of smoking, counseling, and suitable glycemic control through diet [4, 37].

Findings of this study provided a baseline/preliminary data for further research and interventions in the Offinso North district and its environs. The data in this area could be useful evidence for the treatment of erectile dysfunction in both healthy and diabetes mellitus men, more especially among young diabetes mellitus men who would want to have children in the future. This study also increased our understanding of the roles of the factors contributing to the pathogenesis.

5. Conclusion

A high frequency of erectile dysfunction was observed in our study participants, irrespective of their sociodemographic, clinical and lifestyle characteristics. However, moderate to severe and severe erectile dysfunctions appeared to be more prevalent among type II diabetes men than healthy men. Our results confirmed that diabetes mellitus significantly contributes to the pathophysiology and manifestation of ED.

This high prevalence of ED among the study participants is worrisome, owing to the profound negative impact on the affected individuals. ED in patients highly threatens the wellbeing of clients by increased psychological distress, decreased quality of life, and increased risk of cardiovascular disease. The multivariate regression analysis also revealed that the prevalence of erectile dysfunction among the study participants increased with declining Health-related quality of life. This finding provide a scientific basis for a further understanding of the risk factors of ED in patients with DM and serve as a baseline for preventive strategies.

Health care providers should therefore provide psycho-educational interventions such as counseling to promote better QoL among ED patients, particularly those who ignore the complications resulting from ED such as stress or anxiety, unsatisfactory sex life, and relationship problems. Based on these findings, it is recommended that periodic assessment of erectile function should form part of routine diabetes care, focusing attention on the modifiable risk factors as this may go a long way in preventing ED, delaying its progression, or reversing established ED in persons with type II diabetes.

6. Declarations

6.1. Author Contributions

S.D. conceived; S.D., F.A.B. and K.O.O. designed the study; S.D. and C.N. participated in the data collection; S.D., F.A.B. and K.O.O. analysed and interpreted the data; S.D. and C.N. wrote the first draft of the manuscript. All authors have read and agreed to the published version of the manuscript.

6.2. Funding

6.3. Acknowledgements

6.4. Ethical Approval

This study was conducted based on the Helsinki Declaration and study protocol, consent forms and participant information material were reviewed and approved by University of Ibadan/University Collage Hospital Ethics Committee (UI/EC/18/0621).

6.5. Data Availability Statement

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

6.6. Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

7. References

[1] Lue, T. F. (2000). Erectile Dysfunction. New England Journal of Medicine, 342(24), 1802–1813. doi:10.1056/nejm200006153422407

[2] Johannes, C. B., Araujo, A. B., Feldman, H. A., Derby, C. A., Kleinman, K. P., & McKinlay, J. B. (2000). Incidence of Erectile Dysfunction in Men 40 To 69 Years Old: Longitudinal Results from the Massachusetts Male Aging Study. Journal of Urology, 163(2), 460–463. doi:10.1016/s0022-5347(05)67900-1

[3] Ariba, A., Oladapo, O., Iyaniwura, C., & Dada, O. (2007). Management of erectile dysfunction: perceptions and practices of Nigerian primary care clinicians. South African Family Practice, 49(9), 16–16d. doi:10.1080/20786204.2007.10873632.

[4] McVary, K. T., Carrier, S., & Wessells, H. (2001). Smoking and Erectile Dysfunction: Evidence Based Analysis. Journal of Urology, 166(5), 1624–1632. doi:10.1016/s0022-5347(05)65641-8

[5] Sasayama, S., Ishii, N., Ishikura, F., Kamijima, G., Ogawa, S., Kanmatsuse, K., ... & Yamamoto, Y. (2003). Men's Health Study: epidemiology of erectile dysfunction and cardiovascular disease. Circulation journal, 67(8), 656-659. doi:10.1253/circj.67.656.

[6] Grover, S. A., Lowensteyn, I., Kaouache, M., Marchand, S., Coupal, L., DeCarolis, E., … Defoy, I. (2006). The Prevalence of Erectile Dysfunction in the Primary Care Setting: Importance of Risk Factors for Diabetes and Vascular Disease. Archives of Internal Medicine, 166(2), 213-219. doi:10.1001/archinte.166.2.213.

[7] Yang, C.-M., Shen, Y.-C., Weng, S.-F., Wang, J.-J., & Tien, K.-J. (2015). Increased Risk of Dementia in Patients with Erectile Dysfunction: A Population-based, Propensity Score-matched, Longitudinal Follow-up Study. Medicine, 94(24), e990. doi:10.1097/md.0000000000000990.

[8] Moore, C. S., Grant, M. D., Zink, T. A., Panizzon, M. S., Franz, C. E., Logue, M. W., … Lyons, M. J. (2014). Erectile dysfunction, vascular risk, and cognitive performance in late middle age. Psychology and Aging, 29(1), 163–172. doi:10.1037/a0035463.

[9] Susanti, E., Donosepoetro, M., Patellongi, I., & Arif, M. (2010). Differences between several atherogenic parameters in patients with Controlled and Uncontrolled Type 2 Diabetes Mellitus. Medical Journal of Indonesia, 19(2), 103-108. doi:10.13181/mji.v19i2.392.

[10] Sazandeh, F. S. S. (2004). Serum ferritin in type 2 diabetes mellitus and its relationship with HbA1c. Acta Medica Iranica, 142–145.

[11] Barsiah, S., Behnam‐Rassouli, M., Shahabipour, F., Rostami, S., Sabbaghi, M. A., Momeni, Z., ⋯ Sahebkar, A. (2019). Evaluation of testis hormonal and histopathological alterations in type I and type II diabetic rats. Journal of Cellular Biochemistry, 120(10), 16775–16785. doi:10.1002/jcb.28936.

[12] Shi, G.-J., Zheng, J., Wu, J., Qiao, H.-Q., Chang, Q., Niu, Y., … Yu, J.-Q. (2017). Protective effects of Lycium barbarum polysaccharide on male sexual dysfunction and fertility impairments by activating hypothalamic pituitary gonadal axis in streptozotocin-induced type-1 diabetic male mice. Endocrine Journal, 64(9), 907–922. doi:10.1507/endocrj.ej16-0430.

[13] Owiredu, W. K., Amidu, N., Alidu, H., Sarpong, C., & Gyasi-Sarpong, C. K. (2011). Determinants of sexual dysfunction among clinically diagnosed diabetic patients. Reproductive Biology and Endocrinology, 9(1), 70. doi:10.1186/1477-7827-9-70.

[14] Afolayan, A. J., & Yakubu, M. T. (2009). Erectile Dysfunction Management Options in Nigeria. The Journal of Sexual Medicine, 6(4), 1090–1102. doi:10.1111/j.1743-6109.2008.01064.x.

[15] Djrolo, F., Paraïso, N. M., Diarra, O., & Makoutode, M. (2014). Diabetes Complications and Associated Factors in Type 2 Diabetic Patients in Cotonou. Journal of Diabetes Mellitus, 04(04), 311–315. doi:10.4236/jdm.2014.44043.

[16] Krysiak, R., Gilowski, W., & Okopień, B. (2016). The effect of testosterone on cardiovascular risk factors in men with type 2 diabetes and late-onset hypogonadism treated with metformin or glimepiride. Pharmacological Reports, 68(1), 75–79. doi:10.1016/j.pharep.2015.06.003.

[17] Seftel, A. D., Sun, P., & Swindle, R. (2004). The Prevalence of Hypertension, Hyperlipidemia, Diabetes Mellitus and Depression in Men with Erectile Dysfunction. Journal of Urology, 171(6 Part 1), 2341–2345. doi:10.1097/01.ju.0000125198.32936.38.

[18] Gauthaman, K., Adaikan, P. ., & Prasad, R. N. V. (2002). Aphrodisiac properties of Tribulus Terrestris extract (Protodioscin) in normal and castrated rats. Life Sciences, 71(12), 1385–1396. doi:10.1016/s0024-3205(02)01858-1.

[19] Sondhi, M., Kakar, A., Gogia, A., & Gupta, M. (2018). Prevalence of erectile dysfunction in diabetic patients. Current Medicine Research and Practice, 8(3), 88–91. doi:10.1016/j.cmrp.2018.05.005.

[20] Frimpong Manso, S., Magnus Aryitey, G. T., Hevi, D., Dombi, G., Nyarko, A. K., Boamah, D., & Awan, M. (2016). Bioinorganic elemental content of the Ghanaian aphrodisiac medicinal plant, Paullina pinnata Linn. (Sapindaceae). African Journal of Pharmacy and Pharmacology, 10(11), 206–211. doi:10.5897/ajpp2015.4417.

[21] Burd, I. D., Nevadunsky, N., & Bachmann, G. (2006). Original Research—Education: Impact of Physician Gender on Sexual History Taking in a Multispecialty Practice. The Journal of Sexual Medicine, 3(2), 194–200. doi:10.1111/j.1743-6109.2005.00168.x.

[22] Rhoden, E. L., Telöken, C., Sogari, P. R., & Vargas Souto, C. A. (2002). The use of the simplified International Index of Erectile Function (IIEF-5) as a diagnostic tool to study the prevalence of erectile dysfunction. International Journal of Impotence Research, 14(4), 245–250. doi:10.1038/sj.ijir.3900859.

[23] Offinso north district, G. S. S. (2014). Ghana statistical service, 2010 population and housing Census, District Analytical Report, Offinso North District. Available online: http://www2.statsghana.gov.gh/docfiles/2010_District_Report/ Ashanti/Offinso North.pdf (accessed on September 2020).

[24] Atlas, I. D. (2017). Brussels, Belgium: international diabetes federation; 2013. International Diabetes Federation (IDF), 147.

[25] Larsson, C. A., Krøll, L., Bennet, L., Gullberg, B., Råstam, L., & Lindblad, U. (2012). Leisure time and occupational physical activity in relation to obesity and insulin resistance: a population-based study from the Skaraborg Project in Sweden. Metabolism, 61(4), 590–598. doi:10.1016/j.metabol.2011.09.010.

[26] Jia, H., & Lubetkin, E. I. (2005). The impact of obesity on health-related quality-of-life in the general adult US population. Journal of Public Health, 27(2), 156–164. doi:10.1093/pubmed/fdi025.

[27] Rautio, N., Varanka-Ruuska, T., Vaaramo, E., Palaniswamy, S., Nedelec, R., Miettunen, J., … Ala-Mursula, L. (2017). Accumulated exposure to unemployment is related to impaired glucose metabolism in middle-aged men: A follow-up of the Northern Finland Birth Cohort 1966. Primary Care Diabetes, 11(4), 365–372. doi:10.1016/j.pcd.2017.03.010.

[28] Hu, F. B., Manson, J. E., Stampfer, M. J., Colditz, G., Liu, S., Solomon, C. G., & Willett, W. C. (2001). Diet, Lifestyle, and the Risk of Type 2 Diabetes Mellitus in Women. New England Journal of Medicine, 345(11), 790–797. doi:10.1056/nejmoa010492.

[29] Virtanen, M., Ferrie, J. E., Tabak, A. G., Akbaraly, T. N., Vahtera, J., Singh-Manoux, A., & Kivimäki, M. (2014). Psychological Distress and Incidence of Type 2 Diabetes in High-Risk and Low-Risk Populations: The Whitehall II Cohort Study. Diabetes Care, 37(8), 2091–2097. doi:10.2337/dc13-2725.

[30] Bertrais, S., Beyeme-Ondoua, J.-P., Czernichow, S., Galan, P., Hercberg, S., & Oppert, J.-M. (2005). Sedentary Behaviors, Physical Activity, and Metabolic Syndrome in Middle-aged French Subjects. Obesity Research, 13(5), 936–944. doi:10.1038/oby.2005.108.

[31] Li, C.-L., Lin, J.-D., Lee, S.-J., & Tseng, R.-F. (2007). Associations between the metabolic syndrome and its components, watching television and physical activity. Public Health, 121(2), 83–91. doi:10.1016/j.puhe.2006.08.004.

[32] Irwin, G. M. (2019). Erectile Dysfunction. Primary Care: Clinics in Office Practice, 46(2), 249–255. doi:10.1016/j.pop.2019.02.006.

[33] Ziaei-Rad, M., Vahdaninia, M., & Montazeri, A. (2010). Sexual dysfunctions in patients with diabetes: a study from Iran. Reproductive Biology and Endocrinology, 8(1), 50. doi:10.1186/1477-7827-8-50.

[34] Selvin, E., Burnett, A. L., & Platz, E. A. (2007). Prevalence and Risk Factors for Erectile Dysfunction in the US. The American Journal of Medicine, 120(2), 151–157. doi:10.1016/j.amjmed.2006.06.010.

[35] Dong, J.-Y., Zhang, Y.-H., & Qin, L.-Q. (2011). Erectile Dysfunction and Risk of Cardiovascular Disease. Journal of the American College of Cardiology, 58(13), 1378–1385. doi:10.1016/j.jacc.2011.06.024.

[36] Seid, A., Gerensea, H., Tarko, S., Zenebe, Y., & Mezemir, R. (2017). 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 Endocrine Disorders, 17(1): 1-7. doi:10.1186/s12902-017-0167-5.

[37] Esposito, K., Giugliano, F., Di Palo, C., Giugliano, G., Marfella, R., D'Andrea, F., … Giugliano, D. (2004). Effect of Lifestyle Changes on Erectile Dysfunction in Obese Men. JAMA, 291(24), 2978. doi:10.1001/jama.291.24.2978.

Appendix I: Questionnaire for the Study

Prevalence and Determinant of Erectile Dysfunction in Type Ii Diabetes Mellitus and Healthy Men

SUBJECT'S ID: _____

1. NAME (optional): _____

2. AGE _____

3. HEIGHT(m^2) _____

4. WEIGHT (kg) _____

5. What is your marital status?

    0.   Single, never married   ☐

    1.   Married or domestic partnership   ☐

6. What is your occupation, or what kind of work did you do? _____ ☐

7. Level of education

Have you ever attended school or any early childhood education programme?

    0.   NO ☐   1. Yes ☐

What is the highest degree or level of school you have completed? If currently enrolled, highest degree received?

0. Primary (1-6)   ☐

1. Secondary (7-9)   ☐

2. Tertiary (over 9 years)   ☐

    8. Health related quality of life

By placing a tick in one box in each group below, please indicate which statements best describe your own health state today.

Mobility

I have no problems in walking about   ☐

I have some problems in walking about   ☐

I am confined to bed   ☐

Self-Care

I have no problems with self-care   ☐

I have some problems washing or dressing myself   ☐

I am unable to wash or dress myself   ☐

Usual Activities (*e.g. work, study, housework, family or* leisure *activities)*

I have no problems with performing my usual activities   ☐

I have some problems with performing my usual activities ☐

I am unable to perform my usual activities   ☐

Pain/Discomfort

I have no pain or discomfort   ☐

I have moderate pain or discomfort   ☐

I have extreme pain or discomfort ☐

Anxiety/Depression

I am not anxious or depressed ☐

I am moderately anxious or depressed ☐

I am extremely anxious or depressed ☐

9. Alcohol consumption assessment

Do you consume alcoholic drinks?   YES ☐   NO ☐

10. Smoking habits

Do you smoke?

1) No, I have never smoked ☐

2) Yes, I smoke. ☐

13. Leisure time physical activity (circle the appropriate option)

How physically active are you during your leisure time?

1. Reading, watching television, stamp collecting or other sedentary activity;

2. Walking, cycling, or other physical activity under at least four hours per week;

3. Running, Swimming, tennis, aerobic, heavier gardening, or similar physical activity during at least 2 hours a week;

4. Heavy training or competitions in running, skiing, swimming, football, etc., which is performed regularly and several times a week

14. Sexual Health Inventory for Men (SHIM)

Instructions

Each question has 5 possible responses. Circle the number that best describes your own situation.

Select only 1 answer for each question.

Over the past 6 months:

	0	1	2	3	4	5
How do you rate your confidence that you could keep an erection?	Did not attempt intercourse	Very low	Low	Moderate	High	Very high
When you had erections with sexual stimulation, how often were your erections hard enough for penetration (entering your partner)?	No sexual activity	Almost never Or never	A few times (much less than half the time)	Sometimes (about half the time)	Most times (much more than half the time)	Almost always Or always
During sexual intercourse, how often were you able to maintain your erection after you had penetrated (entered) your partner?	Did not attempt intercourse	Almost never Or never	A few times (much less than half the time)	Sometimes (about half the time)	Most times (much more than half the time)	Almost always Or always
During sexual intercourse, how difficult was it to maintain your erection to completion of intercourse?	Did not attempt intercourse	Extremely difficult	Very difficult	Difficult	Slightly difficult	Not difficult
When you attempted sexual intercourse, how often was it satisfactory for you?	Did not attempt intercourse	Almost never Or never	A few times (much less than half the time)	Sometimes (about half the time)	Most times (much more than half the time)	Almost always Or always