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RESEARCH ARTICLE

Correlates of Erectile Dysfunction among Diabetic Patients Attending Kinshasa Hospitals, the Democratic Republic of the Congo

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ABSTRACT

Objective: We assessed the frequency of erectile dysfunction and associated risk factors among diabetic patients attending Kinshasa hospitals.

Methods: We enrolled 205 male diabetic patients (mean age: 53 ± 11 years) from three public hospitals at Kinshasa to assess erectile dysfunction defined by a score of 6 to 20 on International Index of Erectile Function (IIEF-5). Logistic regression model was applied to identify determinants of erectile dysfunction. A *p*-value ≤ 0.05 was considered significant.

Results: Erectile dysfunction was observed in 59% (95% CI: 52.2 - 66%) of diabetic patients; it was mild, moderate and severe in respectively 68.6%, 25.6% and 7.5%. It commonly affected older patients (55 ± 11 years *vs.* 51 ± 12 years, $p = 0.004$) with a longer duration of diabetes (11 ± 6 years *vs.* 9 ± 6years, $p = 0.045$), abdominal obesity ($p < 0.001$) and diabetic retinopathy ($p < 0.001$). In the logistic model the odds for erectile dysfunction increased with abdominal obesity (OR: 12.9 and 95%CI [5.39-30.91]; $p < 0.001$), age (For age > 50 ans: 7.9 [2.62-23.74]; $p < 0.001$), uncontrolled diabetes (7.1 [2.43-20.62]; $p < 0.001$), hypertension (2.8 [1.13-6.87]; $p = 0.027$) and chronic kidney disease (2.5 [1.05-5.93]; $p = 0.038$).

Conclusion: The magnitude of erectile dysfunction among diabetic patients requires early detection and precocious prevention through control of diabetes, hypertension and underlying obesity.

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Introduction

Erectile Dysfunction (ED), is defined as persistent inability to attain and/or maintain sufficient erection for satisfactory sexual intercourse [1]. It appears to be an important problem among men over the age of 50 years

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[2]. Various cardiovascular risk factors including hypertension and diabetes induce alteration of erectile function through generalized endothelial dysfunction [3-5]. The frequency of erectile dysfunction is higher in diabetic patients (30 to 71%) as compared to general population [6-9]. It has been projected ED will affect about 322 million men by 2025 [10].

Studies in sub-Saharan Africa estimated the prevalence of erectile dysfunction to amount to 24% in the general population and up to 54.3% among diabetic patients [11-13]. Population aging and, among diabetic patients, physical inactivity and comorbities appear to be the main factors associated with ED condition.

The benefit of treatments based on PDE5 inhibitors [14], stem cell therapy [15], or exosomes from corpus cavernosum smooth muscle cells [16] in the management of ED was advocated in some studies.

In 2016 the World Health Organization estimated at 4.3% the prevalence of diabetes mellitus and identified overweight (18.2%), obesity (3.7%) and insufficient physical activity (25%) as associated risk factors in the Democratic Republic of the Congo [17]. A 2010 study by Muyer MT, et al. in Kisantu [18], reported a prevalence of 4.8% for diabetes mellitus. The high proportion of subjects with undiagnosed, untreated and uncontrolled diabetes, might explain higher rates of complications and death attributable to diabetes among hospitalized Congolese patients. ED figures among complications of diabetes not sufficiently addressed in DRC. The present study therefore assessed its frequency and risk factors in diabetic patients with focus on the impact of abdominal obesity using standardized protocol based on International Index of erectile function (IIEF-5) [19].

Methods

Study design, setting and eligibility

From February to December 2018, a consecutive series of 205 diabetic male patients aged 18 years or more, of whom 79 (38.5%) had type 1 and 126 (61.5%) type 2 diabetes mellitus, who attended outpatient clinics at University of Kinshasa Hospital, Monkole Medical Center and Kinshasa Medical Center were assessed for ED and its determinants in a cross-sectional study. To be included in the study, the patient had to complete the IIEF-5 test questionnaire [14] and give an informed consent to participate. They were then physically examined by the investigators. Patients with serum TSH < 0.1 µU/mL or > 20 µU/ml [20], serum testosterone < 300 ng/dL [21], urological pathology or deterioration of the general state were not enrolled.

Data collection procedure

Based on 5 specific questions with a score of 5 points each the IIEF-5 test was used to assess ED [19]. The patients were allowed 20 minutes to complete the self-administered questionnaire. They could then discuss with the investigator to obtain possible answers to any raised concerns. ED was an IIEF-5 score ≤ 20. It was labelled mild (score 16-20), moderate (score 11-15), severe (score 5-10) or uninterpretable (score < 5) [19].

Socio-demographic data (age and sex), lifestyle habits (alcohol and tobacco use), information on type and known duration of diabetes, current treatment and documented complications (diabetic retinopathy, nephropathy, neuropathy and foot ulcer) or co-morbidities (cardiovascular disease) were gathered from patients' charts.

Three Blood Pressure (BP) measurements were obtained at one minute interval, using a validated electronic monitor (Omron Healthcare) with an appropriate cuff size secured on the right arm after the patient had relaxed five minutes or more in sitting position. The average of these BP measurements was used for analysis. Pulse pressure was Systolic Blood Pressure (SBP) minus Diastolic BP (DBP). Hypertension was SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg or use of antihypertensive drugs [22]. The heart rate was obtained concomitantly to BP. Body weight was measured the patient barefoot on loose clothing using an electronic scale. Body height and waist circumference were obtained using a tape measurer. Body Mass Index (BMI) was weight (Kg) divided by the square of height (m^2). Overweight/obesity was a body mass index ≥ 25 Kg/m^2 [23]. Abdominal obesity was a waist circumference ≥ 94 cm for men [24]. External genitalia were examined for morphological abnormalities. A 10 g monofilament test was used to search for sensitive neuropathy. Sensory neuropathy was non-perception of the 10 g monofilament on at least 1 of the 20 sites tested on both feet (10 sites per foot) the patient keeping his eyes closed. Diabetic retinopathy was defined according to the classification of «Early Treatment of Diabetic Retinopathy Study» [25,26].

The last 3 months paraclinic results retrieved from patients medical charts included Fasting Plasma Glucose (FPG), glycated hemoglobin (A1C), serum creatinine, total cholesterol, LDL-cholesterol, HDL-cholesterol, triglycerides, Thyroid Stimulating Hormone (TSH), testosterone and dipstick proteinuria. Uncontrolled diabetes was a glycated hemoglobin ≥ 7% [27]. Glomerular Filtration Rate (eGFR) was estimated using non-abbreviated Modification of Diet in Renal Disease (MDRD) equation and chronic kidney disease was a positive semi-quantitative proteinuria or eGFR < 60 mL/min/1.73 m² [28]. Hypercholesterolemia was total cholesterol > 190 mg/dL [24]. Metabolic syndrome was in addition to diabetes and abdominal obesity, the presence of at least one of the followings: BP ≥ 130/85 mmHg or hypertension, HDL < 40 mg/L for men and < 50 mg/L for women [24]. Urine dipstick 1+ or more defined positive semi-quantitative proteinuria [28].

Data processing and analysis

Statistical analyses were performed with IBM-SPSS for Windows, version 22. Data are expressed as mean ± Standard Deviation (SD) or relative frequency in per cent. Pearson Khi-2 or Exact Fisher test was performed to compare proportions as appropriate. Student t-test was used for comparison of means and logistic regression model to identify independent factors associated with ED A p-value ≤ 0.05 was considered statistically significant.

Results

Characteristics of study population

Erectile dysfunction was observed in 121 out of 205 enrolled patients (59%, 95% CI: 52.2-66%). It was of mild, moderate and severe form in 68.6%, 25.6% and 5.8% of affected patients respectively. ED affected 32.2% and 67.8% of patients with type 1 and type 2 diabetes respectively (p = 0,026). Table 1 summarizes clinical and biological characteristics of the patients with and without ED. Mean values for FBG, serum A1C, eGFR, serum total cholesterol, LDL-Cholesterol, triglycerides and IIEF-5 score were 175 ± 42 mg/dL, 8.3 ± 1.8%, 92 ± 28 mL/min/1.73 m², 225 ± 44 mg/dL, 110 ± 27 mg/dl, 90 ± 21 mg/L and 19 ± 4, respectively. Fasting blood glucose (180 ± 43 *vs.* 167 ± 39 mg/dl; p = 0.043), serum A1C (8.6 ± 2% *vs.* 7.8 ± 1.4%; p = 0.003), LDL-Cholesterol (115 ± 29 mg/dl *vs.* 103 ± 23 mg/dl ; p = 0.001) were higher while eGFR (87 ± 30 mL/min/1.73 m² *vs.* 99 ± 25 mL/min/1.73 m²; p = 0.003) and HDL-cholesterol (68 ± 21 mg/dl *vs.* 75 ± 25 mg/dl ; p = 0.026) were lower in the presence than in the absence of ED.

Table 2 shows cardiovascular risk factors and comorbidities according to ED. Overweight/obesity (78.5%), hypercholesterolemia (78%), uncontrolled

Table 1: Characteristics of the patients according to erectile function.

Variable	All Patients 205	Erectile Dysfunction 121 (59%)	No Erectile Dysfunction 84 (41%)	p
Age, years	53 ± 11	55 ± 11	51 ± 12	0.004
Duration of diabetes, years	10 ± 6	11 ± 6	9 ± 6	0.045
SBP, mmHg	129 ± 16	129 ± 16	128 ± 17	0.496
DBP, mmHg	78 ± 8	78 ± 8	78 ± 8	0.655
PP, mmHg	51 ± 13	52 ± 12	50 ± 13	0.954
Heart rate, beats/min	81 ± 11	81 ± 11	81 ± 11	0.649
BMI, kg/m²	28.7 ± 5.0	29.2 ± 5.3	28 ± 4.4	0.816
Waist, cm	94 ± 9	95 ± 9	93 ± 8	0.090
Positive monofilament test, n (%) *	91 (44.4)	57 (47.1)	34 (40.5)	0.213
IIEF5 Score	19 ± 4	16 ± 2	24 ± 1	< 0.001
Fasting glucose, mg/dl	175 ± 42	180 ± 43	167 ± 39	0.043
A1C, %	8.3 ± 1.8	8.6 ± 2	7.8 ± 1.4	0.003
Total cholesterol, mg/dl	225 ± 44	229 ± 43	218 ± 44	0.082
LDL chol, mg/dl	110 ± 27	115 ± 29	103 ± 23	0.001
HDL chol, mg/dl	70 ± 23	68 ± 21	75 ± 25	0.026
Triglycerides, mg/dl	90 ± 21	92 ± 22	88 ± 20	0.233
Creatinine, mg/dl	1.27 0.6	1.3 ± 0.7	1.1 ± 0.5	0.035
eGFR, ml/min/1,73m²	92 ± 28	87 ± 30	99 ± 25	0.003

diabetes (71.7%), abdominal obesity (52.2%), metabolic syndrome (47.3%), chronic kidney disease (47.3%), alcohol intake (45.9%) hypertension (41%), diabetic peripheral neuropathy (44.4%) and diabetic retinopathy (57.1%) were the main cardiovascular risk factors and comorbidities observed. Uncontrolled diabetes (79.3% *vs.* 60.7%; $p = 0.003$), abdominal obesity (74.4% *vs.* 20.2%; $p < 0.001$), chronic kidney disease (60.3% *vs.* 28.6%; $p < 0.001$), diabetic retinopathy (69.4% *vs.* 39.3%; $p < 0.001$), metabolic syndrome (52.9% *vs.* 39.3%; $p = 0.038$) and ischemic heart disease (5.8% *vs.* 0%; $p = 0.023$) predominated among patients with than without ED.

Figure 1 shows the frequency of erectile dysfunction by type of diabetes mellitus and age-group. The proportions of patients with ED were similar among type 1 and type 2 diabetic patients aged < 40 years (50% *vs.* 50%; $p = 0.760$) and those 40-59 years (50% *vs.* 55%, $p = 0.361$). The trend to higher ED frequency in type 2 patients above 60 years was just not significant (40% *vs.* 74%; $p = 0.139$).

Correlates of erectile dysfunction

The factors associated with ED in univariate analysis were older age, hypertension, and abdominal obesity, reduced kidney function, poor glycemic control and type 2 diabetes. In the logistic model (Table 3), age (for age > 50years, ORa: 7.88[95% CI: 2.62-23.74]; $p < 0.001$), hypertension (present *vs.* absent 2.78; [1.13-6.87]; $p = 0.027$), abdominal obesity (present *vs.* absent 12.91; [5.39-30.91]; $p < 0.001$), uncontrolled diabetes (7.08; [2.43-20.62]; $p < 0.001$) and chronic kidney disease (present *vs.* absent 2.5; [1.05-5.93]; $p = 0.038$) were associated with ED.

Discussion

More than half of diabetic patients in the present study had ED of mainly mild to moderate severity that predominated among patient with type 2 than type 1 diabetes. Microvascular complications of diabetes such as retinopathy and nephropathy were commonest among patients with than those without ED. Older age, metabolic syndrome, uncontrolled diabetes and chronic kidney disease were the features associated significantly to ED.

The rate of ED we report is consistent with the 50% or more observed in some African countries [11,12,29-35]. It also agrees with the worldwide ED prevalence of 52% shown in a recent meta-analysis [36]. Disparities in ED prevalence and severity could be accounted for by differences in study populations, sample size, methodology and criteria to defining ED. The prevalence of sexual disorders among

Table 2: Erectile dysfunction, cardiovascular risk factors and comorbidities.

Characteristics	All Patients 205	Erectile Dysfunction 121 (59%)	No Erectile Dysfunction 84 (41%)	*p*
Age group (years)				
≤ 50	67 (32.7)	21 (17.3)	46 (54.7)	< 0.001
> 50	138 (67.3)	100 (82.6)	38 (45.2)	
Types of diabetes: 1	79 (38.5)	39 (32.2)	40 (47.6)	0.019
Types of diabetes: 2	126 (61.5)	82 (67.7)	44 (52.4)	
Overweight/obesity	161 (78.5)	99 (81.8)	62 (73.8)	0.115
Hypercholesterolemia	160 (78.0)	95 (78.5)	65 (77.4)	0.489
Uncontrolled diabetes	147 (71.7)	96 (79.3)	51 (60.7)	0.003
Diabetic retinopathy	117 (57.1)	84 (69.4)	33 (39.3)	< 0.001
Abdominal obesity	107 (52.2)	90 (74.4)	17 (20.2)	< 0.001
Metabolic syndrome	97 (47.3)	64 (52.9)	33 (39.3)	0.038
Chronic kidney disease	97 (47.3)	73 (60.3)	24 (28.6)	< 0.001
Alcohol consumption	94 (45.9)	55 (45.5)	39 (46.4)	0.502
Positive dipstick proteinuria	93 (45.4)	69 (57)	24 (28.6)	< 0.001
Sensitive neuropathy	91 (44.4)	57 (47.1)	34 (40.5)	0.213
Hypertension	84 (41)	51 (42.1)	33 (39.3)	0.396
Smoking	38 (18.5)	24 (19.8)	14 (16.7)	0.350
Ischemic heart disease	7 (3.4)	7 (5.8)	0	0.023

Values are frequencies and percentages in brackets. The *p*-values compare patients with and those without ED.

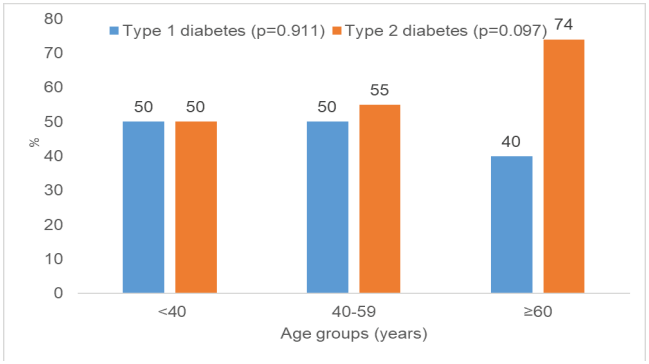

Figure 1 Erectile dysfunction by type of diabetes mellitus and age group.

diabetic patients is high and could be due to chronic hyperglycemia causing atherosclerosis, diabetic neuropathy, endothelial dysfunction and various endocrinological alterations [31].

Our results concur with the Tanzanian studies [12,37,38] where the rate of ED was much common in type 2 than type 1 diabetic patients owing to the constellation in type 2 diabetes of cardiovascular risk factors in the context of insulin resistance with subsequent oxidative stress, endothelial dysfunction and decreased nitric oxide production [39]. A number of studies [39,40], however, reported similar frequencies of ED in both types of diabetes after adjustment for age. In our hands, the predominance of ED among type 2 than type 1 diabetic patients observed in univariate analysis was no likewise longer obvious in the logistic model, after adjustment for various confounders. Instead, older age, the presence of hypertension, abdominal obesity, uncontrolled glycaemia and chronic kidney disease emerged as the independent correlates of ED.

Our results indicate that the likelihood of ED is about 8 times higher among diabetic patients over 50 years of age and this observation is consistent with the literature [12]. Indeed, aging is accompanied by increased vascular stiffness caused by atherosclerosis, favored by oxidative stress and the effect of vasoconstrictive mediators responsible for endothelial dysfunction [41]. Microvascular complications such as diabetic retinopathy and nephropathy were commonest in our patients with ED which is a known predictor of cardiovascular events in diabetic patients [42-44] and constitutes a potentiel marker for screening silent coronary heart disease. ED shares with several chronic complications of diabetes the same pathological pathways and aggravating factors so that the discovery of any chronic complication of diabetes should prompt the search for ED and vice versa.

Table 3: Independent determinants of erectile dysfunction.

Variables	Univariate Analysis		Multivariate Analysis	
	p	OR (IC 95%)	*p*	ORa (IC 95%)
Age (years)				
≤ 50		1		1
> 50	< 0.001	5.76(3.05-10.90)	< 0.001	7.88 (2.62-23.74)
Hypertension				
absent		1		**1**
Present	0.018	3.13(1.64-5.99)	0.027	2.78 (1.13-6.87)
Abdominal obesity				
Absent		1		1
Present	< 0.001	11.44 (5.85-22.38)	< 0.001	12.91 (5.39-30.91)
Chronic Kidney disease				
Absent		1		1
Present	< 0.001	3.80 (2.09-6.91)	0.038	2.5 (1.05-5.93)
Uncontrolled diabetes				
Absent		1		1
Present	< 0.001	12.52 (5.42-28.90	< 0.001	7.08 (2.43-20.62)
Type of diabetes				
1		1		
2	0.027	1.91 (1.08-3.39)	0.465	1.52 (0.497-4.627)

In agreement with other reports, hypertension and central obesity emerged as independent factors associated with ED in the present study. Aruna VS, et al. [45] found that every 10 mmHg increase in systolic BP among men with type 1 diabetes increased the risk for developing incident ED by 25%. Among those with type 2 diabetes, Rosen RC, et al. [46] reported that every 10 mmHg increase in SBP and DBP was associated with 30% and 10% higher prevalence of ED, respectively. Vascular diseases dominated by hypertension, are the leading causes of ED [47]. Hypertension and obesity are major risk factors for atherosclerosis via endothelial dysfunction, oxidative stress, dyslipidemia and insulin resistance responsible for sympathic and renin-angiotensine-aldosterone systems overactivity [48-50].

Uncontrolled diabetes mellitus was also a significant correlate of ED the likelihood of which was 7 times greater than in patient with satisfactory control of their diabetes. Chronic hyperglycaemia is known to induce cardiovascular events through enhanced polyol pathway flux, altered redox state, increased formation of diacylglycerol and subsequent activation of protein kinase C isoforms; non-enzymatic formation of advanced glycation end products is also accelerated [51].

ED was also associated to the presence of chronic kidney disease in our study. Reduced kidney function has been reported to increase the prevalence of ED by 70% to 80% [52]. Features specific to chronic kidney disease, such as abnormalities in gonadal-pituitary system, disturbance in autonomic nervous system, anaemia, secondary hyperparathyroidism, zinc and magnesium deficiency, psychological problems and endothelial dysfunction, appear to be implicated in the occurrence of ED [53]. Among these factors, endothelial dysfunction plays a key role in the development of ED since the production of nitric oxide from the cavernous nerve and vascular endothelium and the subsequent production of cyclic guanosine monophosphate are critically important in initiating and maintaining erection [53].

Study limitations and strengths

Certain limitations must be considered when interpreting the results of the present work. The collective of our sample just was a consecutive series of diabetic patients attending three hospitals in Kinshasa who volunteered in the study. It is therefore uncertain to what extent these results can be reliably extrapolated to all diabetic patients in Kinshasa. The sample size was small and could not allow sufficient power to statistical tests to identify potential associations between all variables of interest. Our study included patients with both type 1 and type 2 diabetes. The comparison of our results with those of studies that exclusively focused on type 2 diabetes mellitus should be qualified. Participants' misinterpretation of the research questionnaire could undermine the sincerity of their answer. The definition of chronic kidney disease was based on semi-quantitative proteinuria and the eGFR obtained on a single occasion. Proteinuria and eGFR monitoring three months apart would be much desirable. Nonetheless, our results show the extent of ED, the need to conduct studies based on a representative sample of diabetic patients to better assess the issue and identify potentiel preventive strategies.

Conclusion

ED of mainly mild and moderate severity affects more than half of diabetic men and was associated with poor glycaemic control as well as traditional and emerging cardiovascular risk factors especially obesity. Our findings suggest the benefit of stringent control of diabetes as potential measure to prevent ED.

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Ethics approval and consent to participate

The study protocol was approved by the Institutional Review Board of the University of Kinshasa Hospital, Department of Internal Medicine. Written informed consent was obtained from the patients, and all clinical investigations were conducted according to the principles expressed in the Declaration of Helsinki. Patients with erectile dysfunction were referred to a doctor for appropriate management.

Consent for p

All authors have approved the final version of this manuscript and assume responsibility of its content.

Availability of data and material

Working in a low income country, we do not have adequate financial resources to pay the costs of keeping data in specialized networks. Our data exists and we can send it to you upon request.

Conflicts of interest

The authors declare no conflict of interest.

Funding

The authors claim to have financed this study with their meager income.

Author's contribution

PMB and MA planned the study. PMB coordinated whilst MA and RYK supervised and implemented the field work in Kinshasa hospitals, Congo. PMB, MA and ANN constructed the data base and did the statistical analysis. PMB, MA, FBL and JRM wrote the first draft of the manuscript. All authors interpreted the results and approved the final version of the article.

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