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ORIGINAL RESEARCH

Prevalence of microalbuminuria among adults with Type 2 Diabetes mellitus at OOUTH, Sagamu

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Abstract

***Background*:** Diabetes mellitus is a serious global epidemic. The menace of this chronic disease is attributable to its chronic complications which threaten both the world economy and life expectancy, especially in Sub- Saharan Africa. Nephropathy is a complication of Diabetes mellitus and a leading cause of End Stage Renal Disease.

***Objectives*:** To determine the prevalence of microalbuminuria as well as the effects of co-morbidities on the pattern of microalbuminuria among adults with Type 2 Diabetes mellitus.

***Methods*:** A total of 325 adults with Diabetes mellitus and 100 controls without Diabetes mellitus was studied. The subjects with diabetes were classified into four groups ([i] diabetes only, [ii] diabetes with hypertension, [iii] diabetes with obesity and [iv] diabetes with hypertension and obesity). Urinary protein, microalbuminuria, fasting plasma glucose and Glycated Haemoglobin (HbA1c) were measured using standard methods.

***Results*:** The overall prevalence of microalbuminuria was 35.1% in the diabetic population, compared to 8.0% in the control group. The prevalence of microalbuminuria in the various diabetic subgroups were as follows: 30.3% (diabetes only), 43.1% (diabetes with hypertension), 37.0% (diabetes with obesity) and 44.6% (diabetes with hypertension and obesity). The fasting plasma glucose and HbA1c were statistically significantly higher in the diabetic population than the control group. This indicated that there is a poor glycaemic control in the diabetic population and hence a possible cause of diabetic nephropathy.

***Conclusion*:** The risk of diabetic nephropathy was significant in the study population. The presence of one or more co-morbidities and poor glycaemic control, increased the occurrence of diabetic nephropathy.

Key words: Chronic Kidney Disease, Diabetes mellitus, Glycated haemoglobin, Hypertension, Microalbuminuria, Obesity.

Introduction

In Nigeria, the absolute prevalence rate of diabetes mellitus (DM) is not known, but it is estimated that about 10% of the Nigerian population have diabetes mellitus. [1] Majority (90-95%) of the people with DM suffer from the Type 2 disease. [2] The acute and chronic complications of DM constitute major global health problems which threaten life expectancy and world economy. The chronic complications of DM include retinopathy, nephropathy, neuropathy and macrovascular problems such as cardiovascular diseases (which accounts for 70-80% of deaths in DM.

Diabetic Kidney Disease is the leading cause of end-stage renal disease in the developed and developing countries. [3] It had been suggested that

diabetic nephropathy may be assuming an increasing role as a cause of chronic kidney disease in Nigeria. [4] The emergence of renal complications of DM may be accelerated by co-existing hypertension and obesity. [5] The earliest feature of diabetic nephropathy is an increase in urinary albumin excretion: first as microalbuminuria (defined as urinary excretion of albumin of 20 - 200mg/L and subsequently as macroalbuminuria (defined as urinary albumin excretion >200mg/L. [6] Therefore, screening for microalbuminuria is useful for early detection of diabetic nephropathy.

In Nigeria, the frequency of clinical diabetic nephropathy was reported to be 39.9% in Ibadan, southwest Nigeria. [7] However, a subsequent study conducted in Sagamu, also within southwest Nigeria, showed a prevalence rate of 28.4% for diabetic nephropathy. [8] Another study conducted at Nsukka, southeast Nigeria reported a prevalence of 49% for incipient nephropathy in a diabetic population. [9] Similarly, a recent study conducted in Warri, in the Niger-Delta part of Nigeria reported a prevalence rate of 58% for microalbuminuria. [10] Incidentally, the prevalence of Type 2 DM is also increasing due to the phenomenon of insulin resistance. [11] Added to this are the rising prevalence rates of hypertension and obesity, which are co-morbid conditions known to increase the risk of diabetic complications such as nephropathy. There is, currently, a global quest to check the threat posed to the world population by the diabetes epidemic; efforts are being made to either find a cure or at least find reliable preventive measures. Currently, there is no cure for DM. [12]

The only study on the prevalence of diabetic nephropathy at the Olabisi Onabano University Teaching Hospsital, Sagamu, Nigeria, the setting for the present study, was done in the year 2003. Therefore, it is attractive to repeat the study examining the current prevalence of diabetic nephropathy in the same facility. The objective of the study was to determine the prevalence of microalbuminuria among adults with Type 2 DM as well as the effects of co-morbidities and quality of glycaemic control on the prevalence of diabetic nephropathy.

Methods

The study was comparative cross-sectional in design and was carried out at the Diabetes Clinic of Olabisi Onabanjo University Teaching Hospital, Sagamu, Nigeria. This clinic provides specialized care for about 500 adult patients with DM from various parts of Ogun State as well as neighboring states. Basic laboratory facilities required in an Endocrinology Unit are also available.

The minimum sample size for the study was determined using the formula: $N=z^2pq/d^2$, where N is the required minimum sample size; d is the margin of error (0.05); p is the known prevalence in the target population = 28.4% [8]; q = 1.0-p; z is the standard of normal deviation corresponding to 95% confidence interval = 1.96. Therefore, the calculated minimum sample size was 325.

Inclusion and exclusion criteria

Adults in the age range of 25-70 years, diagnosed with Type 2 DM (both sexes) were included in the study. Exclusion criteria included age outside the chosen range, pregnancy, use of contraceptives, chronic alcoholism, body building, exposure to heavy metals, established chronic kidney disease, nephrotic syndrome, chronic use of Nonsteroidal Anti-Inflammatory Drugs (NSAIDs), connective tissue disorders, gestational diabetes, positive proteinuria and fever, infection, or exercise in the preceding 24 hours.

A total of 325 adults with Type 2 DM was selected using simple random sampling technique. This consisted of four groups: Group 1 (100 diabetics without hypertension or obesity); Group 2 (75 diabetics with hypertension); Group 3 (75 diabetics with obesity) and Group 4 (75 diabetics with both hypertension and obesity). The control group consisted of 100 non-diabetic, non-obese, and non-hypertensive adults selected from the General Out-Patient Clinic of the same institution. The identity of the participants was concealed using codes. Ethical approval for the study was obtained from the Health Research and Ethics Committee of the Olabisi Onabanjo University Teaching Hospital, Sagamu and written informed consent was obtained from all the subjects recruited into the study.

Using a self-administrable questionnaire, the clinical parameters (age, sex, duration of diabetic illness, blood pressure and Body Mass Index) of each participant were obtained. Blood pressure was measured using Accorson® Sphygmomanometer (hypertension was diagnosed using the criteria by the 7th Joint National Committee for the Prevention, Detection, Evaluation, and the Treatment of High Blood Pressure, [13]) while obesity was determined using the WHO guidelines for the interpretation of Body Mass Index (BMI). [14] Body weight was measured using Surgifriend® weighing scale while the height was measured using a Stadiometer. Diabetic nephropathy was defined as the increased urinary albumin excretion (UAE) in the absence of other renal diseases. This condition was categorized into two stages as microalbuminuria (UAE 20-200mg/L) and macroalbuminuria (UAE > 200mg/L).

After fasting overnight (10 to 12hours), 5mls of venous blood was obtained from each study participant for fasting plasma glucose (FPG) and HbA1c values (3mls into the fluoride oxalate bottle and 2mls into EDTA bottle respectively). In addition, midstream urine sample was collected between 8.00am and 9.00am in a plain plastic universal bottle for the determination of microalbuminuria. The blood sample for FPG was centrifuged at 3,000 revolutions per minute at room temperature for five minutes. The plasma (supernatant) was then obtained and stored at -4°C. The blood sample for biochemical analysis was preserved in the frozen form while the blood sample for HbA1c was analysed same day. The urine samples were analysed on the day of collection and left over urine samples were stored at -4^{0}C.

The determination of microalbuminuria was done using the Homocue urine Albumin Microcuvettes and Homocue Albumin Analyzer (Model 1010R, Angelholm Siredon, Germany) which is a turbidimetric method. It involves an immunochemical antigen-antibody reaction using anti-human antibodies specific for human albumin. [15] Microalbuminuria was defined as urinary protein of 20mg/l - 200mg/l. [6] Urinalysis was performed using Dispstic (Rapid Labs Ltd, UK). [16] In addition, urine microscopy was performed on all urine samples positive for microalbuminuria and proteinuria for quality assurance purposes. FPG was determined spectrophotometrically using the Glucose Oxidase method. [17] Spectrophotometric method was also used for the estimation of HbA1C using Ionic Exchange Resin method. The normal range for FPG and HbA1c are 3 - 5mmol/L (54 - 90 mg/dl) and $\leq$6.5% respectively.

Statistical Analysis

The data analysis was carried out using IBM SPSS version 20 Statistical Software. Mean and standard deviation (mean ± SD) of the concentrations of FPG and HbA1C were determined.

Analysis of Variance (ANOVA) was used to compare multiple mean values of the various parameters between the study groups (diabetics) and control.

Results

The 325 subjects with DM comprised 136 (41.9%) males and 189 (58.1%) females. The age ranged between 37 years and 68 years and the duration of diabetic illness (from diagnosis) ranged from <1 year to 27 years. The control group was made up of 45 (45.0%) males and 55 (55.0%) females.

Microalbuminuria was identified among 35.1% (114/325) subjects and 8% (8/100) of the control group. Similarly, 7.0% (23/325) of the diabetes group had macroalbuminuria (proteinuria) compared to none in the control group.

All the 23 diabetic subjects with macroalbuminuria tested positive to proteinuria and they were excluded from further analysis in the study (Table Ia).

The prevalence rates of microalbuminuria varied among different diabetes groups depending on the type of co-morbidity. Table Ib shows the following prevalence rates in the various diabetes groups: 30.3% (diabetes only), 43.1% (diabetes with hypertension), 37.0% (diabetes with obesity), 44.6% (diabetes with hypertension and obesity). Following the exclusion of the subjects with

macroalbuminuria, the prevalence rates of microalbuminuria in the sub-groups 2 to 4 became 43.1%, 37.0% and 44.6% with the exception of Group 1 which retains the prevalence rate of 30.3%. The patterns of FPG and glycated haemoglobin in the diabetes group revealed poor glycaemic control as shown in Table II. Table II shows that the mean FPG concentrations and HbA1c levels for the various diabetes groups were significantly different from the mean values for the control group.

Table Ia: Distribution of microalbuminuria and macroalbuminuria in each of the Diabetic groups and control prior to exclusion of those with macroalbuminuria

Groups	*Total*	*Subjects with Microalbuminuria n (%)*	*Subjects with Macroalbuminuria n (%)*	*Subjects with normal range of urinary albumin (%)*
1	100	30 (30.0)	1 (1.0)	69 (69.0)
2	75	28 (37.3)	10 (13.3)	37 (49.3)
3	75	27 (36.0)	2 (2.67)	46 (61.3)
4.	75	29 (38.7)	10 (13.3)	36 (48.0)
Control	100	8 (8.0)	0 (0.0)	92 (92.0)

Group 1- Diabetes only; Group 2- Diabetes with Hypertension; Group 3- Diabetes with obesity; Group 4 – Diabetes with Hypertension and Obesity

Table Ib: Prevalence of microalbuminuria in each of the Diabetes groups and the control group (after the exclusion of subjects with macroalbuminuria)

Groups	*Total*	*Frequency*	*Percentage (%)*
1	**99**	**30**	**30.3**
2	**65**	**28**	**43.1**
3	**73**	**27**	**37.0**
4	**65**	**29**	**44.6**
Control	**100**	**8**	**8.0**

Group 1- Diabetes only; Group 2- Diabetes with Hypertension; Group 3- Diabetes with obesity; Group 4 – Diabetes with Hypertension and Obesity

Table II: Comparison of the mean values of FPG concentrations and HbA1c in the various diabetes groups

Parameters	*Groups*	*N*	*Mean ± SD*	*F – test*	*P – value*
FPG (mg/dl)	1	99	165.77 ± 96.79		
	2	65	165.65 ± 94.61		
	3	73	142.41 ± 58.13	27.97	0.000*
	4	65	135.08 ± 58.50		
	Control	100	71.92 ± 13.28		
HbA1c (%)	1	99	8.08 ± 2.71		
	2	65	8.17 ± 2.16		
	3	73	7.97 ± 2.17	7.33	0.000*
	4	65	7.65 ± 1.75		
	Control	100	6.76 ± 1.07		

Group 1- Diabetes only; Group 2- Diabetes with Hypertension; Group 3- Diabetes with obesity; Group 4 – Diabetes with Hypertension and Obesity

Discussion

Various prevalence rates had been reported for diabetic nephropathy in Nigeria. In the year 2001, a prevalence rate of 39.9% was reported for diabetic nephropathy in Ibadan, southwest Nigeria. [7] Another study conducted in Sagamu, also in southwest Nigeria revealed a prevalence of 28.4% for clinical diabetic nephropathy in 2003. [8] In the year 2009, a study on the prevalence of incipient diabetic nephropathy done in Enugu, eastern Nigeria reported a prevalence rate of 49.0% [9] for microalbuminuria while another study in Warri in the year 2016 reported a prevalence rate of 58% [10] for microalbuminuria.

The present study revealed a prevalence rate of 35.1% for microalbuminuria (representing incipient diabetic nephropathy). This finding may suggest the heavy burden of diabetic nephropathy in the study environment. Nevertheless, this observation may not be surprising because previous studies (highlighted above) had shown similarly high prevalence rates in Nigeria. However, the previous study in Sagamu, which was carried out in the year 2003, reported a prevalence rate of 28.4% for clinical diabetic nephropathy (overt nephropathy). Therefore, the present study is the first in Sagamu to report on incipient diabetic nephropathy (microalbuminuria).

Patients with overt nephropathy were excluded from this study. In practice, however, patients with incipient nephropathy require aggressive clinical attention, such as intensified glycaemic control and use of angiotensin converting enzyme inhibitors and calcium channel blockers to slow down further progression of the disease. In addition, microalbuminuria increases the risk of cardiovascular diseases, hence timely clinical intervention is paramount.

The present study also showed varying prevalence rates of microalbuminuria in the different diabetes groups; with and without co-morbidities such as hypertension and obesity, singly or in combination. This finding showed that the presence of one or more co-morbidity (such as hypertension or obesity) in addition to diabetes may be an additional burden with increased risk of the occurrence of diabetic nephropathy. This finding is not peculiar to this study as previous studies had documented similar findings, that hypertension or obesity or both co-existing with diabetes accelerate the onset of diabetic nephropathy. [5, 10] These co-morbidities (hypertension and obesity) are likely to be partly responsible for the increasing prevalence of diabetic nephropathy in this environment.

In the present study, statistically significant differences were demonstrated in the mean values of both the FPG and HbA1c in the various diabetes groups compared with the control group. These observations suggested poor glycaemic control in the study population. This is another factor responsible for the frequent occurrence of diabetic nephropathy. The observation of poor glycaemic control was not peculiar to this study as similar findings had been reported earlier and several factors, such as inadequate or inappropriate pharmacotherapy and psycho-socio-cultural factors among others, have been implicated. [18, 19] In addition, the role of poor glycaemic control as an additional risk factor for diabetic nephropathy had been suggested in a previous study. [5]

This study also observed a prevalence rate of 8.0% for microalbuminuria in the control group. With the exclusion of DM, this observation suggests that other non-diabetes related glomerular diseases could also cause microalbuminuria just as previous studies had also documented microalbuminuria among apparently healthy populations. [20,21] The possible causes of microalbuminuria in the apparently healthy general population include smoking, race, oral contraceptives, exercise, heavy metal poisoning, connective tissue disorders, use of Non Steroidal Anti-Inflammatory Drugs (NSAIDs), sickle cell disease, obesity, as well as family history of diabetes or hypertension.

Conclusion

This study indicated the prevalence of microalbuminuria in a population of adults with

diabetes mellitus as 35.1%. This means that microalbuminuria (representing incipient diabetic nephropathy) is an important health problem in the environment. The study has also shown that co-morbidities such as hypertension, obesity, and poor glycaemic control are likely to be additional risk factors for diabetes nephropathy. Therefore, clinicians should be aware of the frequent occurrence of microalbuminuria in the study population and ensure aggressive treatment modalities targeted at preventing or reducing the progression to overt diabetic nephropathy. Special attention should be directed at patients with DM and co-morbidities such as hypertension or obesity and greater efforts should be geared towards achieving good glycaemic control.

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Authors' Contributions: AAA conceived and designed the study, did the field work and drafted the manuscript. OO participated in designing the study and reviewing the draft manuscript. OOA supervised the laboratory aspects of the study and reviewed the draft manuscript. JAEA participated in the design of the study while OKS performed major statistical analysis. OWE participated in drafting the manuscript. All the authors approved the final version of the manuscript.

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