Diabetic nephropathy in a tertiary care clinic in South Africa: a cross-sectional study

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Keywords: microalbuminuria, diabetes control, estimated glomerular filtration rate, HbA_{1c}

Abstract

Objective: The aim of this study was to determine the prevalence of micro- or macroalbuminuria in type 1 and type 2 diabetic patients, and to examine the relationship with the diabetes control parameters such as haemoglobin (Hb)A_{1c}, blood pressure (BP) and lipids.

Design: This was an analytical cross-sectional study.

Setting and subjects: The study consisted of 754 patients with either type 1 or type 2 diabetes, attending a diabetes clinic at the Kalafong Hospital in Pretoria, South Africa.

Outcome measures: Micro- or macroalbuminuria and estimated glomerular filtration rate (eGFR) were the outcome measures.

Results: An HbA_{1c} > 7% was recorded in 88.9% of the patients, and low-density lipoprotein cholesterol ≥ 1.8 mmol/l in 81%. Overall, the prevalence of micro- or macroalbuminuria was 33.6%. Logistic regression revealed that HbA_{1c}, the duration of diabetes, systolic BP, male sex and triglycerides were predictive of microalbuminuria.

Conclusion: The prevalence of micro- or macroalbuminuria in this study fell within the ranges of what has previously been reported in Africa. HbA_{1c} and the duration of diabetes were the strongest predictors of microalbuminuria in all of the patients, and age was the strongest predictor of a low eGFR. Diabetes was poorly controlled, making the progression to end-stage renal failure a real concern in these patients.

Ⓟ Peer reviewed. (Submitted: 2014-11-20. Accepted: 2015-02-04.) © SEMDSA
JEMDSA 2015;20(1):67-73

Introduction

In 1901, diabetes mellitus was described as "very uncommon" in Africa.[1] Today, the situation is different. According to the International Diabetes Federation atlas, 19.8 million people had diabetes in 2013 in Africa,[2] and the number of patients is increasing. Diabetes in Africa is associated with a higher complication rate than that in developed countries, diabetes control parameters such as haemoglobin (Hb)A1c, blood pressure (BP) and lipids.[3,4]

Diabetic nephropathy is the major cause of end-stage renal disease (ESRD) in developed countries, i.e. ~ 30% of cases.[5,6] In the near future, diabetic nephropathy is expected to become the most frequent cause of ESRD in the developing world.[7] Approximately 20-30% of people with either type 1 or type 2 diabetes develop nephropathy, whose incidence increases with the duration of diabetes.[5] Certain ethnic groups, such as Native Americans, and Mexican and African Americans, demonstrate a higher prevalence rate of severe nephropathy in comparison to Caucasians.[5,6]

The prevalence of diabetic nephropathy ranges from 32-57% in Africa, and overt proteinuria is found in 5-28% of diabetic patients.[3,8] Furthermore, diabetes mellitus contributes to a third of all patients in dialysis units in Africa.[8] Diabetic nephropathy is a major public health concern because dialysis and kidney transplantation therapy are almost completely inaccessible to most diabetic patients in Africa.[9] Already, a 12-year follow-up study conducted in South Africa on a cohort of type 2 diabetic patients showed that ESRD was a major cause of death in 29% of the mainly non-Caucasian patients.[10] Once a patient reaches the renal failure stage, therapeutic options are limited, given the severe shortage of dialysis slots in South Africa. Therefore, taking measures to prevent kidney disease is crucial. Early medical interventions and lifestyles changes, such as a reduction in protein intake and smoking cessation, have been shown to slow the progression from microalbuminuria to overt proteinuria, and eventually ESRD. Furthermore, there is impressive experimental and clinical evidence that angiotensin-converting enzyme (ACE) inhibitors have specific renoprotective properties in

patients with diabetic or nondiabetic renal disease who have proteinuria.[11]

The aim of this study was to determine the prevalence of diabetic nephropathy (micro- or macroalbuminuria) in type 1 and type 2 diabetic patients who attended the Kalafong Diabetes Clinic in Pretoria, and to examine the relationship between diabetes control parameters, including haemoglobin (Hb)A_1, blood pressure (BP) levels, lipids and diabetic nephropathy in this group of predominantly African patients with diabetes.

Method

Study design

The study was an analytical cross-sectional study.

Setting

The study was conducted at Kalafong Hospital, which is a tertiary public hospital in Pretoria, Gauteng, South Africa. The hospital serves as a training institution for the Faculty of Health Sciences of the University of Pretoria. Patients seen at the Kalafong Diabetes Clinic are usually referred on the basis of two criteria; either poorly controlled diabetes or BP, or the presence of diabetic complications.

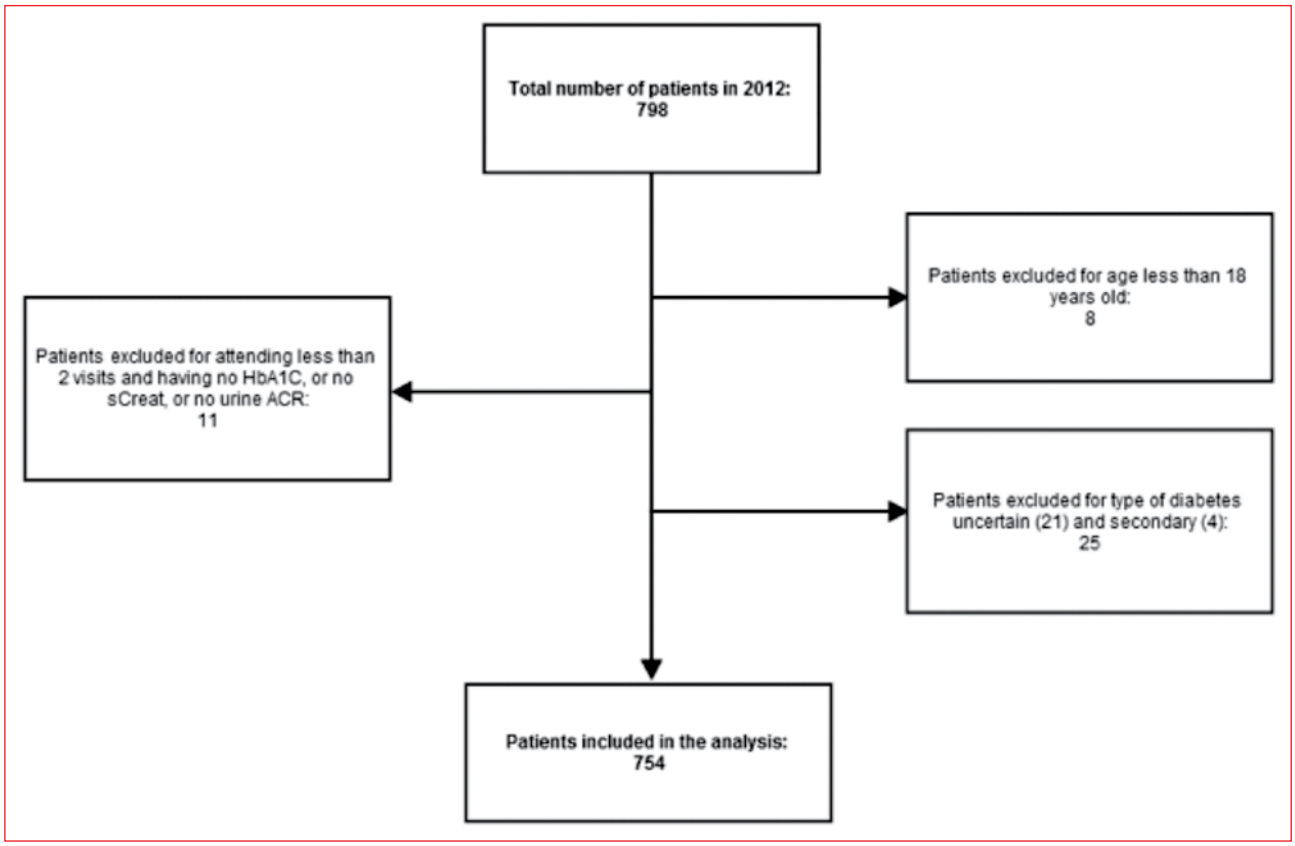
Subjects

Data were extracted from the electronic database of the Kalafong Diabetes Clinic on patients who attended the clinic from January to December 2012. Patients were excluded from the study if they were aged 18 years and younger, had either secondary or uncertain-type diabetes, or had nephropathy stemming from other causes. Patients were also excluded if they had only attended the clinic once in 2012, or if they had not had at least one or more of the following measurements performed: HbA_{1c}, serum creatinine and urine albumin to creatinine ratio (ACR).

Approval for the study was obtained from the Faculty of Health Sciences Research Ethics Committee, University of Pretoria (154/2013).

Measurements

Every patient who attends the Diabetes Clinic is scheduled for a minimum of four visits per year, i.e. one every three months. Kidney function is assessed biannually (ever six months) with a urine ACR on a random urine sample. HbA_{1c} concentration and the serum concentrations of creatinine, total cholesterol, high-density lipoprotein (HDL) cholesterol and triglycerides are measured in peripheral blood, and low-density lipoprotein (LDL) cholesterol calculated using the Friedewald formula. All BP measurements were taken with an electronic BP machine (EDAN® Vital Signs Monitor, model M3A).



ACR: albumin to creatinine ratio, HbA_{1c}: haemoglobin A_{1c}

Figure 1: A flow chart of the patients included in our study

Statistical analysis

Data were statistically analysed by means of Stata® version 12 and SPSS® Statistics version 22. Descriptive statistics were carried out for all of the variables with appropriate methods, based on the type and distribution of the data. Frequency tables, cross-tabulation and the chi-square test were used. Logistic regression was performed to determine which predictor variables influenced the outcome.

Logistic regression was conducted as follows. Univariate logistic regression was carried out for the following variables: sex, race (dummy variables were created for black, white, Indian and coloured patients), age, type of diabetes, snuff use, smoking, body mass index (BMI), duration of diabetes, duration of hypertension, HbA_{1c}, total cholesterol, LDL cholesterol, triglycerides, HDL cholesterol, mean systolic BP (SBP), mean diastolic BP (DBP), use of ACE inhibitors, the coefficients of variation in the SBP measurements and the coefficients of variation in the DBP measurements.

Variables with a p-value of more than 0.2 in a univariate analysis were excluded from the multivariable logistic regression. The analysis was consecutively performed, dropping variables from the preceding model that contributed the least to the overall performance of the model until the most parsimonious model was obtained, with the least number of predictor variables.

The dependent variables were the estimated glomerular filtration rate (eGFR) < 60 ml/minute/1.73m^2 (stage 2 chronic kidney disease and higher) and microalbuminuria based on a urine ACR of more than 2.5 mg/mmol for males and 3.5 mg/mmol for females. The eGFR was calculated by using the Modification of Diet in Renal Disease (MDRD) study equation: eGFR (ml/minute/1.73m^2) = 186 × (serum creatinine)$^{-1.154}$ × (age)$^{-0.203}$ × (0.742, if female) × (1.212, if black).[12] This multivariate analysis were performed for type 1 and type 2 diabetic patients combined, and for both groups separately.

Results

The study population was the 798 diabetic patients who had attended the Kalafong Diabetic Clinic in 2012. On average, the number of visits attended per patient was 4.09 (± 0.92) in 2012, ranging from 1-6 visits. Of all the patients, 44 were excluded. Eight were < 18 years old; 11 made only one visit, or on whom information, such as their HbA_{1c}, serum creatinine or urine ACR, was lacking; and 25 had secondary diabetes, or the type of diabetes was uncertain (Figure 1).

The demographic and clinical characteristics of the 754 patients who fulfilled the inclusion criteria are outlined in Table I.

Table I: The clinical characteristics of the diabetic patients who attended the Kalafong Diabetic Clinic in Pretoria in 2012

Characteristics	N = 754 n (%)*
Age	Mean of 57.2 years, standard deviation 14.9
Gender	
Male	280 (37.1)
Female	474 (62.9)
Race	
Black	687 (91.1)
White	27 (3.6)
Coloured	3 (0.4)
Indian	37 (4.9)
Diabetes type	
Type 1	252 (33.4)
Type 2	502 (66.6)
Duration of diabetes	Range of 0-64 years, median of 11 years (interquartile range of 6-18)
Smoking status	
Current	79 (10.5)
Never	541 (71.8)
Stopped	130 (17.2)
Unknown	4 (0.5)
Snuff use	
Yes	62 (8.2)
No	666 (88.3)
Unknown	26 (3.5)
Body mass index (kg/m^2)	n = 734, mean of 31.5, standard deviation 6.7
Underweight: < 18.5	8 (1.0)
Normal: 18.5-25	107 (14.6)
Overweight: 25-30	214 (29.2)
Obese (class 1): 30-35	199 (27.1)
Obese (class 2): 35-40	129 (17.6)
Obese (class 3): (> 40)	77 (10.5)
Hypertension**	597 (79.2)
Unknown	2 (0.3)
Duration of hypertension	n = 595, range of 0-62 years, median of 11 years (interquartile range of 7-18)
ACE inhibitor use	566 (75.1)

ACE: angiotensin-converting enzyme
*unless stated otherwise
**hypertension of > 140 mmHg systolic blood pressure and/or 90 mmHg diastolic blood pressure

The patients were predominantly black (91.1%) and female (62.9%), with a mean age of 57.2 (± 14.9) years. The majority of the 754 patients (66.6%) had type 2 diabetes. The median duration of diabetes was 11 years. Most patients (71.8%) had never smoked, and 10.5%

Table II: Description of the study population according to the type of diabetes

Characteristics	Type 1, n = 252 n (%)	Type 2, n = 502 n (%)	p-value
Age in years, mean (SD)	46.5 (15.6)	62.6 (11.3)	< 0.001
Gender			
Male	122 (48.4)	158 (31.5)	< 0.001
Female	130 (51.6)	344 (68.5)	
Race			
Black	235 (93.3)	452 (90)	0.001
White	14 (5.6)	13 (2.6)	
Coloured	0 (0.0)	3 (0.6)	
Indian	3 (1.2)	34 (6.8)	
Smoking status			
Current	36 (14.3)	43 (8.6)	0.08
Never	169 (67)	372 (74.1)	
Stopped	46 (18.3)	84 (16.7)	
Unknown	1 (0.4)	3 (0.6)	
Snuff use	17 (6.8)	45 (9)	0.121
Unknown	13 (5.2)	13 (2.6)	
Duration of diabetes (in years), mean (SD)	11.4 (8.3)	13.4 (8.4)	0.003
Body mass index, mean (SD)	29.3 (6.5)	32.5 (6.5)	< 0.001
Hypertension	144 (57.1)	453 (90.2)	< 0.001
Unknown	2 (0.8)	0 (0.0)	
Duration of hypertension, mean (SD)	11 (8)	14.2 (9)	< 0.001
ACE inhibitor use	169 (67.1)	397 (79.1)	< 0.001

ACE: angiotensin-converting enzyme, SD: standard deviation

were current smokers at the time of the data collection. The majority of the patients (84.4%) were classified as overweight and obese, with a mean BMI of 31.5 kg/m^2 (± 6.7 kg/m^2). High BP was diagnosed in 79.2% of the patients, of whom 75.1% were receiving ACE inhibitors.

Patients were compared according to their type of diabetes (Table II). As expected, the type 1 patients were significantly younger than the type 2 patients (mean age 46.5 vs. 62.6 years, p-value < 0.001), had a shorter known duration of diabetes (11.4 vs. 13.4 years), (p-value 0.003), and with lower frequencies of hypertensive disease (57.1% vs. 90.2%) (p-value < 0.001).

Evaluation of diabetes control parameters: haemoglobin A_{1c}, blood pressure and lipids

The HbA_{1c} of the patients ranged from 5.4-22.5%, with a median of 9.6%. The mean SBP was 140.4 mmHg (± 16.9 mmHg), and the mean DBP 80.9 mmHg (± 9.8 mmHg). The medians for total cholesterol, triglycerides and LDL were 4.4, 1.4 and 2.5 mmol/l, respectively (Table III).

Table III: Diabetes control parameters

Variables	n	Statistics
HbA_{1c} (%)	745	Range 5.4-22.5
		Median 9.6 (IQ 7.8-11.8)
BP (mmHg)		
SBP*	754	Mean 140.4, SD 16.9
DBP**		Mean 80.9, SD 9.8
Lipids (mmol/l)		
Total cholesterol	706	Median 4.4
Triglycerides	702	Median 1.4
LDL***	690	Median 2.5

DBP: diastolic blood pressure, HbA_{1c}: haemoglobin A_{1c}, IQ: interquartile range, LDL: low-density lipoprotein, SBP: systolic blood pressure, SD: standard deviation
**Systolic blood pressure:* Good (< 140 mmHg), moderate (140-160 mmHg) and poor (> 160 mmHg)
***Diastolic blood pressure:* Good (< 80 mmHg), moderate (80-100 mmHg) and poor (> 100 mmHg)
***Low-density lipoprotein was calculated using the Friedewald formula. Low-density lipoprotein could not be calculated in a number of patients with very high triglycerides

A small proportion of the study population (11.1%) met the HbA_{1c} target (HbA_{1c} < 7%), i.e. 13.8% of the type 1, and 9.8% of the type 2 patients. An HbA_{1c} of over 10% was recorded in roughly half of the type 1 patients (50.4%). More than 66% of the type 1 patients had a good SBP, against 49.2% of the type 2 patients. Most patients (96.2%) had a DBP of less than 100 mmHg. All of them had relatively good total cholesterol and triglycerides levels, but 79.5% of them had LDL levels ≥ 1.8 mmol/l.

Assessment of the renal function of patients: urine albumin to creatinine ratio and estimated glomerular filtration rate

The results of urine ACR and eGFR are given in Table IV.

Table IV: The assessment of renal function using estimated glomerular filtration rate and the urine albumin to creatinine ratio

Variables	n (%)*
Urine ACR (mg/mmol)	n = 735, range 0.0-977.0, median 1.3 (IQ: 0.6-5.6)
Normal: < 2.5 (male) and 3.5 (female)	488 (66.4)
Microalbuminuria: 2.5-25 (male) and 3.5-35 (female)	169 (23.0)
Macroalbuminuria: > 25 (male) and > 35 (female)	78 (10.6)
eGFR (MDRD) (ml/minute/1.73m^2)	n = 721, range 1.9-430.5, median 102.3 (IQ 71.4-138.9)
> 60 ml/minute/1.73m^2	721 (82.7)
< 60 ml/minute/1.73m^2	721 (17.3)

ACR: albumin to creatinine ratio, eGFR: estimated glomerular filtration rate, IQ: interquartile range, MDRD: Modification of Diet in Renal Disease (study)
* unless stated otherwise

Of the study population, 66.4% had a normal urine ACR, meaning less than 2.5 mg/mmol for males and 3.5 mg/mmol for females. The median recorded urine

ACR for both sexes was 1.3 mg/mmol. The prevalence of microalbuminuria was 23%. The eGFR of the patients using the MDRD formula ranged from 1.99-430.5, with a median of 102.3 ml/minute/1.73m^2. A low eGFR (< 60 ml/minute/1.73 m^2) was recorded in 17.3% of the patients.

Logistic regression analysis

Logistic regression analysis was conducted to determine which predictor variables influenced the outcome, i.e. microalbuminuria (urine ACR) and low eGFR (< 60 ml/minute/1.73 m^2) in all patients, then in the type 1 patients only, and finally in the type 2 patients only.

The prediction success achieved for microalbuminuria in all of the patients was 75.1%, with a model chi-square of 146.9 (p-value < 0.001). The variables of SBP (p-value < 0.001), HbA_{1c} (p-value < 0.001), duration of diabetes (p-value < 0.001), triglycerides (p-value 0.008) and male sex (p-value < 0.001) made a significant contribution to the prediction. Thus, if the values of SBP, HbA_{1c}, duration of diabetes and triglycerides were raised by one unit, the odds of obtaining microalbuminuria would be more likely to increase. The use of ACE inhibitors did not seem to have an influence on microalbuminuria as measured by the urine ACR.

The prediction success for eGFR in all of the patients was 69%. A test of the full model against a constant-only model was statistically significant, indicating that the predictors, as a set, reliably distinguished between diabetic patients with an eGFR < 60 ml/minute/1.73m^2 and the others (chi-square 122.5, p-value < 0.001). Nagelkerke's R^2 of 0.213 indicated a moderate relationship between prediction and grouping. The independent variables that contributed significantly to the prediction were age (p-value < 0.001), duration of hypertension (p-value 0.022) and being Indian (p-value 0.005). It should be noted that an unexpected difference was demonstrated for the predictors of urine ACR and eGFR. There was a small number of Indian patients in the study. Despite this small number, this was still a significant predictor of lower eGFR in this subset of patients.

A logistic regression analysis was conducted to predict microalbuminuria in type 1 diabetic patients only. A value of 49.6 (p-value < 0.001) was reported for the model chi-square. The Hosmer-Lemeshow (H-L) goodness-of-fit test statistic was greater than 0.05. Therefore, the model was quite a good fit. HbA_{1c} (p-value < 0.001), duration of diabetes (p-value < 0.001) and triglycerides (p-value < 0.001) contributed significantly to the model. The use of ACE inhibitors seemed to play a nonsignificant protective role in this model.

The prediction success for eGFR worse than stage 1 was 79.3%. The H-L goodness-of-fit test was 0.055, which means that the estimate of the model fitted the data at an acceptable level. Age (p-value < 0.001), SBP (p-value 0.022) and coefficient variation of DBP (p-value 0.008) significantly contributed to the model.

Finally, logistic regression analysis to predict eGFR < 60 ml/minute/1.73 m^2 and microalbuminuria in type 2 patients was conducted. Overall, the prediction success was 73% and 65% for microalbuminuria and eGFR, respectively.

HbA_{1c} (p-value < 0.001), the duration of diabetes (p-value < 0.001), SBP (p-value < 0.001), male sex (p-value < 0.001) and ACE inhibitors (p-value 0.025) were the independent variables that contributed significantly to the prediction of microalbuminuria in the patients with type 2 diabetes mellitus. According to the model, the use of ACE inhibitors was negatively associated with microalbuminuria, and thus protective [odds ratio (OR) 0.558, 95% confidence interval (CI): 0.336-0.928].

Age (p-value < 0.001) and Indian descent (p-value 0.008) wee the independent variables that seemed to have made a significant contribution to the prediction of eGFR. It seems that from the abovementioned models, protection relating to Indian descent with regard to eGFR was only valid in type 2 diabetic patients, probably because there were very few Indian patients with type 1 diabetes.

Discussion

This analytic cross-sectional study, using a study population of 798 diabetic patients attending a tertiary care diabetes clinic in Pretoria, provided the opportunity of determining the prevalence of micro- or macroalbuminuria, and of examining the relationship between microalbuminuria and putative risk factors.

Glycaemic control, as measured by the $HbA_{1c,}$ was poor. More than 88% of the patients did not meet the HbA_{1c} target of < 7%, as recommended by the 2012 South African Society for Metabolism, Diabetes and Endocrinology (SEMDSA) guidelines. Webb et al found that more than 70% of patients had an HbA_{1c} value > 7% in a cluster randomised trial conducted in the Tshwane district.[13] 73.8% of patients failed to meet the HbA_{1c} target in another study conducted in a South African population with type 2 diabetes.[14] Poor glycaemic control has also been reported in other parts of sub-Saharan Africa, i.e. South Africa (Cape Town), Northern Ethiopia and Kenya.[15-17]

Lipid control was poor, with an LDL cholesterol value > 1.8 mmol/l in 81% of the patients. Webb et al reported similar results. There were uncontrolled lipids in more than 80% of their study population.[13]

In this study, the mean SBP was 140 mmHg and the mean DBP 80 mmHg. More than half of the patients (54%) had a DBP above the target recommended by the 2012 SEMDSA guidelines. Webb et al reported a slightly higher mean SBP and mean DBP of 143 mmHg and 85 mmHg,

respectively.[13] However, Gill et al recorded a lower mean SBP (108 mmHg) and mean DBP (72 mmHg) than that in this study.[16]

In the present study, 84.4% of the patients were overweight, including 55.2% who were obese. Webb et al found similar levels of obesity in their study, where more than 80% of patients were overweight.[13]

One of the limitations of the present study was that it was a tertiary, clinic-based study. The study population was mostly patients who were difficult to control at a lower level of care, and who were therefore referred to the tertiary clinic. This difference in the patient population might have introduced some degree of referral bias, making it difficult to extrapolate the results to the general population or to primary healthcare diabetes management. However, diabetes control was also shown to be suboptimal in two other studies conducted in South Africa.[13,14] The first study was on diabetic patients attending primary healthcare clinics, but the study population from the second study presented at a diabetic clinic in a tertiary academic hospital similar to ours, after being referred by their treating physicians at the primary clinics.[13,14]

The prevalence of micro- or macroalbuminuria in patients with type 1 and type 2 diabetes was 33.6%; 23% for microalbuminuria and 10.6% for macroalbuminuria, in this cross-sectional analysis. In other studies, various frequencies of microalbuminuria have been found, ranging from 10.7-39%.[18-22] This variation in the frequency of microalbuminuria may be attributed to different factors, such as method of urine collection, differences in the population and sample sizes, ethnic susceptibility to develop nephropathy, as well as differing definitions of microalbuminuria.

A statistically significant relationship between microalbuminuria and both poor glycaemic control (HbA_{1c}) and duration of diabetes was shown in our study. This result was consistent when type 1 and type 2 diabetic patients were both included in the logistic regression models, but also when analysed separately.

Poor glycaemic control is a well-defined contributor to the development and progression of microalbuminuria in diabetic patients. Ghosh et al found that HbA_{1c} was strongly associated with microalbuminuria.[21] However, Lutale et al failed to demonstrate any significant relationship between the level of glycaemic control and microalbuminuria in a population of type 1 and type 2 diabetic patients in Tanzania.[22]

Ghosh et al could not demonstrate a significant correlation between microalbuminuria and the duration of diabetes, in contrast to our study.[21] These authors suggest that the absence of a significant correlation between microalbuminuria and diabetes duration could be owing to the difficulty in dating the onset of diabetes.

High BP is known to be the most significant contributing factor to the development of diabetic nephropathy in both type 1 and type 2 diabetic patients.[22] In the current study, SBP was significantly associated with microalbuminuria in type 2 diabetic patients, and also when type 1 and type 2 diabetic patients were combined in the predictive model. Similar results were found in two studies conducted in Tanzania in 2007 and 2012, as well as in a cohort of African patients with type 1 diabetes in South Africa.[21-23]

Triglycerides significantly correlated with microalbuminuria in logistic regression models for the type 1 and type 2 patients combined, and for the type 1 diabetic patients only. Male sex was significantly predictive of microalbuminuria in logistic models for all of the diabetic patients and for the type 2 diabetic subjects only. Male sex has previously been found to be associated with a high risk of nephropathy in type 2 diabetic patients.[11]

Although 10.5% of the patients were currently smoking, smoking was not predictive of either microalbuminuria or a reduced eGFR in this study. The failure to provide evidence that confirmed smoking as a predictor of diabetic nephropathy could be explained by the low prevalence of smoking in the study population. Parving et al, who analysed a study population of 32 208 type 2 diabetic patients, found an association between micro- and macroalbuminuria and smoking (OR 1.15, 95% CI: 1.08-1.22).[19]

The use of ACE inhibitors seemed to play a protective role in type 2 diabetic patients in the current study, yet nonsignificantly in type 1 diabetic patients. Seventy-five per cent of the study population were on ACE inhibitors. The only times that patients attending the Kalafong Diabetes Clinic were not given ACE inhibitors were when they could not tolerate the medicine, if they had significant side-effects therefrom, and when they had a normal BP without microalbuminuria. This may have contributed to confounding by indication or contraindication. ACE inhibitor use is not commonly reported in studies on diabetic nephropathy in African patients. In the study by Pinchevsky et al, 80% of the patients were on ACE inhibitors.[14] Ghosh et al found that hypertensive patients who were on ACE inhibitors or angiotensin-receptor blockers were three times more likely to have normoalbuminuria than those using other antihypertensive medications.[21]

The median eGFR was 102.3 ml/minute/1.73 m^2, and 17% of the patients had more than stage 1 renal insufficiency (eGFR < 60 ml/minute/1.73 m^2). These results are similar to those found in a cross-sectional study in which diabetic patients from 33 countries were evaluated, where the authors reported that eGFR was below 60 ml/minute/1.73 m^2 in 22% of the patients.[19]

In this study, a low eGFR (< 60 ml/minute/1.73 m^2) was significantly associated with age in all of the models. Indian race was predictive of a lower eGFR. However, there was a small number of patients of Indian descent in the study. Despite this, it was still a significant predictor of lower eGFR in this subset of patients. This may be explained by the fact that patients of Indian decent have a lower muscle mass, which could explain the lower eGFR.[24]

Micro- or macroalbuminuria were not always confirmed by two urine specimens in the present study, contrary to most recommendations. However, a similar method has been used in other settings.[19,20] The size of the study population was a strength in this study.

Conclusion

The prevalence of micro- or macroalbuminuria in our study fell within the range of what has previously been reported in sub-Saharan Africa. HbA_{1c} and duration of diabetes were the strongest predictors of microalbuminuria in all of the patients, and age was the strongest predictor of a low eGFR. Diabetes was poorly controlled, making the progression to ESRD a real concern in those patients. Therefore, focus must be placed on measures to prevent the progression of renal lesions, i.e. strict glycaemic control, smoking cessation, the attainment of an optimal BP, the initiation of lipid-lowering therapy, and attempts to decrease urinary albumin excretion.

Conflict of interest

The authors state that they have no conflict of interest.

Acknowledgments

The authors would like to thank the staff members of the Kalafong Diabetes Clinic, Pretoria, for their assistance.

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