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Prevalence and determinants of microalbuminuria among patients with type 2 diabetes in Parakou, 2024

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Abstract

Introduction: Type 2 diabetes is a major cause of nephropathy, with microalbuminuria being one of its key indicators. The objective of this study was to determine the prevalence and factors associated with microalbuminuria among patients with type 2 diabetes (T2D).

Methods: This was a descriptive and analytical study, conducted from June 24 to July 17, 2024. It included T2D outpatients followed in Parakou, in whom 24-hour microalbuminuria was measured using the immunofluorescence method. An exhaustive sampling method was used. Microalbuminuria was defined as a urinary albumin excretion between 30 and 300 mg/24h. Factors associated with microalbuminuria were identified using logistic regression. The level of statistical significance was set at 5%.

Results: A total of 192 T2D patients were included. Their mean age was 58.27 ± 11.06 years, with a female predominance (65.63%). The prevalence of microalbuminuria was 17.71% (95% CI [10.67–26.83]). In multivariate analysis, age ≥ 50 years (OR = 3.23; p < 0.001), disease duration ≥ 5 years (OR = 2.54; p < 0.001), hypertension (OR = 8.24; p < 0.001), high blood glucose (OR = 2.52; p = 0.015), and elevated serum creatinine (OR = 16.98; p = 0.022) were significantly associated with microalbuminuria.

Conclusion: The prevalence of microalbuminuria is substantial among patients with type 2 diabetes in Parakou. Hypertension, elevated blood glucose, and increased serum creatinine levels are factors that promote microalbuminuria among these patients.

Keywords: Type 2 Diabetes; Microalbuminuria; Determinants; Parakou

1. Introduction

Diabetes mellitus, predominantly type 2, is a major public health problem, with its global prevalence projected to increase from 10.5% in 2021 to 12.2% in 2045 if no effective preventive measures are implemented [1]. Chronic hyperglycemia induced by diabetes mellitus leads, in the long term, to failure of various organs, notably the eyes, kidneys, nerves, heart, and blood vessels, resulting in complications that may be macrovascular (myocardial infarction, transient ischemic attack, stroke, and limb ischemia) and/or microvascular (retinopathy, nephropathy, peripheral neuropathy) [2–3]. The high prevalence of these complications is often responsible for increased morbidity and mortality among diabetic patients [4–5]. The development of diabetic nephropathy progresses through several stages,

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including glomerular hyperfiltration, microalbuminuria, which may evolve to overt proteinuria, and ultimately end-stage renal disease (ESRD) [6]. Indeed, 20 years after the onset of diabetes, 20–40% of patients with microalbuminuria progress to overt nephropathy, and approximately 20% eventually develop ESRD [7]. This explains why microalbuminuria remains the best-documented predictor of the risk of developing diabetic nephropathy. It can be assessed either by semi-quantitative methods or by quantitative measurement [8–9]. The latter represents the gold standard, providing excellent accuracy in determining 24-hour urinary albumin excretion, although it is costly [10]. The natural course from the early stages of diabetic nephropathy to ESRD spans several years [11]. However, in patients with type 2 diabetes, the diagnosis is often made at an advanced stage. Clinical trials have shown that intensive control of hyperglycemia and blood pressure can significantly reduce renal damage [12–14]. Therefore, prevention and management of risk factors for microalbuminuria may slow the progression of renal impairment. In Benin, as in many African countries, the burden of diabetes-related complications is increasingly significant, with major health and economic consequences. In 2021, Ahoui et al. [15] reported a prevalence of 28.95% of diabetic patients with chronic kidney disease in the Department of Internal Medicine at Parakou, most of whom had already reached the stage of ESRD. The present study was therefore undertaken to provide an overview of microalbuminuria in order to prevent diabetic nephropathy and improve the management of patients with type 2 diabetes.

2. Methods

Study design and period: This was a cross-sectional, descriptive, and analytical study with prospective data collection conducted from June 24, 2024, to July 17, 2024.

Study population: The study population consisted of outpatients with type 2 diabetes followed at the medical clinic of *Diabetes Benin* for at least 6 months, aged 18 years or older, and who provided informed consent to participate in the study. Patients presenting with fever or an active infection, chronic kidney disease, pregnancy, a history of urinary tract surgery, or those who engaged in physical activity the day before or on the day of urine collection were excluded. The same applied to diabetic patients on angiotensin II receptor antagonists, angiotensin-converting enzyme inhibitors, or those with monoclonal gammopathy. Patients unable to complete the 24-hour urine collection for microalbuminuria assessment were also excluded.

Variables: The dependent variable was the presence of microalbuminuria in diabetic patients, defined as albuminuria between 30 and 300 mg/24h. Microalbuminuria was measured on 24-hour urine samples using the AFIAS Microalbumin test, which is based on a sandwich immunoassay method. Independent variables included sociodemographic data, anthropometric parameters, lifestyle, diabetes characteristics and treatment, and biochemical parameters. Blood pressure was measured using an electronic sphygmomanometer in a patient seated in a quiet room, shielded from noise, after 20 minutes of rest. Normal waist circumference was defined as ≥ 80 cm in women or ≥ 94 cm in men. Sedentary behavior was defined as an average duration of physical activity of less than 30 minutes per day. Medication adherence was assessed using Teo Girerd's questionnaire. Normal blood glucose was defined as [70 – 100 mg/dl[, low as < 70 mg/dl and high as ≥ 100 mg/dl. and normal serum creatinine was defined as [6 – 14 mg/L].

Data analysis: After data collection, survey forms were checked for completeness and consistency. Double data entry was performed using Epi Info 7.2.2.6 (CDC Atlanta, 2018), and the dataset was exported to Excel (Microsoft, 2019). Data analysis was also performed using Epi Info 7.2.2.6 (CDC Atlanta, 2018). Quantitative variables were expressed as means with standard deviations or as medians with interquartile ranges depending on distribution normality, while qualitative variables were expressed as percentages. Means were compared using Student's t-test or ANOVA, as appropriate (bivariate: Student's t-test; multivariate: ANOVA). Logistic regression was used to identify associations between microalbuminuria and independent variables in patients with type 2 diabetes. The effect of each variable significantly associated with microalbuminuria was first studied in bivariate analyses, then in multivariate analyses using logistic regression . Statistical significance was set at 5%. Explanatory variables were reported with adjusted odds ratios (aOR) and their 95% confidence intervals (95% CI).

Ethical considerations: Written informed consent was obtained from all study participants. All survey forms were coded to ensure anonymity, and all collected data remained confidential. The study protocol was approved by the Local Ethics Committee for Biomedical Research of the University of Parakou (Ethical Approval No. 566/2024/CLERB-UP/P/SP/R/SA).

3. Results

3.1. Sociodemographic and clinical characteristics of the study population

The study population consisted of 192 patients. The mean age was 58.27 ± 11.06 years (range: 35–82 years). There was a female predominance (65.63%) with a male-to-female sex ratio of 0.52. The mean duration since diabetes diagnosis was 9.17 ± 6.68 years. Hypertension was observed in 57.29% of patients. Lifestyle characteristics included alcohol consumption in 26.04%, tobacco use in 8.33%, and physical inactivity in 63.54%. Regarding treatment adherence, 77.08% had good medication adherence, 56.25% had good dietary adherence, and 72.92% attended regular medical follow-up. Anthropometric assessment showed that 61.46% had a body mass index (BMI) ≥ 25 kg/m^2 (overweight), and 79.17% had an elevated waist circumference (Table 1).

Table 1 Sociodemographic and clinical characteristics of the study population (n = 192)

	n	**%**
Age		
< 50 years	52	27.08
≥ 50 years	140	72.92
Sex		
Femala	126	65.63
Male	66	34.38
Duration since diagnostic		
< 5 years	64	33.66
≥ 5 years	128	66.34
Arterial hypertension		
Yes	110	57.29
No	82	42.71
Lifestyle		
Alcohol consumption	50	26.04
Tobacco consumption	16	8.33
Physical inactivity	122	63.54
Treatment adherence		
Medication	148	77.08
Dietary	108	56.25
Regular medical follow-up	140	72.92
Body mass index		
< 18.5 kg/m^2	4	2.08
[18.5 ; 25 kg/m^2[	70	36.46
≥ 25 kg/m^2	118	61.46
Waist circumference		
Normal	40	20.83
High	152	79.17

Table 2 Biochemical characteristics of the study population (n = 192)

	n	**%**
Fasting blood glucose		
Low (< 70 mg/dl)	10	5.21
High (≥ 100 mg/dl	120	62.50
Normal ([70 ; 100 mg/dl[	62	32.29
Total cholesterol		
High (≥ 2 g/l)	106	55.21
Normal ([1,10 ; 2 g/l[	86	44.79
HDL cholesterol		
Low (< 0,4 g/l)	92	47.92
Normal (≥ 0,4 g/l)	100	52.08
LDL cholesterol		
High (≥ 0,70 g/l)	8	4.17
Normal (< 0,70 g/l)	184	95.83
Triglyceridemia		
Low (< 0,5 g/l)	6	3.13
High (> 1,5 g/l)	18	9.38
Normal ([0,5-1,5 g/l]	168	87.50
Serum creatinine		
Low (< 6 mg/l)	26	27.08
High (> 14 mg/l)	4	4.17
Normal ([6-14 mg/l)	66	68.75
DFG (mL/min/1.73m^2)		
[30-60[	4	2.08
[60-90[	38	19.79
≥90	150	78.13

Table 3 Factors associated with microalbuminuria (multivariate analysis)

	OR (IC 95%)	**p-value**
Duration since diagnostic		
< 5 years	1	< 0.001
≥ 5 years	2.54 (1.38 - 4.85)	
Age		
< 50 years	1	< 0.001
≥ 50 years	3.23 (1.87- 5.01)	
Arterial hypertension		

Non	1	< 0.001
Oui	8.24 (4.18 - 20.02)	
Blood glucose		
Normal or low	1	0.015
High	2.52 (1.87 - 6.74)	
Serum creatinine		
Normal ou low	1	0.022
High	16.98 (3.87 - 38.59)	

3.2. Biochemical characteristics of the study population

The mean fasting blood glucose level was 1.56 ± 0.57 mg/dl (range: 49–400 mg/dl), with 62.50% having elevated blood glucose. Total cholesterol was elevated in 55.21% of patients, and HDL cholesterol was decreased in 47.92%. Serum creatinine was within the normal range in 68.75% of patients, and 78.13% had an estimated glomerular filtration rate (GFR) ≥ 90 mL/min/1.73 m^2 (Table 2). The prevalence of microalbuminuria among type 2 diabetic patients was 17.71% (95% CI [10.67–26.83]). The mean urinary albumin excretion was 30.10 ± 62.27 mg/24h, with values ranging from less than 1.84 mg/24h to 360.35 mg/24h (Figure 1).

3.3. Factors associated with microalbuminuria

In multivariate analysis, factors significantly associated with microalbuminuria were diabetes duration ≥ 5 years, age ≥ 50 years, hypertension, elevated blood glucose, and elevated serum creatinine (Table 3).

4. Discussion

To our knowledge, this study is one of the few to focus on microalbuminuria in diabetic patients in northern Benin. The measurement technique used, specifically the sandwich immunoassay method, is well-suited for this type of assessment. Precautions were also taken to exclude conditions that could cause microalbuminuria unrelated to diabetes. The statistical analyses employed, particularly multivariate analysis, allowed the identification of true factors associated with microalbuminuria. These methodological precautions, combined with a relatively large sample size, contributed to reliable results that likely reflect the population of diabetic patients followed at the center. However, large-scale studies involving more patients across multiple centers are needed to obtain findings representative of all diabetic patients. In the present study, the prevalence of microalbuminuria among diabetic patients was 17.71%, similar to reports by Jamil et al. [6] in Pakistan (20.9%) and Suleiman et al. [9] in Nigeria (22.6%). Other studies have reported higher prevalence rates, such as Bari et al. [16] in Qatar and Iqbal et al. [17] in Morocco, with proportions of 29.4% and 32.1%, respectively. The prevention and management of microalbuminuria rely on identifying associated risk factors. In this study, these factors included diabetes duration ≥ 5 years, age ≥ 50 years, hypertension, elevated blood glucose, and elevated serum creatinine, consistent with findings from other authors. For example, longer diabetes duration was reported as a factor associated with microalbuminuria in studies by Murtarza et al. [18] in Pakistan and Khan et al. [19] in Nepal. In Bari et al.'s study [16] in Qatar, patients with microalbuminuria had a significantly longer duration of diabetes compared to those with normoalbuminuria (10.4 ± 5.3 vs 7.9 ± 4.8 years). Advanced age as a risk factor for microalbuminuria was reported by Rahman et al. [20] in Bangladesh and Al-Shammakh et al. [1] in India. Hypertension was associated with microalbuminuria in diabetic patients in the cohorts of Shah et al. [21] in India and Murtaza et al. [18] in Pakistan. The deleterious role of hypertension in renal function deterioration is well-established, highlighting the importance of early detection and management using renin-angiotensin system blockers known for their antiproteinuric effect. Poor glycemic control was reported as a factor associated with microalbuminuria in studies by Abdelwahid et al. [7] in Egypt and Asghar et al. [2] in Pakistan. The harmful effect of hyperglycemia on microvessels is well-documented, supporting recommendations for good glycemic control with HbA1c < 7% in all diabetic patients. Elevated serum creatinine was also identified as a risk factor for microalbuminuria in diabetic patients by Suleiman et al. [9] in Nigeria.

Limitations

The main limitation of this study is the small sample size. Conducting studies with a larger population is necessary

5. Conclusion

This study shows that more than one in six patients has microalbuminuria. Annual assessment of microalbuminuria in diabetic patients is essential to enable early detection of renal lesions and ensure better follow-up especially in patients aged 50 years or older, or those whose diabetes was diagnosed at least 5 years ago. Hypertension, elevated blood glucose, and increased serum creatinine levels are factors that promote microalbuminuria among these patients.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare there are no competing interests

Statement of ethical approval

The study protocol was approved by the Local Ethics Committee for Biomedical Research of the University of Parakou

Statement of informed consent

Written informed consent was obtained from all study participants. All survey forms were coded to ensure anonymity, and all collected data remained confidential.

Author contributions

All authors designed the study. AA, AS and FR participated in data collection. Data were analysed by AA and ZL. AA and AS wrote the main manuscript text . All authors reviewed the manuscript.

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