**Original Article**

# Prevalence of Microalbuminuria among Diabetic Patients Attending Federal Medical Centre Gusau, Nigeria

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## ABSTRACT

Microalbuminuria is persistent albumin excretion between 30 and 300 mg/day. In patients with diabetes, it is usually indicative of diabetic nephropathy which is the most common cause of end-stage renal disease; it is also associated with cardiovascular disease. The main objective was to determine the prevalence of microalbuminuria and its association with glycemic control, blood pressure, and duration of diabetes in type-1 and type-2 diabetic patients attending Federal Medical Center Gusau, Nigeria. This study evaluated the level of microalbuminuria among 150 diabetic patients and 50 control subjects. The urinary albumin concentration was measured by immunoturbidimetric assay. From both the control and diabetic subjects, fasting blood sugar was estimated and blood pressure was measured with an automated manometer. Prevalence of microalbuminuria (MAL) according to demographic, the incidence of variables was detected in 12 males 28 females, and < 40 years of age 10 and > 40 years of age 31. The Mean of Fasting Blood Glucose (FBG) was slightly higher in patients with Non-insulin Dependent Diabetes Mellitus (NIDDM) when compared to IDDM patients. There was no significant ($p>0.05$) difference between males and females, within the group regarding age, blood pressure, and glycemic status. However, there is a statistically significant difference ($p>0.05$) in FBG and MAL between the patients and the control. The results suggest that there is a high prevalence of microalbuminuria in patients attending Federal Medical Center Gusau which is an independent risk factor for renal and cardiovascular diseases.

**Keywords:** Microalbuminuria; Diabetes; Diabetes nephropathy; cardiovascular disease, Chronic Kidney Disease

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Citing this article
*Shinkafi T.S. Ismail A. and Bunza F.U. Prevalence of Microalbuminuria among Diabetic Patients Attending Federal Medical Centre Gusau, NigeriaKIU J. Health Sci, 2023: 3(1);

Conflict of Interest: None is declared

## INTRODUCTION

Diabetes is a metabolic disorder of multiple aetiology that primarily occurs due to either shortage or lack of insulin secretion and/or reduced insulin sensitivity of the tissue to insulin (1). It is characterized by chronic hyperglycemia with disturbance of Carbohydrates, fat and protein metabolism resulting from defects in insulin secretion, insulin action or both (2). Two major types of diabetes commonly exist; Type 1 diabetes otherwise called Insulin Dependent Diabetes Mellitus (IDDM) is characterized by pancreatic islet β-cell destruction (3). Patients with type 1 diabetes are prone to ketoacidosis (3). While Type 2 diabetes otherwise called Non-insulin Dependent Diabetes Mellitus (NIDDM) which is the common type of diabetes is associated with a defect(s) in insulin secretion and insulin resistance in most cases (4). Diabetes is usually chronic and is associated with macro and microvascular complications thereby affecting the heart, the eyes, the nerves, and the kidneys leading to diabetes retinopathy, neuropathy, and nephropathy (5). Diabetes complications develop in both type 1 and type 2 diabetes however, morbidity and mortality are often seen in the latter type whereas the former has a low prevalence for diabetes complications (6). In any case, the appearance of protein in the urine (microalbuminuria) is a major clinical sign of kidney disease (7). The factors that can lead to kidney damage are diabetes, the use of herbal remedies and environmental toxicants (8). Most people in low- and middle-income (LMIC) countries are exposed to environmental toxicants and heavily rely on herbs for the treatment of different ailments. As a result, there is a high prevalence of non-communicable diseases including chronic kidney disease (CKD). The Low- and Middle-Income Countries (LMIC) region has the highest number of undiagnosed diabetes (9). This makes screening for microalbuminuria essential to prevent kidney damage. Nigeria is among the countries in the world with a high prevalence of CKD as depicted in a study conducted by (10). Odubbanjo et al., (2011) (11) reported a high mortality rate among CKD patients in Nigeria.

A positive correlation exists between diabetes prevalence and its secondary complications, and there is a need to determine the prevalence and factors associated with the development of these complications (12). A significant proportion of people with diabetes live in middle and low-income countries, these countries will bear the most burden of diabetes (13). Lack of access to good health care facilities coupled with also a lack of availability, high cost of conventional anti-diabetic drugs, lack of regular follow-up visits to clinics and also late presentation before a diagnosis is making diabetes more and more chronic in most African countries including Nigeria (14). This is further increasing the tendency for the disease to progress to secondary complications.

Microalbuminuria is an important marker for diabetes complications, especially in diabetic kidney damage and consequently, an increase in diabetes prevalence has the tendency of increasing chronic kidney disease (CKD) which is a well-known risk factor that can be used to predict


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cardiovascular diseases (CVD) (15). Determination of the prevalence of microalbuminuria in a population will no doubt help in the monitoring and control of the debilitating conditions associated with diabetes complications thereby minimizing the mortality and morbidity as well as reducing the cost of health care for diabetes (16).

The main objective of the study was to determine the prevalence of microalbuminuria and its association with glycemic control, blood pressure, and duration of diabetes in type-1 and type-2 diabetic patients attending Federal Medical Center Gusau..

## METHODS

### Geographical location of the study site

Federal Medical Centre Gusau is located in Gusau, the state capital of Zamfara State, Nigeria. Nigeria is divided into 36 States. Zamfara State is located in the Northwest Nigeria.

### Ethical considerations

Ethical approval was obtained for this study by the health research and ethics committee of the Federal Medical Center, Gusau (FMC/SUB/858/VOL.1/P.165) before the commencement of data collection.

### Inclusion and Exclusion Criteria

Age 18 years, blood pressure [BP] 140/90 mmHg or antihypertensive therapy, and/or diagnosed DM (fasting blood glucose [FBG] 126 mg/dl or 2-hour glucose level 200 mg/dl or on oral antidiabetics [OADs] and/or insulin), as well as laboratory test results from the previous 12 months, were the inclusion criteria for patients with hypertension and/or type 2 DM. Women who were expecting, menstruating, breastfeeding, being regularly observed in nephrology consultations, suffering from a febrile illness or concurrent urinary tract infection, having type 1 diabetes, being treated for an autoimmune condition, being taking oxytetracycline, engaging in strenuous exercise within the previous 24 hours all of which increase the possibility of a false positive result for MAU were also excluded (17).

### Study population and design

A total number of one hundred and fifty (150) samples was estimated using the following formula, (18)

$$n = z^2pq/d2$$

Where,

n = Minimum sample size

z = Standard normal deviation, that is 1.96 or 2, standard deviation at 95% confidence level.

p = Prevalence rate of microalbuminuria in diabetic patients = 10% or 0.10

q = Complementary proportion, q = 1-p = 1-0.10 = 0.9.

d = Precision or tolerable marginal error = 5% or 0.05.

$$n = \frac{1.96^2 \times 1.0 \times 0.9}{0.05^2} = 138$$


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**Subjects**

Patients with both type-1 and type-2 diabetes male and female were included in this study. Microalbuminuria, age, FBG level and blood pressure were determined for both the control and patients.

**Sampling Technique**

Early first-morning urine was collected from the patients at GOPD in Federal Medical Center Gusau. The samples were taken during the day from resting patients. Boric acid was used as a preservative. When performing albumin excretion measurement, a portion of the carefully timed well-mixed samples was used and also patients who have avoided exercise.

**Laboratory methods**

**Determination of Microalbuminuria**

A quantitative method was used to estimate microalbuminuria. It estimated the amount of albumin in the urine using an immunoturbidimetric assay. Briefly, urine was collected from the subjects using clean sterile containers randomly. Before the commencement of the test, Albustix was used to detect the concentration of urinary protein (albymin) which was determined to be greater than 300 mg/L. Utilizing autoblank endpoint analysis, albumin was calculated. Following a 10 s incubation period, the sample (25µL) and diluent (5 µL) were added to the reagent (250 µL) at 25°C, and the change in absorbance at 340 nm was recorded between 0.5 s and 100 s. 4% (w/v) polyethylene glycol 6000 was added to rabbit antiserum to human albumin in sodium barbitone buffer (0.1 M, pH 8.0) to make the reagent. Results were computed based on variations in absorbance caused by eight standard albumin solutions in the concentration range of 3-180 mg/L in 0.9% NaCI. Albumin-spiked urine samples served as controls (19).

**Determination of Fasting Blood Sugar**

The fasting blood glucose was determined from fasting individuals. Briefly, drops of blood were collected from the subjects by pricking and applied to the strip of an accu check glucometer. Values between 80 and 120 mg/dl were considered normal and anyone having FBG above 126mg/dl was considered diabetic (20)

**Blood Pressure**

For blood pressure, a suitable automated manometer was used to measure the blood pressure of the subjects (21). During the measurements, subjects were asked to rest in a sitting position and then blood pressure was taken. Both systolic blood pressure (SBP) and diastolic blood pressure (DBP) were recorded. Values of SBP≥140 mmHg and DBP≥90 mmHg were used to define hypertension.

**Data analysis and statistical methods**

Results were expressed as mean ± SEM test and ANOVAwas used for comparison between the groups. A P-value less than 0.05 were considered significant.

RESULTS


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The demographic and clinical characteristics of the study subjects such as age, blood pressure and fasting blood glucose level are presented in Table 1. In the study, 30% (15/50) of the control subjects, 55 % (22/40) of IDDM (Type1 DM) and 73% (44/60) of NIDDM (Type 2 DM). A total of 54% (81/150) of the total subjects were females while a total number of 46% (69/150) male subjects participated in the research. There was no significant ($p>0.05$) difference between males and females, within the group with regard to age, blood pressure and glycemic status. The mean age of the males, females and pooled IDDM (Type 1 DM) patients was significantly lower than the corresponding ones for the NIDDM (Type 2 DM). However, female patients with IDDM and control females have similar mean ages (46.22± 1.79 to 47.22±1.62). For type 2 diabetes females (46.22 ±1.79) were younger than males (60.63±2.96yrs).

Systolic blood pressure was higher in Type 2 DM (138.58±1.95 mmHg) than diastolic (91.67±1.65 mmHg) and equally, in Type 1 DM, systolic (148.87±3.37 mmHg) was higher than diastolic (98.25±2.14 mmHg). There was no significant difference in mean blood pressure between females and males in type1 DM with females having (141.14±4.03 mmHg) and males (157.87±5.23 mmHg) and in type 2 DM, females (140.58±2.36 mmHg) and males (135.58±2.74 mmHg) but in type 2 DM, males have a slightly shorter blood pressure than females.

In type1 DM,blood pressure was higher in males (157.87±5.23 mmHg) and mean fasting blood glucose (FBG) was not significantly different between males 4.25±0.07 mmol/l and females 4.67±0.15 mmol/l in the control group. In patients with IDDM, there is no significant different ($p>0.05$) in the level of FBG between males and females (7.65±0.52 mmol/l) and females (8.28±0.52 mmol/l) but females have slightly higher levels in NIDDM patients (Table 6). There was no significant difference in FBG between males (10.84±1.89 mmol/l) and females (9.04±0.48 mmol/l) but males have slightly higher levels. The overall mean of FBG was slightly higher in patients with NIDDM (10.61±1.77) when compared to IDDM patients (8.06±0.44).

The mean values of MAL in males were significantly slightly lower (6.14±0.91 mg/dl) than in females (7.08±1.41 mg/dl) (Table 2).

Microalbuminuria in type 1 diabetes has been presented in Table 3. The results show that the female (14.26±0.69) subjects have higher microalbuminuria than the male (10.01±0.47) subjects.

Microalbuminuria in type 1 diabetes has been presented in Table 4. The results show that the male (18.58±1.33) subjects have higher microalbuminuria than the female subjects (16.46±0.63). This is contrary to the situation in Table 3 where the female subjects have higher microalbuminuria than the male counterparts.

In Table 5, clinical parameters of the study subjects were presented. The results show that the fasting blood glucose level of the patients (8.72±0.40) is above the reference range of diabetes and is higher than the fasting blood glucose level of the control subject (4.3±0.07). There was a statistically significant difference in FBG ($p>0.05$) between

the patients (8.72±0.40 mmol/l) when compared (4.3 ±0.07 mmol/l). Similarly, the systolic blood pressure (142.75±1.76) and diastolic blood pressure (93.50±1.36) of the patients is higher than the systolic blood pressure (123.00±0.91) and diastolic blood pressure (73.00±0.68) of the control.

In Table 6, the fasting blood glucose level and microalbuminuria are presented. There was a statistically significant difference in FBG ($p>0.05$) between the patients (8.72±0.40 mmol/l) when compared (4.23 ±0.09 mmol/l). Similarly, there was a significant difference ($p>0.05$) in MAL between with the control the patients (15.83±0.41 mg/dl) with the control (4.58±0.78 mg/dl). Prevalence of microalbuminuria (MAL) according to demographic, the incidence of variables is presented in Table 7 as many as 12 males 28 females, and < 40 years of age 10 and > 40 years of age 31.

## DISCUSSION

From the results of this cohort study, we found the prevalence of microalbuminuria in diabetic patients based on demographic incidences in Federal Medical Center, Gusau in the Northwest of Nigeria to be; male 23.4%, female 21.9%, <40 years of age 23.5% and >40 years of age 22.4% (Table 7). In a similar study conducted by, Erasmus et al., (1992) (22) they found that there is a high prevalence of diabetes complications, especially among patients with type-2 diabetes in Nigeria. In their study, it was shown that at least 50% or more of the type-2 diabetic patients had some form of microvascular complication with diabetic nephropathy as the second highest. Recently, Jenewari et al., (2023) (23) in another study have also indicated that there is a high prevalence of microalbuminuria among NIDDM diabetics in the southern part of the country. However, there are reports also that indicate even among juvenile diabetic patients (type-1), complications develop especially when diabetes is poorly controlled (24). Studies have also indicated that metabolic syndrome may be associated with diabetic kidney diseases in type-1 diabetes (25). In the Southwest, Udenze et al., (2012) (26) have also reported a prevalence of 24% in Lagos state which is similar to our results. A prevalence of 22% was reported by Bunza et al., 2014 (27) in a similar survey conducted at Usmanu Danfodiyo University Teaching Hospital in Sokoto, north-west Nigeria. While in the South-south, Unigbe et al., (2001) (28) screened 66 newly diagnosed diabetics (comprising both type-1 and type-2) in Benin and found a 50% prevalence of microalbuminuria. Similarly, in the southeast, the prevalence of 33.2% of microalbuminuria among secondary students in Rivers state was reported by Okpere et al., (2012) (29) which is above the prevalence found in this study.

The results of this study were found to be lower than the result of a similar study in North-west India with a 30% prevalence of microalbuminuria Agrawal et al., (2014) (30) and also lower than the result of a similar study conducted in neighbouring Ghana where they found a prevalence of 43% (31). A similar prevalence of 43% again was reported by Eghan et al., (2007) (32) in the same city in Ghana. Several factors including population difference, age, sex, method of urine collection, and the pattern of

microalbuminuria determination or even the period of puberty determine the variation in the prevalence of microalbuminuria (33). For example, genetic polymorphism in the ACE gene is associated with persistent microalbuminuria and severe microalbuminuria in type-1 Caucasian diabetes patients (34). These differences arise due to methods used in urine collection, population differences and even the definition of microalbuminuria itself. Proteinuria screening methods such as reagent strips are considered inefficient for monitoring urine albumin concentration below 100-300mg/L but methods involving high-performance liquid chromatography and several immunochemistry assays such as Enzyme-linked immunosorbent assay, radioimmunoassay, turbidimetric, and nephelometric assays are regarded as the efficient methods for monitoring microalbuminuria (35).

Microalbuminuria is persistent albumin excretion between 30 and 300 mg/day, in patients with diabetes it is usually indicative of diabetic nephropathy which is the most common cause of end-stage renal disease; it is also associated with cardiovascular disease (36). Early detection of microalbuminuria and early control of diabetes retards the development of structural changes in early diabetic nephropathy (37). About half of the patients in this study were found to be diabetics for five years or less and they develop microalbuminuria within this range. At the time of diagnosis, over half have one or more diabetes complications. Similarly, values for fasting blood glucose were statistically ($p>0.05$) higher in patients when compared with control subjects (Table 6). Equally, when compared, microalbuminuria is higher in type-2 than in type-1 diabetes. Unlike in type-1 diabetes where the females have higher microalbuminuria than males (Table 3), in type-2 diabetes males were found to have higher microalbuminuria than females (Table 4), and these results are higher ($p>0.05$) than the microalbuminuria values of the control subjects in Table 2. Likewise, systolic and diastolic blood pressure is higher in type-1 diabetes (IDDM) when compared to type-2 (IDDM) diabetes (Table 1). In Table 5, clinical parameters of the study subjects were presented. The results show that the fasting blood glucose level of the patients (8.72±0.40) is above the reference range of diabetes and is higher than the fasting blood glucose level of the control subject (4.3±0.07). There was a statistically significant difference in FBG ($p>0.05$) between the patients (8.72±0.40 mmol/l) when compared (4.3 ±0.07 mmol/l).

Early detection of microalbuminuria will help prevent the menace of diabetic complications and cardiovascular diseases (38). These complications develop in patients with poor blood sugar control over some time (39). Most diabetic patients are negligent in taking their daily antidiabetic drugs and therefore, these patients need to determine their risk for developing these morbid complications (40). Screening for microalbuminuria is essential in diabetes and hypertension to avoid renal and cardiovascular adverse effects (41).

**Limitations of the study**

The study was conducted among diabetic patients attending Federal Medical Centre Gusau rather than in the


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community. Therefore, the results may not be sufficient to represent the entire population.

## CONCLUSION

The results obtained from the present study suggest that there is a high prevalence of microalbuminuria in patients attending Federal Medical Center Gusau which is an independent risk factor for renal and cardiovascular diseases. There is, therefore, a need to educate these patients on the benefit of controlling their blood sugar effectively to avoid the development of these conditions.

**Acknowledgements**

The authors appreciate the help and cooperation of both the patients and the management of and staff of Federal Medical Center Gusau.

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**Table 1:** Demographic and clinical characteristics of the study subjects

| Subject | n | Mean age ±SEM | Mean SBP (mmHg) | Mean DBP (mmHg) | Mean FBG±SEM |
|---|---|---|---|---|---|
| Control | 50 | 41.01±1.48 | - | - | 4.23±0.09 |
| Male | 35 | 47.12±1.90 | - | - | 4.15±0.06 |
| Female | 15 | 47.22±1.62 | - | - | 4.72±0.13 |
| IDDM | 40 | 49.27±0.63 | 148.87±3.37 | 98.25±2.14 | 8.06±0.44 |
| Male | 18 | 53.00±2.69 | 157.87±5.23 | 102.78±3.21 | 7.65±0.52 |
| Female | 22 | 46.22±1.79 | 141.14±4.03 | 93.64±2.89 | 8.28±0.52 |
| NIDD | 60 | 53.30±1.73 | 138.58±1.95 | 91.67±1.65 | 10.61±1.77 |
| Male | 16 | 60.63±2.96 | 135.58±2.74 | 88.12±2.62 | 10.84±1.89 |
| Female | 44 | 46.22 ±1.79 | 140.58±2.36 | 91.82±2.66 | 9.04±0.48 |
| P-value | _ | >0.05 | >0.05 | - | >0.05 |

Values represent Mean ± SEM n=number of a population group, the SEM=standard error of the mean, FBG=fasting blood glucose, mmol/l=milli mole per litre p-value is within the groups, SBP=systolic blood pressure, DBP=diastolic blood pressure.

**Table 2:** Microalbuminuria in the control subjects

| Parameters | Male (n=35) | | Female (n=15) | | Pooled (n=50) | |
|---|---|---|---|---|---|---|
| | Range | mean±SEM | Range | mean±SEM | Range | mean±SEM |
| Mal (mg/dl) ($1^{st}$mv) | 0.00-15.0 | 6.12±0.82 | 0.028-14.30 | 7.02±1.30 | 0.00-15.0 | 5.39±0.67 |
| P-value | <0.05 | | <0.05 | | <0.05 | |

Values represent Mean±SEM n=number of the control subjects SEM=standard error of mean, mg/dl=milligram per deciliter, 1stmv=first morning void mal=microalbuminuria p-value is within the group.

**Table 3:** Microalbuminuria in type 1 diabetes in the study subjects

| Parameters | Male (n=18) | | Female (n=22) | | Pooled (n=40) | |
|---|---|---|---|---|---|---|
| | Range | Mean±SEM | Range | mean±SEM | Range | mean±SEM |
| Mal (mg/dl) ($1^{st}$mv) | 6.66-19 | 10.01±0.47 | 6.66-20 | 14.26±0.69 | 6.66-20 | 15.79±0.69 |
| P-value | >0.05 | | >0.05 | | >0.05 | |

Values represent Mean±SEM SEM=Standard error of the mean

**Table 4:** Microalbuminuria in type2 diabetes in the study subject

| Parameter | Male (n=16) | | Female (n=44) | | Pooled (n=60) | |
|---|---|---|---|---|---|---|
| | Range | mean ± SEM | Range | mean ± SEM | Range | mean ± SEM |
| Mal(mg/dl) ($1^{st}$mv) | 10.56-29.8 | 18.58±1.33 | 11.2-28.9 | 16.46 ± 0.63 | 10.56-29.8 | 17.84±0.43 |
| P-Value | >0.05 | | >0.05 | | >0.05 | |

Values represent Mean ±SEM SEM= Standard error of the mean

**Table 5**: Some Clinical Parameters of the Study Subject

| Mean±SEM Subject | Mean±SEM n | Mean±SEM Age (yrs) | Mean±SEM FBG (mmol/l) | Mean±SEM SBP (mmHg) | DBP (mmHg) |
|---|---|---|---|---|---|
| Patients | 100 | 52.37±1.27 | 8.72±0.40 | 142.75±1.76 | 93.50±1.36 |
| Control | 50 | 41.01±1.48 | 4.3±0.07 | 123.00±0.91 | 73.00±0.68 |
| P-value | | >0.05 | >0.05 | >0.05 | >0.05 |

Values represent Mean±SEM

n=sample size, SBP=systolic blood pressure, DBP=diastolic blood pressure, SEM=standard error of mean, yrs=years mmHg=millimeter of mercury.

**Table 6:** Microalbuminuria and FBG in the study subject

| Mean±SEM Subject | n | Mean±SEM Age (yrs) | Mean±SEM FBG (mmol/l) | Mean±SEM Mal (mg/dl) |
|---|---|---|---|---|
| Patients | 100 | 52.37±1.27 | 8.72±0.40 | 15.83±0.41 |
| Control | 50 | 40.16±1.68 | 4.23±0.09 | 4.58±0.78 |
| P-value | | >0.05 | >0.05 | <0.05 |

Values represent Mean±SEM

n=sample size, yrs=years, FBG=fasting blood glucose, Mal=microalbuminuria, SEM=standard error of mean.

**Table 7:** Prevalence of Microalbuminuria according to demographic and incidence of variables

| Subjects | 100 | with Microalbuminuria | % |
|---|---|---|---|
| Male | 34 | 12 | 23.4% |
| Female | 66 | 28 | 21.9% |
| <40yrs of age | 15 | 10 | 23.5% |
| >40yrs of age | 85 | 31 | 22.4% |

Values represent Mean±SEM