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Prevalence of Diabetes Mellitus in Bukuru Metropolis of Plateau State

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Abstract: *This study aimed to determine the prevalence of diabetes mellitus (DM) and its associated risk factors in Bukuru Metropolis in jos south L.G.A of Plateau state. Personal and demographic data were obtained through the use of questionnaire. Blood samples were collected from participants after an overnight fast. Weight, height, and blood pressure (BP) measurements were taken. Results were analysed statistically by t-test, Chy square test, and analysis of variance. A total of 998 individuals aged 25-70 years comprising of 487(48.8%) men and 511(51.2%) women were recruited for the study. Subjects were classified into diabetic and control groups based on the laboratory findings. DM was defined according to 1999 WHO criteria. Individuals who were previously known to have diabetes based on history and laboratory data were classified as having diabetes without oral glucose tolerance test (OGTT). Thirty-six subjects were found to be diabetic for a prevalence of 3.6%, made up of 2.2% previously known cases and 1.4% newly diagnosed, majority being asymptomatic. The prevalence rates were 1.9% and 1.7% for males and females respectively. There was no significance difference ($p>0.05$) in the prevalence between the sexes. Body mass index (BMI) ≥25 kg/ m^2, BP >140/90 mm Hg, family history of diabetes, physical inactivity and older age were associated with significantly ($p<0.05$) higher prevalence of type 2 diabetes. The asymptomatic nature of diabetes recorded in this study points to the need to improve health services and awareness in the general population.*

Key Words: *Body mass index, diabetes mellitus, diabetes risk factors, fasting glucose*

I. Introduction

Diabetes mellitus is a predominant public health concern, affecting millions of people worldwide [1]. Globally, as of 2010 it was estimated that there were 285 million people with diabetes, type 2 making up about 90–95% of all diagnosed cases [2]. Diabetes Mellitus (DM) has substantial impact on the development of a wide array of co-morbidities, subsequently decreasing quality of life, and life-expectancy [3]. It is a disproportionately expensive disease. Overall, the annual financial cost from diabetes exceeds $100 billion, almost $1 of every $7 dollars of US health expenditures in terms of medical care and loss of productivity [4].

Symptoms of marked hyperglycaemia include polyuria, polydipsia, weight loss, sometimes with polyphagia, and blurred vision [5, 6, 7]. Many people however have no symptoms during the first few years and are diagnosed on routine testing [8]. Worldwide, the percentage of undiagnosed diabetes is high and the consequences of untreated or poorly diagnosed diabetes are extremely serious [4]. They include coronary artery disease (CAD), stroke, blindness, kidney failure, and foot or leg amputation [1]. Acute, life-threatening consequences of uncontrolled diabetes are hyperglycaemia with ketoacidosis or the nonketotic hyperosmolar syndrome [9, 3, 7].

Literature search has shown that there are few data available on the prevalence of type 2 DM in Africa as a whole. Studies examining data trends within Africa point to evidence of a dramatic increase in prevalence in both rural and urban setting, and affecting both gender equally. Increasing incidence of diabetes in the developing countries, especially in the younger age group, affecting mainly the people in the productive years of their lives is of great concern [3]. The increase in incidence of diabetes in developing countries follows the trend of urbanization and lifestyle changes, perhaps most importantly a "Western-style" diet and obesity [10].

The management of diabetes mellitus is considered a global problem and successful treatment is yet to be discovered [11]. Most often, patients who have diabetes can be managed so that they can live normal, healthy lives and avoid serious sequelae. Therefore a major opportunity exists to help patients who have diabetes live better, more comfortable lives, while saving health care dollars. This could be realised by recognising and diagnosing these individuals early enough to institute a management program that avoids progression to these extremely serious complications. Early detection of DM and its complications, and their control are therefore of great public health concern. Prevalence of diabetes in the study area have not been documented, hence the need for this study.

II. Materials And Methods

1.1 Study Location/Population

This research was carried out in Plateau State with its capital as Jos, and located in the North Central Region of Nigeria. Plateau state is characterised by a near temperate climate on the Jos plateau and a hot and humid climate on its lower parts. Generally, weather conditions are warmer during the raining season (April-October) and much colder during the harmattan period (December-February). The mean annual temperature in the state ranges between 20^0C and 25^0C, while the mean annual rainfall figures ranges from 131.71 cm, in the southern part and 146 cm on the Jos plateau. The state falls largely within the northern guinea savannah zone. The landscape rises steeply from 200 metres along the plains of river Benue in the south to an average height of 1,200 metres on the jos plateau. Plateau, a state that derives its name from the Jos plateau is located more or less at the centre of Nigeria. The state has an area of about 26,899 sq. Km and shares a common boundary with Nasarawa, Kaduna, Taraba, Bauchi and Gombe. The state consists of seventeen local Government Areas (LGA), with a population of 2, 959,588 according to 1991 National census. The populations are predominantly farmers and public workers. This project was carried out amongst rural dwellers, students, farmers, public workers of Jos South LGA within Bukuru metropolis. Areas covered include Zawan, Kuru and Kaduna Vom, all located in Jos south L.G.A. of plateau state.

1.2 Sampling method

A non probability sampling technique by Purposive selection was used to select the study subjects as described [12]. The sampling procedure lasted for 2 weeks. Nine hundred and ninety-eight subjects who fulfilled the inclusion criteria were selected for the survey. Inclusion criteria include individuals aged 25 years and above, male and female, willingness to participate and compliance with the instructions e.g. overnight fast, while the exclusion criteria include pregnancy, chronic infectious diseases and history of use of drugs that could affect glucose metabolism e.g. steroids.

Ethical approval for this study was obtained from the Ethics Committees of JUTH, Plateau Specialist and ECWA Evangel hospitals and from the village heads of the various communities recruited for the study. Questionnaire designed for the study was administered on arrival at the study venue. Demographic data such as age, sex, education level, occupation, marital status; social habits (smoking and alcohol consumption), information on level of physical activity, relevant medical and family history (diabetes in a first or second-degree relative) were obtained. Informed consent was used in the recruitment of the participants. Confidentiality was maintained in accordance with standard medical practice.

Physical examination was carried out by medical personnel. Blood pressure was measured by mercury sphygmomanometer in the right upper arm of the subject, who was seated for 5 minutes before the measurement. Blood pressure was measured twice, and the mean of these two measurements was used in the analysis. Weight was measured without shoes to the nearest 0.1kg by a weighing machine and height was measured to the nearest 0.1m with an anthropometric rod. Body mass index was calculated as weight in kilograms divided by the square of height in metres.

1.3 Specimen collection/Biochemical Analysis :

A 2ml of venous blood was collected from each volunteer after an overnight fast into fluoride Oxalate bottle and transported to the chemical pathology Laboratory of FCVMLT, NVRI Vom, where glucose concentration was determined immediately using glucose oxidase method described [13].

1.4 Diagnosis of DM

Diabetes was defined according to 1999 WHO criteria of fasting plasma glucose (FPG) of $\geq$ 7.0 mmol/l.

1.5 Statistical Analysis

All statistical analysis was performed with SPSS for windows version 16.0. The Chi square test was used to compare significance differences between categorical variables while Student t-test was employed in comparing means of continuous variables. Statistical significance was considered when p value was less than 0.05.

III. Results

3.1 Prevalence of Diabetes

The total prevalence rate of diabetes in the study population, Bukuru metropolis, is shown in Fig. 1. Blood glucose results were available in 994 subjects. 958 subjects had their fasting blood glucose concentration below 7.00 mmol/l and were classified as normal individuals while 36 subjects had their FPG above 7.00

mmol/L and were classified as diabetics for a prevalence rate of 3.62%. The male to female prevalence ratio is 1.12:1 (1.9% vs 1.7%). The difference between males and females was not statistically significant ($p>0.05$).

3.2 Physical Anthropometric Indices (Variables) of Subjects in Relation to Age, Gender and Blood Glucose Status

The results are presented on TABLES 1, 2 and 3, respectively. The mean age for the entire population was 40.24 ± 0.43. The diabetic subjects were significantly ($p<0.05$) older than the subjects with normal glucose concentration (TABLE 1). The mean fasting plasma glucose concentration, body mass index, and blood pressure of diabetic subjects were significantly higher ($p<0.05$) than those of control subjects.

Out of the 998 subjects, 487 (48.8%) were men and 511 (51.2%) were female. There was no significant difference ($p>0.05$) in the mean age of men compared to that of women (TABLE 2). There was also no significant difference ($p>0.05$) in the mean glucose concentration of men compared to women. Females had significantly higher ($p<0.05$) BMI than males. Males had significantly higher ($p<0.05$) systolic blood pressure compared to women while there is no significant difference ($p>0.05$) in their diastolic blood pressure.

The mean age for subjects aged 45years and above was significantly higher ($p<0.05$) than that of those below the age of 45 years (TABLE 3). Also subjects aged 45 years and above had significantly higher ($p<0.05$) FPG, BMI, systolic and diastolic blood pressure than subjects below 45 years.

3.3 Prevalence of Demographic and Lifestyle Risk Factors among Diabetic Subjects

Subjects with diabetes were compared with non diabetic individuals for test of significance in the prevalence of diabetes in relation to diabetes risk factors (TABLE 4)

The percentage of subjects with body mass index ≥ 25 kg/m^2 (4.7%) was found to be significantly ($p<0.05$) higher than those of the subjects with body mass index < 25kg/m^2 (2.1%), implying that being overweight may predispose one to diabetes.

Diabetes was significantly more prevalent ($p<0.05$) in people who do not partake in exercise (6.2%) compared to those who indulge in physical activity (1.4%). Also diabetes was significantly more prevalent ($p<0.05$) in people with a family history of diabetes (13.3%) compared with those without a family history (2.2%), suggesting that physical activity and family history of diabetes are important factors influencing the prevalence of diabetes among subjects in this study.

Diabetes was more prevalent among alcohol consumers and smokers (5.1% and 4.8%, respectively) than non alcohol consumers and non smokers (3.0% and 3.1% respectively). However, the difference was not statistically significant ($p>0.05$) in both groups.

Diabetes was more frequent in people aged 45 years and above (9.1%) than those below the age of 45 years (1.0%), suggesting that age is a risk factor for DM.

Diabetes was significantly more prevalent ($p<0.05$) in subjects with blood pressure > 140/90 mm Hg, compared to subjects with blood pressure < 140/90 mm Hg.

Diabetes was more prevalent among subjects who are not educated compared to those who are educated. This was statistically significant ($p<0.05$)

Sex, marital status and occupation show no influence on the diabetes prevalence in this study.

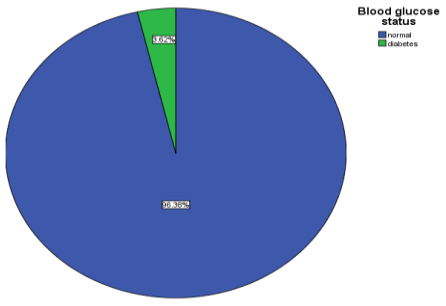

Figure 1: Prevalence rate of diabetes mellitus among the study population

Table 1: Mean Physical Anthropometric Variables of Subjects According to Blood Glucose Status

Variables	Mean Value for Subject	
	Normal	Diabetic
Age (Years)	39.84 ± 0.44	50.60 ± 1.98[a]
Weight (Kg)	66.40 ± 0.40	69.92 ± 2.65
Height (m)	1.62 ± 0.01	1.62 ± 0.02

BMI (kg/m^2)	25.41 ± 0.15	25.55 ± 0.95
FPG (mmol/l)	4.36 ± 0.03	9.23 ± 0.34[a]
Systolic BP (mmHg)	133.05 ± 0.76	156.35 ±7.01[a]
Diastolic BP (mmHg)	81.39 ± 0.41	91.17 ± 3.65[a]

Tabulated values are means ± S.E.M
[a]=Depict significance difference between the two groups ($p<0.05$)
BP= blood pressure, BMI= body mass index, FPG= fasting plasma glucose

Table 2: Mean Physical Anthropometric Variables of Subjects According to Gender

Variables	Mean Value for Subject	
	Male	Female
Age(Years)	40.13 ± 0.59	40.35 ± 0.63
Weight (Kg)	68.04 ± 0.50[a]	64.91 ± 0.60
Height (m)	1.67 ± 0.01[a]	1.57 ± 0.01
BMI (kg/m^2)	24.55 ± 0.18	26.21 ± 0.23[a]
FPG (mmol/l)	4.60 ± 0.06	4.47 ± 0.05
Systolic BP(mmHg)	135.80 ± 1.06[a]	131.74 ± 1.11
Diastolic BP(mmHg)	81.85 ± 0.63	81.48 ± 0.55

Tabulated values are means ± S.E.M
[a]=depicts significant difference between the two groups ($p<0.05$)
BP= blood pressure, BMI= body mass index, FPG= fasting plasma glucose

Table 3: Mean Physical Anthropometric Variables of Subjects According to Age

Variables	Mean Values for Age Groups	
	<45 yr	≥45 yr
Age (Years)	32.26 ± 0.27	54.74 ± 0.50[a]
Weight (Kg)	65.82 ± 0.48	68.93 ± 0.75[a]
Height (m)	1.62 ± 0.01	1.61 ±0.01
BMI (kg/m^2)	25.04 ± 0.18	26.59 ± 0.29[a]
FPG (mmol/l)	4.33 ± 0.04	4.92 ± 0.09 [a]
Systolic BP (mmHg)	126.87 ± 0.68	148.18 ± 1.56[a]
Diastolic BP (mmHg)	79.14 ± 0.46	87.70 ± 0.75[a]

Tabulated values are means ± S.E.M
a= depicts significance difference between the two groups ($p<0.05$)
BP= blood pressure, BMI= body mass index, FPG= fasting plasma glucose

Table 4: Summary of Data on Demographic and Lifestyle (related) Diabetes Risk Factors among the Subjects

Variable	Number of Subjects		
	Normal	Hyperglycaemic	Total
Gender			
Male	468(96.1)	19(3.9)	487(100)
Female	490(96.6)	17(3.4)	507(100)1
Marital Status			
Single	324(99.1)	3(0.9)	327(100)
Married	482(95.6)	22(4.4)	504(100)
Occupation			
Employed	441(96.7)	15(3.3)	456(100)
Unemployed	363(97.1)	11(2.9)	374(100)
Education			
Educated	554(98.8)	7(1.2)	561(100)

Uneducated	242(93.1)	18(6.9)[a]	260(100)
Family History of DM			
Yes	65(86.7)	10(13.3)[a]	75(100)
No	790(97.8)	18(2.2)	808(100)
Alcohol			
Yes	300(94.9)	16(5.1)	316(100)
No	652(97.0)	20(3.0)	672(100)
Smoking			
Yes	40(95.2)	2(4.8)	42(100)
No	819(96.9)	26(3.1)	845(100)
Physical activities			
Yes	507(98.6)	7(1.4)	514(100)
No	305(93.8)	20(6.2)[a]	325(100)
BMI (Kg/m^2)			
< 25	458(97.9)	10(2.1)	468(100)
≥ 25	385(95.3)	19(4.7)[a]	404(100)
Systolic BP (mmHg)			
< 140	569(98.3)	10(1.7)	579(100)
> 140	238(93.7)	16(6.3)[a]	254(100)
Diastolic BP (mmHg)			
< 90	610(98.1)	12(1.9)	622(100)
>90	197(93.4)	14(6.6)[a]	211(100)
Age Group(years)			
< 45	595(99.0)	6(1.0)	601(100)
≥ 45	301(90.9)	30(9.1)[a]	331(100)

a= depict significant difference between two groups ($p<0.05$)

BP= blood pressure

Figures in parenthesis are the equivalent values in %

IV. Discussion

Diabetes mellitus is a growing public health problem both in developing and developed nations, and a major cause of morbidity in the world [14, 15], thus research efforts on it are justified. The most frequently documented risk factors associated with type 2 diabetes include older age, obesity, family history of the disease, hypertension, dyslipidemia, physical inactivity, and belonging to certain racial/ethnic groups [16]. Prevalence of DM and its associated risk factors was carried out in Bukuru metropolis of Plateau state and the prevalence rate of 3.62% was obtained.

Overweight is one of the risk factors of type 2 DM identified in this study. This report accords with what has been reported by previous researchers [17, 18, 19; 20, 14, 21]. In obese individuals adipose tissue releases increased amounts of non-esterified fatty acids, glycerol, hormones, pro-inflammatory cytokines and other factors involved in the development of insulin resistance [22]. When insulin resistance is accompanied by dysfunction of the beta cells, the following fall in insulin secretion results in failure to control blood glucose level leading to type 2 diabetes [23]. Genes responsible for obesity and insulin resistance interact with environmental factors such as increased fat/ calorie intake and decreased physical activity resulting in the development of obesity and insulin resistance followed ultimately by the development of type 2 diabetes [24, 25, 26].

Physical inactivity is another factor influencing the prevalence of diabetes in this study. This is in line with report of many researchers [27, 18, 28, 29, 30, 31, 21]. Evidence from clinical trials which included physical activity as an integral part of life style interventions suggested that onset of type 2 diabetes can be prevented or delayed as a result of successful lifestyle interventions that included physical activity as a part of these interventions [32, 33, 34]. Physical activity plays an important role in delaying or preventing the development of type 2 diabetes in those at risk both directly by improving insulin sensitivity and reducing insulin resistance, and indirectly by beneficial changes in body mass and body composition [35, 36, 37].

Advancing age identified as risk factor for diabetes in this study is also in agreement with report of previous researchers [17, 18, 19, 14, 21]. In Nigeria, the risk of diabetes increases 3- 4 folds after the age of 44 years [38]. The worsening of insulin resistance with age and increasing longevity of diabetic patients due to

improved care, may have contributed to the rising prevalence of type 2 diabetes with age in this study.

Family history of diabetes identified as a risk factor for type 2 diabetes in the study population is also in agreement with the reports of several researchers [18, 19, 21]. Several prospective studies and cross sectional studies have reported that positive family history among first degree relatives confers an increased risk of type 2 diabetes and the risk is greater when both parents are affected [38, 39, 40, 41]. Data from multiple laboratories support that genetic factors predispose to development of type 2 diabetes by reducing insulin sensitivity and insulin secretion which deteriorate in parallel in most human type 2 diabetes cases [42, 43, 44].

Hypertension being another risk factor associated with DM in this study is in agreement with what have been reported by previous studies [45, 18, 46]. Several possible factors are likely causes of the association between type 2 diabetes and hypertension. Studies have shown that markers of endothelial dysfunction are associated with new-onset of diabetes and endothelial dysfunction is closely related to blood pressure and hypertension [47, 48, 49]. Evidence from epidemiological studies suggests a strong relation between blood pressure and BMI and risk of type 2 diabetes [50, 51]. A causal relationship between hypertension and type 2 diabetes is further strengthened by a randomized clinical trial study showing a 14% reduction of risk of diabetes in subjects with glucose intolerance by allocation to 5 year treatment with valsartan, an angiotensin II blocker with antihypertensive properties [52].

V. Conclusion

As reported for most populations in Africa and many parts of the world, most diagnosed diabetic subjects were asymptomatic [53]. The asymptomatic nature of diabetes as was observed in this study is an indicator for the need to improve health services and awareness in the general population. Some of the identified risk factors for type 2 diabetes are modifiable, making type 2 diabetes a potentially preventable disease. It would be prudent, therefore, to recommend screening of subjects at risk and lifestyle modification to reduce the prevalence of diabetes and diabetic complications when they do occur.

Conflict of interest statement: The authors declare no conflict of interest.

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