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Prevalence of Diabetes in Heipang District of Barkin Ladi Local Government Area of Plateau State Nigeria

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Abstract

Background: Hyperglycemia could be asymptomatic in which case, it does not show any obvious symptoms in most individuals until it reaches the chronic state, leading to Full-blown diabetes which has high morbidity and mortality. **Aim:** This study was aimed at knowing the prevalence of hyperglycemia among inhabitants of Heipang District, who may not show obvious signs and symptoms of diabetes, but may have high blood glucose. **Materials and Methods:** A total of 471 participants from the six villages of Heipang district aged 16 - 95 years were randomly recruited for the study. After obtaining informed consent, fasting blood samples were collected and analyzed for glucose levels using the Glucose Oxidase method. Data were processed with SPSS using ANOVA and Student's T-test for statistical comparisons. **Results:** The results obtained showed that 58 (12.3%) participants were Hypoglycemic, 407 (86.4%) were normal, 5 (1.1%) were pre-diabetic and 1 (0.2%) was hyperglycemic. The 0.2% hyperglycemia prevalence indicated no statistically significant difference ($p > 0.05$) in plasma glucose concentrations of participants. The results obtained from the biodata indicated that 27 (5.7%) participants said they were known diabetics, but the laboratory assay confirmed only one, even after test was repeated twice in each case. **Conclusion:** Based on the results of this rural community survey, we therefore conclude that the preva-

lence of Hyperglycemia or Diabetes in Heipang district of Barkin Ladi Local Government Area of Plateau State in the Middle Belt of Nigeria is 5.7%. These findings are hereby discussed and recommendations made.

Keywords

Prevalence, Asymptomatic, Hypoglycemia, Hyperglycemia, Diabetes, Plasma, Insulin, Heipang, Barkin Ladi

1. Introduction

Hyperglycemia is the presence of high amount of glucose in the blood. This does not result in any obvious symptoms until glucose values are uncontrollably increased in blood, thus, resulting in Diabetes Mellitus (DM); a chronic glucose metabolic disease that is characterized by hyperglycemia in which both fasting and random blood glucose levels are above 6.9 mmol/L and 10 mmol/L respectively [1]. Diabetes is a disease of concern that has claimed many lives. It is the 8th cause of death globally, which recorded about 1.5 million deaths in 2012 alone, and estimates of 422 million adults are said to be living with the disease [2]; with a forecasted figure of 844 million or more by the year 2030 [3]. This calls for great concern as estimates in terms of monetary evaluation for the treatment and management of diabetes from the year 2011 to 2030 would cause a loss of about 1.7 trillion US Dollars of the global Gross Domestic Products (GDP), both in the developed and developing countries in all continents; thus, describing it as an elephant in the room [4].

According to the International Diabetes Federation (IDF), about 14.2 million people in Africa are living with undiagnosed diabetes mellitus as compared to other continents of the world [5]. The symptoms of diabetes vary from one individual to another based on their physiological make-up. Hence an individual may be Asymptomatic, having the disease without manifesting the obvious signs and symptoms. Asymptomatic hyperglycemia is characterized by atherosclerosis; most of the time, there is no polyuria or weight loss. It occurs in middle-aged individuals that are obese and do not require insulin therapy but hypoglycemic drugs like metformin and sulfonylureas are used for their treatment [6].

Diabetes mellitus can be classified into three which include Type 1 Diabetes Mellitus (T1DM) formally known as Insulin Dependent Diabetes Mellitus (IDDM), which can start from early childhood or adolescence usually before 40 years of age. Type 2 Diabetes Mellitus (T2DM) formally called Non-Insulin Dependent Diabetes Mellitus (NIDDM), often occurs after 40 years of age and Gestational Diabetes Mellitus (GDM) occurs during pregnancy [7].

Whichever type of diabetes it may be, there are risk factors that may be linked to it, some of which include lifestyle changes and environmental factors. The exact causes of T1DM are unknown, but it is generally agreed that it could be a result of complex interactions between genes and environmental factors, though no spe-

cific environmental risk factors have been shown to cause a significant number of cases. It has been shown that majority of T1DM occurs in children and adolescents [4].

The risk of T2DM has been linked to several dietary practices, unhealthy body weight, high intake of saturated fatty acids, high total fat intake, inadequate consumption of dietary fiber and high consumption of sugar-sweetened beverages [8]-[10].

Other factors that increase the risk of developing T2DM later in life include poor fetal growth, low birth weight (particularly if followed by rapid postnatal catch-up growth), high birth weight and poor early childhood nutrition [11] [12]. Smoking has also been identified as a risk factor for Type 2 Diabetes Mellitus, with the highest risk among heavy smokers, which could linger on for up to 10 years after smoking cessation, falling more quickly for lighter smokers [13] [14].

Risk factors and risk markers for GDM include age (the older a woman of reproductive age is, the higher her risk of GDM); overweight or obesity; excessive weight gain during pregnancy; a family history of diabetes; GDM during a previous pregnancy; a history of stillbirth or giving birth to an infant with congenital abnormality and excess polyuria during pregnancy [15]. GDM increases the risk of future obesity and the development of type 2 diabetes in offspring later in life [16].

Heipang district is a rural community that is rapidly metamorphosing into a semi-urban cosmopolitan town, located in Plateau State in the Middle Belt of Nigeria may be exposed to risks factors of hyperglyglcaemia and diabetes mellitus. Heipang was chosen as the study site out of curiosity, and as a fast-growing community into a semi-urban town with many ethnic nationalities residing there, yet no modern medical facilities to cater for their health needs. Thus, the essence of this investigation was to determine the prevalence of Hyperglycemia or diabetes among the inhabitants; the results of which could be used to create awareness for early intervention to avoid complications that may develop if allowed to progress to chronic stages.

2. Materials and Methods

2.1. Study Design

The study was a random cross-sectional epidemiological survey conducted in Heipang district in Barkin Ladi Local Government Area of Plateau State in the Middle Belt of Nigeria, between December, 2019 and January, 2020.

2.2. Study Area and Population

The study was carried out among residents of Heipang district in Middle Belt of Nigeria. Heipang is located at an elevation of 1238 m above the sea level and lies on Latitude 9 38' 00" and Longitude 8 53' 00" East. The district houses the Yakubu Gowon International Cargo Airport, Jos; Plateau State Polytechnic Barkin Ladi; the Jos Dry Inland Container Depot (under construction), and a Railway station with a line from Jos through to Bauchi, Gombe and Maiduguri in Borno State in

the North Eastern part of the country. Majority of the people engage in farming, while some are civil servants and a few engaged in trading and various artisanship activities. Heipang district has a population of over 139,494 [17]. A random survey of the district was carried out and 471 inhabitants gave consent and participated in the study, comprising 314 females and 157 males between the ages of 16 - 95 years. The study covered all six village areas of the district, made up of 74 participants from Tapo, 49 from Kpang, 178 from Ban, 67 from Chit, 60 from Tatu and 110 from Pwomol.

2.3. Ethical Considerations

The study was carried out in line with the World Medical Association (WMA) Helsinkii - revised version (2013) [18] declaration. Permission was obtained from the Plateau State Ministry of Health, Ref. No: MOH/MIS/202/VOL.T/X. The study was a random survey, among people who gave their consent to participate, aged 16 - 95 years. Parents of children below the age of 18 years gave consent for their wards to participate. Members of the community who did not give consent, and non-residents of the district, in addition to those who were below the age of 16 years, were excluded from the study. A total of four hundred and seventy-one (471) blood samples were randomly taken without bias from participants in the survey.

2.4. Blood Sample Collection, Preparation and Assay

Blood samples were collected by venipuncture into Fluoride oxalate bottles after an overnight fast. The samples were transported to the Laboratory within 2 - 3 hours and the plasma was separated into dry, clean and plain specimen bottles. Fasting plasma glucose was immediately estimated spectrophotometrically using Randox test kits according to the enzymatic Glucose oxidase method [19] [20].

2.5. Data Analysis

The data obtained from the laboratory and demographic biodata from questionnaire, were analyzed using the Statistical Package for the Social Sciences (SPSS) software version 25.0 using analysis of variance (ANOVA) for the laboratory data generated to compare means between groups. Student T-test was used for non-parametric demographic data analysis. Significance level was set at $p < 0.05$.

3. Results

The results are presented in the tables below:

Table 1 indicates that 12.3% of participants were hypoglycemic, 86.4% were normal while 1.1% were pre-diabetics and 0.2% was hyperglycemic.

Table 2 shows the relationship between fasting plasma glucose concentrations and age distribution, averagely within range but statistically significant ($p < 0.05$) in-between ages among ages 16 years to 85.

Table 1. Distribution of fasting plasma glucose concentrations (mmol/L) in Heipang.

Parameter	Number (%)	Mean ± SEM	p-value
Hypoglycemia	58 (12.3)	2.8 ± 0.015	0.058
Normal (2.8 - 6.5 mmol/L)	407 (86.4)	4.8 ± 0.016	0.000*
Pre-diabetes (6.6 - 9.9 mmol/L)	5 (1.1)	7.0 ± 0.005	0.939
Diabetes (≥10.0 mmol/L)	1 (0.2)	10.2 ± 0.003	0.999

Key: SEM = Standard Error of Mean, mmol/L = millimoles per liter, *Significant.

Table 2. Mean ± SEM of fasting plasma Glucose levels (mmol/L) in relation to age.

Age (years)	Number	Mean ± SEM	p-value
16 - 25	79	4.26 ± 1.12	0.018
26 - 35	108	4.36 ± 1.26	0.0009
36 - 45	108	4.36 ± 1.25	0.0009
46 - 55	81	4.44 ± 1.67	0.014
56 - 65	41	4.43 ± 1.13	0.033
66 - 75	25	4.58 ± 1.11	0.044
76 - 85	19	4.25 ± 1.09	0.049
86 - 95	10	4.37 ± 1.41	0.077
Total	471	4.37 ± 1.29	

Key: SEM = Standard Error of Mean, mmol/L = millimoles per liter.

Table 2 shows the relationship between fasting plasma glucose concentrations and age distribution, averagely within range but statistically significant ($p < 0.05$) in-between ages among ages 16 years to 85.

Table 3. Distribution of Plasma Glucose concentration in relation to alcohol intake, hypertension and knowledge of diabetes status.

Parameter	Number (%)	Mean ± SEM (mmol/L)	p-value
Alcohol			
Yes	90 (19.1%)	4.55 ± 1.13	0.17
No	381 (80.9%)	4.33 ± 1.30	
Total	471	4.37 ± 1.29	
Hypertension			
Yes	112 (23.8%)	4.52 ± 1.12	0.17
No	359 (76.2%)	4.33 ± 1.34	
Total	471	4.37 ± 1.29	
Known Diabetic status			
Yes	27 (5.7%)	4.90 ± 2.35	0.029*
No	444 (94.3%)	4.34 ± 1.19	
Total	471	4.37 ± 1.29	

Key: SEM = Standard Error of Mean, mmol/L = millimoles per liter, *Significant.

Table 3 indicates that lifestyle practices of alcohol consumption and knowledge of hypertension were not statistically significant ($p > 0.05$), but inhabitants who knew their diabetic status were statistically significant ($p < 0.05$).

4. Discussion

The fact that hyperglycemia could be asymptomatic, was investigated in this study with the view to knowing its incidence and prevalence for early medical interventions. Failure of early interventions can lead to serious health challenges resulting in diabetes mellitus and its complications which may lead to death, both in developed and in developing countries of the world [21] [22].

In total, 471 people participated in the study in the entire district; out of which 157 (33.3%) were males, while 314 (66.7%) were females. Table 1 shows the prevalence of fasting plasma glucose concentrations of residents with 12.3% of participants were hypoglycemic, 86.4% were normal, 1.1% were found to be pre-diabetic and only one individual who already knew his status representing 0.2% was hyperglycemic. This prevalence is lower than those of similar reports in Bukuru metropolis in Jos South Local Government Area of Plateau State, Nigeria and Calabar metropolis, Cross Rivers State, Nigeria which had prevalence rates of 3.6% and 6.5% respectively [23] [24]. Only one individual, a male had high blood glucose level diagnosed and confirmed in the population. Research has shown that type 2 diabetes develops with increase in age, ranging from 45 years and over. This is because as one gets older, the organs and tissues of the body become weak in performing their physiological functions. One of such functions is the production and maintenance of glucose in circulation, which could be impaired and diabetes mellitus ensues. The fellow diagnosed as diabetic was between the age range of 56 - 65 years old. This finding agrees with report of Medical News Today that, the average age of developing diabetes is between 46 - 64 years [25] [26]. Individuals who already knew their diabetes status, consented to participate in the study had their blood glucose levels within normal range. This could be as a result of proper glycaemic control (adherence to lifestyle changes, exercise and good medication).

The results of plasma glucose levels in relation to age distribution (Table 2) was 4.46 ± 1.43mmol/L, indicating no statistically significant difference to increase in age ($p > 0.05$). The one individual found positive in this study was aged 50. Our findings agree with a report of studies in the United States of America which found out that individuals aged 45 - 65 or older are the most diagnosed with diabetes, which was 20% or more and 8 times higher than those between 18 - 44 years old [27]. The age distribution in the study population was restricted in order not to introduce bias in the study. Being a randomized cross-sectional study, all categories of people of both gender residing within the communities were mobilized, and those that gave consent to participate were sampled.

Lifestyle changes such as alcohol consumption and tobacco smoking have been identified to be predisposing factors to developing diabetes [28]; but another study observed that moderate alcohol intake reduces the risk of developing Type 2 dia-

betes in both men and women, as compared to those that abstain completely from alcohol and beverages. However, it agrees that the risk of developing Type 2 diabetes increases with heavy drinking [29]. Research has indicated that the heavy use of alcohol is a risk factor as it affects the physiological functions of the liver and the pancreas. Also, alcohol consumption in moderate amounts is said to be associated with reduced risk of developing atherosclerotic disorders. In addition to lipid metabolism, haemostatic balance and blood pressure, alcohol improves insulin sensitivity; which have a positive effect when under control. However, chronic alcohol consumption can lead to impaired insulin secretion, and loss of metabolic control thereby lowering blood glucose levels. The underlying mechanism of action in this situation is that, alcohol is catabolized in the liver, producing metabolites that block the liver from producing new glucose, as a result, it leads to hypoglycaemia. Heavy alcohol consumption increases insulin resistance in some major tissues like the liver, skeletal muscle, and adipose tissue [30]-[32]. In this study, the participant diagnosed with the condition was not an alcoholic, but 90 (19.1%) participants were alcoholics, while 381 (80.9%) were non-alcoholics, having mean and standard error of mean of 4.33 ± 1.30 and 4.55 ± 1.23 mmol/L for non-alcoholics and alcoholics respectively, with no significant difference in their plasma glucose levels ($p > 0.05$). The study did not quantify the volume and concentration of alcohol taken by participants.

The study revealed that, 112 (23.8%) participants were hypertensive, while 359 (76.2%) were non-hypertensive, with means and standard error of means of 4.65 ± 1.52 mmol/L and 4.39 ± 1.39 mmol/L of blood glucose, respectively, which were not statistically significant ($p > 0.05$) (**Table 3**). This could be due to the low prevalence of the disease in the district. However previous studies have shown that the presence of diabetes causes a significantly high increase in low density lipoprotein and very low density lipoprotein (LDL and VLDL) consequence of which leads to increased levels of Cholesterol and other triglycerides that can be deposited on the walls of blood vessels causing atherosclerosis, making the heart to pump more blood as a result of a signal being received by the hypothalamus which could then or subsequently result to hypertension and other cardiovascular complications [33].

5. Conclusions

From the biodata generated in this study, it was observed that 27 (5.7%) respondents said they knew their diabetes status; that they were previously diagnosed at various times with diabetes and were on medication; this was statistically significant ($p < 0.05$) (**Table 3**). However, the laboratory test indicated normoglycemia except for one. This could be as a result of good glycaemic control strategies, such as diet and lifestyle changes by the previously diagnosed participants. The participants who previously had diabetes and the positive case were followed up annually from the time of the survey; with results of proper glucose control and the resultant demise of the positive case on 19th December, 2023 when he died due to

diabetes complications. Thus, the researchers concluded that the prevalence of diabetes in Heipang is 0.2%.

In relation to physical activities, most participants are farmers whose work on the farm serves as a form of physical exercise all year round. Notably, a few of them still do some physical exercise such as playing football and bicycle riding on irregular basis. Averagely, they are involved in some of physical activity routinely. That could explain the low prevalence of diabetes in the district and the glycaemic control for those previously diagnosed with the condition.

Recommendations

In view of these findings, the researchers wish to recommend the following:

- A more comprehensive survey be carried out in the district as a way of follow-up with higher number of participants in view of the population of people in the locality. More so that, there is an influx of people into Heipang which fast growing to a semi-cosmopolitan area.
- Regular routine glucose monitoring services should be made available and affordable to rural dwellers in communities such as Heipang, in order to discover asymptomatic hyperglycemia with a view to curbing it early, to avoid its progression to full-blown diabetes and its complications. No such test is done in the government-owned Health facilities in the district.
- Confirmed diabetics should be monitored regularly and advised to adopt lifestyle changes and exercise to avoid the disease.
- Governments at all levels should provide healthcare access with laboratory facilities in rural communities for easy access to members of communities. In Heipang district, health facilities are poorly funded and laboratory services are not adequate (as some do not even have equipment for any test).
- Health personnel should consciously and deliberately educate the rural dwellers about the risk factors of diabetes and the importance of imbibing lifestyle changes, coupled with regular physical activities.

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Conflicts of Interest

The authors wish to declare that there is no conflict of interest with any individual or organization regarding this study.

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