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# PREVALENCE OF PREDIABETES AND ASSESSMENT OF ASSOCIATED RISKS OF CARDIOVASCULAR DISEASE IN NNEWI, ANAMBRA STATE, NIGERIA

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**ABSTRACT**

This study was designed to investigate the prevalence of prediabetes and the associated risk of cardiovascular disease in Nnewi, Nigeria. A total of 277 apparently healthy adults (73males and 204 females) who were willing to participate were recruited. A structured questionnaire was used to obtain the demographic data and dietary pattern of subjects. Anthropometric indices and blood pressure were measured using standard methods. 5mls of blood was collected from eligible subjects and dispensed in fluoride oxalate and plain containers for glucose estimation and other biochemical parameters respectively. Plasma glucose, serum LDL, HDL, TG and TC were analyzed using standard methods. The result showed a prevalence of 7.2% prediabetes in the population. BMI was significantly higher in prediabetes than the control groups (39.4±5.8 vs 29±4.4kg/m$^2$; P>0.05). Similarly, there were significant increases in the prediabetic values of FBG (117.54±16.84 vs 83±16.84mg/dl; P>0.05) than the control group. Significant increase was observed in TG (1.8 ± 0.33 vs 0.01 ± 0.25mmol/l; P>0.05) and TC (4.96 ± 0.55 vs 4.06 ± 0.24mmol/l; P0.05) whereas HDL and LDL showed no significant increase. The SBP (128± 11.26 vs 120±2.2mmHg; P>0.05) and DBP (92±4.43 vs 60±5.3mmHg; P>0.05) was observed to be higher in prediabetic groups. The study therefore, suggests that the major determinant for predabetes in the study population may be hypertension and obesity whereas cardiovascular function was not impaired.

**Key Words:** Hypertension, Prehypertension, Cardiovascular Disease, Lipid Profile.

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## INTRODUCTION

Diabetes mellitus (DM) is a metabolic disorder characterized by chronic hyperglycemia with disturbances in carbohydrate, fat, and protein metabolism resulting from defects of insulin secretion, insulin action, or a combination of both. Diabetes mellitus is currently a very prevalent disease, especially in Africa with highest occurrence in Nigeria (Bos and Agyemand, 2013). Globally at the end of 2013, as much as 382 million people had the disease while the number is expected to reach 592 million by

2035. Prediabetes refers to the intermediate metabolic states between normal and diabetic glucose homeostasis, it is a risk state that defines a high chance of developing diabetes. The diagnostic criteria for prediabetes are based on basically IGT and IFG and the idea that these are predisposing factor to cardiovascular disease is assessed in this study. An individual is of high risk of developing diabetes and its complications if the individual is prediabetic. Prediabetes is an intermediate state of hyperglycemia with glycemic parameter above normal but below the diabetes threshold. Around 5-1% of people with prediabetes become diabetic annually although transition rate is specific for a given population (Knowler *et al.,* 2009). According to an American Diabetes Association expert panel, up to 70% of



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individual with prediabetes will eventually develop diabetes.

According to recent studies the prevalence of prediabetes in Nigeria is 21% and if not checked would increase to about 25%b as the years goes by (Nwatu *et al.,* 2015). The study conducted among rural Fulani showed the prevalence of prediabetes to be relatively high, a factor that may predispose to future DM development (Anas *et al.,* 2013). Impaired fasting glucose (6.1 - 6.9 mmol/L or 110-125(mg/dl) and impaired glucose tolerance between 7.8 – 11.0 mmol/L (140mg/dl-200mg/dl) are considered a prediabetic state, associated with insulin resistance and increased risk of cardiovascular disease, although of lesser risk than impaired tolerance (IGT).

Without lifestyle changes to improve their health, 15% to 30% of people with prediabetes will develop type 2diabetes within five years and cardiovascular disease (American Diabetes Association, 2012). The risk factors include: age, especially after 45 years of age, being overweight or obese, hypertension, hyperlipidaemia, a family history of diabetes; having an African American, Hispanic/ Latino, American Indian, Asian American, or Pacific Islander racial or ethnic background; a history of diabetes while pregnant (gestational diabetes) or having given birth to a baby weighing nine pounds or more; and being physically active less than three times a week.

Two metabolic defects occur in most patients with type 2 diabetes: insulin resistance and deficient insulin secretion which is also seen in prediabetes. The metabolic syndrome involves the fulfilment of at least criteria that include elevated waist circumference, impaired fasting glucose, elevated blood sugar, elevated triglycerides, or low high density lipoprotein (HDL) cholesterol. The present of the metabolic syndrome is a strong risk factor for the subsequent development of diabetes, conferring risks as a nearly 7-fold increased risk among those with, as compared to those without the metabolic syndrome.

While people with prediabetes do not have the increased risk for microvascular disease as seen in diabetes, they are at risk of the development of metabolic syndrome, diabetes and cardiovascular disease. Impaired glucose tolerance is more strongly associated with CVD outcomes than is IFG. Individuals identified as having both IFG and IGT are at higher risk for diabetes as well as CVD (Lilly *et al.,* 2009).

Cardiovascular disease risk assessment must take into account the major risk factors (cigarette smoking, elevated blood pressure, abnormal serum lipid and lipoprotein, and hyperglycemia) and predisposing risk factors (excesses body weight and abdominal obesity, physical inactivity, and family history of CVD), while age related factors and gender are put into consideration.

Lipid profile is a panel of blood tests serves as an initial broad medical screening tool for abnormalities in lipids, such as cholesterol and triglycerides. The lipid profiler typically includes: Low density lipoprotein (LDL), High-density lipoprotein (HDL), Very low density lipoprotein (VLDL), Triglycerides (TG) and Total cholesterol (TC). High levels of serum cholesterol and triglyceride have been proposed to increase the risk of CVD (Allot *et at.,* 2014). This study was therefore, designed to investigate the prevalence of prediabetes and the associated risk of cardiovascular disease in Nnewi, Nigeria.

## MATERIALS AND METHODS

**Study Area:** Nnamdi Azikiwe University, Okofia-Otolo, Nnewi campus comprises the College of Health Sciences having the faculties of Basic Medical Sciences, Health Sciences and Technology and Medicine. It is located in the suburb of Nnewi - a popular town in Anambra State Nigeria. The environment is poorly developed and lacking basic amenities such as housing, road, communication, electricity and potable water compared to campuses located in urban areas.

**Study Design:** On the day preceding each data collection, subjects were informed to eat dinner not later than 10 p.m. and be present on each morning of the study, which was to commence by 7 a.m., without eating any food or drink. Questionnaires were distributed to obtain the subject's demographics, knowledge, and family history of diabetes, physical activity levels, and general dietary habits. Blood pressure and anthropometric parameters were obtained using standard procedures (Chobanian *et al.,* 2003; Kliegman and Berhman, 1996; Paynter and Parkin, 1991). 5mls of blood was collected from eligible subjects. 2mls of blood was dispensed in fluoride oxalate and 3mls into plain tubes for plasma glucose and other biochemical parameters respectively. Plasma Fasting blood sugar (FBS) and 2-hours post prandral (2THPP) glucose as well as lipid profile (LDL, HDL, TG and TC) were analyzed using standard methods described by Bergmeyer and Bernt (1974); Assman *et*



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*al.* (1984); Burstein *et al.* (1980); Tietz (1990) and Roeschlau *et al.* (1974) respectively.

**Inclusion Criteria and Exclusion Criteria:** Apparently healthy male and female subjects aged 45 years and above were recruited for the study. Subjects younger than 45years, pregnant, known diabetic, those with cardiovascular disease and heart failure as well as those on drugs were excluded from this study.

**Ethical Consideration**: Ethical approval was obtained from the Faculty of Health Sciences and Technology ethical committee, Nnamdi Azikiwe University, Nnewi campus, Anambra State, Nigeria for sample collection.

## RESULTS

The demographics of the study population were illustrated in table 1. Among the 277 subjects that were recruited for the study, 73 (26.4%) were males and 204 (73.6%) were females. Twenty (20) subjects of the total study population were prediabetic among which 3 (15%) were females and17 (85%) were males. The results showed the prevalence of prediabetes in the study population was seven percent (7%) representing 20 subjects of which 3 (15%) were males and 17 (85%) were females.

From the anthropometric assessment (Table 2), there were significant differences in the mean values of BMI and weight between prediabetics and the control group. The mean values were significantly higher in prediabetes' weight (89.05±13.6) and BMI (39.44±5.86) when compared with the control groups' weight (72.55±11.19) and BMI (29.19±4.41) respectively. The mean FBG (Table 3) of the prediabetic subjects was 117.54±16.84mg/dl (6.53 ± 0.94 mmol/L), while the mean THPP was 150.95±24.71mg/dL (8.39 ± 1.37mmol/L) indicating that the FGB and THPP in prediabetic individuals were significantly higher than in control groups.

The mean level of TC (Table 4) of the prediabetic group was 4.96 ± 0.55 and that of the control was 4.06 ± 0.24. Whereas, the mean TG in prediabetic group was 1.80 ± 0.33 and that of the control group was 0.10 ± 0.25. The mean TG and TC were significantly higher in prediabetes than the control group ($p > 0.05$). Moreover, HDL and LDL showed no significant difference. Table5 showed significant difference in the HDL paramenters among prediabetic male (1.12 ± 0.16) and female (1.26 ± 0.13) indicating that the serum HDL concentration was higher in females than in males. Moreover, TC, TG, and LDL showed no significant difference.

The results demonstrated in table 6 showed that there was significant difference in the SBP and DBP ($p<0.05$) among the prediabetes and control groups. The mean values of SBP (128±11.26) and DBP (92±4.43) was significantly higher in prediabetes than in the control groups. From table 7 there was no association between the cardiovascular (TC, TG, HDL, LDL) and prediabetes parameter (IFG and LDL) and prediabetes parameter (IFG and IGT).

**Table 1: Demographics of the participants**

| Variables | Number | No of Prediabetes | Percentage (%) |
|---|---|---|---|
| Total population | 277 | 20 | 7.2 |
| Male | 73 | 3 | 4.1 |
| Female | 204 | 7 | 8.3 |



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**Table 2: The Anthropometric parameters of prediabetes and control**

| Variables | Pre-diabetes N=20 | Control N=20 | t-value | p-value |
|---|---|---|---|---|
| Age (yrs) | 50.95±11.27 | 49.30±9.96 | 0.491 | 0.627 |
| Ht(inches) | 149.80±5.16 | 156.15±6.62 | -3.384 | 0.002* |
| Wt(kg) | 89.05±13.6 | 72.55±11.19 | 4.18 | 0.000* |
| HWC(inch) | 1.05±0.11 | 1.03±0.19 | 0.428 | 0.671 |
| BMI(kg/m$^2$) | 39.44±5.86 | 29.19±4.41 | 6.392 | 0.000* |

All values are expressed as Mean ± SD; P < 0.05

**Table 3: Fasting blood glucose and 2-hours postpandral in prediabetes and control.**

| Variables | Pre-diabetes N=20 | Control N=20 | t-value | p-value |
|---|---|---|---|---|
| FBS(mg/dl) | 117.54±16.84 | 83±16.84 | 9.22 | 0.000* |
| THPP(mg/dl) | 150.95±24.71 | 100±24.71 | 7.25 | 0.000* |

All values are expressed as Mean ± SD; P < 0.05

**Table 4: Cardiovascular parameters in prediabetes and control subjects.**

| Cardiovascular parameters | Prediabetes | Control | t-value | p-value |
|---|---|---|---|---|
| TC(mmol/l) | 4.96 ± 0.55 | 4.06 ± 0.24 | 5.18 | 0.00* |
| TG(mmol/l) | 1.8 ± 0.33 | 0.10 ± 0.25 | 3.11 | 0.00* |
| HDL (mmol/l) | 1.29 ± 0.15 | 1.17 ± 0.12 | 2.64 | 0.12 |
| LDL (mmol/l) | 3.34 ± 6.65 | 2.26 ± 0.38 | 1.71 | 0.95 |

All values are expressed as Mean ± SD; P < 0.05



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**Table 5: Cardiovascular parameters in male and female.**

| Cardiovascular parameters | Male | Female | t-value | p-value |
|---|---|---|---|---|
| TC(mmol/l) | 4.20 ± 0.15 | 4.46 ± 0.60 | 1.08 | 0.29 |
| TG(mmol/l) | 0.9 ± 0.3 | 0.96 ± 0.32 | 3.29 | 0.78 |
| HDL (mmol/l) | 1.12 ± 0.16 | 1.26 ± 0.13 | 2.47 | 0.02* |
| LDL (mmol/l) | 2.70 ± 0.97 | 3.74 ± 5.37 | 0.54 | 0.59 |

All values are expressed as Mean ± SD; P < 0.05

**Table 6: The systolic and diastolic blood pressure among the prediabetes and control**

| Variables | Pre-diabetes N=20 | Control N=20 | t-value | p-value |
|---|---|---|---|---|
| SBO(mm/Hg) | 128±11.26 | 120±2.2 | 8.50 | 0.000* |
| DBP(mm/Hg) | 92±4.43 | 60±24.71 | 3.99 | 0.000* |

All values are expressed as Mean + SD; P < 0.05

## DISCUSSION

From this study, the prevalence of prediabetes in Nnewi was generally low (7.2%) which is in contrast to findings of Nwatu *et al.* (2015) who reported a prevalence of 21.5% in an urban community in Enugu State to be 21.5% and Ogbu *et al*. (2012) who reported the 25% prevalence of prediabetes among hypertensives in Enugu. However, in this present study, the subjects were mostly market people with relatively low income, compounded by economic downturn of the country. Their daily activity also involves frequently regular physical activities like trekking, farming, cycling etc, which reduces their risk of been prediabetic. Mukamal *et al*. (2010) reported that physical activities assist weight loss, improves blood glucose control, blood pressure, lipid profile and insulin sensitivity. Also, Gillies (2007) recommended that lifestyle intervention and physical exercise are important for medical management and reduces their risk of been prediabetes. Also in this study, abdominal obesity (BMI) was observed in most of the prediabetic subjects. Bardenheier *et al* (2013) reported that BMI has a direct association with prediabetes. Also, reports of Ogunmola *et al* (2013) and Adegoke *et al* (2010) state that the reason for the high prevalence of prediabetes in overweight and obese adults may be due insulin resistance and toxicity to beta cells due to the high level of free fatty acids in acid in obese individuals. The mean serum TC and TG levels were significant higher in prediabetic subjects compared with control group



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similar to findings by Okafor *et al* (2012) which showed elevated TC as the major lipid abnormality in prediabetes. However, there was no significant difference observed in the mean serum level of HDL and LDL in prediabetic subjects compared with the control group. This is contrary to lloh et al (2011) report which suggest low HDL levels as the commonest dyslipidemia. The high levels of physical activity noted in the subjects, have accounted for the similarities of HDL in both prediabetic and control subjects, as exercises are known to increase HDL-C levels.

In this study however, the HDL cholesterol concentration was higher in females that in males. These results are in conformity with the study of Mooradian *et al* (2010) who reported that HDL are higher in females than in males though not a predisposing risk factor of cardiovascular disease in males.

However, SBP and DBP were higher in prediabetes when ompared to the control groups, which indicates that they are predisposed to prehypertension, or worst still hypertension, most of the prediabetics individuals had had blood pressure levels of 120/90 mmHg. This is in accordance with Garber *et al* (2008) who demonstrated in his report that the treatment of hypertension decrease both microvascular and marcovascular disease risk.

## CONCLUSION

The study assessed the prevalence of prediabetes in apparently hesalthy adult subjects 45 years and older in Nnewi, and examined the correlation between prediabetes and cardiovascular disease risk. Finding from this study indicated that the prevalence of prediabetes in Nnewi was 7.2%. Though, the prediabetic subjects had higher BMI, increased systolic and diastolic pressure, their cardiovascular function was not impaired. Hence, it is suggested that the major determinant for prediabetes in this population may be obesity and hypertension.

## RECOMMENDATION

Screening for hypertension should be routine as it is a risk factor not only for prediabetes but also cardiovascular disease. Increased awareness should also be created on the need of early diagnosis and the developments of healthy lifestyles that prevent or delay the onset of the prediabetes.


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**AUTHORS' CONTRIBUTIONS**

All authors (Oponi BB, Ogbodo EC, Amah UK, Ezeugwunne IP, Ihim AC, Onah CE, Analike RA, Okwara JE, Madukwe DUP, Obiorah MO, Ugwu MC, Meludu SC) contributed to the completion of this research work and were actively involved in the presentation of this manuscript.



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