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Original Article

# Prevalence of Undiagnosed Dysglycaemias and their Correlates amongst Hypertensive Patients in a Tertiary Health Facility in Abuja, North Central Nigeria

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## Abstract

**Background:** Dysglycaemia, (diabetes mellitus, DM, and Prediabetes) and Hypertension (HTN) are two common non-communicable diseases that are closely linked. Cardiovascular risk profile and cardiovascular-related death rise significantly when they co-exist. A third of cases of diabetes mellitus amongst hypertensive patients are undiagnosed and most people who are newly diagnosed have a low level of awareness. This study is therefore designed to assess the prevalence of dysglycaemia and associated factors, among hypertensive patients attending our facility.

**Methodology:** Clinical and laboratory information on 858 patients was extracted and analyzed. This includes sociodemographic variables such as age, sex, socioeconomic status, and level of physical activity. Also, family history of diabetes mellitus, the duration of hypertension as well as types of antihypertensives used by those already attending the clinic for hypertension care. Other variables were blood pressure, height, weight, waist and hip circumferences, and body mass index (BMI). Blood glucose and plasma lipid profile as well.

**Results:** More than a quatre of the patients had prediabetes. Between 2% and 6.1% had diabetes mellitus using 2HPP and FBG respectively. Following cross-tabulation, dysglycaemia was significantly associated with age, duration of hypertension, body mass index, BMI, elevated total cholesterol, LDL as well as the use of beta blockers and thiazides.

**Conclusion:** Dysglycaemias are common among hypertensive patients in Abuja. Age, duration of hypertension, body mass index, dyslipidemias, beta blocker, and thiazide use were positively associated with dysglycaemia. Screening for dysglycaemia is recommended for all hypertensive patients at the point of entry to care.

**Keywords:** Undiagnosed Dysglycaemia; Correlates; Hypertensive Patients; Abuja.

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**Quick Response Code:**

## Introduction

Diabetes Mellitus and Prediabetes are two disturbed glucometabolic states collectively referred to as dysglycaemia or abnormal glucose regulation[1-3]. Dysglycaemias (especially diabetes mellitus), and hypertension (HTN), are two common non-communicable diseases that are closely related [4-6]. Cardiovascular risk profile and cardiovascular-related morbidity and mortality rise significantly when these two entities co-exist [7]. Therefore, targeted screening for early detection and timely intervention can significantly reduce related morbidity and mortality [5]. This explains why the World Health Organization, (WHO), recommends glycemic profiling as part of the cardiovascular risk assessment in hypertensive patients[4,8].

Notably, persons with type 2 diabetes mellitus usually go through prediabetes phase for a while, during which there is an opportunity to identify them and initiate timely preventive interventions[9-12]. Prediabetes is a stage in altered glucose regulation when the blood glucose level is higher than the normal value but below the diabetes range. Without intervention, it may progress to diabetes mellitus even in hypertensive patients[3]. Notably, undiagnosed prediabetes and diabetes mellitus in hypertensive patients are associated with a high risk for related complications [11,12].

Mechanisms for dysglycaemia in patients with hypertension may include the atherogenic effect of hypertension-related insulin resistance and β-cell failure, suggesting that, dysglycaemia may partly be a consequence of vascular impairment in long-standing hypertension [13]. The vascular impairment is mainly microvascular in nature, with documented changes such as arteriolar narrowing with consequent impairment of microvascular blood flow[14]. There is literature evidence that these changes take place in the pancreas, resulting in pancreatic microvascular dysfunction as well, with ischemia prior to dysglycaemia in hypertensive subjects[15,16]. Another mechanism for dysglycaemia in hypertensive subjects is endothelial dysfunction and impaired nitric oxide-mediated vasodilatation which directly lead to reduced insulin delivery to skeletal muscles, resulting in peripheral insulin resistance and thus hyperglycaemia[17].

In routine clinical practice, the assessment of dysglycaemia is often based on fasting blood glucose (FBG),2-hours post prandial blood glucose(2HPP) and oral glucose tolerance test (OGTT), although glycated haemoglobin (HbA1c) is superior [18]. Available literature shows a strong correlation between average plasma glucose and HbA1C in predicting the development of diabetes mellitus in hypertensive patients [19]. Furthermore, it appears that the paradigm now includes the use of the Finish Diabetes risk score, FINDRISC, as another good tool for dysglycaemia screening [20]. Thus, screening for dysglycaemias in hypertensive patients should be a priority in line with the WHO recommendation of risk-profile-based diabetes screening [4, 8, 21], thus furthering the American Diabetes Association, (ADA), recommendation of 3-yearly/annual or at most 2-yearly screening for diabetes mellitus in adults who are low-risk and high-risk respectively. High-risk groups include those with a family history of diabetes mellitus and those living with hypertension among others [22]. Studies across the globe have reported high yields amongst hypertensive patients who were opportune to be screened for dysglycaemia[23,24]. This averts the potential missed-opportunity for prevention, early detection, and treatment of diabetes mellitus.

There is a paucity of data on dysglycaemia amongst hypertensive patients in Nigeria. Such data will help with prevention, early detection, and treatment as well as provide useful information for designing appropriate policies to mitigate the possible impacts of dysglycaemia on hypertensive patients in the country and beyond. Furthermore, recognizing associated factors of dysglycaemia amongst hypertensive patients should provide useful information for healthcare professionals, while attempting to minimize its impacts on hypertensive patients. Therefore, this study is aimed at determining the prevalence and associated factors of dysglycaemia amongst hypertensive patients in Abuja.

## Materials and Methods

*Design, study population and study setting.*

This is a retrospective study involving a cohort of all hypertensive patients, eighteen years and above, who made clinic visits over a five-year period from January 1st, 2016, to December 31st, 2020, at the medical out-patients unit of the Asokoro District Hospital/Nile University Teaching hospital Abuja, Federal Capital Territory, (FCT) Nigeria. The FCT is in the center of Nigeria, with a current population of approximately 3.3 million inhabitants[25]. Our facility is a 154-bed tertiary healthcare facility, providing clinical services in all the major medical specialties. Ethical clearance with approval number; FCTA/HHSS/ADH/EC/0052/18 was obtained from the Asokoro District Hospital Ethics Committee.

One thousand two hundred and sixty-seven case folders were retrieved, but data was extracted from eight hundred and fifty-eight, (858) having most of the required variables including blood sugars. Folders with documented chronic kidney and liver diseases were excluded. Pregnant women and those documented as known diabetic patients in the hypertension clinic were excluded. Clinic appointments for stable patients at the medical outpatients' unit, were at three monthly intervals. The routine investigations requested for during the first visit include fasting blood glucose, FBG, and 2 hours postprandial, 2HPP, and blood glucose. Only those with complete FBG and 2HPP were eligible. The patients were categorized into two groups. The new group referred to the newly diagnosed hypertensive patients who were also treatment naïve, while the old group referred to previously known hypertensive patients. This group had been on treatment for hypertension.

*Study Variables, Data Collection, and Data Handling.*

Data were extracted into an Excel spreadsheet before exporting for analysis. Data included social demographic variables such as age, sex, socioeconomic status, and physical activity (High, moderate, and low). Family (first-degree relatives) history of diabetes mellitus and the duration of hypertension for those already attending the clinic for hypertension care were obtained. The types of antihypertensives were also documented for this group only. Other variables were blood pressure, height, weight, waist and hip circumferences, and body mass index (BMI). BMI<18.5 was recorded as underweight; 18.5-24.9 as normal; 25-29.9 as overweight; and >30 as obese. FGB and 2HPP as well as lipids values were retrieved.

The outcome variable was dysglycaemia, namely, prediabetes or diabetes mellitus. Analysis was done using the SPSS version 23. Descriptive variables were presented as frequencies. Proportions and means were used to describe certain quantitative variables. Cross tabulations were done using the Chi-square test for the significance of the associations of variables with dysglycaemia. An association was considered significant at $P<0.05$ and 95% confidence intervals (CI).

## Results

### Socio-demographics of participants

Of the 858 participants, 70.4% were females. Females dominated both old and new groups. Figure 1 shows that most of the patients were in the age bracket of 44-64 years and were of the middle (49.1%) and lower (46.1%) socio-economic classes respectively. Physical activity level was majorly moderate, (77.5%). Family history of diabetes mellitus was positive in about a fifth, 19.5%, of all groups. 2.7% did not know if they had a family history of diabetes mellitus. Table 1 is the table of means of certain quantitative variables, including age, duration of hypertension for the old group, blood pressure, anthropometric measures, glycaemia, and lipid profiles. Most of these variables were surprisingly higher in the old group, i.e., previously known hypertensive patients, than in the newly diagnosed. Subjects in the old group were slightly older and the mean blood pressure between the two groups was similar. This is surprising because we expect lower blood pressure in the old group who were on antihypertensives and should be treatment experienced. Waist circumference was similar among the males in both groups, but again surprisingly higher amongst the females in the old group. BMI, and blood glucose, both FBG and 2HPP were higher in the old group, while dyslipidaemic features were more in the new group.

**Prevalence of Dysglycaemias and associations**

Figure 2 shows the frequencies of dysglycaemia (prediabetes and diabetes) using FBG and 2HPP blood glucose respectively. More than a quarter of the patients had prediabetes and between 2% and 6.1% had diabetes mellitus using 2HPP and FBG respectively. Following cross-tabulation, table 2, dysglycaemia was significantly associated with age, duration of hypertension, BMI, elevated total cholesterol, elevated low-density lipoprotein, LDL, and the use of beta blockers and thiazides.

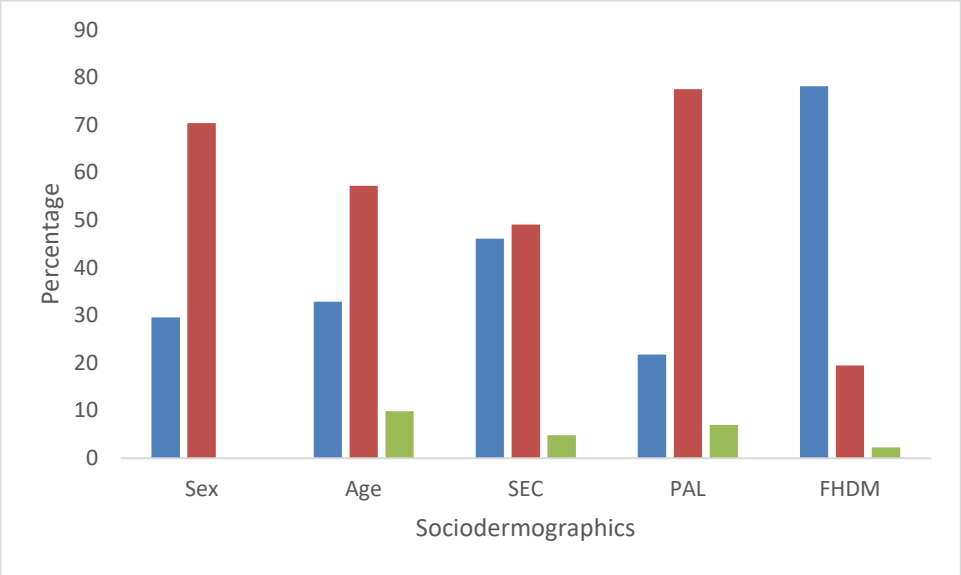


**Figure 1:** Frequency distribution of certain socio-demographic characteristics

SEC: Socio-economic Class. PAL: Physical Activity Level. FHDM: Family History of Diabetes Mellitus

**Table 1:** Table of Means of Quantitative Variables

| **Variables** | **Mean+SD** | **Mean+SD** | **Mean+SD** |
|---|---|---|---|
| | **Old** | **New** | **Combined** |
| Age(years) | 49.2+11.1 | 48.2+13.3 | 49.02+11.5 |
| Duration of Hypertension(years) | 7.3+6.2 | ---------- | 21.78+31.5 |
| Systolic Blood Pressure(mmHg) | 151.6+12.9 | 151.8+11.9 | 151.6+12.8 |
| Diastolic Blood Pressure(mmHg) | 92.2+12.4 | 89.5+12.5 | 91.7+12.4 |
| Waist Circumference male(cm) | 98.6+13.2 | 98.2+14.9 | 98.5+13.5 |
| Waist Circumference female(cm) | 86.4+11.8 | 84.2+0.9 | 85.2 |
| Body Mass index(kg/m2) | 30.8+5.9 | 29.4+5.2 | 30.6+5.8 |
| Fasting Blood Glucose(mmol/l) | 5.2+1.6 | 4.9+0.81 | 5.2+1.5 |
| 2Hours Post Prandial (mmol/l) | 7.1+2.8 | 6.6+1.4 | 7.03+2.7 |
| Total Cholesterol (mmol/l) | 4.9+1.1 | 5.7+1.2 | 5.1+1.2 |
| Triglycerides(mmol/l) | 1.5+0.8 | 1.4+0.7 | 1.5+0.8 |
| Low Density Lipoprotien (mmol/l) | 3.2+0.9 | 3.9+1.0 | 1.14+0.25 |
| High Density Lipoprotien (mmol/l) | 1.1+0.3 | 1.2+0.2 | 3.4+1.02 |

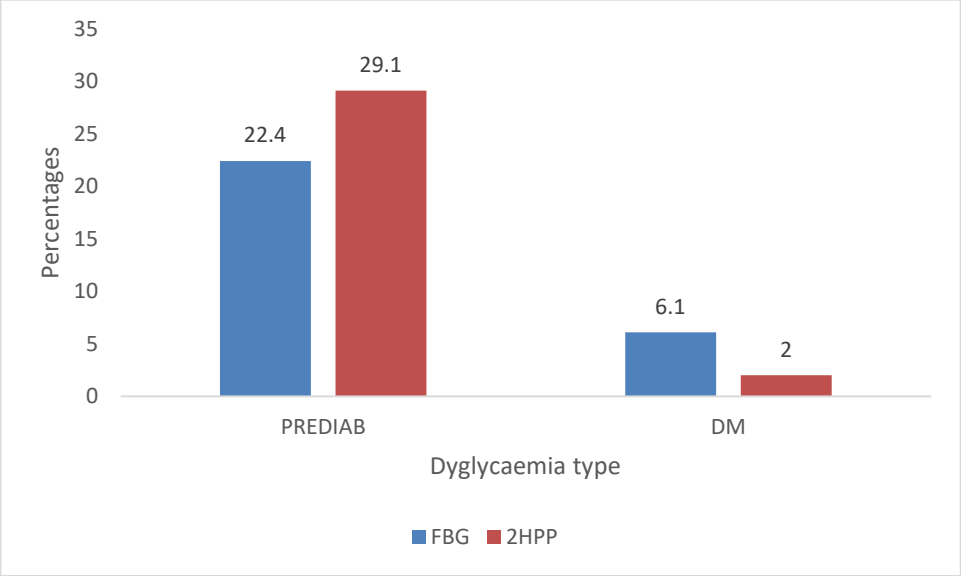


**Figure 2:** Frequencies of Prediabetes and diabetes using FBG and 2HPP.

PREIAB: Prediabetes. DM : Diabetes Mellitus. FBG: Fasting Blood glucose

**Table 2:** Associations of certain variables with Dysglycaemia

| | Old | New | Combined |
|---|---|---|---|
| Variables | $\chi^2$ (p-value) | $\chi^2$ (p-value) | $\chi^2$ (p-value) |
| Age | 23.036(0.000) | 34.107(0.000) | 8.218(0.000) |
| Duration of Hypertension | 42.371(0.000) | ---------- | ---------- |
| Systolic blood pressure | 13.447(0.001) | 4.157(0.032) | 12.732(0.002) |
| Diastolic blood pressure | 0.108(0.948) | 0.415(0.315) | 0.05(0.975) |
| Body mass index | 24.572(0.000) | 10.926(0.004) | 11.345(0.023) |
| Elevated Total Cholesterol | 30.199(0.000) | 11.820(0.000) | 37.371(0.000) |
| Elevated Triglycerides | 4.270(0.118) | 0.270(0.370) | 2.736(0.255) |
| Elevated Low-density Lipoprotein | 22.217(0.000) | 7.789(0.007) | 17.342(0.000) |
| Reduced High density Lipoprotein | 10.616(0.005) | 1.874(0.181) | 5.482(0.064) |
| Truncal obesity from WC (male) | 633.6 (0.000) | 90.7 (0.000) | 697.9 (0.000) |
| | | | |
| Use of ACE-I | 42.104(0.284) | ---------- | ---------- |
| Use of Beta blocker | 18.175(0.006) | ---------- | ---------- |
| Use of ARB | 11.984(0.102) | ---------- | ---------- |
| Use of Calcium channel blocker | 2.107(0.349) | ---------- | ---------- |
| Use of methyl dopa | 3.672(0.159) | ---------- | ---------- |
| Use of thiazides | 163.302(0.000) | ---------- | ---------- |
| Family History of Diabetes | 20.7 (0.000) | 3.0 (0.082) | 13.8 (0.001) |

ACE-I: Angiotensin-converting enzyme inhibitor. ARB; Angiotensin receptor blocker. WC; waist circumference

## Discussion

This study reveals the frequency of dysglycaemia and associated factors among hypertensive patients attending the medical outpatients' services of the Asokoro District Hospital, ADH, (Nile University Teaching Hospital) in Abuja, North central Nigeria. Based on FBG and 2HPP, 22.5%and 29.1% had impaired fasting glucose and impaired glucose tolerance respectively, while 6.1%and 2.0%respectively met the criteria for diabetes mellitus. The estimated frequency of diabetes was lower than that reported earlier from East Africa, while we found higher frequencies of prediabetes[26]. A larger sample-sized Minnesota study showed a lower prediabetes prevalence than that reported in our study, but a much higher diabetes prevalence [23]. Furthermore, the Euro Heart Survey on diabetes and the heart reported a prevalence of 36% (pre-diabetes) and 22%(diabetes) among hypertensive patients who had coronary heart disease[27]. A German study reported a prediabetes and diabetes prevalence of 39% and 12% respectively among hypertensive subjects[28]. These disparities could be explained by differences in sample size, the mean age of study populations, and methodology. The German study for example had a very small sample size, which may have influenced the outcome. Furthermore, patients in the European and American studies were older than ours, and the study involved the use of glycated hemoglobin which was more sensitive in assessing dysglycaemia. One study from the southwestern part of Nigeria, using FBG only, reported a diabetes prevalence of 25.7% amongst hypertensive patients[29], which was much higher than the 6.1% we found using FBG. Possible explanations include a smaller sample size, an older cohort, poorer control of hypertension in the reference study. The smaller sample size in the reference study (160 vs 858) may not have allowed for a good spread, even though both studies were facility based. The reference study also had an older cohort of hypertensive patients (mean age 64.6 vs 49.2 years) especially as advancing age increases non-communicable disease(diabetes inclusive) risk.[30,31]. The higher mean systolic blood pressure (161vs 151.6mmHg) in the reference study may suggest higher cardiovascular risk, including diabetes frequency amongst others [13-17,32,33]. Notably, there is a positive association between hypertension-related vascular impairment (which is more likely with uncontrolled hypertension), and incident diabetes mellitus[13-17]. Interestingly, a supporting study by the United States Preventive Services Task Force, (USPSTF), evidenced that, lowering blood pressure reduces the incidence of dysglycaemia [34].

### Associated factors for Dysglycaemia

Our study found the following significant associations with dysglycaemia (P<0.05), [Table 2]; Age, duration of hypertension in the previously known hypertensive subjects, body mass index, BMI, dyslipidaemia, (elevated total cholesterol, elevated low-density lipoprotein, partly reduced high-density lipoprotein), truncal obesity, family history of diabetes mellitus, thiazides and beta-blocker use in the treatment of hypertension in the previously known hypertensive patients.

### Age

The mean age in our study was slightly below 50 years, consistent with some studies that tested for dysglycaemia amongst hypertensive patients. After the age of 44 years, the chances of a hypertensive patient developing diabetes mellitus increases. This trend compares with that reported in a previous study from East Africa [26] but is inconsistent with earlier studies from Nigeria [29] and Europe [27]. This is due to the many physiologic changes that occur with time, age is a known risk factor for the development of type 2 diabetes mellitus[30,31].

### BMI and Dyslipidaemia

There was a significant association with BMI above 25, p=0.000. Similar findings of high BMI and older age as associations for dysglycaemia amongst hypertensive patients were reported in earlier studies from Europe [32], East Africa [26,] and Nigeria[9]. A study from Abuja suggested that the chances of hypertensive patients developing dysglycaemia increase with rising BMI, especially in those with elevated total cholesterol, and elevated low-density lipoprotein, whether newly diagnosed or previously known hypertensive patients[35]. Interestingly, elevated triglycerides and reduced low-density lipoprotein appear to be commoner among patients with longer duration of hypertension[35]. Notably, some of these features are

components of metabolic syndrome and may further emphasize the role duration plays in the development of dysglycaemia amongst hypertensive patients. However, while the others were true for our study, elevated triglycerides were not significantly related to dysglycaemia. This same pattern was seen in a related study by Onyegbutulem et al[35] in Abuja, suggesting that, elevated triglyceride may not be a strong risk association for dysglycaemia in this cohort of hypertensive patients in Abuja.

**Family History**

Our study showed that having a family history of diabetes mellitus increases the chances of dysglycaemia among hypertensive patients. Interestingly, similar findings have been reported by earlier studies involving black Africans[26] and elsewhere [36]. This may be partly explained by a possible genetic predisposition and environmental antecedents, with the expression of the 'common soil' hypothesis[37]. Among the newly diagnosed hypertensive patients, the association was surprisingly very weak, p=0.082. This may possibly be from the smaller sample size and limited documentation of family history in this group, a factor of health awareness.

**Duration of Hypertension**

There was a significant association between dysglycaemia and duration of hypertension in the previously known hypertensive patients in our study, p=0.000, table 2. The chances increased after five years of living with hypertension. This is consistent with available data suggesting that the longer the duration of hypertension, the likelihood for type 2 diabetes mellitus to develop or exist [38]. This may be explained partly by the suggestion that hypertension-related insulin resistance progressed with time, with advancing age, and got worse in treatment-experienced patients who used certain antihypertensives that have been shown to worsen insulin resistance and increase the risk for dysglycaemia [39,40].

**Truncal obesity**

We found a positive association between truncal obesity and dysglycaemia in our study groups. This is consistent with findings from an earlier study in Abuja[35]. Truncal obesity is a constant component of metabolic syndrome which may underline dysglycaemia. This may explain why the global increase in obesity prevalence in recent decades is associated with an increased prevalence of dysglycaemia[41]. Available literature points to chronic low-grade adipose tissue inflammation as being the mechanism behind this link [42,43]. This is because the infiltration of proinflammatory cells into adipose tissue, reduces adiponectin levels, a key insulin-sensitizing molecule[44].

**Thiazides and beta-blocker use**

There was a positive association between thiazide and beta-blocker use with dysglycaemia in our study. This is consistent with previous findings which suggested worsened insulin resistance with the use of this antihypertensive drugs [39,40]. This calls for increased surveillance for dysglycaemia in hypertensive patients treated with these drugs.

## Conclusion

A good number of hypertensive patients in Abuja have concomitant dysglycaemia that appears hidden. This can only be known if patients enrolled for hypertension treatment get their glycaemic profiles checked. Bearing in mind the associated factors for dysglycaemia and using a targeted screening approach will help determine the glycaemic status of these patients and offer both patients and healthcare providers an opportunity to modify this long-term risk through appropriate interventions before complications occur.

## Study Limitations

Our study had some limitations. Physical activity data, and tobacco and alcohol consumption information were sparsely documented so were left out of this analysis. These are social-related risk factors that could have given this study added value. We used blood sugar rather than glycated hemoglobin which is more sensitive but sparsely documented. This may have introduced some form of bias. However, the study

successfully exhibited some key information and relationships that would sensitize healthcare workers to screen for dysglycaemia in hypertensive patients at the entry point for care.

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