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Prevalence of Diabetes And Unrecognized Diabetes in Hypertensive Patients.

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Abstract: This study aimed to assess the prevalence of diabetes and unrecognized diabetes in hypertensive patients aged 40 to 79 years in Kaduna metropolis of Nigeria. From December 2016 to May 2017, a cross-sectional survey was conducted in 2021 hypertensive patients aged 40 to 79 years living in Kaduna North, Kaduna South and Igebi LGA of Kaduna state. Fasting plasma glucose (FPG) and 2h plasma glucose (2-hPG) in an oral glucose-tolerance test (OGTT) were used for assessments. Whether the patients previously had diabetes mellitus (DM) was determined by their own reports. The survey was carried out by the same questionnaire for all respondents. DM prevalence was 32.0% in hypertensive patients aged 40 to 79 years in Kaduna metropolis, with the rates of 29.6% and 33.5% in men and women, respectively (P<0.001). DM prevalence increased with age and body-mass index. DM prevalence rates were 16.9%, 24.7%, 38.2% and 41.9% in hypertensive patients aged 40–49, 50–59, 60–69 and over 70, respectively. DM prevalence were 30.6%, 27.9%, 37.1%, and 37.4%, for BMI<18.5, 18.5–24.9, 25.0–29.9, and ≥30, respectively. Prevalence of unrecognized DM were 20.8% in hypertensive patients aged 40 to 79 years in Kaduna which was noted to be high. Using only fasting blood glucose testing without OGTT would have resulted in 65.0% of missed DM diagnosis in these newly diagnosed patients. These findings indicate that hypertensive patients aged 40 to 79 years should regularly submit to community-based OGTT screening for timely DM diagnosis.

Keywords: Diabetes, hypertensive, diabetes mellitus, oral glucose-tolerance and fasting plasma glucose.

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I. INTRODUCTION

Cardiovascular disease (CVD) is a class of diseases that involve the heart or blood (Abbott et al, 2014). Cardiovascular disease includes coronary artery diseases (CAD) such as angina and myocardial infarction (commonly known as a heart attack). Other CVDs include stroke, heart failure, hypertensive heart disease, rheumatic heart disease, cardiomyopathy, heart arrhythmia, congenital heart disease, valvular heart disease, carditis, aortic aneurysms, peripheral artery disease and venous thrombosis (Berger et al, 2011 ; Abbott et al, 2014). The underlying mechanisms vary depending on the disease in question. Coronary artery disease, stroke, and peripheral artery disease involve atherosclerosis. This may be caused by high blood pressure, smoking, diabetes, lack of exercise, obesity, high blood cholesterol, poor diet, and excessive alcohol consumption, among others. High blood pressure results in 13% of CVD deaths, while tobacco results in 9%, diabetes 6%, lack of exercise 6% and obesity 5%. Rheumatic heart disease may follow untreated strep throat (Berger et al, 2011). It is estimated that 90% of CVD is preventable (Astrup et al, 2011). Prevention of atherosclerosis involves improving risk factors through: healthy eating, exercise, avoidance of tobacco smoke and limiting alcohol intake (Abbott et al, 2014). Treating risk factors, such as high blood pressure, blood lipids and diabetes is also beneficial (Abbott et al, 2014). Treating people who have strep throat with antibiotics can decrease the risk of rheumatic heart disease (Chowdhury et al, 2014) .

Cardiovascular diseases are the leading cause of death globally (Finegold et al, 2012). This is true in all areas of the world (Abbott et al, 2014). Together they resulted in 17.9 million deaths (32.1%) in 2015 up from 12.3 million (25.8%) in 1990 (Anderson et al, 2001; Farwell et al, 2004). Deaths, at a given age, from CVD are more common and have been increasing in much of the developing world, while rates have declined in most of the developed world since the 1970s (Dickinson et al, 2006). Coronary artery disease and stroke account for 80% of CVD deaths in males and 75% of CVD deaths in females (Fortmann et al, 2013). Most cardiovascular disease affects older adults. In the United States 11% of people between 20 and 40 have CVD, while 37% between 40 and 60, 71% of people between 60 and 80, and 85% of people over 80 have CVD (Astrup et al, 2011). The average age of death from coronary artery disease in the developed world is around 80 while it is

around 68 in the developing world (Remig et al, 2010). Disease onset is typically seven to ten years earlier in men as compared to women (Jani et al, 2006).

Hypertension is a common chronic disease, and a major risk factor for cardiovascular diseases. It greatly increases the risk of stroke, myocardial infarction, heart failure, and chronic kidney disease (Abbott et al, 2014). In Nigeria, the prevalence of hypertension in adults over 20 years of age is 26.6%, with about 32 million individuals suffering from high blood pressure (Fortmann et al, 2013). As another risk factor for cardiovascular diseases, Diabetes mellitus (DM) is highly prevalent in Nigeria. Indeed, 9.7% of adults over 20 years have DM, that is 12 million Nigerian (Kvan et al, 2007). Cardiovascular disease prevention and control faces huge challenges. If hypertensive patients also have DM, the occurrence and development of atherosclerosis might be accelerated. Specifically, the risk of cardiovascular diseases in hypertensive patients with DM is at least twice than patients only suffering from hypertension (Astrup et al, 2011). In addition, it is harder to control blood pressure in hypertensive patients with DM than those without DM. Three antihypertensive drugs are often needed for hypertensive patients with DM (Jan et al, 2017). Thus, early diagnosis and intervention of DM in hypertensive patients are of great significance.

In Nigeria, epidemiological studies assessing the prevalence of DM in hypertensive population are scarce. (Berger et al, 2009) reported the prevalence of DM, based on fasting plasma glucose (FPG) alone, in hypertensive patients aged 45–75 years was 13.2% in Lianyungang, a city in eastern China (Kvan et al, 2007). Obviously, this number may not reflect the true prevalence of DM in hypertensive patients because 2-h plasma glucose (2-hPG) in an oral glucose tolerance test (OGTT) was not carried out. Hence, diabetic patients only showing postprandial hyperglycemia were left unrecognized. We therefore carried out the present epidemiological survey to assess hypertensive patients aged 40–79 years in the urban areas of Kaduna northern Nigeria. FPG combined with OGTT 2-hPG were used to assess patients' glucose status. This analysis of the epidemiological status of DM in hypertensive individuals provides a knowledge base for better implementation of prevention and control of cardiovascular diseases in Nigeria, the largest developing country (Dickinson et al, 2006).

II. LITERATURE REVIEW

There is a strong correlation between diabetes and mental illness. Abbott et al, (2014) stated that diabetes mellitus is more common among individuals with schizophrenia and schizoaffective disorders than in the general population. For bipolar disorder, Kwok et al, (2014) reported a higher overall frequency of diabetes mellitus in hospitalized patients diagnosed with bipolar disorder than the general population. They stated that the association between bipolar and diabetes is clinically relevant and underscores the importance of screening for diabetes in the bipolar population. As well, in their review of the literature, Astrup et al, (2011) found that individuals with diabetes were twice as likely to have depression when compared to individuals in the same setting without diabetes. Astrup et al, (2011). also found that the reported rates of depression were approximately two to three times higher in studies that used self-report measures compared with studies using diagnostic interviews.

There is a proven link between the use of antipsychotic medication and the development of diabetes in mental health patients (Kvan, 2007; Dickinson et al, 2006; Abb0tt, 2014; Logan et al., 2007; and Norhammar et al., 2004). Jee (2002) found that olanzapine was found to be a statistically significant risk factor for the development of diabetes. They suggested that new onset diabetes associated with olanzapine is not caused by weight gain but by an effect of the atypical antipsychotic on metabolism. Nordmann et al. (2011) found that the strongest association between antipsychotics and diabetes was seen with clozapine, phenothiazines, thioxanthines, sulpiride, and haloperidol. They found diabetes was more prevalent among patients treated with antipsychotics (11.1%) compared to patients not on antipsychotics (4.4%), and that the prevalence of diabetes was higher among recipients of antipsychotics in younger age groups. However, contrary to previous studies, Nordmann et al, (2011) found that although both typical and atypical antipsychotic medications were associated with an increased prevalence of diabetes, the association between mental illness and diabetes was higher with typical antipsychotics as compared to atypical antipsychotics. Obarzanek et al, (2001) recommended from their study that patients with schizophrenia be monitored for the occurrence of diabetes regularly regardless of antipsychotic class.

It is unclear what the linkage is between diabetes and depression. Astrup et al. (2011) found that the severity of the diabetes increased the risk for depression. They also noted that the prevalence of depression was higher in individuals with uncontrolled diabetes compared with those who had controlled diabetes. Linden et al, (1996) found that improved mental health was related to improved medical outcome for diabetic patients, while Lavigne et al, (2013) suggested that mental health care workers should consider educating patients in order to prevent diabetes and to manage weight gain. Although they recognize the strong correlation between diabetes and depression, Mukamal et al, (2010) stated that type 2 diabetes does not increase the risk of depression and

that both diabetic and non-diabetic patients had similar incidents of new onset depression. They stated that patients with comorbid conditions in addition to diabetes, such as stroke or peripheral arterial disease, place individuals at increased risk of depression. As well, Jee et al, (2002) stated that they found no association between depressive symptoms and glucose investigation to determine whether patients with newly diagnosed diabetes would benefit from screening for the development of depression, and vice versa. Remig et al, (2010) looked at the relationship between diabetes and depression in an overview of the literature. They found there was support of depression as a result of diabetes, as well as depression as a precursor to diabetes, and suggest the relationship may be bidirectional. Pelliccia et al, (2014) in their review of the literature found that there is emerging data that suggest the association between diabetes and depression is in fact bidirectional, and that it cannot be conclusively said whether the higher rate of depression in diabetic patients is due to an increased rate of depression in patients with diabetes, or an increased rate of diabetes in patients with depression.

Several studies described the link between depression and non-adherence to diabetic treatment. Siri-Tarino et al, (2010) conducted a limited study which showed that individuals with medium to high severity depressive symptoms were less likely to adhere to a dietary treatment of diabetes and that high severity depressive symptoms were associated with a greater percentage of interruptions in the use of oral hypoglycemic therapy. Thompson et al, (2013) found that patients with diabetes and persistent or worsening depressive symptoms over a five year period showed significantly worse adherence to dietary and exercise regimens than patients without depression. Mukamal et al (2010) agree that the coexistence of diabetes and depression is associated with decreased adherence to treatment, however in a subsequent study Mukamal (2010) found that measures of metabolic control did not differ significantly between depressed and non-depressed patients. Pelliccia et al, (2014) in a study of male veterans found that participants were most likely to have poor adherence to their diabetic medication regimen as compared to their mental health medication regimen. Dickinson et al, (2006) state that recognizing cognitive deficits in patients may be important in the development of specialized education programs for individuals with mental illness. They found that the mean diabetes knowledge score was lower among participants with schizophrenia than among those with mood disorders, and that the score was associated with education levels. The study showed that the knowledge scores of individuals with schizophrenia were lower than those of individuals with type 2 diabetes in the general population.

There is evidence of lower quality of diabetic care for those with serious mental illnesses. Te morenga et al, (2014) found that individuals with mental illness received fewer services and less education regarding diabetes from health care providers than those without mental illness. Vanhecke et al, (2006) stated that individuals with diabetes and mental illnesses were significantly less likely to be hospitalized for diabetes after presenting in the emergency department than were those without mental illness. They found that patients with depression and anxiety were more likely not to be admitted than those with psychotic disorders. Patients with comorbid psychiatric disorders which influence some aspects of their self-reports of quality of life may be misunderstood by clinicians who use this information to guide therapeutic decisions (Wei et al., 2014). For patients with schizophrenia, Abbott (2014) found that the social and economic consequences of their mental illness interfered with the ability to access the resources for associated with significantly increased health costs (Mukamal, 2010; Jan, 2017; and Willett et al, 2012).

There is consensus that when treating diabetes, treatment of mental illness should be a priority for patients (Abbott, 2014; Remig et al., 2010; Kvan et al., 2007). Linden et al. suggest that prompt treatment of depression may prevent the progression of mood to suicidality and may reduce the burden of long-term diabetes related complications. In a retrospective study Kwok (2014) found that 31% of patients with comorbid diabetes and depression received adequate treatment for depression. Comorbid mental disorders are found to be associated with lowered quality of life for individuals with diabetes (Mukamal, 2010; Fortmann et al, 2013; Pelliccia et al., 2014; Jani et al, 2006). Thompson et al, (2013) found that the highest quality of life scores are experienced by those without diabetes and without depression, and the lowest quality of life scores are those with diabetes and depression. Willett et al. (2012) suggest that more effort needs to be made in order to provide optimal care for diabetics with a mental illness.

Patients with depression and diabetes are at increased risk for developing comorbid conditions. In their work with individuals with bipolar, Chowdhury et al, (2014) stated that early detection and control of diabetes is important for the prevention of medical comorbidity of diabetes and for the prevention of cerebral micro vascular disease that may exacerbate the course of bipolar disorder. Co morbid illness such as hypertension, cardiovascular risks, hyperlipidemia, and obesity occurred more frequently in patients with diabetes and depression than in those with diabetes alone (Obarzanek et al., 2001; Norhammar et al., 2004; WHO, 2007). Wei, Remig and Jee estimate that cardiovascular disease is two to three times higher in individuals with serious mental illness and they die ten to fifteen years earlier than the general population. The coexistence of diabetes and depression alone is also associated with an increased risk of death (Mukamal et al, 2010; Jani et al, 2006; Kvan et al, 2007).

III. METHODOLOGY

3.1 Study subjects

This was a cross-sectional survey conducted in hypertensive individuals. This survey was conducted in urban communities in Kaduna city of nigeria, using a multi-stage stratified sampling method. In the first phase, Kakuri, TudunWada and Rigasa districts were randomly selected in the urban area of Kaduna North, Kaduna south and Igebi LGA.. In the second phase, a random sub-district was selected in each district. In the third stage, one community was randomly selected in each sub-district, total of five random communities were selected.

3.2 Selection criteria

Inclusion criteria for the study were: (1) more than 5 years of residence in the community; (2) 40–79 years old; (3) systolic blood pressure (SBP)≥140 mmHg and /or diastolic blood pressure (DBP)≥90 mmHg, and /or diagnosis of hypertension and currently under antihypertensive treatment. Exclusion criteria were mental illness, renal insufficiency requiring dialysis, and end-stage cancer. Patients declining study participation were also excluded. Based on the above inclusion and exclusion criteria, 2836 hypertensive patients were enrolled, of which 2478 participated in the study from December 2016 to May 2017. Due to missing demographic information or blood glucose data, 457 patients were excluded. Thus, 2021 patients were included in the final analysis.

3.3Data collection

More than 20 investigators were trained for data collection. All subjects filled the same oral questionnaire, which included demographic characteristics, lifestyle risk factors, personal and family history, according to the cardiovascular survey methods of world health organization(WHO) (2007). The questionnaire also included height, weight, waist circumference, and blood pressure. When measuring the height and weight, the subject needed to be barefoot and take off any hat, wearing only lightweight clothes. Body-mass index (BMI) was calculated as weight (kg) by height (in meters) squared.

3.4Blood sample collection and laboratory tests

Venous blood was drawn after 12 hours fasting. Patients without a history of DM were submitted to OGTT: 75 g of glucose dissolved in 300 ml of warm water was administered orally and within five minutes, venous blood was drawn 2 hour later (2-hPG). All blood samples were sent to the Clinical Laboratories Center of Yusufu Dansoho Specialist Hospital and Nursing Home Specialist Hospital in kaduna metropolis. Both laboratories are up-to-date with the national standards. Blood glucose, lipids and uric acid were assessed in all blood samples. Blood glucose amounts were detected by enzymatic method. Serum uric acid was measured by the phosphotungstic acid method on an automatic biochemical analyzer.

3.5 Diagnosis standards

According to the US JNC-7 (Nordmann et al, 2011) standard, high blood pressure was defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg, and/or being diagnosed with hypertension and currently under antihypertensive drug treatment]. DM was defined as FPG level ≥7.0 mmol/L, 2-hPG level ≥11.1 mmol/L, or with a previous clinical diagnosis. Overweight was defined as a body-mass index between 25.0 and 29.9, Obesity was defined as a body-mass index of 30.0 or more. Family history of hypertension was defined as immediate family members (grandparents, parents, or sibling) having hypertension. Family history of DM was defined as immediate family members (grandparents, parents, or sibling) having DM. Physical exercise was defined as having at least one exercise session per week.

3.6 Sample size estimation

There are a lack of data for prevalence of DM among Kaduna hypertensive patients of communities, thus, we calculated sample size based on prevalence of 18% for DM in the population aged 40–79 years in Tudun Wada (Kaduna North). If the prevalence of DM were 18%, the estimated sample size was 893, the actual sample size in the study was 2021.

3.7 Statistical analysis

The Epidata3.1 software was used to double input data and ensure their quality. Data processing and analysis were carried out with the SPSS software . Qualitative data were compared by χ^2 test, and quantitative data by one sample t-test or Wilcoxon rank sum test. The χ^2 linear trend test was used to detect the trend of DM prevalence in middle-aged and older hypertensive individuals, in association with age and BMI. The regression was used to explore the potential risk factor. $P<0.05$ was treated as significance.

4.0 Analysis And Results

4.1 Baseline characteristics of subjects

This study totally included 2021 Kaduna hypertensive individuals, of 40 to 79 years old. Among them, 79.6% had little school education or none. Of the 2021 hypertensive patients, 647 (32.0%) had DM. The prevalence of DM was 29.6% in men and 33.5% in women (*P*<0.001). Interestingly, DM prevalence in hypertensive individuals gradually increased with age and BMI. See figure 1 below. (*P*<0.001).

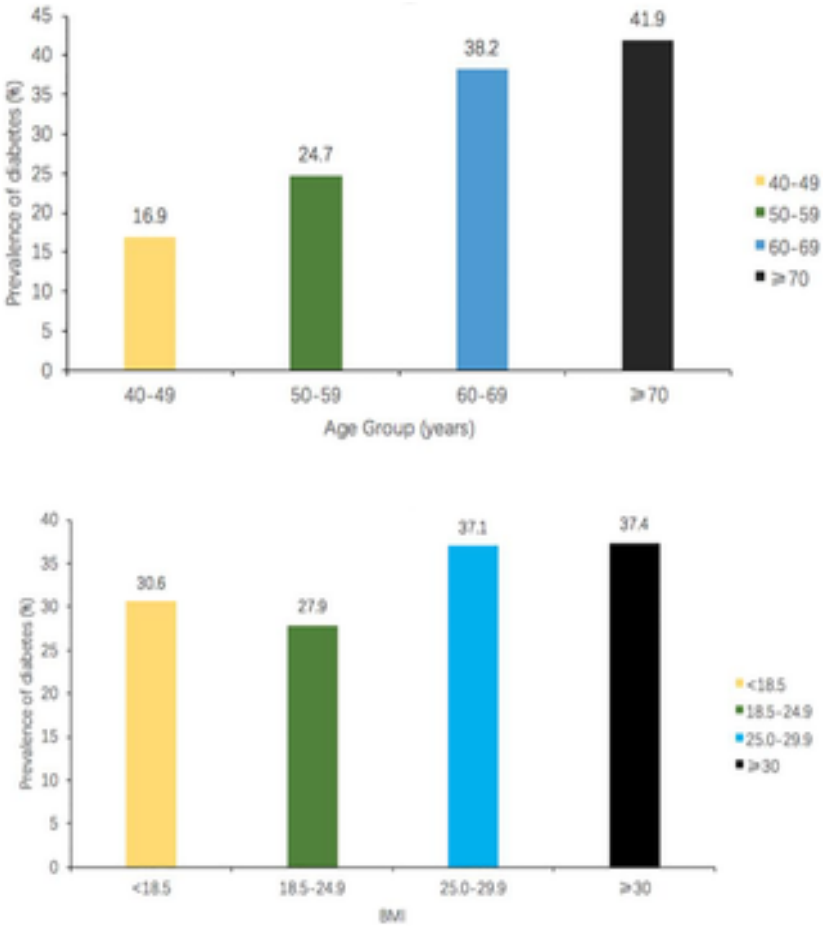

Fig 1. DM prevalence in hypertensive patients aged 40 to 79 years gradually increased with age and BMI. Of the 647 (32.0%) diabetic patients, 227 (11.2%) had been previously diagnosed, and 421 (20.8%) were newly diagnosed. In other words, the prevalence of unrecognized DM in hypertensive patients aged 40 to 79 years in Kaduna metropolis were 20.8%. Unrecognized DM cases accounted for 65.1% (421/647) of all patients with DM. Among patients less than 50 years old, 89.5% of diabetic patients were newly diagnosed. The ratio of newly diagnosed DM cases decreased with age (*P* value for linear trend <0.01). For patients over 70, the ratio of newly diagnosed DM cases was 55.4%.

Among the newly diagnosed DM patients, only 35.0% would have been diagnosed if only fasting glucose levels were measured. 36.4% and 32.4% in females and males, respectively. These findings indicated that DM diagnosis rates were low (about 29.4–42.7% for all age groups) when fasting glucose tests only were carried out. In newly DM diagnosed cases, 86.7% patients would have been found if only 2-hPG was used. Consequently, undiagnosed rate was relatively low using the latter assay. In both sex and age groups, DM diagnosis rates were high (all above 80 percent), using only 2-hPG for detection. See table 1 below. Chi-square tests for both gender and age are highly significant. Which means the prevalence of DM in Kaduna Metropolis are based on gender and age (Chi-square value for gender and age are 0.157, 0.199 respectively) see table2 and 3. P<(0.001).

Table 1: Detection rates of newly diagnosed diabetes in hypertensive populations using two different methods

	Newly diagnosed	Using FPG	Using 2=hPG
Total	421	147 (35%)	365 (86.7%)
Gender			
Male	147 (32.4%)	48 (32.4%)	124 (84.6%)
Female	274 (36.4%)	100 (36.4%)	227 (82.9%)
Age group			
<50	34 (8.1%)	14 (39.7%)	31 (89.7%)
50-59	125 29.6%)	53 (42.7%)	104 (83.5%)
60-69	161 (38.2%)	55 (34.1%)	144 (89.4%)
>70	101 (24.0%)	26 (25.4%)	86 (85%)

Table 2 **Crosstab**

Count

		FPG		Total
		48	100	
GENDER	Female	0	1	1
	Male	1	0	1
Total		1	1	2

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.000[a]	1	.157		
Continuity Correction[b]	.000	1	1.000		
Likelihood Ratio	2.773	1	.096		
Fisher's Exact Test				1.000	.500
N of Valid Cases	2				

a. 4 cells (100.0%) have expected count less than 5. The minimum expected count is .50.

b. Computed only for a 2x2 table

Table 3 Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	6.000[a]	4	.199
Likelihood Ratio	6.592	4	.159
Linear-by-Linear Association	1.774	1	.183
N of Valid Cases	3		

a. 9 cells (100.0%) have expected count less than 5. The minimum expected count is .33.

The Analysis of variance for regression estimate has really show how insignificant the coefficients are in terms of prediction of DM rate in Kaduna Metropolis (ANOVA value is 0.000) see the two tables below. P<(0.01).

ANOVA[a]

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	12309.268	1	12309.268	224.490	.000[b]
	Residual	274.161	5	54.832		

	Total	12583.429	6			
a. Dependent Variable: FPG						
b. Predictors: (Constant), OGTT						

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	-.084	5.072		-.017	.987	-13.121	12.953
	OGTT	.410	.027	.989	14.983	.000	.340	.481
a. Dependent Variable: FPG								

IV. DISCUSSION

From 2016 to 2017, a cross-sectional survey was carried out in hypertensive populations aged 40 to 79 years in the city of Kaduna and the investigation found DM prevalence was 32.0%. These findings suggested that approximately one-in-three hypertensive patients aged 40 to 79 years are diabetics. The DM prevalence in Kaduna hypertensive patients aged 40 to 79 years was high.. A higher DM prevalence for women aged 40 to 79 years was obtained in comparison with male counterparts, suggesting that women with hypertension more easily develop into DM. With increasing age, DM prevalence increased gradually. Nearly two-fifths of hypertensive individuals between 60 and 69 years of age suffered from DM, and the situation was worse between 70 to 79 years, more than two-fifths of hypertensive individuals suffered from DM. With increasing BMI, DM prevalence also tended to increase gradually. As shown above, DM diagnosis rate of 35% was obtained in hypertensive populations aged 40 to 79 years using FPG; while diagnosed rate for OGTTwas 87%. It means that people with hypertension aged 40 to 79 years in Kaduna metropolis, more than half of them would have been tested wrongly of absent of DM.

V. CONCLUSION

Our findings indicate that most diabetic patients of community were not timely recognized, especially the relatively young patients. Compared with outpatients, the prevalence of unrecognized DM in hypertensive patients may be higher (65.1%). It is very important to enforce DM screening in Kadunan hypertension patients of broad community. The studies showed that nearly half (or even more) of individuals would be diagnosed while relying on 2-hpG levels. The current study found that relying solely on fasting glucose yielded 35% of new DM diagnoses. Meanwhile, 65% of newly diagnosed DM were detected based on 2-hPG levels, indicating that nearly two-thirds of new DM diagnoses rely on 2-hpG among hypertensive patients aged 40 to 79 years. At present, some Kaduna urban community health service institutions routinely check FPG for middle-aged and elderly people, with postprandial blood glucose often overlooked. Although some DM cases are detected this way, it may yield a high proportion of undiagnosed DM. We found that most new DM cases would be missed if only fasting blood glucose test is performed in hypertensive patients, and 2-hpG level detection for DM diagnosis may have a better value compared with fasting glucose.

Kaduna doctors often assess hypertensive outpatients only for fasting glucose levels, missing an important fraction of diabetic patients. We recommend that hypertensive patients aged 40 to 79 years should regularly submit to OGTT for timely detection of DM. The current study in communities showed that more than one-third of hypertensive patients aged 60 years and above suffer from DM. Therefore, elderly people with hypertension should be the focus of screening.

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