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(RESEARCH ARTICLE)

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Metabolic syndrome risk scores and their correlates amongst hypertensive patients attending university of Port Harcourt teaching hospital

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Abstract

Hypertension is one of the leading causes of premature morbidity and mortality. It is largely asymptomatic, often undetected and only detected through opportunistic screening. This study assessed the metabolic syndrome risk scores and their correlates amongst hypertensive patients attending University of Port Harcourt Teaching Hospital, Port Harcourt. Nigeria. The study adopted a cross-sectional study design involving a total of 76 hypertensive patients. Data were collected using structured self-administered questionnaire, anthropometric records, biochemical analyses and review of associated medical records. The results recorded more females (65.8%) than males (34.2%), mean age of participants was 55.3 ± 10.8 year. Assessment of lifestyle characteristics revealed 15.8% were smokers, 81.6% consumed alcohol and 39.5% were physically active. The prevalence of metabolic syndrome was 64.5%; satisfying at least three of the four National Cholesterol Education Program – Adult Treatment Panel III (NCEP-ATP III) criteria framework. The mean HbA1c value was 6.83 ± 1.34% and Glycaemic index results of dysglycaemia in this population showed 58.2% and 55.3% based on Fasting Plasma Glucose and Glycated Haemoglobin (HbA1c) assay respectively. Lipid profile results showed 51.3% of participants exhibited low High-Density Lipoprotein (HDL) levels; 46.1% elevated triglycerides (TG) levels; 43.4% abnormal Low-Density Lipoprotein (LDL) and 39.5% Total Cholesterol (TC) levels. A chi-square analysis comparing sex revealed a higher occurrence among female subjects (66.0%) compared to male (61.5%), (χ^2 = 0.09, p = 0.766). These biochemical evaluations served to identify those subjects who are at risk based on co-morbidities and support risk profiling of patients thereby facilitating tailored management and treatment.

Keywords: Hypertension; Cardiovascular; Metabolic Syndrome; Dyslipidaemia; Dysglycaemia

1. Introduction

A number of cardiovascular risk factors are grouped together to form Metabolic Syndrome (MetS). It is a general term for the group of interconnected metabolic risk variables that seem to directly contribute to the development of atherosclerotic cardiovascular disease (Okafor, 2012).

Abdominal obesity, dysglycaemia, hypertension (HTN), and dyslipidaemia are components of the metabolic syndrome, which has been linked to an elevated risk of cardiovascular diseases (CVDs), diabetes mellitus (DM), and other co-morbidities. An individual's overall cardiovascular risk is increased when hypertension is linked to dyslipidaemia, obesity, and dysglycaemia (together referred to as MetS) (Silviu et al., 2023).

The condition known as hypertension (HTN), sometimes referred to as high blood pressure or elevated blood pressure, is characterized by chronically elevated blood vessel pressure. The blood vessels (vascular system) transport blood from the heart to every organ of the body. A serious non-communicable disease that causes considerable morbidity and mortality, hypertension is a global health concern. Reducing the prevalence of hypertension by 33% between 2010 and

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2030 is one of the global goals for non-communicable diseases. Worldwide, an estimated 1.28 billion persons between the ages of 30 and 79 have hypertension, with the majority (two-thirds) residing in low- and middle-income nations (WHO, 2024).

Due in large part to elevated risk factors in those populations in recent decades, the burden of HTN is disproportionately felt in low- and middle-income countries, where two thirds of cases are found (WHO, 2024). Like most African nations, Nigeria has seen a steady rise in the prevalence of HTN as a result of rapid urbanization, unhealthy lifestyle changes, and a decline in the prevalence of infectious diseases. It gradually rose from 10.1–13.3% in late 1960 to 38.8–44.5% in Nigeria. Nigeria had 20 million cases in 2010; by 2030, that number is expected to increase to 39.1 million (Oluwafisayo et al., 2020).

The development of HTN is influenced by behavioral, environmental, and genetic variables. Additionally, intricate relationships between hormones, regional vascular variables, and brain processes are important (Vijatha et al., 2014). The most significant behavioral risk factors for heart disease and stroke are poor nutrition, physical inactivity, tobacco use, and excessive alcohol consumption. Air pollution is a significant environmental risk factor. These intermediate risk factors, which show a higher risk of heart attack, stroke, heart failure, and other consequences, can be assessed in primary care settings (WHO, 2024).

Another major component of MetS is obesity, which is commonly defined as an accumulation of excess body fat that shows up as an increase in weight or waist circumference. Insulin resistance is frequently associated with it (Okafor, 2012). Lack of physical exercise and an unbalanced energy intake (diet) lead to overweight and obesity. It is impossible to overlook the financial effects of obesity. Overweight and obesity are expected to cost the world $3 trillion annually by 2030 and over $18 trillion by 2060 (WHO, 2024). In addition to having a negative impact on children's and teenagers' immediate health, being overweight increases the risk of developing a number of non-communicable diseases, including Type-2 diabetes and cardiovascular disorders (WHO, 2024).

The term "dysglycaemia" refers to the aberration in blood sugar stability and includes both Type-2 diabetes mellitus (T2DM) and impaired glucose tolerance (IGT). Hypoglycaemia (low blood sugar) and hyperglycaemia (high blood sugar) are two examples of this. The pancreas produces the hormone insulin, which controls blood sugar levels. When hypertension and/or dyslipidaemia are present, the detrimental effects of dysglycaemia are more noticeable. Therefore, it is crucial to check for dysglycaemia in patients receiving treatment for dyslipidaemia and/or hypertension (Shahim, 2018).

Abnormal levels of plasma lipids, particularly high-density lipoprotein, low-density lipoprotein, and triglycerides, are referred to as dyslipidemia. Low-Density Lipoproteins are vulnerable to oxidation and glycation due to these abnormalities, which can lead to foam cell formation, endothelial dysfunction, and ultimately atherosclerosis. Conversely, the consequences of High-Density Lipoproteins are known to play significant roles in the development and progression of atherosclerosis (Chijioke et al., 2021). Reduced HDL and hypertriglyceridemia are the two most common dyslipidaemias linked to MetS. According to Okafor (2012), hypertriglyceridaemia is rare in Nigeria, although dyslipidaemia presents as decreased HDL.

Equally, the most prevalent non-communicable diseases that are strongly associated with metabolic syndrome include dysglycaemia, obesity, and dyslipidaemia, which are cardiovascular risks frequent among hypertension patients. Patients with diabetes mellitus frequently have mixed dyslipidemia, which is characterized by increased LDL and low HDL. Secondary dyslipidaemia, which is brought on by diseases like obesity and type 2 diabetes, is the reason of this association.

Similarly, dysglycaemia and hypertension are significant risk factors for atherosclerotic cardiovascular disease (ASCVD). More than 80% of all fatalities and disabilities in low- and middle-income countries are caused by ASCVD, which also causes significant financial loss and burdens individuals, families, and governments as a whole (Oluwafisayo et al., 2020).

Additionally, when dysglycaemia, dyslipidaemia, and hypertension co-exist, the metabolic syndrome risk profile and cardiovascular-related mortality increase dramatically (Uloko et al., 2018). Patients with hypertension have undiscovered cases of diabetes mellitus, and the majority of those who receive a new diagnosis are not well-informed (Chijioke et al., 2021).

As a result, many people with hypertension do not have symptoms and may not be aware that they have an issue. Early morning headaches, nosebleeds, abnormal heartbeats, changes in vision, and buzzing in the ears are other symptoms. Fatigue, nausea, vomiting, disorientation, anxiety, chest pain, and tremors in the muscles are symptoms of more severe versions. Untreated hypertension can result in heart attacks, heart failure, persistent chest pain (also known as angina), irregular heartbeats, and even sudden death. Additionally, it can cause kidney damage, which can result in renal failure, and strokes by obstructing or rupturing arteries that carry blood and oxygen to the brain (WHO, 2024).

The goal of the current study is to examine the metabolic syndrome risk scores and their associations among hypertensive patients who visit the University of Port Harcourt Teaching Hospital (UPTH) in Rivers State, Nigeria. Understanding the epidemiology of hypertension can have a significant impact on the development and application of prevention, control, and management techniques meant to lessen the burden of these disorders, as this group represents a crucial high-risk population.

2. Materials and methods

2.1. Study Design

The study adopted a cross-sectional study design with the primary objective of determining the prevalence of metabolic syndrome and their correlates and exploring the casual effects with associated factors among a specific population – hypertensive patients attending University of Port Harcourt Teaching Hospital (UPTH) situated in Port Harcourt, Rivers State, Nigeria.

2.2. Study Area

This study was conducted at the University of Port Harcourt Teaching Hospital (UPTH) Choba, located in Port Harcourt, Rivers State Nigeria and run by the Federal Government of Nigeria. UPTH is a prominent tertiary health institution in the Niger Delta region, known for quality healthcare.

2.3. Study Population

This study focused on hypertensive patients attending UPTH for their Medicare, between the ages of 27 and 83, who came from diverse ethnic group to represent diverse geographic origins in Nigeria with many residing within Rivers State.

2.4. Study Tools

Data were collected using the following tools:

- Socio-demographic questionnaire: This captured data on variables like age, gender, ethnicity, parental education and occupation.
- Clinical questionnaire: This recorded clinical history like prior high blood sugar crisis, previous hospitalizations, family history, known comorbidities etc.
- Cardiovascular disease (CVD) Knowledge, Attitudes and Practices Questionnaire: Used to assess awareness and behaviour regarding cardiovascular risk diseases.
- Biochemical investigations: Packed Cell Volume (PCV), FPG, HbA1c, Lipid Profiling, etc.
- Anthropometry: Height, weight, blood pressure and body mass index determination (dividing weight in kilograms by height in meters squared)
- Review of associated medical record of subjects.

2.5. Sampling Technique

The multi-stage sampling technique employed for this study involves a systematic approach to ensure a comprehensive understanding of the hypertensive population. In the first stage, a stratified sampling method was applied, wherein the entire population was categorized into strata based on their respective departments. Following this, a proportional number of subjects were randomly selected from each stratum, taking into account the overall enrolment numbers within the department in UPTH. Thereafter, simple random sampling was employed to avoid bias.

3. Biochemical analysis

3.1. Lipid Profile Analysis

Total cholesterol (TC), high-density lipoprotein (HDL), low-density lipoprotein (LDL), and triglycerides (TG) are all measured by the lipid profile test. According to Onwuchekwa & Chinenye (2010), enzymatic colorimetric techniques were employed.

3.2. Total Cholesterol (TC) Measurement

Exactly 10 µL of serum was pipetted into a test tube and 1.0 mL of cholesterol reagent containing cholesterol esterase, cholesterol oxidase, peroxidase, and chromogen were added. The mixture was incubated at 37°C for 10 minutes and absorbance was measured at 500 nm using a spectrophotometer.

3.3. Triglyceride (TG) Measurement

Exactly 10 µL of serum was pipetted into a test tube and 1.0 mL of triglyceride reagent containing lipoprotein lipase, glycerol kinase, glycerol phosphate oxidase, and peroxidase were added. Incubation was done at 37°C was for 10 minutes and absorbance was measured at 500 nm.

3.4. High-Density Lipoprotein (HDL) Measurement

The low-density lipoprotein in serum (LDL and VLDL) were precipitated by adding a precipitating reagent to 100 µL of the sample. The mixture was centrifuged at 3,000 rpm for 10 minutes. The clear supernatant was used for HDL cholesterol measurement using the same enzymatic method as TC.

3.5. Low-Density Lipoprotein (LDL) Calculation

LDL was estimated by calculation using the Friedewald formula. This formula is only valid when TG is below 400 mg/dL.

3.6. Blood Glucose Analysis

Blood glucose was measured after a long fasting period using the glucose oxidase-peroxidase (GOD-POD) enzymatic method as reported by (Anas et al., 2016).

3.7. Plasma Glucose Determination

Exactly 10 µL of plasma was pipetted into a test tube and 1.0 mL of glucose reagent containing glucose oxidase, peroxidase, and chromogen were added. Incubation at 37 °C was for 10 minutes was done and absorbance was measured at 505 nm using a spectrophotometer.

3.8. Glycated Hemoglobin (HbA1c) Analysis

HbA1c was measured using an immunoturbidimetric assay as reported by (Chukwuonye et al., 2018).

Exactly 3 mL of venous blood was collected into an EDTA tube and the blood was gently mixed by inverting the tube several times.

3.9. Analysis (Immunoturbidimetric Assay Method)

Exactly 10 µL of whole blood was added to a reagent containing antibodies against glycated hemoglobin and the mixture was incubated at 37°C for 5 minutes. Absorbance was measured at 415 nm and the results were expressed as a percentage of total haemoglobin.

3.10. Data Analysis

All questionnaires were sorted and coded serially and the data was analyzed using SPSS version 20.0. Descriptive statistics such as mean, frequencies and percentage were calculated for demographic data and other categorical variables. Prevalence of the different hypertension was expressed as percentages.

Bivariate analysis using the Chi-square test was used to determine factors associated with hypertension. Continuous variables like clinical records and haematological records scores were compared using ANOVA or Kruskal Wallis.

Multiple logistic regression was used to determine independent predictors of hypertension by adjusting confounders. P-value < 0.05 was considered statistically significant.

4. Results

4.1. Socio-Demographic Distribution of the Study Population

This study included seventy-six (76) hypertensive patients from the University of Port Harcourt Teaching Hospital (UPTH), 26 were male (34.2%) and 50 were female (65.8%). Business owners made up the largest occupational subgroup (42.10%), followed by professionals or civil servants (34.21%). The percentages of unemployed people (10.53%), artisans/tradespeople (10.53%), and others (2.63%) were smaller. The UPTH catchment area's preponderance of self-employed and formally employed individuals is reflected in this distribution (Adeloye et al., 2021; WHO, 2024). The comparatively high percentage of people who live sedentary life or inactive points to behavioural habits that may increase the risk of metabolic and cardiovascular diseases (Adeloye et al., 2021).

Table 1 Socio-Demographic Characteristics of Study Participants (N = 76)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	26	34.21
	Female	50	65.79
Age group (years)	15–30	4	5.26
	31–45	10	13.16
	46–60	32	42.11
	61–75	26	34.21
	≥76	4	5.26
Marital status	Single	3	3.9
	Engaged	2	2.6
	Married	65	85.5
	Divorced	4	5.4
	Widowed	2	2.6
	Other	0	0.0
Educational level	Primary	8	10.53
	Secondary	32	42.10
	Tertiary	36	47.37
Occupation	Unemployed	8	10.53
	Farmer	0	0.00
	Artisan/Tradesperson	8	10.53
	Business Owner	32	42.10
	Professional/Civil Servant	26	34.21
	Other	2	2.63
Smoking habit	Yes	12	15.79
	No	64	84.21
Alcohol consumption	Yes	62	81.58
	No	14	18.42

Physical activity	Active	30	39.47
	Moderately active	26	34.21
	Sedentary	20	26.32

The majority of participants (42.11%) were in the 46–60 age range, as shown in Figure 1. Only 5.26% of people were between the ages of 15 and 30 and 76 or older, suggesting that middle-aged and elderly adults were more likely to have hypertension and accompanying metabolic consequences. The average age of the participants was 55.3 ± 10.8 years, indicating that the majority were in the middle-aged to older age range that is frequently linked to metabolic risk factors. This is consistent with the research done by Onwuchekwa & Chinenye (2010).

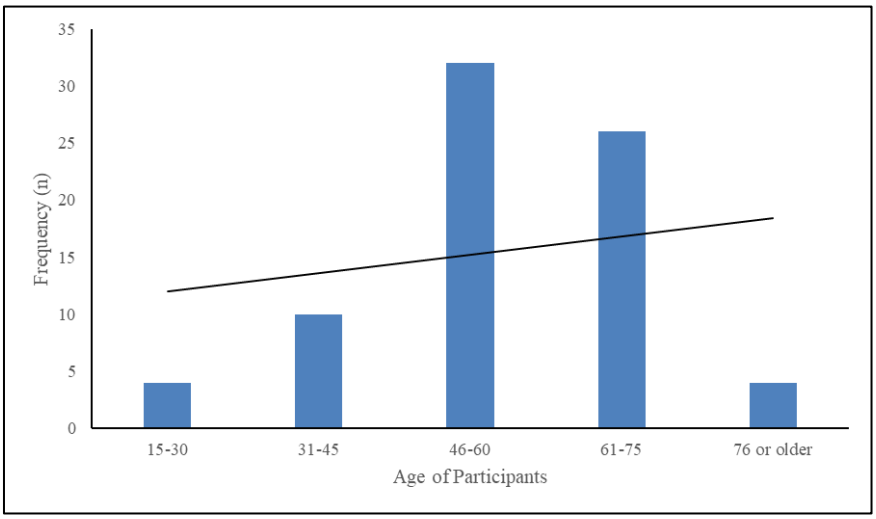

Figure 1 Age Distribution of Hypertensive Subjects Attending UPTH

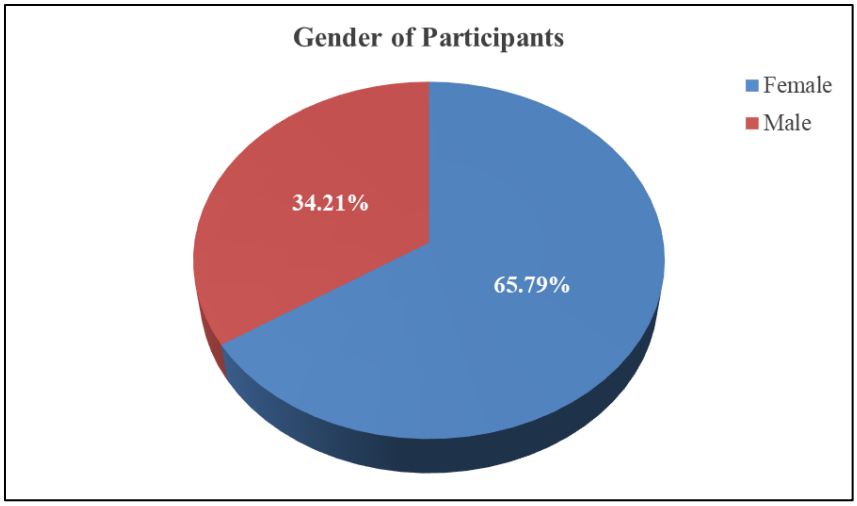

Figure 2 Gender Distribution of Hypertensive Subjects Attending UPTH

Figure 2 shows that females (65.79%) outnumbered males (34.21%), consistent with observed gender trends in outpatient hypertension clinics.

4.2. Evaluation of Dysglycaemia among Hypertensive Subjects Attending UPTH

Table 2 Glycaemic Parameters among Hypertensive Subjects Attending UPTH

Parameter	Mean ± SD	NR	NDS (n)	PDS (%)
Fasting Blood Glucose (FBG)	6.92 ± 1.85 mmol/L	<5.6 mmol/L	45	59.2
HbA1c	6.83 ± 1.34%	<5.7%	41	53.9

*SD = Standard Deviation; NR = Normal Range; NDS = Number of Dysglycaemic Subjects; PSD = Percentage of Subjects with Dysglycaemia

Table 2 above showed that 59.2% of hypertensive participants had dysglycaemia based on FBG, while 53.9% were dysglycaemic based on HbA1c.

Table 3 Classification of Glycaemic Status among Hypertensive Subjects Attending UPTH

Glycaemic Category	FBG (n, %)	HbA1c (n, %)
Normal	31 (40.79%)	34 (44.74%)
Prediabetic	22 (28.95%)	20 (26.31%)
Diabetic	23 (30.26%)	22 (28.95%)

*FPG = Fasting Plasma Glucose, HbA1c = Glycated Haemoglobin; ** Classification of Glycaemic Status Based on ADA (2023) cut-offs: Normal FBG: <5.6 mmol/L; Impaired FBG: 5.6–6.9 mmol/L; Diabetic FBG: ≥7.0 mmol/L; Normal HbA1c: <5.7%; Prediabetic HbA1c: 5.7–6.4%; Diabetic HbA1c: ≥6.5%

Table 3 specifically showed, 30.26% of participants had fasting glucose levels in the diabetic range and 28.95% were prediabetic. The mean HbA1c value of 6.83 ± 1.34% also reflects poor long-term glycaemic control in more than half of the participants.

4.3. Evaluation of Dyslipidaemia among Hypertensive Subjects Attending UPTH

Table 4 Lipid Profile among Hypertensive Subjects Attending UPTH

Lipid Parameter	Mean ± SD (mmol/L)	NR (mmol/L)	NAS (n)	% AS
TC	5.12 ± 0.97	<5.2	30	39.5
TG	1.73 ± 0.52	<1.7	35	46.1
HDL	1.09 ± 0.31	>1.0 (M), >1.3 (F)	39	51.3
LDL	3.48 ± 0.88	<3.4	33	43.4

*TC = Total Cholesterol; TG = Triglycerides; HDL = High Density Lipoprotein; LDL = Low Density Lipoprotein; SD = Standard Deviation; NR = Normal Range; AS = Abnormal Subjects; NAS = Number of Abnormal Subjects.

Table 4 revealed that 51.3% of participants exhibited low HDL levels, while 46.1% had elevated triglycerides. Abnormal LDL and TC levels were observed in 43.4% and 39.5% of participants, respectively. Overall, 53.9% of the participants met at least one criterion for dyslipidaemia.

Table 5 Comparison of Lipid Parameters among Hypertensive Subjects Attending UPTH

Lipid Parameter	Male (Mean ± SD)	Female (Mean ± SD)	t-value	p-value	Remark
TC (mmol/L)	5.08 ± 1.02	5.14 ± 0.94	0.26	0.794	NS
TG (mmol/L)	1.79 ± 0.49	1.69 ± 0.55	0.81	0.420	NS
HDL (mmol/L)	1.05 ± 0.29	1.11 ± 0.32	0.86	0.394	NS
LDL (mmol/L)	3.46 ± 0.84	3.49 ± 0.91	0.13	0.897	NS

*TC = Total Cholesterol; TG = Triglycerides; HDL = High Density Lipoprotein; LDL = Low Density Lipoprotein; SD = Standard Deviation; NS = Not significant

There were no statistically significant sex differences in lipid profile parameters ($p > 0.05$), suggesting a comparable lipid pattern among male and female hypertensive subjects at UPTH.

4.4. Prevalence of Metabolic Syndrome among Hypertensive Subjects Attending UPTH

The prevalence of metabolic syndrome (MetS) among hypertensive patients attending the University of Port Harcourt Teaching Hospital (UPTH) was evaluated based on the presence of four major metabolic abnormalities: Obesity, Dyslipidaemia, Dysglycaemia, and Hypertension, consistent with the National Cholesterol Education Program Adult Treatment Panel III (NCEP ATP III) framework.

Table 6 Prevalence of Metabolic Syndrome Components among Hypertensives Attending UPTH (N = 76)

Metabolic Component	Defining Criterion	Number of Participants (n)	Percentage (%)
Obesity	BMI ≥ 30 kg/m^2	47	61.8
Dysglycaemia	FBG ≥ 5.6 mmol/L or HbA1c ≥ 5.7%	45	59.2
Dyslipidaemia	TC ≥ 5.2 mmol/L, TG ≥ 1.7 mmol/L, HDL < 1.0 mmol/L (M) / <1.3 mmol/L (F), or LDL ≥ 3.4 mmol/L	41	53.9
Hypertension	BP ≥ 130/85 mmHg	76	100.0
Participants meeting ≥ 3 criteria (MetS present)	—	49	64.5

The prevalence of MetS was 64.5%. According to the NCEP-ATP III criteria, metabolic syndrome is present when an individual has at least three of these conditions; dyslipidaemia, dysglycaemia, obesity, hypertension.

4.5. Comparison of Metabolic Syndrome between Genders

Gender comparison of metabolic syndrome components among the hypertensive subjects is contained in Table 7. All participants were hypertensive by inclusion; therefore, comparisons were focused on the remaining three variables of metabolic syndrome namely; obesity, dysglycaemia, and dyslipidaemia.

Table 7 Gender Comparison of Metabolic Syndrome Components among Hypertensive Subjects Attending UPTH

MetS Component	Male (n = 26)	Female (n = 50)	χ^2	p-value	Remark
Obesity	14 (53.8%)	33 (66.0%)	2.10	0.147	NS
Dysglycaemia	15 (57.7%)	30 (60.0%)	0.07	0.788	NS
Dyslipidaemia	14 (53.8%)	27 (54.0%)	0.10	0.751	NS
MetS ≥3components	16 (61.5%)	33 (66.0%)	0.09	0.766	NS

*MetS = Metabolic Syndrome; NS = Not significant ($p > 0.05$)

A chi-square analysis comparing MetS prevalence by sex revealed a higher occurrence among female hypertensive patients (66.0%) compared to males (61.5%), though the difference was not statistically significant ($\chi^2 = 0.09$, $p = 0.766$).

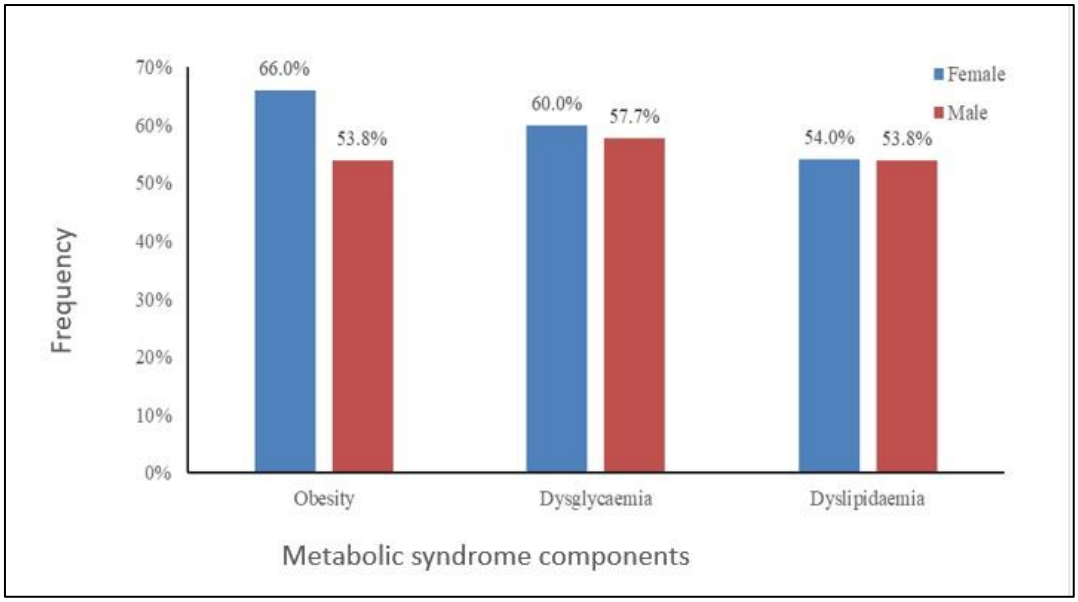

Figure 3 Gender Distribution of Metabolic Syndrome Components among Hypertensive Subjects

Table 8 Comparison of Biochemical Parameters by Gender of Hypertensive Subjects Attending UPTH

Parameter	Male (Mean± SD)	Female (Mean± SD)	t-value	p-value	Remark
BMI (kg/m^2)	28.4 ± 4.2	30.2 ± 4.8	1.62	0.109	NS
FBG (mmol/L)	6.85 ± 1.91	6.96 ± 1.82	0.23	0.818	NS
HbA1c (%)	6.72 ± 1.29	6.89 ± 1.36	0.49	0.627	NS
TC (mmol/L)	5.08 ± 1.02	5.14 ± 0.94	0.26	0.794	NS
TG (mmol/L)	1.79 ± 0.49	1.69 ± 0.55	0.81	0.420	NS
HDL (mmol/L)	1.05 ± 0.29	1.11 ± 0.32	0.86	0.394	NS
LDL (mmol/L)	3.46 ± 0.84	3.49 ± 0.91	0.13	0.897	NS

*NS = Not Significant

Table 8 showed no significant difference in biochemical parameters by gender of hypertensive subjects attending UPTH. Equally, it reaffirms that metabolic syndrome is highly prevalent among hypertensive patients, regardless of gender. The absence of significant gender differences in the study may reflect comparable dietary habits and sedentary lifestyles across both sexes in Port Harcourt's urban setting.

5. Discussion

5.1. Socio-Demographic Distribution

The study population comprised 76 hypertensive individuals, predominantly female (65.79%) and within the middle-aged to elderly bracket, with a mean age of 55.3 ± 10.8 years. The dominance of married participants (85.5%), and the high representation of business owners (42.10%) and professionals/civil servants (34.21%) are consistent with the socio-economic profile of tertiary hospital patients. This demographic trend aligns with reports by Adeloye *et al*. (2021) and Ogedengbe *et al*. (2020), who observed a higher prevalence of hypertension and metabolic syndrome among middle-aged and older adults. The predominance of females corresponds with previous Nigerian hospital-based studies, where women were more likely to seek medical care and exhibit higher rates of metabolic abnormalities due to hormonal factors and post-menopausal changes.

5.2. Evaluation of Dysglycaemia among Hypertensive Patients

Dysglycaemia was observed in 59.2% of participants based on fasting glucose and in 53.9% based on HbA1c. Notably, 30.26% were diabetic, while 28.95% were prediabetic according to fasting glucose classification. This aligns with findings from Chukwuonye *et al*., (2018), who reported dysglycaemia rates exceeding 55% among hypertensive Nigerian adults. The strong correlation between FBG and HbA1c ($r = 0.78$, $p < 0.001$) underscores the reliability of both parameters for glycaemic assessment.

5.3. Evaluation of Dyslipidaemia among Hypertensive Patients

Dyslipidaemia was prevalent in 53.9% of the study population, with low HDL (51.3%) and elevated triglycerides (46.1%) being the most common abnormalities. This pattern mirrors the atherogenic dyslipidaemia characteristic of metabolic syndrome (high TG and low HDL) frequently linked to insulin resistance and central obesity.

These results are consistent with Oguejiofor *et al*. (2018), who reported similar lipid abnormalities among hypertensive Nigerians. No significant sex differences were observed in lipid levels, implying that both genders are equally prone to dyslipidaemia, although female participants had slightly higher mean HDL values.

5.4. Prevalence of Metabolic Syndrome among Hypertensive Subjects

The prevalence of metabolic syndrome, defined by the co-existence of obesity, dysglycaemia, dyslipidaemia, and hypertension, was 64.5% in this study. This finding underscores a substantial clustering of metabolic abnormalities among hypertensive patients in Port Harcourt. Comparable rates have been reported in other Nigerian populations: Ogedengbe *et al*., (2020) reported 61.0% in Lagos, and Adeleyo *et al*., (2021) found 65.8% in Ibadan, both using NCEP ATP III criteria. Internationally, similar patterns have been observed in urban African and Asian populations (Grundy *et al*., 2019).

5.5. Comparison of Metabolic Syndrome between Genders

Although the overall prevalence of metabolic syndrome was higher among females (66.0%) than males (61.5%), this difference was not statistically significant ($p = 0.766$). Females, however, demonstrated higher rates of obesity (66.0% vs. 53.8%), dysglycaemia (60.0% vs. 57.7%), and dyslipidaemia (54.0% vs. 53.8%). These trends are in line with Adeleyo *et al*., (2021) and Ogedengbe *et al*., (2020), who attributed female predominance in MetS to hormonal and lifestyle factors, particularly weight gain after menopause.

The absence of significant gender differences in this study may reflect comparable dietary habits and sedentary lifestyles across both sexes in Port Harcourt's urban setting. Overall, the findings demonstrate that metabolic syndrome affects both male and female hypertensives similarly, warranting inclusive management approaches that target all metabolic components rather than focusing on a specific demographics.

6. Conclusion

The study population assessed for metabolic syndrome risk was predominantly female (65.79%) within middle-aged to elderly bracket, with a mean age of 55.3 years and dominance of married participants (85.5%). Dysglycaemia was observed in 59.2% of participants based on fasting glucose and in 53.9% based on HbA1c. Notably, 30.26% were diabetic, while 28.95% were prediabetic. Dyslipidaemia was prevalent in 53.9% of the study population, with low HDL (51.3%) and elevated triglycerides (46.1%) being the most common abnormalities. The prevalence of metabolic syndrome, defined by the coexistence of obesity, dysglycaemia, dyslipidaemia, and hypertension, was 64.5%.

This clustering of obesity, dysglycaemia, and dyslipidaemia among hypertensive patients attending UPTH underscores the multifactorial nature of metabolic syndrome and its role as a major predictor of cardiovascular morbidity. Given the high prevalence (64.5%), it is essential that clinicians routinely assess hypertensive patients for these associated abnormalities. Integrating metabolic screening into hypertension management protocols at tertiary hospitals will enable early intervention through lifestyle modification, dietary counselling, and pharmacological therapy.

Compliance with ethical standards

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Disclosure of Conflict of Interest

The authors declare no conflict of interest.

Statement of Ethical Considerations

This study adhered to a comprehensive set of ethical principal and safeguards to ensure the rights, well-being, and confidentiality of all participants. Ethical permission was sought from University of Port Harcourt Teaching Hospital Administration prior to the commencement of the study.

Statement of Informed Consent

Written informed consent was obtained from each participant before their inclusion in the study. The concept of voluntary participation was emphasized and participants retained the freedom to withdraw from the study at any point without incurring any adverse consequences.

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