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Prevalence of Metabolic Syndrome among Adults in Ibadan, Nigeria.

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Abstract

A group of metabolic risk factors known as the Metabolic Syndrome (MS) increase the risk of cardiovascular disease (CVD) and type-2 diabetic mellitus (T2DM). These include hypertension, atherogenic dyslipidaemia, excessive fasting plasma glucose, and abdominal obesity. The prevalence of MS and its constituent parts among adults in Ibadan, southwest Nigeria, is the main emphasis of this study. The aim of this study was to ascertain the prevalence of metabolic syndrome and risk factors among persons who appear to be in good health in the city of Ibadan. A random sample strategy was used to select 207 participants from 11 local government areas in Ibadan for this cross-sectional study. Anthropometric information and blood samples were gathered. The Joint Interim Statement criteria were used to define metabolic syndrome. Regression analysis and chi-square testing were among the statistical tests that were performed. The results showed that 16.9% of people had MS. Akinyele LGA had the greatest prevalence (25.7%) of MS participants, with 57.1% of them being female. Significant differences between the MS and non-MS groups were seen in the study's measurements of waist circumference, blood pressure, fasting glucose, and lipid profiles. The results show that Ibadan has a considerable MS burden, especially among women. Obesity, dyslipidemia, and elevated fasting glucose have been identified as risk factors. These show how urgently targeted public health strategies that emphasize regular screening and lifestyle change are needed.

Keywords: Metabolic Syndrome, prevalence, cardiovascular risk, type-2 diabetes, Ibadan, Nigeria

Introduction

Metabolic Syndrome (MS), a collection of metabolic abnormalities that dramatically raises the risk of type 2 diabetes mellitus (T2DM) and cardiovascular disease (CVD), has become a major global health concern. These anomalies, which collectively increase the burden of chronic diseases globally, include insulin resistance, dyslipidaemia, hypertension, and abdominal obesity. About 25% of adults worldwide suffer from MS, a startlingly high prevalence that has been increasing over the past few decades. Changes in Western culture-related lifestyles, like eating a lot of sugar, eating a lot of calories, and being sedentary, are mostly to blame for this rise. In addition to being common in industrialized countries, these lifestyle variables have also spread to developing countries, which has led to an increase in the incidence of multiple sclerosis in these areas (Madan *et al.*, 2023; Muradova, 2024).

Over the years, there have been numerous discussions on the definition of multiple sclerosis, with various health organizations adopting slightly different diagnostic criteria. Nonetheless, one of the most generally used and accepted definitions of MS in the world is the Joint Interim Statement (JIS) criteria. These standards highlight how crucial it is to detect and treat MS as soon as possible in order to lessen its detrimental effects on health. The presence of the syndrome raises the risk of major health problems such CVD, type 2 diabetes, and stroke, hence the JIS guidelines emphasize the importance of thorough screening to identify it early (Hussain *et al.*, 2023). It also emphasizes the importance of early diagnosis and preventative public health actions.

The multidimensional process of managing multiple sclerosis typically involves lifestyle changes, including encouraging regular exercise, eating a balanced diet, and controlling weight. Additionally important is pharmacotherapy, especially in the management of blood pressure, cholesterol, and blood sugar. Additionally, novel techniques such as gene therapy are being investigated as new treatments to target the underlying pathophysiology of multiple sclerosis and address its comorbidities. There is hope for better management in the future thanks to these innovative treatments, which attempt to stop or reverse the metabolic abnormalities linked to MS (Mahnoor *et al.*, 2022; Hussain *et al.*, 2023). Thus, it is crucial to comprehend the complicated pathophysiology of multiple sclerosis (MS) and the intricate interactions between MS and its associated comorbidities in order to design comprehensive and successful prevention and treatment measures.

According to epidemiology, the prevalence of MS is increasing worldwide, with urbanization and changes in lifestyle placing a greater burden on emerging nations. The incidence of MS has grown due to dietary changes, urbanization, and more sedentary lifestyles, especially in sub-Saharan Africa.

Despite the fact that these areas were once thought to have lower MS risks, new research shows a concerning trend of increasing MS prevalence. Significant changes in food consumption patterns and levels of physical activity have coincided with sub-Saharan Africa's transition to urban environments, which has led to an increase in non-communicable illnesses (NCDs) such as multiple sclerosis (Bonomi *et al.*, 2021; Safiri *et al.*, 2024). Furthermore, research has revealed that the gut microbiota of urban inhabitants in sub-Saharan Africa is altered, which could have a major impact on health outcomes, including the onset and course of multiple sclerosis. The development of a number of metabolic and inflammatory illnesses has been linked to changes in the microbiome, which may help to explain some of the variations in MS presentation seen in distinct populations (Simon *et al.*, 2023).

Additionally, MS's clinical features in sub-Saharan Africa are different from those in Western populations; some research suggests that the disease progresses more aggressively in these

regions. These variations underline the necessity of more investigation into the fundamental causes of these disparate clinical characteristics. More thorough research is required to completely comprehend the pathophysiology of MS and to create region-specific care and prevention measures due to its increasing prevalence and unique characteristics in sub-Saharan Africa (Heine *et al.*, 2020; Bonomi *et al.*, 2021).

The global burden of MS is still growing as a result of these new developments, which has important ramifications for healthcare systems, especially those with low resources. This emphasizes how urgently focused healthcare plans and public health initiatives are needed, particularly in sub-Saharan Africa, where there is growing concern about MS. Raising awareness, enhancing early detection, and putting into practice efficient management techniques should be the top priorities of public health initiatives in order to combat the rising incidence of MS in these areas (Han *et al.*, 2023).

Contributing useful local epidemiological data on the prevalence of MS in adults in Ibadan, Nigeria, is the goal of this study. In the end, we seek to support international efforts to battle this metabolic condition by improving knowledge and informing public health strategies for the appropriate management of MS in this region by analyzing the prevalence and finding contributing factors in this setting.

Materials and Methods

Study Design and Setting

This cross-sectional survey, which covered 11 local government areas, was carried out in Ibadan, southwest Nigeria. The purpose of the study was to gather clinical and biochemical information from participants in order to determine the prevalence of metabolic syndrome.

Study Design

In order to gather demographic and lifestyle data, the study used a descriptive survey methodology, gathering anthropometric measures and blood samples in addition to questionnaire responses. To guarantee accuracy and dependability, data collection instruments were verified before being put into use.

Sample Size Determination

With a margin of error of 0.05 and a prevalence rate of 16% ($p = 0.16$), the necessary sample size was calculated using Cochran's method to be 207 participants. The study population's representativeness and statistical significance were guaranteed by the sample size.

Study Subjects

Inclusion Criteria

- Adults aged 18 years and older residing in Ibadan.
- Participants who provided informed consent.

Exclusion Criteria

- Individuals under 18 years.
- Participants who declined consent.

Materials and Equipment

The study utilized a range of equipment for clinical and biochemical assessments. These included:

- **Anthropometric tools:** Weighing scales, stadiometers, and tape measures for recording weight, height, and waist circumference.
- **Blood collection materials:** Syringes, tourniquets, fluoride oxalate tubes, EDTA tubes, and plain bottles for sample collection.
- **Biochemical analysis tools:** A semi-automated spectrophotometer was used for lipid profiling and glucose analysis.
- **Blood pressure assessment tools:** Sphygmomanometers for measuring systolic and diastolic blood pressure.

Ethical Consideration

The Lead City University Research Ethics Committee (LCU-HREC) granted ethical approval. All subjects provided written informed consent, and study confidentiality was upheld at all times. The ethical guidelines for medical research were followed when collecting the data.

Clinical Laboratory Investigation

Sample Collection and Analysis

Venipuncture was used to obtain blood samples; 2 mL were placed in fluoride oxalate tubes for glucose assay, and 3 mL were placed in EDTA tubes for lipid profiling. In order to guarantee accuracy, samples were processed quickly. To assess obesity indicators, anthropometric measurements such as height, weight, and waist circumference were taken.

Statistical Analysis

SPSS software was used to examine the data. Continuous variables were described using means and standard deviations, whilst categorical data were summarized using frequency distributions and percentages. One-way ANOVA evaluated the means of continuous variables, while chi-square tests looked at relationships between categorical variables. The associations between demographic characteristics and metabolic indices were assessed using regression models.

Results

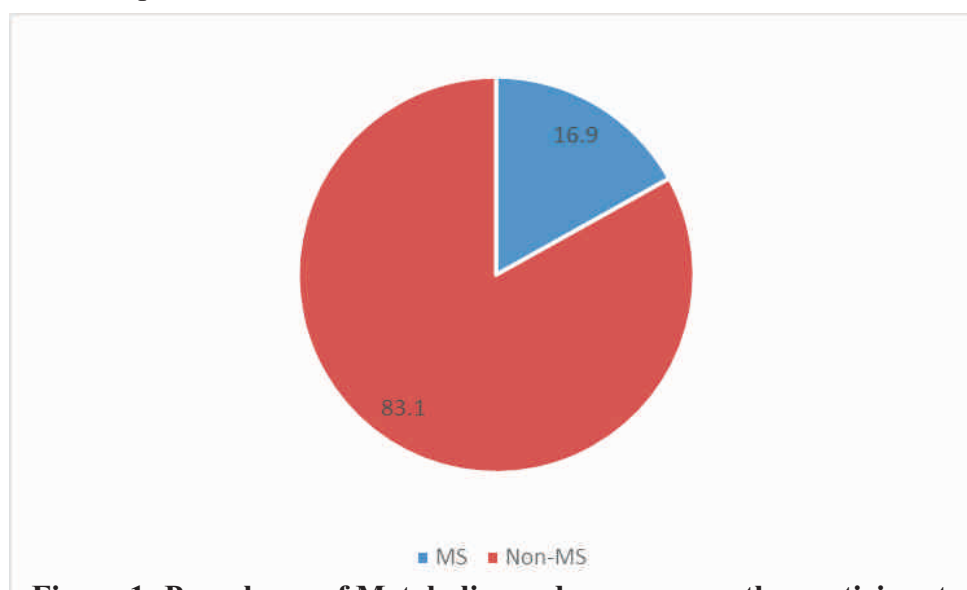


Figure 1: Prevalence of Metabolic syndrome among the participants

In this study, 207 subjects participated. Frequency and percentage was used to summarize categorical variables and mean (SD) was used to summarize the quantitative variables. Chi-square was used to test the association of categorical variables while one-way Anova was used to determine the mean level of the quantitative variables and linear regression was used to determine the association between the lipid serums. The prevalence of metabolic syndrome among the participants was 16.9% as shown in Figure 1.

Table 1: Demographic Characteristics of participants

Characteristics	Metabolic syndrome	Non metabolic syndrome	N (%)	X ²	P-value
Age (years)					
18-30	8 (22.9)	36(20.9)	44 (21.3)		
30-39	20 (57.1)	89 (51.7)	109 (52.7)		
40-49	4 (11.4)	32 (18.6)	36 (17.4)	1.074	0.783
50 and above	3 (8.6)	15 (8.7)	18 (18.7)		
Total	35 (100)	172 (100)	207 (100)		
Gender					
Male	15 (42.9)	75 (43.6)	90 (43.5)		
Female	20 (57.1)	97 (56.4)	117 (56.5)	0.007	0.544
Total	35 (100)	172 (100)	207 (100)		
LGA					
IBN	0	19(11.0)	19 (9.2)		
IBNE	1 (2.9)	18 (10.5)	19 (9.2)		
IBNW	1 (2.9)	18 (10.5)	19 (9.2)		
IBSE	2 (5.7)	17 (9.9)	19 (9.2)		
IBSW	2 (5.7)	17 (9.9)	19 (9.2)		
Akinyele	9 (25.7)	10 (5.8)	19 (9.2)	33.031	<0.001*
Egbeda	7 (20.4)	11 (6.4)	18 (8.7)		
Ido	4 (11.4)	14 (8.1)	18(8.7)		
Lagelu	1 (2.9)	18 (10.5)	19 (9.2)		
Ona ara	6 (17.1)	13 (7.6)	19 (9.2)		
Oluyole	2 (5.7)	17 (9.9)	19 (9.2)		
Total	35 (100)	172 (100)	207 (100)		

Occupation					
Civil servant	7 (20.0)	36 (20.9)	43 (20.8)		
Self-employed	25 (71.4)	101 (58.7)	126 (60.9)		
Artisan	1 (2.9)	20 (11.6)	21 (10.1)	3.309	0.346
Other	2 (5.7)	15 (8.7)	17 (8.2)		
Total	35 (100)	172 (100)	207 (100)		

SES = socioeconomic status, LGA = local government area, X² = chi square, P = is significant at <0.05, N = total population

Table 2: Demographic Characteristics of participants

Characteristics	Metabolic syndrome	Non metabolic syndrome	N (%)	X²	P-value
Socioeconomic Status					
Low	5 (14.3)	40 (23.3)	45 (21.7)		
Medium	26 (74.3)	99 (57.6)	125 (60.4)	3.403	0.182
High	4 (11.4)	33 (19.2)	37 (17.9)		
Total	35 (100)	172 (100)	207 (100)		
Religion					
Christianity	24 (68.6)	89 (51.7)	113 (54.6)		
Islam	10 (28.6)	81 (47.1)	91 (44.0)	4.354	0.113
Other	1 (2.9)	2 (1.1)	3 (1.4)		
Total	35 (100)	172 (100)	207 (100)		
Ethnicity					
Yoruba	26 (74.3)	92 (53.5)	118 (57.0)		
Hausa	3 (8.6)	40 (23.3)	43 (20.8)		
Igbo	5 (14.3)	38 (22.1)	43 (20.8)	6.655	0.084
Others	1 (2.9)	2 (1.2)	3 (1.4)		
Total	35 (100)	172 (100)	207 (100)		

Education

None	2 (5.7)	6 (3.5)	8 (3.9)		
Primary	7 (20.0)	20 (11.6)	27 (13.0)		
Secondary	10 (28.6)	39 (22.7)	49 (23.7)	6.571	0.160
Graduate	16 (45.7)	107 (62.2)	123 (59.5)		
Total	35 (100)	172 (100)	207 (100)		

Key: SES = socioeconomic status, LGA = local government area, X² = chi square, P = is significant at <0.05, N= total population

Table 1 shows the demographic characteristics of the participants. In this study, out of 16.9% of the participants that have metabolic syndrome, 57.1% and 8.6% of them are age 30-39years and 50 years and above respectively. More than half of the participants (57.1%) with metabolic syndrome are female. Akinyele LGA has the highest prevalence (25.7%) of people with metabolic syndrome.

Table 3: Diet History of participants

Characteristics	Metabolic syndrome	Non-metabolic syndrome	N (%)	X ²	P-value
Cigarette smoking					
Before	9 (25.7)	29 (16.9)	38 (18.4)		
Presently	5 (14.3)	33 (19.2)	38 (18.4)	1.694	0.429
Never	21 (60.0)	110 (64.0)	131 (63.3)		
Total	35 (100)	172 (100)	207 (100)		
Alcohol intake					
Daily	4 (11.4)	12 (7.0)	16 (7.8)		
Weekly	6 (17.1)	39 (22.7)	45 (21.8)		
Occasionally	7 (20.0)	38 (22.1)	45 (21.8)	1.292	0.731
Never	18 (51.4)	83 (48.2)	102 (48.6)		
Total	35 (100)	172 (100)	207 (100)		

Processed food					
Yes	26 (74.3)	122 (70.9)	148 (71.5)		
No	9 (25.7)	50 (29.1)	59 (28.5)	0.161	0.838
Total	35 (100)	172 (100)	207 (100)		
Vegetable intake					
Daily	1 (2.9)	25 (14.5)	26 (12.6)		
Weekly	25 (71.4)	99 (57.6)	124 (59.9)	4.142	0.126
Occasionally	9 (25.7)	48 (27.9)	57 (27.5)		
Total	35 (100)	172 (100)	207 (100)		
Performance enhancing drug					
Daily	5 (14.3)	18 (10.5)	93 (44.9)		
Weekly	7 (20.0)	45 (26.2)	52 (25.1)		
Occasionally	3 (8.6)	28 (16.3)	31 (15.0)	2.744	0.601
Previous	2 (5.7)	6 (3.5)	8 (3.9)		
Nil	18 (51.4)	75 (43.6)	93 (44.9)		
Total	35 (100)	172 (100)	207 (100)		

Key: X^2 = chi square, P = is significant at <0.05 , N = total population

Table 3 shows the dietary intake of the participants. Of the 16.9% of subjects with metabolic syndrome in this study, more than half of the participants (60.0%) that have never smoked cigarettes have metabolic syndrome though it is not statistically significant. Also, half of the participants (51.4%) that have never taken alcohol had metabolic syndrome though it is not statistically significant. 74.3% of the participants that have metabolic syndrome eats processed food. One-fifth of those (20.0%) that have metabolic syndrome are using performance enhancing drug weekly, more than half of this 58.8% of them used orthodox method and 41.2% used traditional method.

Table 4: Knowledge of metabolic syndrome of participants

Characteristics	Metabolic syndrome	Non-metabolic syndrome	N (%)	X ²	P-value
Knowledge of hypertension					
Yes	33 (94.3)	148 (86.0)	181 (87.4)	1.798	0.264
No	2 (5.7)	24 (14.0)	26 (12.6)		
Total	35 (100)	172 (100)	207 (100)		
Knowledge of obesity					
Yes	29 (82.9)	122 (70.9)	151 (72.9)	2.096	0.210
No	6 (17.1)	50 (29.1)	56 (27.1)		
Total	35 (100)	172 (100)	207 (100)		
History of family hypertension					
Yes	8 (22.9)	68 (39.5)	76 (36.7)	3.481	0.044*
No	27 (77.1)	104 (60.5)	131 (63.3)		
Total	35 (100)	172 (100)	207 (100)		

Key: X² = chi square, P = is significant at <0.05, N = total population

Table 5: Knowledge of metabolic syndrome of participants

Characteristics	Metabolic syndrome	Non-metabolic syndrome	N (%)	X ²	P-value
Family history of obesity					
Yes	10 (28.6)	58 (33.7)	68 (32.9)	0.350	0.694
No	25 (71.4)	114 (66.3)	139 (67.1)		
Total	35 (100)	172 (100)	207 (100)		

Knowledge of BP

Yes	22 (62.9)	96 (55.8)	118 (57.0)		
No	13 (37.1)	76 (44.2)	89 (43.0)	0.589	0.462
Total	35 (100)	172 (100)	207 (100)		

Knowledge of glucose

Yes	25 (71.4)	104 (60.5)	129 (62.3)		
No	10 (28.6)	68 (39.5)	78 (37.7)	1.489	0.222
Total	35 (100)	172 (100)	207 (100)		

Knowledge of lipids

Yes	18 (51.4)	69 (40.1)	87 (42.0)		
No	17 (48.6)	103 (59.9)	120 (58.0)	1.527	0.216
Total	35 (100)	172 (100)	207 (100)		

BMI calculation

Yes	21 (60.0)	76 (44.2)	97 (46.9)		
No	14 (40.0)	96 (55.8)	110 (53.1)	2.921	0.087
Total	35 (100)	172 (100)	207 (100)		

Key: X² = chi square, P = is significant at <0.05, N= total population

Table 6: Knowledge of metabolic syndrome of participants

Characteristics	Metabolic syndrome	Non-metabolic syndrome	N (%)	X ²	P-value
Is obesity related to hypertension					
Yes	23 (65.7)	97 (56.4)	120 (58.0)	1.037	0.309
No	12 (34.3)	75 (43.6)	87 (42.0)		
Total	35 (100)	172 (100)	207 (100)		
Is obesity hereditary disease					
Yes	23 (65.7)	109 (63.4)	132 (63.8)	0.069	0.793
No	12 (34.3)	63 (36.6)	75 (36.2)		
Total	35 (100)	172 (100)	207 (100)		
Is Hypertension hereditary disease					
Yes	18 (51.4)	112 (65.1)	130 (62.8)	2.322	0.092
No	17 (48.6)	60 (34.9)	77 (37.2)		
Total	35 (100)	172 (100)	207 (100)		

Key: X² = chi square, P = is significant at <0.05, N = total population

Table 6 shows knowledge of metabolic syndrome among participants. Almost all of the participants (87.4%) had the knowledge of hypertension. More than two-thirds of the participants (72.9%) had knowledge of obesity. Few of the participants (36.7%) had a family history of hypertension (p=0.004). Few of the participants (32.9%) had a family history of obesity. More than half of the participants (57.0%) and (62.3%) had knowledge of blood pressure and glucose respectively. Less than half of the participants (42.0%) and (46.9%) had knowledge of lipids and BMI calculations respectively. More than half of the participants (58.0%), (63.8%) and (62.8%) knows that obesity and hypertension is related, obesity is hereditary disease, and hypertension is hereditary disease respectively.

Table 7: Anthropometric and Clinical Characteristics of participants

Characteristics	Metabolic syndrome	Non metabolic syndrome	F	p-value
Height (m)	1.520.1	1.5±0.1	1.121	0.291
Weight (kg)	80.5±17.5	74.9±12.9	4.749	0.030*
BMI (kg/m ²)	33.3±6.1	32.6±7.1	0.320	0.572
Waist C	40.4±7.1	36.4±6.7	10.055	0.002*
Hip C	41.6±13.0	38.8±6.9	3.359	0.068
Waist/Height	26.4±5.1	24.2±5.0	5.504	0.020*
Waist/Hip	1.0±0.2	0.9±0.2	2.903	0.090
SBP (mmHg)	138.0±51.4	119.3±18.4	14.057	<0.001*
DBP (mmHg)	87.9±11.2	83.9±12.3	3.206	0.075
Glucose (mmol/L)	8.0±2.6	4.6±0.7	21.521	<0.001*
Cholesterol (mmol/L)	4.8±0.8	4.5±0.5	8.954	0.003*
Trigl (mmol/L)	2.1±0.4	1.9±0.3	13.912	<0.001*
HDL (mmol/L)	1.4±0.3	1.3±0.3	3.328	0.070
LDL (mmol/L)	2.4±0.6	2.3±0.4	1.389	0.240

Key: P= is significant at <0.05, F= Anova

Table 7 and figure 2 shows comparison of anthropometric and clinical indices in metabolic syndrome and non-metabolic syndrome. The mean (SD) of weight of participants 17.5% in metabolic syndrome (80.5±17.5) was higher than the 12.9% non-metabolic syndrome (74.9±12.9) (p=0.030). The mean (SD) of waist circumference of participants 7.1% in metabolic syndrome (40.4±7.1) was higher than the 6.75% non-metabolic syndrome (36.4±6.7) (p=0.002). The mean (SD) of waist/height of participants 5.1% in metabolic syndrome (26.4±5.1) was higher than the 5.0% non-metabolic syndrome (24.2±5.0) (p=0.020). The mean (SD) of systolic blood pressure of participants 51.4% in metabolic syndrome (138.0±51.4) was higher than the 18.9% non-metabolic syndrome (119.3±18.4) (p<0.001). The mean (SD) of glucose of participants 2.6% in metabolic syndrome (8.0±2.6) was higher than the 0.7% non-metabolic syndrome (4.6±0.7) (p<0.001). The mean (SD) of total cholesterol of participants 0.8% in metabolic syndrome (4.8±0.8) was higher than the 0.5% non-metabolic syndrome (4.5±0.5) (p=0.003). The mean (SD) of triglycerides of participants 0.4% in metabolic syndrome (2.1±0.4) was higher than the 0.3% non-metabolic syndrome (1.9±0.3) (p<0.001).

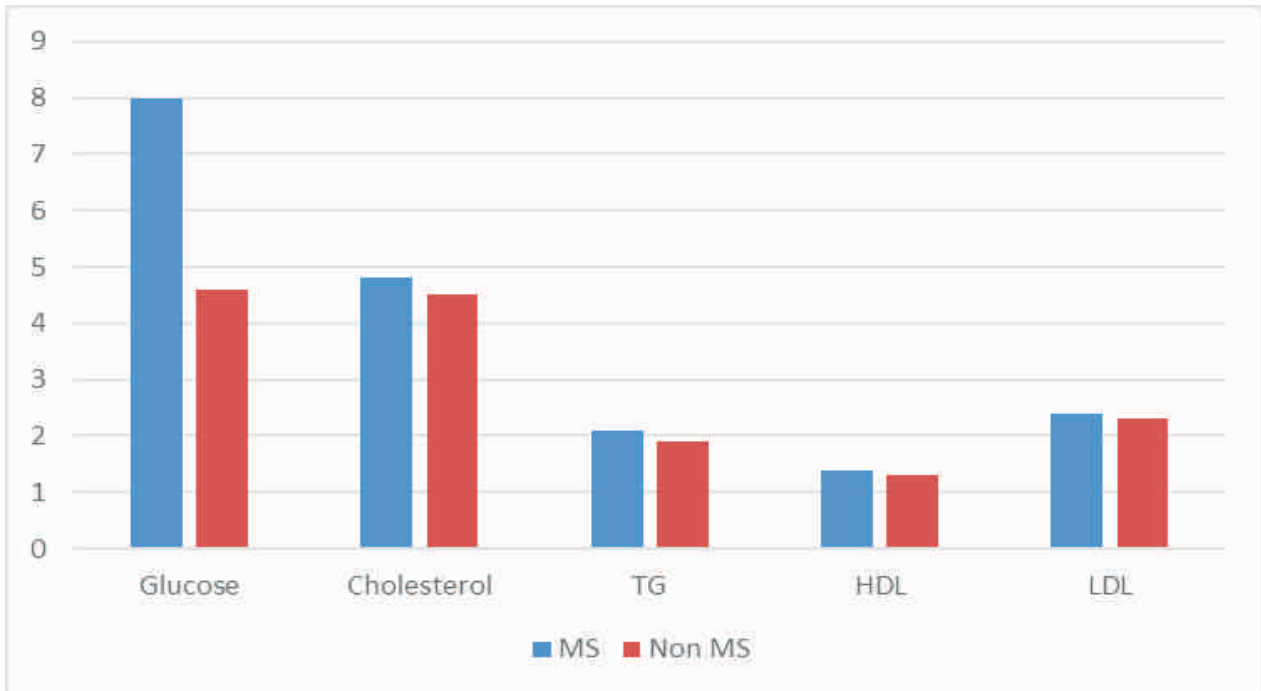


Figure 2: Comparison of Plasma Lipids among participants with metabolic syndrome and non-metabolic syndrome

Figure 3 shows the gender distribution among participants with MS that are obese. More than half of the participants (51.9%) with MS that are obese are female. Table 8 shows the anthropometric and clinical indices of body mass among metabolic syndrome participants. All the participants has the same average heights ($p < 0.001$). Participants that are obese (85.8 ± 16.0) has the highest mean (SD) of weight while normal weight (53.3 ± 1.5) participants has the lowest mean (SD) ($p = 0.003$). Participants that are normal weight (8.7 ± 1.8) has the highest mean (SD) of glucose while over weight (7.4 ± 2.1) participants has the lowest mean (SD) ($p = 0.004$). Participants that are normal weight (2.4 ± 0.3) has the highest mean (SD) of triglycerides while obese (2.0 ± 0.3) participants has the lowest mean (SD) ($p = 0.030$).

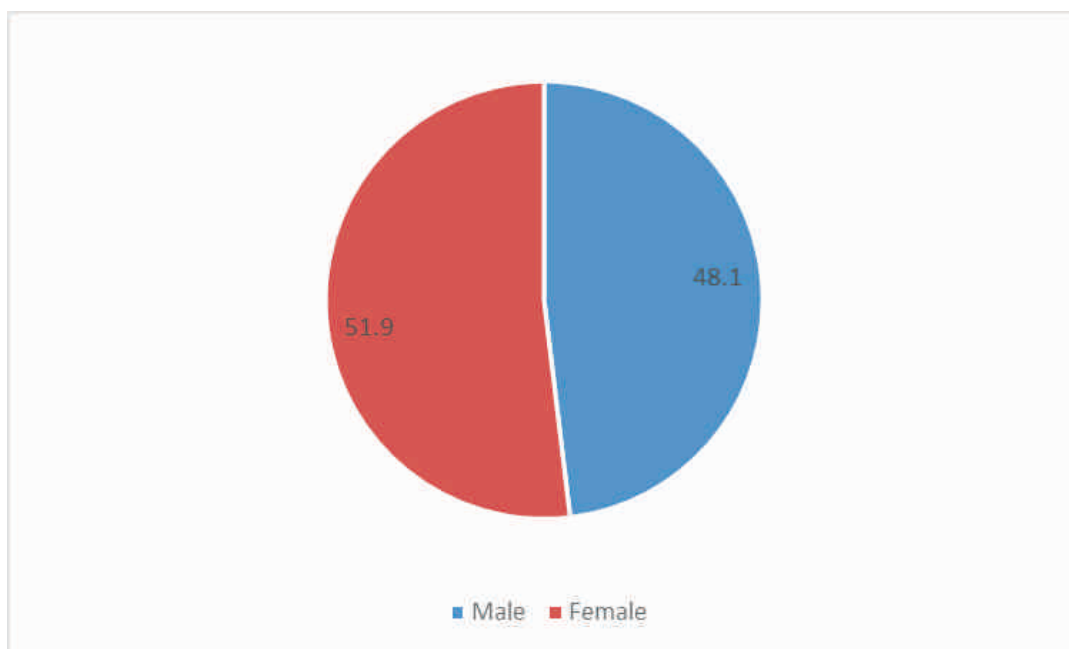


Figure 3: Gender distribution among participants with Metabolic Syndrome that are obese.

Table 8: Comparison of Anthropometric and Clinical Indices of Body Mass in Metabolic Syndrome

Variables	Underweight N=1	Normal weight N=3	Overweight N=4	Obese N=27	F	P-value
Height (m)	1.5	1.5	1.5±0.1	1.5±0.1	13.645	<0.001*
Weight (kg)	71.0	53.3±1.5	67.3±4.6	85.8±16.0	5.812	0.003*
Waist (cm)	32.0	42.3±7.5	44.5±16.4	39.9±4.9	1.044	0.387
Hip (cm)	41.0	44.3±3.5	38.8±9.2	41.8±14.4	0.102	0.958
Waist/Height	15.2	28.2±5.0	29.4±11.3	26.1±3.4	2.427	0.084
Waist/Hip	0.8	1.0±0.1	1.2±0.3	1.0±0.2	1.056	0.382
SBP (mmHg)	80.0	118.3±17.6	125.8±12.9	144.1±56.3	0.758	0.526
DBP (mmHg)	100.0	79.3±14.0	83.5±7.8	89.1±11.1	1.332	0.282
Glucose (mmol/L)	6.7	8.7±1.8	7.4±2.1	7.7±2.3	5.471	0.004*
Cholesterol (mmol/L)	5.4	5.3±0.2	4.9±0.3	4.7±0.9	0.649	0.590
Trigl(mmol/L)	2.9	2.4±0.3	2.2±0.2	2.0±0.3	3.393	0.030*
HDL(mmol/L)	1.9	1.6±0.1	1.4±0.1	1.4±0.3	1.100	0.364
LDL (mmol/L)	2.1	2.7±0.1	2.5±0.2	2.4±0.7	0.309	0.819

Key: P= is significant at <0.05, F= Anova, N= total number

Table 9: Relationship between plasma lipids among metabolic syndrome participants

Dependent variables	Predictors	B	T	P-value
Height	Weight	0.009	10.726	<0.001*
	BMI	-0.023	-9.668	<0.001*
	Glucose	0.009	2.573	0.017*
Weight	BMI	2.531	18.970	<0.001*
Waist/Height	Height	-6.379	-4.719	<0.001*
	Weight	-0.087	-6.311	<0.001*
	Waist	0.673	47.350	<0.001*
	BMI	0.180	5.009	<0.001*

Waist/Hip	Hip	-0.012	-9.238	<0.001*
	Triglycerides	-0.152	-2.703	0.013*
	HDL	0.171	2.505	0.020*
TG	Chol	2.146	121.123	<0.001*
	HDL	-2.143	-96.741	<0.001*
	LDL	-2.148	-11.822	<0.001*
	Weight	0.071	2.374	0.026*
	Glucose	0.003	2.581	0.017*
Chol	HDL	0.999	21.866	<0.001
	LDL	0.719	48.410	<0.001*
	Weight	-0.015	-2.375	0.026*
	Glucose	-0.004	-2.569	0.017*
HDL	LDL	-1.001	-17.065	<0.001*
	Weight	0.043	2.357	0.027*
LDL	Weight	0.001	2.388	0.026*
	Glucose	0.001	2.584	0.017*

P = is significant at <0.05

Table 9 shows the relationship between plasma lipids among participants with metabolic syndrome. Height is positively related to weight ($p < 0.001$), glucose ($p = 0.017$) and negatively related to BMI ($p < 0.001$). Weight is positively related to BMI ($p < 0.001$). Triglycerides are positively related to cholesterol ($p < 0.001$), weight ($p = 0.0026$) and glucose ($p = 0.017$). Waist-height ratio is negatively related to height ($p < 0.001$) and weight ($p < 0.001$). Waist-height ratio is positively related to waist ($p < 0.001$) and BMI ($p < 0.001$). Waist-hip ratio is negatively related to hip ($p < 0.001$) and triglycerides ($p = 0.013$) but positively related with HDL ($p = 0.020$).

Triglycerides are negatively related to HDL ($p < 0.001$) and LDL ($p < 0.001$). Cholesterol are positively related with HDL ($p < 0.001$) and LDL ($p < 0.001$). Cholesterol are negatively related to weight ($p = 0.026$) and glucose ($p = 0.017$). HDL is positively related to LDL ($p < 0.001$) and negatively related to weight ($p = 0.027$). LDL are positively related to weight ($p = 0.026$) and glucose ($p = 0.017$).

Discussion

The observed 16.9% prevalence of metabolic syndrome (MS) observed in this study is consistent with findings from comparable metropolitan environments in Africa, underscoring the rising incidence of metabolic diseases in the area. This number is in line with worldwide patterns that show a higher prevalence of MS, especially among women, in urbanized regions. Women made up 57.1% of MS cases in this study, a gender gap that is in line with recent global assessments of MS prevalence. A mix of dietary practices, lifestyle variables, and hormonal impacts may be responsible for this increased frequency in females. For instance, women are more likely to gain weight and be obese, both of which are known risk factors for multiple sclerosis. In the affected group, elevated body mass index (BMI) and waist circumference were important contributors to the syndrome, highlighting the crucial role that obesity plays in the pathophysiology of MS (Klein and Burton, 2014; D'Anca *et al.*, 2023).

Furthermore, the interplay of lifestyle, environmental, and genetic factors suggests a complicated etiology for multiple sclerosis, especially in women. Estrogen and other hormones may contribute to women's heightened vulnerability to obesity and insulin resistance, two major aspects of multiple sclerosis (Voskuhl and Gold 2012). The risk of multiple sclerosis is further increased by lifestyle modifications such a shift in diet toward processed and high-calorie meals and a decrease in physical exercise. These results highlight the necessity of gender-specific prevention and management methods as well as the significance of a thorough understanding of the interactions between these factors (Jakimovski *et al.*, 2019).

The high frequency of MS in the Akinyele Local Government Area (LGA), where 25.7% of the population was afflicted, was one of the study's most notable findings. Localized socioeconomic and environmental factors, such as differences in access to healthcare, diet, and chances for physical activity, may have an impact on this heightened prevalence. The results from Akinyele LGA are consistent with other research

conducted throughout Nigeria, which indicates notable regional variations in MS prevalence, possibly caused by socioeconomic inequality, urbanization, and patterns of rural-urban migration. According to a comprehensive study, the average prevalence of MS in Nigeria was 28%. Lifestyle variables such poor eating habits and physical inactivity played a significant role in this trend (Oguoma, 2016). The greater incidence of MS in Akinyele emphasizes the necessity of region-specific public health initiatives that target these environmental and socioeconomic factors.

The important role that insulin resistance plays in the development of multiple sclerosis is further shown by the notable variations in fasting glucose levels between MS and non-MS groups. A defining characteristic of the syndrome, insulin resistance, is strongly associated with other metabolic abnormalities, including hypertension and dyslipidemia, which were also found to be more common in MS patients in this study. These results support the documented link between MS and a higher risk of type 2 diabetic mellitus (T2DM) and cardiovascular disease (CVD) (Mehdipour-Dastjerdi and Ashtari, 2022; Jakimovski *et al.*, 2019). The high prevalence of dyslipidemia and hypertension in MS patients highlights the critical need for focused interventions to address these risk factors, especially in vulnerable groups such those living in remote places or having little access to medical care (Babura *et al.*, 2019; Musilanga *et al.*, 2024).

The necessity of treatments that focus on eating patterns, exercise, and regular health checks is one of the most important recommendations of the study. Public health measures must emphasize prevention through education and lifestyle change as the prevalence of MS continues to rise. Programs for community-based education are crucial for encouraging better food choices, boosting physical activity levels, and spreading knowledge about the value of routine medical examinations. Furthermore, early detection and management of MS could be facilitated by including MS screening into basic healthcare services, which would lessen the long-term burden of associated disorders like CVD and T2DM.

Reducing the risk of MS also requires addressing more general social determinants of health, such as socioeconomic circumstances and access to medical treatment. Targeted interventions that increase access to treatment and preventative care are essential in places with inadequate healthcare infrastructure, such as underserved and rural areas. Public health policies can improve health outcomes for vulnerable populations by addressing these causes and reducing the increased prevalence of MS and its related comorbidities.

Although this study's cross-sectional design restricts the capacity to draw conclusions about causality, the methodology and sample size increase the findings' dependability. In order to better understand the causal pathways leading to MS and its comorbidities, future research should focus on gathering longitudinal data. A more thorough understanding of the long-term impacts of lifestyle changes and therapies on the prevalence and course of MS would be possible with longitudinal research. Furthermore, further research is required to assess the efficacy of policy interventions and public health initiatives targeted at lowering the incidence of MS, especially in high-risk populations like those in sub-Saharan Africa.

Conclusion

Obesity, hypertension, and dyslipidaemia are the main causes of metabolic syndrome, which is a serious public health issue in Ibadan. The results emphasize the critical need for all-encompassing public health initiatives that focus on modifiable risk factors, such as poor eating habits, sedentary lifestyles, and irregular health examinations. To reduce the risks of diabetes and cardiovascular illnesses, effective interventions should emphasize education, early detection, and the encouragement of healthy lifestyles. Reducing the burden of MS would need strengthening healthcare systems to include regular screening and individualized management programs for those who are at risk. The study emphasizes how crucial it is for the community, legislators, and healthcare professionals to work together in order to produce long-lasting gains in population health outcomes.

Recommendations

Strong health policies that prioritize prevention, regular screening programs for early identification, and community awareness efforts that highlight risk factors and preventive interventions are all necessary to combat the increased prevalence of metabolic syndrome in Ibadan. Promoting regular physical exercise, offering easily available healthcare solutions, and educating people about good eating habits should be the top priorities of public health initiatives. In order to investigate causative pathways and evaluate the effect of preventative strategies on lowering the burden of metabolic syndrome, more longitudinal studies are advised.

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Disclaimer (Artificial intelligence)

Author(s) hereby declare that generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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