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(RESEARCH ARTICLE)

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Pattern of specific comorbidities and the association with overweight and obesity in adults attending a tertiary hospital in Rivers State, Nigeria

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Abstract

Aims: Overweight and obesity constitute a major risk to the development of chronic non communicable diseases such as hypertension, diabetes mellitus, dyslipidaemias, osteoarthritis which in turn impact on the individual, the family and the community. This study explored specific comorbidities associated with overweight and obesity among adults attending the Family Medicine Clinic of a tertiary health centre in Nigeria.

Methods: This was a descriptive hospital-based study. A combination of structured questionnaires, physical examination and laboratory analysis were used to generate appropriate data. The information was analysed using Statistical Package for Social Sciences (SPSS) version 22. Chi square (x^2) and Fisher's exact test were used to investigate the association between variables and the level of significance was set at $p<0.05$.

Results: The mean age of the subjects was 44.9±13.8years. Females constituted the majority (64.4%) with a female to male ratio of 1.8:1. While 55 persons (28.4%) were normal weight, 63 (32.5%) were overweight, 36 (18.5%) had class 1, 27 (13.9%) had class 2 obesity and 8 (4.1%) were morbidly obese. The prevalence of overweight/obesity was 69.1%. There was a significant relationship between overweight/obesity with previous diagnosis of hypertension and osteoarthritis but not with a previous diagnosis of DM. There was no statistically significant relationship between overweight/obesity and elevated BP, abnormal gait and blood glucose; however, the relationship with total cholesterol was significant.

Conclusion: This study highlights a high prevalence of overweight/obesity and the association with specific comorbidities in the Nigeria.

Keywords: Comorbidities; Overweight; Obesity; Nigeria

1. Introduction

Overweight and obesity have reached epidemic proportions globally, with a staggering 2.8 million deaths occurring annually as a consequence of these diseases [1]. Overweight/obesity is defined as the abnormal or excessive fat accumulation that present a risk to health [1]. The number of obese adults aged 20 years and over about doubled between the years 1980 to 2008, and the World Health Organization estimates that over 1.9 billion adults aged 18years and above are overweight with more than half a billion obese [2,3]. This upward trend has been attributed to increased

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economic growth, industrialization, mechanized transport, urbanization, a rise in physical inactivity, and a nutritional transition to consumption of processed foods and calorie dense diets over the last 3 decades [4]. The rate of overweight and obesity are greater in high income countries than in middle and low income countries [4]. Globally, about 3.4 million adult deaths occur annually as a result of overweight and obesity [5]. In a systematic review on the prevalence of overweight and obesity among adult Nigerians which used the WHO classification of the BMI only to categorize both overweight and obesity, the prevalence of overweight participants ranged from 20.3%–35.1%, while that of obesity was between 8.1% to 22.2% [6].

Obesity is associated with various adverse effects on health and the quality of life [1]. It poses a concomitant or an increased risk of nearly every non communicable disease [4]. Important is its contribution to the rising global incidence of cardiovascular disease, type 2 diabetes mellitus (T2 DM), certain cancers, dyslipidaemia, osteoarthritis, work disability and sleep apnoea [1,4,7]. Obesity increases cardiovascular risk because of its association with increased fasting plasma triglycerides, high LDL cholesterol, low HDL cholesterol, elevated blood glucose and insulin levels and high blood pressure [7]. When obesity occurs in childhood, in addition to predisposing to an increased risk of developing obesity in adulthood, such children are at risk of breathing difficulties, increased risk of fractures, high blood pressure and markers of cardiovascular disease, insulin resistance, disability, psychological disturbances and premature death [1].

It is pertinent that health professionals refrain from thinking of obesity as a character flaw which causes the individual to make poor food choices or not engage in adequate physical activity, but to instead appreciate that it is a disease [8]. This hopefully will motivate these professionals to be proactive and intervene sooner when individuals are identified as being at risk or meet the criteria which define obesity.

There is no single or simple approach to this rising epidemic. The problem is complex and will require a multifaceted approach at individual and population levels [9].

2. Material and methods

The study was carried out at the Family Medicine department of the Braithwaite Memorial Specialist Hospital (BMSH), Port Harcourt. Port Harcourt is the capital city of Rivers State, located in the Niger-Delta region of Nigeria.

2.1. Participants

A total of 204 respondents aged 18 years and above attending the family medicine clinic were selected via the systematic sampling technique over a period of 8 weeks. Critically ill patients and pregnant women were excluded from the study.

Ethical approval was obtained from the ethical board of the hospital. Documented informed consent was given by all the participants.

2.2. Outcome measures

- To determine prevalence of overweight / obesity using the BMI among patients attending the Family Medicine Clinic
- To determine the pattern of specific co-morbidities among patients attending the clinic.
- To evaluate the relationship between overweight and obesity and specific co-morbidities (Hypertension, Diabetes, Dyslipidaemia and Osteoarthritis).

2.3. Data collection instruments and procedure

Interviewer administered questionnaires were used to obtain demographic variables (age and sex) and assess comorbidities (hypertension, diabetes mellitus, osteoarthritis, peptic ulcer disease, bronchial asthma). A clinical examination was performed to for anthropometric measurements (height and weight) as well as measurement of blood pressure and examination of the musculoskeletal system to assess gait abnormalities (symmetry, movement, arm swing, pelvic tilt, normal stride length and ability to turn quickly which were recorded as normal or abnormal gait). Fasting blood samples were obtained from all respondents for fasting blood glucose and fasting lipid profile.

The Body Mass Index (BMI) was classified using the WHO classification of obesity, a fasting blood glucose level of ≥7.0mmol/L was used to establish a diagnosis of diabetes mellitus [4]. Abnormal lipid profile was defined as elevated

triglyceride with TG >1.7 mmol/l, hypercholesterolemia with TC >5.2 mmol/l, low high density lipoprotein cholesterol with HDL-c <1.03mmol/l and elevated low density lipoprotein cholesterol LDL-c >3.0mmol/l [10].

2.4. Statistical analysis

The results obtained were coded and entered into an excel worksheet and analysed using the SPSS version 22(Statistical package for Social Science version 22). The results have been expressed using percentages, tables, pie charts and Bar charts. Fishers exact test was also used to test for associations between the overweight/obesity and specific comorbidities such as Hypertension, Diabetes, Dyslipidaemia and Osteoarthritis. The confidence interval was set at 95% (p value of 0.05). Logistic regression analysis was used to determine which variables were independently associated with the BMI.

3. Results

A total of 204 respondents were recruited for the study but due to incomplete data only 194 of the respondents were included (the response rate was 95%).

The mean age of the subjects was 44.9±13.8 years with a range of 20-82 years. Females constituted the majority of the respondents, accounting for 64.4% (125) of the population with a female to male ratio of 1.8:1.

3.1. Distribution of the BMI of the respondents

The mean BMI was 28.7 ± 6.3 kg/m^2 with a range of 16.2 kg/m^2 to 46.7 kg/m^2. Among the respondents, 5 (2.6%) were underweight, 55 (28.4%) were of normal weight, 63 (32.5%) were overweight, 36 (18.5%) had class 1 obesity, 27 (13.9%) had class 2 obesity and 8 (4.1%) were morbidly obese. The prevalence of overweight and obesity in this study population was 69.1% with overweight accounting for 32.5% and obesity 36.6% (Fig. 1).

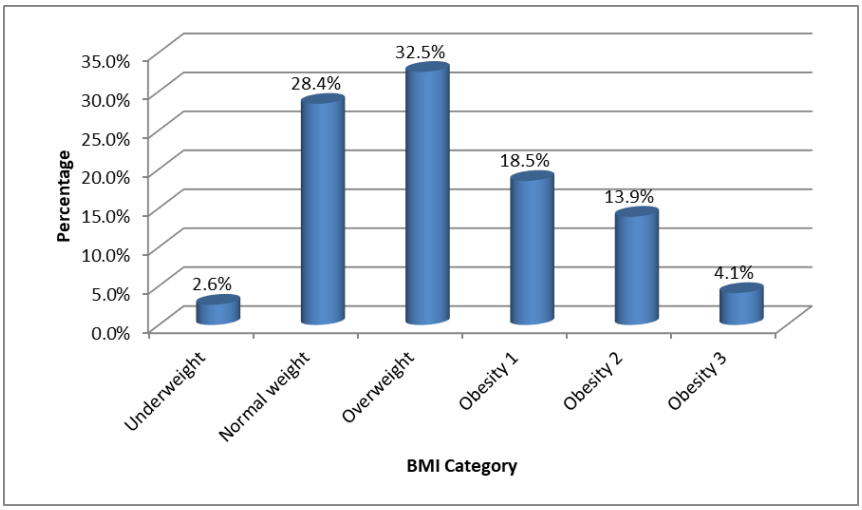

Figure 1 Distribution of the BMI of the respondents

3.2. Analysis of the Relationship between Overweight/Obesity and Specific Co-Morbidities

Amongst the respondents with a previous diagnosis of hypertension, 39% were in the overweight class while the rest were obese. A majority of respondents (54.3%) without a previous diagnosis of hypertension were in the overweight class. The relationship between a previous diagnosis of hypertension and overweight / obesity was statistically significant (p=0.001).

Regarding having been diagnosed with diabetes, 48% were in the overweight class while there was none in the obesity class III category. A smaller proportion (46.8%) of those who had not been diagnosed with diabetes was overweight while the rest were obese. The relationship between a previous diagnosis of diabetes and overweight / obesity however not statistically significant (p=0.383).

Concerning the respondents with a previous diagnosis of osteoarthritis, the highest proportion (43.7%) was in the obesity class II category, while obesity class III category had the smallest proportion (12.5%). Majority of the

respondents (55.9%) without a previous diagnosis of osteoarthritis were in the overweight class. The relationship between a previous diagnosis of osteoarthritis and overweight and obesity was statistically significant (p<0.001).

With regards to peptic ulcer disease, the highest proportions of respondent with a previous diagnosis were the overweight and obesity class II categories with 32.4% each. Majority of the respondents (52.6%) who had not been previously diagnosed with peptic ulcer disease were in the overweight class. The relationship between a previous diagnosis of peptic ulcer disease and overweight / obesity was not statistically significant (p=0.107).

Most of the respondents (57.1%) who had been diagnosed with bronchial asthma were overweight, while 46.5% without a prior diagnosis were also overweight. The relationship between a previous diagnosis of bronchial asthma and overweight / obesity was not statistically significant (p=0.127).

Table 1 The relationship between the history of comorbidities and overweight/ obesity Fisher's corrected.

	Over Weight n=63(%)	**Obesity I n=36(%)**	**Obesity II n=27(%)**	**Obesity III n=8(%)**	**Total n (%)**	**p-value**	***x*²**
HTN							
Yes	25(39.0)	13(20.3)	20(31.3)	6(9.4)	64(100)	0.001*	20.298
No	38(54.3)	23(32.8)	7(10.0)	2(2.9)	70(100)		
DM							
Yes	12(48.0)	9(36.0)	4(16.0)	0(0)	25(100)	0.383	4.899
No	51(46.8)	27(24.8)	23(21.1)	8(7.3)	109(100)		
OA							
Yes	6(18.8)	8(25.0)	14(43.7)	4(12.5)	32(100)	<0.001*	27.269
No	57(55.9)	28(27.5)	13(12.7)	4(3.9)	102(100)		

*statistical significance. HTN- Hypertension, DM- Diabetes Mellitus OA- Osteoarthritis

There was a mean systolic blood pressure of 136.2±22.0mmHg with a range of 87.0 to 230.0mmHg and a mean diastolic blood pressure of 82.6±13.5mmHg with range of 55.0mmHg to 125.0mmHg.

There were 104 (53.6%) respondents with normal blood pressure readings and 90 (46.4%) with elevated blood pressure readings.

Table 2 Relationship between the examination findings and Overweight/obesity Fisher's corrected

	Over weight n=63(%)	**Obesity I n=36(%)**	**Obesity II n=27(%)**	**Obesity III n=8(%)**	**Total n (%)**	***x*² (p-value)**	**95% CI**
Blood Pressure							
Normal	35(53.0)	19(28.8)	10(15.2)	2(3.0)	66(100)	7.937	
Elevated	28(41.1)	17(25.0)	17(25.0)	6(8.8)	68(100)	0.153	0.192-0.208
Gait							
Normal	63(48.4)	34(26.2)	25(19.2)	8(6.2)	130(100)	7.983	
Abnormal	0(0)	2(50.0)	2(50.0)	0(0.0)	4(100)	(0.77)	0.178-0.193

Majority (53.0%) of the respondents with normal blood pressure measurements were in the overweight class, while the minority (3.0%) were in the obesity III class. Concerning the respondents with elevated blood pressure

measurements 41.1% were overweight, while the rest were obese. This relationship between blood pressure and overweight/ obesity was not statistically significant. (p=0.153) as seen in table 2.

Amongst the respondents with a normal gait, 48.4% were in the overweight class while the rest were obese. All the respondents with abnormal gaits were in either the obesity I or II classes. The relationship between gait and overweight / obesity (table 2) was not statistically significant (p= 0.77).

The mean Fasting plasma glucose was 5.79±3.54 mmol/l with a range of 2.69 mmol/l - 27.10 mmol/l. Amongst the respondents with elevated fasting plasma glucose, there were 11 (47.9%) respondents in the overweight class, and non in the obesity III class. Also, 52 (46.9%) of those who did not have elevated fasting plasma glucose were overweight. The relationship between fasting plasma glucose levels and overweight / obesity was not statistically significant (p= 0.505).

Table 3 Relationship between Fasting plasma glucose results and Overweight/Obesity

Elevated FPG	Over weight n=63(%)	Obesity I n=36(%)	Obesity II n=(27%)	Obesity III n=8(%)	Total n (%)	x^2 (p-value)	95%CI
Yes	11(47.9)	7(30.4)	5(21.7)	0(0)	23(100)	4.053	0.651-0.669
No	52(46.9)	29(26.1)	22(19.8)	8(7.2)	111(100)	(0.505)	

Table 4 Relationship between Fasting Lipid Profile Results and Overweight/Obesity

	Over weight n=63(%)	Obesity I n=36(%)	Obesity II n=27(%)	Obesity III n=8(%)	Total n (%)	x^2 (p-value)	95% CI
Abnormal TC							
Yes	14(35.9)	8(20.5)	12(30.8)	5(12.8)	39(100)	12.818	
No	49(51.6)	28(29.5)	15(15.8)	3(3.1)	95(100)	(0.018*)	0.016-0.021
Abnormal TG							
Yes	8(53.3)	4(26.7)	3(20.0)	0(0)	15(100)	2.525	
No	55(46.2)	32(26.9)	24(20.2)	8(6.7)	119(100)	(0.744)	0.834-0.848
Abnormal HDL-c							
Yes	35(49.3)	19(26.8)	13(18.3)	4(5.6)	71(100)	3.566	0.937-0.946
No	28(44.5)	17(27.0)	14(22.2)	4(6.3)	63(100)	(0.627)	
Abnormal LDL-c							
Yes	33(40.7)	22(27.2)	19(23.5)	7(8.6)	81(100)	7.123	0.148-0.162
No	30(56.6)	14(26.4)	8(15.1)	1(1.9)	53(100)	(0.206)	

*Statistical significance. TC-total cholesterol, TG-triglycerides, HDL-c-high density lipoprotein cholesterol, LDL-c-low density lipoprotein cholesterol

The mean Total cholesterol level was 4.58±1.07 mmol/l with a range of 0.67 mmol/l to 7.36 mmol/l while that of triglycerides was 0.99± 0.72 mmol/l with a range of 0.15 mmol/l to 5.50 mmol/l. HDL-c level had a mean of 1.01±0.27 mmol/l with a range of 0.30 mmol/l to 1.59 mmol/l while that of LDL-c was 3.17±0.81 mmol/l with a range of 0.56mmol/l to 5.29 mmol/l. The relationship between Fasting Lipid Profile results and overweight/obesity is shown in table 4.

Of the respondents who had abnormal TC levels, 35.9% were overweight, while the rest were obese. The relationship between Total Cholesterol levels and overweight/ obesity was statistically significant (p=0.018).

The highest proportion of respondents with abnormal triglyceride levels (53.3%) was in the overweight class. Amongst the respondents with normal triglyceride levels, 46.2% were overweight, while 6.7% were in the obesity III class. The relationship between Triglyceride levels and overweight/ obesity was not statistically significant (p=0.744).

Regarding abnormal HDL levels, 49.3% of the respondents were in the overweight class. Amongst those with normal HDL levels, 44.5% were overweight while the rest were obese. The relationship between HDL levels and overweight/ obesity was however not statistically significant (p=0.627)

Of the respondents who had abnormal LDL levels, 33 (40.7%) were overweight while the rest were obese. Majority of respondents with normal LDL levels (56.6%) were overweight, while 1.9% were in obesity class III. The relationship between LDL level and overweight/obesity was not statistically significant (p=0.206).

4. Discussion

Obesity and overweight are on the increase in the developing nations [8]. The comorbidities associated with these diseases have deleterious effect to health and impact greatly on the quality of life of patients, thereby posing a huge economic burden to society. This study was therefore designed to identify the pattern of specific co-morbidities (hypertension, diabetes, osteoarthritis and dyslipidaemia) among overweight/obese patients attending the Family Medicine Clinic of a tertiary hospital in Nigeria.

The findings confirmed the high prevalence of overweight and obesity in the study population and its association with specific comorbidities. The high combined prevalence of overweight and obesity (69.1%) found in this study is comparable to 68.7% obtained in a community based among a market population by Anyabolu et al in Awka, Nigeria [11]. This prevalence was also similar to 71.3% obtained in the United States NHANES (National Health and Nutrition Examination Survey) [12], but however is slightly lower than the prevalence of 78.9% reported by Pantalone et al in a hospital based study among primary care patients in the United States [13]. The slightly higher prevalence obtained in the United States may be attributable to the differences in sample size as well as racial differences. The prevalence of 69.1% obtained in this study is however, higher than values of 28.3% and 47.8% obtained in Nairobi [14], and Europe [15]. The lower rate observed in Nairobi [14] may be as a result of the study having been carried out in an Urban slum. In developing countries, obesity is a problem of the rich and not likely to be prevalent in slum dwellers [16]. Marques et al in Europe used data from cross sectional study involving 20 European countries [15]. The lower rates also reported in the European study may be attributable to the conclusion by Marques et al which was that participants have a tendency to overestimate their height and underestimate their weight measurements, so using these were self-reported values to calculate the BMI would result in lower BMI values [15].

Several studies have associated the development of high blood pressure with increasing BMI [13,17]. Results from this study show that when comparing overweight with obesity, majority of the respondents with a self-reported history of hypertension, were in the obese category. Also, amongst the participants who did not report a prior history of hypertension the majority was in the overweight category. The relationship between a prior history of hypertension and overweight and obesity was statistically significant. Pantalone et al in the USA similarly reported that the proportions of respondents with hypertension increased as the body mass index increased [13]. Sun et al in a retrospective study on the association between obesity and cardiovascular diseases in Chinese adults similarly reported a significant association between rising body mass index and hypertension [17]. In their study also, the proportion of hypertensive adults was higher in the obese than the overweight class.

Although the relationship between blood pressure readings and overweight / obesity in this study was not a statistically significant one, the results show that among the overweight and obese respondents, a higher proportion of those with normal blood pressure readings were in the overweight category, whereas among those with elevated blood pressure readings, the majority were in the obese category. Anyabolu [11] similarly, in a community based cross sectional study in Nigeria, in corroboration with the findings in the present study, reported that 34.6% of those with systolic hypertension and 35.4% of those with diastolic hypertension were overweight as opposed to 40.4% and 45.8% respectively in the obese class.

Several studies have reported a link between rising BMI and developing T2DM [13,18,19]. Results from this study show that of the overweight and obese respondents who self-reported a prior diagnosis of diabetes mellitus, the majority were in the obese category. The results from this study indicate that the prevalence of diabetes mellitus increases as the body mass index increases from the overweight to the obese category. Supporting the findings of this study is that by Pantalone et al in the USA who reported that the prevalence of diabetes mellitus increased as the body mass index increased [13]. Di-Bonaventura in Europe also reported that of the diabetic respondents, 36.25% were overweight,

while 49.3% were obese [18]. Also corroborating the findings of this study are the results from a cross sectional study in Awka, Eastern Nigeria where of the respondents who self-reported a previous diagnosis of diabetes mellitus, more than a half were in the obese category as opposed to 14.1% in the overweight class [19].

This study also showed that the proportion of those with increased fasting plasma glucose results rose with increasing BMI. Of the participants with elevated fasting plasma glucose, a greater proportion was in the obese category than in the overweight category. Similarly, results from a community based study in an urban slum in Kenya showed that of the respondents who had elevated fasting blood glucose levels, 44.6% were obese while 21.5% were overweight [20]. A meta-analysis on the trends in obesity and diabetes across Africa also reported a strong positive association between rising mean BMI levels and diabetes prevalence [21]. Results from this study as well as the findings of the aforementioned studies support the fact that being of above normal body mass index is associated with the development of type II diabetes mellitus.

The relationship between being of above normal body mass index and osteoarthritis has been extensively documented [21,22]. Of the respondents with above normal body mass index who self-reported a previous diagnosis of osteoarthritis, majority were in the obese category. Otang-Mbeng et al in a cross sectional study among adults in Nkonkobe Municipality, South Africa reported that of the participants who had self-reported a previous diagnosis of osteoarthritis, the disease was more prevalent among the obese in comparison to those in the overweight category [21]. Adebusoye et al similarly in a cross-sectional study among adult participants who had been diagnosed with knee osteoarthritis using the American College of Rheumatology (ACR) criteria reported that of the participants with above normal body mass index, 55.5% were obese while 45.5% were overweight [22]. Guh et al in a systematic review and meta-analysis reported that the risk of having osteoarthritis was higher in obese than in overweight individuals [23].

The association between dyslipidaemia and obesity has been well established and this relationship has been explored in several studies [13,17,24,25]. The findings from this study revealed that amongst the respondents with above normal BMI, a larger proportion of participants who had abnormal total cholesterol, HDL-c and LDL-c levels were in the obese category.

The mean total cholesterol level of 4.58±1.07mmol/L obtained in this study is comparable to that of 4.92±1.00mmol/L reported in Eastern Nigeria [24]. Sun et al reported that the odds of dyslipidaemia were higher in obese than overweight individuals [17]. Rao et al in a cross-sectional study also reported significant associations between increasing body mass index and increased odds of dyslipidaemia in obese than in overweight individuals [25].

In contrast to the association between increasing BMI and increasing LDL-c is the report by Pantalone et al in the USA who reported no appreciable difference in the levels of LDL-c among the different BMI categories [13]. Also contrary to the findings of this study was their finding of a higher proportion of obese respondents with increased triglyceride levels in comparison to overweight respondents. They however reported a decrease in the proportions of respondents with abnormal HDL-c levels in obese respondents in comparison to overweight respondents as was the finding in the present study. The possible reason for the differences between both studies may be due to a much larger sample size in the USA study. It may also have been secondary to differences in the dietary habits of both populations or the influence of treatment for dyslipidemia which was not explored in either study.

5. Conclusion

This study reported the pattern of specific comorbidities among overweight and obese individuals attending a Family Medicine Clinic in a tertiary hospital in Nigeria. It demonstrated a statistically significant association between being either overweight/obese and being hypertensive or developing knee osteoarthritis. Though the findings of an association between dyslipidaemia and diabetes mellitus with being of above normal BMI were not statistically significant ones, this study reveals a high prevalence of both diseases in our environment. Knowledge about the predispositions to developing overweight and obesity and putting preventive measures in place will go a long way in reducing the prevalence of both diseases and the associated non-communicable diseases.

Limitations

- This was hospital-based study therefore the respondents may not be a truly representative sample of the community so caution should be applied when extrapolating to different populations.
- Some variables not included in the study such as familial predispositions, physical activity levels, dietary patterns and the effect of drug therapy may confound the results.

Compliance with ethical standards

Acknowledgments

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Disclosure of conflict of interest

The authors declare no conflict of interest.

Statement of ethical approval

Ethical approval was given by the Rivers State Health Research Ethics Committee (November 2017).

Statement of informed consent

A written informed consent was obtained from the proposed study participants before recruitment in accordance with ethical principles.

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