PATTERN OF ABDOMINAL ADIPOSITY AND ITS ASSOCIATION WITH HYPERTENSION AND PREDIABETES IN OGBOMOSO, NIGERIA

ABSTRACT

Aims: To determine pattern of abdominal adiposity and its association with prediabetes and hypertension.

Study Design: The study was a descriptive cross-sectional study.

Place and Duration of Study: The study was conducted at Bowen University Teaching Hospital, Ogbomoso and the data was collection between September and October, 2014.

Methodology: A total of 121 participants were recruited using the systematic random sampling. A standardized questionnaire was administered to obtain the socio-demographic, physical activity and clinical parameters. Physical measurements of waist circumferences were done using a flexible tape rule. Blood pressure measurement was done with a mercury sphygmomanometer and a Littman's stethoscope. Biochemical measurements of fasting plasma glucose and 2 hour post prandial plasma glucose test were determined using the enzymatic method.

Results: The prevalence of abdominal obesity among the participants was 40.5%. The prevalence among the female was 54.0% and among the male was 5.9% ($p<0.001$). The prevalence of prediabetes among the participants who had abdominal obesity was 16.3% while it was 8.5% among the participants who had normal abdominal adiposity ($p=0.624$). The prevalence of hypertension among the participants who had abdominal obesity was 55.1% while it was 21.3% among the participants who normal abdominal adiposity.

Conclusion: The prevalence of abdominal obesity (40.5%) found among our study participants was high. There was a statistically significant association between abdominal obesity and hypertension. The prevalence of prediabetes was found to be higher in participants who had abdominal obesity (16.3%) than those with normal abdominal fat (8.5%), though the association was not statistically significant.

Keywords: ***Abdominal obesity, hypertension, prediabetes and physical activity.***

1. INTRODUCTION

Abdominal adiposity refers to the presence of excess fat in the abdominal area and it is usually determined by measuring the waist circumference (WC). The prevalence of abdominal obesity is growing at an alarming rate all over the world

(1). The prevalence has reached a similarly high rate in low, middle, or high-income countries (1). More than 1 billion adults are overweight, and at least 300 million of them are clinically obese (1).
Studies have found that measures of abdominal obesity are better predictors of cardiovascular disease risk, (2) although using multiple measures, including BMI may increase sensitivity. Unhealthy diets and physical inactivity are the main contributors to abdominal adiposity. Abdominal adiposity can either be visceral or subcutaneous adiposity. Abdominal adiposity especially visceral adiposity is associated with a range of metabolic disorders, including dyslipidemia, impaired glucose tolerance and insulin insensitivity, hypertension, and others (2). Abdominal overweight is associated with a WC of 94 cm to 101cm for men and 80 to 87 cm for women, whilst abdominal obesity is associated with a WC measurement equal or exceeding 102 cm (for men) or 88 cm (for women) (2)
Prediabetes is a medical condition where blood sugar levels are higher than normal, but not high enough to be diagnosed as type 2 diabetes (3). It encompasses impaired fasting plasma glucose and 2 hours postprandial glucose. It is characterized by a reduced peripheral insulin sensitivity, near normal hepatic insulin sensitivity, progressive loss of beta cell function, and inappropriately elevated glucagon secretion (4,5). The people with prediabetes are at a risk of developing type 2 diabetes, heart disease, and stroke. Prediabetes is characterized by fasting glucose between 5.6 and 6.9 mmol/L and/or postprandial glucose of 7.8 to 11.1 mmol/L (6).
Hypertension is defined as a sustained elevation of blood pressure above 140mmHg systolic and or above 90mmHg diastolic. Hypertension significantly increases the risks of heart, brain, kidney and other diseases. An estimated 1.28 billion adults aged 30-79 years worldwide have hypertension and about two-thirds of them are living in low- and middle-income countries. About 46% of adults with hypertension are unaware that they are hypertensive. Less than one- half of adults (42%) who were diagnosed to be hypertensive are actually not receiving any treatment for the hypertension. Hypertension is a major cause of premature death worldwide. One of the global targets for noncommunicable diseases is to reduce the prevalence of hypertension by 33% between 2010 and 2030 (7).
This study aimed to determine pattern of abdominal adiposity and its association with prediabetes and hypertension.

2. MATERIAL AND METHODS

Study area
Ogbomoso is a town in Oyo state and it is located about 100 kilometers north of the capital city Ibadan, in the western part of Nigeria. The indigenous people are mainly farmers and traders.

Study Center
The study was carried out in the General Out Patient Department of the Bowen University Teaching Hospital (formerly known as Baptist Medical Centre, until December 1st, 2009), Ogbomoso. It is a 240-bed teaching hospital which renders primary, secondary and tertiary health care services. It is a referral center for many other hospitals in and around Ogbomoso.

This was a cross-sectional descriptive study, conducted between September and October 2014. The study population consisted of respondents aged 18 years and above attending the General Outpatient Depatment of the Bowen University Teaching Hospital Ogbomoso. All consenting respondents 18 years and above attending the General Outpatient clinic of the Bowen University Teaching Hospital, Ogbomoso were recruited into the study. The exclusion criteria include participants who were known diabetics, participants who were very ill**,** all pregnant women (this was determined using history and last menstrual period) and non-consenting patients.

The participants were recruited using the systematic random sampling and a total of 121 participants were recruited for the study. A standardized questionnaire was then used to obtain the socio-demographic, level of physical activity and clinical parameters.

Physical measurements of waist circumferences were done using a flexible tape rule. Blood pressure measurement was done with a mercury sphygmomanometer made by Dekamet Accosson in England with adult cuff size and a Littman's stethoscope. Biochemical measurements of fasting plasma glucose and 2 hour post prandial plasma glucose test were determined by the laboratory using the enzymatic method (glucose oxidase and peroxidase enzymes). The machine used was the SP 830 PLUS Metertech made in Germany.

Physical Activity Level: Classification of physical activities commonly undertaken by individuals in their daily living was done into vigorous work and leisure activities; and moderate work and leisure activities respectively. Applying the Metabolic Equivalent Method (MET) to the activity levels of participants, their total physical activity levels were calculated (8). MET is the ratio of a person's working metabolic rate relative to the resting metabolic rate. One MET is defined as the energy cost of sitting quietly, and is equivalent to a caloric consumption of 1 kcal/kg/hour. It is estimated that, compared to sitting quietly, a person's caloric consumption is four times as high when being moderately active, and eight times as high when being vigorously active. For the calculation of a categorical indicator, the total time spent in physical activity during a

typical week, the number of days as well as the intensity of the physical activity was taken into account. *Total physical activity= time spent (minutes) x number of days per week x intensity of activity i.e. MET value*. Using the MET, the physical activity level of participants was classified as high if a minimum of 3,000 MET-minutes per week was achieved; moderate for a value of between 600 to 2999 MET-minutes per week; a person with less than 600 MET-minutes per week was described as having a low level of physical activity.

Blood Pressure Measurement: The blood pressure readings were taken on arrival after the participant had rested for at least 10minutes. The blood pressure was measured using a mercury sphygmomanometer and a Littman's stethoscope at the right mid arm with the respondent in the sitting position. The average of two readings taken 5 minutes apart was recorded. Hypertension was defined as a systolic pressure of ≥ 140mmHg and/or a diastolic blood pressure of ≥ 90mmHg (2) The systolic and diastolic blood pressures were used to categorise participants into hypertensives, and non-hypertensives.

Waist measurement: Waist circumference was determined using a flexible measuring tape and measured to the nearest 0.01 meters as the participant was standing erect with the arms at the side and feet together. The landmarks for the waist circumference were the midway between the lower border of the rib cage and the left and right anterior superior iliac spines.

Metabolic Studies: These were carried out after an eight to twelve (8 to 12) hours fast. Metabolic studies were done on the same day for participants already fasting overnight (determined using previous day dietary history). Participants who did not fulfill this requirement had their metabolic studies rescheduled to the following day after observing the overnight fast. Fasting plasma samples were taken from each respondent. The blood sample was analyzed for glucose in the laboratory. Subsequently, 75g of anhydrous glucose was dissolved in 500 ml of water and given to each participant to drink. A repeat veno-puncture was then performed after 2 hours from the time of commencement of the glucose drink, to obtain another sample of venous blood from each participant for the determination of the postprandial plasma glucose level. Based on the results, each patient was appropriately categorized using the WHO criteria for IGT, which was a 2 hour (post oral 75g of glucose) plasma glucose (2hPG) level of between 7.8 to 11.1mmol/L (6,7). Prediabetes is characterized by fasting glucose between 5.6 and 6.9 mmol/L and/or postprandial glucose of 7.8 to 11.1 mmol/L. Diabetes mellitus was classified as a 2hPG level of greater than 11.1mmol/L, while normal 2hPG level was classified as plasma values less than 7.8mmol/L.

Data Analysis

The completed copies of the questionnaire and measurements were collected, coded, and serially entered into a computer. The data was analyzed using the statistical package for social sciences (SPSS) version 17.0. All descriptive statistics such as frequencies, percentages, means and standard deviations were generated for quantitative variables, while for categorical variables; tables were used for data presentation. The Chi-square and Fisher's exact test were used to test associations. The p-value was set at 0.05 (p-value < 0.05 was regarded as statistically significant) at 95% confidence interval.

3. RESULTS AND DISCUSSION

The age of the respondents ranges from 19 to 90 years, with a mean age of 42.39 ± 16.21 years. Thirty-four (28.1%) participants were males while 87 (71.9%) were females, giving a male-female ratio of 0.4:1. Almost one-third (30.6%) of participants had obtained a university degree. The overwhelming majority (95.8%) of participants were of the Yoruba ethnicity, and almost two-thirds (60.3%) were married. More than one-half of the participants (54.5%) earned less than 25000 Naira/month.

The prevalence of abdominal obesity among the participants was 40.5%. The prevalence among the female was 54.0% and among the male was 5.9% (p<0.001). The prevalence of low physical activity was 28.9%. More than one-third (36.4%) of the participants were hypertensive and 14.0% of them were classified as having prediabetes.

TABLE 1: SOCIODEMOGRAPHIC CHARACTERISTICS OF THE PARTICIPANTS

VARIABLE	FREQUENCY, N=121	PERCENTAGE (%)
Sex		
Male	34	28.1
Female	87	71.9
Age (years)		
Less than 30	36	29.8
30-39	16	13.2
40-49	19	15.7
50-59	32	26.4
60 and above	18	14.9
Mean age	42.39±16.21	
Education		
No formal education	12	9.9
Primary	14	11.5
Secondary	25	20.7
Polytechnic/college of Education	33	27.3
University	37	30.6
Ethnicity		
Yoruba	116	95.8
Igbo	3	2.5
Hausa	2	1.7
Marital Status		
Single	41	33.9
Married	73	60.3
Divorce	1	0.8
Widowed	6	5.0
Occupational status		
Unemployed	2	1.7
Self employed	20	16.5
Student	39	32.2
Retired	8	6.6
Civil service	52	43.0
Monthly income (Naira)*		
< 25000	66	54.5
26000-50000	27	22.3
51000-75000	10	8.3
>76000	18	14.9

TABLE 2: PREVALENCE OF SOME VARIABLES

VARIABLE	FREQUENCY, N=121	PERCENTAGE (%)
ADIPOSITY		
Normal	47	33.8
Overweight	25	20.7
Obesity	49	40.5
PHYSICAL ACTIVITY		
High	1	0.8
Moderate	85	70.3
Low	35	28.9
HYPERTENSION		
Normotensive	77	63.6
Hypertensive	44	36.4
CLASSIFICATION BASED ON IGT AND IFG		
Normal	99	81.8
Prediabetes	17	14.0
Diabetes	5	4.2
FAMILY HISTORY OF DIABETES		
Yes	28	23.1
No	93	76.9

The age group 40-49 years had the highest proportion (68.4%) of participants with abdominal obesity (p=0.013). The prevalence of hypertension among the participants with abdominal obesity was 61.4% while it was 22.7% among the participants with normal abdominal adiposity (p=0.002). The prevalence of low physical activity among the participants with abdominal obesity was 22.4% while it was 34.0% among the participants with normal abdominal adiposity. (p=0.453). The prevalence of prediabetes among the participants who had abdominal obesity was 16.3% while it was 8.5% among the participants who had normal abdominal adiposity (p=0.624). Sixteen (57.1%) of the participants who had normal abdominal adiposity had positive family history of diabetes while 39.4% of the participants with abdominal obesity had positive family history of diabetes. (p=0.018).

TABLE 3: ASSOCIATION BETWEEN ABDOMINAL ADIPOSITY AND SOCIODEMOGRAPHIC CHARACTERISTICS.

VARIABLE	ABDOMINAL ADIPOSITY			χ2	P-VALUE
	NORMAL	OVERWEIGHT	OBESE		
AGE RANGE					
< 30	21(58.3)	8(22.2)	7(19.4)		
30-39	9(56.2)	3(18.8)	4(25.0)		
40-49	3(15.8)	3(15.8)	13(68.4)	F= 18.751	0.013
50-59	9(28.1)	7(21.9)	16(50.0)		
≥60	5(27.8)	4(22.2)	9(50.0)		
Total	47(38.8)	25(20.7)	49(40.5)		
SEX					
Male	26(76.5)	6(17.6)	2(5.9)		
Female	21(24.1)	19(21.8)	47(54.0)	31.435	0.000
Total	47(38.8)	25(20.7)	49(40.5)		
LEVEL OF EDUCATION					
No Formal Education	5(41.7)	3(25.0)	4(33.3)		
Primary	4(28.6)	2(14.3)	8(57.1)		

Secondary	8(32.0)	5(20.0)	12(48.0)	F=4.669	0.808
Polytechnic/college of edu	12(36.4)	7(21.2)	14(42.2)		
University	18(48.6)	8(21.6)	11(29.7)		
Total	47(38.8)	25(20.7)	49(40.5)		
FAMILY HISTORY					
Yes	16(57.1)	7(25.0)	5(17.9)		
No	31(33.3)	18(19.4)	44(47.3)	8.083	0.018
Total	47(38.8)	25(20.7)	49(40.5)		
MARITAL STATUS					
SINGLE	25(61.0)	9(22.0)	7(17.1)		
MARRIED	21(28.8)	15(20.5)	37(50.7)		
DIVORCED /SE	0(0.0)	0(0.0)	1(100.0)	F=18.197	0.001
WIDOWED	1(16.7)	1(16.7)	4(66.7)		
Total	47(38.8)	25(20.7)	49(40.5)		
ETHNICITY					
YORUBA	46(39.7)	22(19.0)	48(41.4)		
IGBO	1(33.3)	2(66.7)	0(0.0)		
HAUSA	0(0.0)	1(50.0)	1(50.0)	F=5.661	0.087
Total	47(38.8)	25(20.7)	49(40.5)		
OCCUPATION					
UNEMPLOYED	0(0.0)	0(0.0)	2(100.0)		
STUDENT	6(30.0)	6(30.0)	8(40.0)		
CIVIL SERVANT	21(53.8)	8(20.5)	10(25.6)	F= 9.670	0.237
SELF EMPLOYED	2(25.0)	1(12.5)	5(62.5)		
RETIRED	18(34.6)	10(19.2)	24(46.2)		
TOTAL	47(38.8)	25(20.7)	49(40.5)		

TABLE 4: ASSOCIATION BETWEEN ADIPOSITY, HYPERTENSION, PREDIABETES, PHYSICAL ACTIVITYAND FAMILY HISTORY OF DIABETES.

VARIABLE	**ABDOMINAL ADIPOSITY**			**χ2**	**P-VALUE**
	NORMAL	**OVERWEIGHT**	**OBESE**		
HYPERTENSION					
NORMOTENSIVE	37(78.7)	18(72.0)	22(44.9)		
HYPERTENSIVE	10(21.3)	7(28.0)	27(55.1)	12.814	0.002
PHYSICAL ACTIVITY					
HIGH	1(2.1)	0(0.0)	0(0.0)		
MODERATE	30(63.8)	17(68.0)	38(77.6)		
LOW	16(34.0)	8(32.0)	11(22.4)	F=3.584	0.453
CLASSIFICATION BASED ON IGT AND IFG					
NORMAL	41(87.2)	19(76.0)	39(79.6)		
PREDIABETES	4(8.5)	5(20.0)	8(16.3)		
DIABETES	2(4.3)	1(4.0)	2(4.1)	F=2.561	0.624
FAMILY HISTORY					
Yes	16(34.0)	7(28.0)	5(10.2)		
No	31(66.0)	18(72.0)	44(89.8)	8.083	0.018

Discussion

It was discovered from this study that female constituted more than two-third (71.9%) of the study population. This is not surprising because it is a hospital-based study and women visit the hospital more than their male counterpart. Nearly one-third (29.8%) of our participants were below 30 years. This is the age group that is less likely to be affected by the subject matter. More than one-half of our study participants (54.5%) earned less than 25000 Naira/month and this is not unexpected because less than one-third (30.6%) of them had University education.

The prevalence of abdominal obesity found among our study participants was 40.5%. The value obtained in this study was higher when compared with what was obtained by Chukwuonye et al (21.75%) in Abia State (8) and Iloh et al (11.6%) in Imo State (9), Nigeria. The difference may be due to the fact that our study was a hospital-based study while the Abia and Imo studies were community-based study. We found a much higher prevalence of abdominal obesity among the female (54.0%) than male (5.9%) and this finding was statistically significant. This same pattern was observed in the Abia (8) and Imo (9) studies.

It was observed that moderate intensity physical activity was the most prevalent form of physical activity encountered among participants in this study, found in 85 (70.3%) of the participants. This finding was comparable to the observation from the Nigeria's 2013 Report Card on Physical activity, where moderate intensity activity level was found to be most prevalent (10). The prevalence of abdominal obesity was observed to be higher among the participants with moderate intensity physical activity (44.7%) than those with low physical activity (31.4%). Though, this finding was not statistically significant (p=0.453)

We discovered that more than one-third (36.4%) of our study participants were hypertensive. This finding was lower than what was found by Ahaneku et al (44.5%) in Enugu State (11), Nigeria. Our study revealed that the prevalence of hypertension was much higher among the participants who were obese (61.4%) than those who had normal abdominal fat (22.7%). This association was statistically significant. (p=0.002). This finding is in line with what Ahaneku et al found in Enugu State, Nigeria (11). They observed a statistically significant association between hypertension and obesity.

The prevalence of prediabetes found among the participants in our study was 14.0%. This finding was very close to what was found in Indonesia (10.0%) by Pradana et al (12). The prevalence of prediabetes was found to be higher in participants who had abdominal obesity (16.3%) than those with normal abdominal fat (8.5%). Though, this finding was not statistically significant (p=0.624). This finding was surprising and it may not be unconnected with the fact that majority of the participants with normal abdominal fat (57.1%) had positive family history of diabetes while fewer number of those with abdominal obesity had (17.9%) positive family history of diabetes.

4. CONCLUSION

The prevalence of abdominal obesity (40.5%) found among our study participants was high. It was much higher among the female (54.0%) than male (5.9%). There was a statistically significant association between abdominal obesity and hypertension. The prevalence of prediabetes was found to be higher in participants who had abdominal obesity (16.3%) than those with normal abdominal fat (8.5%), though the association was not statistically significant.

ETHICAL APPROVAL AND CONSENT

The study was reviewed by the ethical committee of Bowen University Teaching Hospital, Ogbomoso and ethical approval was obtained. All the participants gave informed consent to the research work.

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