European Journal of Preventive Medicine
2013; 1(3): 70-78
Published online January 10, 2014 (http://www.sciencepublishinggroup.com/j/ejpm)
doi: 10.11648/j.ejpm.20130103.14

Prevalence and family biosocial predictors of abdominal obesity among adult Nigerian Africans in a resource constrained setting of a rural hospital in Eastern Nigeria

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To cite this article:
Gabriel Uche Pascal Iloh, Agwu Nkwa Amadi, Augustine Obiora Ikwudinma, Patrick Uchenna Njoku. Prevalence and Family Biosocial Predictors of Abdominal Obesity among Adult Nigerian Africans in a Resource Constrained Setting of a Rural Hospital in Eastern Nigeria. *European Journal of Preventive Medicine.* Vol. 1, No. 3, 2013, pp. 70-78. doi: 10.11648/j.ejpm.20130103.14

Abstract: Background: The variability of abdominal obesity within and across families is influenced by several factors. However, the relevance of family biosocial factors in the variability of abdominal obesity is an important health care challenge that is often neglected especially in this era of personalized medicine. Aim: This study was designed to determine the prevalence and family biosocial predictors of abdominal obesity among adult Nigerian Africans in a resource constrained setting of a rural hospital in Eastern Nigeria. Materials and Methods: A cross sectional analytic study carried out on 3012 adult patients aged 18-91 years who were screened for abdominal obesity using the Third Report of National Cholesterol Education Panel (NCEP) in adult (ATP III) criterion and 350 patients who had waist circumference (WC) ≥102cm and ≥88cm for men and women respectively and met the inclusion criteria were age and sex matched with 350 non-obese, non-hypertensive and non-diabetic control. Family bio-social variables were obtained using a pretested, structured and interviewer-administered questionnaire. Hypertension and diabetes mellitus were defined using Joint National Committee 7 Report on Prevention, Detection, Evaluation and Treatment of High Blood Pressure and American Diabetic Association criteria respectively. Results: .The prevalence of abdominal obesity was 11.6%. The family biosocial variables significantly associated with abdominal obesity were family history of obesity (p=0.036) and family inadequate dietary fruits consumption (p=0.042). The most significant predictor of abdominal obesity was family history of obesity (OR=2.60, CI=0.95-13.01, p=0.022). The patient with family history of obesity was two and half times more likely to be obese than those without family history of obesity. Conclusion: Abdominal obesity is associated with family history of obesity and inadequate dietary fruits consumption. The interventional control programs for abdominal obesity should consider these risk factors alongside the complex of other cardiovascular risk factors.

Keywords: Abdominal Obesity, Family Biosocial Predictors, Hospital, Rural Nigeria

1. Introduction

Abdominal obesity is socially acceptable among Nigerian Africans and therefore is not usually recognized as a health risk.[1-3] It is a medical problem in which excess fat has accumulated in the abdomen to the extent that it may have an adverse effect on health and/or increase medical problems.[1,2] It was once thought the health problem of affluent advanced countries but now exists in Nigeria in varying prevalence ranges[1-3,5] and has been described as a time bomb for the future explosion in the frequency of cardiovascular disease and metabolic syndrome.[1,4,5] Globally, in the past, abdominal obesity was viewed as a sign of wealth and wellness.[1,3,6] However, in the present, public perceptions of healthy body shape and weight have changed significantly since the beginning of the epidemic of obesity, metabolic syndrome and cardiovascular diseases. [6-8] Normal adiposity of the

abdomen (flat abdomen) is viewed as the ideal abdominal adiposity in western societies [6,7] in contrast to the perception in traditional Nigerian societies where protruding abdomen (abdominal obesity) is culturally perceived as a symbol of good health and wealth.[1,3,5]

The clinical criteria for defining obesity have been variously described including anthropometric measurement of body mass index, [9, 10, 11] waist circumference (WC), [1,5] waist hip ratio, [2] neck circumference [12] among others and imaging techniques such as computed tomography scan and magnetic resonance imaging.[1,2] Although, the imaging methods are the gold standard for assessing abdominal adiposity, they are expensive for large scale epidemiological studies.[1,2] Waist circumference is therefore one of the most popular measures of abdominal adiposity and the simplest anthropometric index of abdominal obesity. [1,2] The validity of WC as a measure of abdominal obesity is further supported by its association with obesity-related risk factors [1,7,13] and a crucial correlate of metabolic syndrome.[14] The waist circumference therefore provides an easy method of describing pattern of abdominal obesity even if the body mass index is about right.[5,15] The metabolic and structural changes in obese individuals are most often seen in abdominal obesity [1,15,16] and have consistently been related to increased risk of coronary heart disease in men[17] and women.[18] Obesity is defined using waist circumference (WC) criterion as an excess of adipose tissues resulting in waist circumference ≥102cm (40 inches) and ≥88cm (35 inches) for men and women respectively.[19] Similarly, abdominal overweight refers to the waist circumference between 94-101cm and 80-87cm for men and women respectively.[19]

The prevalence of obesity as defined by waist circumference in the developing nations such as Nigeria is changing.[1,2,4,5] Ongoing nutritional, socio-economic and demographic, family-related lifestyle and epidemiologic changes in Nigeria have contributed to the burden of abdominal obesity.[1,5,20,21] The prevalence of abdominal obesity has been reported within and across populations in Nigeria[1,2,5,22] and other parts of the world such as United States of America,[23], South Korea [24] and Cotonou, Benin Republic.[25] In Nigerian Africans a prevalence of 50.8% was reported among geriatric hypertensives in Amurie Omanze, Imo state[1]; 21.7% was reported in selected rural and urban communities of Abia state, Nigeria;[5] 31.7% was reported in Okirika, Rivers state, Nigeria;[2] 16.9% was reported in Port Harcourt, Nigeria, [2] and 33.8% was reported in Ogbomoso, Western, Nigeria.[22]

The development of any medical conditions such as abdominal obesity is influenced by predisposing, promotional and enabling risk factors and these factors interact to contribute to the morbid clinical picture.[1,2] The predisposition factors include family-related bio-social characteristics such as type of family, family structure, family size, type of marriage, family diets, family physical activities, and family history of cardio-metabolic disorders among others.[1,9,10,11] These family biosocial variables have been documented to influence disease morbidity profiles in Nigerian families.[11,26,27] The promotional factors include health promotional and wellness technologies and programs. The enabling factors include quality of care, policy direction on obesity control services and existence of public health network for obesity. Studies have also shown that family environment is instrumental in the development of obesity and obesity tend to cluster in families with variable distribution and penetrance.[11,21,28,29,30] Although, the mechanisms involved in the development of obesity have been elucidated but there is now evidence for strong genetic influence and most human obesity develops from the interactions of multiple genes, environmental and behavioural factors.[30,31]

The variability of abdominal obesity within and across Nigerian populations have been reported in different parts of the country.[1,2,5,22] However, there is absence of data on family biosocial factors associated with abdominal obesity in Nigeria. Failure to recognize abdominal obesity as a family health condition has serious implications for control interventions. Identification of these family biosocial associations and targeting them for primary prevention will improve the health status of Nigerians in the study area as regards abdominal obesity and its medical correlates. It is against this background that this study was designed to determine the prevalence and family biosocial predictors of abdominal obesity among adult Nigerian Africans in a resource constrained setting of a rural hospital in Eastern Nigeria.

2. Materials and Methods

2.1. Ethical Consideration

Ethical certificate was obtained from the Ethics Committee of the hospital. Informed consent was also obtained from respondents included in the study.

2.2. Study Design

This was a hospital-based cross sectional analytic study carried out between June 2008 and June 2011. A total of 3012 adult patients aged 18-91 years were screened for abdominal obesity using the Third Report of National Cholesterol Education Panel(NCEP) in adult (ATP III) criterion and 350 patients who had WC ≥102cm and ≥88cm for men and women respectively were age and sex matched with 350 non-obese, non-hypertensive and non-diabetic control.

2.3. Study Setting

Amurie-Omanze is a rural community in Imo State, South-East Nigeria. Imo State is endowed with abundant mineral and agricultural resources with supply of professional, skilled, semi-skilled and unskilled manpower. Economic and social activities are low compared to

industrial and commercial cities such as Onitsha, Port Harcourt and Lagos in Nigeria.

St Vincent De Paul Hospital is a rural General Hospital in Imo state, South-east Nigeria and renders twenty four hours service daily including public holidays to the community.

2.4. Study Population

The study population was made up of 350 adult patients who had abdominal obesity and met the inclusion criteria. This category of patients constituted the cases. The control population was also selected from outpatient clinic of the hospital and was made up of 350 non-abdominally obese, non-hypertensive and non-diabetic patients.

The control group was matched for age and sex with the cases. The matching for the age was based on age group matching as in the case category. The cases and control were studied simultaneously during the study period

2.5. Inclusion and Exclusion Criteria

The inclusion criteria were abdominally obese patients aged ≥ 18 years who gave informed consent for the study. The exclusion criteria were critically ill patients, pregnant women, women in pueperium, patients with demonstrable ascites and intra-abdominal masses determined by history and physical examination. The five patients that were used in pre-testing the questionnaire who may be influenced by their previous interaction with the content of the questionnaire were also excluded.

2.6. Sample Size Determination

The sample size (N) was calculated using the formula for comparative study [32] $N= [(Z\alpha + Z\beta) \times 2pq]/d^2$ Where N = Desired sample size, Z= The standard normal deviate set at 1.96 which correspond to 95% confidence level. P = the prevalence of abdominal obesity of 33.8% from a previous study in Ogbomoso, Nigeria.[22] q= 1.0 – p, and d=degree of precision desired set at 0.05 The level of significance was set at 5%(α=0.05) while the power of the study(1-β) was set at 80%. $N= [(1.96x0.05+1.96x0.2) x 2x0.33x0.67]/0.05^2$ =86. Therefore, N = 86.

The calculated minimum sample size was 86. However, to improve the precision of the study, the estimated sample size=Ns was determined considering an anticipated response rate of 90% (0.9). The estimated sample size (Ns) was determined by dividing the original calculated sample size (N) by the anticipated response rate [33] as follows, Ns= N/0.9, where N=Minimum calculated sample size, Ns=Selected sample size, anticipated response rate=0.9. Thus, the estimated sample size = 86/0.9= 95. However, a sample size of 350 cases and 350 control groups were used for representativeness of the study population.

2.7. Sampling Technique

Sample selection was done consecutively based on the inclusion criteria for the abdominally obese patients. The control group was selected simultaneously based on those that met the matching criteria with the cases.

2.8. Diagnostic Procedures

The waist circumference was measured using flexible non-stretchable tape.[1,33] The subject stood erect with arms at the side and feet together. The researcher faced the subject. The iliac crest and lower rib cage were first identified by palpation. The waist circumference was taken as the midpoint between the lower border of lower rib cage and iliac crest in a horizontal plane parallel to the floor.[1]

The blood pressure was measured using auscultatory method with standard mercury in glass Accuson sphygmomanometer.[1,9-11,28,33] The blood glucose was determined after an overnight fast between 8.00 hours to 10.00 hours using venous plasma by glucose oxidase method.[1,9-11,28,33] A repeat fasting plasma glucose was done for those who had abnormal fasting plasma glucose test result on the next scheduled clinic visit.

2.9. Diagnostic Criteria

Abdominal overweight was defined as waist circumference from 94cm to 101 cm for men and 80cm to 87cm for women while abdominal obesity was defined as waist circumference ≥102cm and ≥88cm for men and women respectively.[19]

Blood pressure readings were based on the Joint National Committee 7 Report on Prevention, Detection, Evaluation and Treatment of High Blood Pressure classification and guidelines.[1,9-11,28,33,34] Hypertension was defined as systolic and/or diastolic blood pressure≥140/90 mmHg and/or documented use of antihypertensive medications in a previously diagnosed person with hypertension.[34]

Diabetes mellitus was defined based fasting venous plasma glucose of ≥126 mg/dL which was confirmed by a repeat test on second clinic visit or current use of anti-diabetic medications. [35]

2.10. Methods

Data collection instrument had two sections: The basic demographic factors and family biosocial variables. The questionnaire instrument was adapted from the generic WHO-STEPS instrument approach to surveillance of chronic non-communicable diseases risk factors [36] and was modified to suit Nigeria environment through robust review of relevant literature.[1-5,9-11,26-28,37] The basic demographic variables of age, sex, occupation, education and social class and family biosocial factors like type of household, type of marriage, family structure, family size and family histories of primary cardiovascular risk factors such as obesity, hypertension and diabetes mellitus, family dietary fruits and vegetables consumption during meal times and type of oil use in household meal preparations..

The family history of obesity, hypertension and diabetes mellitus was coded as yes or no for the presence or absence of obesity, hypertension and diabetes mellitus in any of the

first, second or third degree generation family members respectively.

The family behavioural risk factor of dietary fruits and vegetables consumption were evaluated by asking how many days in the previous 7 days do the family eat fruits and vegetables. The dietary responses were graded into: never (0 serving/week), rarely (<3 servings/week) and oftentimes (≥3 servings/week). Those who have ≥3 servings/week have adequate dietary fruits intake while those who had 0 serving/week and <3 servings/week have inadequate dietary fruits and vegetables consumption respectively. The question on family dietary use of oils was got by inquiring in the previous 7 days the type of oil used in household meal preparations. The information on family behavioural measurements was based on previous 7 days dietary recall method. This method was expected to give required information on family dietary assessment based on the feasibility and the Nigerian rural practice population setting. The researchers explained briefly the concept of the study and made vigorous effort to maximize positive response in order to minimize the potential for information bias especially response acquiescence and social desirability response.

The pre-testing of the questionnaire was done internally at the hospital using five obese and five non-obese patients from the outpatient clinic. The pre-testing of the questionnaire lasted for two days. The respondents for the pre-testing of the questionnaire were selected haphazardly from the clinic. The pretesting was done to find out how the questionnaire would interact with the respondents and ensured that there were no ambiguities. However, no change was necessary after the pre-test as the questions were interpreted with the same meaning as intended.

The questionnaire instrument was interviewer-administered. Language used was English Language. However, local languages were used to explain verbally to the patients who could not understand the medical language in the questionnaire. The questionnaire was administered once to each eligible respondent.

2.11. Operational Definitions

The researchers defined adult patients as those age 18 years and above.[9-11] Biosocial risk factors of abdominal obesity refer to antecedent condition(s) whose presence is(are) positively associated with an increased probability that abdominal obesity will develop later. The biosocial risk factors studied included the traditional non-modifiable factors of age, sex, family history of obesity, hypertension and diabetes mellitus; modifiable behavioural risk factors of dietary fruits, vegetables and household cooking oils. Family history of obesity, hypertension or diabetes refers to previous information on obesity, hypertension or diabetes mellitus in any of the first, second or third degree generation family members who were dead or alive made by a health professional.[11] Family refers to two parents and their children or single parent family made of either parent and their children. Household family in Nigerian family demographic geography refers to a number of persons eating from the same pot.

2.12. Statistics

The results generated were analyzed using software Statistical Package for Social Sciences (SPSS) version 13.0, Microsoft coperation, Inc. Chicago, IL, USA. Categorical variables were described by frequencies and percentages. Bivariate analysis involving Chi-square test was used to test for the significance of associations between categorical variables. Furthermore, to identify family biosocial variables independently associated with abdominal obesity, simple logistic regression analysis was performed at 95% confidence limit. The level of significance was set at $p<0.05$.

3. Results

Of the 3012 adult patients screened for abdominal obesity, three hundred and fifty were abdominally obese giving a prevalence of 11.6%. One thousand, one hundred and seventy four (39.0%) had pre-abdominal obesity (overweight abdominal adiposity) while one thousand, four hundred and eighty-eight (49.4%) had normal abdominal adiposity.[Table 1]

The age of the abdominally obese patients ranged from 18 years to 91 years with mean age of 48±10.1 years whilst the age of the control group ranged from 18 years to 88 years with mean age of 47±12.5 years. There were one hundred and fifty four (44.0%) males and one hundred and ninety six (56.0%) females with male to female ratio of 1:1.3. Other socio-demographic profiles of the study population are shown in Table 2.

Bivariate analysis of predictor family biosocial variables as related to abdominal obesity showed that family history of obesity(x^2=13.09, P=0.036) and family inadequate dietary fruits consumption(x^2=8.06, P=0.042) were statistically significant while other variables were not statistically significant.[Table 3]

On logistic regression of the statistically significant variables family history of obesity remained statistically significant.[Table 4] A significantly higher proportion of the abdominally obese patients had family history of obesity compared to the non obese control.(OR=2.60, CI=0.95-13.01, P-value=0.022) The abdominally obese patients were two and half times more likely to have family history of obesity compared to the non abdominally obese control.

Table 1. *Distribution of the screened patients based on abdominal adiposity*

Parameter	Number (%)
Normal abdominal adiposity	1488(49.4)
Pre-abdominal obesity (overweight abdominal adiposity)	1174(39.0)
Abdominal obesity	350(11.6)
Total	3012(100.0)

Table 2. *Basic socio-demographic variables of the study population*

Variables	Abdominally-obese cases Number (%)	Abdominally non-obese control Number (%)
Age(years)		
18-39	36(10.3)	36(10.3)
40-60	183(52.3)	183(52.3)
>60	131(37.4)	131(37.4)
Total	350(100.0)	350(100.0)
Sex		
Male	154(44.0)	154(44.0)
Female	196(56.0)	196(56.0)
Total	350(100.0)	350(100.0)
Marital status		
Single	15(4.3)	34(9.7)
Married	233(66.6)	225(64.3)
Widowed	94(26.8)	86(24.6)
Separated/Divorced	8(2.3)	5(1.4)
Total	350(100.0)	350(100.0)
Education		
Primary and less	80(22.9)	44(12.6)
Secondary and more	270(77.1)	306(87.4)
Total	350(100.0)	350(100.0)
Occupation		
Unemployed	36(10.3)	18(5.1)
Student/Apprentice	12(3.4)	10(2.9)
Public/civil servants	39(11.1)	61(17.4)
Farming	107(30.6)	94(26.9)
Trading	46(13.1)	59(16.9)
Artisans	48(13.7)	36(10.3)
Driving	8(2.3)	5(1.4)
Clergy	11(3.1)	16(4.6)
Retirees	43(12.4)	51(14.5)
Total	350(100.0)	350(100.0)
Social class		
Lower class	285(81.4)	213(60.9)
Middle class	47(13.4)	94(26.9)
Upper class	18(5.2)	43(12.2)
Total	350(100.0)	350(100.0)

Table 3. *Family biosocial variables as related to abdominal obesity among the study population*

Variables	Abdominal obesity Number (%)	Non-obese control Number (%)	x^2	P-value
Type of marital union				
Monogamous	329(94.0)	337(96.3)		
Polygamous	21(6.0)	13(3.7)		
Total	350(100.0)	350(100.0)	3.17	0.190**
Type of family structure(household)				
Nuclear household family	320(91.4)	337(96.3)		
Extended household family	30(8.6)	13(3.7)		
Total	350(100.0)	350(100.0)	5.05	0.272**
Type of parenthood				
Single parenthood	102(29.1)	91(26.0)		
Both parenthood	248(70.9)	259(74.0)		
Total	350(100.0)	350(100.0)	2.98	0.106**
Family size				
1 - 4	84(24.0)	111(31.7)		
>4	266(76.0)	239(68.3)		
Total	350(100.0)	350(100.0)	7.09	0.606**
Family history of hypertension				
Yes	233(66.6)	152(43.4)		
No	117(33.4)	198(56.6)		
Total	350(100.0)	350(100.0)	3.14	0.170**
Family history of diabetes mellitus				
Yes	66(18.9)	28(8.0)		
No	284(81.1)	322(92.0)		
Total	350(100.0)	350(100.0)	11.74	0.068**
Family history of obesity				
Yes	318(90.9)	105(30.0)		
No	32(9.1)	245(70.0)		
Total	350(100.0)	350(100,0)	13.09	0.036*
Family dietary fruits consumption				
Adequate	66(18.9)	144(41.1)		
Inadequate	284(81.1)	194(58.9)		
Total	350(100.0)	350(100.0)	8.06	0.042*
Family dietary vegetables consumption				
Adequate	95 (27.1)	106(30.3)		
Inadequate	255(72.9)	244(69.7)		
Total	350(100.0)	350(100.0)	9.14	0.055**
Family dietary oils consumption				
Saturated	283(80.9)	239(68.3)		
Unsaturated	67(19.1)	111(31.7)		
Total	350(100.0)	350(100.0)	3.75	0.264**

Remark: *Significant, **Non-significant

Table 4. *Predictors of abdominal obesity among the abdominally obese patients*

Variables	Odds ratio	Confidence interval (95%)	P-value
Family history of obesity			
No	1.0	0.95 -13.01	0.022
Yes	2.60		
Family dietary fruits consumption			
Adequate	1.0	0.57 – 7.02	0.070
Inadequate	1.78		

4. Discussion

The prevalence of abdominal obesity of 11.6% in this study is less than 31.7% reported among adult patients in Okirika, Rivers State, South-south Nigeria,[2] 21.7% reported in Abia State, South-east Nigeria,[5] 33.8% reported in Ogbomoso, South-west Nigeria [22] and 32.0% reported in Cotonou, Benin Republic. [25] The finding of this study has buttressed the reports that abdominal obesity is an issue of phenomenal medical importance in Nigeria [1,2,5,22] and in other parts of the world such as Cotonou, Benin Republic, [25] United States of America[23], South Korea[24] and Jamaica[38] This study has demonstrated that abdominal obesity is no longer the disease of affluent countries and has corroborated the reports that abdominal obesity exist in Nigeria in variable proportions.[1,2,5,22] The abdominal obese condition could predispose the patients to increase cardio-metabolic morbidity and mortality.[1,2,38] This study therefore creates a pedestal for the patients and their families to understand abdominal obesity as a health risk not an indication of prosperity that can be reduced through lifestyle modifications involving healthy diet, adequate exercise among other diverse interventions. It is therefore pertinent to detect early the development of abdominal obesity in family members particularly among the study population as early intervention may alter morbidity end points. Identification of abdominally obese patients during clinical consultation therefore avails greater opportunities for appropriate health information and health promotion among the family members. Educating these patients and their families on the relevance of waist size determination and its interpretation should be integrated as part of patient and family health education during clinical encounter with abdominally obese patients in the study area.

The family history of obesity was significantly associated with abdominal obesity. Family history of obesity has been reported in previous studies.[2,11,30,31] Accordingly, genetic factors are estimated to explain 30%-50% of hereditability of obesity. [39] This study has buttressed the reports of the growing evidence of genetic influences on the development of human obesity.[2,11,37,40] It is therefore likely that genes and other socio-environmental factors interact and potentiate their individual impact on the pathogenetic mechanisms that lead to the emergence of obesity.[41,42,43,44] The finding of this study is very important especially in Nigerian family environment where abdominal obesity is not always perceived as a health risk. [2,11] Although fats act as storage organ for excess calories, its abdominal distribution is however associated with increased risk of cardiovascular diseases. [1,38] Abdominal obesity can therefore have adverse effects on the family health and can trigger other acute and chronic complications of abdominal obesity in family members.[2,11] Screening adult patients with family history of obesity for abdominal obesity needs to be at initial clinical encounter as the development and damage by abdominal obesity start even before the diagnosis is made. The longitudinal and latitudinal care of these patients should be a family care challenge especially in resource-constrained setting where there are limited options for healthy living.

The result of this study has shown that inadequate family dietary fruits consumption was significantly associated with abdominal obesity among the study population. This could be attributed to low priority given to intake of fruits in study area and a reflection of the Nigerian family diet which is predominantly made of carbohydrate.[2,21] More so, the high cost of dietary fruits in the study area is contributory especially in the environment where subsistence and commercial agriculture is at its low ebb with an economy driven by petroleum and petroleum products. Patho-genetically, the mechanism linking dietary factors with cardio-metabolic disorders such as abdominal obesity has been elucidated in medical research.[42,43,45] However abdominal obesity may be considered to be the consequences of chronic ingestion of excess calories amidst other factors.[44] In addition, a positive energy balance between the amounts of energy consumed over the energy expended in day-to-day life contributes to the aetiopathogenesis of abdominal obesity. [6, 8, 44] Furthermore regulation of energy balance is a complex mechanism involving family behavioural, genetic, hormonal, and neural influences [44, 45]. In this regard, beyond individual preventive actions, intervention at level of families could promote healthy eating and prevent future obesity in the family. This study therefore bring to the fore the prospects of controlling obesity through a family friendly and oriented proactive approaches. It emphasis the need for family based intervention strategies in high risk families which should incorporate the need for adequate family dietary fruits consumption habits and other diverse primary prevention interventions.

The most significant predictor variable of abdominal obesity in this study was family history of obesity. This finding is consistent with other reports on the family history of obesity as an important risk factor for development of abdominal obesity.[2,11,29,30,31] This association could be explained partly by the influence of heredity.[29,31,39] This genetic contribution involves

multiple genes with variable penetrance and expressions. Family studies including twin and adoption studies have established that obesity is heritable, and an individual's risk of obesity is increased when one of his relatives is obese [30]. Apart from genetic predilection, other family behavioural factors such as acquisition of carbohydrate food preference and poor family dietary fruits consumption habits could predispose to emergence of abdominal obesity in the family.[2,37] Although not every patient with family history of obesity are at risk for developing abdominal obesity but their chances are high. Such family members who may not develop abdominal obesity are probably those with low metabolic, behavioural and environmental risk profile. As the prevalence of obesity increases worldwide so will the family history of abdominal obesity increase. With the changing family lifestyle in the study area, the presence of family history of obesity during clinical encounter should provide guide for screening for abdominal obesity and can help tailor health promotion, risk reduction and health maintenance messages to family lifestyle modifications.

4.1. Implications of the Study

Abdominal obesity is commonly overlooked as a family health problem whereas its deleterious effects on metabolic homeostasis and cardiovascular health of family members are enormous. One of the pillars identified that reduces obesity-related medical conditions is early recognition and modification of non-constitutional family-behavioural risk factors. However, families with biosocial factors that predispose to abdominal obesity may not recognize the medical implications of abdominal obesity. Inquiring for the family biosocial factors and consideration of its associated medical impact is very important for effective family health services as regards family health promotion and diverse requirements for abdominal obesity. It is envisaged that the mutable family biosocial factors associated with abdominal obesity may change in the future as a result of family health education, and diverse family socio-behavioural changes.

4.2. Limitations of the Study

The limitations imposed by the study are recognized by the researchers. First and foremost, the waist circumference was taken at a single point in time and the authors had no information on previous measurements. In addition, the authors had no direct measures of abdominal fat or muscle composition. The researchers also anticipated measurement errors and biases for abdominal adiposity. However, there effects were reduced by using non-stretchable tape and training of the researchers. The training of the research team included standardization of measurement of waist circumference. This was to ensure accuracy and reliability and reduce inter- and intra-observer errors and ensure comparability of measurements.

More so, the limitation of not matching the abdominally obese patients for other socio-demographic characteristics such as occupation, marital status, education and socio-economic class among others are recognized by the authors. This was designed to avoid over-matching on the patients socio-demographic characteristics which might lead to variable degree of systematic error.

Information were collected from the consultand or proband and not from all the family members and so the findings may be subject to information bias. This also made it difficult to study other family variables such as family physical activity among others.

The limitation imposed by the cross sectional study design is recognized. The cross sectional study design didn't allow elucidation of the direct effects of predictor family biosocial variables on abdominal obesity and vice versa. The cross sectional design allows only establishment of an association between dependent and independent variables. Further longitudinal studies to explore the interactions as well as studies to unravel its clinical relevance in the study area are advocated.

Furthermore, the authors didn't measure leptin levels because of absence of facilities for it in the study centre. However, high leptin concentrations are not found in every patient with obesity and not all patients with high leptin levels are obese.[37,40] This study therefore provides useful baseline information on which subsequent interventions in the study area could be based and evaluated.

4.3. Strengths of the Study

This is the first study that has highlighted the association between abdominal obesity and family biosocial variables in the study area. The sample size is larger than the minimum estimated sample size and the population of 3012 patients screened for abdominal obesity in a hospital based study is also significant.

5. Conclusion

This study has shown that abdominal obesity is associated with family history of obesity and family inadequate dietary fruits consumption. The interventional control programs for abdominal obesity should consider these predictive risk factors alongside the complex of other cardiovascular risk factors. This will invariably improve the quality of care received by these patients and their families who are living in a resource constrained rural setting.

6. Future Research Direction

In the study area, further hospital-based and community-based studies are recommended in order to further explore other family related risk factors of abdominal obesity and its correlates. This will provide valuable clinical and community epidemiological data for collaborative purposes.

Acknowledgement

The authors are grateful to Rev. Sister Francisca Eya of St. Vincent de Paul hospital, Amurie-Omanze for permission for the study.

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