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Magnitude of Obesity, Abdominal Adiposity and their Association with Hypertension and Diabetes- A Cross Sectional Study

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Abstract

Background: The transition from customary African lifestyles to a "western" standard has resulted in the increase of obesity, abdominal adiposity and diabetes known to contribute significantly to morbidity and mortality rates around the world. We therefore aimed to identify the magnitude of overweight, obesity, abdominal adiposity and hypertension among a sample of patients with type 2 diabetes.

Methods: A sample of convenience was utilized to recruit all Type 2 diabetes patients that attended the 2013 World Diabetes day celebration. Sociodemographic information along with anthropometric measurements was taken (BMI, WC, WHR). Furthermore, blood pressure and fasting blood sugar level was measured for each participant.

Result: Out of the 468 diabetics that participated in this study, majority 248 (53.0%) were males and 220 (47.0%) females. The mean age and FBS was 42.6 ± 11.3 years and 6.9 ± 3.2mm/dl respectively. Hypertension was reported in 226 (48.3%) diabetics; while 182 (38.9%) were within the normal weight range, 41.0% (192) were overweight and 20.1% (94) were obese. A high WC was reported in 51.7% (n=242) and a high WHR in 52.6% (n=246). Obesity was significantly associated with middle-age (40-64 years) (p=0.001, F=15.4) and females (p=0.000, F=15.8). Those who were hypertensive had a significantly higher BMI (p=0.000, F=12.4), WHR (p=0.000, F=2.1) and WC (p=0.000, F=5.2). High WHR and WC was associated with higher FBS (p=0.000).There was a tenuous but significant difference in WHR by gender ($p<0.05$), with females having a higher WHR than males (0.88 ± 0.1 vs. 0.87 ± 0.1). There was a relationship between BMI, WC and WHR.

Conclusion: The proportion of obesity, abdominal adiposity and hypertension among type 2 diabetics is worrisome. Early diagnosis of obesity and abdominal adiposity and advice on lifestyle modification is imperative. Furthermore, a coherent and multifaceted public health strategy aimed at systematically debunking unhealthy myths and encouraging adoption of healthy lifestyles is imperative.

Keywords: Body Mass Index (BMI), Abdominal adiposity, Obesity, Hypertension, Diabetes

Introduction

Developing countries of Africa are vulnerable to the predicted diabetes epidemic, projected to become one of the world's main disabler and killer within the next twenty-five years [1]. This can be attributed to increase in urbanization, which has resulted in a continuous generational paradigm shift of lifestyle from the customary African model to a more "western" standard. Many have abandoned the rural life characterized by agriculture based energy-intensive occupations in search of so-called "white collar" jobs characterized by sedentary lifestyle along with dependence on unhealthy or "junk" meals. Furthermore, as income and social development improves, lifestyles have become more sedentary due to internet communications, computer games, televised entertainment, academic study and private lessons and poor urban planning [2]. Also, healthier conventional lifestyles characterised by regular and vigorous physical activity accompanied by sustenance on high fibre whole grain-based diet rich in vegetables and fruits has been replaced by over-reliance on motorised transport and consumption of unhealthy diets rich in carbohydrates, fats, sugars, and salts [3]. The resultant effects of this "adopted" regime is a change in disease patterns with communicable diseases being replaced by non-communicable or life style related diseases like diabetes, obesity, cardiovascular disease and cancer [4].

Globally, the proportion of chronic, non-communicable diseases is increasing at an alarming rate. Propelling the upsurge in cases of diabetes and hypertension which are major predisposing factors for cardiovascular disease is the growing prevalence of overweight and obesity. The World Health Organization has estimated that by 2015, 2.3 billion adults will be overweight and 700 million adults will be obese [5]. Obesity has in the last decade joined underweight, malnutrition, and infectious diseases as major health problems threatening the developing world [6]. Overweight and obesity are risk factors for a number of non-communicable diseases including diabetes and as the prevalence rate rises, so does the rates of diabetes. Approximately 197 million people worldwide have impaired glucose tolerance, most commonly because of obesity and the associated metabolic syndrome. This number is expected to increase to 420 million by 2025 [7].

Except proactive measures are taken quickly, a non-communicable disease epidemic is expected with obesity and diabetes leading the way

especially considering the intimate relationship they share. According to Wannamethee and Shaper [8], adult weight gain, the degree of obesity and the duration of obesity are all independently and strongly predicting the risk of type 2 diabetes. Furthermore, diabetes is by far the most important of the direct and indirect costs associated with obesity [9] and it is generally accepted that the increasing prevalence of diabetes is associated with increased rates of overweight and obesity [10], with an estimated 90% of Type 2 diabetes attributed to excess weight [7]. Lahti-Koski et al. [11] reported that an elevated waist to hip ratio (WHR) signifying abdominal obesity is shown to be a strong risk factor for Type 2 diabetes mellitus. Also, some prospective studies have supported the association of various anthropometric indices of abdominal adiposity and the future development of diabetes [12]. It has been suggested that abdominal adiposity is an independent predictor of alteration in the plasma lipid, lipoprotein and plasma glucose concentrations [13].

In a bid to curb the global rising trends of non-communicable the rising trends in morbidity and mortality related to chronic non-communicable diseases, the World Health Organization and other international and national organizations have devised strategies for chronic non-communicable disease prevention and control [14]. Nigeria is not left out of this campaign which aims to identify risk factors involved in these medical conditions so as to formulate a suitable and effective programme for prevention, early detection and effective control. However, anecdotal evidence suggests that clinicians fail to diagnose obesity and in essence obesity-related co-morbidities, thus passing up the opportunity to screen these patients for obesity-related morbidities and counsel them on lifestyle modification. This is possibly because obesity is accepted in some social and cultural classes as a sign of affluence and well-being. Early recognition of these disorders will lead to a reduction in the morbidity and mortality associated with non-communicable diseases. The aim of this study was to identify the magnitude of overweight, obesity, abdominal adiposity and hypertension among a sample of patients with Type 2 diabetes (Figure 1).

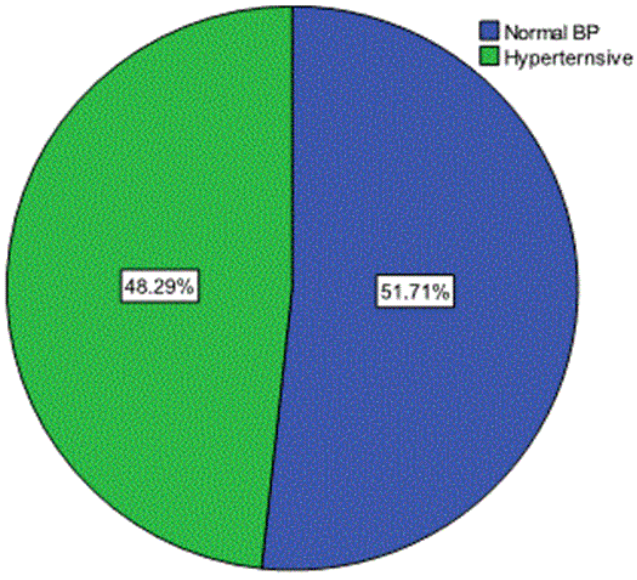

Figure 1: Proportion of hypertension among diabetics

Material and Methods

This was a cross sectional descriptive study carried out during the world diabetes day celebration at a diabetes screening centre in Jos, Plateau State, Nigeria. Approval to carry out this study was sought and obtained from the management of the diabetes screening centre. A sample of convenience was utilized to recruit all the diabetic patients who attended the screening programme. The weight was measured in kilograms, with patients standing bare feet in their minimal clothing and with their pockets free of objects that might add to their weights such as mobile phones, wallets, keys, rings, etc. using a bathroom weighing scale (Hamson, China), which was validated daily using a known 10 kg weighted mass and measured to the nearest 0.1 kg.

The weighing scale was checked for zero error after each measurement. The patients' heights were taken from a measuring scale drawn against the wall. In measuring the height, the patient who was barefooted and without head-gear or cap stood against the marked wall with the Achilles, gluteus and occiput touching it. A pointer was firmly pressed against the scalp and the measurement was read off on the wall scale in meters.

Body Mass Index (BMI) was calculated using the formula, weight (in kg) divided by height (in m^2).The hip circumference was measured at the maximum circumference around the hips, and the waist circumference was obtained at the level of the umbilicus with the subject supine. The waist to hip ratio (WHR) was also calculated. Venous blood sample of all the subjects was collected after an overnight fast. Subjects were defined as having diabetes if they met the WHO criteria (fasting whole venous blood glucose ≥ 126 mg/dl or 2 h blood glucose after a 75 g oral glucose test ≥ 200 mg/dl) or if there was documented evidence of diabetes in the medical records (Figures 2 and 3).

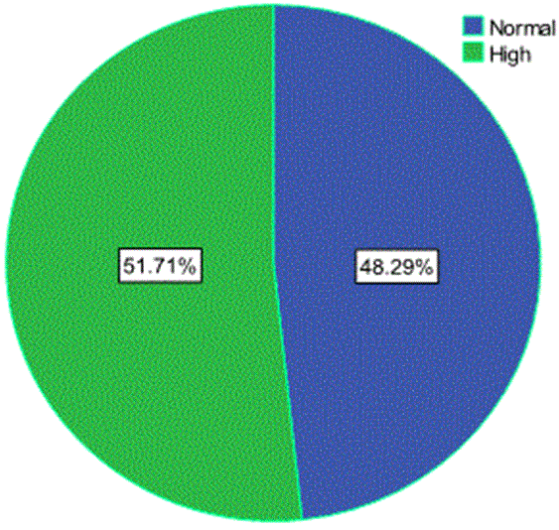

Figure 2: Classification of waist circumference among diabetics

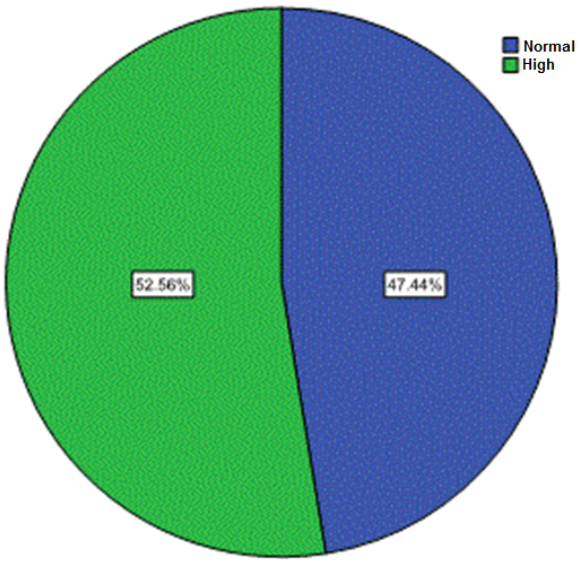

Figure 3: Classification of waist-hip-ratio among diabetics

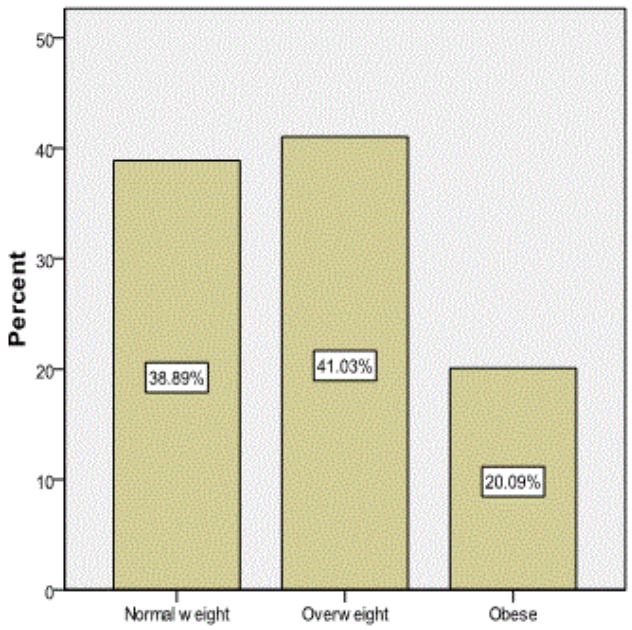

Figure 4: Classification of body mass index among diabetics

The blood pressure (BP) was measured using the auscultatory method with standard mercury in glass sphygmomanometer. Prior to the measurement, the patient was seated and rested for 5 min in a sitting position on a chair that supported the back comfortably. For each participant, the BP was measured every 2 minutes for three times and the average score was recorded.

Data was analysed using Statistical Package for Social Sciences (SPSS) version 17. Results were summarised as mean (SD), frequencies and percentages. Independent T-test and one-way Anova was used to compare differences in mean as appropriate, while spearman rank correlation was used to find relationships between variables. Values of $p<0.05$ were considered statistically significant.

Results

A total of 468 diabetic patients participated in this study. There were 248 (53.0%) males and 220 (47.0%) females, with a male to female ratio of 1:1.3. A simple majority were not hypertensive (51.7%, n=242), while 226 (48.3%) were hypertensive. One hundred and eighty two (38.9%) were within the normal weight range, 41.0% (192) were overweight and 20.1% (94) were obese. A further classification of obesity revealed that 61.7% (58) had class one obesity, 27.7% (26) were in the class two obesity ranges, while 10.6% (10) were diagnosed as having class three obesity.

A simple majority of the patients had abdominal adiposity measured by WC (51.7%, n=242) and WHR (52.6%, n=246). This is shown in table 1 and Figure 4.

Variables	Mean (SD)	Frequency (n)	%
Age	42 (11.3) years		
Fasting blood sugar	6.9 (2.3) mm/dl		
Diastolic BP	91.9 (13.6) mmHg		
Systolic BP	142 (22.6) mmHg		
BMI	26.5 (4.7) kg/m2		
Waist circumference	90 ± 12 cm		
Waist-to-hip ratio	0.9 ± 0.1		
Gender			
Male		248	53.0
Female		220	47.0
Hypertensive			
Yes		226	48.3
No		242	51.7
BMI class			
Normal Weight		182	38.9
Overweight		192	41.0
Obese		94	20.1
Waist Circumference			
Normal		226	48.3
High		242	51.7

Waist-to-hip ratio			
Normal		222	47.4
High		246	52.6

Table 1: Clinical Characteristics of study subjects

The age of the patients ranged from 21 to 90 years, with a mean age of 42.6 ± 11.3 years and mean fasting blood sugar (FBS) of 6.9 ± 3.2 mm/dl. The mean systolic and diastolic blood pressure was 142 ± 22.6 mmHg and 91.9 ± 13.6 mmHg respectively. Body mass index of the participants ranged from 18-43 kg/m2, with a mean score of 26.5 ± 4.7 kg/m2. The mean waist circumference (WC) and waist-to-hip ratio (WHR) was 90 ± 12 cm and 0.9 ± 0.1 respectively Table 1.

Obesity was significantly associated with middle-age (40-64 years) (p=0.0001, F=15.4) and female gender (p=0.000, F=15.8). Those who were hypertensive had a significantly higher BMI (p=0.000, F=12.4) than normotensive participants (27.6 ± 4.6 vs. 25.4 ± 4.6), with systolic and diastolic blood pressure increasing exponentially as weight increases (p=0.000). There was no significant difference in blood glucose level among the different BMI groups (p>0.05).

Diabetics with a high WHR had significantly higher blood glucose level (p=0.000, F=28.2) than those with normal WHR (7.2 ± 3.9 vs. 6.5 ± 2.1). There was a tenuous but significant difference in WHR by gender (p<0.05), with females having a higher WHR than males (0.88 ± 0.1 vs. 0.87 ± 0.1). A high WHR was significantly associated with hypertension (p=0.000, F=2.1), systolic blood pressure (p=0.000, F=16.5) and diastolic blood pressure (p=0.000, F=18.0). Furthermore, there was a significant relationship between BMI and WHR (r=0.43, p=0.000).

Females had a significantly higher WC (p=0.001, F=10.6) than males (91.6 ± 13.0 vs. 86.6 ± 10.6). Hypertensive diabetics had a significantly higher WC (91.8 ± 12.0) than diabetics without hypertension (86.3 ± 11.5) (p=0.000, F=5.2). A higher FBS was associated with a high WC (7.1 ± 2.8 vs. 6.3 ± 2.0). Furthermore, a high WHR was significantly associated with systolic blood pressure (p=0.000, F=15.3) and diastolic blood pressure (p=0.000, F=13.9). There was a significant relationship among WC and BMI (r=0.78, p=0.000) and WC and WHR (r=0.54, p=0.000).

Discussion

Appropriate prevention and management strategies are delayed or non-existent because the health and economic burden from diabetes associated with obesity has probably been under estimated by governmental and non governmental agencies in Nigeria. This has increased the risk of developing and worsening the elements of metabolic syndrome. In an economic environment where it is difficult to access diabetes medication for the less privileged, emphasis should be on lifestyle modification in other to lessen the risk of developing metabolic syndrome. A major means of achieving this is to identify persons with diabetes who are at risk of developing obesity and abdominal adiposity or are already obese.

In this study, 48.3% (226) of diabetics are hypertensive or are currently on anti-hypertensive, a finding which is in line with earlier Nigerian studies which have reported a hypertension prevalence of between 30 to 55% among clinical patients with diabetes [15-17]. It is however lower than figures in western climes where more than 70% of people with diabetes reportedly have high blood pressure or are being treated with medications for hypertension [18]. This is plausibly due to differences in geography. Hypertension in diabetes accelerates development and progression of micro vascular and macro vascular complications in patients with diabetes [19]. Among Nigerians, mortality is increased in diabetic patients with hypertension compared to normotensive diabetics [20]. In other to prevent diabetes related complications, especially those of vascular origin, adequate and timely blood pressure control is necessary. It has been shown that a 10 mm Hg decrease in blood pressure can reduce a person's risk for any diabetic complication by up to 12% and by 15% for deaths related to diabetes [21].

Hypertension and diabetes are independent risk factors for cardiovascular disease (CVD), and when they co-exist they multiply morbidity and mortality of CVD [22]. This situation is worse when obesity and abdominal adiposity is thrown into the picture because of the risk of developing and worsening the elements associated with metabolic syndrome through mechanisms that include insulin resistance, hypercoagulability, endothelial dysfunction, and inflammation. In our study, diabetics with a high abdominal obesity and BMI (48.3%) also had a higher blood pressure. Earlier, a study in Nigeria has reported the presence of both hypertension and obesity defined by BMI in 44.9% of patients with T2DM [17]. Obese people have an incidence of hypertension that is five times the incidence among people of normal weight [7]. Co-existence of adiposity, dyslipidemia and hypertension are risk factors for insulin resistance syndrome [23] and with diabetes, the risk of developing atherosclerosis increases [24]. To prevent the above complications in diabetics, physicians, dieticians and physical therapists should intensify efforts at educating diabetics on the need for proper blood glucose and blood pressure monitoring, well balanced diabetes diet and adequate physical activity. It has been shown that blood pressure reduction has been associated with a decreased risk of T2DM-related complications, stroke and the need for retinal photocoagulation [21], while weight loss through dieting or exercise helps correct insulin resistance and dyslipidemia found in patients with T2DM [25].

Majority of the diabetics in this study were either overweight or obese (61.1%). The mean weight score revealed that the study group was overweight, a finding which is in line with another study [26]. Furthermore, mean fasting blood glucose level revealed a not too effective but encouraging control of diabetes. A major means of reducing metabolic syndrome is to prevent or control the coexistence of obesity and diabetes, especially among those with poorly controlled diabetes because obesity worsens all the elements of metabolic syndrome. Since components of the syndrome synergistically increase vascular risk, the obvious corollary is that with increasing BMI, many Nigerians especially diabetics will be predisposed to cardiovascular events such as coronary heart disease and stroke. This places a huge economic burden on Nigeria since they are expensive to manage.

Abdominal obesity (high WHR and WC) was recorded in a simple majority of the participants, a finding consistent with other studies in Nigeria [27] and India [26]. Towards the middle of the 20th century, relative proportion of body fat in the upper body versus lower body was an important factor to consider while investigating obesity-related health problems. However, since the 1980-90s more attention has been focused on abdominal obesity, rather than obesity per se as an important correlates for various metabolic disturbance [28]. A common myth in some West African countries including Nigeria, pictures abdominal obesity and a "large" waist-to-hip ratio as a sign of

good health, affluence, robustness and beauty. For example, a study in Cameroon found that heavy men were perceived as imposing and authoritative and thinness was antithetical to power [29]. This probably makes it difficult for diabetics to make adjustments even after thorough advice from health workers on the need to reduce weight, especially around the central area. A study emphasizes that a modest but achievable weight loss of 5% to 10% can be a realistic goal for improving glycemic control in patients with Type 2 diabetes [30].

Middle aged diabetics had a higher BMI than other age groups, a finding consistent with a Pakistani study which reported the highest prevalence of obesity and overweight among those aged 35–64 years [31]. Furthermore, females had a higher BMI than their male counterparts. Earlier studies in Nigeria [27], Pakistan [31] and Trinidad [32] have revealed a higher female to male obesity preponderance. Among the predisposing factors for obesity and overweight in Nigeria is female gender and age above 40 years [33,34]. Also across Sub-Saharan Africa, there is a universal preference for a curvy body shape among women and extra weight is seen as an indicator that her husband is caring for her well [35]. It is not surprising that in our study, women also had higher levels of abdominal adiposity (measured by WC and WHR) than men. In a bid to address this trend, it has been suggested that black females with DM should be considered a special subgroup at risk of obesity-related complications and be given a distinct focus of targeted therapies to reduce the prevalence and impact of obesity in DM [27]. Furthermore, to curb the rising levels of obesity and other non communicable diseases associated with it in Sub-Saharan Africa and Nigeria specifically, time tasted but unhealthy myths and practices has to be systematically discouraged among the general population and especially among those at risk of developing metabolic syndrome.

A high blood sugar level was associated with abdominal adiposity but not obesity. A study reported that abdominal adiposity (WHR) was a strong risk factor for Type 2 diabetes mellitus [11]. This is probably because a preponderance of enlarged fat cells in intra-abdominal fat depot increases the risk of glucose intolerance, hyperinsulinemia and hypertriglyceridemia [12,28]. This finding is a wake-up call for medical and health personnel and researchers in Africa to consider WHR and WC in people who may not necessarily be obese while assessing and advising for weight loss. It is also imperative to raise public health awareness of WHR and WC as an important measure of obesity-related health risk. There was a relationship between WC, WHR and BMI in our study; a finding previously reported by Fasanmade and Okubadejo [27]. This probably underscores the interdependence of each anthropometric measure in the diagnosis and management of adiposity, overweight and cardio metabolic risk factors.

Conclusion

This study brought to the fore the proportion of overweight, obesity and abdominal adiposity in a cohort of Type 2 diabetics. Obesity and abdominal adiposity was found in a majority of the study cohort. Even though a simple majority were not hypertensive, hypertension was associated with BMI and abdominal obesity (WHR and WC). Female diabetics were more likely to be obese and have a high WHR and WC compared to males. WHR and WC were associated with a high blood sugar level; and the three anthropometric measures utilized in this study were related to each other. Early diagnosis of obesity and abdominal obesity and advice on weight loss and other lifestyle modification along with good glycemic control is imperative to avoid the development of metabolic syndrome and other complications associated with obesity, hypertension and diabetes. Furthermore, a coherent and multifaceted public health strategy aimed at systematically debunking unhealthy myths and encouraging adoption of healthy lifestyles is imperative.

Limitations

This study was carried out in a single center, thus limiting the generalization of its findings. However, being a population based study lends some power and eligibility to its outcome. Furthermore, we did not assess the serum biochemical profile of the study population, which would have further explored the risk of developing metabolic syndrome among diabetics with different measures of adiposity. Future studies should look at the relationship between serum biochemical profile of diabetes patients and their individual adiposity levels.

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