The relationship between obesity and peripheral arterial disease in adult Nigerian diabetics

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Summary
Aims and Objectives: *The aim was to identify any relationship between obesity and peripheral arterial disease (PAD) in diabetic subjects.*

Subjects and methods*: Male and female diabetic subjects aged 50-89 years. Body mass index (BMI) was used to estimate total body weight and the waist-to-hip ratio (WHR) as well as waist circumference (WC) were used for abdominal fat distribution estimation. Peripheral arterial disease was defined by an ankle brachial index <0.9.*
Results*: Peripheral arterial disease (PAD) was observed in 52.5% of the subjects. BMI, WHR and WC did not correlate with PAD.*
Conclusion*: None of the parameters (i.e BMI, WHR and WC) used to assess the relationship between obesity and PAD was found to correlate with PAD.*

Keywords*: Obesity, peripheral arterial disease, diabetes, body mass index, waist hip ratio, and waist circumference.*

Introduction

The World Health Organization defines obesity as a condition with excessive fat accumulation in the body, to the extent that health and well being are adversely affected.[1] Over 350 million people globally are obese (BMI of 30 and above) and about 1 billion are overweight (BMI of between 25 and 29.9). Overweight and obese individuals are common in Nigeria where they cut across all strata of the society.[2] Obesity is a risk factor associated with cardiovascular disease, atherosclerosis and diabetes as well as a leading determinant of hypertension, dyslipidemia and diabetes mellitus[3].

It has been reported that women who are overweight or obese are more likely to develop conditions that put them at risk for peripheral arterial disease including high blood pressure, diabetes, high cholesterol and a high C-reactive protein. Excess body fat also puts an individual at risk for many other heart and blood vessel problems, including coronary artery disease, stroke, heart failure, and blood clots in the veins. On the average, a woman who is overweight will die 3 years earlier than if she had a healthy weight, and an obese woman will die more than 7 years earlier[4].The major modifiable risk factors for coronary heart disease include obesity, hypertension, hyperlipaemic states and diabetes mellitus among others.

The pathway by which fatty deposits block the walls of large and medium –sized arteries that lead to the heart, brain and lower limbs, is through atherosclerosis. Atherosclerosis is therefore the deposition of hard pasty materials from fat, especially cholesterol together with other substances like calcium, cellular debris, fibrin and platelets, along the endothelium- the inner lining of vessels[5]. Peripheral arterial disease is an indicator of systemic atherosclerosis [6]. These deposits distort the texture of the intima of the vessels. In addition, they narrow down the vascular lumen in this case the arteries, and so reduce blood flow and oxygen to the affected organ or tissue.

The reduction in the capacity of the lumen could proceed to a point at which there could be complete blockage. Alternatively, the plaque can become unstable and dislodge leading to the formation of a thrombus or an

embolus which could block vessels that lead to the heart causing a myocardial infarction or the brain, causing a cerebrovascular accident.[4] When the vessels leading to the lower limbs are blocked, then leg ischaemia and possible limb loss result. Over 90% of all limb amputations in the Western world occur as a direct or indirect consequence of peripheral arterial disease (PAD) and/or diabetes.[7] Also it has been reported that nearly 2% of people with PAD, will progress to a major amputation.

The relationship between lower extremity arterial disease and obesity in subjects with diabetes mellitus is a matter of continuing investigation. It is known that obesity has been associated with functional decline in persons with PAD.[8]

Some studies have found an association between WHR and PAD. Obesity was inversely associated with low ankle brachial index (PAD) in the cardiovascular health study,[9] however there was no evidence of any association between intermittent claudication (a clearly defined manifestation of PAD) and body mass index.[10]

In view of these disparate findings in the association of measures of body fatness with indicators of peripheral arterial disease, we decided to carry out this study using diabetics as a cohort**.**

Subjects and methods:

The study population consisted of adult male and female diabetic subjects aged 50-89 years who were seen at the medical out-patients' department. Two hundred and nineteen (219) subjects were recruited for this study. Subjects below 50 years of age, subjects older than 89 years, non-diabetic subjects, subjects with past or current history of smoking , and subjects who withheld consent for the study were excluded. Others excluded in this cross sectional study were those who had amputation from non-diabetic causes, those with foot deformities, and those with known haemoglobinopathies. The hospital is a 200-bed faith based hospital which renders primary and secondary health care. It is the referral centre for all other hospitals in Ogbomoso and its environs.

Through a systematic sampling method, every 2nd patient was recruited for the study. The selected patients were screened and those who met the inclusion criteria were recruited for the study after they gave a written informed consent.

Each study subject had their heights, waist circumferences, and hip circumferences measured. They also had their body mass indices as well as the waist-to-hip ratios calculated. Ankle/brachial pressure indices were also performed on each subject. The height was measured to the nearest 0.5cm without shoes with a stadiometer built into the weight measuring scale. Body weight in light clothes was measured to the nearest 0.1kg with Healthometer scale made by Continental Scale Corporation, USA. The scale was re-validated daily before use. Waist circumference was measured at the mid point between the lower rib border and the iliac crest at the end of expiration and read to the nearest 0.1cm with a flexible measuring tape. Hip circumference was measured as the maximum circumference of the buttocks over the greater trochanters also with a flexible measuring tape.

Abdominal overweight was defined as WC e" 94cm and e" 80cm for men and women respectively, while abdominal obesity was defined as WC e" 102cm and e" 88cm for men and women respectively.[8]

The Body Mass Index was obtained by dividing the body weight by the square of the height (kg/m^2). Waist to Hip Ratio was obtained by dividing the waist circumference by the hip circumference. Rest ankle?brachial pressure indexes (ABI) were performed with a mercury sphygmomanometer and a hand-held Doppler device (an 8.1MHz hand-held Doppler device made by Parks Medical Electronics, Aloha, Oregon, U.S.A). Peripheral arterial disease was defined by an ankle brachial index <0.9. Details of how ankle brachial pressure indexes were performed is documented in a study by Oyelade *et al*[11]

Ethical considerations

The Ethics Committee of the Baptist Medical Centre, Ogbomoso (now Bowen University Teaching Hospital) granted approval for the study. A signed informed consent was also obtained from each subject before commencement of the study.

Results

There were 219 subjects in all and 115 (52.5%) had PAD. The overall prevalence of obesity in this sample of diabetic subjects was 23.3%. The prevalence of obesity in the subset of subjects with PAD was 24.3%, while the prevalence in those without PAD was 22.1%.

The relationship between BMI, WHR, WC and PAD were assessed, using bivariate analysis and tested for significance using student t test. The results are presented in the tables. No associations were found between each of these parameters and PAD.

Table i

Distribution of subjects by age and sex.

Age	Male	Female	Total
50-59	38	45	83
60-69	27	49	76
70-79	19	30	49
80-89	6	5	11
Total	90	129	219

A total of 219 subjects were recruited for the study, and consisted of 90 males and 129 females. The male: female ratio was 1:1.4. The ages of the subjects ranged from 50 to 89 with a mean age of 63 ± 8.72.

Table ii

Relationship between body mass index and peripheral arterial disease (PAD)

Body mass index	PAD (%)	NO PAD (%)	Total(%)
Normal	49(42.6)	42(40.4)	91(41.6)
Obese	28(24.3)	23(22.1)	51(23.3)
Overweight	30(26.1)	35(33.7)	65(29.7)
Underweight	8(7)	4(3.8)	12(5.5)
Total	115(100)	104(100)	219(100)

PAD: peripheral arterial disease

Chi-square	d f	Probability
2.1996	3	0.5320

Out of 51 subjects who were found to be obese, 28 had PAD while 23 subjects did not have PAD. Also 30 subjects out of 65 who were overweight were assessed to have PAD as against 35 who did not have PAD.

Table iii

Relationship between waist hip ratio (WHR) and peripheral arterial disease (PAD)

PAD	WHR (mean)	t-test	p-value
	Females		
Present(73)	3.88±17.59	0.18	0.67
Absent (56)	2.70±12.97		
	Males		
Present(42)	3.49±16.12	0.03	0.87
Absent (48)	2.96±13.71		

Table iv

Relationship between waist circumference (WC) and peripheral arterial disease (PAD)

PAD	WC (mean)	t test	p-value
	Females		
Present(73)	95.95±10.97	0.15	0.69
Absent (56)	95.11		
	Males		
Present (42)	92.85±12.35	1.22	0.27
Absent (48)	95.74±12.41		

Discussion

The effect of fat distribution on disease risk has been a subject of great interest. Central fat has been measured anthropometrically, by computed tomography, and by magnetic resonance imaging. Both cross-sectional and longitudinal studies have related central fat accumulation to type 2 diabetes mellitus and cardiovascular disease, independent of body mass index.[12]

The body mass index was not found to have any association with PAD in this study and this agrees with findings in other studies.[7,8,13]

Abdominal fat distribution has been found to be positively associated with Coronary Heart Disease and stroke incidence, independently of BMI, in several studies.[15,16,17,18]

In the current study, abdominal fat distribution was not associated with PAD. This could be because it was a hospital-based study carried out over a few months compared to a study carried out by Lu , Zhou , Waring, Parker , Eaton , [19] which was population-based and over a much longer period(minimum of 3 years). In their study waist to thigh ratio was associated with PAD in men and women while waist circumference was associated with PAD in women, but not in men.

Conclusion

This study seems to suggest that obesity itself does not raise the risk of PAD.

There is need for a larger, multi-center preferably community-based study in Nigeria to further investigate this.

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