

The prevalence of obesity and its relationship with hypertension in an urban community: Data from world kidney day screening programme

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ABSTRACT

Background: Obesity is a global health problem that is linked directly with several disease processes, notably hypertension. **Aims:** The study sought to determine the prevalence of overweight/obesity and to examine its relationship with hypertension in an urban community in a developing country. **Materials and Methods:** We conducted a cross-sectional survey of participants aged ≥ 18 in Lagos, an urban community in southwest Nigeria, on every World Kidney Day from 2006 to 2010. Data on age, gender, body mass index, blood pressure and urinalysis were obtained. **Results:** 1368 participants were studied comprising of 720 (52.6%) males, mean age overall was 41.9 ± 12.9 years. The prevalence of overweight and obesity was 32.7% and 22.2% respectively. Obesity was highest among those in the 45-54years age group and also higher in women compared with men with prevalence rate of 29.5 % in women versus 15.7% in men; $\chi^2 = 37.45$, $p < 0.0001$. Hypertension was present among 33.3% (456) of the population and highest among those > 65 years (58%). Obese subjects had 2.59 increased odds of developing hypertension (95% CI: 1.89 - 3.56). Forty-nine (3.6%) subjects had proteinuria; 4.9% obese subjects versus 2.4% of non-obese subjects had proteinuria; $\chi^2 = 3.87$ $p = 0.049$. **Conclusion:** This study indicates that hypertension and obesity are highly prevalent in Lagos. Obesity is a strong independent risk factor for hypertension. Therefore concerted efforts should be made to control this unwholesome trend by promoting health education with emphasis on associated risk factors for obesity such as eating habits and weight gain.

Key words: Obesity, overweight, excess weight, hypertension

INTRODUCTION

Obesity and hypertension have become public health issues with rising prevalence globally, associated with increased morbidity and mortality from cardiovascular diseases as well as increased socio-economic costs.^[1] Currently about 1.5 billion

people in the world are overweight. About 200 million men and 300 million women are obese.^[2] More than one in ten of the world's adult population are obese. Overweight and obesity are the fifth leading risk for global deaths; with at least 2.8 million adults dying annually as a result of these malnutrition.^[2] According to global estimates, in 2000, 972 million adults had hypertension and it is

predicted to rise by 60% to a total of 1.56 billion by 2025.^[3] The incidence and prevalence of obesity is rising in developing countries due to rapid unplanned urbanisation and adoption of western life styles and reduced physical activity.^[4] In developing countries, obesity often co-exists with under-nutrition and affects virtually all age groups.^[4] Obesity has been associated with chronic non-communicable diseases like hypertension, coronary heart disease, type 2 diabetes, dyslipidaemia, chronic kidney disease (CKD), cancers and arthritis.^[1,2,5] Obesity is a multifactorial disorder in which both genetic and environmental factors have been implicated.^[5] The key causes of obesity are reduced physical activity, increased consumption of foods high in sugars and saturated fats.^[4]

Obesity and weight gain have been reported to be the most significant determinants of hypertension.^[1,4,6] In the Framingham study, a 10% rise in body weight is associated with a 7mmHg rise in systolic blood pressure (SBP).^[7] The National Health and Nutrition Examination survey reported linear association between increase in Body Mass Index (BMI) and systolic, diastolic and pulse pressure in the American population.^[8] It is reported that an increase of BMI of 1.75 kg/m² in men and 1.25 kg/m² in women will cause 1 mm Hg rise in systolic blood pressure.^[8] Obese patients are more prone to hypertension and hypertensive patients also appear prone to weight gain.^[1,6] Findings from the Framingham and Tecumseh studies revealed that future weight gain is significantly higher in hypertensive than in normotensive subjects, which thus suggests that even hypertensive patients with normal weight are at increased risk of developing obesity.^[6,7] A potential hypothesis to explain this reverse relationship is that the enhanced sympathetic activation observed in hypertensive subjects, might lead to development of insulin resistance and subsequent obesity later in life. Thus, the relationship between obesity and hypertension can be considered a "two-way street".^[6]

The aim of this study was to determine the prevalence of overweight and obesity among urban dwellers in Lagos and to establish the relationship between obesity and hypertension.

MATERIALS AND METHODS

We conducted a community-based screening for CKD risk factors on every World Kidney Day from 2006 to 2010 in Ikeja, the administrative capital of Lagos state in south-west Nigeria. All volunteer

participants above the age of 18 years were recruited. Excluded from this study were pregnant women and those who were ill. Weights were taken with light clothing on to the nearest 0.5kg. Heights were measured using a stadiometer without shoes or headgear. BMI was determined based on the formula weight in Kg/height in metres squared.^[9] BMI was classified using the WHO classification for adults as follows: normal for values in the range of 18.5 – 25kg/m², overweight BMI between 25 and 29.9 kg/m², Class 1 obesity BMI 30.0 to 34.9 kg/m², class II 35.0 to 39.9 kg/m², Class III or extreme obesity BMI \geq 40 kg/m².^[9]

The blood pressure of the subjects was measured after 5 minutes rest with an Accoson's mercury sphygmomanometer using an appropriate cuff size in the right arm. Korotkoff's 1st and 5th sounds were used as the systolic and diastolic blood pressure.^[10] Hypertension was defined according to the Joint National Committee (JNC) VII criteria.^[10] Urinalysis was done with Combi-Screen 3 urine dipstick (Biotechnologies AG Germany). All measurements were carried out by trained nurses. The population studied was not selected.

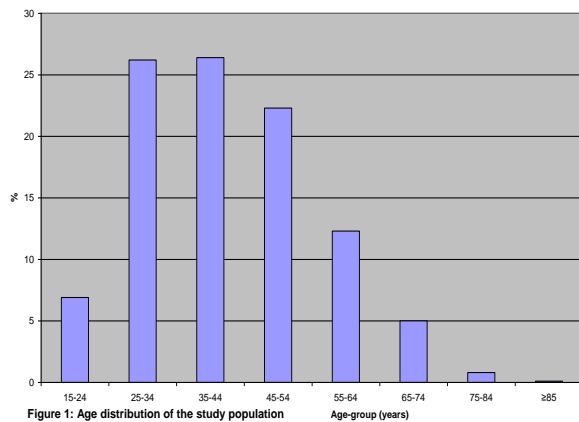
Statistical analysis

Data were entered in Microsoft ® Excel and analyzed using Epi info ® 2007. Values are expressed as means \pm standard deviation and percentages. Mean values of continuous variables were compared using the unpaired t-test. Percentages were compared using χ^2 test. Analysis was done by comparing mean values obtained for male and female subjects and subjects with normal weight and excess weight. Logistic regression analysis was used to determine risk factors for hypertension among the study population. Statistical significance was assumed at a *P* value <0.05 .

RESULTS

One thousand six hundred and eighty subjects participated in the screening exercise, however only 1368 had complete data and were thus analysed. There were 720 (52.6%) male and 648 female subjects (47.4%). The mean age did not differ among male and female participants. Mean age overall was 41.9 \pm 12.9 years; 42.1 \pm 13.1 for females and 41.7 \pm 12.7 for males *p* = 0.59. Table 1 shows the clinical characteristics of the study population. The age distribution of the respondents was skewed with majority (74.9%) in the 25-54 years age range, the elderly constituted 5.9% of the

population while the adolescents 6.9%, the age range was 18 to 88years (figure 1).



Overweight and obesity

The prevalence of overweight and obesity in this study was 32.7% (447) and 22.2% (304) respectively, while 43 (3.1%) subjects were underweight. Among the obese subjects, 213 (70.1%) had class 1 obesity, 62 (20.4%) class II and 29 (9.5%) class III obesity. Table 2 shows the prevalence of obesity and overweight by age group. Prevalence of overweight and obesity was highest in the 45-54 years age-group and expectedly the lowest prevalence was in the 15 -24 age group. Two hundred and forty (33.3%) male subjects were overweight, while 207 (31.9%) female subjects were overweight; both sexes were equally affected $\chi^2 = 0.30$; $p = 0.59$ (OR 0.95; 95% CI: 0.74 – 1.18). However, in terms of obesity, women were 2.25 times more likely to be obese compared with men 29.5 % in women vs 15.7% $\chi^2 = 37.45$ $p = 0.000$ (OR 2.25; 95% CI 1.71 – 2.94).

Hypertension

Hypertension was present among 33.3% (456) of the population. When the patients were classified according to BP class, 682 (49.8%) had normal blood pressure, 230 (16.8 %) were in the pre-hypertension stage, 287 (21%) had stage 1 hypertension while 169 (12.4%) stage 2. Prevalence of hypertension was higher among male subjects compared with female subjects 276 (38.3%) vs 180 (27.8%) $\chi^2 = 17.09$, $p < 0.0001$ (OR 1.62 95% CI 1.28-2.04). We divided the study population into 4 major age-groups, namely age 18 - 24 years, 25 - 44 years, 45-64 years and above 65years. Prevalence of hypertension increased steadily with age from 12.6% in age-group 15-24 years to 58% among the elderly (> 65 years) figure 2. Prevalence of hypertension also increased with

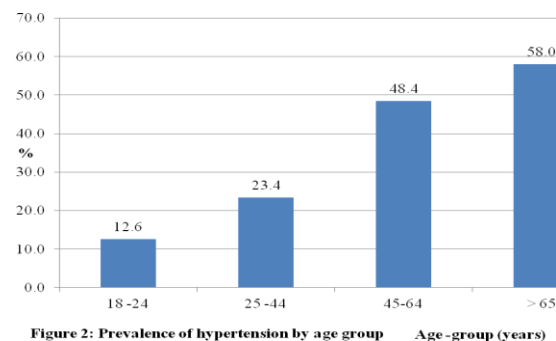
increasing BMI from 26.1% (150) among patients with normal BMI to 35.3% (158) among overweight subjects and 48 % (146) among the obese subjects $\chi^2 = 42.65$ $df = 2$ $p < 0.0001$.

Logistic regression analysis

Multiple logistic regression analysis of risk factors associated with hypertension is presented in table 3. The male gender was associated with a 2-fold increase risk of developing hypertension; obese subjects had 2.59 increased odds of developing hypertension while increasing age was associated with 1.05 odds of developing hypertension.

Urinalysis

Forty-nine (3.6%) subjects had overt proteinuria of which 2.6% (36) had 1+, 0.7% (9) had 2+, while 0.3% (4) had 3+ proteinuria. Proteinuria was present in 2.4% (14) of subjects with normal BMI, 4.3% (19) of overweight subjects, 4.9% (15) of obese individuals and 2.3% (1) of underweight respondents. The obese patients had a higher prevalence of proteinuria compared with normal weight subjects, however this was of borderline significance $\chi^2 = 3.87$, $p = 0.049$ (OR 0.48 95% CI 0.22-1.07). No difference was observed in prevalence when overweight subjects were compared with normal weight individuals $\chi^2 = 2.63$, $p = 0.105$ (95% CI 0.26-1.19). There was no gender difference in the prevalence of proteinuria 3.3% in men and 3.9% in women (table 1). Surprisingly, no difference was noted in the prevalence of proteinuria in patients with normal BP (3.5%) and hypertensive subjects (3.7%) $\chi^2 = 0.04$, $p = 0.837$.



DISCUSSION

There is an alarming rate of rise in the prevalence of overweight and obesity both in developed and developing countries of the world. In this study about half the population was either overweight or obese. This is comparable to results from the developed countries^[11-13] but lower than reports

from surveys among the general population from other parts of Nigeria.^[14-17] Prevalence rates of obesity and overweight ranging from 21.4% to

32.8% have been reported from different parts of the country among the general population.^[14-17]

Table 1: The clinical characteristics of the study population

Variable	Males	Females	t stat/ χ^2	p-value
	N=720	N = 648		
	Means \pm SD	Means \pm SD		
Age (years)	41.7 \pm 12.7	42.1 \pm 13.1	0.53	NS
BMI (Kg/m ²)	25.4 \pm 4.4	27.4 \pm 6.0	6.83	0.000
Systolic BP (mmHg)	132.0 \pm 21.4	126.8 \pm 21.7	4.49	0.000
Diastolic BP (mmHg)	81.6 \pm 13.2	79.2 \pm 14.0	3.19	0.001
Proteinuria	24 (3.3%)	25 (3.9%)	0.27	NS

Table 2: The prevalence of obesity and over-weight by age-group

Age group (years)	Population size N	Number of Obese subjects (n)	Age-specific Prevalence of Obesity (%)	Number of Overweight Subjects (n)	Age-specific Prevalence of Overweight (%)
15-24	95	3	3.2	13	13.7
25-34	358	45	12.6	110	30.7
35-44	361	93	25.8	129	35.7
45-54	305	97	31.8	113	37
55-64	168	50	29.8	62	36.9
65-74	69	15	21.7	16	23.2
75-84	11	1	9.1	4	36.4
> 85	1	0	0	0	0
Overall	1368	304	22.2	447	32.7

Table 3: Risk factors associated with hypertension in the study population

Hypertension	Odds Ratio	z	p value	95%Confidence interval	
Age	1.05	9.99	< 0.001	1.04	1.06
Obese	2.59	5.88	< 0.001	1.89	3.56
Overweight	1.45	2.54	0.011	1.09	1.93
Male/female	2.03	5.48	< 0.001	1.58	2.62

Bakari *et al* reported prevalence of obesity and overweight to be present in about one third of the population studied in Zaria a suburban community.^[14] Adedoyin *et al* conducted a survey among 2097 adult residents of Ile-Ife, a semi urban town in South-West Nigeria where they reported crude prevalence rate of 20.3% for overweight 12.5% for obesity.^[17] The rate of excess weight in this study is close to prevalence rates in the developed world. In the Australian diabetes, obesity and lifestyle study (AusDiab), 60% of the population was obese or overweight, while in the United States prevalence of excess weight was as high as 68%.^[11,12] The reasons for the much higher prevalence in our study compared with the other studies from Nigeria include the urban nature of Lagos and the changing behavioural patterns of the people as this may be due to a shift from the consumption of complex carbohydrate diets to diets high in saturated fats and sugars caused by the proliferation of fast food joints in the city. In addition there may well be a shift towards less physically demanding jobs and an increasing use of automated technology at home, in the office and more passive leisure pursuits.

In this study, women were more obese than men and this is in agreement with studies in the literature^[12,14-17] but differs from reports from the AusDiab study in which men had higher BMI compared with women.^[11] Obesity increased with age and this finding is consistent with reports in the literature.^[11,14-17] Obesity increased with age probably from reduced physical activity associated with ageing thereby leading to less energy expenditure.

Obesity has been recognised as an most important risk factor for developing hypertension.^[1,5,18,19] Several epidemiological studies from different populations have reported a significant association

between obesity and hypertension.^[17-21] In a retrospective study of 2411 adults in South Korea, Lee *et al* reported an adjusted relative risk of hypertension in men and women with BMI > 27kg/m² as 2.56 (95% CI 1.27-5.16) and 3.17 (95% CI 1.72-5.86) respectively.^[18] In the Women's Health Study in Ghana, the odds ratio for hypertension in women with BMI > 30kg/m² was 2.89.^[20] In this study, obese subjects had 2.59 odds of developing hypertension compared with non obese subjects and being overweight was associated with 1.45 odds of developing hypertension. The link between obesity and hypertension is through neuroendocrine mechanisms and most recently, factors derived from adipose tissue are thought to play a major role.^[5] Obesity might lead to hypertension and other cardiovascular diseases by activating the renin-angiotensin-aldosterone system (RAAS), thus increasing sympathetic activities and enhancing insulin and leptin resistance, with increased pro-coagulatory activities. It can also be associated with endothelial dysfunction. Activation of RAAS also cause to increased renal sodium reabsorption, leading to a shift to the right of the pressure-natriuresis relationship and resulting in volume expansion.^[5] Obesity with hypertension, but not obesity alone is associated with an increased risk of cardiovascular disease. In overweight and obese subjects, the cardiovascular risk is not significantly increased unless hypertension is present.^[1] This emphasize the influence of hypertension as a mediator of cardiovascular disease in obesity.

Obesity is associated with proteinuria, CKD and end stage renal disease.^[1,22-24] In a large cross sectional study of young Japanese men and women below 40 years, obesity was found to be an independent risk factor for proteinuria.^[22] Furthermore, data from the Prevention of Renal and Vascular End Stage Disease study (PREVEND) did

show that BMI is independently associated with urinary albumin excretion.^[23] In this study, although obese subjects had higher prevalence of proteinuria compared with normal weight individuals, however this relationship was of borderline significance. The reasons may be because we used a semi-quantitative dipstick method for assessing overt proteinuria. The quantitative assessment of both microalbuminuria and macroalbuminuria may be more informative and therefore preferred. Nevertheless, our findings suggest that obesity is a possible risk factor for proteinuria. Proteinuria is an indicator of renal damage as well as a risk factor for progression of renal disease.^[1,23,24] The mechanism responsible for obesity-related glomerulopathy includes glomerular hyperfiltration, hyperlipidaemia-induced proliferation of mesangial cells and possible role for leptin and other adipocyte derived hormones.^[1,24]

Several studies have shown that weight reduction through diet and regular physical exercise has been associated with reduction in blood pressure.^[1,2] It has been shown that 5% weight loss is associated with reduction in renin-angiotensinogen levels, decreased sympathetic nerve activity and improved endothelial function, thus improving blood pressure in hypertensive subjects.^[1] Overweight and obesity, like other public health challenges, should be tackled and prevented early as envisioned in the WHO Global strategy on diet, physical activity and health.^[2] Strategies and programmes aimed at promoting healthy lifestyle thus preventing and controlling obesity remains pertinent especially among the urban populations of Nigeria. This will help to stem the rising trend in the prevalence of non-communicable diseases like hypertension and type 2-diabetes which are being fuelled by the current epidemic of obesity.

In conclusion, hypertension and obesity are highly prevalent in the study population. Obesity is an independent risk factor for hypertension, therefore efforts should be geared towards promoting healthy eating habits and maintenance of healthy weight through health education. The relationship between obesity and proteinuria needs further research.

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