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Association of hypertension with generalized obesity in rural south-western Nigeria

Nijerya'nın kırsal güneyindeki genel obezite ile hipertansiyon ilişkisi

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Abstract

Aim: There is a rising prevalence of hypertension worldwide with Africa reported to have the greatest disease burden. Obesity is the major risk factor for hypertension. This study aims to determine the prevalence of hypertension and its relationship with general obesity in rural south-western Nigeria.

Methods: Cross-sectional descriptive survey was conducted in two rural communities in Remo North Local Government area of Ogun State, Nigeria. Four hundred and twelve (412) participants comprising 216 (50%) males, aged 20-70 years, were studied. Participants were screened for generalized obesity and hypertension according to standard protocols. Hypertension was defined according to the seventh report of Joint National Committee on Prevention, Detection, Evaluation and Treatment of high blood pressure (JNC VII). Associations between obesity and hypertension were determined by analysis of variance (ANOVA), Pearson's correlation and Chi-Square tests.

Results: The mean of all the blood pressure indices (systolic, diastolic and mean arterial blood pressure) increased from first to fourth quartile of body mass index (BMI) (For trend, P<0.001). The prevalence of hypertension was 32.5% (28.6% in males and 36.4% in females). Compared to males, more females had systolic hypertension (45.1% vs 33.5%, P=0.02). The prevalence of hypertension increased with age (P<0.001 for systolic blood pressure (SBP) and diastolic blood pressure (DBP); P=0.019 for isolated systolic hypertension (ISH), and BMI (X^2=8.508, P=0.019 [95% CI, 0.001-0.038]). BMI correlated with both systolic and diastolic blood pressures (P<0.001).

Conclusions: The prevalence of hypertension is high and it is positively associated with obesity in the population. Aggressive lifestyle intervention to curb obesity is necessary to prevent hypertension and future cardiovascular disease.

Keywords: Hypertension, Obesity, Cardiovascular diseases, Prevalence

Öz

Amaç: Dünya çapında hipertansiyon prevelansında bir artış bildirilmekle birlikte, Afrika'nın en yüksek hastalık yüküne sahip olduğu bilinmektedir. Obezite, hipertansiyon için major risk faktörüdür. Bu çalışmada Güneybatı Nijerya'nın kırsal kesiminde hipertansiyon prevalansı ve genel obezite ile ilişkisinin araştırılması amaçlanmıştır.

Yöntemler: Nijerya'nın Ogun Eyaleti, Remo Kuzey Yerel Yönetim bölgesinde iki kırsal toplulukta bir kesitsel tanımlayıcı anket yapılmıştır. Yaşları 20-70 arasında değişen, 216'sını erkeklerin oluşturduğu (%50) toplam 412 hasta incelenmiştir. Katılımcılar, standard protokollere göre genel obezite ve hipertansiyon açısından taranmıştır. Hipertansiyon, Ortak Ulusal Yüksek Tansiyonun Önlenmesi, Saptanması, Değerlendirilmesi ve Tedavisi Komitesi'nin yedinci raporuna göre tanımlanmıştır (JNC VII). Obezite ve hipertansiyon arasındaki ilişki Pearson'un korelasyon testi ve ki-kare testi ile belirlendi.

Bulgular: Tüm kan basıncı endekslerinin ortalaması (sistolik, diyastolik ve ortalama arteriyel kan basıncı) vücut kitle indeksinin (BMI) ilk dördüncü çeyreğinden arttı (Eğilim için P<0,001). Hipertansiyon prevalansı %32,5'tu (erkeklerde %28,6 ve kadınlarda %36,4). Erkek olgulara kıyasla kadınlarda sistolik hipertansiyon daha sık gözlemlenmekteydi (%45,1'e karşı %33,5, P=0,02). Hipertansiyon prevalansı yaşla birlikte artmaktaydı (sistolik kan basıncı (SBP) ve diyastolik kan basıncı (DBP) için P<0,001); izole sistolik hipertansiyon (ISH) ve BMI için P=0,019 (X^2=8,508, P=0,019 [% 95 CI, 0,001-0,038]) BMI, hem sistolik hem de diyastolik kan basınçları ile korelasyon gösterdi (P<0,001).

Sonuç: Hipertansiyon prevalansı yüksektir ve popülasyondaki obezite ile pozitif olarak ilişkilidir. Hipertansiyonu ve gelecekteki kardiyovasküler hastalıkları önlemek amacıyla obeziteyi azaltmak için agresif yaşam tarzı müdahalesi gerektirmektedir.

Anahtar kelimeler: Hipertansiyon, Obezite, Kardiyovasküler hastalıklar, Prevalans

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Introduction

Arterial hypertension is a major cardiovascular risk factor, resulting in stroke, ischemic heart disease, heart failure, and contributes to the burden of kidney disease [1]. There is a rising prevalence of hypertension worldwide [2], and Africa, including Nigeria, is reported to have the greatest burden of the disease [3]. The estimated prevalence of hypertension in Nigeria ranges between 2.1% to 47.2% depending on the population [4,5]. In 2016, reports from semi-urban cities revealed prevalence rates of 27% and 44.9% in south-east and south-west Nigeria, respectively [6,7]. Egbi et al. [8] determined a prevalence of 50% in a rural community in south-south Nigeria in 2018. Globally, death resulting from hypertension and its complications are also increasing [2].

Obesity has been recognized as a disease and a major risk for global deaths [9]. It constitutes a major public health challenge because of its co-morbidities. General obesity is strongly associated with arterial hypertension [10], which is increasing in some populations [11]. Several authors [12-16] have documented the association of obesity and hypertension, and the link is attributed to increased leptin, low adiponectin, activation of rennin-angiotensin-aldosterone system, increased sympathetic drive, sodium retention, and endothelial dysfunction [17]. The frequent occurrence of obesity and hypertension have led to the term "obesity-related hypertension". Fortunately, obesity is preventable.

There are challenges in the management of hypertension in rural communities in Nigeria [18]. Therefore, emphasis should be laid on prevention of its major risk factors such as obesity. This study sought to determine prevalence of arterial hypertension and its association with generalized obesity in two rural communities in south-western Nigeria.

Materials and methods

This is a cross-sectional descriptive survey of Isara and Ode-Remo communities, in Remo North local government area of Ogun State, Nigeria. The local government was chosen because of convenience. Approval was obtained from the Ethics and Research Committee of Olabisi Onabanjo University Teaching Hospital (REF: OOUTH/DA.326/508). The consent of the king and community leaders was sought after initial sensitization visits to the communities. People who met the inclusion criteria were told to meet at a designated point for the screening. The participants included market men and women, artisans, farmers, drivers, and few civil servants.

With the aid of a pre-tested structured questionnaire, demographic and clinical parameters such as age, gender, marital status, occupation, history of hypertension were obtained. The blood pressure, height, and weight were measured.

Anthropometric measurements

The height was measured (in meters) to the nearest 0.1 meter with a calibrated meter rule placed horizontally against the wall. The subjects were asked to be barefooted and wore light clothing. Subjects were asked to stand on a flat surface, with weight distributed evenly on both feet, heels together and the head positioned so that the line of vision is perpendicular to the body. The arms hung freely by the sides, and the head, back, buttocks and the heels were in contact with the vertical board. The movable headboard was brought onto the topmost point on the head with sufficient pressure to compress the hair [19]. The weight was measured (in kilograms) with a weighing scale without shoes and with the patient wearing light clothing, to the nearest 0.1kg [19].

The Body Mass Index (BMI) was measured as the ratio of weight (kg) to the square of the height (m^2), and classified as follows: ≤18.5 kg/m2, underweight; 18.5-24.9kg/m^2, normal; 25.0-29.9 kg/m^2, overweight; 30.0-34.9 kg/m^2, class 1 obesity; 35.0-39.9 kg/m^2, class 2 obesity; ≥40.0 kg/m^2, class 3 obesity [19].

Blood pressure measurement

Blood pressure was measured with a standard mercury sphygmomanometer with the subjects in the sitting position and the arm resting on a table at the same level of the heart. Systolic and diastolic blood pressures were obtained with the appearance and disappearance of the Korotkoff sounds (Phases I and V) respectively. Hypertension was defined as systolic blood pressure of (SBP) >140mmHg and /or diastolic blood pressure (DBP) >90mmHg. Blood pressure was further classified as follows: SBP <120mmHg and DBP <80 mmHg, normal, SBP 120-139mmHg or DBP 80-89 mmHg, prehypertension, SBP 140-159mmHg or DBP 90-99mmHg, stage 1 hypertension, SBP >160 mmHg or DBP >100 mmHg, stage 2 hypertension [20]. Isolated systolic hypertension (ISH) was defined as SBP ≥140mmHg and DBP <90mmHg.

Statistical analysis

Using the statistical package for social sciences (SPSS) version 16 (Chicago, IL, USA), Chi-square (χ^2) test was used to find the association between categorical variables (expressed as percentages) and t-test to compare continuous variables (expressed as mean). Body mass index was further categorized into quartiles, and the means of blood pressure indices (SBP, DBP, and mean arterial pressure [MAP]) were compared with one-way analysis of variance (ANOVA). Pearson correlation was used to find the association between blood pressure and body mass index. Level of significance was inferred at $P<0.05$.

Results

Four hundred and twelve (412) individuals comprising 206(50%) males were included in the study. Table 1 shows the mean values of Age, SBP, DBP, and MAP according to the quartiles of BMI for all participants. The means of all blood pressure indices increase from first to fourth quartiles of BMI (For trend, $p<0.001$). The overall prevalence of hypertension (BP≥140/90mmHg), systolic hypertension, diastolic hypertension and isolated systolic hypertension were 32.5%, 39.3%, 35.4%, 10.7% respectively (Table 2). Compared to males, more females had systolic hypertension (45.1% vs 33.5%, $P=0.02$).

Table 3 shows the prevalence of hypertension stages. More females had stage 2 systolic hypertension than males (24.8% vs 12.6%).

The prevalence of systolic hypertension increased with age in both men and women, ($P<0.001$), whereas the prevalence of diastolic hypertension increased with age in women only ($P<0.001$, Table 4). The prevalence of ISH also increased with

age in all participants (P=0.019). Overall, prevalence of systolic and diastolic hypertension was highest among those who were 70 years old and above.

Table 1: Mean values of age and blood pressure indices according to quartiles of body mass index

	Quartile 1 mean(SD) n=103	Quartile 2 mean(SD) n=103	Quartile 3 mean(SD) n=103	Quartile 4 mean(SD) n=103	F	*P*-value
Age(years)	47.2(16.8)	39.0(16.1)	43.4(15.6)	48.6(11.9)	8.3	<0.001
SBP (mmHg)	126.8(26.6)	132.0(22.9)	130.9(22.6)	145.1(27.4)	10.3	<0.001
DBP (mmHg)	78.7(13.5)	81.4(14.1)	79.5(13.8)	90.1(17.4)	13.0	<0.001
MAP (mmHg)	94.7(16.8)	98.3(16.0)	96.6(15.7)	108.4(19.6)	13.2	<0.001

SD: Standard deviation, BMI: Body mass index, DBP: Diastolic blood pressure, SBP: Systolic blood pressure

Table 2: Prevalence of hypertension among participants

Characteristics	All n=412 n (%)	Males n=206 n (%)	Females n=206 n(%)	*P*-value
BP≥140/90mmHg	134(32.5)	59(28.6)	75(36.4)	0.115
SBP ≥140mmHg	162(39.3)	69 (33.5)	93(45.1)	0.020
DBP ≥90mmHg	146 (35.4)	70(34.0)	76(36.9)	0.607
ISH	44(10.7)	20(9.7)	24(11.7)	0.633

BMI: Body mass index, DBP: Diastolic blood pressure, ISH: Isolated systolic hypertension, SBP: Systolic blood pressure (ISH is defined as SBP ≥140mmHg and DBP <90mmHg)

Table 3: Prevalence of hypertension according to the stages of hypertension

Characteristics	All n=412 n (%)	Males n=206 n (%)	Females n=206 n (%)	X^2 (df)	*P*-value	95% CI
SBP				37.3(3)	<0.001	0.000-0.007
Normal	112 (27.2)	41 (19.9)	71 (34.5)			
Pre-hypertension	138 (33.5)	96 (46.6)	42 (20.4)			
Stage 1	85 (20.6)	43 (20.9)	42(20.4)			
Stage 2	77(18.7)	26 (12.6)	51(24.8)			
DBP				2.7(3)	0.471	0.423-0.519
Normal	142 (34.5)	69 (33.5)	73 (35.4)			
Pre-hypertension	124 (30.1)	67(32.5)	57 (27.7)			
Stage 1	84 (20.4)	44 (21.4)	40 (19.4)			
Stage 2	62 (15.0)	26 (12.6)	36 (17.5)			

DBP: Diastolic blood pressure, SBP: Systolic blood pressure

Table 4: Prevalence of hypertension in relation to age and gender

Characteristics	Age (years) 18-29 n (%)	30-39 n (%)	40-49 n (%)	50-59 n (%)	60-69 n (%)	>=70 n (%)	*P*-value
SBP							
All	13(14.9)	28(31.1)	24(35.3)	32(52.5)	40(52.5)	25(64.1)	<0.001
Males	13(20.0)	21(36.2)	8(22.2)	13(52.0)	10(62.5)	4(66.7)	<0.001
Females	0(0.0)	7(21.9)	16(50.0)	19(52.8)	30(58.8)	21(63.6)	<0.001
DBP							
All	15(17.2	24(26.7)	29(42.6)	27(44.3)	28(41.8)	23(59.0)	<0.001
Males	15(23.1)	20(34.5)	15(41.7)	9(36.0)	7(43.8)	4(66.7)	0.180
Females	0(0.0)	4(12.5)	14(43.8)	18(50.0)	21(41.2)	19(57.6)	<0.001
ISH							
All	5(5.7)	11(12.2)	3(4.4)	8(13.1)	3(7.7)	3(7.7)	0.019
Males	5(7.7)	8(13.8)	0(0.0)	4(16.0)	3(18.8)	0(0.0)	0.121
Females	0(0.0)	3(9.4)	3(9.4)	11(21.6)	11(21.6)	3(9.1)	0.126

DBP: Diastolic hypertension, ISH: Isolated systolic hypertension, SBP: Systolic blood pressure

As the degree of obesity increases, so does the prevalence of hypertension. More than 50% of those with overweight and class 1 obesity had hypertension (Figure 1). There is significant correlation between SBP (r=0.258, P<0.001) and DBP (r=0.276, P<0.001) with body mass index (Figures 2 and 3).

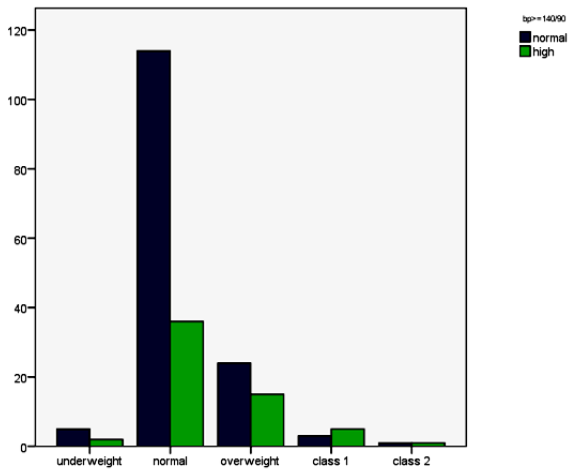

Figure 1: Relationship between obesity and hypertension in all the participants (X^2=8.508, df=5, P=0.019 (95% CI, 0.001-0.038))

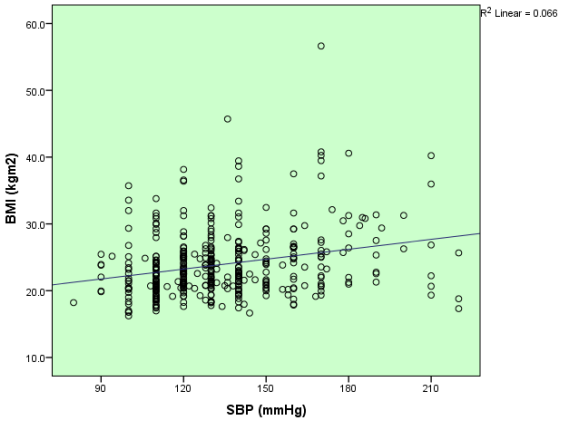

Figure 2: Scatterplot showing relationship between body mass index and systolic blood pressure (Correlation between BMI and SBP, r=0.258 (P<0.001))

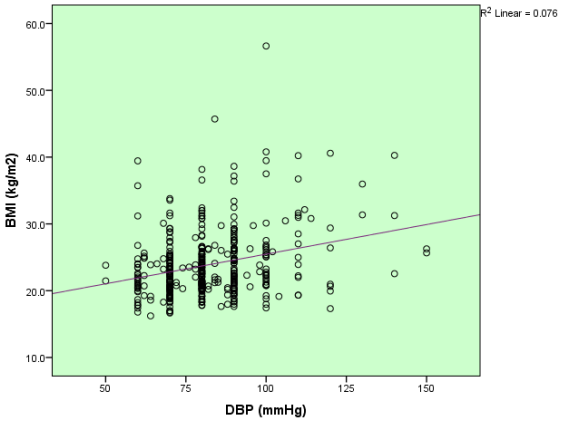

Figure 3: Scatterplot showing relationship between body mass index and diastolic blood pressure (Correlation between BMI and DBP, r=0.276 (P<0.001))

Discussion

Obesity is one of the most important causes of hypertension worldwide. We sought to determine the prevalence of hypertension in two rural communities of south-western Nigeria, and its association with general obesity.

Prevalence of hypertension

The overall prevalence of hypertension (BP ≥140/90mmHg) in the rural communities studied is 32.4%, higher than findings from studies from some rural communities in Nigeria, [21,22], 19.3% in rural northern Ghana [23], and 14.5- 23.5% in rural India [24,25], but lower than the prevalence of 45.8% from a rural community in Enugu, south-eastern Nigeria [26], and 44.9% from south-west Nigeria [7]. The prevalence of hypertension was higher in our study than the Ghanaian study probably because our subjects were older, had higher mean BMI and waist circumference values. Conversely, the lower prevalence of hypertension in our study than the Enugu study may be ascribed to our subjects being younger than theirs. Similar to our findings, a more recent study from Ghana revealed a prevalence of 32.5% [13].

In contrast to what most authors reported, hypertension was equally present in both genders, but systolic and stage 2 hypertension was more prevalent among the female participants [21,26-30]. This may be due to the older age, and higher prevalence of obesity among the females. Hypertension is known to be strongly associated with age and obesity [10,28]. The World Health Organization also reported a higher prevalence of hypertension in Nigerian females [27].

Systolic and diastolic hypertension was present in 39.3% and 35.4% of the people studied, higher than a prevalence of 31% and 22.5% respectively for SBP and DBP in Abia state, south-eastern Nigeria [29]. In addition, both the female and male subjects in our study had higher prevalence of DBP hypertension than in the Abia study. Furthermore, SBP was more prevalent in our female population than those in Abia (45.1% vs 30.5%) [29]. Nevertheless, the prevalence of systolic hypertension in males (33.5%) in our study is similar to the findings in male population in Abia, south-eastern Nigeria, (33.5%) [29].

Few studies reported isolated systolic hypertension (ISH) in Nigeria, even though it has been shown to correlate with cardiovascular diseases in Systolic Hypertension in the Elderly Program (SHEP) study [31]. Isolated systolic hypertension was present in 10.7% of the people studied, akin to a prevalence of 13.3% in north central Nigeria [32], but higher than 6.6% prevalence in an earlier study in rural south-western Nigeria [33]. It is however lower than a prevalence of 22.1% in another study in south-western Nigeria [34] and 39.4% in a study from rural south-eastern Nigeria [35]. This may be due to the fact that the study from the south-western Nigeria was conducted in a semi urban community unlike ours which was from a rural setting, and the participants from the study from rural south-eastern Nigeria were older than those in our study. Our study further showed that the prevalence of ISH increases with age, as reported by previous authors [31,36]. Adediran et al. [37] also showed that hypertension and related disorders were more prevalent in urban setting. The impact of urbanization on hypertension can further be deduced from a study by Ulasi et al. [38], in which those from urban community had higher prevalence of hypertension despite their younger age compared to participants from rural community [38]. Generally, hypertension prevalence increases with age [39].

Pre-hypertension defined as SBP ≥120 but <140mmHg and/or DBP ≥80 but <90 mmHg was found in 31.8% of the participants in our study. It was reported to occur in 44.5% [25] and 45.5% [6] of Indians and Nigerians, respectively. These rates are high and worrisome because it is not a benign condition. Okwuonu et al. [6], reported its association with proteinuria. It has also been shown that SBP ≥110-115mmHg is associated with increased cerebrovascular diseases (ischemic and hemorrhagic strokes), ischemic heart disease, chronic kidney disease, and death [2].

Relationship between hypertension and obesity

In this study we found a positive and linear relationship between hypertension and general obesity. The percentage of participants with hypertension increases with the class of obesity. The means of SBP, DBP and MAP significantly increases with higher quartiles of index. Furthermore, obesity significantly correlates with both SBP and DBP. Previous workers also found that obesity was a major predictor of hypertension [29,35,40,41]. It was reported by Amole et al. [40] that 72.9% of people with obesity had hypertension. Gao et al. [41] reported that general obesity increased the prevalence of obesity by 23% and 37% in males and females, respectively. They also found that the hypertensive effect of general obesity was greater than that of isolated upper body obesity. Dua et al. [42] reported a positive correlation between obesity with both SBP and DBP.

Obesity-induced hypertension is attributed to increased leptin, low adiponectin, activation of rennin-angiotensin-aldosterone system, increased sympathetic activity, increased sodium retention, and endothelial dysfunction [17]. Obesity is associated with insulin and leptin resistance resulting in hyperinsulinemia and hyperleptinemia, respectively. The two abnormalities result in elevated sympathetic activity, which is associated with increased vascular resistance and sodium reabsorption [17]. The adipose tissue increases angiotensinogen, aldosterone, endothelin, resistin and other substances which all act in concert and contribute to high blood pressure [17,43-44]. In view of this, successful prevention and management of obesity is expected to lower the incidence and prevalence of systemic hypertension.

Limitations

The cross-sectional design of this study cannot establish causality between obesity and hypertension. Furthermore, the precise contribution of obesity to hypertension was not determined in this population.

Recommendation

Aggressive health education on healthy lifestyle to prevent obesity should be incorporated into the primary health care system. This will in turn curb hypertension in communities.

Conclusion

The prevalence of hypertension is high and it is positively associated with obesity in rural communities of south-western Nigeria.

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