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Body fat distribution and other anthropometric blood pressure correlates in a Nigerian urban elderly population

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SUMMARY

Blood pressure (BP) has been reported to be more consistently correlated with body mass index (BMI) than with waist-hip ratio (WHR) in Blacks. We present the correlates of BP in a systematic sample of 152 (65,7 pc response rate) elderly urban Nigerians, with a mean age of 72,7 yrs. +/-12,1 for males and 73,2 yrs, +/-11,9 for females.

There were 12,3 pc and 22,3 pc obesity rates in the males and females respectively, with an equivalent mean BMI of 22,8 kg/m^2 and 23,4 kg/m^2 and WHR of 0,97 and 0,94. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) correlated with BMI, $r = 0,26$; $p < 0,01$ and $r = 0,42$; $p < 0,001$, only in females. WHR did not correlate with BP in either sex, but waist and hip measurements correlated significantly with BP in both sexes. The most important predictor of BP is BMI for females and waist measurement for men.

Although smoking and alcohol were not related to BP in either sex, the data suggests that alcohol enhanced, while tobacco inhibited weight gain significantly in males, who on the whole indulged more than the females. Fasting or two hour whole blood glucose were not related to BP. The findings are in support of the adverse effects of weight on BP in the elderly. There is need to study attitudes to adult weight gain as expressed in body shape, and to use the findings in the development of weight control programmes as part of blood pressure control in the elderly.

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INTRODUCTION

Blood pressure and hypertension have been found to be more strongly related to age and environmental factors such as social class and education, than to ethnic background[1-4] However, obesity and body fat distribution as expressed in BMI and WHR differences have not completely explained the racial disparity in the hypertension prevalence among African Americans and their White counterparts.[5,6]

The majority of African studies show that blood pressure, like BMI, increased with age as in the US[7-12] but some studies of rural African populations showed minimal or no increase in either BMI or blood pressure with age.[13-17] This has been attributed to lack of increase in weight with age as a result of sustained physical activity as in nomadic shepherds and farm workers.[13,18] Raised blood pressures in the elderly should therefore not be viewed as normal or an inevitable consequence of aging.[19]

BMI was directly related to blood pressure in adult Americans and Nigerians, but this was not the finding in the younger Nigerian adults. WHR did not correlate with blood pressure in either Nigerians nor African Americans as it did in their White counterparts.[20-22]

This pilot study of urban elderly Nigerians has been carried out primarily to describe the pattern of body fat distribution and other anthropometric correlates of blood pressure in the population.

MATERIALS AND METHODS

The study was conducted in Benin-city, capital of Edo State, Nigeria, and was confined to the old section enclosed within its ancient wall and moat. The sampling frame was based on a house to house enumeration of all adults over 50 years in five of the 32 'sampling units' of approximately 150 houses each. A sex stratified systematic random sample from each sampling unit, restricted to only those 60 years and above, was then selected with a sampling ratio of 1:2 or 1:3. Informed consent was obtained from all participants.

The survey protocol was approved by the University of Pittsburgh and the University of Benin Institutional Review Boards.

Height and weight were measured with participants wearing cotton clothing without shoes. The waist was measured around the umbilicus, and the hips around the widest part of the buttocks. Body mass index (BMI), (weight (kg)/height (m^2)), and waist-hip-ratio (WHR), (waist (cm)/hips (cm)), and tertiles of all measurements were computed. For males, BMI > =27,8 kg/m^2 was regarded as moderate obesity, and BMI >31,1 kg/m^2 was severe obesity. The equivalent cut off points for females were 27,3 kg/m^2 and 32,3 kg/m^2. (National Centre for Health and Statistics classification).[23]

Three blood pressure measurements separated by 30 seconds were taken by certified observers according to a standardised protocol,[24] on three different mornings, using a standard mercury sphygmomanometer and an appropriate size cuff. First and fifth Korotkoff sounds were recorded as the systolic and diastolic blood pressures. The average of the second and third readings on the first visit was used in the analyses.

Venous fasting blood samples and the hour post prandial (75 grams of glucose dissolved in water) finger prick blood samples were analysed for blood glucose using the One Touch II (Lifescan, Johnson and Johnson, Milpitas, CA) glucometer. Calibration of the glucometer was checked with a standard glucose strip after every 10 blood glucose measurements. A venous whole blood fasting glucose and two hour glucose load level of <120 mg/dl was regarded as normal. A fasting whole blood glucose level >=120 mg/dl, or a two hour glucose load >=180 mg/dl (even when fasting whole blood glucose was <120 mg/dl) was classified as diabetes. A two hour whole blood glucose load level of between 120 to 180 mg/dl with a normal fasting blood glucose of <120 mg/dl was termed impaired glucose tolerance.[25]

A detailed and accurate demographic profile, including any history of illness, alcohol, cigarette and tobacco consumption was obtained by trained interviewers using standard questionnaires.

Comparison of means between two groups was by the t-test, and between three or more groups was by ANOVA. Differences in proportion were measured with the Chi-square test. The association between anthropometric measurements and blood pressure was determined using Pearson's correlation coefficient. Demographic variables (coded Present = 1 and Absent = 0) and physical measurements that were statistically univariately correlated with systolic or diastolic blood pressure, in either sex, were offered in backward multiple regression, to assess their relationships with blood pressure. Multiple regression was used to assess the relationship of tobacco and alcohol use (coded Yes = 1 and No = 0) with physical measurements. All statistical calculations were carried out with SPSS/PC+4.0 (SPSS Inc., Chicago, IL).

RESULTS

Of the 915 persons enumerated 268 (29,3 pc) males and 285 (31,1 pc) females reported being 60 years and above. Two hundred and forty two people (121 males and 121 females) were sampled and 159 (65,7 pc) participated in the study. Seven of the participants were excluded from further analysis because they were found to be less than 55 years following more extensive interviews at the first visit to ascertain age. There were 66 males (54,5 pc participation) with a mean age of 72,2 yrs;+/-12,1 and 86 females (71,7 pc participation) with a mean age of 73,2 yrs;+/-11,9.

Thirty (45,5 pc) of the males and 80 (93,0 pc) of the females had no education. The rest of the females had

Table I: Characteristics of study population by sex.

	Male (66)		Female (86)		M/F
	Mean	SD	Mean	SD	p-value
Age (yr)	72,7	12,1	73,2	11,9	0,77
SBP (mmHg)	134,1	24,2	135,5	28,5	0,74
DBP (mmHg)	75,0	14,5	76,3	16,5	0,57
Pulse	75,4	12,3	75,1	11,3	0,89
BMI (Kg/m^2)	22,8	5,8	23,4	6,1	0,34
WHR	0,97	0,84	0,94	0,11	0,02
Weight (Kg)	62,4	13,8	57,8	14,8	0,05
Waist (cm)	88,7	13,6	90,1	15,6	0,10
Hips (cm)	91,3	12,6	96,0	13,7	0,01
Height (cm)	166,1	8,9	157,2	6,1	0,05

SBP: Systolic Blood Pressure.
DBP: Diastolic Blood Pressure.
BMI: Body Mass Index.   WHR: Waist/HIP.

Table II: Blood Pressure, Body Mass Index and Waist-Hip ratio by age and sex.

	SBP		DBP		BMI		WHR	
Age (n)	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Male								
55–64 (21)	137,8	23,1	79,8	12,0	23,9	6,7	0,97	0,07
65–74 (20)	131,6	25,7	77,4	14,8	22,1	4,0	0,96	0,06
75–84 (14)	129,5	16,6	68,4	13,8	22,1	4,0	0,99	0,11
>84 (11)	137,5	32,1	69,8	16,0	22,7	8,2	1,00	0,09
Total (66)	134,1	24,2	75,0	14,5	22,8	5,8	0,97	0,08
Linearity	p = 0,76		p = 0,01		p = 0,49		p = 0,18	
Female								
55–64 (22)	135,1	24,5	81,5	18,5	24,5	7,4	0,94	0,07
65–74 (28)	135,0	24,2	77,1	14,0	22,9	5,3	0,96	0,15
75–84 (22)	139,4	37,5	74,4	12,7	23,3	5,8	0,93	0,09
>84 (14)	131,0	28,6	69,6	21,5	22,6	6,1	0,91	0,07
Total (86)	135,5	28,5	76,3	16,5	23,4	6,1	0,94	0,10
Linearity	p = 0,91		p = 0,03		p = 0,48		p = 0,31	

Figure Ia: BMI distribution by sex in elderly Nigerians.

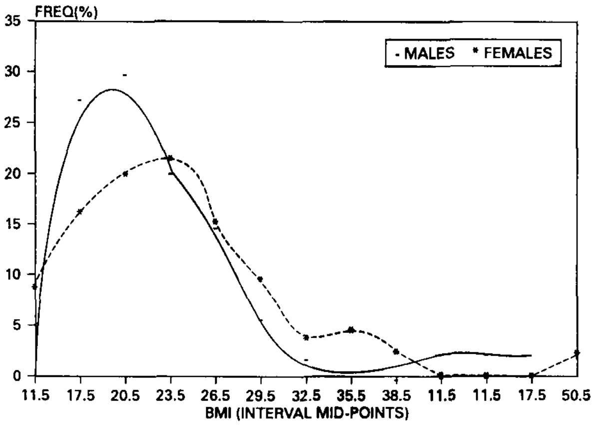
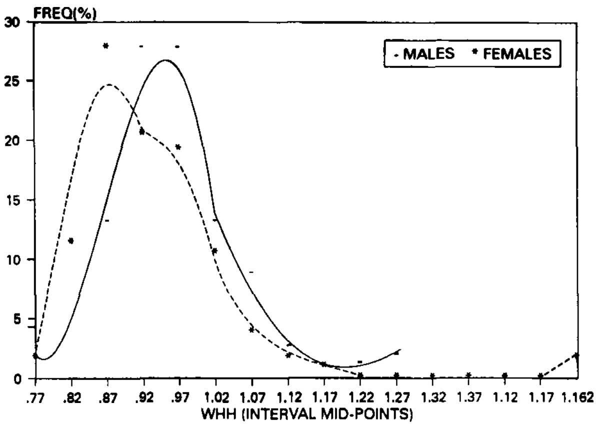


Figure Ib: Waist-Hip-ratio distribution by sex in elderly Nigerians.



primary or secondary education. Twenty two (33,3 pc), 10 (15,2 pc) and four (6 pc) of the males had primary, secondary and university or post secondary technical education, respectively. Only 10 (15,2 pc) males smoked cigarettes; seven smoked five cigarettes daily, while three smoked five to 10 cigarettes a day. No female smoked cigarettes. Twenty five (37,9 pc) of the males chewed, licked or sniffed tobacco, as compared to 22 (25,6 pc) of the females. Oral use of tobacco was more popular among the females while males preferred to sniff tobacco powder. More males, 44 (66,7 pc) than females, 30 (34,9 pc), drank alcohol, $p < 0,001$.

Severe and moderate obesity rates for males were three (4,6 pc) and five (7,7 pc) respectively and the equivalent rates for females were seven (8,2 pc) and 12 (14,1 pc). BMI was not significantly higher in females than males; 23,4 kg/m^2 and 22,8 kg/m^2, while males had a significantly higher waist-hip ratio than females; 0,97 and 0,94; $p < 0,02$ (Table I). The distributions for BMI and WHR were positively skewed in both sexes, (Figures Ia, Ib.) and neither changed significantly across age groups (Table II). BMI correlated with waist and

Table III: Effect of alcohol and tobacco use: separately and combined on blood pressure and anthropometric measurements in the elderly by sex.

Group (n)	SBP mean	DBP mean	BMI mean	WT mean	WST mean	HIPS mean	WHR mean
M							
1 (23)	142,6	80,1	25,1	69,8	95,9	98,9	0,97
2 (18)	127,4	71,3	21,6	60,9	86,1	88,9	0,97
3 (21)	128,1	73,2	22,3	58,5	84,7	87,0	0,98
4 (4)	147,0	71,0	18,1	49,4	80,1	80,5	1,0
Ln:	ns	ns	0,02	0,001	0,002	0,000	ns
F							
1 (20)	134,6	78,8	24,6	61,3	93,0	99,5	0,93
2 (44)	137,0	75,5	23,5	58,2	90,3	95,7	0,95
3 (10)	138,1	81,1	21,3	52,2	84,9	92,2	0,92
4 (12)	129,3	72,3	22,6	54,8	88,4	94,4	0,93
Ln:	ns	ns	ns	ns	ns	ns	ns

Group 1: Alcohol ***Group 2: None*** ***Group 3: Alcohol + Tobacco*** ***Group 4: Tobacco***
Ln: Significance of linearity, p-value, ns: not significant

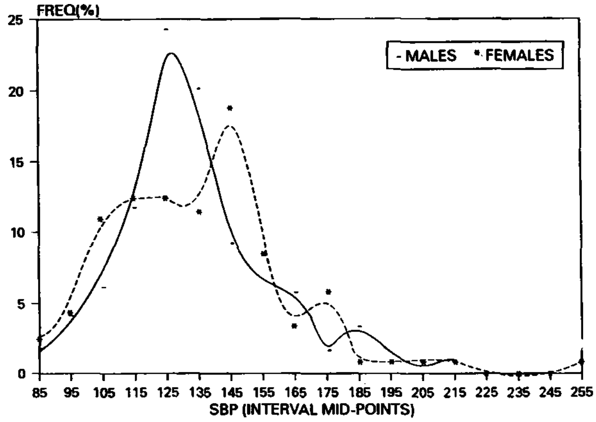
Table IV: Multivariate linear regression coefficient for the association of alcohol and tobacco use with BMI, Waist and Hip measurements in elderly males.

	B	SE B	Sig T
BMI			
Alcohol	3,676	1,517	0,018
Tobacco	-2,955	1,476	0,049
Weight			
Alcohol	8,996	3,477	0,012
Tobacco	-11,360	3,382	0,001
Waist			
Alcohol	8,529	3,470	0,017
Tobacco	-10,044	3,373	0,004
Hips			
Alcohol	9,175	3,083	0,004
Tobacco	-11,055	3,022	0,0005

hip; p < 0,001 but did not correlate with WHR in either sex. WHR indirectly correlated with hips in males, r =-0,54; p < 0,001 but directly with the waist in females, r = 0,62; p < 0,001.

More females reported weight gain in the past year,

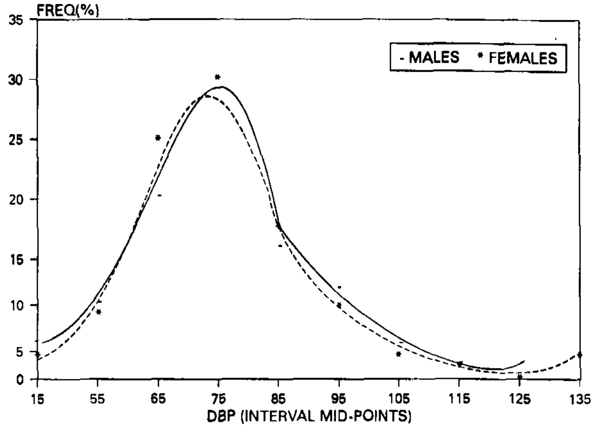
Figure IIa: Systolic Blood Pressure distribution by sex in elderly Nigerians.



11 (12,8 pc) females and two (3,1 pc) males; p < 0,03. Proportions that reported weight maintainance, and weight loss were 42 (63,6 pc) and 22 (33,3 pc) for males and 42 (48,8 pc) and 33 (38,4 pc) for females, respectively. Self reported weight gain status correlated adequately with BMI, hips and waist in females, p < 0,03; p < 0,01 and p < 0,15 respectively, but not in the males.

There was a significant relationship between alcohol and tobacco use with physical measurements in

Figure IIb: Diastolic Blood Pressure distribution by sex in elderly Nigerians.



males only. In combination, the negative effect of tobacco on physical measurements was stronger than the positive effect of alcohol (Table III). Multiple regression analysis revealed that tobacco and alcohol use significantly affected BMI, weight, waist and hip measurements in males, and explained 11 to 22 pc of the variation in these measurements (Table IV).

Although mean SBP was not significantly different for males and females (Table I), and both distributions were positively skewed with the female curve shifted to the right, modal SBP was 125 mmHg and 145 mmHg in males and females respectively. DBP was normally

Table V: Correlation between physical measurements and Blood Pressure.

	Age	BMI	WT	WHR	WST	HIP
M						
SBP	-0,03	0,14	0,17	0,16	0,23	0,18
	ns	ns	@	ns	*	@
DBP	-0,31	0,18	0,24	0,08	0,21	0,22
	**	@	*	*	ns	*
*						
F						
SBP	-0,02	0,26	0,18	-0,01	0,16	0,19
	ns	**	*	ns	@	*
DBP	-0,21	0,42	0,38	0,02	0,30	0,33
	*	**	**	ns	**	**

M: Males. ***F: Females.***
:p < 0,01; *:p < 0,05; @:p < 0,1; ns: not significant.

Table VI: Multivariate regression coefficient for the association of physical measurements and selected demographic variables with blood pressure in elderly Nigerian males and females.

BP variables	Males	Females				
	B	SE B	p	B	SE B	p
SBP:						
Age	0,180	0,259	ns			
BMI				2,138	0,929	0,02
HIPS						
Married	19,367	8,353	0,02			
Pcturban				-0,199	0,141	ns
Waist	0,483	0,219	0,03	-0,363	0,361	ns
DBP:						
Age	-0,347	0,144	0,02	-0,333	0,134	0,02
BMI				1,653	0,499	0,001
HIPS	0,227	0,139	ns	0,185	0,221	ns
Married						
Pcturban				-0,216	0,072	0,004
Waist				-0,344	0,218	ns

Pcturban: pc of life time spent in an urban town/city. ***Married: (Code: Married = 1, All others = 0).***
Only variables retained in the model for SBP or DBP in either sex are presented in the table. All six variables were offered and subjected to backward regression.

distributed in both sexes with the mode at 75 mmHg (Figure IIa, IIb). Unlike SBP, mean DBP decreased significantly with age in males, p < 0,01; and in females, p < 0,025; using the ANOVA test for linearity. (Table II).

Weight significantly correlated with SBP and DBP, p < 0,05 an p < 0,01 in females, but only with DBP in males, p < 0,01. However, BMI correlated with SBP, r = 0,26 and DBP, r = 0,42 only in females, p < 0,01. Waist and hip measurements more consistently correlated significantly with SBP and DBP, while WHR did not correlate significantly with SBP and DBP, while WHR did not correlate with either SBP or DBP in both sexes. Age correlated negatively with SBP and DBP in both sexes, r = 0,31; p < 0,01 and r = 0,21; p < 0,21; p < 0,05 for DBP in males and females respectively (Table V).

Multiple regression analysis confirmed that BMI was a significant predictor of SBP and DBP in females while waist measurement was the best predictor of SBP in males (Table VI).

Of the seven (4,4 pc) people who gave a history of diabetes, four had normal fasting blood sugar. Using the criteria outlined previously 12 (19,0 pc) males and seven (8,2 pc) females were found to be diabetic, while 31 (49,2 pc) males and 20 (23,5 pc) females had an abnormal two hour glucose load test, p = 0,001. The diabetic subjects had higher BMI and SBP than the non-diabetics, however, fasting or two hour load whole blood glucose did not correlate with either SBP or DBP. Mean blood pressures did not significantly vary by marital status, educational status or duration of urban residency in either sex.

DISCUSSION

BMI and WHR values in these elderly Nigerians are similar to those of other Africans.[8,9,12-15] Their BMI is however, lower while their WHR is higher than those of US Whites or Blacks.[6,20,21,27] This lean elderly population should have correspondingly lower WHR. Our findings may be the result of racial differences in body shape, Blacks depositing fat at the waist and hip regions with age. Exercise directed at reducing the waist line will therefore lead to higher WHR values with age. A longitudinal study of body fat distribution patterns in males and females in this population will confirm this suspicion.

That females, and not males, were able to more accurately describe gain status over the past year is an indication of differential attitudes towards weight gain in this population. In this culture weight gain ('pot-belly') in males is regarded as a sign of prosperity while large hips is a sign of beauty and fertility in the females. Elderly males may more readily claim weight gain. It is important to study the attitudes of Nigerians to weight gain and body shape as this may affect their response to health education directed at weight control, dietary and exercise interventions.

While BMI is a measure of total body fatness, WHR is a measure of body fat distribution. WHR had no significant relationship with blood pressure in males or females in this elderly population. This is consistent with our findings among younger Nigerians and African Americans[20,21] and unlike the situation seen in White populations.[28]

BMI has been reported to correlate more strongly with SBP than DBP, and more strongly in males than in females in adult populations in the US and in Africa.[10,26,29,30] In this study BMI correlated with SBP and DBP only in females, who had a higher BMI, and the correlation was stronger with DBP. It is possible that these elderly males have BMI levels below the level at which BMI correlates with blood pressure. Under representation of those with higher BMI can be the result of selective or blood pressure related mortality (Table II and Figure IIa).

Although educational status is inversely related to blood pressure in the US,[1] and directly to blood pressure in the Nigerian civil servants in Benin-City,[22] it is not related to blood pressure in this elderly group. It is not unlikely that socio-economic status was not the dictate of lifestyle in this traditional population 20 to 40 years ago. Besides, their present socio-economic status will reflect that of their children rather than their own educational status.

We conclude that waist measurement and BMI are the important correlates of blood pressure in elderly males and females respectively, waist measurement being a better index of central weight than WHR in this population. The findings are in support of the adverse effects of weight on blood pressure. There is need to study attitudes to adult weight gain as expressed in body shape, and to use the findings in the development of weight control programmes as part of blood pressure control in the elderly. It will also be interesting to study the pattern and distribution of BMI and WHR and their relationship with blood pressure in a longitudinal study in this population.

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