ARTERIAL BLOOD PRESSURES AND HYPERTENSION IN AN URBAN AFRICAN POPULATION SAMPLE

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In the last three decades increasing attention has been paid to a systematic study of arterial blood pressures and hypertension in the native African. The recent reports have shown that, contrary to the opinions of earlier authors (Donnison, 1929; Vint, 1937; Kenney and Watkins, 1956), hypertension commonly affects Africans (see Symposium on Blood Pressure and Hypertension in Africa, 1969) and already certain peculiarities of the disorder are being described in them (Akinkugbe, 1968, 1969).

For many reasons, nearly all the community studies have concerned rural groups of Africans, and worth-while studies in well-defined, unselected, and representative urban communities are few.

This paper describes the results of a study of the distribution of arterial blood pressures and the prevalence and familial occurrence of hypertension in an urban West African population sample.

AREA OF STUDY

Lagos, the capital of the Federal Republic of Nigeria, is an urban area, largely over-crowded, cosmopolitan, and fast growing. The pattern of its health problems is slowly evolving into that of a town in the more socially advanced parts of the world.

Since 1967, the Department of Community Health of the Lagos University College of Medicine has maintained 30 survey sample blocks chosen on a random systematic basis as a 'Community Health Laboratory'. The areas of the present study were chosen for the author at random from these survey blocks to give a sample closely representative of the entire 'Lagos community sample'.

SUBJECTS AND METHODS OF STUDY

All the permanent inhabitants aged 10 years and above in this sub-sample were considered for the study, but, during the survey, subjects who had travelled from their homes for more than 12 weeks were excluded. All the respondents were examined in their homes by the author and many of them were already familiar with him from previous surveys. Also, many of the women in the child-bearing age

had at one time or another had their blood pressures taken in hospital or maternity clinics and were fully aware of the painless procedure involved. Each subject was questioned about age, marital and educational status, present or immediate past occupations, and exact relationship in the household. The subjects were examined as seen and not in any particular order of age or seniority in the household.

The physical measurements taken on subjects in this sample population have already been described (Johnson, 1970 a, b). The subjects sat relaxed for at least 5 minutes before the blood pressures were recorded. Readings were taken on a portable mercury sphygmomanometer and recorded to the nearest 5 or 10 mmHg gradation below the observed figure. The systolic figure was taken at the first appearance of the sound and an abrupt fading or muffling of the sounds (phase IV) was taken as the index of diastolic pressure.

In order to ensure accuracy, a pressure cuff with a bladder 12.5 cm wide by 22 cm long was applied snugly 2-3 cm above the antecubital fossa in all subjects. The arm bared and with no constriction was supported at the level of the heart at an angle of about 45° away from the trunk. All measurements were taken on the right arm, except in two of the subjects.

RESULTS

SAMPLE STATISTICS

Table I shows the age and sex composition of the 1,392 subjects (642 males and 750 females) examined.

TABLE I
AGE AND SEX DISTRIBUTION OF SUBJECTS

Age Group (years)	Males		Females	
	No.	%	No.	%
10-19	150	23.4	220	29.3
20-29	197	30.7	198	26.4
30-39	111	17.3	153	20.4
40-49	96	15.0	90	12.0
50-59	48	7.5	47	6.3
60-69	27	4.2	20	2.7
70+	13	2.0	22	2.9
Total	642		750

FIG. 1. Comparison of age structure of subjects in present study (1968), Lagos Community Sample (1967), and the Federal Territory of Lagos (1963).

Ages ranged from 10 to 102 years. Figure 1 compares the age structure of the studied group with those of the entire 'Lagos Sample' (Morgan, 1967) and the Federal Territory of Lagos (Federal Department of Statistics, 1963) for subjects aged 10 years and above. The overall response rate was good. Nine refusals were encountered.

EDUCATION AND OCCUPATION

The education and occupation classifications of the subjects are given in Table II. Males had better

TABLE II
EDUCATION AND OCCUPATION CLASSIFICATIONS OF SURVEY SUBJECTS

Sex	No Schooling	Primary School	Beyond Primary School
M (%)	23.5	51.7	24.8
F (%)	46.1	44.4	9.5
Both sexes	35.7	47.8	16.5

Sex	Skilled and Professional Occupations	Semi- skilled	Unskilled	Unemployed
M (%)	42.6	33.1	19.6	4.7
F (%)	6.4	8.3	57.8	27.5
Both sexes	23.4	19.9	39.9	16.8

educational attainments than females. The proportions of subjects in this Table who had gone beyond primary school included those who were at or had been through a university. One-hundred and twenty-eight males and 169 females, most of them aged 10 to 19 years, were still at school and were excluded in the occupation groupings. By far the largest proportion of females was in the unskilled

occupation of petty trading, and of the unemployed members of this sex, 78.8% were entirely dependent on their husbands' income.

BLOOD PRESSURE READINGS

SYSTOLIC

Figure 2 shows the frequency distributions of systolic blood pressures in the sample. The number of subjects has been expressed as percentages of the total in each age block. Readings ranged from 80 to 220 mmHg in males and from 80 to 250 mmHg in females. The widest pressure ranges were observed in the fifth and sixth decades in males and in the sixth and seventh decades in females.

DIASTOLIC PRESSURES

Figure 3 shows the distributions of the diastolic readings. The readings extended from 20 to 135 mmHg in males and from 40 to 150 mmHg in females. The highest value (150 mmHg) was obtained on two symptomless women aged 55 and 58 years.

AGE AND SEX DIFFERENCES

Table III and Fig. 4 show the trends of mean systolic and diastolic pressures with age for males and females. In the younger age groups both mean systolic and mean diastolic pressures tended to be higher in males than in females but, with advancing age, the converse became true. Thus, for the systolic pressures, the means for females over the age of 50 years were significantly higher ($P < 0.001$) than those for males of the same age group. The differences between the diastolic readings of the two sexes in these older age groups were less obvious.

Among the females there was a progressive and almost linear rise in mean systolic pressure after the age of 29 years.

FIG. 2. Frequency distribution of systolic pressures in different decades of both sexes.

PREVALENCE OF HYPERTENSION

Hypertension has been defined as a systolic blood pressure of 160 mmHg or more or a diastolic pressure of 95 mmHg or more or both (American Heart Association, 1960; W.H.O., 1962; Burgess, Fejfar and Kagan, 1963). Although the diastolic readings were taken in this study at phase IV, the author's experience in the field showed that in a

number of the subjects studied phase IV coincided with phase V.

During the survey, the author encountered only nine respondents (6 females and 3 males) all over the age of 45 years, who were previously known to be hypertensives—an overall prevalence rate of 0.64%. In none of these subjects were the initial pressure readings taken in hospital by their physicians below

TABLE III
MEANS AND STANDARD DEVIATIONS OF SYSTOLIC AND DIASTOLIC PRESSURES BY AGE AND SEX

Age Groups (years)	Males					Females				
	n	Systolic		Diastolic		n	Systolic		Diastolic	
		Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.
10-14	73	109.2	12.0	69.7	10.2	126	113.4	12.2	71.7	16.6
15-19	77	124.3	17.0	78.8	11.8	94	125.4	13.6	78.8	10.0
20-24	95	130.0	15.1	83.7	11.1	93	122.5	15.1	75.9	13.7
25-29	102	128.2	15.6	82.7	14.2	105	121.6	15.8	78.1	10.8
30-39	111	133.0	17.2	86.4	10.9	153	129.5	20.5	81.7	13.6
40-49	96	136.4	24.8	89.9	14.0	90	143.2	27.3	90.7	15.6
50-59	48	143.9	24.7	89.5	14.6	47	154.8	33.4	92.1	17.7
60-69	27	145.2	22.7	92.4	14.7	20	164.0	30.4	97.0	13.4
70 and above	13	159.2	27.4	90.8	10.3	22	169.8	32.1	98.0	19.5

FIG. 3. Frequency distribution of diastolic pressures in different decades of both sexes.

100 mmHg diastolic and 180 mmHg systolic.

Table IV shows the prevalence of hypertension by age and sex in this population sample according to several criteria. Systolic hypertension—systolic 160 mmHg and above, diastolic below 95 mmHg

(American Heart Association, 1960)—was commoner among females than males. The prevalence of hypertension (BP 160/100 mmHg and above) rose with age in both sexes, and females in the older age groups had significantly higher rates than males.

TABLE IV
PREVALENCE OF 'HYPERTENSION' BY AGE AND SEX IN URBAN NIGERIANS, ACCORDING TO SEVERAL CRITERIA

Age Group (years)	Males				Females			
	Systolic* Hypertension	Systolic 160 mmHg	Diastolic 100 mmHg	Both	Systolic* Hypertension	Systolic 160 mmHg	Diastolic 100 mmHg	Both
10-19	1.3	2.7	3.3	1.3	0.5	0.9	3.6	0.5
20-29	0.5	5.1	9.1	3.0	1.0	3.5	6.1	2.5
30-39	0.9	9.9	17.1	7.2	2.6	10.5	12.4	7.2
40-49	0.0	13.5	25.0	12.5	2.2	26.7	32.2	24.4
50-59	2.1	22.9	35.4	20.8	6.4	42.6	38.3	34.0
60-69	0.0	33.3	37.0	33.3	15.0	65.0	50.0	45.0
70 and above	23.1	53.8	30.8	30.8	13.6	59.1	50.0	45.5
All ages	1.2	10.1	15.1	7.9	2.4	12.7	14.3	9.9

*See text for definition.

FIG. 4. Trends of systolic and diastolic pressures with age (male and female).

FAMILIAL OCCURRENCE OF HYPERTENSION

The word family was taken in the strict sense to mean first-degree relations (siblings, father, mother, and children) and not in the usual sense of the extended family system of most African communities.

BLOOD PRESSURES IN PARENTS AND OFFSPRING

The blood pressure data on 108 spouses with children aged 15 years and above were analysed. The average ages of the fathers (age range 36 to 76 years) and mothers (age range 33 to 69 years) were 55.0 (± 10.0) and 46.4 (± 7.4) years respectively and all except two (aged 43 and 46 years) of their 159 children were in the age group 15 to 39 years. Table V shows the occurrence of hypertension in parents and offspring.

Only one of the 38 children of the normotensive parents was hypertensive as compared with nine of the 42 children of hypertensive spouses. When only

TABLE V
OCCURRENCE OF HYPERTENSION IN PARENTS AND OFFSPRING

B.P. Status and No. of Parent Pairs	B.P. Status and No. of Offspring	
	Normotensive	Hypertensive
Both hypertensive n = 19	33	9
Both normotensive n = 27	38	1
Father or mother hypertensive n = 62	88	5

one of the parents was hypertensive the prevalence rate of hypertension among offspring was 5.7%.

BLOOD PRESSURE IN SIBLINGS

From the records in the field the first subject in each sibship was taken as the proband. As the analysis was confined to siblings aged 30 years and above, the number of sibships in the population surveyed was reduced to 49 and the maximum number of persons in each sibship did not exceed four. Of the 49 probands, 33 had blood pressures in the defined hypertensive range. Twenty (i.e., 60.6%) of these hypertensive probands each had at least one other hypertensive brother or sister but, of the 16 normotensive probands, six (i.e. 3.8%) had at least one hypertensive sibling.

DISCUSSION

In Fig. 5 mean pressures of the present study are compared with those of surveys among Caucasians.

The systolic pressure data of Master, Dublin, and Marks (1950) taken on American subjects are much lower than those of the urban Nigerians, but the more recent figures in the Tecumseh study (Johnson, Epstein, and Kjelsberg, 1965) are rather similar. The Bergen data (Bøe, Humerfelt, and Wedervang, 1957), which were taken in two different districts and were analysed separately by the authors because of the unexplained differences found, have been plotted as different lines. They span the Lagos data for males and females. In the older age groups, mean systolic values in Lagos are lower among males but higher among females than those of the British subjects studied by Hamilton, Pickering, Roberts, and Sowry (1954a). The younger Nigerian males have definitely higher mean values than the British subjects. The growth of pressure with age is somewhat similar in all groups.

The diastolic curves for males show that the Lagos values (readings at phase IV) are very closely similar to those of Johnson *et al.* (1965)—readings at phase IV—on Americans. Mean pressures for the Nigerian males and females are, however, distinctly higher in almost all the age groups than those of Hamilton *et al.* (1954a)—readings at phase IV—on British subjects. Bøe and his colleagues recorded the diastolic readings at phase V, except in cases where this was not distinct when the pressures were taken at phase IV.

It was of considerable interest to compare the results on Negroes in America (Comstock, 1957) and the West Indies (Miall, Kass, Ling, and Stuart, 1962), the ancestors of most of whom came from West Africa in the seventeenth and eighteenth centuries, with those of the urban West African Negroes of this study and urban Zulus of South

FIG. 5. Mean blood pressures in Caucasians and urban Nigerians.

Africa (Scotch, Gampel, Abramson, and Slome, 1961) (see Fig. 6). Mean blood pressures are lower in the Negroes of the Lagos Sample than in the Negro Americans of Comstock's study, but, except in a few age groups, the Lagos values are not very different from those of West Indian Negroes or those of the urban Zulus of South Africa.

The prevalence of hypertension among urban Nigerians is compared with that among Negroes and white Americans (National Center for Health Statistics, 1966) in Table VI. A limitation of this comparison must be pointed out; the minimum diastolic level (at phase IV) employed in the present study was 100 mmHg and not 95 mmHg (at phase V), as in the American study.

In white Americans, up to the age of 55 years, hypertension appears more commonly in males than in females. This trend is absent in the two Negro groups, but in all these three groups the overall prevalence rates of hypertension are similar among males and females. In the youngest age group (15 to 24 years) Nigerians have the highest prevalence rates of the three groups and in all the other age groups they also have higher rates than the American white subjects. Hypertension appears to be more common among Nigerian men aged 45 to 54 years and women aged 55 to 64 years than among

TABLE VI

FREQUENCY OF NIGERIAN AND AMERICAN* (WHITE AND NEGRO) ADULTS WITH HYPERTENSION, i.e., SYSTOLIC PRESSURE 160 mmHg OR DIASTOLIC PRESSURE 95 mmHg (IN AMERICANS), 100 mmHg (IN NIGERIANS) OR BOTH

Age Group (years)	Percentages					
	Males			Females		
	White	Negro	Nigerian	White	Negro	Nigerian
15-24	2	2	8	1	3	5
25-34	4	12	10	2	8	9
35-44	12	26	21	6	26	23
45-54	17	31	35	15	42	32
55-64	21	45	38	31	41	56
65-74	27	66	35	49	71	64
75 and over	40	60	50	45	69	50
All ages	15	28	17	16	28	17

*U.S.P.H.S. (1966)

their Negro counterparts in the United States. The similarities in the overall rates of hypertension between these Nigerians and the white American subjects may be a reflection of the age structure of the communities examined, the Nigerian sample representing the youngest population.

In an earlier study, I showed (Johnson, 1970a) that the average Nigerian male of the 'Lagos Sample' was heavier for height than the average white American male, and that at all ages the

FIG. 6. Mean blood pressures in American and West Indian Negroes and urban Africans.

heights and weights of the Nigerian females were lower than those of white American females. Hathaway and Foard (1960) found that American Negro women were heavier than white females of corresponding heights, but differences between their male counterparts were minor. It does not appear, therefore, that differences in physique would explain the differences in rates of hypertension between these Nigerians and the American white and Negro subjects. In this respect Shaper and Saxton (1969) showed that, although rural Bagandans of Uganda were considerably lighter in body bulk than American white subjects, they exhibited virtually the same pattern of blood pressure levels at all ages and approximately the same prevalence of hypertension.

Among Europeans and Americans, there is suggestive evidence of a familial tendency to hypertension (Weitz, 1923; Ayman, 1934; Sjøbye, 1948; Morrison and Morris, 1960; Hamilton *et al.*, 1954a, 1963; Platt, 1963; Miall and Oldham, 1963; Johnson *et al.*, 1965). To my knowledge, this factor

has not been examined in Africans. The method employed for the analysis in this study has as its basis a concept of 'normal' and 'abnormal' pressure levels derived by specific cut-off points and has at least the advantage of early and wide usage.

Ayman (1934), studying blood pressure in 1,524 members of 277 families, found that the prevalence of hypertension (B.P. over 140/80 mmHg) in offspring aged 14 to 39 years was 3.1% if no parent had hypertension, 28.3% if one parent had hypertension, and 45.5% if both parents had hypertension. These figures are much higher than those obtained in the present study in which hypertension was defined by higher blood pressure readings. The present study, however, shows that when both parents are hypertensive the chances that one or more of their offspring will also show hypertension are greater than if either or both parents are normotensive. The number of sibship sets analysed is small, but the results obtained also show that hypertension in this African milieu does run in families.

SUMMARY

The distributions of arterial blood pressures recorded by the author on 1,392 adult Africans living in the urban environment of the Capital of the Federal Republic of Nigeria are described.

The overall prevalence of hypertension as defined was as common in females as in males, although there were age-specific differences between the two sexes. In both sexes the prevalence rates rose with age.

In so far as conclusions could be drawn from comparisons of data in different surveys, it appeared that mean blood pressures were higher and arterial hypertension was commoner in many age groups of this urban African community than in some Caucasian communities. They were, however, appreciably lower than among Negro subjects in the North American continent.

Data are presented which afford evidence for a familial factor in hypertension in these subjects, but elucidation of the modes of its inheritance must await the results of more extensive family studies.

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