The Prevalence of Hypertension in Seven Populations of West African Origin

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ABSTRACT

Objectives. This study was undertaken to describe the distribution of blood pressures, hypertension prevalence, and associated risk factors among seven populations of West African origin.

Methods. The rates of hypertension in West Africa (Nigeria and Cameroon), the Caribbean (Jamaica, St. Lucia, Barbados), and the United States (metropolitan Chicago, Illinois) were compared on the basis of a highly standardized collaborative protocol. After researchers were given central training in survey methods, population-based samples of 800 to 2500 adults over the age of 25 were examined in seven sites, yielding a total sample of 10 014.

Results. A consistent gradient of hypertension prevalence was observed, rising from 16% in West Africa to 26% in the Caribbean and 33% in the United States. Mean blood pressures were similar among persons aged 25 to 34, while the increase in hypertension prevalence with age was twice as steep in the United States as in Africa. Environmental factors, most notably obesity and the intake of sodium and potassium, varied consistently with disease prevalence across regions.

Conclusion. The findings demonstrate the determining role of social conditions in the evolution of hypertension risk in these populations. (*Am J Public Health.* 1997;87: 160–168)

Introduction

The higher rates of hypertension among persons of African descent in the United States compared with Whites has been recognized for most of this century.[1–3] However, the underlying cause of this differential in risk remains one of the most perplexing biological questions in cardiovascular disease epidemiology. Despite considerable research and widespread speculation,[4–6] the extent to which the steeper slope of blood pressure increase with age among US Blacks can be attributed to genetic or environmental factors has never been resolved. Although blood pressure has a strong familial component,[7] attempts to identify its molecular origins are in their infancy,[8] and all genetic inferences are thus, by necessity, indirect. At the same time, the known environmental exposures leading to hypertension are difficult to quantify and collectively account for only about a quarter of the variance in blood pressure within societies.[9,10] Psychosocial factors, which are thought to play a key role in the Black predilection, are particularly difficult to measure in a generalizable manner.[11,12] While attempts to adjust for known exposures do not entirely close the gap between Blacks and Whites in the United States, this analytic approach is limited by the imprecision of the measurements, particularly for psychosocial factors, and the potential for residual confounding is large.[5] It is entirely possible that Blacks are exposed to stressors associated with racial discrimination that do not impact on Whites and therefore cannot be accounted for in cross-group adjustments. The comparison between Blacks and Whites in the same society is therefore fraught with methodological hazards, which cannot be satisfactorily resolved given the current state of knowledge.[13]

In this paper we describe the pattern of hypertension prevalence determined through door-to-door surveys in Africa, the Caribbean, and the United States, and we demonstrate the cross-cultural associations of hypertension with obesity and with sodium and potassium intake. To date, no direct comparisons of hypertension risk have been attempted between geographically separated Black populations to estimate the impact of known environmental factors. While these populations share a common genetic ancestry, they live under very different social and economic conditions.[14] This makes it possible to examine the evolution of Black hypertension risk within a biological context not defined by reference to a separate ethnic group.

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Methods

Sampling Procedures

The project was known as the International Collaborative Study of Hypertension in Blacks (ICSHIB). Population samples were recruited in Nigeria, Cameroon, Jamaica, St. Lucia, Barbados, and the United States. Nigerian participants were sampled from rural and urban communities; both types of communities were low income and revealed no substantive differences in lifestyle, so they were pooled for the analysis. In Cameroon civil servants were enrolled in the capital of Yaounde to represent a more affluent segment of African society, and villages in a district in the same region provided the rural sample. Caribbean participants were drawn from periurban areas, including Bridgetown in Barbados, Spanish Town in Jamaica, and Vieux Forte in St. Lucia. Maywood, Illinois, the survey site in the United States, is a working-class neighborhood adjacent to Chicago. Fieldwork began in the United States, Africa, and all Caribbean sites except Jamaica in 1991 and was completed by 1994. Fieldwork was carried out in Jamaica in 1994 and 1995.

The sociocultural gradient established by this sampling scheme was multidimensional. The sites were ranked by region first, and then by income and education within region, giving the following order: Nigeria, rural Cameroon, urban Cameroon, Jamaica/St. Lucia/Barbados, and the United States. Overall, Nigeria and rural Cameroon represent the extreme comparison to the United States. Within the Caribbean, per capita gross national product in 1990 was $1103 in Jamaica, $1500 in St. Lucia, and $5965 in Barbados.

Stable, residential communities ranging in size from 10 000 to 40 000 adults aged 25 years and older were identified and sampled according to the "probability proportional to size" method.[15,16] After appropriate subunits were identified, the population of each primary sampling unit was ascertained. These sampling units included villages in rural Nigeria and Cameroon; apartment blocks in urban Cameroon; enumeration areas in St. Lucia, Jamaica, and Barbados; and city blocks in Maywood, Illinois. A random sample was generated, and all eligible subjects living in the designated areas were approached to participate in the study. The recruitment strategy called for a stratified sample with equal proportions of men and women in four age groups (25 to 34, 35 to 44, 45 to 54, and 55 to 74). Given the underlying distribution of the population by age, our efforts to fulfill this sampling scheme met with varying success.

TABLE 1—Number of Participants, by Age, Gender, and Site: The ICSHIB Study, 1995

	No.	Age Group 25–34	35–44	45–54	55+
Men					
West Africa	2528	806	554	511	657
Nigeria	1171	374	202	182	413
Cameroon	1357	432	352	329	244
Urban	612	233	178	140	61
Rural	745	199	174	189	183
Caribbean	1345	378	324	295	348
Jamaica	524	144	122	109	149
St. Lucia	491	151	116	116	108
Barbados	330	83	86	70	91
United States (Maywood)	708	207	198	139	164
Women					
West Africa	2809	895	669	580	665
Nigeria	1338	456	285	215	382
Cameroon	1471	439	384	365	283
Urban	749	247	226	183	93
Rural	722	192	158	182	190
Caribbean	1814	496	424	396	498
Jamaica	733	193	178	171	191
St. Lucia	598	186	139	126	147
Barbados	483	117	107	99	160
United States (Maywood)	810	203	207	193	207

Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

Households were visited by field staff three times, or until all eligible household members were contacted. Participation rates were estimated by including in the denominator all eligible individuals who were contacted face-to-face and presented with the aims and procedures of the study, while all participants in the final sample constituted the numerator. No information was available on noncontactable refusals. The participation rate was 61% in the United States, 60% in Jamaica, 63% in Barbados, 90% to 95% in both urban Cameroon and St. Lucia, and 96% to 99% in both Nigeria (urban and rural sites) and rural Cameroon. It is recognized that the lower participation rates in the non-African sites may reduce the generalizability of the findings.

Training and Certification

It was also recognized that the primary threat to the validity of this study lay in potential differences in measurement technique between sites, so a rigorously standardized protocol was implemented, as described elsewhere.[17] An investigator from each of the collaborating institutions attended a 2-week training seminar at the Coordinating Center in Chicago. Questionnaires were refined and translated into Yoruba for Nigeria and into French and Eton for Cameroon. All trainees received hearing tests. A Dinamap Portable Vital Signs Monitor (model 8100) was purchased for each site, and supervisors were trained to calibrate the monitor with the mercury sphygmomanometers.

The blood pressure measurement protocol was adapted from multisite US studies.[18,19] All trainees passed a videotaped test (Shared Care, Inc, Torrance, CA), which required that no more than 5 of 24 (or 80%) blood pressure measurements differed by more than 4 mm Hg and that no single measurement could differ by more than 6 mm Hg from the correct response. In addition, blood pressure was measured with double-headed ('Y' terminal) stethoscopes. A single individual from the Coordinating Center subse-

TABLE 2—Sex-Specific Mean Level for Anthropometric Variables among Persons of West African Origin: The ICSHIB Study, 1995

		Height, cm		Weight, kg		Body Mass Index, kg/m²		Waist, cm		Hip, cm		Waist-to-Hip Ratio	
	No.	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Men													
Nigeria	1171	168.3	7.3	61.5	11.0	21.7	3.6	77.3	8.4	88.3	8.2	0.88	0.06
Cameroon													
Urban	612	172.3	7.2	74.5	12.1	25.1	3.6	83.3	9.1	96.8	8.1	0.86	0.06
Rural	745	170.1	7.0	68.1	10.4	23.5	3.1	80.4	7.1	90.7	6.7	0.89	0.05
Jamaica	524	172.1	6.9	70.6	13.7	23.8	4.3	80.8	11.9	95.8	8.3	0.84	0.07
St. Lucia	491	173.5	7.5	73.0	11.4	24.3	3.7	82.7	9.5	95.3	7.4	0.87	0.06
Barbados	330	171.9	7.4	76.4	13.2	25.9	4.3	86.2	11.3	97.8	7.7	0.88	0.07
United States (Maywood)	708	176.5	7.3	84.5	18.0	27.1	5.5	92.4	14.0	103.4	10.7	0.89	0.07
Women													
Nigeria	1338	158.3	6.7	56.6	12.3	22.6	4.7	73.9	9.6	93.5	10.8	0.79	0.06
Cameroon													
Urban	749	162.1	5.7	71.0	13.6	27.0	4.7	82.5	9.8	102.5	11.0	0.81	0.07
Rural	722	160.7	6.6	60.6	11.9	23.5	4.3	80.9	9.2	92.6	9.3	0.87	0.06
Jamaica	733	160.7	6.5	72.2	17.7	27.9	6.6	83.2	12.9	104.3	13.0	0.80	0.06
St. Lucia	598	162.3	6.8	72.3	17.0	27.3	6.2	85.5	13.4	103.7	13.1	0.82	0.07
Barbados	483	160.1	6.4	75.2	16.3	29.4	6.4	87.1	12.6	106.7	12.8	0.82	0.07
United States (Maywood)	810	163.4	6.4	82.4	20.9	30.8	7.7	91.4	15.4	111.8	15.0	0.82	0.08

Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

TABLE 3—Distribution of Urinary Electrolytes among Persons of West African Origin: The ICSHIB Study, 1995

	Sodium		Potassium		Sodium:Potassium Ratio	
	Mean	SD	Mean	SD	Mean	SD
West Africa	76.6	56.3	36.7	23.2	2.3	1.3
Nigeria	121.5	76.1	48.9	26.4	2.7	1.3
Cameroon	60.7	36.2	32.3	20.4	2.1	1.2
Urban	54.3	30.2	29.9	17.2	2.0	0.8
Rural	88.4	47.7	42.8	29.1	2.8	2.2
Caribbean	131.5	60.1	56.5	36.9	3.0	1.8
Jamaica	143.6	112.6	54.3	38.2	3.3	2.4
St. Lucia	145.9	62.5	74.6	39.5	2.2	1.0
Barbados	115.3	53.5	36.2	19.0	3.8	2.1
United States (Maywood)	172.5	80.3	49.5	23.5	4.1	2.5

Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

quently visited each site at the beginning of the fieldwork and repeated the training.

A standardized examination was used in all sites. Briefly, participants were asked to empty their bladders and sit quietly for at least 10 minutes before blood pressure was measured. The first and fifth phases of the Korotkoff sounds were recorded. Three sets of auscultatory readings were taken with 1 minute between each reading. A 30-second pulse was counted between the first and second and the second and third blood pressure measurements. Recertification was performed every 3 months or after 400 individuals had been examined, whichever came first. A 1-in-20 sample of participants was recalled for a quality control exam.

As described, the Coordinating Center trainer made cross-site adjustments with reference to the automated device and the field visit.[17] Individual blood pressure readings at each non-US site were adjusted with reference to the Coordinating Center by a fixed amount that varied from −3.7 to +4.5 mm Hg. In the Caribbean, the adjustment was determined by the average of the difference between readings made by the field team against the Dinamap and against the trainer from the Coordinating Center. In both African countries, a single team of observers carried out a quality control resurvey of a sample of participants to verify urban–rural differences. In Nigeria, blood pressure differences were small and no adjustment was made. In Cameroon, systematic differences ranging from 4.5 to 0.4 mm Hg in the measurement techniques of the urban and rural teams were found, so appropriate site-specific adjustments were made. Simultaneous readings against the Dinamap were also used as the basis for comparing mean values in Africa with those in the rest of the sites.

Standard criteria—that is, systolic or diastolic blood pressure of at least 140/90,

160/95 mm Hg, or current treatment—were used to define hypertension prevalence, except in Nigeria and rural Cameroon, where consistent antihypertensive therapy was not found.

Risk Factor Measurements

Anthropometric measurements were made on all participants according to the central protocol. In brief, weight in light clothing was measured to the nearest 0.1 kg with an electronic digital scale while height was taken against a vertical wall with a rigid headboard. Obesity was estimated as body mass index (kilograms/square meters). As a result of a faulty scale, however, data on weight were not used on a subset of participants from Nigeria (n = 410). Waist and hip circumference were measured with a flexible tape at the natural waist and the maximum extension of the buttocks. A subset of participants at each site were asked to collect a single 24-hour urine sample for estimation of sodium and potassium. Data on self-reported alcohol use were collected with a standard instrument. The relationship between alcohol intake and hypertension was weak and inconsistent in some populations, particularly those in Africa, where reported intake was very low, and this variable was not used in the cross-site comparisons.

Statistical Methods

Statistical analyses were performed using programs available on either SAS (SAS Institute, Cary, NC) or SPSS/PC+ (SPSS, Chicago, IL). Prevalence estimates were age adjusted to the total sample by the direct method; pooled estimates were adjusted by sex, where appropriate. The *t* test was used to assess differences in continuous variables while the chi-square test was used for categorical variables. The slope of hypertension prevalence and mean blood pressure was determined in a regression model with the use of data for each of the four age groups. Thus, the change by decade was estimated as the mean rate of increase across the age-specific categories. The impact of the measured risk factors on between-site variation in hypertension prevalence was estimated on the basis of the R^2 value obtained from a linear regression model. In this model, age- and sex-adjusted hypertension prevalence was used as the dependent variable, and mean body mass index and sodium-potassium ratio were used as the independent variables.

TABLE 4—Mean Blood Pressure among Persons of West African Origin, by Sex: The ICSHIB Study, 1995

	Systolic Blood Pressure		Diastolic Blood Pressure	
	Mean	SD	Mean	SD
		Men		
Nigeria	121.5	19.7	73.3	13.0
Cameroon				
Urban	123.7	13.5	78.0	13.0
Rural	119.9	17.9	74.3	10.4
Jamaica	123.2	20.8	71.2	14.7
St. Lucia	126.8	18.9	75.9	13.7
Barbados	125.5	17.0	77.0	10.9
United States (Maywood)	125.3	19.5	73.9	13.4
		Women		
Nigeria	119.1	21.8	72.1	12.8
Cameroon				
Urban	118.4	18.8	73.4	13.8
Rural	119.4	24.8	72.6	11.9
Jamaica	122.3	21.6	70.9	14.1
St. Lucia	122.7	22.5	73.4	14.6
Barbados	122.0	19.9	73.5	11.5
United States (Maywood)	122.4	19.6	72.7	11.8

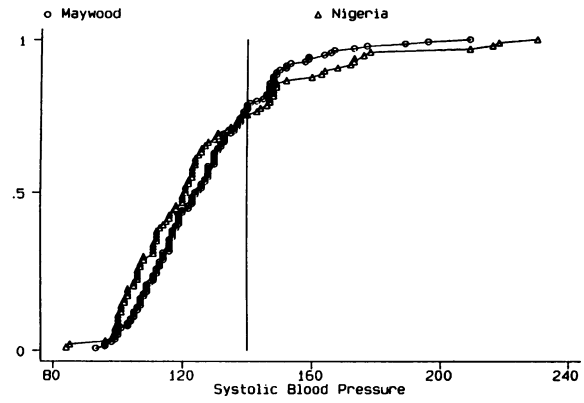
Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

Results

The distribution of participants by age and site is presented in Table 1. Although the sampling design specified recruitment of equal numbers of persons in each of the eight age-sex strata, participation was generally lowest in the 45- to 54-year age group for both men and women. Migration patterns from the village to the city made it difficult to maintain balanced recruitment in Africa.

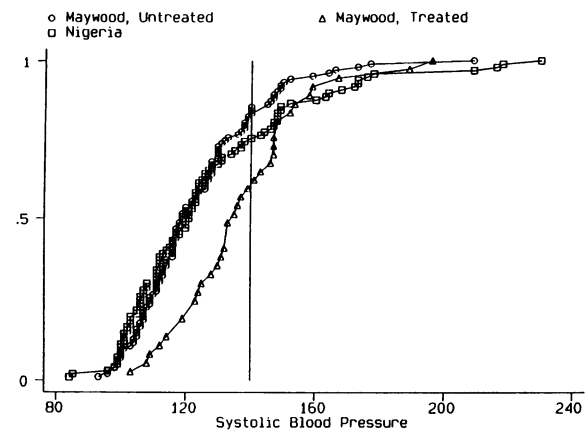
Measures of body size varied consistently across the sociocultural gradient (Table 2). Height increased by 8 cm for men and 5 cm for women across sites. Weight increased disproportionately to height, leading to a consistent trend in all measures of obesity. Not only were increases in mean weight, body mass index, and waist noted in the United States relative to Africa, but the variability was much greater because the distribution was skewed rightward. Thus, the coefficient of variation for body mass index was approximately 15% in Africa compared with 20% in the United States. Waist-to-hip ratio varied little across the range of body mass index, reflecting proportionate increases in body fat by location. Sodium excretion was lowest in Africa (77 mEq/day), intermediate in the Caribbean (132 mEq/day), and highest in the United States (173 mEq/day) ($P < .05$, all comparisons) (Table 3). The ratio of sodium to potassium rose from 2:1 in Cameroon to 4:1 in the United States.

Systolic blood pressures were lowest in rural Africa (Table 4). An urban–rural gradient was observed in Cameroon, except for systolic blood pressure among women (Table 4). Given the high levels of treatment of hypertension in the United States, mean values in Caribbean sites overlapped with those found among both men and women in Maywood despite sizable differences in prevalence. It was anticipated that the attenuation of the blood pressure differences would be greatest in the comparison between the United States and Africa, and this effect was examined directly by plotting the cumulative distribution of systolic blood pressure among men aged 45 to 54 in Maywood and Nigeria. Two distinct distributions were observed (Figure 1). In Maywood, blood pressures were higher below the treatment cut-point of 140 mm Hg while they were lower above that level. A similar analysis demonstrated that this effect was in fact the result of treatment (Figure 2). Treated hypertensives in Maywood had pressures that clustered below the 140 treatment cut-point. Among untreated hypertensives in



Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

FIGURE 1—Cumulative distribution of systolic blood pressure among men aged 45–54, Nigeria and United States (Maywood): the ICSHIB Study, 1995.



Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

FIGURE 2—Cumulative distribution of systolic blood pressure among men aged 45–54, Nigeria and United States (Maywood), by treatment status: the ICSHIB Study, 1995.

TABLE 5—Age-Adjusted Prevalence (%) of Hypertension among Persons of West African Origin, by Sex: The ICSHIB Study, 1995

	Hypertension[a]			Hypertension[b]		
	Men	Women	Total	Men	Women	Total
West Africa	16.3	15	15.6	6.9	7.3	7.1
Nigeria	14.7	14.3	14.5	6.9	6.9	6.9
Cameroon	17.7	16.3	16.9	6.5	8.0	7.3
Urban	22.8	16.0	19.1	8.7	8.7	8.7
Rural	14.2	16.3	15.4	4.7	7.4	6.1
Caribbean	22.6	27.9	25.5	14.6	21.3	18.2
Jamaica	19.1	28.2	24.0	12.9	20.6	17.1
St. Lucia	24.1	27.4	25.9	13.9	20.8	17.6
Barbados	25.9	28.2	27.2	18.0	22.9	20.6
United States (Maywood)	31.3	33.6	32.6	23.1	28.2	25.8

Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.
[a]Defined as having systolic blood pressure ≥140 or diastolic blood pressure ≥90, or taking antihypertension medications.
[b]Defined as having systolic blood pressure ≥160 or diastolic blood pressure ≥95, or taking antihypertension medications.

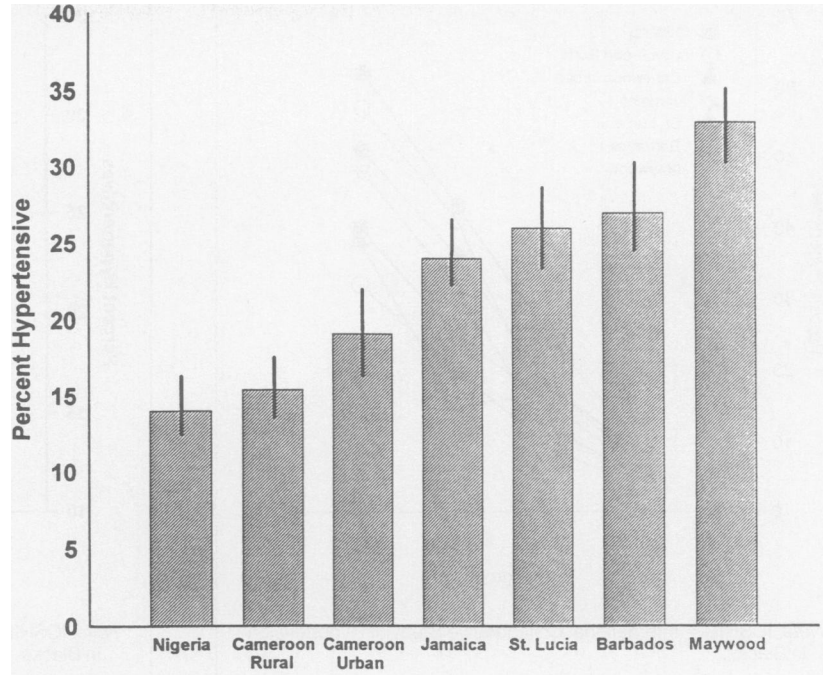
Nigeria and Maywood, pressures were similar below 140 mm Hg, but in Nigeria, persons with high pressures were overrepresented above that level. Among persons in the lowest age group (25 to 34), where no one was treated, essentially no differences in blood pressure were noted (mean systolic blood pressure = 113.6 ± 12.6 vs 113.1 ± 12.9 mm Hg for Maywood and Nigeria, respectively), demonstrating that cumulative exposures over the course of a lifetime result in differential prevalences of hypertension.

By both hypertension criteria, prevalence rose in a stepwise fashion from Nigeria to the United States following the sociocultural gradient (Tables 5, Figure 3; differences by region were all significant; $P < .001$). Nigeria and rural Cameroon had the lowest prevalence (15%; hypertension = blood pressure ≥ 140/90). The frequency of hypertension among male civil servants in Yaounde was similar to that among men in the Caribbean (23%), while among women it was lower (16% vs 28%, urban Cameroon vs the Caribbean, respectively). Within the Caribbean, hypertension prevalence was intermediate between Africa and the United States and was lower in men than in women, particularly in Jamaica. This pattern was consistent with the sex-specific differences in obesity.

The age trajectory of hypertension prevalence exhibited considerable heterogeneity across groups (Figure 4). Estimates were similar in all sites in the age decade of 25 to 34 years, and differences in total hypertension burden were clearly a function of trends with aging. The increase in the proportion of the population with hypertension by decade of age was 0.08 in Africa, 0.16 in the Caribbean, and 0.18 in the United States; differences between the slope for Africa and the other two regions were significant ($P < .01$). The trend in blood pressure by age was similar although the between-site contrasts were reduced by treatment. Thus, by region, the slope estimating the mean rise in systolic blood pressure by decade of age beginning at 25 was 5.7 mm Hg in rural Africa and 7.8 in both the Caribbean and the United States; the differences between Africa and the other two regions were also significant ($P < .01$).

After age, relative weight makes the largest contribution to the risk of hypertension. To assess the impact of obesity on

cross-site variation, this relationship was first examined within each population. In a logistic regression model with hypertension as the dependent variable and age and sex as the covariates, the relative risk associated with a unit change in body mass index was positive and significant in all groups except those in rural Africa, where obesity was uncommon, and among men in Barbados. The mean relative risk for hypertension associated with body mass index for all 14 sex-site groups was 1.05, with a range of 1.01 to 1.12. At the population level, a strong correlation between age-sex-standardized body mass index and hypertension prevalence was observed across sites (Figure 5). This gradient was similar, although less consistent, for the sodium-potassium ratio (Table 3), demonstrating the correlation among the hypertension risk factors. In a regression model, with the age- and sex-adjusted hypertension prevalence for each site used as the outcome variable, the mean body mass index and the sodium-potassium ratio accounted for 70% of the geographic variation in prevalence.



Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.
[a]Hypertension defined as having blood pressure ≥140/90 or taking antihypertension medication.

FIGURE 3—Age and sex-adjusted prevalence of hypertension[a] among seven populations of West African origin (age-adjusted to the total population): the ICSHIB Study, 1995.

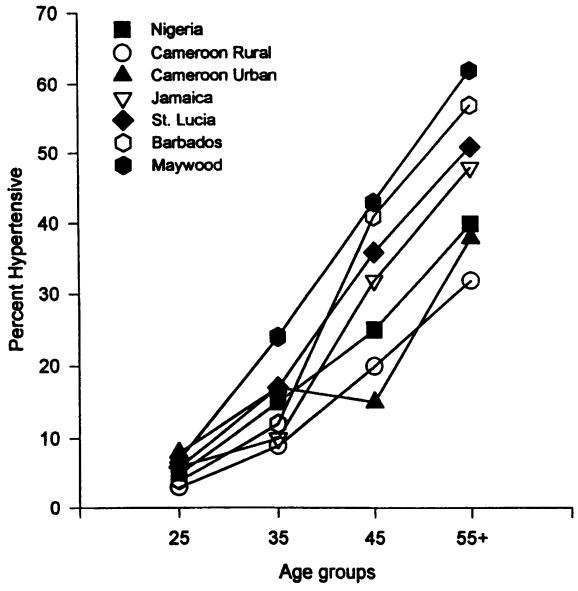
Discussion

In this international collaborative study we have demonstrated a linear increase in prevalence of hypertension across populations of the African diaspora from among the lowest to the highest recorded. In rural West Africa, on the basis of the 140/90 mm Hg cut-point, one in seven adults was found to be hypertensive compared with one in three adults in the United States. Because the surveys were carried out with a common protocol and all field measurements were made after extensive central training, the mean levels of blood pressure in the various sites can be compared directly. In addition, the door-to-door sampling strategy makes the estimates generalizable to the majority population stratum of each society.

External evidence in support of the estimates is available from a recently completed national prevalence survey in the United States.[20] Despite some differences in methodology, prevalence estimates in the national survey were identical to those in the current study (32.4% vs 32.6%, respectively), and mean pressures were again similar (range for systolic blood pressure for both sexes = 123 to 129 mm Hg).[20] The findings from this study are also broadly consistent with prior evidence from Africa and the Caribbean, although direct comparison is difficult given the variation in survey technique.[5,21–27]

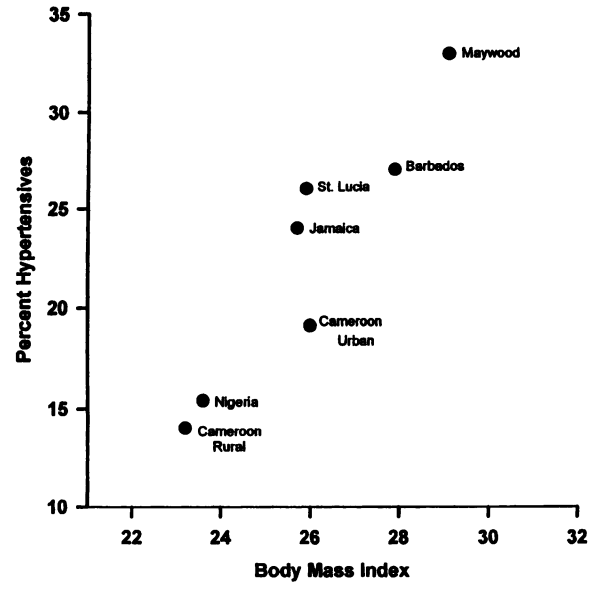
The principal risk factors for hypertension are obesity, high sodium/low potassium intake, psychosocial stress, physical inactivity, and alcohol.[3,10,28,29] We examined obesity at the individual level and the ratio of sodium to potassium intake at the group level. An additional substudy in the Nigerian site demonstrated important roles for sodium and potassium and for psychosocial factors among individuals.[22] Physical activity was not measured directly, and alcohol intake was too low in Africa for the relative risk to be estimated; given the expected direction of their effects, both factors are likely to contribute to the gradient across sites. Psychosocial measures that explain differentials in risk across populations have not been developed, and it is unlikely that constructs could be found that would apply equally to the disparate societies in this study. Although the effect of social class should be generalizable, since hierarchical arrangements are common to all the communities, this problem is obviously complex. Persons of lower socioeconomic status consistently have an increased risk of hypertension in industrialized societies.[2,3,9,10] However, a positive class gradient exists in Africa,[22–24] and this was true in our analyses in which countries were taken as the unit of comparison. Much of this effect seen at the macrosocial level is likely to result from confounding by obesity, physical inactivity, and diet. Whether psychosocial factors play a separate, independent role remains unknown, given the absence of data on within-group relationships at each site and the lack of comparability of measures across groups. It is reasonably certain, however, that the impact of racial discrimination varies from the Black African societies to the racially polarized United States. In sum, the observed cross-cultural gradient among these populations appears to be proportional to the prevalence of risk factors, although no accounting can be made for the psychosocial dimension.

The historical debate over the predisposition of US Blacks to hypertension has focused almost exclusively on Black–White comparisons, with a prominent



Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

FIGURE 4—Prevalence of hypertension among seven populations of West African origin, by age group: the ICSHIB Study, 1995.



Note. ICSHIB = International Collaborative Study of Hypertension in Blacks.

FIGURE 5—Prevalence of hypertension among seven populations of West African origin, by mean body mass index: the ICSHIB Study, 1995.

emphasis on genetic hypotheses.[1-6] The historical view of hypertension in Africa has likewise been shaped by the expectation that unique or unusual processes were at play. On the one hand, some observers proposed that hypertension was common in Africa, consistent with the experience among US Blacks,[30] and the same conclusion was reached with regard to the Caribbean.[27] At the same time, a virtual absence of hypertension among Africans was reported by the early informal surveys.[31,32] A parallel view has been taken on the ethnic comparison of the impact of the common risk factors. Thus, some investigators have argued that "blood pressure seems to be higher among ... African, American, Caribbean, and other black populations ... at the same level of sodium intake," concluding that this "difference is likely to be genetically determined."[33]

Given both the availability of data that permit only the direct comparison of Blacks and Whites and the preoccupation of US public health research with the concept of race, it is perhaps understandable that etiologic hypotheses were constructed as dichotomous alternatives, which were in turn based on the supposition of genetic differences. In retrospect, however, it could be argued that this approach constrained the scientific debate. The data presented here demonstrate an entire range of hypertension risk, confirming the extent to which environmental factors are the determining influence among these populations, as in all other ethnic groups. Of course it remains possible that persons of African origin experience a steeper dose-response curve in relation to certain exposures, as suggested above for dietary sodium. To our knowledge, however, no convincing body of evidence exists to support that assertion, for sodium or other factors.[5] In the end, all we know with confidence is that the aggregate dose of risk factors experienced by US Blacks is larger than that experienced by both US Whites and African and Caribbean Blacks, particularly if one considers the potential impact of psychosocial stress associated with racial discrimination.[34-37]

Additional evidence that environmental factors are the primary determinant of the gradient in hypertension across these populations arises from the observation that, despite several hundred years of separation, these populations share a common genetic background. Although prior molecular information on the ancestral origin of US and Caribbean Blacks has been derived from loci unrelated to blood pressure regulation,[38,39] recent data on allele frequencies of the renin-angiotensin genes confirm that the US and Jamaican Blacks we studied derive approximately 75% of their ancestry from populations similar to the Nigerians.[40,41]

It must be acknowledged, however, that available data do not allow either the genetic or environmental hypotheses to be tested rigorously since measures of both components are still very imprecise. Known environmental risk factors in aggregate explain no more than 15% to 25% of the total variance in blood pressure,[9,10] and differential dose-response relationships across populations are extremely difficult to model. While progress has been made toward identifying molecular variants that condition the risk of hypertension,[42] the effects of individual genes are likely to be small and inconsistent across groups.[5,40] It is also likely that gene-environment interactions occur, with specific genotypes expressed differently in settings where the mix of exposures differs. Cross-ethnic group comparisons of hypertension risk thus fall prey to a special form of the "ecological fallacy," in which the precision of the

within-group exposure-outcome relationships is too weak to permit conclusions about the impact of these relationships on mean differences between groups.

Hypertension has emerged as a crucial determinant of ill health among persons of African descent in the Western Hemisphere,[43–45] accounting for a large portion of the Black-White differential. Remarkable progress has been made over the last 2 decades toward hypertension control among Blacks,[20,46,47] although survey data in the 1990s show significantly lower control rates among Blacks than among Whites.[49] While differences in survey methodology make direct comparisons hazardous, taken at face value mean systolic pressures have dropped 30 mm Hg in the last 4 decades among US Blacks over 55 years of age.[1,2,20,48–50] It seems likely that some of this decline may be due to a reduction in the force of the disease as well as to treatment; however, the specific reasons have not been identified.

In summary, these findings demonstrate in a standardized setting the impact of social and cultural factors underlying one of the most common cardiovascular conditions in human societies. By choosing geographic samples to reproduce the historical migration pattern,[13] we have attempted to characterize the evolution of hypertension during the transition from subsistence farming to an industrialized lifestyle. On the basis of an even broader range of contrasts, these findings are consistent with the evidence on migration from other ethnic groups.[51–53] In combination with the body of knowledge already available demonstrating that external risk factors determine the variation in risk within groups,[9,10,29] across groups,[51,52] and over time,[53–55] these findings lend support to the environmental hypothesis of Black hypertension. Although they do not exclude the possibility of a permissive genetic effect, they provide an estimate of the impact of social factors acting on a common substrate. A new generation of studies that can define with greater precision the attributes of risk within these Black populations and provide summary estimates of their aggregate impact at the population level, particularly for psychosocial stress, will improve our understanding of the environmental basis of hypertension risk and suggest the most appropriate strategies for prevention. □

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Errata

In: El-Sadr W, Medard F, Barthaud V. Directly observed therapy for tuberculosis: the Harlem Hospital experience, 1993. *Am J Public Health.* 1996;86:1146–1149.

Vladimir Berthaud's name was incorrectly printed as Barthaud.

A clarification regarding the prevalence of injection drug users in the sample: the 46.2% reported in the second paragraph of the Results section represents the total prevalence of injection drug users among all 145 patients enrolled in the program; the percentages of injection drug use in Table 3 refer to patients with confirmed tuberculosis.

In: Zhu B-P, Giovino GA, Mowery PD, Eriksen MP. The relationship between cigarette smoking and education revisited: implications for categorizing persons' educational status. *Am J Public Health.* 1996;86:1582–1589.

In the first sentence of the third paragraph of the Discussion, the reference to Pirie et al.'s work should have read as follows [change in italics]: "who found that daily smoking prevalence among in-school students is substantially *lower* than that among persons of the same age who are not in school."