THE EFFECTS OF RACE AND OCCUPATION
ON HYPERTENSION MORTALITY

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American Negroes consistently show a higher prevalence of hypertension and greater morbidity and mortality from hypertensive disease than do American whites.[1-7] In 1950, for the United States as a whole the male nonwhite-white mortality differential for hypertension was greater than that for any other cause of death except homicide and syphilis.[93]

Various hypotheses have been suggested to explain the race difference in hypertension: (1) the genetic hypothesis argues that Negroes are genetically different from whites in ways that predispose more of them to hypertension;[4,5,9,10] (2) the physical exertion hypothesis argues that Negroes are more likely than whites to be engaged in manual labor occupations and that greater physical exertion leads to higher mortality from hypertension;[4] (3) the associated disorder hypothesis argues that Negroes are more prone to diseases such as pyelonephritis and syphilis, which may result in secondary hypertension;[4,11] (4) the psychological stress hypothesis argues that Negroes are severely frustrated by racial discrimination and that this stress and the repressed aggression associated with it lead to a higher prevalence of hypertension;[4,11,12] (5) the diet hypothesis argues that Negroes may have dietary patterns that increase their susceptibility to hypertension;[11,13-15] (6) the medical care hypothe-

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sis argues that Negroes receive poorer medical care than do whites and that this results in greater morbidity and mortality from hypertensive disease[3] and perhaps a higher prevalence of secondary hypertension.

Two of these theories definitely reflect the fact that American Negroes are of lower socioeconomic status than whites. Thus, the physical exertion hypothesis is based on the notion of different occupational distributions for Negroes and whites, and the medical care hypothesis is based on the idea that the lower economic status of Negroes along with racial discrimination prevents them from acquiring adequate medical supervision and therapy. Three other hypotheses seem to involve socioeconomic considerations: the diet hypothesis because the food habits of Negroes apparently vary with income;[15] the associated disorder hypothesis because the prevalence of certain diseases that may be related to hypertension seems to be higher among those of lower socioeconomic status;[8, 16–19] and the genetic hypothesis because lower-class Negroes appear to be the most Negroid in genetic makeup.[20–22] Emotional stress from racial discrimination may vary with socioeconomic status, but it is debatable whether the Negro lower class suffers more or less frustration than the middle class.[23]

Although numerous studies have revealed the higher prevalence of hypertension among Negroes, few have explored its cause. The purpose here is to study the effects of occupation and socioeconomic status on race differences in hypertension mortality.

In 1963, the Vital Statistics Division of the United States Public Health Service published male deaths for the United States in 1950 for selected causes by age, race, occupation and socioeconomic status.[8, 24] For the first time deaths from hypertension were classified by occupation as well as age, race and sex; so it is possible to study the effect of socioeconomic status (as indexed by occupation) on hypertension mortality for the United States as a whole. Deaths and death rates by occupation were published for the decennial years 1890, 1900 and 1930.[25]

However, no grouping of causes of death comparable to hypertension (with and without heart disease) existed before 1949.[3] Even in 1950, many deaths associated with hypertension were not so classified since such disorders as arteriosclerotic heart disease (I.S.C. 420) and stroke (I.S.C. 330–334) took precedence as underlying causes of death.[26]

PRIOR RESEARCH ON SOCIOECONOMIC FACTORS AND HYPERTENSION

Studies of the relation between social class and hypertension have been relatively few and widely scattered, and key variables such as race are not always controlled. Results vary and are somewhat contradictory, but certain consistencies are worth noting. Because the present research focuses on males, only data for males are summarized here.

American studies are of two types: those that control for race[5, 27–33] and those that do not.[34–40] (If race is not mentioned in American studies, the authors assume a mixture of whites and nonwhites except for Framingham[29] in which the proportion of nonwhites is quite small.[41]) In both groups most studies show or tend to show an *inverse* relation between socioeconomic status and hypertension[5, 29–32, 35–38, 40] (the higher the class, the lower the prevalence, morbidity or mortality rates) rather than a direct relation,[27] and one in each group shows trends in both directions.[33, 34] In many studies presenting a trend, additional data (for another race, age group and so forth) show no tendency in either direction,[5, 27, 29, 31–34, 38] and two other studies consistently show no relation between class and hypertension.[28, 39] Two American studies have not been included, which combine the sexes. One shows no trend,[42] and the other has findings of three types: inverse, direct and no trend.[43]

The National Health Survey[31] deserves special comment because it samples the whole United States, controls race, sex and age, and uses multiple indices of status. For both white and Negro males, rates of hypertension (actual prevalence rates

minus expected rates) tend to be inversely related to education and occupation. For Negroes the income picture is also inverse except that the wealthiest group ($10,000 plus) has a high rate. Whites show no income trend. Hypertensive heart disease shows no pattern for income or white education, but trends for occupation and Negro education tend to be inverse.

Studies from Europe and India[35, 44-55] contradict the American pattern. More show a direct[35, 47, 48, 50, 51, 53, 55] than an inverse[44, 45, 49, 54] relation between class and hypertension, with one study presenting data in both directions[52] and one showing no trend at all.[46] A Taiwan study with mixed sexes also shows a direct trend.[56] In some studies presenting a trend, additional data show no tendency in either direction.[35, 44, 45, 49, 51]

In the few American studies permitting interracial comparisons between persons of comparable class, hypertension among nonwhites is always or almost always greater.[5, 27, 28, 30-33, 35, 40]

In addition to studies of social class and hypertension, research has focused on the effects of work-related physical activity. Most of these studies (all foreign) present data showing higher blood pressures or rates of hypertension in lighter rather than heavier occupations.[46-48, 51, 53, 55, 57-63] Only two studies show the opposite pattern.[32, 64] The rest show contradictory results or no trend at all,[38, 44, 49, 65] and a few of the single-trend studies contain additional data showing no pattern.[46, 51, 64] Four studies with mixed sexes showed higher pressures in lighter work,[56] the opposite pattern[66] and no relation at all.[29, 67]

Social class and physical exertion are, of course, intertwined, and only the rare study attempts to separate their effects on hypertension.[49, 68]

METHODOLOGY OF THE PRESENT STUDY

The data of concern here were derived from the 1963 Public Health Service publication dealing with mortality by occupation level and cause of death.[8] The deaths were presented for two hypertensive diseases: hypertension with heart disease

(categories 440–443) and hypertension without mention of heart (categories 444–447) ; two racial groups: whites and non-whites;[94] seven age groups: 20–24, 25–29, 30–34, 35–44, 45–54, 55–59 and 60–64; and 27 occupations, classified into five socio-economic classes and a residual "agricultural workers" category.

Deaths were reported for the two races separately for only 19 occupations from four socioeconomic classes and for agricultural workers. Too few nonwhite deaths occurred in certain occupations including Class I (professional workers) to merit subdivisions by race.[8] However, the number of white and non-white deaths was derived for professional workers alone and for the other six occupations combined (see Table 1). This gave a total of 22 occupational categories for which racial comparisons were possible: 21 nonfarm occupations, classified into five socioeconomic classes, and agricultural workers.

Deaths for hypertension with and without heart disease were combined to give a more complete picture.[97] The first age interval was disregarded and the others were grouped into four ten-year categories covering the range 25–64. Then death rates per 100,000 population[8] were computed for the 176 age-race-occupation subcategories and standardized mortality ratios for the 44 race-occupation subcategories. The ratios cover the age range 20–64. Whenever calculations were made for occupations, they were also made for class groupings of occupations.

Race differences were computed in death rates and standard mortality ratios for all cases and the significance of these differences was tested. For each race the differences were measured between the ratios of the various socioeconomic classes and their significance was tested. Last, the amount of variance in the mortality ratio for the two races was computed and compared.

RESULTS OF THE DATA ANALYSIS

This study concerns the effects of race, occupation and age on mortality from hypertensive disease. The variables will be considered separately, but interrelations will be discussed.

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TABLE I. HYPERTENSIVE DISEASE: AGE SPECIFIC AND AGE STANDARDIZED DEATH RATES,[a] 1950, PER 100,000 U.S. MALES 20-64 YEARS OF AGE WITH WORK EXPERIENCE

| | Age Standardized Rates | | | | | | | | | |
| | White Ages | | | | | Nonwhite Ages | | | | |
Socioeconomic Class	(20-64)	25-34	35-44	45-54	55-64	(20-64)	25-34	35-44	45-54	55-64
I Professional workers	31.0	1.2	9.4	41.5	122.5	118.6	0	0	251.4	414.2
II Technical, administrative and managerial workers	30.6	1.7	9.0	43.0	118.2	131.4[b]	7.4	60.0	168.6	494.0
III Clerical, sales and skilled workers	33.6	2.3	9.4	43.6	134.2	104.6	14.7	49.2	148.9	354.1
IV Semiskilled workers	31.2	1.8	10.2	40.6	122.2	101.2	12.7	60.4	165.0	298.6
V Laborers	34.3	1.9	14.1	49.0	124.0	186.7[c]	23.6	107.9	298.6	564.0
Class Occupation										
All occupations[d]	31.3	2.0	9.6	41.6	122.6	143.2	16.5	72.5	215.2	469.6
I A-1 Professional workers[e]	31.0	1.2	9.4	41.5	122.5	118.6	0	0	251.4	414.2
II A-2[f] All other professional, technical and kindred workers	34.7	1.6	11.3	48.0	133.9	199.1[g]	10.8	76.9	265.5	758.4
A-3 Officials, inspectors and specified managers	29.2	1.8	7.8	41.3	113.3	64.8	0	36.2	88.7	232.1
III A-4 Managers, officials and proprietors	36.1	2.1	11.3	45.7	143.5	122.9	13.4	75.3	182.1	389.6
A-5 Clerical and kindred workers	33.3	2.8	10.3	47.4	125.2	74.4	11.5	30.9	75.6	287.6
A-8 Mechanics and repairmen, except radio	24.6	1.8	6.6	29.1	101.8	79.0	7.4	46.3	125.5	241.4
A-10 Metal craftsmen	39.1	2.1	14.8	45.4	158.5	80.2	15.5	21.4	173.4	216.1
A-12 Cabinetmakers and carpenters	23.6	0.4	6.7	27.8	99.8	123.2	9.6	49.4	159.7	467.7
A-13 All other craftsmen	37.7	3.6	8.4	45.9	155.9	148.4	33.7	69.7	199.9	500.5
A-6, A-7, A-9, A-11, A-14, A-15 Residual category of six Class III occupations[h]	34.6	2.3	8.3	47.6	136.9	101.2	12.8	53.8	148.8	332.0

TABLE I. (CONTINUED)

IV A-16 Painters and plasterers	37.8	1.5	10.1	49.4	152.0	161.3	6.9	68.6	226.8	592.4
A-17 Metal operatives	23.0	0.8	8.0	29.9	90.5	40.3	2.1	36.8	61.8	105.4
A-18 Drivers and deliverymen	30.4	3.4	11.3	41.0	113.0	106.9	20.4	68.2	178.9	289.4
A-19 Operatives in selected manufacturing industries	28.7	1.6	9.9	35.6	114.1	68.2	9.0	41.4	103.8	208.9
A-20 Mine operatives and laborers	50.0	0.6	12.1	62.4	208.2	143.4	27.0	58.5	231.9	456.8
A-21 All other operatives	24.5	1.5	9.1	29.3	98.0	81.0	10.9	66.9	149.6	185.0
A-22 Service workers	38.4	1.5	12.3	55.1	144.3	138.4	14.5	77.2	223.4	427.7
V A-23 Laborers in metal manufacturing	41.7	3.5	13.8	53.0	163.7	231.9	19.7	114.8	352.6	765.2
A-24 Laborers in other manufacturing	44.5	1.5	9.1	52.0	191.9	279.6	29.9	173.4	459.2	818.6
A-25 Construction and outdoor laborers	28.9	2.1	11.9	40.8	104.3	149.5	22.6	83.2	209.4	488.6
A-26 Laborers in other nonmanufacturing industries	33.9	1.3	18.7	53.4	110.1	178.3	22.8	101.4	296.5	527.7
Agricultural workers[i]	27.9	2.5	8.1	36.0	109.6	165.4	15.9	65.2	225.8	607.6

[a] The formula for computing age standardized death rates is reported in reference 89. These rates do not lend themselves to tests of significance as easily as SMRs; so they were not used for that purpose.

[b] When the nonwhite clergy are removed from Class II, the age standardized death rate is 75.1, and the age specific rates are 7.80, 55.16, 116.43 and 271.49.

[c] When the nonwhite clergy are placed in Class V, the age standardized death rate is 189.7, and the age specific rates are 23.51, 107.71, 300.61 and 580.35.

[d] Including occupation not stated.

[e] The number of white and nonwhite deaths for professional workers was derived by subtracting deaths for "all other professional, technical and kindred workers" from deaths for "professional, technical and kindred workers."[8,24]

[f] Clergymen are a subgrouping of category A-2. The age standardized death rates for the white and nonwhite clergy are 29.4 and 272.9 respectively.

[g] When the nonwhite clergy are removed from category A-2, the age standardized death rate is 116.2, and the age specific rates are 11.70, 72.43, 175.09 and 364.30.

[h] Salesmen and sales clerks, retail trade; all other sales workers; foremen; engine and construction machinery operators; transportation and public utility workers; and guards and protective-service workers.[8] The six residual occupations are all in Class III; so white and nonwhite deaths were derived by summing figures for all the other Class III occupations and subtracting them from the totals for Class III.[8]

[i] "Agricultural workers" includes farmers and farm managers as well as foremen and laborers; so it does not fall into a specific class.

TABLE 2. HYPERTENSIVE DISEASE: STANDARDIZED MORTALITY RATIOS,[a] 1950, U.S. MALES 20–64 YEARS OF AGE, WITH WORK EXPERIENCE

Socioeconomic Class	Whites		Nonwhites		Race Differences SMR(N) minus SMR(W)	Rank
	SMR	Rank	SMR	Rank		
I Professional workers	75	1.5	294	3	219	3
II Technical, administrative and managerial workers	75	1.5	319[b]	4	244	4
III Clerical, sales and skilled workers	82	4	259	1	177	1
IV Semiskilled workers	76	3	261	2	185	2
V Laborers	84	5	469[c]	5	385	5

Class	Occupation					
	All occupations[d]	77		355		278	
I	A-1 Professional workers	75	10	294	9	219	10
II	A-2[e] All other professional, technical and kindred workers	84	13.5	483[f]	20	399	20
	A-3 Officials, inspectors, and specified managers	72	8	159	2	87	2
III	A-4 Managers, officials and proprietors	88	15	300	10.5	212	9
	A-5 Clerical and kindred workers	81	12	188	4	107	4
	A-8 Mechanics and repairmen, except radio	58	2	208	5	150	6
	A-10 Metal craftsmen	96	19	210	6	114	5
	A-12 Cabinetmakers and carpenters	59	3	300	10.5	241	13
	A-13 All other craftsmen	92	16	371	15	279	15
	A-6, A-7, A-9, A-11, A-14, A-15 Residual category of six Class III occupations	84	13.5	248	8	164	8
IV	A-16 Painters and plasterers	93	17	393	17	300	16
	A-17 Metal operatives	55	1	109	1	54	1
	A-18 Drivers and deliverymen	74	9	301	12	227	11
	A-19 Operatives in selected manufacturing industries	70	6	174	3	104	3
	A-20 Mine operatives and laborers	120	22	351	14	231	12
	A-21 All other operatives	60	4	216	7	156	7
	A-22 Service workers	95	18	348	13	253	14

TABLE 2. (CONTINUED).

Socioeconomic Class	Whites SMR	Rank	Nonwhites SMR	Rank	Race Differences SMR(N) minus SMR(W)	Rank
V A-23 Laborers in metal manufacturing	103	20	585	21	482	21
A-24 Laborers in other manufacturing	110	21	728	22	618	22
A-25 Construction and outdoor laborers	71	7	377	16	306	17
A-26 Laborers in other nonmanufacturing industries	80	11	440	19	360	19
Agricultural workers	69	5	403	18	334	18

ᵃ The formula for computing SMRs is reported in reference 8.
ᵇ When the nonwhite clergy are removed from Class II, the SMR is 209.
ᶜ When the nonwhite clergy are placed in Class V, the SMR is 475.
ᵈ Including occupation not stated.
ᵉ The clergy SMRs for whites and nonwhites respectively are 73 and 686.[24, 25]
ᶠ When the nonwhite clergy are removed from category A-2, the SMR is 305.

The Effect of Race

Race differences in hypertension mortality may be measured in two ways: either death rates or standardized mortality ratios may be compared for the two racial groups.

For the death rates, 88 white-nonwhite comparisons are possible: 22 occupational categories times four age categories (see Table 1). In 85 of the 88 cases, the nonwhite death rate is larger than the white; 69 of these differences are statistically significant, most at the .001 level. In only three cases (all significant) do nonwhites have a lower death rate than whites. With regard to class groupings of occupations, nonwhites have a higher mortality than do whites in 18 of the 20 class-age subcategories, and all but one of these differences are significant, 15 at the .001 level.

The comparison of standardized mortality ratios for the two races by occupation and class gives a picture similar to the death rates. For all 22 occupational categories, nonwhites have a higher mortality ratio than whites (see Table 2), and all the differences are statistically significant, 21 at the .001 level and

TABLE 3. ALL CAUSES OF DEATH COMBINED: STANDARDIZED MORTALITY RATIOS,[a] 1950, U.S. MALES 20–64 YEARS OF AGE, WITH WORK EXPERIENCE

Socioeconomic Class	Whites SMR	Rank	Nonwhites SMR	Rank	Race Differences SMR(N) minus SMR(W)	Rank[c]
I Professional workers	82	1	100	1	18	1
II Technical, administrative and managerial workers	84	2	146	4	62	4
III Clerical, sales and skilled workers	96	3	124	2.5	28	3
IV Semiskilled workers	97	4	124	2.5	27	2
V Laborers	120	5	244	5	124	5

Class Occupation						
All occupations[b]	93		174		81	
I A-1 Professional workers	82	4	100	5	18	7
II A-2[d] All other professional, technical and kindred workers	89	10	205	18	116	19
A-3 Officials, inspectors and specified managers	82	4	84	3	2	4
III A-4 Managers, officials and proprietors	98	12	141	11	43	13
A-5 Clerical and kindred workers	85	9	89	4	4	5
A-8 Mechanics and repairmen, except radio	83	6.5	118	7.5	35	10
A-10 Metal craftsmen	116	17	132	9	16	6
A-12 Cabinetmakers and carpenters	84	8	145	12	61	15
A-13 All other craftsmen	108	15	152	13	44	14
A-6, A-7, A-9, A-11, A-14, A-15 Residual category of six Class III occupations	97	11	118	7.5	21	8
IV A-16 Painters and plasterers	114	16	184	15.5	70	16
A-17 Metal operatives	72	1	69	1	−3	1
A-18 Drivers and deliverymen	99	13	138	10	39	11.5
A-19 Operatives in selected manufacturing industries	82	4	80	2	−2	2
A-20 Mine operatives and laborers	185	22	184	15.5	−1	3
A-21 All other operatives	79	2	110	6	31	9
A-22 Service workers	117	18	156	14	39	11.5

TABLE 3. (CONTINUED).

Socioeconomic Class	Whites		Nonwhites		Race Differences SMR(N) minus	
	SMR	Rank	SMR	Rank	SMR(W)	Rank[c]
V A-23 Laborers in metal manufacturing	145	21	331	21	186	21
A-24 Laborers in other manufacturing	143	20	353	22	210	22
A-25 Construction and outdoor laborers	122	19	211	19	89	17
A-26 Laborers in other nonmanufacturing industries	106	14	223	20	117	20
Agricultural workers	83	6.5	190	17	107	18

[a] The white and nonwhite SMRs for all causes of death combined were taken from references 8 and 24 or computed from data therein.

[b] Including occupation not stated.

[c] In this table the lowest rank (1) is assigned to the largest race difference favoring nonwhites, and the highest rank (22) is assigned to the largest race difference favoring whites.

[d] The clergy SMRs for whites and nonwhites respectively are 83 and 261.

one at the .01 level. When occupations are grouped into classes, nonwhites always show a higher mortality ratio than whites and the differences are always significant at the .001 level.

The importance of the race variable can be seen in the fact that virtually no overlapping of mortality ratio distributions occurs for the two races. With one exception, all the ratios for nonwhites are higher than those for whites. Nonwhite metal operatives with a ratio of 109 are lower than white miners with 120 and white laborers in other manufacturing industries with 110, but this is the only overlap.

The white and nonwhite standardized mortality ratio distributions for hypertension are more distinct than for all causes of death combined. In the latter case, only six of the 22 nonwhite occupations have mortality ratio values higher than the highest white value, and four nonwhite mortality ratios fall below the white median. In fact, the lowest value for either race is the standardized mortality ratio for nonwhite metal operatives (see Table 3).

Race and occupation. The magnitude of the race difference in standardized mortality ratios varies by occupation and class.

Using either a simple difference in ratios (see Table 2) or a ratio of standardized mortality ratios, the largest nonwhite-white difference is found in Class V (laborers) and the smallest in Class III (clerical, sales and skilled workers).

With respect to specific occupations, the biggest difference between the races is found among laborers in other manufacturing industries where the mortality ratio for nonwhites is 728 and for whites 110. All the laborers (A-23, A-24, A-25, A-26) show large race differences as do agricultural workers and semi-professionals (A-2). The smallest difference between the races is found among metal operatives where nonwhites have a mortality ratio of 109 and whites 55. Relatively small race differences are found among officials, inspectors and specified managers (A-3), operatives in selected manufacturing industries (A-19), clerical and kindred workers (A-5) and metal craftsmen (A-10) (see Table 2).

It is readily apparent that the relative magnitude of the race differences in standardized mortality ratios is directly related to the relative magnitude of the nonwhite ratios. The white mortality ratios for specific occupations and classes are so similar that the nonwhite differences are determinant. Thus, in Table 2, the rank order of the race differences in mortality ratios resembles the rank order of the nonwhite mortality ratios.

Race and age. The effect of age on the race differential depends on the mode of analysis. If the focus is on the nonwhite/white death rate *ratios,* the magnitude of the race difference decreases with age (see Table 4). If *simple differences* in death rates are used, the race differential increases with age because of the profound increase in the size of the death rates (see Table 1).

The Effect of Socioeconomic Status and Occupation

Socioeconomic status has varying effects on mortality from hypertension depending on the race and age group under consideration. However, the findings show some consistency. Among nonwhites, the lowest class (laborers) always shows the largest

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TABLE 4. HYPERTENSIVE DISEASE: NONWHITE/WHITE DEATH RATE RATIOS

Socioeconomic Class	Ages			
	25–34	35–44	45–54	55–64
I and II*	3.92	5.60	4.22	4.07
III	6.45	5.25	3.42	2.64
IV	7.07	5.95	4.06	2.44
V	12.49	7.63	6.10	4.55
All occupations	8.20	7.59	5.18	3.83

* Because there are so few nonwhite deaths in Class I, we have generally combined Classes I and II.

hypertension mortality regardless of age; and among whites it always shows the largest or next-to-largest mortality (see Table 1). The two highest classes combined (professionals; and technical, administrative and managerial workers) always show the smallest or next-to-smallest mortality for whites; for nonwhites the pattern varies with age. In the younger years the death rate of the upper classes is relatively small; in the older years it is large, second to laborers.

Examination of the standardized mortality ratios for the various classes reveals the following pattern:

Socioeconomic Class	Whites		Nonwhites	
	SMR	Rank	SMR	Rank
I and II combined (professionals; and technical, administrative and managerial workers)	75	1*	316	3
III (clerical, sales and skilled workers)	82	3	259	1
IV (semiskilled workers)	76	2	261	2
V (laborers)	84	4	469	4

* Unless otherwise noted in this paper, rank 1 represents the smallest SMR or smallest difference between SMRs.

For both races laborers have the largest mortality ratio, but semiskilled workers show small values. For whites the highest classes (I and II) have the smallest ratio; for nonwhites Class III is smallest. Tests of significance show that for whites Classes V and III have significantly larger values than do the other categories. For nonwhites Class V has a significantly larger value than any other category, and the mortality ratio for Classes I

and II combined is significantly larger than values for III and IV. No other differences are significant for either race.

If standardized mortality ratios are computed for whites and nonwhites together instead of separately, a perfect inverse relation is seen between class position and hypertension mortality as indexed by the mortality ratio. The higher the class, the smaller the mortality ratio. This is partly because the proportion of nonwhites increases as class status decreases,[8] and nonwhites show the higher mortality from hypertension:

Socioeconomic Class	SMR for Both Races Together	Proportion of Nonwhites in Class
I	77	.01
II	82	.03
III	88	.04
IV	95	.13
V	181	.30
All occupations	100	.10

The standardized mortality ratios for specific occupations can be seen in Table 2. The smallest value for both whites and nonwhites is found among metal operatives (A-17); the largest value for whites is found among mine operatives and laborers (A-20) and for nonwhites, among laborers in other manufacturing industries (A-24). All four laborer occupations (A-23, A-24, A-25, A-26) show large mortality ratios for nonwhites; they are all above the median. This is not true for whites. However, the mortality ratio rank orders for the two races are positively correlated. The Spearman rank correlation coefficient over the 22 occupations is $+.51$ which is statistically significant at the .05 level by a two-tailed test $(.01 < p < .02)$.

The range of standardized mortality ratios over the various occupations is considerably greater for nonwhites than for whites: 109 to 728 for nonwhites and 55 to 120 for whites (see Table 2). To control the influence of the larger nonwhite mean and the smaller nonwhite population at risk, a midrange was computed for both the white and nonwhite distributions. They

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were standardized in terms of the means, and the significance of their difference was tested.[90]

Because each distribution comprises 22 occupations, the first and third quartiles fall between ranks; so the midranges were computed in two ways, comparing occupations at ranks 6 and 17 and ranks 7 and 16. By both approaches the nonwhite standardized midrange is larger than the white. In one case (rank 6 versus 17) the race difference is not statistically significant at the .05 level by a two-tailed test $(z = 1.47; p = .142)$. In the other case (rank 7 versus 16) it is significant $(z = 2.18; p = .029)$.

The Effect of Age

For all 44 race-occupation subcategories the death rates increase with each ten-year increase in age (see Table 1). Only one exception is found to this pattern. Nonwhite professionals (A-1) show no deaths for age groups 25–34 and 35–44; therefore, both categories have a death rate of zero.

When the death rates for whites and nonwhites are plotted on log paper, all occupations combined, the nonwhite age line is always higher than the white, but the white line is steeper. With each ten-year increase in age, the proportionate increase in mortality for whites is greater than for nonwhites (see Figure 1). This pattern holds for every socioeconomic category except Classes I and II combined where nonwhites show a steeper slope than whites from the first age interval to the second (see Figure 2).

For both races class differences occur in regularity (linearity) of mortality increase with age, but with one exception (Class III for whites) the largest proportionate increase in mortality occurs over the youngest age span, and the smallest increase occurs over the oldest age span (see Figure 2).

Generally speaking, for the socioeconomic classes of both races an inverse relation is found between proportionate increase in mortality from the first to second age intervals and
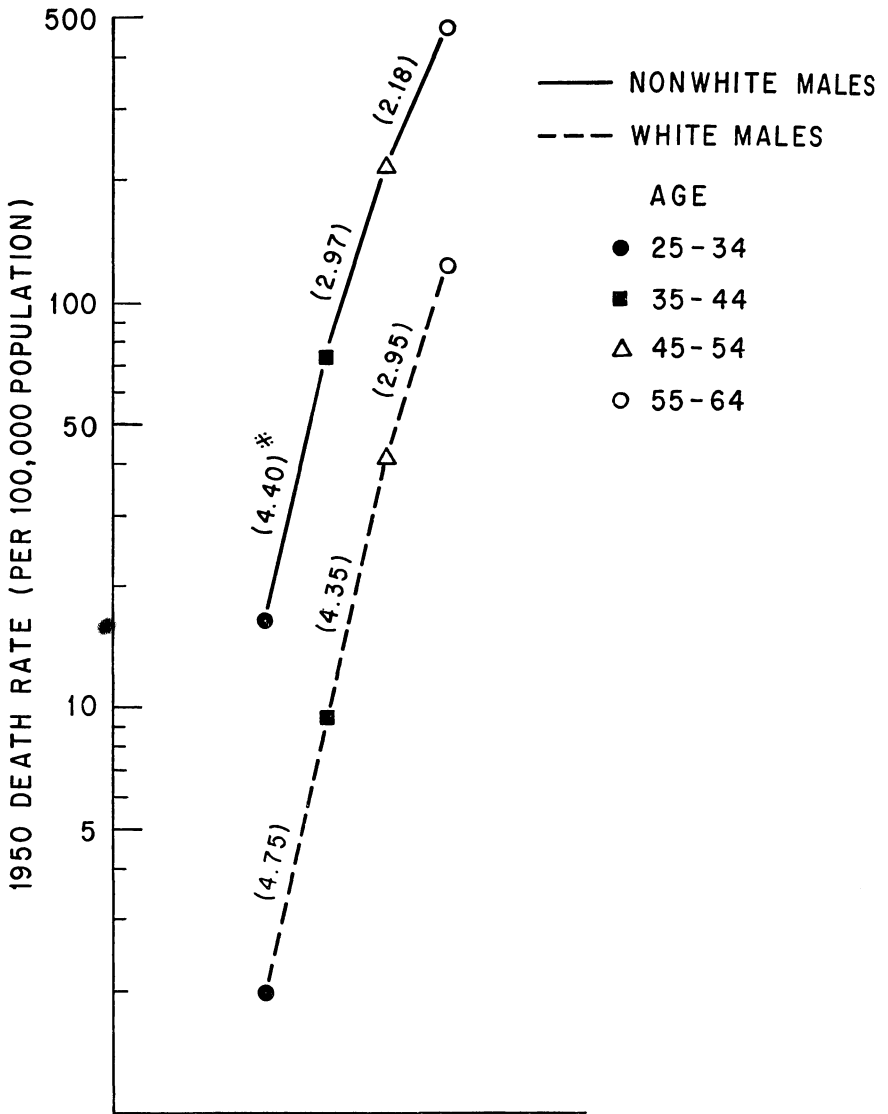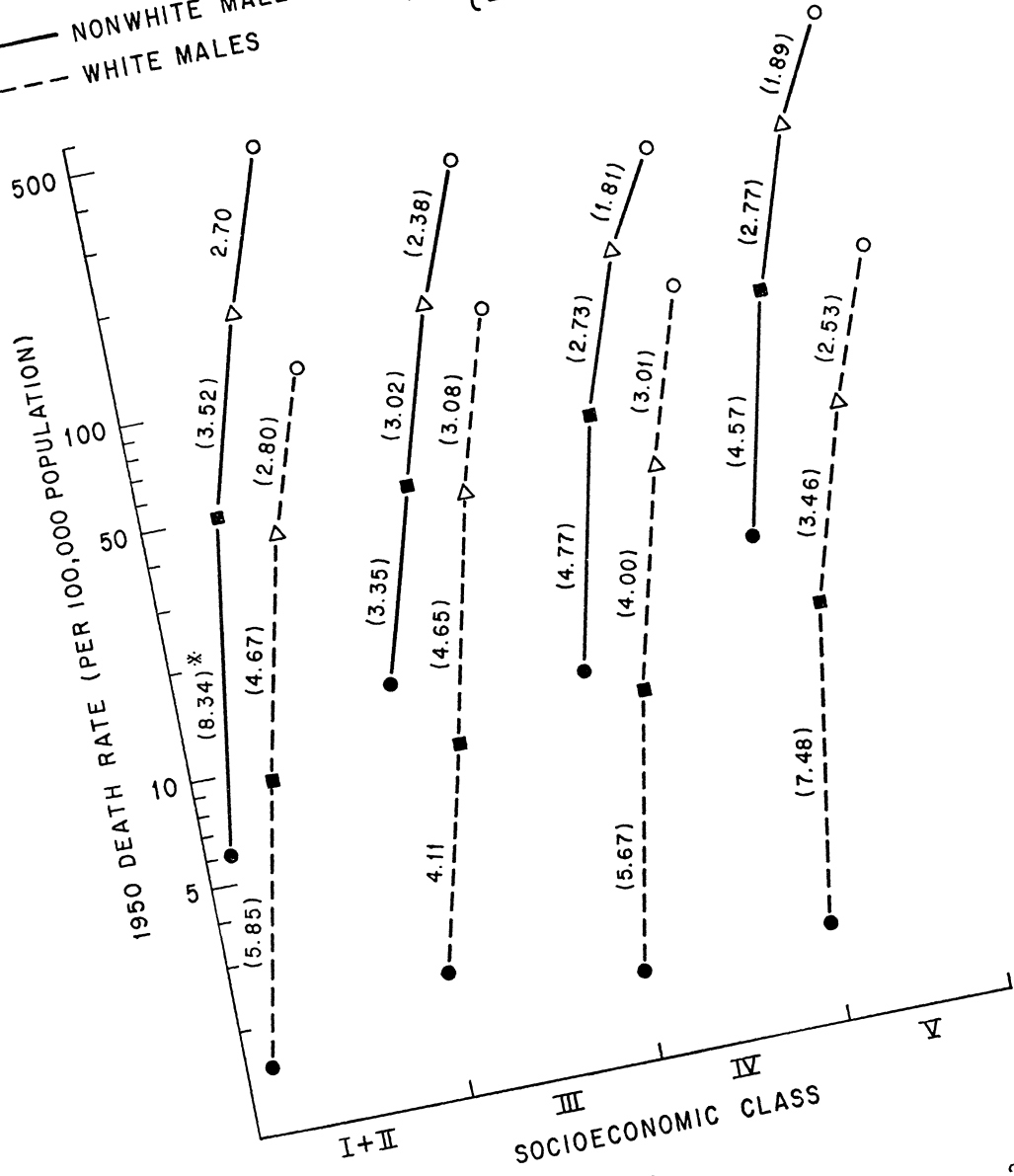
* Proportionate increase in mortality over age span.

FIGURE 2. HYPERTENSION MORTALITY BY AGE, RACE AND SOCIOECO-
NOMIC CLASS

AGE { ● 25-34 △ 45-54
      ■ 35-44 ○ 55-64 }

—— NONWHITE MALES
---- WHITE MALES

1950 DEATH RATE (PER 100,000 POPULATION)

500
100
50
10
5

SOCIOECONOMIC CLASS

I+II   III   IV   V

(2.70)
(3.52)
(2.80)
(4.67)
(8.34) *
(5.85)

(2.38)
(3.02)
(3.08)
(3.35)
(4.65)
4.11

(1.81)
(2.73)
(3.01)
(4.77)
(4.00)
(5.67)

(1.89)
(2.77)
(2.53)
(4.57)
(3.46)
(7.48)

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* Proportionate increase in mortality over age span.

proportionate increase from the third to fourth intervals. The greater the increase in the younger years, the lesser the increase in the older years and vice versa. For nonwhites Classes I and II combined are an exception to this pattern. They always show the largest proportionate increase in mortality regardless of the age span involved.

Generally speaking, when the age trends for the various classes are considered, an inverse relation is found between the size of a death rate at a particular age and the magnitude of its proportionate increase ten years later.

RECLASSIFYING THE NONWHITE CLERGY

In the course of this research some standardized mortality ratios were inspected for hypertension among the subcomponents of the 22 occupational categories.[24] The ratio for the nonwhite clergy was disproportionately large (they had a mortality ratio of 670 for hypertension with heart disease)[24] compared to the value for the semiprofessions (A-2) of which clergymen are a part. It was similar to the mortality ratio for some of the laborers rather than those for higher-class occupations. White clergymen, on the other hand, had a mortality ratio like that of the upper classes.

The pattern for all causes of death combined (see Table 3) resembled that for hypertension. This brought up the question of whether nonwhite clergymen had been misclassified. It seemed possible that many Negroes identified as clergy on their death certificates were only Sunday preachers and were laborers the rest of the week.

On the hunch that this was true the nonwhite clergy were removed from the semiprofessions (occupation A-2, Class II) and were placed in Class V (laborers). Death rates and standardized mortality ratios were recomputed for both Classes II and V. The white clergy were left where they were originally placed, on the theory that only a small proportion of them would have been engaged in other occupations. With one ex-

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ception the remaining occupations in the semiprofessions (for example, social workers, teachers, pharmacists) seemed appropriately classified.[8] Only musicians appeared to be in a part-time occupation, and their deaths were not subdivided by race.

With two minor exceptions (watchmen and taxicab drivers), occupations in categories other than the semiprofessions seemed to be full-time positions;[8] no other adjustments were necessary.

Changing the placement of the nonwhite clergy changed the results of the data analysis in certain important ways:

1. The nonwhite death rates for occupation A-2 and Class II dropped for all ages except 25–34 (see Table 1); and the standardized mortality ratios were accordingly reduced (see Table 2). The death rates for Class V were essentially unchanged except for a slight increase at 55–64.

2. The race difference in mortality ratios for occupation A-2 was appreciably reduced, from the third largest difference to twelfth. The race difference in mortality ratios for Class II and Classes I and II combined became smaller than for Class III, which had previously shown the smallest difference.

3. Changing the placement of the nonwhite clergy results in a perfect inverse relation for nonwhites between class position and standardized mortality ratios. The higher the class, the smaller the mortality ratio:

	SMR
Classes I and II combined	222
Class III	259
Class IV	261
Class V	475

The figure for Class V is significantly larger than all the others, but that is the only significant difference.

The major findings from the study are as follows:[91]

1. Nonwhites have a higher mortality from hypertension than have whites for all ages, occupations and socioeconomic classes.

    a. The magnitude of the nonwhite/white death rate ratio decreases with age.

    b. Class V (laborers) shows the largest race difference in mortality ratios for hypertension and depending on how the nonwhite clergy are classified, Class III or Classes I and II combined shows the smallest difference. For specific occupations, laborers in other manufacturing industries show the largest race difference, and metal operatives the smallest.

2. For both races Class V has the largest mortality ratio for hypertension, and when the nonwhite clergy are removed from Class II, Classes I and II combined have the smallest ratio. Otherwise Class III is smallest for nonwhites.

    a. When the nonwhite clergy are removed from Class II, a perfect inverse relation is seen between class position and standardized mortality ratios for nonwhites. Otherwise the pattern is irregular for both races.

    b. For both races metal operatives have the smallest mortality ratio of any specific occupation. Miners have the largest ratio for whites, and laborers in other manufacturing industries are largest for nonwhites.

    c. The range of standardized mortality ratios over the various occupations and the standardized midrange are greater for nonwhites than for whites.

3. As age increases, mortality from hypertension increases for both races and all occupations and classes. White mortality generally shows a greater proportionate increase with age than does nonwhite mortality.

These findings are consistent with the other American studies of race, class and hypertension summarized earlier. Like these studies, the present results differ from foreign findings, which tend to show a direct rather than inverse relation between socioeconomic status and hypertension.

INTERPRETATION OF THE FINDINGS

The Consistent Race Difference

The main finding of interest here is that nonwhites consistently show a higher death rate from hypertension than do whites. The race difference characterizes every occupation and socioeconomic class, and with only one exception all the nonwhite standardized mortality ratios are larger than the largest white mortality ratio. The generality of this race difference highlights explanations that apply to Negroes and whites in general rather than to specific subgroups of them.

In the introduction to this paper a number of hypotheses were set forth seeking to explain why Negroes have a higher prevalence of hypertension and greater morbidity and mortality from hypertensive disease than do whites. Two of these theories (the physical exertion and medical care hypotheses) suggest that the race differences are really a function of socioeconomic differences between Negroes and whites. The findings cast doubt on such an interpretation. The fact that the race differences in hypertension mortality remain when occupation and class are held constant indicates that more than socioeconomic variables are involved. The fact that these are 1950 mortality data lessens the importance of the medical care explanation because antihypertensive pharmacologic agents did not appear until the late 1940's and early 1950's.[3] It could, of course, be argued that socioeconomic factors were not completely controlled, that within given occupations and classes nonwhites occupy a lower status than whites. This is undoubtedly true. But even the highest-status nonwhites have substantially larger mortality rates from hypertension than do the lowest-status

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whites. This renders untenable any explanation based solely on socioeconomic considerations.

The genetic hypothesis is universally applicable to Negroes, and the notion of psychological stress from racial discrimination seems applicable to most Negroes, if not all of them. Either or both of these theories could explain the general finding of higher mortality from hypertension among nonwhites than whites. The genetic explanation may also be consistent with the fact that the lowest-class nonwhites have the highest mortality of all. Darker skin color appears to be associated with higher blood pressure,[71] and various studies suggest that lower-class Negroes are darker skinned and more racially pure in their genetic makeup than the upper class.[20-22] They may also suffer more from racial discrimination although Franklin Frazier contends that the Black Bourgeoisie, rather than the lower class, "exhibits most strikingly the inferiority complex of those who would escape their racial identification."[23] He argues that middle-class Negroes are obsessed with the struggle for status and frustrated by rejection, but they repress their hostility toward whites.[23]

One need not invoke the same theory to explain *race* and *class* differences in hypertension mortality. Inasmuch as both races show the highest standardized mortality ratio among the lowest class, the genetic and discrimination hypotheses would appear to have limited relevance. They could explain the race difference and perhaps the class difference among nonwhites, but they could not account for differences among whites.

It would be premature at this time to favor either the genetic or the discrimination hypothesis. A combination of genetic predisposition and discrimination might actually be involved. The stress of continuous frustration and repressed hostility could trigger an otherwise latent tendency toward hypertension. Neither of these hypotheses has been adequately tested in the field. Support for both is primarily speculative.[4, 5, 9-11]

The diet and associated disorder hypotheses might still be applicable although both appear to involve socioeconomic con-

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siderations, and to that extent their relevance is diminished. It seems quite unlikely that the pervasive nonwhite-white differences that were found are a result of cultural differences in diet, but this could possibly be a contributing factor. With respect to the associated disorder hypothesis, the 1950 standardized mortality ratio pattern for nephritis shows that nonwhite males have a higher mortality than whites even when class is held constant.[8] So one can argue that race differences in the severity of this disease do not reflect simply differences in socioeconomic status. Evidence also indicates that the presence of sickle-cell disease among Negroes can lead to kidney damage, [72,73] and this could result in higher rates of secondary hypertension. However, the magnitude of the race difference in hypertension mortality seems much larger than one would expect from differences in secondary hypertension alone.

The Decreasing Race Difference with Increasing Age

A second finding that merits interpretation is the decreasing race difference in hypertension mortality with increasing age. The nonwhite/white death rate ratio diminishes considerably by age 55–64. This is because whites show a greater proportionate increase in mortality with increasing age than do nonwhites. This is not the first observation of this pattern. Geoffrey Rose discusses it in his analysis of 1957 mortality data and suggests several explanations:[74]

> It may be that there is a very rapidly rising incidence of hypertension now appearing among younger Negroes—with frightening prospects for the future; or the population may contain only a limited number susceptible to hypertension, the declining rate of increase of mortality with age among Negroes being due to their premature removal; or there may be a form of hypertension to which younger Negroes are particularly predisposed. Perhaps the last of these explanations is the most probable.[95]

Rose is undoubtedly referring to the relatively high rate of malignant hypertension among young Negroes. Malignant hypertension is a killer of the comparatively young (persons in

their thirties and forties) ,[79-81] and Negroes seem to be especially susceptible to this form of hypertension.[81-83] Whether this fully explains the different age trends for nonwhites and whites is debatable. The limited susceptibility theory may also be applicable, and it could help explain two other findings: the inverse relation between proportionate increase in mortality in the younger years and proportionate increase in the older years, and the inverse relation between initial size of a death rate and its proportionate increase ten years later.

Another possible explanation for the different age trends of nonwhites and whites is a survival-of-the-fittest or selectivity theory, based on the idea that the less healthy Negro is selectively removed from the population at risk. It is supported by the fact that as age increases the nonwhite/white mortality ratio for all causes of death combined approaches unity,[70] and old nonwhites actually have a greater life expectancy than whites.[70] One explanation would be that only the healthier Negro can survive the wear and tear of social and economic persecution, and, thus, the aged Negro is healthier than the aged white. Applied to the age trends for hypertension the argument would be similar to the limited susceptibility theory. As age increases, surviving Negroes are more resistant to death from hypertension than are whites, considering the mortality of the two races at the beginning of the age span in question.

The Higher Mortality of Laborers

The third finding of interest here is the class difference in hypertension mortality. For both races laborers show the largest standardized mortality ratio. For nonwhites the value is significantly larger than that for any other class; for whites it is significantly larger than the values for all classes but III. As has been suggested, for nonwhites the genetic and discrimination hypotheses may help explain the class difference in hypertension mortality. However, for both races other hypotheses are probably more relevant. Laborers obviously engage in greater physical exertion than do other workers, with the

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possible exception of those in agriculture. They may have higher rates of disorders that can lead to secondary hypertension,[92] but they are least likely to receive competent medical care.[84, 85] Their station in life subjects laborers to greater deprivation than people of higher status, and their mortality from all causes combined is considerably greater than for other classes[8, 86] (see Table 3).

In the case of hypertension, however, the standardized mortality ratio for white laborers is not substantially or significantly larger than the value for Class III, which suggests that socioeconomic explanations are not entirely applicable to the class pattern for whites.

It is curious that for both whites and nonwhites metal operatives have the lowest mortality ratio for hypertension. The high mortality ratios for white miners and nonwhite laborers in other manufacturing industries are more easily explained by the physical exertion hypothesis and other socioeconomic interpretations. It appears, however, that the standardized mortality ratio distribution for hypertension is similar to that for all causes of death (see Table 3). Here, too, the lowest mortality is found among metal operatives, and the highest mortality for whites is found among miners and for nonwhites among laborers in other manufacturing industries.[8] This suggests that more general interpretations are called for than those applicable to hypertension alone, unless one wishes to argue that hypertension profoundly influences the overall mortality pattern.

The Greater Range of Standardized Mortality Ratios for Nonwhites

Occupation is a more important consideration for nonwhite mortality than for white. The range of mortality ratios over the various occupations is greater for nonwhites than whites, even when the effects of different means and populations at risk are controlled. This is true for all causes of death combined as well as hypertension. For hypertension three explana-

tions seem possible. They are stated below as tentative hypotheses. Certain of the ideas might also apply to all causes of death combined.

1. Negroes have a greater genetic predisposition toward hypertension than do whites, but for this predisposition to have its full impact environmental pressure is necessary. Analogously, environment can have its full impact only in the presence of genetic vulnerability.

Where occupational demand appears to be low (among metal operatives), the nonwhite/white ratio of standardized mortality ratios is only two to one;[96] but where this demand seems high (among laborers in other manufacturing industries), the ratio of mortality ratios is greater than six to one. Analogously, where racial predisposition toward hypertension is low (among whites), the largest ratio of mortality ratios is only two to one as occupation varies. But among nonwhites it exceeds six to one.

2. The nonwhite has less control over his life chances than does the white, including fewer occupational options;[22] so he is less able to use occupational change as a coping mechanism to reduce physical and emotional stress. If he suffers from hypertension and his work environment accentuates his problem he cannot select himself out of that environment as easily as the white. He is more likely to become severely ill and die from his disease because he cannot reduce environmental stress. The white, on the other hand, is better able to cope with his illness by altering situational demands, and consequently for the white, mortality from hypertension is more equalized over the occupational range.

3. American Negroes are less pure as a race than American whites, and this difference affects the mortality patterns for hypertension. A large proportion of the Negro gene pool is white,[87, 88] and these genes are not evenly distrib-

uted among them. The upper class appears to be more white in its genetic makeup than does the lower class.[20-22] This could help explain the greater variation in hypertension mortality among nonwhites than whites. Nonwhite mortality would be affected by varying racial purity as well as varying environmental demand, whereas white mortality would be relatively unaffected by varying racial purity. (Coon considers the question of how much "Negro blood" white Americans have as a result of instances of Negroes' passing, and he suggests that the genetic impact on the American population has been negligible.[88])

SUMMARY

The purpose of this research was to study the effects of occupation and socioeconomic status on race differences in hypertension mortality. Regardless of occupation and class, nonwhites were found to have a higher mortality from hypertension than whites. This suggests the relevance of a genetic or racial discrimination hypothesis, although the associated disorder hypothesis may also be applicable. Future research should be designed to test these theories. The magnitude of the race difference in hypertension mortality (as indexed by the nonwhite/white death rate ratio) decreases with age. Various explanations for this trend are offered.

For both races laborers have the largest mortality from hypertension. In this case socioeconomic considerations seem most relevant as explanations.

Nonwhites show more variability in mortality over the various occupations and classes than do whites. Several possible interpretations of this difference are suggested taking into account genetic predisposition and environmental stress.

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[86] Environmental factors such as air pollution may be directly related to hypertension mortality and poorer people are more likely to live in highly polluted areas. *See* Zeidberg, Horton and Landau, *op. cit.;* Rumford, J., Mortality Studies in Relation to Air Pollution, *American Journal of Public Health,* 51, 165–173, 1961.

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[90] It was difficult to find an appropriate test of the race difference in variance. The method used was practical, conservative and based on realistic assumptions. To standardize the two midranges we divided each by the mean for that distribution. The test of significance controlled the effect of different populations at risk, because the standard error of an SMR considers the actual number of deaths. (See D below.) The difference between the standardized midranges and the standard error for the difference can be expressed as follows:

$$\text{diff} = \frac{SMR_{Q3,W} - SMR_{Q1,W}}{x_W} - \frac{SMR_{Q3,NW} - SMR_{Q1,NW}}{x_{NW}}$$

$$\text{S.E. (diff)} = \sqrt{\frac{1}{x_W^2}\left[\frac{SMR^2_{Q1,W}}{D_{Q1,W}} + \frac{SMR^2_{Q3,W}}{D_{Q3,W}}\right] + \frac{1}{x_{NW}^2}\left[\frac{SMR^2_{Q1,NW}}{D_{Q1,NW}} + \frac{SMR^2_{Q3,NW}}{D_{Q3,NW}}\right]}$$

[91] It appears that the 1950 census underestimated the size of the United States population, particularly nonwhites, and most especially nonwhite males (*See* Coale, A. J., The Population of the United States in 1950 Classified by Age, Sex and Color: A Revision of Census Figures, *Journal of the American Statistical Association,* 50, 16–54, 1955; Siegel, J. S. and Zelnik, M., An Evaluation of Coverage in the 1960 Census by Techniques of Demographic Analysis and by Composite Methods, *Proceedings of the Social Statistical Section of the American Statistical Association,* 71–90, 1966; U.S. Public Health Service, National Office of Vital Statistics, *op. cit.*). Estimates vary, but the true population of nonwhite males for 20–64 years old may be 18 per cent larger than the census count, whereas the population of white males may be only three per cent larger (Coale, *op. cit.*). Such corrections of the population would proportionately reduce death rates. But even if the undercount is as biased as indicated, none of the major findings in this study would be affected. The magnitude of the race differences would be reduced, but nonwhites would still show the higher mortality. On the other hand, the direction of certain class and occupational differences might be altered by an accurate census count. Apparently, poor people were particularly undercounted, which could have biased these results somewhat.

[92] Several studies have reported higher blood pressures among syphilitic patients than among controls (Olansky, S., *et al.,* Untreated Syphilis in the Male Negro: X. Twenty Years of Clinical Observation of Untreated Syphilitic and Presumably Nonsyphilitic Groups, *Journal of Chronic Diseases,* 4, 177–185,

1956; Comstock, G. W., An Epidemiologic Study of Blood Pressure Levels in a Biracial Community in the Southern United States, *American Journal of Hygiene*, 65, 292–295, 1957), and laborers have shown higher rates of syphilis than other groups (Guralnick, L., Mortality by Occupation Level and Cause of Death Among Men 20 to 64 Years of Age: United States, 1950, *Vital Statistics, Special Reports*, 53, 448–451, 1963; Bowdoin, et al., op. cit.; Guthe and Hume, op. cit.; Usilton, Bruyere and Bruyere, op. cit.). However, authorities contend that syphilis and hypertension are not causally related. Kidney disease, on the other hand, can certainly lead to hypertension, and some evidence shows that for both races severe renal disorders are most prevalent among laborers, especially if the nonwhite clergy are removed from Class II (Guralnick, op. cit.).

[93] Nonwhite and white standardized mortality ratios were compared for males 20–64 years of age with work experience (Guralnick, L., Mortality by Occupation Level and Cause of Death Among Men 20 to 64 Years of Age: United States, 1950, *Vital Statistics, Special Reports*, 53, 448–451, 1963). The residual category, "symptoms, ill-defined and unknown causes," was not considered nor were causes showing fewer than 500 nonwhite deaths.

[94] In 1950, 95 per cent of employed nonwhite males 14 years of age and older were Negroes. The remainder were Chinese, Japanese, American Indians and other nonwhites. (United States Bureau of the Census, CENSUS OF POPULATION, 1950, Vol. 2, CHARACTERISTICS OF THE POPULATION, Part 1, U.S. Summary, Washington, United States Government Printing Office, 1953, pp. 1–172.) The proportion of Negroes increased as class status decreased, from .80 for Class I to .98 for Class V. These figures were computed by grouping data in the above reference into class categories comparable to those used in this paper.

[95] One explanation Rose did not suggest is that, by 1957, young hypertensives were being effectively treated with the new antihypertensive agents introduced since 1950 (Brest and Moyer, op. cit.; Edwards, op. cit.; and Schroeder and Perry, op. cit.). One could hypothesize that whites have had greater access and exposure to these agents than have Negroes and thus fewer whites with severe hypertension have died (Howard, op. cit.; and Howard and Tiedeman, op. cit.). This would help explain the fact that in 1957, 14 times more nonwhite males than white males aged 25–34 died from hypertension with heart disease, whereas, in 1950, the difference was only nine-fold (*see* Howard, op. cit.).

[96] The idea of occupational *demand* suggests that the occupation itself is a crucial factor in hypertension mortality. It may well be, however, that variables associated with occupational position rather than the occupation itself are the important factors.

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