Published in final edited form as:
Soc Sci Med. 2008 November ; 67(10): 1604–1611. doi:10.1016/j.socscimed.2008.07.002.

Details for Manuscript Number SSM-D-07-01437R2 "Social Context as an explanation for race disparities in hypertension: Findings from the Exploring Health Disparities in Integrated Communities (EHDIC) Study"

Dr. Roland James Thorpe,
Johns Hopkins Medical Institutions Baltimore, MD UNITED STATES rthorpe3@jhmi.edu

Dwayne T Brandon, Ph.D., and
North Carolina Central University, dtbrandon@nccu.edu

Thomas A LaVeist, Ph.D.
Johns Hopkins Bloomberg School of Public Health, tlaveist@jhsph.edu

Abstract

Disparities in hypertension between African Americans and non-Hispanic whites have been well-documented, yet an explanation for this persistent disparity remains elusive. Since African Americans and non-Hispanic white Americans tend to live in very different social environments, it is not known whether race disparities in hypertension would persist if non-Hispanic whites and African Americans were exposed to similar social environments. We compared data from the Exploring Health Disparities in Integrated Communities-SWB (EHDIC-SWB) Study with the National Health and Nutrition Examination Survey (NHANES) 1999–2004 to determine if race disparities in hypertension in the USA were attenuated in EHDIC-SWB, which is based in a raciallyintegrated community without race differences in income. Hypertension was defined as systolic Blood Pressure (BP)>= 140 millimeters of mercury (mmHg) and/or diastolic BP >= 90 mm Hg or respondent's report of taking antihypertensive medications. Of the 1408 study participants, 835 (59.3%) were African American, 628 (44.6%) were men, and the mean age was 40.6 years. After adjustment for potential confounders, various analytic models from EHDIC-SWB and NHANES 1999–2004 data, we found the race odds ratio was between 29.0% and 34% smaller in the EHDIC-SWB sample. We conclude that social and environmental exposures explained a substantial proportion of the race difference in hypertension.

Keywords

Racial disparities; hypertension; residential segregation; confounding race and socioeconomic status (SES); Integrated community; USA

Correspondence to: Roland James Thorpe.

Introduction

Approximately 65 million adults in the United States have hypertension (Fields et al., 2004). African Americans tend to have earlier onset, higher prevalence and more severe hypertension than do non-Hispanic whites (Burt et al., 1995; Klag et al., 1997). Hypertension is an important risk factor for several vascular diseases including coronary heart disease, stroke, heart failure and kidney disease (Klag et al., 1996; Levy, Larson, Vasan, Kannel, & Ho, 1996; MacMahon et al., 1990; Slama, Susic, & Frohlich, 2002; Stamler, Stamler, & Neaton, 1993; Whelton, Perneger, Brancati, & Klag, 1992; Whelton et al., 2002). African Americans have a greater risk of cardiovascular disease mortality compared with non-Hispanic whites, and most of this risk is attributable to hypertension (Bravata et al., 2005; Wong, Shapiro, Boscardin, & Ettner, 2002).

Most of the research examining factors that underlie race differences in hypertension prevalence posit individual level explanations. For example, some studies indicate that the higher prevalence of hypertension observed in African Americans is inversely associated with socioeconomic status (Colhoun, Hemingway, & Poulter, 1998), while other studies suggest that psychosocial factors such as discrimination may explain the race difference (Myers & Mcclure, 1993; Williams & Neighbors, 2001; Brondolo, Rieppi, Kelly, & Gerin, 2003). Krieger and Sidney (1996) found that perceived discrimination and unfair treatment largely accounted for the racial differences in blood pressure. Physical inactivity has also been posited as an explanation for the association between race and hypertension. However, Bassett and colleagues (2002) found that African Americans who had a higher age-adjusted prevalence of hypertension across all levels of physical activity and even within the same level of physical activity. In general these individual-level factors have been able to explain some of the race disparity in hypertension, but a substantial amount of the disparity remains unexplained.

No previous study has examined the possibility that race differences in social context in which African Americans and non-Hispanic whites live may contribute to disparities. It is possible that race differences in hypertension result from race differences in social and environmental exposures resulting from residential segregation (LaVeist, 2005). Non-Hispanic whites and African Americans tend to live in very different social environments. Studies of racial residential segregation have found that upwards of 60% of African Americans would need to move to another census tract in order to achieve complete integration between African-Americans and non-Hispanic white Americans (Iceland, Weinberg, & Steinmetz, 2002; Massey & Denton, 1993). This extreme racial segregation contributes to race differences in social and environmental health risk exposures (LaVeist, 2005). Direct tests of the segregation-health disparities hypothesis has found associations between segregation and a variety of outcomes including, infant mortality (LaVeist,1989; LaVeist, 1993), adult mortality (Collins & Williams, 1999; Fang, Madhavan, Bosworth, & Alderman, 1998; Jackson, Anderson, Johnson, & Sorlie, 2000; Polednak, 1996), tuberculosis (Acevedo-Garcia, 2001), hospital admissions (Hart, 1997), availability of supermarkets (Morland, Wing, Diez Roux, & Poole, 2002), and availability of pharmaceuticals (Morrison, Wallenstein, Natale, Senzel, & Huang, 2000).

Racial segregation is an important, yet understudied, determinant of health disparities which may complicate the ability of national data to produce truly similar groups appropriate for comparisons (LaVeist, Thorpe, Mance, & Jackson, 2007). Failure to account for race differences in health risk exposures resulting from segregation can potentially lead to erroneous conclusions about the etiology of racial disparities in health. For example differences demonstrated in national data may be the result of differential environmental risk exposures, but erroneously ascribed to a direct effect of race. This may contribute to widely

held beliefs about biological explanations for race disparities and possibly even an overemphasis on cultural differences causing race differences in health behaviors.

Another complicating factor for race disparities in hypertension research is the well-documented association between race and socioeconomic status (SES). Race and SES are highly correlated and both are predictors of hypertension. Typically this problem is addressed by using multivariate modeling in national samples to simultaneously specify the effects of race and measures of SES (such as income or education) on a dependent variable. However, this approach may be inadequate (LaVeist et al., 2007). Even after adjusting for income and education, there are remaining unmeasured differences in SES between race groups owing to historical discrimination and inter-generational transfers of wealth. Multivariate modeling may not be sufficient to overcome this source of heterogeneity (Braveman et al. 2005; LaVeist 2005). Moreover, even in a large national survey multivariate modeling may lead to biased results because of small cell sizes in some race/SES groupings. For example, small numbers of low income whites or high income blacks (see LaVeist et al., 2007 for a more detailed illustration of this issue).

Accounting for social and environmental factors may reveal important insights into the nature of inequalities between black and white adults in health outcomes such as hypertension. The objective of this report is to examine the association between race and hypertension in a sample of African American and non-Hispanic white adults with similar income status, dwelling in the same social context. Within such a community setting, we can account for unmeasured heterogeneity associated with living within a different social context, which is not possible in national samples which suffer from the complex interplay between race, SES and segregation (Braveman et al., 2005; Conley, 1999; Hodge, Dawkins, & Reeves, 2007; Kaufman, Cooper, & McGee, 1997; LaVeist, 2005; Oliver & Shapiro, 1995; Raich & Rich, 2002). We compared results of analytic models in our sample (Exploring Health Disparities in Integrated Communities or EHDIC) with those from a national sample (NHANES 1999–2004) to determine whether disparities in hypertension differed within a context where black and white Americans live under similar social conditions. Specifically, we hypothesized that black-white disparities in hypertension will be attenuated after accounting for race-SES confounding and the different environmental contexts in which whites and blacks typically live.

METHODS

Populations

EHDIC (Exploring Health Disparities in Integrated Communities) is an ongoing multisite study of race disparities within communities where African Americans and non-Hispanic whites live together and where there are no race differences in SES (as measured by median income). The first EHDIC study site was in Southwest Baltimore, Maryland (EHDIC-SWB). Future EHDIC locations are planned.

To have a neighborhood that is racially integrated and homogenous on income makes this sample quite unusual. In fact only 425 of the 66,438 census tracts in the United States met the criteria for inclusion in the EHDIC study (LaVeist et al., 2008). The history of racial integration in this neighborhood goes back to the early-mid 1900s. At that time, Southwest Baltimore was a hub for manufacturing. There were several factories in the area. Both African American and non-Hispanic white workers migrated to Southwest Baltimore for jobs. The non-Hispanic whites came mainly from West Virginia and the African Americans from Virginia and North Carolina. Historically there had been a clear racial residential boundary which led to racial segregation, but beginning in the 1960s anti-discrimination laws were enacted, leading to an influx of African Americans into communities where they

had previously been excluded. Middle and upper income non-Hispanic whites fled to the suburban areas. Also, at this time the manufacturing base of the area began to erode. Both African American and non-Hispanic white workers were “trapped” – unable to afford to leave, and the former coworkers became neighbors.

EHDIC-SWB, is a cross-sectional face-to-face survey of the adult population (age 18 and older) of two contiguous census tracts. In addition to being economically homogenous, the study site was also racially balanced and well integrated, with almost equal proportions of African American and non-Hispanic white residents. In the two census tracts, the racial distribution was 51% African American and 44% non-Hispanic white, and the median income for the study area was $24,002, with no race difference. The census tracts were block listed to identify every occupied dwelling in the study area. During block listing, we identified 2618 structures. Of those, 1636 structures were determined to be occupied residential housing units (excluding commercial and vacant residential structures). After at least five attempts, contact was made with an eligible adult in 1244 occupied residential housing units. Of that number, 65.8% were enrolled in the study resulting in 1489 study participants (41.9% of the 3555 adults living in these two census tracts recorded in the 2000 Census). Because our survey had similar coverage across each census block group in the study area, the bias to geographic locale and its relationship with socioeconomic status should be minimal (LaVeist et al., 2008).

Comparisons to the 2000 Census for the study area indicated that the EHDIC-SWB sample included a higher proportion of blacks and women, but was otherwise similar with respect to other demographic and socioeconomic indicators (LaVeist et al., 2008). For instance, our sample was 59.3% African American and 44.4% male, whereas the 2000 Census data showed the population was 51% African American and 49.7% male. Age distributions in our sample and 2000 Census data were similar with the median age for both samples – 35–44 years. The lack of race difference in median income in the census, $23,500 (African American) vs. $24,100 (non-Hispanic whites) was replicated in EHDIC $23,400 (African American) vs. $24,900 (non-Hispanic whites).

The survey was administered in person by a trained interviewer and consisted of a structured questionnaire, which included demographic and socioeconomic information, self-reported health behaviors and chronic conditions, and three blood pressure (BP) measurements. The EHDIC study has been described in greater detail elsewhere (Casagrande, Gary, LaVeist, Gaskin, & Cooper, 2007; Gary, Stark, & Laveist, 2007; LaVeist et al., 2007; LaVeist et al., 2008). The study was approved by the Committee on Human Research at the Johns Hopkins Bloomberg School of Public Health.

The National Health and Nutrition Examination Survey (NHANES) is a survey conducted to determine the health, functional, and nutritional status and their interrelationships in the U.S. population. Releasing public use data files in two-year increments (e.g., NHANES 1999–2000, NHANES 2001–2002, NHANES 2003–2004, etc.), NHANES has been conducted as a continuous, annual survey since 1999 (Centers for Disease Control and Prevention [CDC], 2006). Each sequential series of this cross-sectional survey is a nationally representative sample of the civilian non-institutionalized population, with an over sample of low income individuals, participants ages between12–19 years, adults ages 60 years and older, African Americans, and Mexican Americans (CDC, 2000). Each of these surveys used a stratified, multistage probability sampling design (CDC, 2000). Data were collected from respondents in two steps. First, information regarding the participant’s health history, health behaviors and risk factors were obtained during the home interview. Second, participants were invited to participate in the medical examination where they received a detailed physical examination at a mobile examination center (CDC, 2005). In this analysis we used the

combined 1999–2004 dataset which consists of 19,678 adults aged 18 years and older who completed the household interview and the physical examination.

Outcomes

The average of three sitting BP measurements was measured using appropriately-sized electronic cuffs that were calibrated to an ambulatory standard. Systolic and diastolic BP was defined as the first and fifth phases of the Korotkoff sounds, respectively. Hypertension was defined as systolic BP ≥ 140 mm Hg and/or diastolic BP ≥ 90 mm Hg or study participant report of taking antihypertensive medication(s).

Main Independent Variable

Race, the primary independent variable, was self reported. For EHDIC we included only those participants who self-identified as African American or non-Hispanic white (n = 1480), which was 95% of the study population.

Covariates

Other covariates included demographic variables and health-related characteristics. Demographic variables included: age, household income, male sex, marital status, and educational attainment. Age and household income were measured as continuous variables. Male sex was coded as a dichotomous variable. Four binary variables represented marital status (married, widowed, divorced/separate, or never been married), and three binary variables reflected a participant's level of educational attainment (< 12 years of school, high school graduate/GED, and more than high school). We further accounted for SES by constructing a measure of wealth by summing the number of assets reportedly owned by the participant (ownership of a home or other real estate, automobile, savings account, checking account, a business, mutual funds, stocks or bonds) and classified as having none, 1 or 2, or greater than 2 assets (Rooks et al., 2002).

Health-related characteristics included: having a "regular doctor or health-care professional", health insurance status, whether the respondent was a current smoker, and had ever been a "regular" drinker of alcohol. Binary variables were created for each of these health-related factors. Self-rated health status consisted of five binary variables (excellent, very good, good, fair, or poor). Respondents who were also asked to rate how often they "exercise or participate in physical activity" for at least one hour (none at all, less than once a month, once a month, once a week, three days a week, more than three times a week). Physical inactivity was coded as a binary variable indicating inactivity. Weight status, assessed by body mass index (BMI) and identified by four binary variables, was classified as underweight (< 18.5), normal (18.5 – 24.9), overweight (25 – 29.9), and obese (≥ 30) levels. Diagnosis of diabetes was ascertained by respondents reporting whether a "doctor or other healthcare professional" informed them they had diabetes or not. All dichotomous and binary variables were created with value 1 representing the attribute described in the name of the variable and zero otherwise.

Statistical analysis

The mean and proportional differences between racial categories for the demographic and health-related characteristics were evaluated using *Student's* t for continuous variables and Chi-square tests for categorical variables, respectively. The odds of being hypertensive were modeled using progressively more complex multiple logistic regression models to determine the influence of each group of variables on the association between race and hypertension. In each successive model we add a set of covariates grouped as follows: Model 1 – age-adjusted only, Model 2 – demographic variables, Model 3 – measure of socioeconomic

status (excluding assets), Model 4 – health related variables, Model 5 – assets and having a "regular doctor." Assets and regular doctor were not available in NHANES so we would not be able to replicate those variables in that data set. Therefore, we analyzed assets and regular doctor in a separate model.

Using the NHANES, we estimated logistic regression models for Models 1 through 4 to determine the extent to which our findings differed from analysis conducted in a national sample that does not account for race/SES confounding or the different environments in which non-Hispanic whites and African Americans live. All analyses using NHANES 1999–2004 accounted for the stratified, multistage probability design (CDC, 2000). The percent difference in the odds ratio for race between models from NHANES and the EHDIC-SWB was calculated using $((OR_{NHANES} - OR_{EHDIC}) / OR_{NHANES}) * 100$ (Szklo & Nieto, 2000). All statistical procedures were conducted using the SAS statistical software package, version 9.1.3 (SAS Institute, Inc., Cary, North Carolina).

RESULTS

A unique aspect of the EHDIC-SWB is the similarity of demographic and health-related characteristics between African American and non-Hispanic whites, which is not the case in NHANES or any nationally representative sample. By design EHDIC-SWB and NHANES are quite different; however, it is instructive to specify the ways in which the samples differ. Table 1 displays the demographic characteristics of the EHDIC-SWB and NHANES samples. As expected the African Americans and non-Hispanic whites in EHDIC-SWB were younger and substantially more likely to have never been married than African Americans and non-Hispanic whites in NHANES, respectively. Although the proportion of African American males was similar in both samples, there was a much smaller proportion of non-Hispanic whites in EHDIC-SWB relative to the whites in NHANES. With regard to SES indicators, African Americans and non-Hispanic whites in EHDIC-SWB had, on average, lower incomes than their respective counterparts in NHANES. However, African Americans in EHDIC-SWB were more likely to be a high school graduate/GED than those in NHANES; whereas the opposite is true when comparing the non-Hispanic whites in EHDIC-SWB to those in NHANES.

Table 2 presents age-adjusted proportions for the health-related characteristics of the EHDIC-SWB and NHANES samples. In general African Americans and non- Hispanic whites in EHDIC-SWB had poorer health status than African Americans and non-Hispanic whites in NHANES, with greater likelihood of self-reporting fair/poor health, being a drinker, hypertensive, and a higher mean systolic and diastolic BP. Also, African Americans and non-Hispanic whites in EHDIC-SWB were less likely to report having health insurance. African Americans in EHDIC-SWB were less likely to be physically inactive, obese, and diagnosed with diabetes compared to African Americans in NHANES. Non-Hispanic whites in EHDIC-SWB and NHANES were similar with regard to being physically inactive and obese. Non-Hispanic whites were more likely to be diagnosed with diabetes than whites in the national sample.

In Table 3 we examined the association between race and hypertension. Model 1 tested for race differences in age-adjusted hypertension. The analysis found that African Americans exhibited greater odds of being hypertensive (odds ratio (OR = 1.48, 95 % confidence interval (CI): 1.16 – 1.89) relative to non-Hispanic whites. After adjusting for demographic variables in Model 2, African Americans still displayed greater odds of being hypertensive (OR=1.45, 95% CI:1.12–1.87) compared to non- Hispanic whites. However, the race odds ratio decreased. Thus, race differences in demographic factors partially accounted for race differences in hypertension.

In Model 3, we added health insurance status to the analysis, African Americans continued to display greater odds of being hypertensive (OR=1.43, 95% CI:1.11–1.85) than non-Hispanic white adults. This relationship remained virtually unchanged, but reduced slightly when accounting for health-related characteristics in Model 4 and both the number of assets and having a regular doctor in Model 5.

In Table 4, we estimated Model 1 through Model 4 in NHANES to determine the degree to which findings from EHDIC-SWB differed from a national sample previously used to test race disparities in hypertension that does not account for the race/SES confounding or the different environments that non-Hispanic whites and African Americans live. In Model 1, the age-adjusted model, African Americans displayed a greater odds of being hypertensive (OR = 2.25, 95 % CI: 1.95 – 2.59) relative to non- Hispanic whites. Adjusting for demographic factors in Model 2 reduced the race disparity in hypertension (OR = 2.07, 95 % CI: 1.79 – 2.04) Also, accounting for health insurance status in Model 3 and health-related characteristics in Model 4 further reduced the race effect, but, did not eliminate the disparity. Although the patterns for the relationship between race and hypertension in this national sample were consistent with those observed in EHDIC- SWB, the magnitude of the association was much smaller in EHDIC- SWB, with an average of 31% difference in OR between similar models using the different data sets. Compared to the national sample, the OR in the EHDIC- SWB sample was 34% lower in the age-adjusted model, 29% lower when adjusting for demographic variables, 31% lower after accounting for health insurance status, and 29% lower when adjusting for health-related characteristics.

DISCUSSION

We examined the association between race and hypertension in the EHDICSWB sample, a survey of African American and non-Hispanic white adults living in similar socioeconomic and socio-environmental circumstances. We hypothesized that race differences in hypertension would be attenuated in EHDIC-SWB compared with NHANES because of the similarity of the social context in which the EHDIC- SWB respondents live. Using multiple logistic regression models, we found that the ethnic disparity in hypertension was narrower in EHDIC- SWB than in NHANES, but the disparity was not fully eliminated. When non-Hispanic whites and African Americans live in similar social settings, their health outcomes are much more similar than those found in national samples.

Because blood pressure is known to vary by age we specified each of our models within age subgroups to determine if our findings varied by age. We also replicated each model after excluding individuals age 18–24. The results of these analyses were not substantially different from analysis in the full sample (reported in this paper). The design of the EHDIC studies significantly reduces the confounding of race and SES and accounts for as much unmeasured SES heterogeneity as is likely to be possible without an experimental design. However, we make no claim that the EHDIC study design can account for all heterogeneity. There are likely to be additional unmeasured aspects of SES and/or social context that we were not able to account for. These factors may contribute to the remaining race difference in hypertension observed in EHDIC-SWB. For example, in these analyses, we included income, education, and number of assets, but additional SES measures such as intergenerational transfers of wealth, occupation, or occupational prestige may produce additional unmeasured heterogeneity between the African American and non-Hispanic white study participants (Braveman et al, 2005; Conley, 1999; Hodge et al., 2007; Kaufman et al., 1997; LaVeist, 2005; Oliver & Shapiro, 1995; Raich & Rich, 2002). However, we believe by examining disparities within a community where people live under similar social and environmental exposures, we were able to move closer to equalizing variation in the

unmeasured aspects of social status (Braveman et al., 2005; Kaufman et al., 1997; LaVeist, 2005).

Beyond SES measures, other unmeasured factors that may contribute to the remaining race effect include psychosocial factors such as social support, stress, coping strategies, discrimination, and other personality characteristics (James, Hartnett, & Kalsbeek, 1983; James, 1994). Although all EHDIC-SWB respondents live in similar socio-environmental conditions, it is likely that not all individuals will respond to the attendant stressors in the same way. Indeed, personality and possibly family characteristics may interact with social and environmental factors to produce variation in physiological response (Brondolo et al., 2003; James et al., 1983; James, LaCroix, Kleinbaum, & Strogatz, 1984; Krieger & Sidney, 1996; Peters, 2004; Steffen, Hinderliter, Blumenthal, & Sherwood, 2001).

The design of the EHDIC studies provides a unique opportunity to examine racial disparities after controlling for social context. However, we are not able to account for race difference in work-life context. There may be differential occupational exposures which contribute to race-related differences in hypertension (LaVeist, 1993; Massey & Denton, 1993; Williams & Collins, 2001). Because the study was conducted in a low income urban context, the generalizability of our results is limited to such communities. It is not known if our results would differ in a higher income or non-urban environment. Because these analyses only included African American and non-Hispanic white participants, we have no information concerning the relationship among these factors in other racial ethnic groups. It would be valuable to examine the relationship between other minority groups living under similar social and environmental conditions.

This study adds to the growing body of research on health and place. We demonstrated that socio-environmental context plays a substantial role in producing race disparities. Our findings have moved the literature closer to understanding the nature of ethnic disparities in hypertension prevalence. Given similar socioeconomic status and similar socio-environmental conditions ethnic disparities in hypertension prevalence are substantially lessened.

Acknowledgments

This research was supported by grant# P60MD000214-01 from the National Center on Minority Health and Health Disparities (NCMHD) of the National Institutes of Health (NIH), and a grant from Pfizer, Inc. Dr. Thorpe was supported by a training grant from the National Institute on Aging (T32AG000120) and contract from the National Center for Minority Health and Health Disparities Loan Repayment Program.

References

Acevedo-Garcia D. Zip code-level risk factors for tuberculosis: Neighborhood environment and residential segregation in New Jersey: 1985–1992. American Journal of Public Health. 2001; 91(5): 734–741. [PubMed: 11344881]

Bassett DR Jr, Fitzhugh EC, Crespo CJ, King GA, McLaughlin JE. Physical activity and ethnic differences in hypertension prevalence in the United States. Preventive Medicine. 2002; 34(2):179–186. [PubMed: 11817913]

Bravata DM, Wells CK, Gulanski B, Kernan WN, Brass LM, Long J, et al. Racial disparities in stroke risk factors: The impact of socioeconomic status. Stroke. 2005; 36(7):1507–1511. [PubMed: 15961710]

Braveman PA, Cubbin C, Egerter S, Chideya S, Marchi KS, Metzler M, et al. Socioeconomic status in health research: One size does not fit all. Journal of the American Medical Association. 2005; 294:2879–2888. [PubMed: 16352796]

Brondolo E, Rieppi R, Kelly KP, Gerin W. Perceived racism and blood pressure: A review of the literature and conceptual and methodological critique. Annals of Behavioral Medicine. 2003; 25(1): 55–65. [PubMed: 12581937]

Burt VL, Whelton P, Roccella EJ, Brown C, Cutler JA, Higgins M, et al. Prevalence of hypertension in the US adult population. results from the third national health and nutrition examination survey: 1988–1991. Hypertension. 1995; 25(3):305–313. [PubMed: 7875754]

Casagrande SS, Gary TL, LaVeist TA, Gaskin J, Cooper LA. Perceived discrimination and adherence to medical care in a racially integrated community. Journal of General Internal Medicine. 2006; 22(3):389–395. [PubMed: 17356974]

Centers for Disease Control and Prevention. National Centers for Health Statistics. National Health and Nutrition Examination Survey. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2000. Retrieved from http://www.cdc.gov/nchs//data/nhanes/gendoc.pdf on December 18, 2006.

Centers for Disease Control and Prevention. National Centers for Health Statistics. The National Health and Nutrition Examination Survey Analytic and Reporting Guidelines. Hyattsville, MD: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention; 2006. Retrieved from http://www.cdc.gov/nchs/about/major/nhanes/nhanes2003-2004/analytical_guidelines.htm on December 18, 2006

Centers for Disease Control and Prevention. National Centers for Health Statistics. The National Health and Nutrition Examination Survey Questionnaire and Exam Protocol. Hyattsville, MD: U. S. Department of Health and Human Services, Centers for Disease Control and Prevention ; 2005. Retrieved from http://www.cdc.gov/nchs/about/major/nhanes/nhanes2003-2004/questexam03_04.htm on December 18, 2006.

Colhoun HM, Hemingway H, Poulter NR. Socio-economic status and blood pressure: An overview analysis. Journal of Human Hypertension. 1998; 12(2):91–110. [PubMed: 9504351]

Collins CA, Williams DR. Segregation and mortality: The deadly effects of racism? Sociological Forum. 1999; 14:495–523.

Conley, D. Being black, living in the red. University of California Press; 1999.

Dressler, WW. Pathophysiology of hypertension in blacks. Fray, JCS.; Douglas, JG., editors. New York: Oxford University Press; 1993. p. 69-89.

Falkner B. Differences in blacks and whites with essential hypertension: Biochemistry and endocrine. State of the art lecture. Hypertension. 1990; 15(6 Pt 2):681–686. [PubMed: 2190920]

Fang J, Madhavan S, Bosworth W, Alderman MH. Residential segregation and mortality in New York City. Social Science & Medicine (1982). 1998; 47(4):469–476.

Fields LE, Burt VL, Cutler JA, Hughes J, Roccella EJ, Sorlie P. The burden of adult hypertension in the United States 1999 to 2000: A rising tide. Hypertension. 2004; 44(4):398–404. [PubMed: 15326093]

Gary TL, Stark SA, Laveist TA. Neighborhood characteristics and mental health among African Americans and whites living in a racially integrated urban community. Health & Place. 2007; 13(2):569–575. [PubMed: 16904931]

Hart KD. Racial segregation and ambulatory care-sensitive admissions. Health Affairs (Project Hope). 1997; 16(1):224–225. author reply 225. [PubMed: 9018961]

Hodge M, Dawkins M, Reeves J. A case study of mortgage refinancing discrimination: African American intergenerational wealth. Sociological Inquiry. 2007; 77(1):23–43.

Iceland, J.; Weinberg, DH.; Steinmetz, E. Racial and ethnic residential segregation in the United States: 1980–2000. Washington, DC: US Government Printing Office; 2002.

Jackson SA, Anderson RT, Johnson NJ, Sorlie PD. The relation of residential segregation to all-cause mortality: A study in black and white. American Journal of Public Health. 2000; 90(4):615–617. [PubMed: 10754978]

James SA, Hartnett SA, Kalsbeek WD. John Henryism and blood pressure differences among black men. Journal of Behavioral Medicine. 1983; 6:259–278. [PubMed: 6663614]

James SA, LaCroix AZ, Kleinbaum DG, Strogatz DS. John Henryism and blood pressure differences among black men. II. The role of occupational stressors. Journal of Behavioral Medicine. 1984; 7:259–275. [PubMed: 6481796]

James SA. John Henryism and the health of African Americans. Culture, Medicine and Psychiatry. 1994; 18(2):163–182.

Kaufman JS, Cooper RS, McGee DL. Socioeconomic status and health in blacks and whites: The problem of residual confounding and the resiliency of race. Epidemiology. 1997; 8(6):621–628. [PubMed: 9345660]

Klag MJ, Whelton PK, Randall BL, Neaton JD, Brancati FL, Ford CE, et al. Blood pressure and end-stage renal disease in men. The New England Journal of Medicine. 1996; 334(1):13–18. [PubMed: 7494564]

Klag MJ, Whelton PK, Randall BL, Neaton JD, Brancati FL, Stamler J. End-stage renal disease in African-American and white men. 16-year MRFIT findings. Journal of the American Medical Association. 1997; 277(16):1293–1298. [PubMed: 9109467]

Krieger N, Sidney S. Racial discrimination and blood pressure: The CARDIA study of young black and white adults. American Journal of Public Health. 1996; 86(10):1370–1378. [PubMed: 8876504]

LaVeist TA. Linking residential segregation and the infant mortality race disparity. Sociology and Social Research. 1989; 73:90–94.

Laveist TA. Segregation, poverty, and empowerment: Health consequences for African Americans. The Milbank Quarterly. 1993; 71(1):41–64. [PubMed: 8450822]

LaVeist TA. Disentangling race and socioeconomic status: A key to understanding health inequalities. Journal of Urban Health : Bulletin of the New York Academy of Medicine. 2005; 82(2 Suppl 3):iii26–iii34. [PubMed: 15933328]

LaVeist, TA. Minority populations and health: An introduction to health disparities in the United States. San Francisco, CA: Jossey-Bass; 2005.

LaVeist TA, Thorpe RJ Jr, Mance G, Jackson J. Overcoming confounding of race with socioeconomic status and segregation to explore race disparities in smoking. Addiction. 2007; 102(Suppl 2):65–70. [PubMed: 17850615]

LaVeist TA, Thorpe RJ Jr, Bowen-Reid T, Gary T, Gaskin D, Browne D. Exploring health disparities in integrated communities: Overview of the EHDIC study. Journal of Urban Health: Bulletin of the New York Academy of Medicine. 2008; 85(1):11–21. [PubMed: 17999196]

Levy D, Larson MG, Vasan RS, Kannel WB, Ho KK. The progression from hypertension to congestive heart failure. Journal of the American Medical Association. 1996; 275(20):1557–1562. [PubMed: 8622246]

MacMahon S, Peto R, Cutler J, Collins R, Sorlie P, Neaton J, et al. Blood pressure, stroke, and coronary heart disease. part 1, prolonged differences in blood pressure: Prospective observational studies corrected for the regression dilution bias. Lancet. 1990; 335(8692):765–774. [PubMed: 1969518]

Massey, D.; Denton, N. American apartheid: Segregation and the making of the underclass. Boston: Harvard University Press; 1993.

Morland K, Wing S, Diez Roux A, Poole C. Neighborhood characteristics associated with the location of food stores and food service places. American Journal of Preventive Medicine. 2002; 22(1):23–29. [PubMed: 11777675]

Morrison RS, Wallenstein S, Natale DK, Senzel RS, Huang LL. "We don't carry that"--failure of pharmacies in predominantly nonwhite neighborhoods to stock opioid analgesics. The New England Journal of Medicine. 2000; 342(14):1023–1026. [PubMed: 10749965]

Myers, HF.; McClure, FH. Psychosocial factors in hypertension in blacks: The case for an interactional perspective. In: Fray, JCS.; Douglas, JG., editors. Pathophysiology of hypertension in blacks. New York: Oxford University Press; 1993.

National Center for Health Statistics. National health and Nutrition Examination Survey. Retrieved on December 27, 2007, from http://www.cdc.gov/nchs/nhanes.htm

Oliver, M.; Shapiro, T. Black wealth/White wealth: A new perspective on racial inequality. United Kingdom: Routledge; 1995.

Parmer RJ, Cervenka JH, Stone RA, O'Connor DT. Autonomic function in hypertension. Are there racial differences? Circulation. 1990; 81(4):1305–1311. [PubMed: 1969334]

Peters RM. Racism and hypertension among African Americans. Western Journal of Nursing Research. 2004; 26(6):612–631. [PubMed: 15359074]

Polednak AP. Trends in US urban black infant mortality, by degree of residential segregation. American Journal of Public Health. 1996; 86(5):723–726. [PubMed: 8629726]

Raich P, Rich J. Field experiments of discrimination in the market place. The Economic Journal. 2002; 112(483):F480–F518.

Rooks RN, Simonsick EM, Miles T, Newman A, Kritchevsky SB, Schulz R, et al. The association of race and socioeconomic status with cardiovascular disease indicators among older adults in the health, aging, and body composition study. Journal of Gerontology: Social Sciences. 2002; 57(4):S247–S256.

Shapiro, T. The hidden cost of being African American: How wealth perpetuates inequality. New York: Oxford University Press; 2005.

Slama M, Susic D, Frohlich ED. Prevention of hypertension. Current Opinion in Cardiology. 2002; 17(5):531–536. [PubMed: 12357131]

Stamler J, Stamler R, Neaton JD. Blood pressure, systolic and diastolic, and cardiovascular risks. US population data. Archives of Internal Medicine. 1993; 153(5):598–615. [PubMed: 8439223]

Steffen PR, Hinderliter AL, Blumenthal JA, Sherwood A. Religious coping, ethnicity, and ambulatory blood pressure. Psychosomatic Medicine. 2001; 63(4):523–530. [PubMed: 11485105]

Szklo, M.; Nieto, FJ. Epidemiology beyond the basics. Gaithersburg, Maryland: Aspen Publishers, Inc; 2000.

Whelton PK, He J, Appel LJ, Cutler JA, Havas S, Kotchen TA, et al. Primary prevention of hypertension: Clinical and public health advisory from the national high blood pressure education program. Journal of the American Medical Association. 2002; 288(15):1882–1888. [PubMed: 12377087]

Whelton PK, Perneger TV, Brancati FL, Klag MJ. Epidemiology and prevention of blood pressure-related renal disease. Journal of Hypertension. 1992; 10(7):S77–S84. [PubMed: 1291660]

Williams DR, Collins C. Racial residential segregation: A fundamental cause of racial disparities in health. Public Health Report. 2001; 116(5):404–416.

Williams DR, Neighbors HW. Racism, discrimination and hypertension: evidence and needed research. Ethnicity & Disease. 2001; 11:800–816. [PubMed: 11763305]

Wong MD, Shapiro MF, Boscardin WJ, Ettner SL. Contribution of major diseases to disparities in mortality. The New England Journal of Medicine. 2002; 347(20):1585–1592. [PubMed: 12432046]

Table 1

Distribution of Demographic Variables of the EHDIC-SWB and NHANES 1999–2004 Participants by Race[a]

	EHDIC-SWB		NHANES 1999–2004	
Variable	**Non-Hispanic Whites (n=573)**	**African Americans (n=835)**	**Non-Hispanic Whites (n=12106)**	**African Americans (n=7572)**
Age (years)	43.9 ±16.2	38.4±13.3 *	46.9± 33.2	42.3±30.8 *
Male sex (%)	43.1	45.6	49.0	46.4 *
Marital status (%)				
Married	25.7	15.2 *	61.4	37.0 *
Widowed	10.8	4.8 *	6.5	6.5
Divorced/separated	26.4	18.0 *	10.0	16.4 *
Never been married	37.1	62.0 *	21.9	40.0 *
Income (dollars)	24817±23415	23471±32486	7.8±0.11	6.1±0.11 *
Number of assets (%)			--	--
None	36.0	59.1 *	--	--
1–2	51.0	33.6 *	--	--
3–6	13.1	7.3 *	--	--
Education level (%)			--	--
Less than high school graduate	47.5	35.4 *	28.7	50.4 *
High school graduate/GED	34.3	45.1 *	23.5	18.7 *
More than high school graduate	18.3	19.4	47.7	30.7 *

Notes. Plus-minus values are means ± SD. All binary variables are coded 1 and 0 where 1 represents the name of the variable.

* $p<0.05$.

[a] Tests of significance are for differences in means for continuous variables(i.e., t-test) and differences in proportions(i.e., chi-square test) by race. All estimates using NHANES 1999–2004 data account for the stratified, multistage probability sampling design by applying the appropriate weights and strata variables.

Table 2

Age-Adjusted Distribution of Health Related Characteristics of EHDIC-SWB and NHANES 1999–2004 Participants by Race[a]

	EHDIC-SWB		NHANES1999–2004	
Variable	**Non-Hispanic Whites (n=573)**	**African Americans (n=835)**	**Non-Hispanic Whites (n=12106)**	**African Americans (n=7572)**
Regular doctor (%)	60.1	62.2	---	---
Health Insurance (%)	58.3	65.9*	87.9	80.7*
Self-rated health (%)				
Excellent	11.3	16.1*	22.0	17.4*
Very Good	18.3	23.1	33.5	21.2*
Good	35.2	30.8	28.6	35.3*
Fair	27.3	24.7	11.8	20.2*
Poor	7.7	5.1	3.5	5.8
Physical Inactivity (%)	24.1	20.3	23.9	34.9*
Weight status (%)				
Underweight	3.2	1.6	1.2	1.0
Normal	41.9	38.2	34.4	25.6*
Overweight	25.2	27.7	34.4	32.1*
Obese	29.5	32.3	29.8	41.2*
Current smoker (%)	59.5	53.3*	45.7	60.3*
Ever drink (%)	83.3	79.5	9.6	12.9
Diagnosis of diabetes (%)	10.1	10.5	6.9	12.1*
Hypertension (%)	64.4	72.5*	34.5	47.8*
Systolic blood pressure (mmHG)	128.8±0.84	134.4±0.70*	123.9±0.35	129.6±0.42*
Diastolic blood pressure (mmHG)	93.6±0.56	97.4±0.46*	71.7±0.26	73.4±0.35

Notes. Plus-minus values are means ± SD. All binary variables are coded 1 and 0 where 1 represents the name of the variable.

*$p<0.05$.

[a]Tests of significance are for differences in means for continuous variables(i.e., t-test) and differences in proportions(i.e., chi- square test) by race. All estimates using NHANES 1999–2004 data account for the stratified, multistage probability sampling design by applying the appropriate weights and strata variables.

Table 3

Odds Ratios and 95 Percent Confidence Intervals for the Association between Race and Hypertension Prevalence in the EHDIC-SWB Study

Independent Variable	Model 1 (N=1405)	Model 2 (N=1402)	Model 3 (N=1400)	Model 4 (N=1367)	Model 5 (N=1366)
Black	1.48[a]	1.45	1.43	1.42	1.43
	1.16–1.89[b]	1.12–1.87	1.11–185	1.09–1.86	1.09–1.89
Age	1.04	1.04	1.04	1.04	1.04
	1.03–1.05	1.03–1.05	1.03–1.05	1.02–1.05	1.02–1.05
Male		1.69	1.72	1.95	1.90
		1.32–2.17	1.33–2.21	1.49–2.56	1.44–2.51
Marital Status					
Married[c]		1.00	1.00	1.00	1.00
Widowed		1.55	1.54	1.84	1.76
		0.81–2.99	0.80–2.96	0.91–3.70	0.87–3.57
Divorced/separated		1.37	1.40	1.33	1.30
		0.93–2.03	0.94–2.07	0.88–2.00	0.86–1.96
Never been married		1.05	1.06	1.15	1.14
		0.75–1.48	0.76–1.50	0.81–1.65	0.79–1.63
Income		1.00	1.00	1.00	1.00
		1.00–1.00	1.00–1.00	1.00–1.00	1.00–1.00
Education level					
< high school[c]		1.00	1.00	1.00	1.00
High school		1.34	1.34	1.29	1.30
graduate/GED		1.02–1.76	1.02–1.76	0.97–1.71	0.97–1.73
> high school		1.16	1.14	1.18	1.25
graduate		0.81–1.66	0.79–1.64	0.81–1.73	0.83–1.87
Insurance Status			1.15	1.10	1.15
			0.90–1.49	0.85–1.44	0.86–1.54
Self-rated health					
Excellent[c]				1.00	1.00
Very good				0.89	0.90

Independent Variable	Model 1 (N=1405)	Model 2 (N=1402)	Model 3 (N=1400)	Model 4 (N=1367)	Model 5 (N=1366)
				0.59–1.34	0.60–1.35
Good				1.11	1.10
				0.75–1.62	0.75–1.62
Fair				1.26	1.27
				0.83–1.93	0.83–1.94
Poor				1.42	1.39
				0.702–2.87	0.68–2.83
Weight Status					
Underweight				0.99	1.01
				0.44–2.22	0.45–2.27
Normal[c]				1.00	1.00
Overweight				1.62	1.64
				1.19–2.20	1.20–2.22
Obese				2.92	3.00
				2.11–4.04	2.16–4.16
Physical Inactivity				0.97	0.99
				0.70–1.34	0.72–1.37
Diabetes				1.01	1.05
				0.62–1.65	0.63–1.72
Current Smoker				1.14	1.14
				0.87–1.49	0.86–1.50
Ever Drink				1.03	1.05
				0.74–1.42	0.76–1.45
Number of assets					
None					1.00
1–2					1.05
					0.79–1.40
3–6					0.82
					0.47–1.41
Regular doctor					0.91

Soc Sci Med. Author manuscript; available in PMC 2012 December 13.

Independent Variable	Model 1 (N=1405)	Model 2 (N=1402)	Model 3 (N=1400)	Model 4 (N=1367)	Model 5 (N=1366)
					0.67–1.22

Notes:

*p<0.05;

**p<0.01;

***p<0.001

[a]Risk Ratio.

[b]95% Confidence interval.

[c]Normal weight (body mass index ≥ 18.5 & < 25) is the reference group

Table 4

Association between Race and Hypertension by Dataset *

	NHANES 1999–2004	EHDIC-SWB	Percent difference †
	O.R. (95% CI)	O.R. (95% CI)	
Model 1	2.25(1.95–2.59)	1.48(1.16–1.89)	34
Model 2	2.07(1.79–2.40)	1.45(1.12–1.88)	29
Model 3	2.08 (1.80–2.42)	1.43 (1.11–1.85)	31
Model 4	2.01 (1.63–2.48)	1.42 (1.09–1.86)	29

* OR=odds ratio; CI=confidence interval; White adults are the reference category. Hypertension was defined as systolic blood pressure >=140 and/or diastolic blood pressure >=90, or reported taking antihypertensive medications. [C]Only models that contained variables in both EHDIC and NHANES 99-04 datasets were conducted. All estimates using NHANES 1999–2004 data account for the stratified, multistage probability sampling design by applying the appropriate weights and strata variables.

† Percent difference computed by $((OR_{NHANES} - OR_{EHDIC\text{-}SWB})/OR_{NHANES})*100$.

Model 1 included race and age.
Model 2 included race, age, gender, marital status, household income, and education level.
Model 3 included race, age, gender, marital status, household income, education level, and insurance status.
Model 4 included race, age, gender, marital status, household income, education level, insurance status, self-ratings of health, weight status, Physical inactivity, diagnosis of diabetes, drinking and current smoking status.