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Black–White Disparity in Disability: The Role of Medical Conditions

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Abstract

OBJECTIVES—To describe the independent contributions of selected medical conditions to the disparity between black and white people in disability rates, controlling for demographic and socioeconomic factors.

DESIGN—Cross-sectional analysis of a community-based cohort.

SETTING—Urban and rural counties of central North Carolina.

PARTICIPANTS—Two thousand nine hundred sixty-six adults aged 68 and older participating in the Duke Established Populations for Epidemiologic Studies of the Elderly (EPESE).

MEASUREMENTS—Self-reported data on sociodemographic characteristics and medical conditions, Short Portable Mental Status Questionnaire, activities of daily living (ADLs).

RESULTS—Fifty-five percent of the cohort was black. Blacks were more likely than whites to report disability (odds ratio = 1.39, 95% confidence interval = 1.15–1.68). Controlling for age, sex, marital status, and socioeconomic status, blacks were more likely to be obese and have diabetes mellitus, and less likely to report vision problems, fractures, and heart attacks. The higher prevalence of obesity and diabetes mellitus in blacks, after adjustment for sociodemographic factors, accounted for more than 30% of the black–white difference in disability. Conversely, the black–white disability gap would be approximately 45% wider if whites had a lower prevalence of fractures and vision impairment, similar to their black peers.

CONCLUSION—Higher rates of obesity and diabetes mellitus in older black Americans account for a large amount of the racial disparity in disability, even after controlling for socioeconomic differences. Culturally appropriate interventions that lower the prevalence or the functional

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consequences of obesity and diabetes mellitus in blacks could substantially decrease this racial health disparity.

Keywords

race; health disparity; aged; comorbidity; function

In the United States, older blacks experience higher rates of disability than non-Hispanic whites (hereafter referred to as whites).^{1–3} The black–white disparity in disability persists despite a declining trend in disability rates overall and evidence that disability rates are declining more steeply in blacks.^{4,5} Because disability (defined here as limitations in ability to perform personal care tasks) is associated with higher healthcare costs and worse self-rated health and quality of life,^{6–9} it is imperative to understand the various contributors to racial inequity in this important outcome.

Questions about factors that contribute to the different rates of disability observed in blacks and whites remain unanswered. One recent study found that adjusting for income and education explained 90% of the black–white difference in disability rates for men and 75% for women, leading the authors to conclude that “the greatly elevated risk of disability among blacks aged 55 to 74 is largely explained by differences in socioeconomic status [SES].”¹⁰ Similarly, several previous studies have reported that adjusting for SES eliminated all^{2,11,12} or most^{13–15} of the observed racial disparity in disability rates. These findings do not exclude the possibility that other factors may play counterbalancing roles in the relationship between race and disability, even when adjustment for SES appears to largely or completely explain that relationship.

For example, some medical conditions may be more common in blacks regardless of SES, and these conditions could contribute independently to excess disability rates in blacks. Alternatively, disabling conditions that are more common in whites would reduce the black–white disability gap. The opposing influence of these medical conditions with respect to racial discrepancy in disability rates could counterbalance each other, leading investigators to underestimate the independent role of disease in the disability gap. Although previous studies have addressed the role of disease in black Americans’ disproportionate health decline and disability, they have not examined the independent contributions of specific medical conditions to the racial gap in disability.^{2,16–18}

The objective of the current analysis was to assess and quantify the independent contributions of selected medical conditions to the black–white disparity in disability rates after controlling for demographic and socioeconomic factors. This analysis extends previous work by considering the effect of black–white differences in the prevalence and the disabling effects of nine common medical conditions in a large, well-defined, racially diverse cohort of older adults. Specifically, the study addresses two related issues: the degree to which racial differences in the prevalence of particular medical conditions explain black–white disparity in disability, after controlling for SES, and whether blacks and whites with the same condition experience differing rates of disability.

This knowledge is important for several reasons. First, understanding which conditions contribute substantially to the black–white disability gap can yield important points of emphasis for efforts aimed at minimizing racial disparity in older Americans. Second, as rates of particular medical conditions fluctuate in both races, the results of this analysis might help predict the degree to which the black–white disability gap could be expected to widen or narrow in the future as a result of shifting disease patterns. From a public health

standpoint, such knowledge may be useful in planning and targeting systems to deliver care to a growing population of older Americans.

METHODS

Population

Data were derived from the Duke Established Population for Epidemiologic Studies of the Elderly (EPESE). The Duke EPESE was a prospective cohort study that included community-dwelling adults aged 65 and older at the time of enrollment (1986/87) who resided in five counties in the Piedmont region of North Carolina. A major goal of the study was to estimate and compare the prevalence and incidence of chronic conditions and disabilities in blacks and whites. Commensurate with this goal, the study employed a four-stage random sampling design stratified according to race so that the final sample would include at least 50% older black adults. Sampling was based on census tract data with purposeful oversampling of black households but approximately equal probability of inclusion at the housing-unit level for blacks and whites. Eligible blacks (86.2%) and whites (76.6%) had similarly high rates of participation. Further details on sampling procedures and data collection have been published previously.^{19,20}

The current analyses are restricted to data collected during the second in-person wave of the study (1989/90). Data from the 1989/90 interviews were used because they include information on health conditions pertinent to this analysis that were not assessed at other waves. Of the original 4,162 participants enrolled in the Duke EPESE, 3,314 were alive and participated in the 1989/90 interviews. Participants were excluded from the current analysis if their information was obtained by proxy ($n = 278$) or by telephone ($n = 52$), because those abbreviated interviews lacked some relevant data. Also excluded were 18 participants whose race was classified as neither black nor white. The remaining 2,966 participants make up the sample for this cross-sectional study. The percentage of black participants in this sample (54.7%) is similar to the percentage of black participants originally enrolled in Duke EPESE (54.3%). All participants signed informed consent, and the study was approved by the Duke institutional review board.

Primary Outcome: Disability

During in-person interviews, participants were queried about their ability to perform seven activities of daily living (ADLs): bathing, dressing, walking across a room, transferring from a bed to a chair, using the toilet, grooming, and eating.²¹ Consistent with previous work, the dichotomous outcome of disability was defined as inability to independently perform at least one of the seven tasks.¹²

Medical Conditions

The analysis included all medical conditions in the data set that were expected to contribute substantially to ADL disability, based on clinical judgment or known associations in the medical literature.^{22–26} The nine medical conditions in the analysis are obesity, diabetes mellitus, hip fracture, any other bone fracture, vision impairment, heart attack, stroke, cognitive impairment, and arthritis.

Obesity was determined by calculating participants' body mass index (BMI) from self-reported height and weight (weight in kilograms/height in meters²). Obesity was defined as a BMI of 30 kg/m² or greater. Diabetes mellitus, hip fracture, stroke, heart attack, and arthritis were assessed according to participant self-report of whether a physician had ever told them they had the condition. For each condition, standardized interview questions included several alternate terms for the condition (e.g., to assess history of heart attack,

participants were asked whether a physician had told them they had a “heart attack or coronary or myocardial infarction or coronary thrombosis or coronary occlusion”). Bone fractures other than hip fractures were included only if the participant reported that the fracture had occurred in the last year, because remote non-hip fractures were considered less likely to contribute to disability at the time of study. Visual impairment was considered present in participants who reported that, while using their best glasses or contacts, they were not able to see well enough to recognize a friend across the street or to read ordinary newspaper print. Cognitive ability was assessed using the 10-item Short Portable Mental Status Questionnaire (SPMSQ), with cognitive impairment defined as four or more errors.^{27,28}

Other Variables

Age, race, sex, and marital status were determined according to self-report. Indicators of SES included years of education and a single question that assessed adequacy of finances: “How well does the amount of money you (or your husband or wife) have take care of your needs?” Responses to this question were collected on an ordinal scale of poorly, fairly well, or very well.

Missing Data

No variable had more than 5% missing observations. For variables with less than 2% missing values, the mean value was imputed. For variables with 2% to 5% missing values, regression-predicted values were imputed.

Analysis

Descriptive statistics were used to characterize the cohort. *T*-tests for means and proportions were used to test whether blacks and whites differed significantly with respect to each variable. Analyses then addressed two related issues: the extent to which differing prevalence of selected medical conditions in blacks and whites explains race-based disparity in disability and whether the disabling effects of particular medical conditions differ in blacks and whites. These analyses are based on a medical model of disability, whereby medical conditions generally precede disability in a causal pathway.²⁹ Guided by this model, the analyses assess the “effects” of disease on disability, recognizing that the true direction of cross-sectional associations cannot be determined.

To address the first issue, the indirect effects of black race on disability as mediated by each medical condition were estimated. Multiple logistic regression equations were constructed in which black race was an independent variable, and the dependent variable was a particular medical condition or disability. Indirect effects mediated by each medical condition were estimated as the product of two regression coefficients as follows: (the coefficient for black race when the dependent variable is a particular medical condition) $\times$ (the coefficient for that medical condition when the dependent variable is disability) in models that included race, age, sex, marital status, education, adequacy of finances, and the medical conditions.³⁰ These analyses were performed with Mplus software (Muthen & Muthen, Los Angeles, CA), which is especially suited to estimations that involve multiple mediators and a dichotomous dependent variable.^{30,31} Indirect effects are reported as percentages of the total effect of black race on disability, which was estimated in a model that included age and sex in addition to race (Figure 1). Reported in this manner, the indirect effects represent the percentage of the black excess in disability which can be explained by uneven prevalence of the medical condition in blacks and whites.

To address the second issue, analyses examined whether the effects of the nine medical conditions on disability were different in blacks and whites. In other words, these analyses

examined interactions between race and medical conditions with respect to disability. For this analysis, the rate (rather than the odds) of disability was modeled because it has been shown that, when the dependent variable is dichotomous, additive models are superior for assessing interactions between risk factors.³² Rothman's Relative Excess Risk due to Interaction (RERI) statistic was used to test the significance of interactions between race and each of the nine medical conditions.³³ If a significant interaction is detected between race and a medical condition, it can be said that the condition's effect on disability differs in blacks and whites. SAS methods were employed to estimate the RERI statistic based on a proportional hazards model (SAS Institute, Inc., Cary, NC).³⁴

RESULTS

Table 1 details characteristics of the participants, which included 1,622 (54.7%) blacks and 1,344 (45.3%) whites. The mean age of participants was 75.7, and two-thirds were female; blacks and whites did not differ significantly with respect to these demographics. Blacks reported fewer years of education and lower adequacy of their finances to meet their needs. Blacks were significantly less likely to be married. One-quarter of blacks had a BMI of 30.0 kg/m², compared with 11% of whites. Likewise, diabetes mellitus was reported in 23% of blacks and 14% of whites. A higher percentage of blacks also reported arthritis, although the racial difference was not as striking (59% vs 54%). By contrast, 5% of whites and 2% and 3% of blacks reported hip fractures and other bone fractures, respectively. Seventeen percent of whites and 14% of blacks reported a history of heart attack. Without adjustment for demographic or SES factors, blacks and whites did not differ significantly in terms of cognitive impairment, vision impairment, or stroke. A higher percentage of blacks (20%) than whites (15%) reported disability.

Table 2 presents the association between black race and disability before and after adjustment for demographic and SES variables. In unadjusted regression analysis, blacks had greater odds of ADL disability (odds ratio (OR) = 1.39, 95% confidence interval (CI) = 1.15–1.68). This association was unchanged after controlling for age and sex but was completely attenuated by further adjustment for years of education and adequacy of finances.

Indirect Effects Mediated by Medical Conditions

The next set of analyses examined whether medical conditions mediated indirect effects of black race on disability after adjustment for SES. Because adjustment for SES appeared to eliminate excess disability in blacks (Table 2), any indirect effects mediated by other variables were likely to exist in opposing directions. As a first step toward estimating such effects, analyses were undertaken to consider the association between race and the nine medical conditions. Controlling for sex, age, race, education, adequacy of finances, and the other eight medical conditions, blacks were more likely to be obese and have diabetes mellitus and less likely to report fractures, vision impairment, or heart attacks (Table 3). In these adjusted models, blacks and whites did not differ significantly in prevalence of stroke, cognitive impairment, or arthritis.

Next, analyses were conducted to quantify the indirect effect of race on disability that each condition mediated. The magnitude of the indirect effect mediated by a given condition is determined by how much more or less common the condition is among blacks (as presented in Table 3) and how much more common disability is in people with the condition. Table 4 summarizes the relationship between each medical condition and disability (Column 1) and the magnitude of the indirect effect of black race on disability as mediated by that condition (Column 2). All nine medical conditions were independently associated with ADL

disability, and the association was particularly strong in the case of hip fracture, vision impairment, and stroke (Table 4, Column 1).

The second column of Table 4 reports the percentage of the race-based disparity in disability that each medical condition mediates, adjusting for SES status. For example, excess diabetes mellitus and obesity in blacks independently accounted for 16.9% and 15.8%, respectively, of the differing rates of ADL disability between blacks and whites. If all other factors remained constant, and the SES-adjusted rates of diabetes mellitus and obesity in older blacks became equal to the rates in whites, one would expect the racial disparity in ADL disability to be approximately one-third less ($16.9\% + 15.8\% = 32.7\%$).

Alternatively, negative values represent the indirect effects mediated by white-prevalent conditions in Table 4. The indirect effects mediated by these conditions are in the opposite direction of those mediated by diabetes mellitus and obesity. If fractures and vision impairment had affected blacks as commonly as whites (controlling for demographics and SES), one would expect the black–white disparity in disability rates to be 45.2% ($7.9\% + 20.9\% + 16.4\%$) greater. If the SES-adjusted rates of vision impairment, fractures, and heart attacks were as high in blacks as they were in whites, the racial disability gap would be expected to widen by more than 50%.

Although the objective of this study was to estimate the contribution of medical conditions to the black–white disability gap after controlling for racial differences in SES, the independent effects mediated by medical conditions are smaller than the magnitude of effects mediated by the SES indicators themselves. Lower education and poor adequacy of finances were more common in blacks and were strongly associated with disability. Controlling for age and sex, education explained 53.6% of the black–white difference in ADL disability, and adequacy of finances explained 27.7%.

Interactions

Finally, a series of analyses assessed whether low SES or any medical condition yielded a different risk of disability in blacks and whites. No such interactions with race were found, indicating that the disability rates associated with each medical condition or with low SES status were similar in blacks and whites.

DISCUSSION

This analysis provides new information about the independent role of medical conditions in racial disparity in disability in older Americans. The findings are consistent with previous reports that racial differences in SES are a major contributor to disparity in disability in old age,^{2,11–15} but this analysis extends previous work by further examining the independent contributions of medical conditions to racial disparity—after controlling for SES. Previous studies have not quantified the opposing influences of black- and white-prevalent diseases on racial differences in disability rates. The large effects presented here would have gone undetected if no further analyses had been conducted beyond those reported in Table 2.

There are public health implications of the finding that higher rates of obesity and diabetes mellitus in blacks—after adjustment for SES factors—accounted for more than 30% of blacks' excess disability. The current obesity epidemic in the United States disproportionately affects African Americans,³⁵ and these results provide additional evidence that this epidemic is likely to yield long-term adverse effects and increased racial inequity. Although obesity is associated with lower SES, the odds of obesity were 1.7 times as high in blacks, even after controlling for education and adequacy of finances, supporting the notion that multiple factors contribute to the growing burden of obesity in black

Americans.^{36,37} The current analysis highlights the pressing need to develop and implement culturally appropriate interventions that reduce the prevalence of obesity (and diabetes mellitus) in older blacks.

Unlike obesity and diabetes mellitus, vision impairment, fractures, and heart attacks were more common in whites and thus narrowed the racial gap in disability rate. The higher rates of broken bones and vision impairment reported in older whites were anticipated because osteoporosis and age-related macular degeneration (the leading cause of incurable vision loss in older adults) share a predilection for Caucasians.^{38,39} Before adjustment for SES, the prevalence of self-reported vision impairment was similar in whites and blacks. This may reflect the fact that participants' ability to see "while using your best glasses or contacts" determined vision impairment. In unadjusted data, differences in access to eyewear, which SES would influence, might have resulted in more self-reported vision impairment in blacks, masking the white predominance of irreversible vision impairment due to age-related macular degeneration.

The finding that blacks were less likely than whites to report a history of heart attacks is consistent with population data that suggest that whites are slightly more likely to be diagnosed with coronary heart disease,⁴⁰ yet blacks are more likely to die from it.⁴¹ The higher prevalence of self-reported heart attacks in older whites may reflect a combination of diagnostic and reporting biases as well as the white survival advantage for cardiovascular disease. That is, coronary artery disease may be more likely to claim the lives of blacks before the enrollment age for this study.

If whites had experienced similarly low SES-adjusted rates of vision impairment and broken bones as did their black counterparts, the white disability rate would have been even lower, resulting in an approximately 45% wider racial disability gap (if all else remained equal). Such findings may be relevant for future generations as disease patterns shift. For example, if advances were made in the prevention and treatment of osteoporosis and age-related macular degeneration without concomitant gains in the prevention and treatment of conditions that disproportionately affect blacks (obesity and diabetes mellitus), future generations would expect even greater race-based inequality in older adults' disability burden, even if socioeconomic disparity remained stable.

In this study, no significant interactions were observed between race and any of the nine conditions, suggesting that whites and blacks with the same medical condition experienced similar rates of disability after adjustment for SES. This finding is consistent with a study that found that, in people with arthritis, blacks were at greater risk of developing disability, but the racial difference was completely explained by health and medical access factors.⁴² In contrast, a separate study reported that black stroke survivors were significantly more likely to have disability than white stroke survivors and that adjustment for education did not attenuate the difference.⁴³ That study did not adjust for other indicators of SES, such as income, adequacy of finances, and insurance status. Whereas the current study found no interaction between race and SES indicators with respect to disability status, others have found that more years of education was less predictive of better self-rated health in Blacks than in Whites.¹⁶

Several limitations of this study could affect interpretation of the results. First, the data were collected 2 decades ago, and some notable changes have occurred (e.g., obesity is more common now in blacks and whites). A second limitation is that the data were determined largely according to self-report, although previous work suggests excellent accuracy in older adults' self-report of health conditions,⁴⁴ height and weight,⁴⁵ and disability status.⁴⁶ Finally, the data lack a measure of disease severity, so that potential contributor to race-

based differences in disease-mediated disability could not be explored. Despite these limitations, the Duke EPESE represents a large sample of older adults with meticulous data collection on variables of interest and a sampling design that avoided differential selection but ensured large numbers of randomly sampled black and white participants; thus, the Duke EPESE was considered to be well suited to the current analysis.

This study adds to existing literature by estimating the independent contributions of common medical conditions to racial disparity in the disability rates of older adults. The findings indicate several conditions that influence the relationship between race and disability, even after controlling for racial differences in SES. The results may be helpful in forecasting increases and decreases in disparity that are likely to occur with shifting prevalence of these diseases. The results support the notion that efforts to reduce black–white health disparities in older Americans should target obesity and diabetes mellitus. Interventions that reduce the prevalence or functional consequences of these conditions could have a sizable effect on the disproportionate rates of disability in older blacks, regardless of whether discrepancies in SES persist.

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Figure 1.

Sample calculation of percentage of indirect effect (indirect effect mediated by a particular medical condition expressed as a percentage of the total effect of race on disability). The calculations assume that the total observed effect of race on disability can be separated into indirect effects, which are mediated by intervening variables that lie in the causative pathway between race and disability, and a possible direct effect of race on disability. The percentage of indirect effect mediated by each medical condition was calculated from this ratio: [indirect effect of race on disability mediated by that particular condition]/[total effect of race on disability]. Using the raw (non-exponentiated) coefficients obtained from Mplus, the total effect of race on activity of daily living disability controlling for age and sex was 0.177. The indirect effect of race on disability mediated by obesity was determined to be 0.028. Thus the percentage of indirect effect for obesity equals $(0.028/0.177) \times 100 = 15.8\%$, as reported in Table 4.

Table 1

Characteristics of the Cohort

Characteristic	All Participants N = 2,966	Blacks n = 1,622	Whites n = 1,344	P-Value
Female, %	67	68	66	.22
Age, mean $\pm$ SD	75.7 $\pm$ 6.0	75.8 $\pm$ 6.2	75.5 $\pm$ 5.9	.14
Years of education, mean $\pm$ SD	9.2 $\pm$ 7.2	8.0 $\pm$ 7.4	10.5 $\pm$ 6.7	<.001
Adequacy of finances, mean $\pm$ SD*	1.2 $\pm$ 0.7	1.1 $\pm$ 0.7	1.4 $\pm$ 0.6	<.001
Married, %	37	33	41	<.001
Medical conditions				
Obesity (body mass index $\geq$ 30 kg/m ²), %	19	25	11	<.001
Arthritis, %	56	59	54	<.01
Hip fracture, %	4	2	5	<.001
Other fracture %	3	3	5	<.001
Vision problems, %	9	8	9	.22
Diabetes mellitus, %	19	23	14	<.001
Stroke, %	8	8	8	.42
Heart attack, %	15	14	17	.04
Cognitive impairment	10	11	9	.06
Activity of daily living disability, %	18	20	15	<.001

* Based on response to "How well does the amount of money you (or your husband or wife) have take care of your needs?" poorly = 1, fairly well = 2, very well = 3.

SD = standard deviation.

Table 2

Association Between Black Race and Disability

Dependent Variable	Odds Ratio (95% Confidence Interval)		
	Model 0 [*]	Model 1 [†]	Model 2 [‡]
Activity of daily living disability	1.39 (1.15,1.68)	1.36 (1.20,1.66)	1.06 (0.85,1.31)

* Model 0 included only race as a predictor.

† Model 1 included race, age, and sex.

‡ Model 2 included race, age, sex, education, and adequacy of finances.

Table 3

Associations Between Black Race and Medical Conditions

Medical Condition	Odds Ratio (95% Confidence Interval)
Obesity	2.39 (1.92–2.98)
Diabetes mellitus	1.76 (1.43–2.16)
Broken bones (other than hip)	0.44 (0.28–0.69)
Broken hip	0.39 (0.26–0.60)
Vision impairment	0.64 (0.49–0.85)
Heart attack	0.66 (0.53–0.83)
Stroke	0.96 (0.72–1.28)
Cognitive Impairment	0.97 (0.74–1.27)
Arthritis	1.01 (0.86–1.19)

Model includes race, age, sex, education, adequacy of finances, marital status, and medical conditions.

Table 4

Association Between Medical Conditions and Disability and Percentage of Race-Based Disparity in Disability Mediated by Each Condition

Medical Conditions	Association with Disability Odds Ratio (95% Confidence Interval)	Percentage of Race-Based Disparity in Disability Mediated by Condition
Obesity	1.73 (1.32–2.26)	15.8
Diabetes mellitus	1.37 (1.06–1.77)	16.9
Broken bones (other than hip)	2.31 (1.39–3.86)	–7.9
Broken hip	6.71 (4.30–10.50)	–20.9
Vision impairment	3.96 (2.92–5.36)	–16.4
Heart attack	1.32 (1.01–1.74)	–7.9
Stroke	3.93 (2.86–5.41)	X
Cognitive impairment	2.29 (1.69–3.09)	X
Arthritis	1.51 (1.20–1.90)	X

Models include race, age, sex, marital status, education, adequacy of finances, and medical conditions.

X = the condition was not significantly associated with race in adjusted models.