Environmental and Socio-Economic Factors as Contributors to Racial Disparities in Diabetes Prevalence

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BACKGROUND: We deployed a study design that attempts to account for racial differences in socioeconomic and environmental risk exposures to determine if the diabetes race disparity reported in national data is similar when black and white Americans live under similar social conditions.

DESIGN & METHODS: We compared data from the 2003 National Health Interview Survey (NHIS) with the Exploring Health Disparities in Integrated Communities-Southwest Baltimore (EHDIC-SWB) Study, which was conducted in a racially-integrated urban community without race differences in socioeconomic status.

RESULTS: In the NHIS, African Americans had greater adjusted odds of having diabetes compared to whites (OR: 1.61, 95% CI: 1.26–2.04); whereas, in EHDIC-SWB white and African Americans had similar odds of having diabetes (OR: 1.07, 95% CI: 0.71–1.58). Diabetes prevalence for African Americans was similar in NHIS and EHDIC-SWB (10.4%, 95%CI: 9.5–11.4 and 10.5%, 95%CI: 8.5–12.5, respectively). Diabetes prevalence among whites differed for NHIS (6.6%, 95%CI: 6.2–6.9%) and EHDIC-SWB (10.1%, 95%CI: 7.6–12.5%).

CONCLUSIONS: Race disparities in diabetes may stem from differences in the health risk environments that African Americans and whites live. When African Americans and whites live in similar risk environments, their health outcomes are more similar.

KEY WORDS: diabetes; health disparities; residential segregation.
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INTRODUCTION

Diabetes is a serious condition with a large societal burden as it relates to healthcare costs and years of potential life lost. The United States has seen an increase in diabetes prevalence in recent decades, with African Americans having a considerably higher prevalence of type 2 diabetes and related complications compared to whites.[1] There has been substantial growth in research seeking to understand the causes of race disparities in diabetes and other conditions. Previous studies examining disparities in diabetes prevalence and outcomes have suggested that disparities in healthcare resource allocation[2,3], healthcare utilization[2], quality of diabetes care[4], dietary habits[3], physical activity[3], perceived self-efficacy[5], and genetics[6] are associated with disparities in diabetes. However, this area of research has been hampered by two vexing challenges. The first of these challenges is confounding between race/ethnicity and socioeconomic status (SES).[7] Simply stated, health status varies by race and health status varies by SES. Racial minorities are more likely to have low SES compared with whites. The overlap between race and SES complicates efforts to determine whether it is, "race *and* class" or "race *or* class" that produces disparities in health status.[8]

The second challenge to health disparities research is racial segregation. Minorities tend to live in geographically distinct communities. Racial segregation can lead to different environmental and social risk exposures[9-12]. Consequently, estimates of racial disparities from national samples may be biased because such estimates fail to consider the different risk profiles of communities where different ethnic groups live. Consequently, it is unknown to what extent race disparities reported from national data unadjusted for segregation may be overestimating race differences in health outcomes. To further the understanding of the nature of health disparities, we need databases that attempt to overcome these challenges.

The objective of this paper is to explore race disparities in diabetes prevalence within a dataset which attempts to overcome each of these potential sources of bias. By examining race disparities in a sample where African Americans and whites live in the same risk environment and utilize the same healthcare resources, we can test the hypothesis that estimates of race disparities in diabetes reported in national samples are overestimated because they do not account for socioeconomic and environmental characteristics of the communities in which African Americans and whites tend to reside.

METHODS

Study Population

EHDIC (Exploring Health Disparities in Integrated Communities) is an ongoing multi-site study of race disparities within commu-

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nities where blacks and whites live together and where there are no race differences in socioeconomic status (SES), as measured by median income. The first EHDIC study site was in southwest Baltimore, Maryland (EHDIC-SWB), a low income urban area. Future EHDIC locations are planned in a high income area (Prince Georges County, Maryland) and a rural area (Edgecombe County, North Carolina)

EHDIC-SWB, is a cross-sectional face-to-face survey of the adult population (aged 18 and older) of two contiguous census tracts collected between June and September 2003. In addition to being economically homogenous, the study site was also racially balanced and well integrated, with almost equal proportions of black and white residents. In the two census tracts, the racial distribution was 51% black and 44% 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 2,618 structures. Of those, 1636 structures were determined to be occupied residential housing units (excluding commercial and vacant residential structures). After up to 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 included the study area, the bias to geographic locale and its relationship with socioeconomic status should be minimal.[13]

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.[13] For instance; our sample was 59.3% black and 44.4% male, whereas the 2000 Census data showed the population was 51% black and 49.7% male. Age distributions in our sample and 2000 Census data were similar with the median age (35–44 years) for both samples. The lack of race difference in median income in the census, $23,500 (black) vs. $24,100 (white) was replicated in EHDIC $23,400 (black) vs. $24,900 (white).

The survey was administered in person by a trained interviewer and consisted of a structured questionnaire, which included demographic and socioeconomic information, self-reported height and weight, self-reported health behaviors and chronic conditions, and three blood pressure (BP) measurements. The EHDIC study has been described in greater detail elsewhere.[13] The study was approved by the Committee on Human Research at the Johns Hopkins Bloomberg School of Public Health. These analyses included 1,408 black and white respondents from the EHDIC-SWB sample.

The National Health Interview Survey (NHIS) is an annual, multi-purpose health survey of the civilian, non-institutionalized, households of the U.S. conducted by the National Center for Health Statistics.[14] U.S. Census Bureau interviewers administer the survey in the respondents' home. Adults aged 17 and over are eligible to participate in the survey. Our analyses were restricted to data from the "Sample Adult Core" section of the 2003 NHIS because of similarity with the data collected and age range in the EHDIC-SWB survey. The study population for the Sample Adult Core consisted of 32,374 individuals aged 18 and older who responded to questions regarding their demographic characteristics, health status and behaviors, functional limitations, AIDS, cancer screening and health care access and utilization. Detailed information regarding this sample can be found elsewhere.[14] These analyses included 29,372 black and white respondents from the 2003 NHIS sample.

Measures

Items from NHIS were replicated in the EHDIC-SWB study. Each measure included in these analyses was coded similarly for both datasets. Diabetes was defined as self-report of having been diagnosed by a doctor or other healthcare professional. Race was based on participant self-identification as African American or white. Demographic variables included age (years), sex (1=female, 0=male), education level (less than high school graduate, high school graduate/GED, or more than high school graduate), and income category (<$10,000, $10,000–19,999, $20,000–34,999, $35,000–54,999, >$55,000). Health related characteristics included: health insurance (1=yes; 0=no), physical inactivity (1=yes; 0=no), poor/fair health (1=yes; 0=no), smoking and drinking status (0=never; 1=former; 2=current). Using self-reported height and weight, body mass index was calculated by dividing weight in kilograms by height in meters squared.

Statistical Analyses

Using *Student's* t and Chi-square tests, we evaluated the mean and proportional differences between African American and white adults for demographic and health-related factors for each sample. We then compared age adjusted diabetes prevalence estimates by race. Logistic regression models were specified to examine the association between race and diabetes for each dataset and compared to determine the extent to which findings from the EHDIC-SWB differed from NHIS. The analyses involving NHIS were adjusted by Taylor-linearization procedures to account for the multistage sampling design. P-values < 0.05 were considered statistically significant and all tests were two-sided. Analyses were conducted using SAS, version 9.1.3, software.

RESULTS

Table 1 shows the distribution of demographic and health-related variables for EHDIC-SWB and NHIS participants by race. African Americans in the NHIS sample were younger and more likely to be female than whites. African Americans had a worse SES profile than whites, with more African Americans having household incomes below $10,000 and fewer graduating from high school. African Americans had higher rates of self-reported fair or poor health, lower rates of health insurance, and lower rates of ever smoking or drinking. Although African Americans had a higher mean BMI than whites, no racial differences were observed with regard to physical inactivity.

In the EHDIC-SWB sample, African Americans were younger than whites, but were similar with respect to gender. There was no difference in income level between African Americans and whites, although African Americans were more likely to complete high school. With the exception of current drinking and BMI, African Americans in EHDIC-SWB exhibited better health

Table 1. Distribution of Demographic and Health Behavior Variables of the EHDIC-SWB and 2003 NHIS Participants by Race*

Variable	NHIS			EHDIC-SWB		
	Whites n=25,170)	African Americans n=4,202)	P Value	Whites n=573)	African Americans n=835)	P Value
Age (years)	47.0+0.16	44.0+0.35	< 0.001	43.8 ± 16.2	38.4±13.1	< 0.001
Female sex (%)	54.5	59.4	< 0.001	56.8	54.3	0.349
Income (%)						
< $10,000	33.5	40.4		22.1	25.2	
$10,000–19,999	8.1	12.7		33.1	34.6	
$20,000–34,999	14.4	15.5		22.6	19.7	
$35,000–54,999	16.1	15.3		11.6	11.2	
>$55,000	27.7	15.8	< 0.001	10.3	9.1	0.473
Education level (%)						
Less than high school graduate	15.9	21.7		47.5	35.4	
High school graduate/GED	30.1	31.2		34.2	45.1	
More than high school graduate	53.9	46.9	< 0.001	18.3	19.4	< 0.001
Health insurance (%)	85.4	80.6	0.001	59.7	65.1	0.042
Physically inactive (%)	68.9	70.0	.448	25.7	19.3	0.004
Fair or poor health (%)	11.9	18.5	< 0.001	37.3	28.2	< 0.001
Smoking status (%)						
Never	54.8	64.0		24.7	37.4	
Former	23.8	14.7		16.4	8.8	
Current	21.3	21.1	< 0.001	58.8	53.6	< 0.001
Drinking status (%)						
Never	22.7	35.9		16.5	20.5	
Former	14.6	16.1		40.4	31.1	
Current	62.6	47.8	0.001	42.9	48.3	0.001
BMI (kg/m^2)	26.5+0.04	28.0+0.10	< 0.001	27.1+6.7	28.0+7.3	0.026

**Plus-minus values are means ± SD*

status than whites, with lower rates of self-reported fair or poor health, lower rates of physical inactivity, higher rates of health insurance, and higher rates of never smoking.

In the NHIS sample, the diabetes prevalence estimate was 10.4% (CI: 9.5–11.4) for African Americans and 6.6% (CI: 6.2–6.9) for whites. The black/white ratio of prevalence estimate was 1.57. In EHDIC-SWB, African Americans had a diabetes prevalence estimate of 10.5%, (CI: 8.5–12.5). For whites in EHDIC-SWB, the prevalence was 10.1% (CI: 7.6–12.5) and the black/white ratio of prevalence estimates was 1.03. Whites in EHDIC-SWB had a prevalence estimate 53% greater than whites in NHIS, and the prevalence estimates for whites in the two samples had non-overlapping 95% confidence intervals. In Table 2, we estimated logistic regression models for EHDIC-SWB and NHIS to determine the degree to which EHDIC-SWB findings differed from NHIS, after adjusting for covariates. In the NHIS sample, African Americans had higher odds of diabetes (OR=1.61, 95% CI: 1.29–2.09) than whites. However, there was no race difference in the EHDIC-SWB sample (OR=1.07, 95% CI: 0.72–1.60).

Table 2. Association between Race and Diabetes for Participants in 2003 NHIS and EHDIC-SWB *

	NHIS		EHDIC-SWB	
	OR	95% CI	OR	95% CI
Race**	1.61	1.26–2.04	1.07	0.71–1.58
Age	1.05	1.04–1.06	1.04	1.03–1.06
Female sex	0.64	0.52–0.80	0.73	0.48–1.11
Education				
Less than 12th grade	1.00		1.00	
High school grad/GED	0.94	0.71–1.25	1.03	0.66–1.59
Some college/College grad	1.02	0.78–1.32	0.90	0.49–1.65
Income				
$0–$9,999	1.00		1.00	
$10,000 – $19,999	1.10	0.81–1.49	0.97	0.61–1.56
$20,000– $34,999	1.15	0.87–1.53	0.86	0.47–1.55
$35,000–$54,999	0.99	0.75–1.32	0.66	0.29–1.48
$55,000+	0.88	0.67–1.15	0.93	0.39–2.20
Smoking status				
Never	1.00		1.00	
Former	0.80	0.58–1.09	0.81	0.46–1.43
Current	0.62	0.45–0.84	0.76	0.47–1.23
Drinking status				
Never	1.00		1.00	
Former	2.11	1.70–2.61	0.90	0.57–1.42
Current	1.82	1.40 – 2.38	1.17	0.68–1.99
Fair/Poor health	3.22	2.55–4.07	2.30	1.53–3.44
Physically inactive	0.98	0.78–1.22	1.10	0.72–1.70
Insurance status	1.15	1.13–1.17	1.08	1.05–1.11
BMI	1.34	0.91–1.96	1.29	0.83–2.00

Notes: OR=odds ratio; 95% CI=95% confidence interval
GED=general equivalency diploma
**Model was adjusted for age, sex, education, income, smoking status, drinking status, fair/poor health, physical inactivity, insurance status, and body mass index*
***White adults were the reference category*

DISCUSSION

Race disparities in diabetes have been widely reported in national samples. However, within our sample of a racially integrated community without race differences in socioeconomic and environmental factors, prevalence estimates of diabetes are similar between African Americans and whites. Our findings are likely the result of the EHDIC study sample design which accounts for the social contexts in which African Americans and whites reside. The black and white residents of our study area live in the same low-income urban community,

and are exposed to the same challenging health-risk environment. Moreover, EHDIC-SWB respondents live in the same healthcare marketplace and have access to the same healthcare resources. Previous research has demonstrated that when African Americans and whites access similar healthcare facilities their healthcare outcomes are more simiar.[15,16]

When comparing EHDIC-SWB with NHIS, we observed higher age-adjusted prevalence estimates of diabetes among whites in EHDIC-SWB relative to NHIS. Although EHDIC-SWB is entirely urban, NHIS includes participants from urban and non-urban areas. As such, it is possible that inner-city urban environment accounts for the high prevalence estimates for diabetes among whites in EHDIC-SWB. Nationally, the African American population is predominantly urban. There were no differences in diabetes prevalence for African Americans in EHDIC-SWB compared with the NHIS. The dissolution of racial disparities in diabetes within an integrated community is consistent with our hypothesis that race differences in risk exposures resulting from segregation may obscure the understanding of health disparities when relying on national data. Possible socio-economic and environmental factors that were accounted for in the EHDIC-SWB study and may have precipitated the disparities in diabetes prevalence observed in NHIS include the allocation of preventive healthcare resources[2], food security and quality[17,18], exercise facilities and parks [19,20], and perceived self-efficacy in disease prevention.[5,21,22] However, it is worth noting that segregation and socioe-economic status are not the only determinants of disparities in diabetes. This study provides insight into the nature of health disparities after accounting for confounding of race, SES, and segregation; however, several limitations of the study warrant comment. While the design of EHDIC-SWB mitigates the impact of race differences in risk exposures at home, we were unable to account for risks that respondents may encounter at work or elsewhere. The analysis is somewhat limited by self-report of diabetes. However, self-report of diabetes has been documented as a valid measure of diagnosed diabetes cases (κ= 0.86; 95% CI=0.79, 0.92).[23] The measure of diabetes available in NHIS and EHDIC-SWB does not differentiate between type 1 and type 2 diabetes. Given that type 1 diabetes makes up 5% to 10% of diagnosed diabetes cases[24], the inclusion of type 1 may confound the results; however, both study samples were subject to this limitation. We were not able to determine if any NHIS respondents lived in racially integrated communities. If there are such cases the overlap between the samples would result in nondifferential bias, which would typically bias results toward the null. However, previous census research established that only 9.4% of residents across 50 U.S. cities reside in black-white integrated blocks.[25] As NHIS is designed to be nationally representative sample of the US population, it can be inferred that NHIS respondents are as racially segregated as the general population. This suggests that the proportion of integrated respondents in NHIS is likely small.

EHDIC-SWB is not representative of the entire socioeconomic spectrum and results may differ in higher socioeconomic strata or in non-urban areas. Moreover, our study was limited to separate analyses within the two samples, since the multi-stratified sampling design of NHIS precludes pooling the two datasets. Finally, these analyses included African American and white participants only. It would be worthwhile to understand the nature of health disparities between other minority groups who live in similar social environments.

In this study we demonstrated the role that the social context plays in explaining race disparities in diabetes. National estimates of race disparities in diabetes may be biased because of differential risk exposure among persons of different racial groups. Future research in health disparities would benefit from creative approaches to examining health disparities within samples which account for socioeconomic and environmental factors.

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