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Disparities in the Prevalence of Diabetes: Is it Race/Ethnicity or Socioeconomic Status? Results from the Boston Area Community Health (BACH) Survey

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Abstract

Objectives—Many researchers and clinicians continue to believe that (non-modifiable) race/ethnicity is a major contributor to diabetes, prompting a well-intentioned search for genetic and bio-physiological explanations. We seek to reinforce earlier findings showing that socioeconomic status is more strongly associated with diabetes prevalence than race/ethnicity and suggests a very different and potentially modifiable etiologic pathway.

Methods—A community-based epidemiologic survey of 5503 Boston residents aged 30–79 (1767 Black, 1877 Hispanic, 1859 White; 2301 men and 3202 women).

Results—After adjusting for age and gender, Blacks and Hispanics have statistically significantly increased odds of having diabetes: Black (Odds Ratio 2.0 with 95% confidence interval 1.4–2.9) and Hispanic (2.4; 1.6–3.4) compared to Whites. If socioeconomic status (a combination of education and income) is added to the model, these odds are reduced for both Blacks (1.6; 1.1–2.2) and Hispanics (1.6; 1.1–2.3). In a multivariate logistic regression adjusting for age, gender, socioeconomic status, obesity, hypertension, gestational diabetes, physical activity, trouble paying for basics, health insurance status, and family history of diabetes, these odds are reduced further: Black (1.0; 0.7–1.5) and Hispanic (1.3; 0.9–2.1) and are no longer statistically significant.

Conclusions—Consistent with other reports, we find socioeconomic status has a much stronger association with diabetes prevalence than race/ethnicity. Continuing to focus on race/ethnicity as a primary determinant of diabetes prevalence overemphasizes the importance of biomedical factors and diverts effort from socio-medical interventions (e.g. improving social circumstances, access to effective care, and upstream redistributive social policies).

Keywords

Diabetes; race/ethnicity; socioeconomic status

Introduction

Major federal agencies (like the National Institutes of Health and the Centers for Disease Control) and professional organization (like the American Diabetes Association) continue to identify race/ethnicity as a major determinant of the prevalence of diabetes in the United States[1–3]. This has spawned a well-intentioned search for underlying genetic and bio-

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physiologic explanations, eventually leading to identification of promising biomedical interventions to reduce race/ethnic disparities in diabetes. In contrast, social epidemiologists continue to find that socioeconomic status may be a more important determinant of diabetes prevalence, even accounting for much of the widely accepted race/ethnic effect[4–10]. Such findings suggest markedly different explanations (in social circumstances, and environmental and neighborhood influences) and precipitate different types of primary, secondary, and upstream policy interventions. In the United States and many other countries, race/ethnic minorities are more likely to be poorer and less well educated than the majority white population. This has caused researchers to repeatedly ask the question which motivates this paper: is the widely accepted disparity in the prevalence of diabetes really attributable to race/ethnicity (which is considered non-modifiable), or is it due to socioeconomic status (which is potentially modifiable through upstream social policy interventions)? This question has important implications for clinicians, health services researchers, and policy makers. We attempt to answer it using data from a community-based epidemiologic survey of Boston, Massachusetts residents.

Methods

The Boston Area Community Health (BACH) survey is an epidemiologic survey of Boston residents aged 30–79 years. Detailed methods have been described elsewhere[11]. In brief, a stratified two-stage cluster sample design was used to recruit residents of Boston with the goal of approximately equal number of participants by gender, race/ethnicity (Black, Hispanic, White), and age group (30–39, 40–49, 50–59, 60–79). In total, 5503 adults participated in BACH (1767 Black, 1877 Hispanic, 1859 White respondents; 2301 men and 3202 women). The response rate was 63.3% of screened eligible participants, which is typical of an epidemiologic field survey requiring a lengthy in-home protocol and phlebotomy. Data were collected between 2002 and 2005. After obtaining written informed consent, data were collected during a two hour interview (in English or Spanish), usually in the respondent's home. All protocols and procedures were approved by the New England Research Institutes' Institutional Review Board.

Race/ethnicity was determined by self report following Office of Management and Budget requirements[12]. Socioeconomic status was determined as a combination of standardized levels of education and income in the Northeast[13] (with weights of .7 for education and .4 for income), and categorized such that ¼ of the sample was lower, ½ middle, and ¼ upper. Other covariates considered include the risk factors identified by the American Diabetes Association (gender, age (by decade), body mass index (BMI), exercise habits, history of hypertension or gestational diabetes, and family history of diabetes)[1]. Interviewers directly measured the respondent's height and weight, from which BMI could be calculated (kg/m^2) and was categorized as <25, 25–30, 30+ kg/m^2. Information on co-morbidities was obtained by self report: Has a health care provider told you that you have insulin-dependent or juvenile-onset diabetes, non-insulin-dependent or adult-onset diabetes, high blood pressure, or gestational diabetes (if female)? Physical activity was measured by the Physical Activity for the Elderly (PASE) scale[14], and categorized into low, moderate, or high. In addition to socioeconomic status, we also considered two additional socioeconomic variables: 1) health insurance status (some private insurance, public insurance only (Medicaid or Medicare), or none; and 2) trouble paying for basics (Are you having trouble paying for transportation, housing, health or medical care, medications, or food? (yes or no)).

Chi-square tests were used to test the assumption of equal distributions by race/ethnicity. A multivariate logistic regression was used to determine the joint effect of covariates on the probability of having diabetes. Multiple imputation was used to impute plausible values for missing observations using SAS 9.1.3 (SAS Institute, Cary, NC). We are missing less than 1 percent of the data on most variables with the exception of income in which we are missing 3 percent for Whites, 4 percent for Blacks and 11 percent for Hispanics. Twenty-five multiple imputations were done by gender and race/ethnicity. Observations were weighted inversely to their probability of selection and weights were post-stratified to the Boston census population in 2000. Analyses were conducted in SUDAAN 9.0.1 (Research Triangle Institute, Research Triangle Park, NC).

Results

The overall prevalence of diabetes was 9.5 percent. As expected, the prevalence of diabetes (and many of its associated risk factors) differed significantly by race/ethnicity ($p<.0001$) (Table 1). However, the prevalence of diabetes (and many of its associated risk factors) also varied by socioeconomic status (SES) within a race/ethnic categorization (Table 2) with the exception of family history of diabetes for Blacks and Hispanics. There was no significant association of the prevalence of diabetes by race/ethnicity within a socioeconomic level ($p=.22$ for lower SES, $p=.72$ for middle SES, $p=.24$ for upper SES).

In a logistic regression model (with the dependent variable diagnosed diabetes) after adjusting for gender and age, Blacks (odds ratio=2.04 with 95% confidence interval 1.42–2.94) and Hispanics (odds ratio=2.35 with 95% confidence interval 1.60–3.44) had higher odds of diabetes compared to Whites (Figure 1). When socioeconomic status is added to the model these odds dropped for Blacks (odds ratio=1.55 with 95% confidence interval 1.07, 2.25) and Hispanics (odds ratio=1.57 with 95% confidence interval 1.06, 2.32). In this same model the odds for lower SES compared to upper SES are 3.25 (with 95% confidence interval 1.95, 5.42) and the odds for middle SES compared to upper SES are 2.04 (with 95% confidence interval 1.16, 3.59). After adjusting for all covariates given in Table 1, the odds ratios decreased for both Blacks (odds ratio=1.04 with 95% confidence interval 0.70–1.54) and Hispanics (odds ratio=1.34 with 95% confidence interval 0.89–2.08) and were no longer statistically significant.

Using a generalized R^2 statistic[15], entering the potentially modifiable risk factors first and in order of importance by size of the additional variation explained (body mass index, SES (including trouble paying for basics), physical activity, and health insurance status) and then the non-modifiable risk factors (age, family history of diabetes, history of hypertension, history of gestational diabetes, gender, race/ethnicity), we found that they together explain only 14.1 percent of the variation in the prevalence of diabetes (Figure 2). Of that, 38.5 percent is explained by the potentially modifiable risk factors and 61.5 percent is explained by the non-modifiable risk factors. As the least important non-modifiable risk factor entered into the model, race/ethnicity explained only .4 percent of the explainable variation. Health insurance status is associated with the prevalence of diabetes only as it relates to SES (odds of diabetes for public insurance only compared to some type of private insurance 1.36 ($p=.06$) and odds of diabetes for no health insurance compared to some type of private insurance 0.97 ($p=.88$).

Discussion

We have shown that socioeconomic status (a potentially modifiable risk factor) is more important in determining who has diabetes than the non-modifiable risk factor of race/ethnicity. This result is consistent with other reports showing higher prevalence of diabetes in depressed areas, or in people of lower socioeconomic status[4–10].

While socioeconomic status is not a biological factor, it is considered a marker for other established risk factors for diabetes such as body mass index, physical activity, hypertension, and gestational diabetes. Thus it allows identification of target groups for primary and secondary interventions.

Our results have important implications for public health policy. They suggest that interventions to prevent the onset of diabetes should be focused more on those of lower socioeconomic status (those who are poorer and who have limited access to effective medical care) than on race/ethnic minorities per se. The large proportion (85.9%) of unexplained variation indicates that other factors associated with the prevalence of diabetes remain to be identified.

Our study has both strengths and limitations. Our major strengths: 1) It employs a random community based population (with sufficient diversity in SES and race/ethnicity) and results appear to be generalizable to the US population[11]; 2) BACH contains valuable information on a broad range of risk factors associated with diabetes. With respect to limitations: 1) While some variables are directly measured (height and weight), others rely on self-report. However, self report of co-morbidities are well correlated with medical records[16–18]. 2) It should be noted that individual contributions to an R^2 statistic are highly dependent upon the order in which variables are entered into the model. We felt that entering potentially modifiable risk factors first and entering variables in their order of importance was the most appropriate approach. 3) Our study does not include a number of other minority groups (e.g. Asian Americans). Unfortunately, the city of Boston does not have people of other race/ethnic groups in sufficient numbers to include them given our survey sampling design. 4) While a simple combination of education and income may not fully capture what is signified by the concept of SES, it does appear to account for much of the variation in the prevalence of diabetes. 5) This is a cross-sectional study and reported results are associations. However, as BACH is transitioning to a longitudinal study (follow-up is ongoing), we will be able to determine the incidence of newly diagnosed cases by race/ethnicity and SES.

Conclusions

We have shown that socioeconomic status is more important than race/ethnic categorizations as an indicator of who has been told that they have diabetes. There is no suggestion that our findings are entirely novel, or differ from previous work. Our results are consistent with and reinforce findings from other important studies[4–10]. Given the consistency of these results, it is of concern that research and interventions developed by governments aspiring to reduce worrisome disparities in diabetes continue to focus disproportionately on race/ethnicity categorizations, rather than the apparently more important socioeconomic status. We do not deny that there may be some genetic components in the prevalence of diabetes[19, 20] (as family history is the second most important non-modifiable variable), but our concern is that too much attention is being focused on race/ethnicity rather than on socioeconomic circumstances. Race/ethnicity can not be changed, but socioeconomic circumstances are potentially amenable to change.

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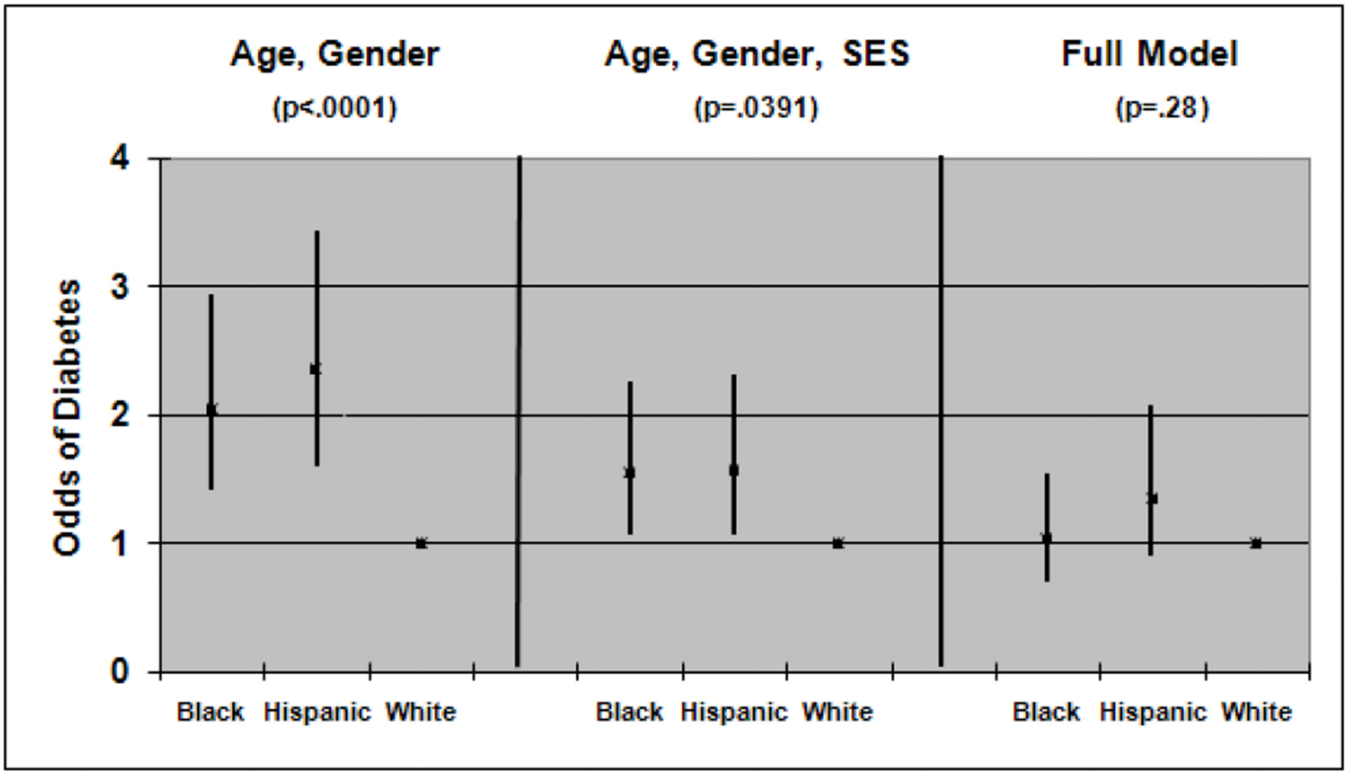

Figure 1.
Odds ratios for the prevalence of diabetes (with 95% confidence intervals) for three models ((1) age, gender, race/ethnicity; (2) age, gender, socioeconomic status (SES), race/ethnicity), and (3) age, gender, socioeconomic status, trouble paying for basics, health insurance status, hypertension, gestational diabetes, and family history of diabetes, race/ethnicity). The p value (for race/ethnicity) is from a Wald F test with 2 degrees of freedom in the numerator.

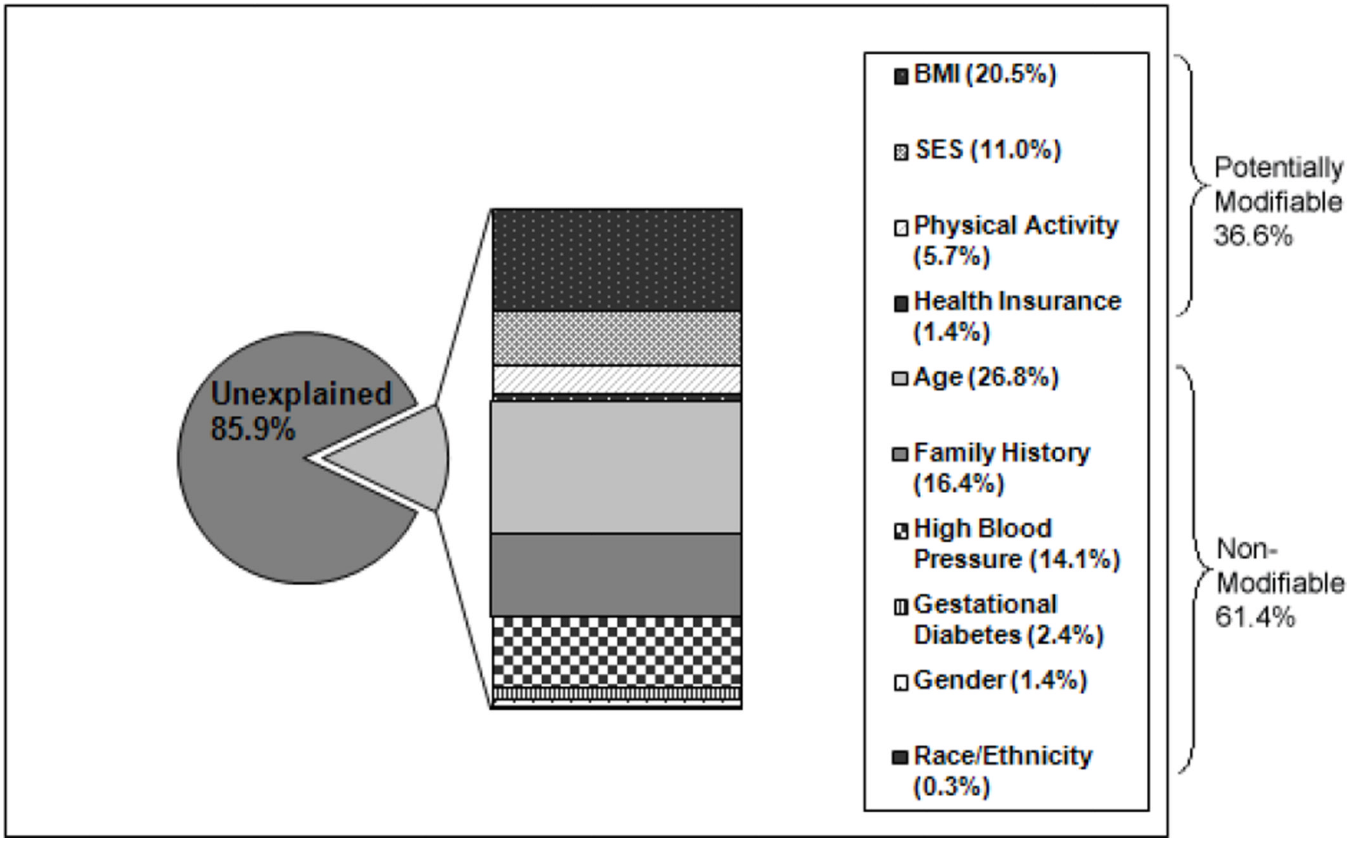

Figure 2.
Proportion of variation in the prevalence of diabetes by modifiable (BMI, SES, physical activity, health insurance status) and non-modifiable (age, family history of diabetes, history of high blood pressure, history of gestational diabetes, gender, race/ethnicity) risk factors.

Table 1

Variation in the prevalence of diabetes and its risk factors by race/ethnicity (p value for chi-square test that the distribution is the same by race/ethnicity)

	Race/Ethnicity			
	Black (N=1765)	**Hispanic (N=1877)**	**White (N=1859)**	**p value**
Diabetes (%)	12.8	11.6	7.5	<.0001
High blood pressure (%)	36.3	24.8	23.6	<.0001
Gestational diabetes[1] (%)	4.1	5.9	3.9	.32
Body Mass Index (%)				<.0001
<25 kg/m^2	22.4	25.3	34.8	
25–30 kg/m^2	30.5	37.0	35.6	
30+ kg/m^2	47.1	37.7	29.6	
Physical Activity (%)				.16
low	26.1	30.0	27.3	
moderate	49.8	51.6	50.8	
high	24.1	18.5	21.8	
Family history of diabetes (%)	47.6	39.6	29.3	<.0001
Socioeconomic status (%)				<.0001
lower	41.2	61.1	14.0	
middle	49.4	30.6	49.7	
upper	9.4	8.3	36.3	
Trouble paying for basics (%)	37.4	30.6	18.6	<.0001
Health insurance status (%)				<.0001
private	51.1	35.7	64.1	
public only	36.8	39.6	24.0	
none	12.0	24.7	11.8	

Table 2

Variation in the Prevalence of Diabetes and Risk Factors for Diabetes by Race/Ethnicity and Socioeconomic Status (p value is from chi-square test of whether the distribution is the same across socioeconomic status by race/ethnicity).

Race/Ethnicity	**Black**				**Hispanic**				**White**			
Socioeconomic Status	**lower**	**middle**	**upper**	**p value**	**lower**	**middle**	**upper**	**p value**	**lower**	**middle**	**upper**	**p value**
Sample size (N)	**841**	**797**	**129**		**1312**	**495**	**70**		**413**	**861**	**585**	
Diabetes (%)	18.2	9.4	6.9	.0001	14.0	7.5	8.5	.0075	15.1	8.4	3.3	<.0001
High blood pressure (%)	42.4	33.1	26.7	.0040	27.2	23.0	14.3	.16	41.2	22.4	18.5	<.0001
Gestational diabetes[1] (%)	5.4	3.5	0.0	.0011	5.0	8.6	0.0	.0140	6.2	5.3	0.1	.0008
Body Mass Index (%)				.051				.056				<.0001
<25 kg/m^2	22.4	22.2	23.7		20.0	29.4	49.1		19.6	33.0	43.0	
25–30 kg/m^2	25.4	33.9	34.5		39.5	36.3	20.8		31.7	35.6	37.0	
30+ kg/m^2	52.1	43.9	41.8		40.4	34.3	30.1		48.6	31.4	20.0	
Physical Activity (%)				<.0001				<.0001				<.0001
low	38.4	17.2	18.6		37.5	17.4	20.8		49.2	29.0	16.6	
moderate	47.8	52.8	43.5		50.5	53.9	50.6		44.5	50.4	53.8	
high	13.8	30.0	37.9		12.0	28.6	28.6		6.3	20.5	29.6	
Family history of diabetes (%)	49.3	46.2	47.8	.75	39.5	40.4	37.7	.95	42.6	27.7	26.4	.0008
Trouble paying for basics (%)	49.9	31.9	12.1	<.0001	36.0	26.0	7.4	.0001	38.6	21.5	7.0	<.0001
Health insurance status (%)				<.0001				<.0001				<.0001
private	23.4	66.0	94.0		18.9	54.3	91.5		38.8	74.2	94.2	
public only	61.8	22.4	3.2		51.9	24.7	3.4		48.1	13.6	3.0	
none	14.8	11.6	2.8		29.2	21.0	5.1		13.1	12.2	2.8	

[1] Among women who have been pregnant