Overweight and Diabetes Prevalence Among US Immigrants

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OBJECTIVES. We estimated the prevalence of overweight and diabetes among US immigrants by region of birth.

METHODS. We analyzed data on 34 456 US immigrant adults from the National Health Interview Survey, pooling years 1997 to 2005. We estimated age- and gender-adjusted and multivariable-adjusted overweight and diabetes prevalence by region of birth using logistic regression.

RESULTS. Both men (odds ratio [OR]=3.3; 95% confidence interval [CI]=1.9, 5.8) and women (OR=4.2; 95% CI=2.3, 7.7) from the Indian subcontinent were more likely than were European migrants to have diabetes without corresponding increased risk of being overweight. Men and women from Mexico, Central America, or the Caribbean were more likely to be overweight (men: OR=1.5; 95% CI=1.3, 1.7; women: OR=2.0; 95% CI=1.7, 2.2) and to have diabetes (men: OR=2.0; 95% CI=1.4, 2.9; women: OR=2.0; 95% CI=1.4, 2.8) than were European migrants.

CONCLUSIONS. Considerable heterogeneity in both prevalence of overweight and diabetes by region of birth highlights the importance of making this distinction among US immigrants to better identify subgroups with higher risks of these conditions. (Am J Public Health. 2010;100:661–668. doi:10.2105/AJPH.2008.149492)

Coincidental with the increases in prevalence of overweight—defined as a body mass index (BMI; weight in kilograms divided by height in meters squared) of 25 kg/m^2 or more—and associated diseases such as diabetes, the US population has grown and diversified, in part due to the immigrant population. In 2006, the US immigrant population accounted for over 12% of the total population, the largest proportion in the United States since the early 1900s, reflecting the large waves of immigration to the United States over the past 2 decades. By 2050, it is projected that nearly 1 in 5 US residents will be an immigrant, compared with 1 in 8 in 2005. At the same time, the numbers of people with diabetes in the United States are projected to rise to 48 million by 2050, with changing US demography cited as a major reason for this increase. These projections, however, do not specifically estimate the contribution of immigrants to current or future prevalence estimates, because there is a dearth of national estimates of overweight and diabetes for this growing and diverse subpopulation.

Generally, immigrants have better health profiles compared with those born in the United States. However, it has been shown that immigrants who arrive to the United States at younger ages are more likely to be overweight or obese with increasing length of residence than are immigrants who arrive to the United States at later ages. Grouping immigrants together into 1 or a few large categories may mask important heterogeneity with regard to specific health conditions, especially overweight and diabetes, which are driven by contemporary urban lifestyles in addition to genetic susceptibility.

We used nationally representative data to estimate and compare overweight and diabetes prevalence across 9 regions of birth, covering 100 countries and representing 16 million US citizens at birth adult respondents were analyzed from the nationally representative National Health Interview Survey (NHIS); we pooled years 1997 to 2005. The NHIS is a continuous, in-person health survey of civilian, noninstitutionalized adults 18 years and older administered by the US Bureau of the Census for the National Center for Health Statistics (NCHS). The survey uses a multistage probability design with an oversampling of Hispanics and Blacks and includes approximately 43 000 households and about 106 000 persons annually.

Respondents provide self-reported information about basic measures of health status, utilization of health services, and social and demographic characteristics. In addition, 1 randomly selected adult per household is asked to complete the Sample Adult Module, which elicits more-detailed information on health care services, behavior, and health status, including height, weight, and diabetes.

Data were pooled to improve reliability of statistical estimates. To pool data, we first merged the sample adult file with the person-level file for each year included. Then, using NCHS guidelines for combining NHIS data with the same sample design, years 1997 to 2005 were concatenated into 1 data set. For this analysis, 2001 was the midpoint of the time interval included in the pooled data, and thus the estimates represent this point in time.

Sample weights provided by NCHS account for the complex sampling design of the NHIS and for unequal probabilities of selection resulting from sample design, nonresponse, and planned oversampling of certain subgroups. The survey is administered in Spanish or English and does not allow proxy respondents for Sample Adult Module questions. Family members may translate for a non–English- or non–Spanish-speaking respondent who is present in the home.

DEFINITION OF IMMIGRANT AND REGION OF BIRTH

Foreign birth was considered a proxy for immigrant status. All naturalized citizens, legal permanent residents, undocumented immigrants, and persons on long-term temporary visas (such as students or guest workers) also fell into this category. Region of birth data are provided by the NHIS from 2002 to 2005 based on the question, “Where were you born?” Prior to 2002, this information is not
publicly available, and thus, use of this variable was requested through the NCHS Research Data Center. The 9 mutually exclusive regions of birth categories provided by NCHS were Mexico, Central America, Caribbean Islands (hereafter Mexico); South America; Europe; Russia (and former Soviet Union areas); Africa; the Middle East; Indian subcontinent; central Asia; and Southeast Asia. Details on specific countries included in each of the regions has been published elsewhere. Europe was considered the referent category for comparative analyses.

Outcomes of Interest
We focused on 2 outcomes: overweight and diabetes. Overweight and obesity were combined into 1 category and referred to as overweight and defined as BMI at or greater than 25 kg/m² among adults. The NHS calculates BMI from self-reported information on height (“How tall are you without shoes?”) and weight (“How much do you weigh without shoes?”), measures previously established as largely valid when used in combination with adjustments for age. To estimate prevalence of diabetes by BMI, we used categories based on the National Institutes of Health cut-offs: normal weight (18.5–24.9 kg/m²), overweight (25.0–29.9 kg/m²), and obese (≥30 kg/m²). We combined overweight and obese categories into a single category for use as a dichotomous outcome in all logistic regression analyses examining the relationship with region of birth. Since 1997, all sampled adults have been asked, “[Other than during pregnancy], have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?” Responses to this question were coded as a dichotomous outcome (yes versus no).

Covariates of Interest
Sociodemographic characteristics included age (18–24, 25–44, 45–64, and 65–74 years), gender, and poverty income ratio (PIR; calculated as the ratio of the midpoint family income divided by the poverty level in dollars as defined by the Census Bureau for the corresponding survey year; <1.00 [below federal poverty line], 1.00–1.99, 2.00–2.99, 3.00–4.99, and ≥5.00). PIR was calculated and recoded for public data use, so there was no direct question relating to this variable. We did not include education level because the effects of number of years of school may not be equivalent across the regions represented. Lifestyle characteristics included smoking status (current, former, never), alcohol drinking status (lifetime abstainer, former, current), and physical activity level (high, moderate, sedentary). Because acculturation to US norms over time may lead to an increasing prevalence of obesity and obesity-related morbidity among immigrants, duration of residence in the United States (respondents were asked, “About how long have you been in the US [years?]”) was also included in the analysis (<5, 5–9.9, 10–14.9, and ≥15 years). Other variables considered but not included in the analyses because of a lack of association were marital status, region of residence in the United States, metropolitan statistical area size, and insurance status. Persons with data missing on immigrant status, region of birth, age, gender, or BMI were excluded (5% of the sample).

Statistical Analysis
Sampling weights were adjusted to account for the pooled data. To assess differences in sample characteristics by region of birth, we used the χ² test for categorical variables and ANOVA for continuous variables. Two-tailed P values of .05 or less were considered significant for all analyses.

We estimated age- and gender-adjusted overweight prevalence by region of birth and BMI categories. We then performed multivariable logistic regression analyses and computed predictive marginals (with standard errors) to estimate the multivariable-adjusted prevalence of overweight and diabetes by region of birth. Predictive marginals are a type of direct standardization in which the predicted values from the logistic regression models are averaged over the covariate distribution of the population. Models had either overweight or diabetes as the outcome and region of birth as the primary exposure of interest. Significance of the interaction term of region of birth with gender was assessed for both outcomes to determine if the associations between region of birth and the outcomes of interest varied by gender. Standard errors were calculated with SAS-callable SUDAAN software version 9.0 (Research Triangle Institute, Research Triangle Park, NC).

RESULTS
The majority of migrants were born in Mexico (48%), followed in descending order by migrants from other regions in Asia (approximately 20%), Europe, South America, Africa, the Middle East, and Russia (Table 1). The mean age ranged from 38.0 years (±0.5; Africa) to 45.8 years (±0.3; Europe). Proportion with PIR below the federal poverty line ranged from 5.4% (±0.4%; Europe) to 18.8% (±0.5%; Mexico). The majority of migrants, regardless of region, had resided in the United States for at least 15 years at the time of the interview.

Overweight and Diabetes Prevalence by Region of Birth
The number of overweight migrants represented over 8 million individuals. Age- and gender-adjusted overweight prevalence varied by region of birth and ranged from 24.4% (±1.3%) among central Asian migrants to 64.4% (±0.4%) among Mexican migrants (Figure 1), which was significantly higher than among other regions (P<.05). Overweight prevalence among respondents from each of the 3 Asian regions was lower than among all other regions (P<.05); within this subgroup, migrants from the Indian subcontinent had the highest prevalence (40.1% ±1.9%; P<.05), followed by those from Southeast Asia (31.9% ±1.2%) and then those from central Asia (24.4% ±1.3%). The 1749 immigrant respondents who self-reported having diabetes represent approximately 1 million individuals. Age- and gender-adjusted diabetes prevalence ranged from 3.1% (±0.3%) among European migrants to 10.0% (±1.2%) among migrants from the Indian subcontinent. Migrants from the Indian subcontinent had the highest diabetes prevalence, significantly higher than migrants from any other region (P<.05), except Mexico and Africa.

Diabetes Prevalence by Body Mass Index and Region of Birth
Among normal-weight immigrants, age- and gender-adjusted diabetes prevalence ranged from 1.2% (±0.7%; Russia) to 7.9% (±1.8%;
Multivariable Adjusted Overweight Prevalence by Region of Birth

Adjusted for age, PIR, and duration of residence, overweight prevalence among both immigrant men and women was the lowest among men from Asia and the Indian subcontinent. In all regions, men had significantly higher overweight prevalence than did women except among migrants from Africa or the Indian subcontinent, where there were no differences by gender. Compared with European migrant men, male migrants from Mexico and South America were more likely to be overweight, whereas male migrants from Africa and anywhere in Asia were less likely to be overweight. Among women, Mexican and African migrant women were more likely to be overweight compared with European migrant women. Women from Southeast Asia were less likely to be overweight compared with European migrant women.

Multivariable Adjusted Diabetes Prevalence by Region of Birth

Adjusted for age, PIR, and duration of residence, diabetes prevalence among immigrant men ranged from 1.7% (±0.9%) among Middle Eastern migrants to 8.2% (±1.6%) among Indian migrants (Table 3). Diabetes prevalence among immigrant women ranged from 2.3% (±0.5%) among migrants from central Asia to 11.6% (±2.3%) among migrants from the Indian subcontinent.

Among men, migrants from Mexico were twice as likely to have diabetes compared with European migrant men, whereas migrants from Africa and the Indian subcontinent were over 3 times as likely to have diabetes (Table 3). Migrants from Southeast Asia were also more likely to have diabetes. Among women, both migrants from Mexico and the Indian subcontinent were more likely to have diabetes compared with European migrant women.

Compared with European migrants, lower odds of overweight and higher odds of diabetes was the general pattern observed among migrant Asian men and women, regardless of region, as exemplified among migrants from the Indian subcontinent. In multivariable models, the inclusion of BMI resulted in little change in diabetes prevalence or predicted probability, except for among participants from Asian regions. The inclusion of BMI increased diabetes prevalence estimates around 1% for each Asian region for both men and women.
and increased odds ratios by over 20% among men, and between 12% and 40% among women (Table 3).

DISCUSSION

Using data from 1997 to 2005 of the NHIS, we report considerable heterogeneity among US immigrants in both the prevalence of overweight and diabetes by region of birth, with overweight prevalence ranging from 24.4% (central Asia) to 64.4% (Mexico, Central America, Caribbean Islands) and affecting over half the represented sample; and diabetes prevalence from 3.1% (Europe) to 10.0% (Indian subcontinent), affecting over 6% of the represented sample. Interestingly, differences in overweight prevalence by region did not necessarily correspond with differences in diabetes prevalence. Specifically, overweight prevalence was highest among both men and women from the Indian subcontinent but lowest among men from the Middle East and among women from central Asia.

Our results indicate that overweight prevalence is lower among all migrants from Asia compared with those from Europe. Of note, adjusting for BMI inflated diabetes prevalence among Asian migrants but deflated it among migrants from all other regions. This suggests that the effect of BMI on diabetes varies by migrant subpopulation and may have an effect at lower thresholds among the Asian population compared with those from other regions.

Our results indicate a higher diabetes prevalence and a lower overweight prevalence among migrants from the Indian subcontinent compared with European migrants. Other US studies have shown that Asians (without a separate distinction for immigrant status) have a lower prevalence of overweight compared with other racial/ethnic groups. Studies specifically comparing immigrant Asians to the native US born have found either a higher diabetes prevalence or variable diabetes prevalence. Similar results for overweight and diabetes have been found in studies among migrants from the Indian subcontinent in the United Kingdom. It is not clear why, in our study, migrants from the Indian subcontinent had the highest diabetes prevalence among all immigrants, but neither age nor BMI, 2 of the most influential factors on diabetes, explain the high diabetes prevalence observed in this population. Diabetes prevalence within urban India, for example, has been reported to be as high as 15%, indicating diabetes is an issue for people from the Indian subcontinent in general, not only migrants. Reasons hypothesized for this higher prevalence of diabetes among those from the Indian subcontinent include a genetic predisposition that coincides with weight gain and insulin resistance, along with a lower BMI threshold, a greater prevalence of high visceral adiposity, and lower levels of adiponectin.

Immigrants from Mexico were the only subgroup more likely to have both higher diabetes and overweight prevalence compared with European migrants. Previous research has shown that Hispanic individuals have higher diabetes and overweight prevalence when compared with non-Hispanic Blacks, Whites, or Asian Americans. However, our results indicate that migrants from South America, Caribbean Islands)

Note. Overweight was defined as a body mass index (weight in kilograms divided by height in meters squared) of 25 kg/m² or more. Self-reported diabetes was assessed from the question “[Other than during pregnancy], have you ever been told by a doctor or health professional that you have diabetes or sugar diabetes?” Estimates are age- and gender-adjusted. Error bars represent standard errors.

FIGURE 1—Prevalence, by region of birth, of (a) overweight and (b) diabetes: National Health Interview Survey, 1997–2005.
America, a subgroup that would typically be classified as Hispanic, have lower diabetes and overweight prevalence than do migrants from Mexico, Central America, and the Caribbean Islands. Not only does this further support the notion that grouping together individuals by region of birth can mask differences in disease prevalence, but also the notion that, from a clinical perspective, classifying a patient as Hispanic may not be as informative as obtaining nativity information.

Blacks (without a separate distinction for immigrant status) are commonly noted as having higher rates of diabetes compared with Whites. Our results provide evidence of this among African migrant men, but not women. The literature also indicates that the higher diabetes prevalence among Blacks can be explained by increased insulin resistance at adiposity levels similar to Whites. Our data are in agreement with previous research that shows Black women have twice the obesity prevalence of White women.

Differences by gender indicated that immigrant men had a consistently higher overweight prevalence compared with women from the same region; however, these differences did not translate into differences in diabetes prevalence between genders. When comparing across regions, associations were variable. Potential gender differences could be explained by weight-gain retention or gestational diabetes among women of childbearing age. Differences by gender in physical activity or dietary intake could also play a part in the differences between genders.

Focusing on region of birth as the exposure variable, rather than on race/ethnicity, is a unique aspect of our analysis. Race/ethnicity was not included in the analyses because we felt this would inappropriately dilute the associations between region of birth and the outcomes of interest. Race/ethnicity as reported in the NHIS is primarily used as a sociocultural construct rather than as a biological variable, whereas using region of birth may be more specific to genetics.
TABLE 3—Multivariable Adjusted Prevalences and Odds Ratios (ORs) of Diabetes Without and With Adjustment for BMI Among US Immigrant Men and Women: National Health Interview Survey, 1997–2005

<table>
<thead>
<tr>
<th>Region of Birth</th>
<th>% (95% CI)</th>
<th>OR (95% CI)</th>
<th>% (95% CI)</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model 1a</td>
<td>Model 2b</td>
<td>Model 1a</td>
<td>Model 2b</td>
</tr>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td>Europe (Ref)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mexico, Central America,</td>
<td>2.65 (1.94,3.75)</td>
<td>1.00</td>
<td>2.79 (1.91,3.67)</td>
<td>1.00</td>
</tr>
<tr>
<td>Caribbean</td>
<td>5.29 (4.64,5.94)</td>
<td>1.98 (1.37,2.67)</td>
<td>5.07 (4.44,5.70)</td>
<td>1.95 (1.34,2.84)</td>
</tr>
<tr>
<td>South America</td>
<td>3.19 (2.00,4.42)</td>
<td>1.13 (0.66,1.93)</td>
<td>3.09 (1.89,4.29)</td>
<td>1.12 (0.65,1.92)</td>
</tr>
<tr>
<td>Russia</td>
<td>5.06 (4.07,6.45)</td>
<td>1.89 (0.87,5.28)</td>
<td>4.78 (0.54,9.01)</td>
<td>1.82 (0.63,5.30)</td>
</tr>
<tr>
<td>Africa</td>
<td>7.76 (4.39,11.13)</td>
<td>3.11 (1.65,5.89)</td>
<td>7.62 (4.37,10.87)</td>
<td>3.16 (1.67,6.00)</td>
</tr>
<tr>
<td>Middle East</td>
<td>1.68 (0.08,3.44)</td>
<td>0.57 (0.20,1.65)</td>
<td>1.69 (0.01,3.40)</td>
<td>0.59 (0.21,1.66)</td>
</tr>
<tr>
<td>Indian subcontinent</td>
<td>8.19 (5.15,11.23)</td>
<td>3.32 (1.90,5.82)</td>
<td>9.32 (6.00,12.65)</td>
<td>4.07 (2.31,7.18)</td>
</tr>
<tr>
<td>Central Asia</td>
<td>3.50 (1.70,5.30)</td>
<td>1.25 (0.67,2.34)</td>
<td>4.13 (2.01,6.25)</td>
<td>1.54 (0.82,2.91)</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>5.06 (3.22,6.90)</td>
<td>1.89 (1.12,3.17)</td>
<td>5.84 (3.76,7.92)</td>
<td>2.30 (1.36,3.89)</td>
</tr>
<tr>
<td>Europe (Ref)</td>
<td>3.42 (2.40,4.44)</td>
<td>1.00</td>
<td>3.51 (2.49,4.53)</td>
<td>1.00</td>
</tr>
<tr>
<td>Mexico, Central America,</td>
<td>6.20 (5.48,6.93)</td>
<td>1.94 (1.36,2.76)</td>
<td>5.64 (4.97,6.31)</td>
<td>1.72 (1.21,2.45)</td>
</tr>
<tr>
<td>Caribbean</td>
<td>3.04 (1.92,4.16)</td>
<td>0.88 (0.53,1.46)</td>
<td>3.11 (1.97,4.25)</td>
<td>0.88 (0.53,1.45)</td>
</tr>
<tr>
<td>Russia</td>
<td>4.25 (1.07,7.43)</td>
<td>1.27 (0.51,3.15)</td>
<td>4.40 (1.13,7.67)</td>
<td>1.29 (0.50,3.32)</td>
</tr>
<tr>
<td>Africa</td>
<td>4.57 (2.36,6.78)</td>
<td>1.37 (0.73,2.57)</td>
<td>4.83 (2.17,6.59)</td>
<td>1.29 (0.67,2.47)</td>
</tr>
<tr>
<td>Middle East</td>
<td>2.54 (0.20,5.28)</td>
<td>0.73 (0.22,2.36)</td>
<td>2.61 (0.17,5.39)</td>
<td>0.72 (0.22,2.34)</td>
</tr>
<tr>
<td>Indian subcontinent</td>
<td>11.57 (7.06,16.08)</td>
<td>4.16 (2.26,7.67)</td>
<td>12.51 (7.88,17.14)</td>
<td>4.70 (2.55,8.68)</td>
</tr>
<tr>
<td>Central Asia</td>
<td>2.26 (1.30,3.22)</td>
<td>0.64 (0.37,1.11)</td>
<td>3.20 (1.87,4.53)</td>
<td>0.90 (0.52,1.56)</td>
</tr>
<tr>
<td>Southeast Asia</td>
<td>4.00 (2.39,5.61)</td>
<td>1.19 (0.68,2.06)</td>
<td>4.96 (2.94,6.98)</td>
<td>1.48 (0.58,2.03)</td>
</tr>
</tbody>
</table>

Note. BMI = body mass index; CI = confidence interval; OR = odds ratio.

*Adjusted for age, poverty income ratio, and duration of residence.

†Adjusted for age, poverty income ratio, duration of residence, and body mass index.

‡Estimates have a relative standard error of greater than 30% and should be used with caution because they do not meet the standard of reliability or precision.

between birthplace and obesity remained even after adjustment for measures of acculturation, suggesting that region of birth represents other phenomena related to the etiology of obesity beyond environmental processes.

Strengths and Limitations

Our study had 3 major strengths: the use of nationally representative data, large sample size, and consistency of measures across all years. Other studies using NHIS data were limited by sample size and unable to disaggregate data by the 9 categories of region of birth represented in our study. It is important to note, however, that pooling almost a decade of NHIS data resulted in less than 2000 immigrants self-reporting diabetes, and we were still unable to disaggregate the countries represented in region of birth any further than the 9 categories in the analysis. Nevertheless, pooling NHIS data is a common practice, and estimates are considered reliable when proper adjustments to sampling weights are made. Another strength of this study is the comparison of migrants to each other. Comparisons among migrants potentially highlight differences related to the migration process, a common experience among migrants that may influence their health. The main limitation of our study is the use of self-reported data. The accuracy of self-reporting for diabetes is reasonably high in population surveys. Undiagnosed diabetes cannot be assessed using the NHIS, and the percentage of undiagnosed diabetes in the migrant population is unknown. As a result, our study may have underestimated the total diabetes prevalence in this population. Regarding self-reported height and weight, a previous study analyzed data from adults in the National Health and Nutrition Examination Survey (NHANES) III and found that the average immigrant woman underreported her weight less than did the average native US woman. On the other hand, average native and immigrant men both underreported their actual weight equally. Although it is a good epidemiological tool in large surveys, BMI is most likely not the best measure of adiposity and does not provide information on the location of adiposity (visceral versus subcutaneous fat), which has implications for diabetes risk and could explain the discordance between overweight and diabetes in our study. Adiposity measures are not available in the NHIS.

The NHIS does not differentiate between type 1 and type 2 diabetes; however, we can assume that 90% to 95% of individuals who self-reported having diabetes had type 2 diabetes. NHIS data also does not differentiate between types of migrants, and thus, naturalized citizens, legal permanent residents, illegal immigrants, and nonimmigrants (students, visitors, guest workers, etc.) are all included in the same category. Although it would be interesting to examine differences between types of migrants and characteristics that distinguish these groups, and consequently their health, this was not the focus of our study.

Finally, we did not have information on dietary habits, activity, or family history. However, the NHIS is the only current and continuous US nationally representative survey that includes information on both nativity and health in the level of detail presented here. Future studies should explore potential lifestyle and genetic contributors to morbidity among immigrants.

Conclusions

There are an estimated 8 million overweight people and 1 million people with diabetes within the diverse immigrant population in the United States. The United States accepts more legal immigrants per year than any other nation in the world. The considerable heterogeneity by region of birth in overweight and diabetes risk among US immigrants and the lack of correspondence between overweight and diabetes risks across immigrants point to the complex epidemiology of these conditions. Further investigations aimed at disentangling this
complexity may provide greater clues to the roles of genes and environment on overweight and diabetes etiology.

Given the growing numbers and diversity of immigrants in the United States, greater attention to prevention research in this subgroup is urgently needed. National data systems should consider oversampling immigrants to get more-accurate prevalence estimates for chronic diseases that will aid in informing prevention efforts specific to this subgroup. Monitoring the health of this growing segment of the US population is important because the health of immigrants impacts national health outcomes. Inclusion of immigrants as a subgroup in national documents, such as Healthy People 2020, would aid monitoring efforts.

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This article was accepted December 14, 2008.

Contributors
R. Oza-Frank completed the analyses and led the writing of the article. K. M. Venkat Narayan supervised analyses and assisted in the drafting of the article. Both authors helped to originate ideas, interpret findings, and review drafts of the article.

Acknowledgments
This study was supported by the Centers for Disease Control and Prevention (grant 1R03SH000008-01). These results were presented in part at the 68th Annual Scientific Sessions of the American Diabetes Association, June 6–10, 2008, San Francisco, CA.

Note. The contents of this article are solely the responsibility of the authors and do not necessarily represent the official views of Centers for Disease Control and Prevention.

Human Participant Protection
This study received exempt approval from the Emory University institutional review board.

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