

Diabetes Risk Perception Among Immigrant and Racial/Ethnic Minority Adults in the U.S.

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Abstract

Purpose: The purpose of the study was to examine associations of immigrant and racial/ethnic status with diabetes risk perception among a population-based sample of U.S. adults without diabetes. Racial/ethnic minorities are at increased risk of developing diabetes. Emerging research shows that immigrant (foreign-born) individuals are also at increased risk, but less is understood about risk perception in this group.

Methods: Respondents were 11,569 adults from NHANES 2011-2016 reporting no diabetes or prediabetes. Immigrant status was coded as foreign-born or U.S.-born and used NHANES racial/ethnic categories: White, Black, Mexican American, other Hispanic, Asian, and other/multi-racial. Immigrant status and variables comparing each minority group to Whites were simultaneously entered into models predicting risk perception (yes/no), adjusting for demographic and diabetes risk factors.

Results: Being foreign-born was associated with *decreased* odds of perceived risk, while being Mexican American, Asian, and other/multi-racial were associated with *increased* odds of perceived risk.

Discussion: Foreign-born adults are less likely to report perceived risk for diabetes than are U.S.-born adults. Lower diabetes risk perception among immigrants could result in poorer preventative behaviors and later diabetes detection.

Keywords: diabetes; risk perception; emigrants and immigrants; race/ethnicity; health disparities.

INTRODUCTION

Public health initiatives urge at-risk individuals to make lifestyle modifications to prevent type 2 diabetes [T2DM] ¹. To increase the potency of such efforts, understanding the role of risk perception is critical ². Risk perception refers to an individual's judgment of his or her own likelihood of a negative event. The health belief model ³ prioritizes risk perception in predicting the likelihood of action and acknowledges the modifying role of sociodemographic factors, such as race/ethnicity.

Although immigrant status has emerged as a social determinant of T2DM health ⁴⁻⁶, how immigrant status modifies diabetes risk perception remains unknown. This is a critical knowledge gap, as longitudinal evidence suggests immigrants are at greater risk for developing T2DM than their U.S.-born peers ⁵. As immigrants and their families contribute substantially to U.S. population growth ⁷, promoting preventative health behaviors in this growing population is key to improving overall U.S. health.

While U.S. immigrants are likely to be members of a racial/ethnic minority group, examining diabetes risk perception solely along racial/ethnic lines is insufficient. Several psychosocial and environmental factors may contribute to lower diabetes risk perception among immigrants. Psychosocial factors include familiarity with diabetes risk, which differs by country of origin, and cultural beliefs about the causes of diabetes, which may be stronger among foreign-born individuals compared to co-ethnic U.S.-born peers ⁸⁻¹⁰. Environmental factors include a lack of linguistically- and culturally-appropriate public health messaging, potentially contributing to decreased knowledge about diabetes risk factors ^{11,12}. Examining the unique influence of immigrant status on diabetes risk perception, over and above the influence of race/ethnicity, may facilitate more responsive public health programming.

No study has examined the association between immigrant status and diabetes risk perception using a population-based sample of adults. Accordingly, the objectives of the present study are to examine associations of (1) immigrant and (2) racial/ethnic status with diabetes risk perception among a population-based sample of U.S. adults without diabetes.

METHODS

Study Design and Sample

The institutional review board approved this study. Data was from the National Health and Nutrition Examination Survey (NHANES) 2011-2016 survey years. NHANES employs a cross-sectional, stratified, multistage probability design to capture a nationally representative sample of the civilian, non-institutionalized population. Survey design and procedures are available online (www.cdc.gov/nchs/nhanes.htm). Briefly, about 5,000 individuals were recruited each two-year cycle. Respondents were asked to complete a computer-assisted in-home interview assessing demographic and health-related factors. Approximately 1-2 weeks later, respondents were asked to attend a Mobile Examination Center (MEC) to undergo physical examinations, laboratory assessments, and additional interviews.

All data came from the in-home interviews, except for A1C values and weight and height measurements, which came from the MEC. From the total sample for the 2011-2016 survey years ($N=29,902$), all respondents aged 18 years or older ($n=17,969$) who reported having no diabetes/prediabetes diagnosis ($n=14,239$) were selected. Diabetes diagnosis was determined by asking, "Have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?" Respondents answering "No" were included in this sample, and those answering "Yes," "Borderline or Prediabetes," "Refused," "Don't Know," or did not answer were excluded. Respondents with no diabetes diagnosis were asked about prediabetes, "Have

you ever been told by a doctor or other health professional that you have any of the following: prediabetes, impaired fasting glucose, impaired glucose tolerance, borderline diabetes or that your blood sugar is higher than normal but not high enough to be called diabetes or sugar diabetes?” Respondents answering “No” were included in this sample. From the 4,239 respondents without self-reported diabetes/prediabetes, respondents with missing data on the outcome, diabetes risk perception ($n=182$) were excluded. Respondents with missing data on the predictors country of birth ($n=9$) and race/ethnicity ($n=0$) were then excluded. Finally, respondents with missing data on demographic factors ($n=7$) and diabetes risk-factor covariates, including clinical CVD ($n=913$), hypercholesterolemia ($n=57$), hypertension ($n=10$), smoking status ($n=15$), family history of diabetes ($n=223$), height/weight ($n=667$), and A1C ($n=587$) were excluded. Because this project focuses on the associations between two sociodemographic factors (immigrant status and race/ethnicity) and diabetes risk perception, over and above actual risk, it is important to include these factors as covariates in models predicting diabetes risk perception. The characteristics of the final sample of 11,569 respondents without self-reported diabetes/prediabetes are shown in Table 1.

Measures and Procedures

Immigrant Status. Respondents indicated country of birth by selecting: “Born in 50 U.S. States or Washington, D.C.,” “Other,” “Refused,” or “Don’t Know.” After excluding respondents who answered “Refused,” “Don’t Know,” or did not answer, a dichotomous immigrant status variable coded as U.S.-born (0=born in U.S. state or Washington, D.C.) or foreign-born (1=born outside of U.S. states or Washington, D.C., including U.S. territories) was computed.

Race/Ethnicity. Respondents indicated race/ethnicity by selecting: non-Hispanic White, non-Hispanic Black, Mexican American, other Hispanic, non-Hispanic Asian, or other race/multi-racial. Five dummy variables to represent race/ethnicity were coded, using the non-Hispanic White group as the referent.

Diabetes Risk Perception. Diabetes risk perception was assessed by asking, “Do you feel you could be at risk for diabetes or prediabetes?” Participants who answered “Refused,” “Don’t Know,” or did not answer were excluded.

Covariates. Demographic covariates were age (years), sex (0=male, 1=female), and four dummy variables for education (referent: college graduate or above). Respondents reported their highest education level: less than 9th grade, 9-11th grade with no diploma, high school diploma or GED, some college or associate degree, and college graduate or above. Diabetes risk factor covariates were: clinical CVD, hypercholesterolemia, hypertension, smoking status, family history of diabetes, body mass index (BMI; kg/m²), and A1C (%; a measure of blood glucose control over last 120 days)¹³. Respondents were coded as having clinical CVD (0=no, 1=yes) if they reported a history of coronary artery disease, angina, myocardial infarction, stroke, or congestive heart failure. Variables were computed to represent a history of hypertension (0=no, 1=yes), a history of hypercholesterolemia (0=no, 1=yes), two dummy variables for smoking status (never versus current smoker, never versus former smoker), and family history of diabetes (0=no, 1=yes). Variables for BMI and A1C were continuous.

Data Analysis

Analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC). *T*-tests and chi-square (X^2) tests examined differences between foreign-born and U.S.-born respondents, and one-way ANOVAs to examine differences between each racial/ethnic minority group and

Whites. Appropriate NHANES sampling design weighted variables were applied to all models to account for survey design. Applying sample weights allows each respondent to represent the proportion of the population s/he represents, thus providing estimates representative of the U.S. civilian non-institutionalized population (see www.cdc.gov/nchs/tutorials/nhanes/SurveyDesign/Weighting/intro.htm). Weights from the MEC subsample were used because BMI and A1C were available for this subsample only.

To determine whether immigrant status and race/ethnicity are uniquely associated with diabetes risk perception, two logistic regressions were completed. Immigrant status (foreign-born vs. U.S.-born) and race/ethnicity (five dummy variables with White as referent) were simultaneously into a model with the diabetes risk perception criterion variable (yes/no). Model 1 included demographic factors (age, sex, and four dummy variables for education) as covariates. Model 2 further adjusted for diabetes risk factors (clinical CVD, hypercholesterolemia, hypertension, smoking status, family history of diabetes, BMI, and A1C) to reduce their confounding effect on the associations of interest.

Nonetheless, differences in risk perception could potentially be attributed to differences in objective diabetes risk (i.e., those with higher objective risk are more likely to perceive a risk). To minimize this possibility, a supplemental Model 3 was completed by rerunning Model 2 in the subsample of respondents with clinically-indicated prediabetes (A1C 5.7%-6.4%). This subsample was selected because prediabetes represents a critical window for intervention efforts to prevent or delay the development of diabetes. Finally, the interaction between immigrant status and race/ethnicity was tested in a supplementary model using the entire sample. Specifically, five cross-product interaction terms (immigrant status by each of the five

race/ethnicity dummy variables) were entered into Model 2. In the presence of significant interactions, Model 2 was reanalyzed stratified by race/ethnicity.

RESULTS

Respondent Characteristics

In the sample of 11,569 adults without a diabetes/prediabetes diagnosis, approximately one-third (31%) were foreign-born. As shown in Table 1, foreign-born and U.S.-born respondents differed in several ways. Foreign-born respondents were more likely to be Mexican American, other Hispanic, or Asian and less likely to be White, Black, or other/multi-racial. Foreign-born respondents were more likely to be in the lowest (e.g., less than 9th grade) and highest (e.g., college graduate and above) education levels. Foreign-born respondents were less likely to report clinical CVD or hypertension, more likely to have never smoked, less likely to currently smoke, more likely to be a former smoker, and less likely to report a family history of diabetes. Foreign-born respondents also had lower BMI and higher A1C.

Racial/ethnic minority respondents differed from Whites on several demographic factors (see Table 1). For example, minority respondents were more likely to have lower education levels, except for Asians. Asians were more likely to have a college education or above compared to Whites but (along with Mexican Americans and other Hispanics) were also more likely to have received less than a 9th grade education. Similarly, minorities differed from Whites on health-related factors. While Black, Mexican American, and other Hispanic respondents had higher BMIs, Asians had lower BMIs. Further, all minorities had higher A1C, except for other/multi-racial respondents, who did not differ from Whites.

One-quarter (25%) of the sample perceived a risk for developing diabetes. Across immigrant status, 769 (21.4%) foreign-born and 2,135 (26.8%) U.S.-born respondents reported

being at risk. Across race/ethnicity, risk perception was highest among other/multi-racial respondents ($n=126$, 35.5%), followed by Mexican American ($n=467$, 31.2%), Black ($n=671$, 27.7%), White ($n=1055$, 23.1%), Asian ($n=321$, 21.6%), and other Hispanic ($n=264$, 21.5%) respondents. Table 2 displays the frequency of diabetes risk perception according to immigrant status and race/ethnicity.

Associations of Immigrant Status with Diabetes Risk Perception

Logistic regressions indicated that both immigrant status and race/ethnicity were uniquely associated with diabetes risk perception; however, the nature of the associations differed (Table 3). In Model 1, being foreign-born was associated with 39% decreased odds of perceiving a diabetes risk ($P<0.001$), compared to being U.S.-born. Adjusting for diabetes risk factors in Model 2, being foreign-born remained associated with a 27% decreased odds of diabetes risk perception ($P=0.001$), compared to being U.S.-born.

Associations of Race/Ethnicity with Diabetes Risk Perception

In the same two logistic regressions, race/ethnicity was also associated with diabetes risk perception. In Model 1, identifying as a racial/ethnic minority was associated with increased odds of perceiving a diabetes risk (Table 3). In Model 2, being Mexican American, Asian, and other/multi-racial remained associated with increased risk perception (52% increased odds, $P<0.001$; 48% increased odds, $P<0.001$; 63% increased odds, $P=0.002$; respectively), whereas being Black and other Hispanic was not ($P=0.056$ and $P=0.702$, respectively).

Associations Among Respondents with Prediabetes

Among respondents with clinically-indicated prediabetes ($n=3028$, 26.2% of the total sample), mean A1C was 5.9% ($SD=0.2$). As is shown in Table 3, being foreign-born remained associated with 35% decreased odds of perceiving a risk ($P=0.018$) and being Asian remained

associated with 89% increased odds of perceiving a risk ($P=0.014$). Associations for other racial/ethnic groups were no longer significant ($P_s>0.05$) but magnitudes and directions of the associations were similar to associations in the total sample.

Race/Ethnicity as a Moderator of the Immigrant Status-Diabetes Risk Perception

Association

The moderating effect of race/ethnicity on the immigrant status-diabetes risk perception association was examined by entering five interaction terms (immigrant status by each of the five dummy-coded race/ethnicity variables) into Model 2. The three interactions of immigrant status by Black, Mexican American, and other/multi-racial (compared to White) were significant ($P_s<0.01$), whereas the others were not ($P_s>0.05$). To probe these interaction terms, analyses were stratified by race/ethnicity (Figure 1). For Black, Mexican American, other Hispanic, and other/multi-racial groups, immigrant status was not associated with risk perception ($P_s>0.10$). Immigrant status was associated with decreased odds of risk perception among Whites and Asians ($P=0.002$ and $P=0.005$, respectively). Notably, results of stratified analyses were consistent with the raw rates reported in Table 2.

DISCUSSION

The aim of this study was to examine the unique associations between immigrant and racial/ethnic status and diabetes risk perception. In a large, nationally representative sample of U.S. adults without diabetes or prediabetes, being foreign-born was associated with lower odds of perceived diabetes risk, over and above the effect of race/ethnicity. Immigrant status' negative association with diabetes risk perception persisted after adjustment for potential confounders, including demographic and diabetes risk factors. Further, race/ethnicity showed a positive association with risk perception for Mexican American, Asian, and other/multi-racial groups.

After minimizing group differences in actual diabetes risk by exploring these associations among the subsample of respondents with prediabetes, the magnitude and direction of associations remained similar to those observed in the total sample. These results, combined with Model 2 results adjusting for diabetes risk factors in the entire sample, suggest that differences in actual diabetes risk are unlikely to account for the observed group differences in perceived risk. Finally, exploratory analyses suggest that foreign-born White and Asian groups may be driving the overall immigrant status effect, with foreign-born White and Asian adults having decreased odds of perceiving a diabetes risk compared to U.S.-born peers of the same ethnicity.

Together, these findings suggest that U.S. immigrants perceive themselves to be at lower risk for developing diabetes, despite emerging empirical evidence to the contrary⁵. Mismatch between risk perception and actual risk may have important consequences, as lower risk perception decreases the likelihood of engaging in lifestyle modifications to prevent or delay diabetes onset³. Further, findings indicate that immigrant and racial/ethnic status are uniquely associated with different diabetes risk perceptions, with immigrants less likely, but racial/ethnic minorities generally more likely, to perceive a diabetes risk. Using the evidence base for risk perception based on race/ethnicity (which is more developed) to assess risk perception among immigrants may hinder effective public health programming for immigrants.

Although not the primary objective, findings on diabetes risk perception by race/ethnicity coalesce with existing evidence. In prior studies of people without diabetes, racial/ethnic minorities were more likely to perceive diabetes risk compared to non-Hispanic Whites. These sampled Filipino, Chinese, and Latinos living in California¹⁴, undergraduates in Texas and Arizona^{15,16}, and women in Appalachia¹⁵. In addition, a 2009 study of older (45+) adults without diabetes found that being Native American, Alaska Native, Asian American, Pacific

Islander, or Native Hawaiian was associated with higher perceived risk; however, this association was not found for African Americans or Hispanics/Latinos ¹⁷. The current findings add to this by confirming some of these racial/ethnic differences using a large, nationally representative sample of adults, including younger adults. Further, Yang et al. ¹⁸ used NHANES data to examine specific reasons for perceiving diabetes risk versus the presence of actual risk factors. They found that Asians were less likely to correctly perceive weight (compared to Whites) and low physical activity (compared to Blacks, Mexican Americans, and other Hispanics) as diabetes risk factors. The present study contextualizes Yang et al.'s findings by showing that perceived diabetes risk does indeed differ by race/ethnicity. Together, these results suggest that although Asians may perceive a higher risk for developing diabetes, they may be less aware of specific risk factors. As a result, Asians may fail to address all of the relevant aspects of preventing or delaying diabetes.

Although this is the first study to examine the association of immigrant status with diabetes risk perception, findings are consistent with other studies implicating immigrant status as a social determinant of diabetes health. As previously described, Oza-Frank et al. ⁵ found that foreign-born adults were at greater risk for incident diabetes than U.S.-born adults. Cross-sectional results from two nationally representative databases suggests immigrants diagnosed with diabetes are less likely to receive, or engage in, optimal disease management. In the Medical Expenditure Panel Survey, immigrants were less likely to have met at least one of seven ADA-recommended diabetes self-management benchmarks ¹⁹. Results from this research group's recent NHANES study found that, among adults with a diabetes diagnosis, being foreign-born was associated with decreased odds of receiving insulin treatment, compared to being U.S.-born ⁶. The present findings add to this by highlighting diabetes risk perception as a

potential intervention target. However, research examining the antecedents and consequences of lower perceived risk is warranted, as unexamined factors may modify the effect of risk perception on the likelihood of engaging in lifestyle modifications for immigrant communities specifically. For example, other modifiers in the health belief model include cues to action (e.g., symptom recognition) and media information (e.g., public health programming).

Several factors may explain the lower risk perception among immigrants. A lack of linguistically- and culturally-appropriate public health messaging likely contributes to decreased diabetes risk knowledge^{11,12}. If known risk factors (such as high BMI, smoking, and a positive family history of diabetes) are not as strongly associated with diabetes for immigrants as they are for the general population, then these weakened associations may be a mechanism through which immigrant status becomes associated with lower risk perception. Resnicow et al.²⁰ argue that targeting aspects of observable culture, such as language, are important for increasing the acceptability of health-related messages; however, achieving message saliency requires incorporating cultural, social, historical, environmental and psychological realities that motivate the target health behavior. For U.S. immigrants, this may mean acknowledging, and providing methods for overcoming, the limitations immigrants face in achieving health, including lower insurance coverage rates and familiarity with an increasingly complex healthcare system²¹⁻²⁴. Still, having requisite diabetes risk knowledge may be insufficient. Walker et al.²⁵ surveyed adults with diabetes on their risk perceptions for diabetes-related complications and found that foreign-born adults were more susceptible to optimistic bias, meaning they perceived themselves to be at less risk for complications compared to others of the same age/gender. Optimistic bias may also contribute to lower diabetes risk perception among those who have not yet developed diabetes, but no studies of this currently exist. Outside of the diabetes context, evidence suggests

that U.S. immigrants exhibit strong optimistic beliefs about the future for themselves and their families²⁶⁻²⁹. The degree to which this ‘immigrant optimism’²⁷ applies to health risk perceptions is an avenue for future research.

Among the study’s strengths is the use of a large, nationally representative sample of adults without a diabetes/prediabetes diagnosis and data collection through interviews, physical examinations, and laboratory tests. In particular, the physical and laboratory components provided objective assessments of BMI and A1C. Some limitations are worth noting. First, although models were adjusted for potential confounders including actual diabetes risk factors, individuals could not be matched on these factors. Rates of certain diabetes risk factors (e.g., CVD) were lower among foreign-born adults; however, most were assessed via self-report, and it is possible that immigrants were less likely to have received these diagnoses. Importantly, foreign-born adults had higher A1C, as objectively measured at the MEC, and associations persisted in this subsample of adults with prediabetes. Second, respondents who self-reported no history of physician-diagnosed diabetes were selected. Because immigrants may be more likely to have undiagnosed diabetes³⁰, this sample may have included undiagnosed diabetes cases, especially among foreign-born adults, thus underestimating their low levels of risk perception observed herein.

Several implications for research and practice are worth considering. In terms of research, the finding that immigrant and racial/ethnic status are each associated with opposing diabetes risk perception outcomes should motivate future research examining why and how these differences arise. This is particularly intriguing when considering the unequal distribution of foreign-born and U.S.-born individuals within certain racial/ethnic groups—i.e., more foreign-born adults in the Asian group and more U.S.-born adults are in the White and Black groups.

While exploratory analyses stratified by race/ethnicity suggest the immigrant status-risk perception association is driven by Whites and Asians, low cell counts of foreign-born (among White) and U.S.-born (among Asian) individuals endorsing diabetes risk perception constrains confidence in these interpretations. Nonetheless, these tentative findings should encourage future research to examine and compare rates (and reasons) of immigrants' diabetes risk perception across race/ethnicity. With respect to practice, public health campaigns to increase diabetes risk perception in high-risk groups should consider developing programs specifically for foreign-born populations. Such immigrant-focused interventions have been in place for smoking cessation and nutritional education ^{31,32}.

NEW CONTRIBUTION TO THE LITERATURE

Foreign-born adults are less likely to report perceived risk for diabetes than are U.S.-born adults. Lower diabetes risk perception among immigrants could result in poorer preventative behaviors and later detection, thus contributing to immigrant health disparities in diabetes.

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Table 1. Differences in Respondent Characteristics by Immigrant Status and Race/Ethnicity in NHANES 2011-2016

	Total Sample (n = 11569)	U.S.-born (n = 7971)	Foreign-born (n = 3598)	Non-Hispanic White (n = 4576)	Non-Hispanic Black (n = 2423)	Mexican American (n = 1498)	Other Hispanic (n = 1228)	Non-Hispanic Asian (n = 1489)	Other/Multi-racial (n = 355)
<i>Demographic Factors</i>									
Age, Years	46.1 (17.4)	46.2 (18.2)	46.0 (15.4)	49.2 (18.7)	44.9 (16.6) ^{††}	43.4 (15.8) ^{††}	46.2 (16.5) ^{††}	43.3 (15) ^{††}	39.6 (15.8) ^{††}
Female, %	6000 (51.9)	4143 (52.0)	1857 (51.6)	2345 (51.2)	1276 (52.7)	785 (52.4)	679 (55.3) [†]	752 (50.5)	163 (45.9)
Immigrant, %	3598 (31.1)	-	-	204 (4.5)	298 (12.3)	875 (58.4) ^{††}	871 (70.9) ^{††}	1281 (86.0) ^{††}	69 (19.4) ^{††}
Education, %									
Less Than 9th Grade	935 (8.1)	241 (3.0)	694 (19.3)**	132 (2.9)	81 (3.3)	407 (27.2) ^{††}	207 (16.9) ^{††}	101 (6.8) ^{††}	7 (2.0)
9-11th Grade	1449 (12.5)	961 (12.1)	488 (13.6)*	461 (10.1)	368 (15.2) ^{††}	316 (21.1) ^{††}	175 (14.3) ^{††}	97 (6.5) ^{††}	32 (9.0)
High School Graduate/GED	2495 (21.6)	1869 (23.4)	626 (17.4)**	987 (21.6)	656 (27.1) ^{††}	300 (20.0)	274 (22.3)	203 (13.6) ^{††}	75 (21.1)
Some College or AA Degree	3569 (30.8)	2814 (35.3)	755 (21.0)**	1556 (34.0)	868 (35.8)	341 (22.8) ^{††}	354 (28.8) ^{††}	303 (20.3) ^{††}	147 (41.4) [†]
College Graduate or Above	3121 (27.0)	2086 (26.2)	1035 (28.8)*	1440 (31.5)	450 (18.6) ^{††}	134 (8.9) ^{††}	218 (17.8) ^{††}	785 (52.7) ^{††}	94 (26.5) [†]
<i>Diabetes Risk Factors</i>									
Cardiovascular Disease, %	812 (7.0)	667 (8.4)	145 (4.0)**	442 (9.7)	173 (7.1) ^{††}	58 (3.9) ^{††}	69 (5.6) ^{††}	39 (2.6) ^{††}	31 (8.7)
Hypercholesterolemia, %	3179 (27.5)	2187 (27.4)	992 (27.6)	1439 (31.4)	586 (24.2) ^{††}	347 (23.2) ^{††}	369 (30.0)	355 (23.8) ^{††}	83 (23.4) [†]
Hypertension, %	3289 (28.4)	2478 (31.1)	811 (22.5)**	1412 (30.9)	878 (36.2) ^{††}	325 (21.7) ^{††}	328 (26.7) ^{††}	258 (17.3) ^{††}	88 (24.8) [†]
Smoking Status, %									
Never	6808 (58.5)	4259 (53.4)	2549 (70.8)**	2289 (50.0)	1446 (59.7) ^{††}	1002 (66.9) ^{††}	760 (61.9) ^{††}	1131 (76.0) ^{††}	180 (50.7)
Current	2361 (20.4)	1947 (24.4)	414 (11.5)**	1087 (23.8)	611 (25.2) ^{††}	212 (14.2) ^{††}	191 (15.6) [†]	149 (10.0) ^{††}	111 (31.3) ^{††}
Former	2400 (20.7)	1765 (22.1)	635 (17.6)**	1200 (26.2)	366 (15.1)	284 (19.0) ^{††}	277 (22.6) ^{††}	209 (14.0) ^{††}	64 (18.0) [†]
Family History of Diabetes, %	4130 (35.7)	2968 (37.2)	1162 (32.3)**	1436 (31.4)	1050 (43.3) ^{††}	635 (42.4) ^{††}	398 (32.4)	476 (32.0)	135 (38.0) [†]
Body Mass Index, kg/m²	28.4 (6.7)	29 (7.1)	27.1 (5.3)**	28.2 (6.6)	30 (7.7) ^{††}	30 (6.4) ^{††}	28.8 (6.0) [†]	24.4 (4.0) ^{††}	28.4 (6.8)
Hemoglobin A1c Level, %	5.5 (0.6)	5.4 (0.5)	5.5 (0.6)**	5.4 (0.5)	5.6 (0.6) ^{††}	5.5 (0.6) ^{††}	5.5 (0.6) ^{††}	5.5 (0.6) ^{††}	5.4 (0.6)

Note: Continuous variables presented as mean and SD, categorical variables presented as n and %. NHANES, National Health and Nutrition Examination Survey; U.S., United States; GED, General Education Diploma; AA, Associate degree.

*Significant difference between U.S.-born and foreign-born, p < 0.05

** Significant difference between U.S.-born and foreign-born, p < 0.001

† Significant difference between racial/ethnic minority group and non-Hispanic white group, p < 0.05

†† Significant difference between racial/ethnic minority group and non-Hispanic white group, p < 0.001

Table 2. Frequency of Diabetes Risk Perception by Immigrant Status and Race/Ethnicity, NHANES 2011-2016

	U.S.-born n (%)	Foreign-born n (%)	Total n (%)
Non-Hispanic White	1026 (23.5%)	29 (14.2%)	1055 (23.1%)
Non-Hispanic Black	606 (28.5%)	65 (21.8%)	671 (27.7%)
Mexican American	233 (37.4%)	234 (26.7%)	467 (31.2%)
Other Hispanic	105 (29.4%)	159 (18.3%)	264 (21.5%)
Non-Hispanic Asian	61 (29.3%)	260 (20.3%)	321 (21.6%)
Other/Multi-racial	104 (36.4%)	22 (31.9%)	126 (35.5%)
Total	2135 (26.8%)	769 (21.4%)	2904 (25.1%)

NHANES, National Health and Nutrition Examination Survey; U.S., United States.

Table 3. Odds Ratios and Confidence Intervals for Logistic Regression Models Examining Associations of Immigrant Status and Race/Ethnicity with Risk Perception, NHANES 2011-2016

	Model 1: Demographic Factors[†]	Model 2: Demographic and Diabetes Risk Factors[†]	Model 3: Demographic and Diabetes Risk Factors among Subsample with Prediabetes^{††}
	<i>OR (95% CI)</i>	<i>OR (95% CI)</i>	<i>OR (95% CI)</i>
<i>Immigrant Status</i>			
<i>U.S.-Born</i>	Ref.	Ref.	Ref.
<i>Foreign-Born</i>	0.613** (0.519 - 0.724)	0.732** (0.610 - 0.878)	0.649* (0.454 - 0.928)
<i>Race/Ethnicity</i>			
<i>Non-Hispanic White</i>	Ref.	Ref.	Ref.
<i>Non-Hispanic Black</i>	1.261* (1.086 - 1.456)	0.855 (0.728 - 1.004)	0.850 (0.610 - 1.185)
<i>Mexican American</i>	1.997** (1.709 - 2.335)	1.520** (1.242 - 1.861)	1.569 (0.997 - 2.471)
<i>Other Hispanic</i>	1.225* (1.009 - 1.489)	1.047 (0.828 - 1.323)	1.027 (0.632 - 1.666)
<i>Non-Hispanic Asian</i>	1.389* (1.137 - 1.696)	1.475** (1.184 - 1.837)	1.889* (1.138 - 3.134)
<i>Other/Multi-Racial</i>	1.828** (1.436 - 2.328)	1.634* (1.202 - 2.223)	1.082 (0.512 - 2.286)

NHANES, National Health and Nutrition Examination Survey; Ref., reference group; U.S., United States.

[†]*n* = 11569, ^{††}*n* = 3028

**p* < 0.05

***p* < 0.001

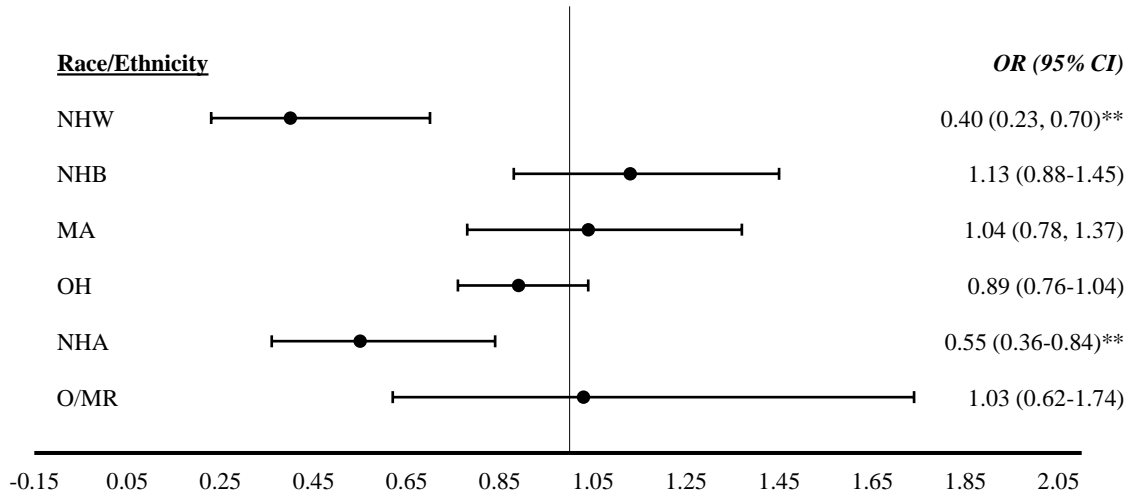


Figure 1. Forest plot summarizing odds ratio estimates of association of being foreign-born with diabetes risk perception, stratified by six race/ethnicity groups. Data from NHANES 2011-2016. Models adjusted for age, sex, education, clinical cardiovascular disease, hypercholesterolemia, hypertension, smoking status, family history of diabetes, body mass index, hemoglobin A1c level, and NHANES sampling design. NHW = non-Hispanic White; NHB = non-Hispanic Black; MA = Mexican American; OH = other Hispanic; NHA = non-Hispanic Asian; O/MR = other/multi-racial; NHANES = National Health and Nutrition Examination Survey.