Undiagnosed Diabetes Among Immigrant and Racial/Ethnic Minority Adults in the U.S.:

National Health and Nutrition Examination Survey 2011-2018

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Abstract

Undiagnosed diabetes disproportionately affects medically underserved groups. It is unknown whether being an immigrant confers additional risk for undiagnosed diabetes. **Purpose:** To examine independent associations of immigrant status and race/ethnicity with the prevalence of diagnosed and undiagnosed diabetes in a U.S.-based population sample. **Methods:** Respondents were 21,306 adults from the 2011-2018 National Health and Nutritional Exam Survey. Immigrant status was coded as foreign-born or U.S.-born. Six racial/ethnic categories were: White, Black, Mexican American, other Hispanic, Asian, and Other/Multi-Racial. Self-report and laboratory data yielded a three-level diabetes status outcome: no diabetes (88%), diagnosed diabetes (10%), and undiagnosed diabetes (2%). **Results:** Adjusted multinomial logistic regression models evaluating immigrant status and race/ethnicity as simultaneous predictors revealed that foreign-born (vs. U.S.-born) adults had a similar prevalence of diagnosed diabetes (*OR*=0.98, 95% *CI*: 0.79-1.22, *p*=0.84) but a higher prevalence of undiagnosed diabetes (*OR*=1.54, 95% *CI*: 1.21-1.97, *p*=0.004). Models showed that all racial/ethnic minority groups except the Other/Multi-Racial group (vs. Whites) had a higher prevalence of diagnosed and undiagnosed diabetes (*p*s<0.04). **Conclusions:** Immigrants and racial/ethnic minority adults have increased odds of undiagnosed diabetes, even after accounting for health insurance. These groups are likely at increased risk for diabetes complications due to prolonged periods of undetected diabetes.

Keywords: type 2 diabetes mellitus; undiagnosed diabetes; immigrants; race/ethnicity; National Health and Nutrition Examination Survey.

Despite advancements in detection and treatment, type 2 diabetes remains a major U.S. public health concern [1]. Undiagnosed diabetes poses a particular threat, as diabetes can damage almost every organ in the body [2]. The burden of diabetes disproportionately falls on medically underserved groups, including racial/ethnic minorities [1]. Despite contending with numerous socio-environmental hardships, whether being an immigrant confers additional risk for undiagnosed diabetes is unknown.

Understanding the prevalence of undiagnosed diabetes among the U.S. immigrant population is important for two primary reasons. First, people with undiagnosed diabetes have a higher prevalence of diabetes-related complications, including kidney disease, retinopathy, and cardiovascular disease [3, 4]. Identifying patterns of undiagnosed diabetes among traditionally overlooked communities is a necessary step toward reducing diabetes health disparities. Second, understanding the prevalence of undiagnosed diabetes among immigrants contributes to the understanding of the 'immigrant paradox,' the phenomenon in which foreign-born individuals tend to possess better health profiles than the U.S.-born despite immigrants' exposure to a higher number of socioeconomic and environmental risk factors. Emerging evidence suggests that higher rates of undiagnosed health conditions [5], which are detected and diagnosed after immigrants enter the U.S., are what lead to the *appearance* that immigrants have a health advantage over their U.S.-born peers. This may be especially true in the case of type 2 diabetes. Early symptoms of type 2 diabetes are often non-specific [6]. Furthermore, despite potentially improved access to health resources post-migration, the path to a formal diagnosis is often littered with obstacles, such as language barriers [7]. Indeed, prior studies find higher prevalence rates of undiagnosed diabetes among Mexican [5] and African [8] immigrant adults compared to

their U.S.-born Mexican American and African American peers, suggesting that undiagnosed diabetes contributes to the 'immigrant paradox' in diabetes health.

To our knowledge, no study has documented the prevalence of undiagnosed diabetes across immigrant status or estimated the association between immigrant status and diabetes status using a nationally representative sample of U.S. adults. Although studies of racial/ethnic differences in diabetes prevalence point to the continued burden of diabetes among racial/ethnic minorities [9, 10], and many immigrants are members of a racial/ethnic minority group, race/ethnicity and immigrant status are not interchangeable. Therefore, the objective of this study is to examine independent associations of immigrant status and race/ethnicity with the prevalence of diagnosed and undiagnosed diabetes in a large U.S. representative sample.

Methods

Study Design and Sample

The institutional review board categorized this study as exempt. Data came from the National Health and Nutrition Examination Survey (NHANES) 2011-2018 survey years. NHANES uses 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 2-year cycle. Respondents completed a computer-assisted in-home interview assessing demographic and health-related factors. Approximately 1-2 weeks later, respondents attended a Mobile Examination Center (MEC) to undergo physical examinations, laboratory assessments, and additional interviews. All data came from the in-home interviews, except for body mass index (BMI, kg/m^2) and hemoglobin (Hb) A1c values (%), which came from the MEC assessments.

From the total 2011-2018 survey years sample (*N*=39,156), we selected all respondents aged ≥18 years who attended the MEC (*n*=22,807). We then excluded those responding "Don't Know" (*n=*15) to the NHANES diabetes diagnosis question (none of the selected respondents refused to answer or had missing data for this question) and those who were missing HbA1c values (*n*=1,114). From the remaining 21,678 respondents, we excluded those with missing data on the two predictors, country of birth (*n*=11) and race/ethnicity (*n=*0). We then excluded those missing data on demographic covariates (*n*=39), height/weight measures (*n*=286), and health insurance status (*n*=36). The characteristics of our final sample of 21,306 respondents (93.4% of adults who attended the MEC) 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 answering "Refused," "Don't Know," or who did not answer, we computed 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).

Race/Ethnicity. NHANES classified respondents into six groups: non-Hispanic White, non-Hispanic Black, Mexican American, other Hispanic, non-Hispanic Asian, or Other/Multi-Racial. We created five dummy variables to represent race/ethnicity, using the non-Hispanic White group as referent.

Diabetes Status. Diabetes diagnosis was determined in the questionnaires by asking, "Have you ever been told by a doctor or other health professional that you have diabetes or sugar diabetes?" We computed a three-level outcome variable to capture respondents' diabetes status.

First, we recoded the diabetes diagnosis question into a dichotomous variable by coding respondents reporting a diabetes diagnosis as having 'diagnosed diabetes' and those reporting no diabetes diagnosis or reporting a prediabetes diagnosis as having 'no diagnosed diabetes.' We then selected respondents with 'no diagnosed diabetes' and examined HbA1c values. Respondents with 'no diabetes diagnosis' but with HbA1c values $\geq 6.5\%$ were coded as 'undiagnosed diabetes,' whereas those with HbA1c values $<6.5\%$ were coded as 'no diabetes.' These statuses were then combined into a three-level diabetes status outcome variable (0=no diabetes, 1=diagnosed diabetes, 2=undiagnosed diabetes).

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, high school diploma or GED, some college or associate degree, and college graduate or above. BMI was computed from weight and height measurements obtained at the MEC. Health insurance coverage (yes/no) was obtained by the question, "Are you covered by health insurance or some other kind of health care plan?"

Data Analysis

Analyses were performed using SAS version 9.4 (SAS Institute, Cary, NC). To characterize the sample, we conducted t-tests and X^2 tests to examine differences on covariates between foreign-born and U.S.-born respondents. Regression analyses examined differences on these covariates between each racial/ethnic minority group and Whites.

To determine whether immigrant status and race/ethnicity are associated with diabetes status, we tested a sequence of multinomial logistic regression models. In all models, we simultaneously entered immigrant status (foreign-born vs. U.S.-born) and race/ethnicity (five dummy variables with White as referent) as predictors of our three-level diabetes status outcome

variable. Model 1 included immigrant status, five dummy variables for race, and the year of data collection (i.e., NHANES wave), Model 2 further adjusted for demographic factors (age, sex, and four dummy variables for education) and BMI, and Model 3 additionally adjusted for health insurance coverage to account for its potentially explanatory power. In all models, we varied the reference group for the outcome variable as either 'no diabetes' or 'diagnosed diabetes' so that we could examine predictor effects on the outcome variable for all pairs of outcome groups. Specifically, using 'no diabetes' as referent allows us to examine effects on the logit (log odds) of having diagnosed diabetes vs. no diabetes and the logit of having undiagnosed diabetes vs. no diabetes. Using 'diagnosed diabetes' as referent allows us to examine effects on the logit of having undiagnosed diabetes vs. diagnosed diabetes.

We applied appropriate NHANES sampling design weighted variables to all analyses to account for survey design. Doing so allows each respondent to represent the proportion of the population they represent, thus providing estimates representative of the U.S. civilian non-institutionalized population (see www.cdc.gov/nchs/tutorials/nhanes/SurveyDesign/Weighting/intro.htm). In line with NHANES guidance, we used weights from the MEC subsample because BMI and HbA1c were available for this subsample only. Additionally, using the MEC subsample weights back-adjusts the MEC sample to be nationally representative.

Results

Respondent Characteristics

In our sample of 21,306 adults, approximately one-third (30.5% unweighted and 18% weighted frequency) were foreign-born. Foreign-born respondents differed from the U.S.-born on several factors. As shown in Table 1, foreign-born respondents had a younger mean age and

were more likely to be a member of a racial/ethnic minority group (Black, Mexican American, other Hispanic, Asian, or Other/Multi-Racial). Foreign-born respondents were more likely to be in the lower levels of education. Foreign-born respondents had a lower mean BMI and were less likely to have health insurance.

Racial/ethnic minority respondents differed from White respondents on several factors. For example, minority respondents had younger mean ages and were generally more likely to have lower education levels. While Asian respondents were more likely to have a college education or above, they were also more likely to have less than a 9th grade education, along with Black, Mexican American, and other Hispanic respondents. Black, Mexican American, and Other/Multi-Racial respondents had a higher mean BMI, while Asians had a lower mean BMI. All minority respondents were less likely to have health insurance.

Prevalence of Diagnosed and Undiagnosed Diabetes

Approximately 12% (*n*=3,490) of the sample had diabetes (diagnosed or undiagnosed). About one in five adults with diabetes were undiagnosed (*n*=644; see Table 2). Of those with undiagnosed diabetes, 269 (43%) reported a prediabetes diagnosis, and 375 (57%) reported no diabetes-related diagnosis. Across immigrant status, approximately 10% of foreign-born and 8% of U.S.-born groups had diagnosed diabetes. Undiagnosed diabetes was detected among 3% of foreign-born and 2% of U.S.-born respondents. Across race/ethnicity, diagnosed diabetes was highest among Black and Other/Multi-Racial respondents (13%), followed by Mexican American, Asian (11% each), White (10%), and other Hispanic (9%) respondents. Undiagnosed diabetes was highest among Asian and Black respondents (4%), followed by Mexican American, other Hispanic (3% each), Other/Multi-Racial, and White (2% each) respondents.

Associations of Immigrant Status with Diabetes Status

Table 3 summarizes results from the multinomial logistic regression models for each pair of outcome groups. Using 'no diabetes' as referent and controlling for race/ethnicity and data collection year in Model 1, being foreign-born was not associated with having diagnosed diabetes. However, being foreign-born was associated with 48% increased odds of having undiagnosed diabetes ($p<0.001$). This association remained in the same direction and magnitude (64% increased odds of having undiagnosed diabetes, $p<0.001$) after adjusting for age, sex, education, and BMI in Model 2. After further adjustment for health insurance in Model 3, and consistent with Models 1 and 2, being foreign-born was associated with 54% increased odds for having undiagnosed diabetes ($p=0.004$).

Using 'diagnosed diabetes' as referent, being foreign-born was associated with 55% increased odds of having undiagnosed diabetes ($p<0.001$). This association strengthened (73% increased odds, $p<0.001$) after adjusting for demographics and BMI. After further adjustment for health insurance, and consistent with Models 1 and 2, being foreign-born was associated with 58% increased odds of having undiagnosed diabetes ($p=0.004$).

Associations of Race/Ethnicity with Diabetes Status

Using 'no diabetes' as referent (see Table 3), race/ethnicity was also associated with diabetes status. Compared to Whites and controlling for immigrant status, Black, Mexican American, and Other/Multi-Racial respondents had increased odds of having diagnosed diabetes, while Black, Mexican American, Other Hispanic, and Asian respondents had increased odds of undiagnosed diabetes ($ps<0.05$). These associations strengthened after adjusting for demographics and BMI in Model 2 ($ps<0.05$). In addition, identifying as Mexican American and identifying as Asian became associated with 77% and 45% increased odds of diagnosed diabetes, respectively ($p=0.001$ and $p<0.001$, respectively). Further adjustment for health insurance had

little impact on the magnitude of the association of race/ethnicity with diagnosed diabetes (ps<0.05). Similarly, adjusting for health insurance did not meaningfully change the magnitude of the association between being Black, Mexican American, other Hispanic, or Asian and undiagnosed diabetes (ps<0.05).

Using 'diagnosed diabetes' as referent (see Table 3) revealed some similar patterns. Black, other Hispanic, and Asian respondents were at increased odds of having undiagnosed diabetes in Model 1 (p<0.001, p=0.02, and p=0.02, respectively). After adjusting for demographics and BMI (Model 2), only being Black was associated with increased odds of undiagnosed diabetes (p<0.001). After further adjustment for health insurance coverage (Model 3), Blacks and Asians were the only racial/ethnic groups to continue to have increased odds of undiagnosed diabetes (p=0.001 and p=0.03 respectively).

Sensitivity Analysis

We conducted a sensitivity analysis by removing the 269 respondents in the undiagnosed diabetes group that reported a prediabetes diagnosis and rerunning the fully-adjusted Model 3. Foreign-born respondents remained at increased odds of having undiagnosed diabetes (see online Supplemental Table 1). In addition, identifying as Other/Multi-Racial became associated with a more than double the odds of having undiagnosed diabetes (p=0.03).

Supplemental Analyses

We ran a set of supplemental analyses to further probe the associations detected in the main Model 3. In the first, we examined the immigrant status-diabetes status association in each race/ethnicity group (Supplemental Model 4). In the second, we examined the influence of length of U.S. residency on diabetes status among the foreign-born subsample.

In supplemental Model 4, we stratified by the six race/ethnicity categories and reran the fully-adjusted Model 3. Stratifying by race/ethnicity reduced cell counts across the three levels of diabetes status outcome (see online Supplemental Table 2)— thus, these models produced unstable estimates for some groups. As such, we view these findings as exploratory and present them to generate future hypotheses.

Using 'no diabetes' as referent, being foreign-born was associated with 71% increased odds of diagnosed diabetes among Asians only ($p=0.02$; see online Supplemental Figure 1). Being foreign-born was also associated with more than double the odds of having undiagnosed diabetes among Mexican Americans ($p=0.001$) and more than four times the odds among Other Hispanics ($p<0.001$). While associations for other groups did not reach significance, being foreign-born was associated with a numerically and potentially meaningfully increased odds of having undiagnosed diabetes among Black and Asian respondents (see online Supplemental Figure 2).

Using 'diagnosed diabetes' as referent, being foreign-born was associated with more than double the odds of having undiagnosed diabetes among Mexican Americans ($p=0.005$) and more than five times the odds among other Hispanics ($p<0.001$; see online Supplemental Figure 3). Associations for other groups did not reach significance.

To examine the influence of length of U.S. residency on diabetes status, we first selected all foreign-born respondents that provided information on how many years they have lived in the U.S. ($n=6,239$, 94.3% of all foreign-born adults from the main analyses). Next, we further adjusted Model 3 for length of U.S. residency. Foreign-born respondents were asked to provide the month and year they immigrated to the U.S. to live. NHANES recoded these responses into nine categories of unequal range, from "less than 1 year" to "50 years or more." To account for

the unequal ranges, we created a quasi-continuous length of U.S. residency variable by taking the midpoint of each range (e.g., "10 years or more, but less than 15 years" was recoded as "12"). "50 years or more" was recoded as "55". As with Supplemental Model 4, reduced cell counts across the three levels of diabetes status resulted in unstable estimates for some groups (online Supplemental Table 2), and these exploratory findings are presented to generate future hypotheses. Among this sample of 6,239 foreign-born adults, 871 (10.3%) had diagnosed diabetes and 273 (3.3%) had undiagnosed diabetes.

Using 'no diabetes' as referent, length of U.S. residency was not associated with diagnosed or undiagnosed diabetes (*OR*=1.02, 95% *CI*: 0.92-1.13, *p*=0.45 and *OR*=0.96, 95% *CI*: 0.85-1.12, *p*=0.76, respectively). Similarly, in the model using 'diagnosed diabetes' as referent, length of U.S. residency was not associated with undiagnosed vs. undiagnosed diabetes (*OR*=0.96, 95% *CI*: 0.82-1.13, *p*=0.46).

Discussion

We sought to examine the independent associations of immigrant status and race/ethnicity with the prevalence of diagnosed and undiagnosed diabetes. In a large, nationally representative sample of U.S. adults, we found that being foreign-born, versus U.S.-born, was associated with increased odds of having undiagnosed diabetes, over and above the effect of race/ethnicity. Immigrant status' positive association with having undiagnosed diabetes persisted after adjustment for potential confounders of demographics, BMI, and health insurance. We also found that nearly all racial/ethnic minority groups had increased odds of diagnosed and undiagnosed diabetes, even after adjustment for potential confounders. However, among those with overt diabetes, the prevalence of undiagnosed versus diagnosed diabetes significantly differed only between Blacks, Asians and Whites, in that Black and Asian respondents had

increased odds of having undiagnosed versus diagnosed diabetes compared to Whites. Collectively, findings suggest that U.S. immigrants are an underserved population in terms of diabetes screening and diagnosis. In addition, our findings add to the evidence base documenting the high burden of diabetes among racial/ethnic minorities and extend that evidence base by showing that associations of race/ethnicity with diagnosed and undiagnosed diabetes are independent of immigrant status.

Several factors may explain the increased prevalence of undiagnosed diabetes among immigrants. Structural challenges, such as discriminatory policies that disproportionately target immigrants, decrease immigrants' access to and use of tangible health resources, including health insurance [11]. Notably, while health insurance coverage improves access to diabetes screening [12], adjustment for health insurance coverage in the current study did not meaningfully change the association of immigrant status with diabetes status, suggesting other barriers remain. Social factors, including feelings of distrust of the medical system, may discourage immigrants from seeking care [13-15]. Prior research has documented medical system distrust among racial/ethnic minorities as well [16]. In addition, even when immigrants utilize care, factors such as lowered health literacy [17] and language barriers [18] contribute to suboptimal medical care through communication difficulties.

Implications for research and practice are worth considering. In terms of research, our finding that immigrants have higher odds of undiagnosed diabetes adds to the literature suggesting that U.S. immigrants may not have as much of a health advantage over the U.S.-born as previously thought, at least in regards to diabetes health [5]. It is also worth noting results from the supplemental analyses showing that length of U.S. residency is not associated with diabetes status. While exploratory, these results are intriguing in light of evidence to the contrary

[19]. One potential explanation for these discrepant findings may be that our primary analyses controlled for factors that overlap with length of U.S. residency, such as health insurance coverage. Nonetheless, the perception that immigrants have a diabetes health advantage over the U.S.-born may contribute to lower rates of diabetes screening and diagnosis, as healthcare providers may delay screening for groups they perceive to be at low risk [20]. A similar phenomenon among Asian Americans has been documented. Prior studies have found that Asian Americans are the least likely racial/ethnic group to be screened for diabetes, despite participation in other forms of preventive screens [20, 21]. Accordingly, with respect to practice, our findings support the need for more systematic efforts for diabetes screening and diagnosis for immigrants, as well as for racial/ethnic minorities.

Among our study's strengths are a large, nationally representative sample of adults and data collection through interviews, physical examinations, and laboratory tests. In particular, the systematic assessment of HbA1c allowed the re-classification of respondents into the three diabetes groups. Some limitations are worth noting. For example, the one caveat to the previous point is that we used self-reported physician-diagnosed diabetes. Therefore, misclassification on this factor was possible if respondents misremembered whether a physician has ever diagnosed them with diabetes. Nonetheless, studies find high rates of agreement between self-reported diabetes and medical charts or physician reports [22, 23]. Also, cases of Other/Multi-Racial respondents in the diagnosed status groups were lower (e.g., there were 20 Other/Multi-Racial respondents with undiagnosed diabetes). Thus, findings for Other/Multi-Racial group should be interpreted with caution due to the relative instability of the estimates. Similarly, our two exploratory examinations are hindered due to low cell counts across the three diabetes status groups (e.g., five of the 12 undiagnosed diabetes cells had frequencies<20).

Conclusions

Immigrants and racial/ethnic minority adults living in the U.S. have increased odds of undiagnosed diabetes, even after taking demographic characteristics, BMI, and health insurance into account. These groups are likely at increased risk for serious diabetes complications due to prolonged periods of undetected and untreated diabetes.

Acknowledgements

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Table 1. *Differences in Respondent Characteristics by Immigrant Status and Race/Ethnicity in NHANES 2011-2018*

	Total Sample	U.S.-born	Foreign-born	Non-Hispanic White	Non-Hispanic Black	Mexican American	Other Hispanic	Non-Hispanic Asian	Other/Multi-racial
	(*n* = 21306)	(*n* = 15058)	(*n* = 6619)	(*n* = 7843)	(*n* = 4743)	(*n* = 2981)	(*n* = 2236)	(*n* = 2714)	(*n* = 789)
Age (years), mean[a] (SE)[b]	46.9 (0.31)	47.4 (0.34)	45.0 (0.42)**	49.2 (0.37)	44.2 (0.45)[††]	40.0 (0.51)[††]	42.2 (0.47)[††]	44.5 (0.55)[††]	43.5 (0.92)[††]
Female, *n* (%)[c]	11003 (51.8)	7621 (42.6)	3382 (51.3)	3964 (51.6)	2486 (55.4)[††]	1537 (48.7)[†]	1252 (53.0)	1392 (53.6)[†]	373 (48.6)
Foreign-born, *n* (%)	6507 (18.0)	-	-	333 (4.3)	502 (10.6)[††]	1680 (54.1)[††]	1549 (65.1)[††]	2317 (85.3)[††]	126 (14.6)[††]
Education, *n* (%)									
Less than 9th Grade	1905 (4.8)	514 (2.0)	1391 (17.5)**	242 (1.7)	190 (3.2)[††]	829 (21.6)[††]	421 (14.7)[††]	198 (6.9)[††]	25 (2.4)
9-11th Grade	2889 (9.9)	1979 (9.1)	910 (13.5)**	852 (7.5)	753 (14.4)[††]	617 (20.3)[††]	369 (15.1)[††]	208 (6.8)	90 (9.6)
High School Graduate/GED	4913 (23.0)	3768 (23.9)	1145 (19.3)**	1907 (22.8)	1269 (27.2)[††]	661 (25.1)	481 (22.7)	415 (14.8)[††]	180 (23.3)
Some College/AA Degree	6540 (32.0)	5238 (34.4)	1302 (21.0)**	2702 (33.0)	1689 (36.1)[†]	654 (24.2)[††]	622 (29.6)[†]	542 (20.1)[††]	331 (41.2)[†]
College Graduate or Above	5059 (30.3)	3300 (30.7)	1759 (28.6)	2140 (35.0)	842 (19.1)[††]	220 (8.8)[††]	343 (18.0)[††]	1351 (51.4)[††]	163 (23.5)[†]
BMI (kg/m^2), mean (SE)	29.2 (0.12)	29.5 (0.13)	27.9 (0.14)**	29.1 (0.14)	30.8 (0.15)[††]	30.5 (0.16)[††]	29.2 (0.20)[††]	25.2 (0.11)[††]	30.1 (0.35)[†]
Health Insurance, *n* (%)	17142 (83.8)	12507 (87.2)	4635 (68.5)**	6812 (89.3)	3854 (79.0)[††]	1873 (58.6)[††]	1642 (70.1)[††]	2327 (86.6)[†]	634 (82.1)[††]

[a]All means weighted. [b]Standard error of weighted mean. [c]All percentages weighted.
Note: NHANES, National Health and Nutrition Examination Survey; GED, General Education Diploma; AA, Associate degree; BMI, body mass index.
**between U.S.-born and foreign-born, $p < 0.001$, [†] between racial/ethnic minority group and non-Hispanic White group, $p < 0.05$, [††] between racial/ethnic minority group and non-Hispanic White group, $p < 0.001$

Table 2. *Frequencies and Prevalence Rates of Diabetes Status by Immigrant Status and Race/Ethnicity in NHANES 2011-2018*

	No Diabetes (*n* = 17816)	Diagnosed Diabetes (*n* = 2846)	Undiagnosed Diabetes (*n* = 644)
	n (%)	*n* (%)	*n* (%)
Immigrant Status			
U.S.-Born	12500 (72.2)	1940 (8.4)	359 (1.8)
Foreign-Born	5316 (86.4)	906 (10.2)	285 (3.4)
Race/Ethnicity			
Non-Hispanic White	6791 (89.0)	918 (9.6)	134 (1.5)
Non-Hispanic Black	3821 (83.6)	732 (12.8)	190 (3.7)
Mexican American	2397 (86.0)	478 (11.2)	106 (2.8)
Other Hispanic	1849 (88.0)	302 (9.1)	85 (2.8)
Non-Hispanic Asian	2291 (85.5)	314 (10.7)	109 (3.8)
Other/Multi-racial	667 (85.1)	102 (12.9)	20 (2.0)

Note: Frequencies are unweighted; percentages are weighted. NHANES, National Health and Nutrition Examination Survey.

Table 3. *Results from Multinomial Logistic Regression Models Examining Associations of Immigrant Status and Race/Ethnicity with Diabetes Status in NHANES 2011-2018*

	Model 1[a]		
	Diagnosed Diabetes vs. No Diabetes	**Undiagnosed Diabetes vs. No Diabetes**	**Undiagnosed Diabetes vs. Diagnosed Diabetes**
	OR (95% CI)	*OR (95% CI)*	*OR (95% CI)*
U.S.-Born	*Ref.*	*Ref.*	*Ref.*
Foreign-Born	0.95 (0.81 – 1.12)	1.48 (1.22 – 1.79)**	1.55 (1.22 – 1.98)**
Non-Hispanic White	*Ref.*	*Ref.*	*Ref.*
Non-Hispanic Black	1.42 (1.26 – 1.61)**	2.58 (1.97 – 3.37)**	1.82 (1.38 – 2.39)**
Mexican American	1.23 (1.00 – 1.51)*	1.60 (1.17 – 2.19)*	1.30 (0.96 – 1.76)
Other Hispanic	0.98 (0.82 – 1.19)	1.53 (1.06 – 2.19)*	1.55 (1.06 – 2.27)*
Non-Hispanic Asian	1.20 (0.97 – 1.49)	1.93 (1.38 – 2.70)*	1.60 (1.10 – 2.35)*
Other/Multi-racial	1.38 (1.02 – 1.87)*	1.38 (0.65 – 2.86)	0.99 (0.47 – 2.10)
	Model 2[b]		
U.S.-Born	*Ref.*	*Ref.*	*Ref.*
Foreign-Born	0.95 (0.76 – 1.18)	1.64 (1.31 – 2.04)**	1.73 (1.28 – 2.33)**
Non-Hispanic White	*Ref.*	*Ref.*	*Ref.*
Non-Hispanic Black	1.70 (1.49 – 1.93)**	2.73 (2.08 – 3.59)**	1.61 (1.22 – 2.13)**
Mexican American	1.77 (1.38 – 2.27)**	1.87 (1.30 – 2.70)**	1.06 (0.75 – 1.49)
Other Hispanic	1.45 (1.16 – 1.81)*	1.92 (1.29 – 2.85)*	1.32 (0.88 – 2.00)
Non-Hispanic Asian	2.85 (2.18 – 3.73)**	4.23 (2.90 – 6.19)**	1.48 (0.97 – 2.26)
Other/Multi-racial	1.81 (1.26 – 2.60)*	1.61 (0.73 – 3.57)	0.89 (0.42 – 1.90)
	Model 3[c]		
U.S.-Born	*Ref.*	*Ref.*	*Ref.*
Foreign-Born	0.98 (0.79 – 1.22)	1.54 (1.21 – 1.97)*	1.58 (1.16 – 2.16)*
Non-Hispanic White	*Ref.*	*Ref.*	*Ref.*
Non-Hispanic Black	1.71 (1.50 – 1.94)**	2.71 (2.06 – 3.57)**	1.59 (1.20 – 2.10)*
Mexican American	1.81 (1.41 – 2.31)**	1.79 (1.24 – 2.59)*	0.99 (0.71 – 1.39)
Other Hispanic	1.45 (1.16 – 1.81)*	1.91 (1.29 – 2.84)*	1.32 (0.88 – 1.99)
Non-Hispanic Asian	2.79 (2.13 – 3.65)**	4.41 (3.00 – 6.49)**	1.58 (1.03 – 2.42)*
Other/Multi-racial	1.82 (1.27 – 2.62)*	1.58 (0.72 – 3.50)	0.87 (0.41 – 1.85)

NHANES, National Health and Nutrition Examination Survey; Ref, reference group.
[a]Model 1 adjusted for year of data collection and NHANES sampling design. [b]Model 2 adjusted for year of data collection, age, sex, education level, body mass index, and NHANES sampling design. [c]Model 3 adjusted for year of data collection, age, sex, education level, body mass index, health insurance status, and NHANES sampling design.
*$p<0.05$, **$p < 0.001$

Supplemental Table 1. Odds Ratios and Confidence Intervals from the Multinomial Logistic Regression Model Examining Associations of Immigrant Status and Race/Ethnicity with Diabetes Status Among *N*=21,037 Without a Prediabetes Diagnosis in NHANES 2011-2018

	Supplemental Model 3[a]		
	Diagnosed Diabetes vs. No Diabetes	**Undiagnosed Diabetes vs. No Diabetes**	**Undiagnosed Diabetes vs. Diagnosed Diabetes**
U.S.-Born	*Ref.*	*Ref.*	*Ref.*
Foreign-Born	0.97 (0.78 – 1.21)	1.71 (1.22 – 2.39)*	1.76 (1.18 – 2.62)*
Non-Hispanic White	*Ref.*	*Ref.*	*Ref.*
Non-Hispanic Black	1.70 (1.49 – 1.94)**	3.46 (2.44 – 4.91)**	2.04 (1.44 – 2.88)**
Mexican American	1.81 (1.41 – 2.31)**	1.62 (1.05 – 2.51)*	0.90 (0.60 – 1.35)
Other Hispanic	1.44 (1.16 – 1.80)*	2.29 (1.40 – 3.77)*	1.59 (0.95 – 2.67)
Non-Hispanic Asian	2.78 (2.12 – 3.64)**	5.18 (3.31 – 8.12)**	1.87 (1.16 – 3.00)*
Other/Multi-Racial	1.82 (1.27 – 2.61)*	2.83 (1.16 – 6.93)*	1.56 (0.66 – 3.568

NHANES, National Health and Nutrition Examination Survey; Ref, reference group.

[a]Supplemental Model 3 adjusted for year of data collection, age, sex, education level, body mass index, health insurance status, and NHANES sampling design.

Supplemental Table 2. *Frequencies of Diabetes Status by Immigrant Status, Stratified by Race/Ethnicity in NHANES 2011-2018*

Group	No Diabetes (*n* = 17816)	Diagnosed Diabetes (*n* = 2846)	Undiagnosed Diabetes (*n* = 644)	Total (*n* = 21306)
	n	*n*	*n*	*n*
U.S.-Born Non-Hispanic White	6488	892	130	7510
Foreign-born Non-Hispanic White	303	26	4	333
U.S.-Born Non-Hispanic Black	3417	656	168	4241
Foreign-born Non-Hispanic Black	404	76	22	502
U.S.-Born Mexican American	1083	191	27	1301
Foreign-born Mexican American	1314	287	79	1680
U.S.-Born Other Hispanic	587	89	11	687
Foreign-born Other Hispanic	1262	213	74	1549
U.S.-Born Non-Hispanic Asian	370	21	6	397
Foreign-born Non-Hispanic Asian	1921	293	103	2317
U.S.-Born Other/Multi-Racial	555	91	4	650
Foreign-born Other/Multi-Racial	112	11	3	126

NHANES = National Health and Nutrition Examination Survey.

Race/Ethnicity		OR (95% CI)
NHW		0.58 (0.26 - 1.31)
NHB		1.20 (0.84 - 1.73)
MA		1.14 (0.87 - 1.49)
OH		0.75 (0.51 - 1.11)
NHA		1.71 (1.07 - 2.72)*
OMR		1.12 (0.33 - 3.82)

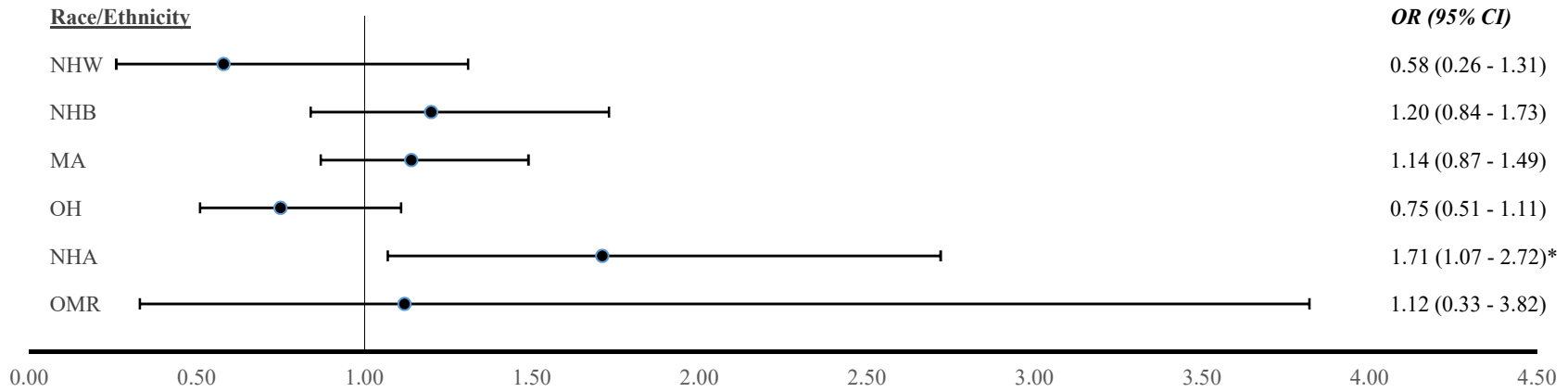0.00 0.50 1.00 1.50 2.00 2.50 3.00 3.50 4.00 4.50

Figure 1. Forest plot summarizing odds ratio estimates of association of being foreign-born with having *diagnosed diabetes* versus *no diabetes*, stratified by six race/ethnicity groups. Data from NHANES 2011-2018. Models adjusted for year of data collection, age, sex, education, body mass index, health insurance, and NHANES sampling design. NHW = Non-Hispanic White, NHB = Non-Hispanic Black, MA = Mexican American, OH = Other Hispanic, NHA = Non-Hispanic Asian, OMR = Other/Multi-Racial, NHANES = National Health and Nutrition Examination Survey.
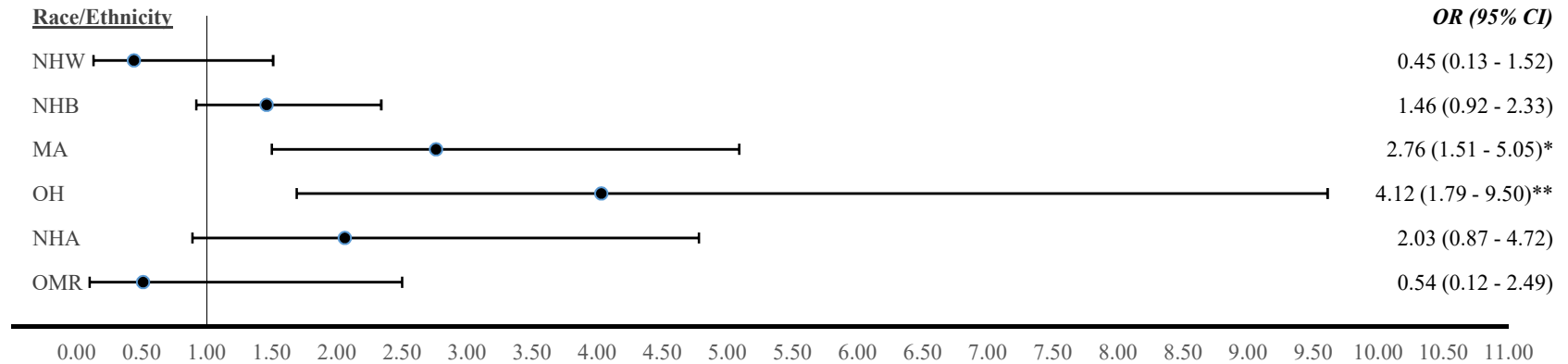
*$p < 0.05$

Race/Ethnicity		OR (95% CI)
NHW		0.45 (0.13 - 1.52)
NHB		1.46 (0.92 - 2.33)
MA		2.76 (1.51 - 5.05)*
OH		4.12 (1.79 - 9.50)**
NHA		2.03 (0.87 - 4.72)
OMR		0.54 (0.12 - 2.49)

Figure 1. Forest plot summarizing odds ratio estimates of association of being foreign-born with having *undiagnosed diabetes* versus *no diabetes*, stratified by six race/ethnicity groups. Data from NHANES 2011-2018. Models adjusted for year of data collection, age, sex, education, body mass index, health insurance, and NHANES sampling design. NHW = Non-Hispanic White, NHB = Non-Hispanic Black, MA = Mexican American, OH = Other Hispanic, NHA = Non-Hispanic Asian, OMR = Other/Multi-Racial, NHANES = National Health and Nutrition Examination Survey.
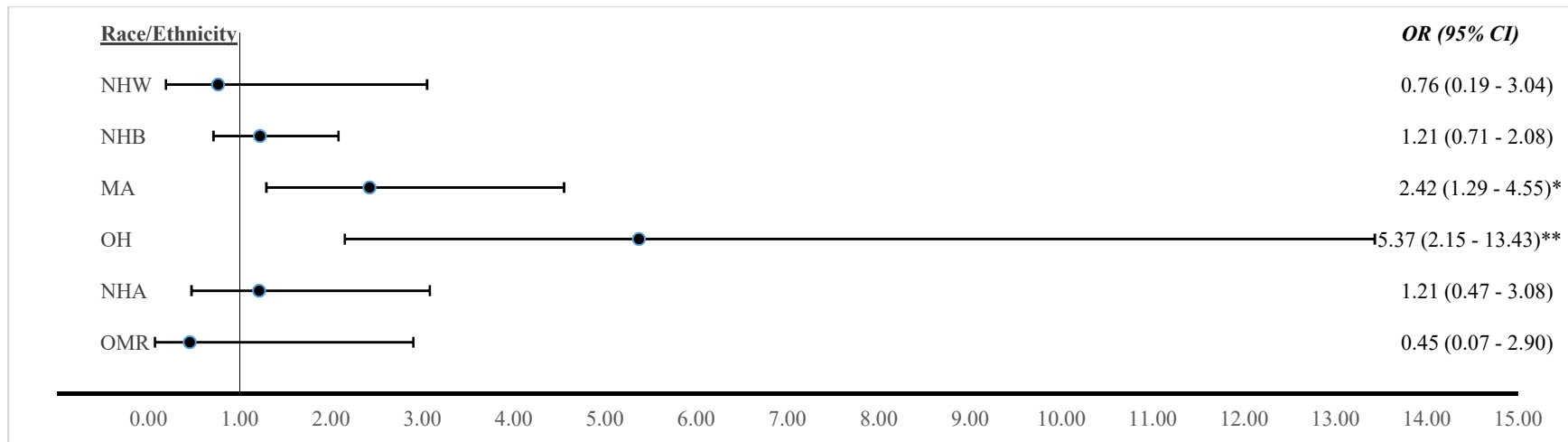
*$p < 0.05$, ** $p < 0.001$

Figure 3. Forest plot summarizing odds ratio estimates of association of being foreign-born with having *undiagnosed diabetes* versus *diagnosed diabetes*, stratified by six race/ethnicity groups. Data from NHANES 2011-2018. Models adjusted for year of data collection, age, sex, education, body mass index, health insurance, and NHANES sampling design. NHW = Non-Hispanic White, NHB = Non-Hispanic Black, MA = Mexican American, OH = Other Hispanic, NHA = Non-Hispanic Asian, OMR = Other/Multi-Racial, NHANES = National Health and Nutrition Examination Survey. *$p < 0.05$, ** $p < 0.001$