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Influenza vaccination coverage among adults by nativity, race/ethnicity, citizenship, and language of the interview - United States, 2012–2013 through 2017–2018 influenza seasons

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Abstract

Background: Approximately 20,000 people died from influenza in the US in the 2019–2020 season. The best way to prevent influenza is to receive the influenza vaccine. Persons who are foreign-born experience disparities in access to, and utilization of, preventative healthcare, including vaccination.

Methods: National Health Interview Survey data were analyzed to assess differences in influenza vaccination coverage during the 2012–2013 through 2017–2018 influenza seasons among adults by nativity, citizenship status of foreign-born persons, race/ethnicity, and language of the interview.

Results: Influenza vaccination coverage increased significantly during the study period for US-born adults but did not change significantly among foreign-born racial/ethnic groups except for increases among foreign-born Hispanic adults. Coverage for foreign-born adults, those who completed an interview in a non-English language, and non-US citizens, had lower vaccination coverage during most influenza seasons studied, compared with US-born, English-interviewed, and US-citizen adults, respectively.

Conclusions: Strategies to improve influenza vaccination uptake must consider foreign-born adults as an underserved population in need of focused, culturally-tailored outreach. Achieving high influenza vaccination coverage among the foreign-born population will help reduce illness

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CONFLICTS OF INTEREST

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among the essential workforce, achieve national vaccination goals, and reduce racial and ethnic disparities in vaccination coverage in the US.

Keywords

Influenza; Vaccination; Immunization; Foreign-born; Migrant

People residing in the United States who were born outside of the country (foreign-born) make up 13.6% (or 44.8 million in 2018) of the population and are disproportionately represented among racial and ethnic minority groups and in the essential workforce compared with people who are US-born.¹ Foreign-born persons experience disparities in access to and utilization of health care and preventive services.² Approximately 25% of persons residing in the US who are foreign-born were born in Mexico.³ Persons who were born in Mexico and live in the US are less likely to speak English, have lower rates of educational attainment, and are more likely to live in poverty than overall foreign-born populations in the US, amplifying barriers to healthcare-seeking in this population.⁴ An annual influenza vaccination is recommended by the Advisory Committee on Immunization Practices for all people 6 months and older who do not have contraindications to vaccination; vaccination is an effective way to prevent illness, hospitalization, and death caused by influenza.⁵ People from racial and ethnic minority groups are less likely to be vaccinated against, and are at higher risk for hospitalization with, influenza.⁶

METHODS

We analyzed data from the NHIS, a cross-sectional, annual, in-person household survey of eligible civilian non-institutionalized adults. Interviews are conducted by the US Census Bureau for the Centers for Disease Control and Prevention's National Center for Health Statistics. Detailed NHIS methods have been published elsewhere.⁷ This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.* The final response rates for estimating influenza vaccination coverage for the 2017–2018 influenza season were 53.0% for 2017 and 53.1% for 2018. The final response rates for estimating influenza vaccination coverage for the 2012–2013 influenza season were 61.2% for 2012 and 61.2% for 2013.^{8,9} Questions about vaccination are asked of one randomly selected adult within each family in the household. Seasonal influenza vaccination status was assessed by asking respondents whether they had received influenza vaccine during the past 12 months and in what month and year the vaccine was received. Interviews from August of the prior year through June of the following year of each influenza season were used to estimate influenza vaccination coverage from July of the prior year through May of the following year using Kaplan-Meier survival analysis. Individuals who refused to answer the influenza vaccination question or did not know their vaccination status were excluded from the analysis (range: 1.6%–1.9%, 2012–2013 through 2017–2018 influenza seasons). Vaccination month and year were imputed for individuals who reported they received vaccination but did not report their month and year of vaccination (range: 2.9%–3.8%, 2012–2013 through 2017–2018 influenza seasons). Foreign-born persons were defined as a

*See for example, 45 C.F.R part 46, 21 C.F.R. part 56; 42 U.S.C. §241 (d); 5 U.S.C. §552a; 44 U.S.C. §3501 et seq.

person not born in a US state or territory and not a US citizen at birth.¹⁰ US-born person refers to a person born in a US state or territory or born abroad of at least one US citizen parent.⁷ Race/ethnicity was reported by respondent and was categorized as Hispanic/Latino, Black, White, Asian, and “other race”. People who identified as Hispanic/Latino might be of any race. People who identified as Black, White, Asian, or other race are non-Hispanic. “Other race” includes American Indian/Alaska Native and people who identified multiple races. The five race/ethnicity categories are mutually exclusive.

Descriptive analyses were performed to calculate weighted estimates of seasonal influenza vaccination coverage. Pair-wise comparisons of influenza vaccination coverage were conducted between US-born citizens and all foreign-born persons, naturalized US citizens, and non-US citizens, respectively. Additional pair-wise comparisons were conducted between US-born and foreign-born adults within each race/ethnicity category, and between English interview and both non-English interview and Spanish interview respondents. Point estimates and 95% confidence intervals were calculated. We conducted a linear trend analysis to evaluate changes in seasonal influenza vaccination by citizenship status, nativity, race/ethnicity, and language of the interview during the 2012–2013 through 2017–2018 influenza seasons. Tests for linear trend from the 2012–2013 season through the 2017–2018 season were performed using a weighted linear regression on the season-specific estimates, using season number as the independent variable and weights as the inverse of the estimated variance of the estimated vaccination coverage. The estimated slope coefficients were interpreted as the average change across seasons assuming a linear increase. Analysis was conducted using SUDAAN (Research Triangle Institute, Research Triangle Park, NC, version 11.0.3) to account for the complex sampling design. Statistical significance was defined as P -value $< .05$. Increases or decreases noted in this report were statistically significant differences.

RESULTS

Overall, the sample sizes for estimating influenza vaccination coverage during 2012–2013 through 2017–2018 influenza seasons ranged from 24,495 to 33,126, with 17.7%–18.9% of respondents being foreign-born (Table 1). Among the foreign-born respondents, the majority (52.5%–58.5% across the study period) reported being naturalized US citizens. The percentage of foreign-born persons varied by racial/ethnic group: most Hispanic and Asian adults were foreign-born, while most White, Black, and other adults were born in the United States. On average, 6.4% of interviews were conducted in a language other than English, with most non-English interviews in Spanish.

Influenza vaccination coverage significantly increased during the study period for US-born adults overall. Among racial/ethnic groups, only US-born Asian adults significantly increased their influenza vaccination coverage from the 2012–2013 to 2017–2018 season. Coverage did not increase for foreign-born adults, except for foreign-born Hispanic persons. When examined separately, coverage increased in Mexican-born adults, who comprised most foreign-born Hispanic adults. US-born adults showed an average annual vaccination coverage increase of 0.5% points, while coverage increased by 1.8% points among foreign-born Hispanic adults (1.9% points among Mexican-born adults) during the study period

(Table 2 and Fig 1). Foreign-born adults had significantly lower vaccination coverage than US-born adults for most influenza seasons studied, including 4.5% points lower in the 2017–2018 season (42.4% vs 46.9%, respectively). There were significant differences in coverage within some racial/ethnic groups stratified by nativity. Among White adults, those born abroad had lower vaccination coverage than those born in the United States in the 2015–2016 and 2017–2018 seasons (9.3% and 7.4% points lower, respectively). Among Black adults, those born abroad had higher vaccination coverage compared with the US-born in the 2013–2014 and 2017–2018 seasons (9.9 and 14.9% points higher, respectively), but lower coverage in the 2014–2015 and 2015–2016 seasons (8.9% and 4.7% points lower, respectively). Hispanic adults born in Mexico had lower coverage than Hispanic adults born in the United States in the 2013–2014 season (5.5% points lower) (Table 2).

Adults who reported being non-US citizens had lower vaccination coverage for all seasons compared with those who reported being US-born, including 15.4% points lower in the 2017–2018 season (31.5% vs 46.9%, respectively). No significant differences in influenza coverage were identified between naturalized US citizens and US-born persons (Table 2, Fig 1). Additionally, participants interviewed in a language other than English had lower vaccination coverage throughout all study seasons compared with those interviewed in English, including 14.2% points lower in the 2017–2018 season (32.6% vs 46.8%, respectively) (Table 2, Fig 1). Vaccination coverage significantly increased for English and Spanish-speakers over the course of influenza seasons studied, but did not for speakers of other languages.

Figure 2 illustrates the differences in influenza vaccination coverage between the 2012–2013 and 2017–2018 influenza seasons for each race/ethnicity and nativity group. Significant increases in vaccination coverage were observed among US-born Asian (14.7% points), foreign-born Hispanic (8.3% points), US-born Hispanic (5.7% points), foreign-born Black (19.5% points), and US-born White (3.1% points) adults. Persons who were born in Mexico also had a significant increase in vaccination coverage of 7.8% points. US-born and foreign-born persons who reported Hispanic ethnicity had amongst the lowest vaccination coverage in all seasons of the study.

DISCUSSION

Influenza vaccination was lower among foreign-born adults compared with US-born adults throughout most influenza seasons in our study, confirming the findings from an earlier report.¹¹ Importantly, coverage among both population groups (42.4% and 46.9% for the foreign-born and US-born adults, respectively, in the 2017–2018 season) remained well below the Healthy People 2030 national target of 70% of adults vaccinated against influenza.¹² Significant increases in vaccination coverage also were identified when comparing the first and last season of the study period in certain foreign-born groups, such as Black and Hispanic groups. Foreign-born populations experience inequities in socioeconomic conditions and access to health care and preventive services that are negatively associated with vaccination coverage.² For example, a higher percentage of foreign-born adults than US-born adults live in poverty (13.9% vs 10.8%, respectively) and are uninsured (19.6% vs 7.5%, respectively).¹ Foreign-born adults may also be less aware of

US adult immunization recommendations or have different attitudes toward vaccinations.¹³ Many countries have an influenza vaccination policy that varies from that in the United States, potentially leading foreign-born respondents to believe they are following best practices by not receiving the vaccination.¹⁴ This highlights an opportunity for public health education regarding best practices in the United States.

The public charge ground of inadmissibility policy in the U.S. states that an immigrant who is likely to become a public charge, or someone who has received one or more public benefit for more than 12 months within a 36-month period, is generally inadmissible to the U.S. and is ineligible to become a lawful permanent resident.¹⁵ There is evidence that policies restricting immigrants' access to public benefits, particularly the public charge policy, contribute to barriers to access to health services among foreign-born persons.¹⁶ Such disadvantages and lower vaccination coverage are exacerbated among adults who are non-US citizens.¹¹ However, all persons, irrespective of their immigration status, are eligible for vaccination through public health programs.^{17,18} Vaccination initiatives aimed at ensuring equitable access and low or no out of pocket costs for vaccination regardless of health insurance and immigration status have the potential to reduce disparities in vaccine uptake in persons who are foreign-born.^{19,20}

Our findings highlight the importance of collecting country of birth, citizenship, and language within vaccination coverage monitoring programs and data systems and disaggregating racial/ethnic data by those variables to identify vaccination disparities within and among broad racial and ethnic categories.^{2,21} Each racial and ethnic group includes individuals from many countries of origin with diverse cultures, languages spoken, and social and environmental experiences that differentially affect their use of health services and health outcomes.² More disaggregated vaccination coverage data can assist in the implementation of culturally and linguistically appropriate interventions focused on population groups experiencing greater coverage disparities.

The findings in this report are subject to at least five limitations. First, although vaccination is recommended for all adults, influenza vaccination is typically higher among older adults and these results do not account for different age distributions among groups. Additionally, the analysis does not account for other factors that may influence vaccination uptake, including occupation or pregnancy status.²² Second, information on nativity and citizenship was self-reported and might be subject to social desirability bias because of fear of disclosing immigration status. Third, the NHIS response rates among adults decreased during the study period, from 61.2% in 2012 to 53.1% in 2018.^{8,9} Nonresponse bias can result if respondents and nonrespondents differ in their vaccination rates. Fourth, self-report of vaccination status is subject to recall and social desirability biases. Fifth, the NHIS sample excludes persons in the military and those residing in institutions, which might result in underestimation or overestimation of vaccination coverage.

CONCLUSION

Foreign-born persons are an integral part of US society. While foreign-born persons represent 17% of the U.S. workforce, they are disproportionately represented among

essential workers, including the health care (eg, 29% of physicians) and food production industries (eg, 27% of agriculture and fishing workers), making them a vital population to ensure high influenza vaccination coverage levels among essential workers.²³ However, we found evidence of significant disparities among foreign-born adults, particularly among non-US citizen adults. Vaccination outreach and interventions need to take into consideration the cultural and linguistic diversity of foreign-born persons and collaborate with health care providers and community-based organizations serving these groups. Methods of reaching diverse populations should involve engaging communities and trusted leaders and community-based organizations while using multiple, tailored platforms and technologies for messaging (eg, social media, radio stations).^{24–26} Further work is needed to better understand and address barriers to access to vaccinations, gaps in information, cultural, migration-related, and other factors driving vaccination coverage disparities among foreign-born adults. Most (82.3%, or 36.8 million) foreign-born persons self-identify as one of the racial and ethnic minority groups.¹ Additionally, as US-born Black adults had significantly lower vaccination rates than their foreign-born counterparts in some influenza seasons studied, there remains a need for understanding disparities in vaccination rates in this population also. Addressing coverage disparities in vaccination uptake among groups experiencing greater disparities will support the elimination of racial and ethnic disparities in disease burden. This is of even greater importance within the context of the COVID-19 pandemic, to ensure equitable access to the COVID-19 vaccine.²¹

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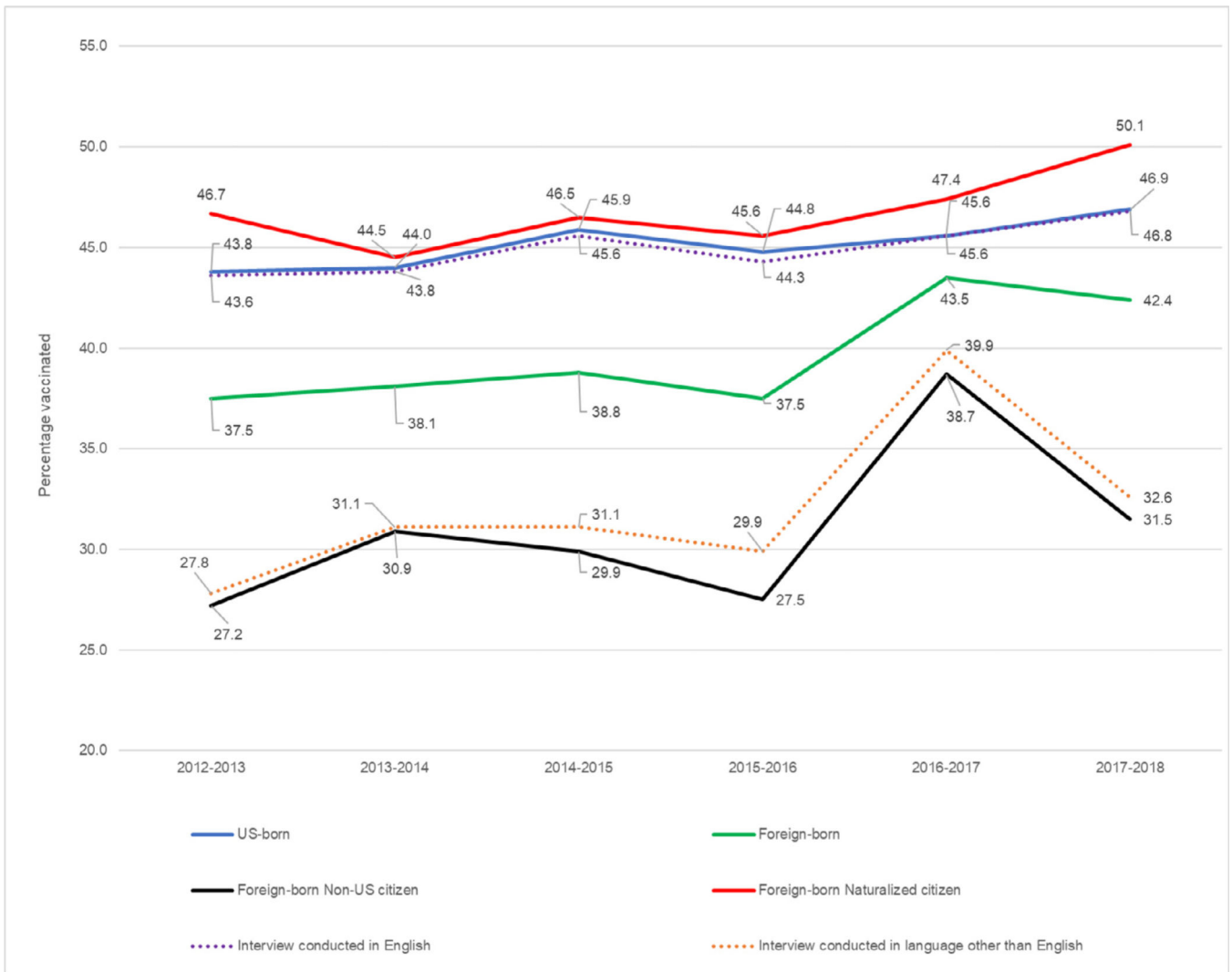


Fig 1. Seasonal influenza vaccination coverage trends by nativity, citizenship, and language of interview, US adults aged 18 y, National Health Interview Survey, 2012–2013 through the 2017–2018 influenza seasons.

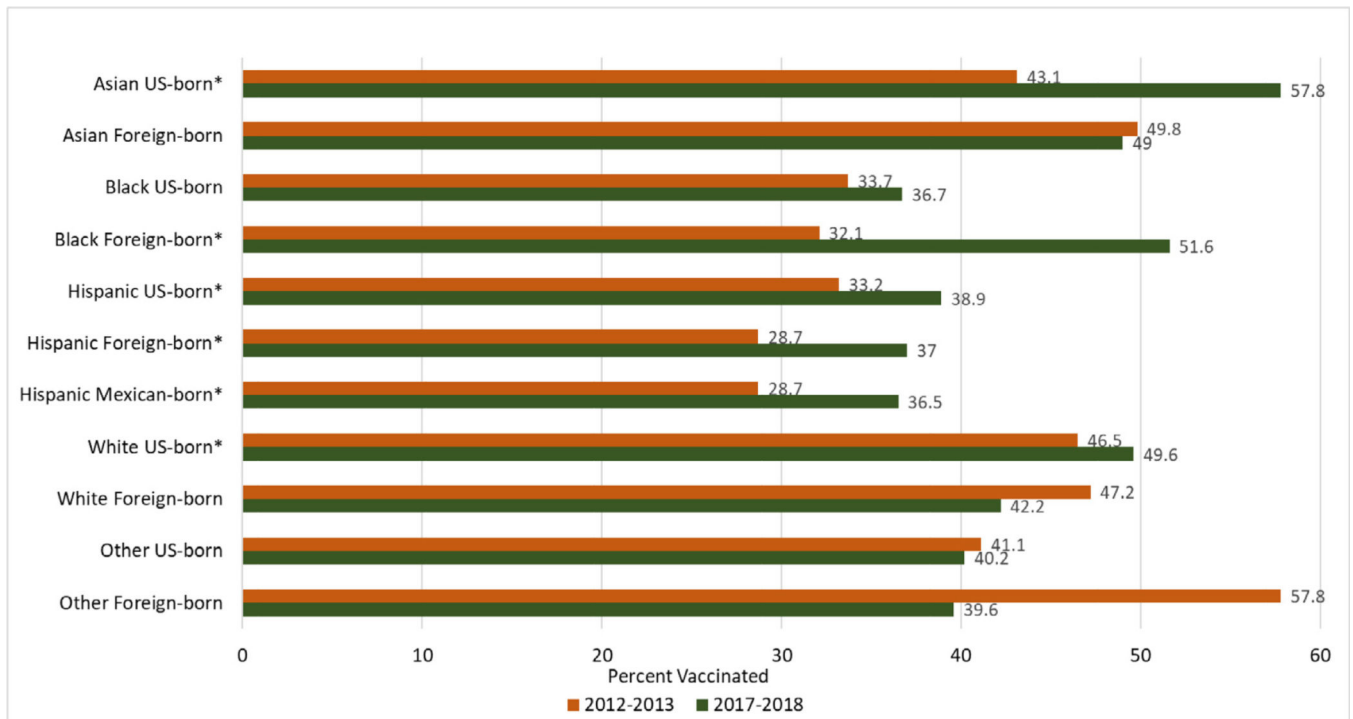


Fig 2. Seasonal influenza vaccination coverage by race/ethnicity and nativity, US adults aged 18 y, National Health Interview Survey, 2012–2013 and 2017–2018 influenza seasons. T-tests were conducted to assess differences in influenza vaccination coverage between the 2012–2013 and 2017–2018 influenza season for each variable, and significant differences in vaccination coverage were observed among non-Hispanic (NH)-Asian US-born, Hispanic-Mexican-born, Hispanic Foreign-born, Hispanic US-born, NH-Black Foreign-born, and NH-White US-born and are marked with an asterisk(*).

Table 1

Number of respondents by nativity, citizenship, race/ethnicity and language of interview, US adults, National Health Interview Survey, 2012–2013 through 2017–2018 influenza seasons

	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018
	N (weighted %)	N (weighted %)	N (weighted %)	N (weighted %)	N (weighted %)	N (weighted %)
Total Interviewed	31,077 (100)	33,126 (100)	32,790 (100)	29,345 (100)	27,279 (100)	24,495 (100)
Nativity*						
US-born	25,077 (82.3)	27,015 (81.9)	26,706 (81.5)	24,500 (81.1)	23,329 (81.3)	20,754 (81.3)
Foreign-born	5,989 (17.7)	6,100 (18.1)	6,067 (18.5)	4,832 (18.9)	3,936 (18.7)	3,732 (18.7)
Citizenship among foreign-born						
Naturalized US citizen	3,045 (52.5)	3,144 (53.5)	3,123 (53.5)	2,647 (53.8)	2,273 (56.7)	2,223 (58.5)
Non-US citizen	2,917 (47.5)	2,940 (46.5)	2,913 (46.5)	2,163 (46.2)	1,636 (43.3)	1,468 (41.5)
Race/ethnicity [†] by nativity						
Asian	1,901 (5.3)	1,885 (5.4)	1,786 (5.6)	1,591 (5.9)	1,309 (5.8)	1,239 (6.0)
US-born	478 (23.8)	442 (20.3)	429 (21.5)	418 (21.9)	337 (21.8)	311 (21.6)
Foreign-born	1,422 (76.2)	1,443 (79.7)	1,355 (78.5)	1,171 (78.1)	972 (78.2)	925 (78.4)
Black	4,510 (11.4)	4,562 (11.5)	4,310 (11.6)	3,472 (11.6)	2,941 (11.7)	2,558 (11.6)
US-born	4,074 (88.9)	4,092 (88.1)	3,810 (86.4)	3,078 (85.6)	2,609 (85.4)	2,261 (85.9)
Foreign-born	434 (11.1)	468 (11.9)	497 (13.6)	392 (14.4)	330 (14.6)	296 (14.1)
Hispanic	5,406 (15.0)	5,490 (15.0)	5,489 (15.4)	4,044 (15.7)	3,181 (15.9)	3,056 (16.2)
US-born	2,163 (40.6)	2,267 (42.1)	2,239 (42.9)	1,713 (42.0)	1,486 (45.1)	1,411 (46.1)
Foreign-born	3,239 (59.4)	3,218 (57.9)	3,243 (57.1)	2,327 (58.0)	1,691 (54.9)	1,644 (53.9)
Mexican-born [‡]	2,888 (88.3)	2,854 (88.6)	2,937 (90.6)	2,061 (88.5)	1,466 (86.9)	1,409 (86.5)
White	18,542 (66.3)	20,321 (66.0)	20,368 (65.3)	19,406 (64.5)	19,097 (64.1)	16,974 (63.6)
US-born	17,691 (95.0)	19,402 (94.6)	19,452 (94.6)	18,534 (94.9)	18,204 (94.6)	16,154 (94.6)
Foreign-born	848 (5.0)	915 (5.4)	911 (5.4)	868 (5.1)	885 (5.4)	816 (5.4)
Other race	718 (1.9)	868 (2.1)	837 (2.1)	832 (2.3)	751 (2.4)	668 (2.7)
US-born	671 (93.9)	812 (92.5)	776 (91.7)	757 (89.1)	693 (89.9)	617 (91.7)
Foreign-born	46 (6.1)	56 (7.5)	61 (8.3)	74 (10.9)	58 (10.1)	51 (8.3)
Language of interview						
English interview	28,770 (93.6)	30,788 (93.5)	30,360 (93.3)	27,738 (93.5)	26,154 (93.9)	23,431 (94.1)
Non-English interview	2,307 (6.4)	2,338 (6.5)	2,430 (6.7)	1,607 (6.5)	1,125 (6.1)	1,064 (5.9)

	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018
	N (weighted %)	N (weighted %)	N (weighted %)	N (weighted %)	N (weighted %)	N (weighted %)
Spanish interview [§]	1,407 (3.6)	1,357 (3.6)	1,418 (3.6)	974 (3.7)	671 (3.5)	620 (3.4)

* Foreign-born persons were defined as persons not born in a U.S. state or territory and not a US citizen at birth. US-born persons refer to persons born in a U.S. state or territory or those born abroad of at least one US citizen parent. 12

[†] Race/ethnicity was reported by respondent. People identified as Hispanic/Latino might be of any race. People identified as Black, White, Asian, or other race are non-Hispanic.

“Other” includes American Indian/Alaska Native and individuals who identified multiple races.

[‡] Mexican-born presented as percentage of total foreign-born respondents

[§] Spanish interview presented as percentage of total responses to language of interview

Table 2

Seasonal influenza vaccination coverage by nativity, race/ethnicity[†], and language of interview, U.S. adults, National Health Interview Survey, 2012–2013 through 2017–2018 influenza seasons[‡]

	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018	Total Change [§] %	Average Annual Change %	P-value*
US-born [#]	43.8 (42.6–44.9)	44.0 (42.8–45.3)	45.9 (44.8–47.1)	44.8 (43.6–46.0)	45.6 (44.4–46.8)	46.9 (45.7–48.1)	3.1	0.5	.03
Foreign-born [#]	37.5 (35.0–40.0)**	38.1 (35.7–40.5)**	38.8 (36.5–41.3)**	37.5 (34.8–40.3)**	43.5 (40.6–46.5)	42.4 (39.6–45.3)**	4.9	1.1	.06
Naturalized US citizen	46.7 (43.2–50.3)	44.5 (41.8–47.4)	46.5 (43.4–49.7)	45.6 (42.0–49.3)	47.4 (44.2–50.7)	50.1 (46.3–54.1)	3.4	0.7	.12
Non-US citizen	27.2 (24.3–30.4)**	30.9 (27.8–34.2)**	29.9 (26.4–33.6)**	27.5 (24.1–31.2)**	38.7 (34.1–43.8)**	31.5 (27.5–35.9)**	4.3	1.0	.28
Asian US-born [#]	43.1 (36.2–50.6)	44.3 (35.6–54.0)	53.2 (45.5–61.4)	55.1 (46.3–64.4)	51.0 (42.2–60.5)	57.8 (47.8–68.2) ^{††}	14.7	2.8	.03
Foreign-born	49.8 (45.0–54.7)	44.7 (40.1–49.5)	47.9 (43.3–52.8)	48.5 (42.5–54.9)	50.0 (43.9–56.4)	49.0 (43.8–54.6)	-0.8	0.3	.56
Black US-born [#]	33.7 (30.8–36.6)	35.3 (32.8–38.0)	39.0 (36.3–41.7)	40.4 (37.0–44.0)	38.9 (35.4–42.6)	36.7 (32.8–40.9)	3.0	1.0	.16
Foreign-born	32.1 (24.6–41.2)	45.2 (37.3–53.8)**	30.1 (24.2–36.9)**	35.7 (27.4–45.6)**	37.5 (26.3–51.6) ^{††}	51.6 (43.0–60.8)**	19.5	2.5	.30
Hispanic US-born [#]	33.2 (29.8–37.0)	35.5 (31.5–39.8)	32.3 (29.1–35.6)	35.0 (30.3–40.1)	33.5 (29.1–38.4)	38.9 (35.2–42.9)	5.7	0.8	.20
Foreign-born	28.7 (25.8–31.9)	31.0 (28.0–34.2)	34.1 (30.8–37.6)	31.9 (28.1–36.0)	39.7 (35.7–43.9)	37.0 (32.8–41.4)	8.3	1.9	.02
Mexican-born	28.7 (25.6–32.1)	30.0 (26.8–33.5)**	33.5 (30.4–36.7)	31.0 (27.0–35.3)	39.4 (35.1–44.1)	36.5 (32.1–41.3)	7.8	1.8	.03
White US-born [#]	46.5 (45.1–47.8)	46.5 (45.0–48.0)	48.5 (47.1–49.8)	46.6 (45.3–47.9)	47.9 (46.7–49.1)	49.6 (48.4–50.8)	3.1	0.5	.08
Foreign-born	47.2 (40.8–54.0)	44.6 (39.2–50.3)	43.6 (38.5–49.2)	37.3 (31.9–43.5)**	47.8 (42.7–53.2)	42.2 (37.1–47.7)**	-5.0	-0.5	.65
Other race US-born [#]	41.1 (35.0–47.7)	38.3 (31.8–45.6)	43.6 (35.4–52.8)	37.2 (30.8–44.6)	48.0 (41.0–55.6)	40.2 (34.3–46.7)	-0.9	0.4	.68
Foreign-born	57.8 (37.6–79.3) ^{††}	36.5 (21.1–58.1) ^{††}	33.8 (12.2–72.9) ^{††}	54.1 (38.9–70.8) ^{††}	50.1 (29.9–74.5) ^{††}	39.6 (22.8–62.6) ^{††}	-18.2	-0.6	.81
Language of Interview English									
interview [#]	43.6 (42.6–44.7)	43.8 (42.6–45.0)	45.6 (44.5–46.7)	44.3 (43.2–45.5)	45.6 (44.4–46.7)	46.8 (45.7–47.9)	3.2	0.6	.02

	2012–2013	2013–2014	2014–2015	2015–2016	2016–2017	2017–2018	Total Change [§] %	Average Annual Change // %	P-value *
Non-English interview	27.8 (24.5–31.6) **	31.1 (27.7–34.9) **	31.1 (28.1–34.4) **	29.9 (25.5–34.9) **	39.9 (35.3–45.0) **	32.6 (27.8–37.9) **	4.8	1.4	.13
Spanish interview	27.0 (22.7–32.1) **	28.7 (24.8–33.1) **	29.4 (25.0–34.3) **	29.9 (24.2–36.5) **	34.6 (28.8–41.3) **	33.1 (26.1–41.3) **	6.1	1.4	.01

* P-value <.05 for overall trend.

** P-value <.05 by t test within each variable with the indicated reference level.

[†] Race/ethnicity was reported by respondent. People identified as Hispanic/Latino were of any race. People identified as Black, White, Asian, or other race were non-Hispanic. “Other” includes American Indian/Alaska Native and individuals who identified multiple races.

[‡] Interviews from August of the prior year through June of the next year of each influenza season were used to estimate coverage from July of the prior year through May of the next year using Kaplan-Meier survival analysis.

[§] Total change from the 2012–2013 season through the 2017–2018 season.

// Average annual change from the 2012–2013 season to the 2017–2018 season. Tests for linear trend from the 2012–2013 season through the 2017–2018 season were performed using a weighted linear regression on the season-specific estimates, using season number as the independent variable and weights as the inverse of the estimated variance of the estimated vaccination coverage. The estimated slope coefficients were interpreted as the average change across seasons assuming a linear increase.

[#] Foreign-born persons were defined as persons not born in a U.S. state or territory and were not a US citizen at birth. US-born persons refer to persons born in a U.S. state or territory or those born abroad of at least one US citizen parent.

[#] Reference level.

^{††} Estimate may be unreliable either due to relative standard error (standard error/estimate) >.3 and/or CI half-width >10.