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Vaccination coverage among foreign-born and U.S.-born adolescents in the United States: Successes and gaps – National Immunization Survey-Teen, 2012–2014

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Abstract

Background: An overall increase has been reported in vaccination rates among adolescents during the past decade. Studies of vaccination coverage have shown disparities when comparing foreign-born and U.S.-born populations among children and adults; however, limited information is available concerning potential disparities in adolescents.

Methods: The National Immunization Survey-Teen is a random-digit-dialed telephone survey of caregivers of adolescents aged 13–17 years, followed by a mail survey to vaccination providers that is used to estimate vaccination coverage among the U.S. population of adolescents. Using the National Immunization Survey-Teen data, we assessed vaccination coverage during 2012–2014 among adolescents for routinely recommended vaccines for this age group (1 dose tetanus and diphtheria toxoids and acellular pertussis [Tdap] vaccine, 1 dose quadrivalent meningococcal conjugate [MenACWY] vaccine, 3 doses human papillomavirus [HPV] vaccine) and for routine childhood vaccination catch-up doses (2 doses measles, mumps, and rubella [MMR] vaccine, 2 doses varicella vaccine, and 3 doses hepatitis B [HepB] vaccine). Vaccination coverage prevalence and vaccination prevalence ratios were estimated.

Results: Of the 58,090 respondents included, 3.3% were foreign-born adolescents. Significant differences were observed between foreign-born and U.S.-born adolescents for insurance status,

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Conflict of interest statement

No conflicts of interest were reported by any of the authors. The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

income-to-poverty ratio, education, interview language, and household size. Foreign-born adolescents had significantly lower unadjusted vaccination coverage for HepB (89% vs. 93%), and higher coverage for the recommended 3 doses of HPV vaccine among males, compared with U.S.-born adolescents (22% vs. 14%). Adjustment for demographic and socioeconomic factors accounted for the disparity in HPV but not HepB vaccination coverage.

Conclusions: We report comparable unadjusted vaccination coverage among foreign-born and U.S.-born adolescents for Tdap, MenACWY, MMR, 2 varicella. Although coverage was high for HepB vaccine, it was significantly lower among foreign-born adolescents, compared with U.S.-born adolescents. HPV and 2-dose varicella vaccination coverage were low among both groups.

Keywords

Adolescent; Vaccination; Immunization; Foreign-born; Human papillomavirus; Teen

1. Background

Routine adolescent vaccination against vaccine-preventable diseases (VPDs) prevents serious illness [1]. During 2012–2014, the Advisory Committee on Immunization Practices' (ACIP) recommendation for adolescents aged 13–17 years in the United States was to receive 1 dose of tetanus and diphtheria toxoids and acellular pertussis (Tdap) vaccine at 11–12 years, 2 doses of quadrivalent meningococcal conjugate (MenACWY) vaccine, one at 11–12 years and one at 16–18 years, and 3 doses of human papillomavirus (HPV) vaccine starting at 11–12 years. Additionally, catch-up vaccination doses are recommended for adolescents who have not already received these vaccines in childhood to bring the adolescent up-to-date with 2 doses of measles, mumps, and rubella (MMR) vaccine, 2 doses of varicella vaccine, and 3 doses of hepatitis B (HepB) vaccine. Vaccination coverage for most vaccines recommended during adolescence has increased during the last decade [1]. However, coverage for certain vaccines remains below levels adequate to reduce disease transmission, and disparities by race and socioeconomic status exist [1].

Approximately 7% (n = 716,000) of persons aged 15–19 years in the United States were born in another country [2]. Most were born in Latin America or Asia, where vaccination schedules, access, and practices can differ from the United States [3]. Although vaccination coverage has improved globally, VPDs are still endemic in many countries. In 2013, vaccination rates in Latin American and Asian children <12 months old were over 74% for 1 dose of DTP3, 1 dose of a measles-containing vaccine, and 3 doses of HepB [4]. However, some vaccines that are routinely recommended for children and adolescents in the U.S. (e.g., HPV, varicella, and MenACWY) are not routinely recommended in these regions, possibly resulting in lower coverage among these adolescents.

In the United States, vaccination disparities have been reported when comparing foreign-born and U.S.-born populations. Vaccination coverage ¹with routinely recommended

¹Vaccination coverage was estimated for the 2011–12 seasonal influenza vaccine, pneumococcal polysaccharide vaccine, tetanus and pertussis vaccines received during the past 7–10 years, 2 doses of hepatitis A vaccine, 3 doses of hepatitis B vaccine, shingles vaccine, and 1 dose of human papillomavirus vaccine.

vaccines was 10%–40% lower among foreign-born adults [5] and the likelihood of foreign-born children aged 19–35 months completing the combined seven-vaccine series² was 61% lower than among U.S.-born children [6]. For adolescents, no such comparison exists. A vaccination coverage evaluation between foreign-born and U.S.-born adolescents could identify disparities, which might indicate differential risk for VPDs by nativity. Disparity characterization will help determine the need for targeted efforts to increase vaccination coverage.

The Centers for Disease Control and Prevention monitors vaccination coverage among adolescents through the National Immunization Survey-Teen (NIS-Teen). Using these data, we determine if disparities exist between foreign-born and U.S.-born adolescents in vaccination coverage for Tdap, MenACWY, HPV, MMR, HepB, and varicella vaccines. Additionally, coverage by birth-region, and differences in attitudes and barriers to HPV, Tdap and MenACWY vaccination were assessed.

2. Methods

The NIS-Teen is an annual, random-digit-dialed survey via land-line and cell phone that collects vaccination information for noninstitutionalized adolescents aged 13–17 years old. Interviews are conducted with a household member over 17 years old who is knowledgeable about the adolescent's medical history (hereinafter referred to as parent) in their language of choice [7]. If a vaccination history is reported, a survey detailing the adolescent's vaccination history is mailed to the healthcare provider after obtaining parental permission to do so. We limited the 2012–2014 data analysis to adolescents with adequate provider data, which is defined as a provider's report of vaccination (2012–2013), at least one provider reporting vaccination (2014) [8], or a provider or parent reporting no vaccinations received. Adolescents living in U.S. territories (e.g., Puerto Rico, Guam, and the U.S. Virgin Islands) were excluded because data were unavailable for all three study period years. Survey responses were weighted using previously described methodology to adjust for over- or undersampled subpopulations, nonresponse, or no household telephone [7,9]. NIS-Teen was approved by the National Center for Health Statistics Research Ethics Review Board (Protocol # 2015-07). Categories used in the analysis were, for the most part, defined by the structure of the survey [7].

2.1. Statistical analyses

2.1.1. Population characteristics—Demographic, socioeconomic, and access-to-care indicators were compared among foreign-born and U.S.-born adolescents. Comparisons included race, ethnicity, sex, age, education level, health insurance coverage, number of vaccination providers (a proxy for access-to-care), maternal race and ethnicity, maternal age, maternal marital status, the mother's highest education level, interview language (English, Spanish, all other languages), household size, income-to-poverty ratio, and United States

²4:3:1:3*:3:1:4 is the vaccine series recommended by ACIP for children aged 19–35 months, including 4 doses of diphtheria, tetanus, and acellular pertussis vaccine/diphtheria and tetanus toxoids vaccine/diphtheria, tetanus toxoids, and pertussis vaccine, 3 doses of poliovirus vaccine, 1 dose of measles-containing vaccine, 3 or 4 doses of *Haemophilus influenzae* type b vaccine depending on product type received, 3 doses of hepatitis B vaccine, 1 dose of varicella vaccine, and 4 doses of pneumococcal conjugate vaccine.

Census region (potential regional differences in vaccination requirements). Chi-square tests were performed on weighted data to determine statistical significance of differences between the two groups.

2.1.2. Vaccination coverage prevalence by population characteristics—We calculated vaccination coverage prevalence estimates for foreign-born and U.S.-born adolescents for the following doses of the recommended vaccines: 1 dose of Tdap; 1 dose of MenACWY (the recommendation includes two doses, but the second dose can be given up to 18 year of age so may not be captured by NIS-Teen); 1, 2, and 3 doses of HPV vaccine for each sex; and the following catch-up vaccines: 2 doses MMR; 3 doses HepB; and 1 and 2 doses of varicella vaccine among those with no chickenpox history. Each of the three recommended HPV vaccine series doses were evaluated to capture adolescents who have started, but not yet completed the series. Estimates were further stratified by the adolescent's birth region (Latin America, Europe, Asia, and Other); data for this comparison were only available from 2014 survey data.

2.1.3. Adjusted coverage prevalence and prevalence ratios—Vaccination coverage estimates were adjusted for characteristics observed to be significantly different between foreign-born and U.S.-born adolescents (see section 2.1.1). Adjusted prevalence ratios were estimated by predictive marginals using logistic regression and the survey data analysis package, "survey," in the statistical software, R, version 3.1.1 [10].

2.1.4. Attitudes towards and barriers to vaccination—NIS-Teen includes questions about attitudes and barriers to HPV, Tdap, and MenACWY vaccination, which are detailed in the NIS-Teen user's guide [7]. We compared responses between the foreign-born and U.S.-born groups. Response options for the decision to vaccinate against HPV included physician recommendation, knowledge about HPV or vaccine, necessity of vaccination, receptiveness, access to care, school requirements, convenience, adequate safety information, and the understanding that vaccination helps prevent HPV infection, genital warts, cervical cancer, anal cancer, and cancer of the throat; these data were only available from 2012 and 2013 survey data. Reasons that adolescents were not vaccinated for HPV, Tdap, and MenACWY included lack of a physician's recommendation, lack of knowledge about HPV or vaccine, lack of access to care, lack of school requirements, safety concerns, postponement until older, and perceived need or consequence of vaccination.

CDC reviewed this analysis for human subject protection and deemed the work to be nonresearch.

3. Results

3.1. Demographic characteristics

Among 105,477 adolescents in the 2012–2014 NIS-Teen datasets, 58,090 (55.3%) were included in the analysis by having adequate provider data and residing in the 50 states. Of the 58,090, 1936 (3.3%) identified as foreign-born. Approximately one in five foreign-born adolescents were uninsured, compared with only one in 20 U.S.-born adolescents; and a lower proportion of foreign-born adolescents had 3 vaccine providers compared with U.S.-

born (Table 1). Approximately half of foreign-born adolescents lived in a household with an income-to-poverty ratio below 133%, compared with approximately one third of U.S.-born adolescents (Table 1). The majority of foreign-born adolescents' mothers had ≤ 12 years of education, compared with the majority of mothers of U.S.-born having > 12 years of education. The foreign-born adolescents were more likely to have a larger household size and a higher percentage of foreign-born adolescents were Hispanic. Equal proportions of foreign-born adolescents had interviews conducted in English and Spanish, whereas most interviews pertaining to U.S.-born adolescents were conducted in English (Table 1).

3.2. Vaccination coverage prevalence

3.2.1. Nativity—Unadjusted foreign-born and U.S.-born adolescent vaccination coverage estimates are presented in Table 2. Both groups had approximately 90% vaccination coverage for Tdap, HepB, MMR, and 1 dose of varicella, and approximately 80% coverage for MenACWY (Table 2). HPV vaccination coverage for 1 dose was 32%–68% among both groups (Table 2). Completion of the three dose series was observed in 14%–38% of adolescents (Table 2). Comparison between the two groups revealed that foreign-born adolescents had significantly higher coverage for 1 dose and 2 doses of HPV vaccine among females and all doses among males (Table 2).

3.2.2. By birth region—The majority of the foreign-born adolescents in the 2014 survey were of either Latin American origin (49.9%) (i.e., Mexico, Caribbean, Central America, and South America) or Asian origin (24.0%). Birth country was unknown for 3.9% of foreign-born adolescents (Table 1). Coverage with 1 dose of HPV vaccine among Latin American-born females was 20 percentage points higher than reported among U.S.-born females (Table 3); significant differences were not noted for 2 or 3 doses. Among those with no history of varicella disease, Asian-born adolescents had significantly lower varicella vaccination coverage; 19 percentage points lower for 1 dose and 34 percentage points lower for 2 doses (Table 3). No significant differences were reported between European-born (representing 11.0% of the foreign-born study population) and U.S.-born adolescents.

3.2.3. Adjusted coverage prevalence comparison—Vaccination coverage was adjusted for the adolescent's education level, the mother's education level, the adolescent's and mother's race/ethnicity, interview language, health insurance type, number of vaccination providers, the mother's marital status, household size, income-to-poverty ratio for the household, and Census region (Table 2). Adjusted coverage estimates revealed an attenuation of differences between foreign-born and U.S.-born adolescents in HPV vaccination coverage, but foreign-born adolescents were still significantly less likely to have received 3 doses of HepB (Table 2). Among adolescents with no history of varicella, vaccination coverage differences remained significant, with foreign-born adolescents having significantly lower coverage for 1 and 2 varicella vaccine doses (Table 2).

3.3. Attitudes towards and barriers to vaccination

Among parents of vaccinated foreign-born and U.S.-born adolescents, the reason most commonly given for receiving HPV vaccine was the provider's recommendation (41.9% and 42.0% of respondents, respectively; data not shown). Beliefs about HPV vaccination were

different between the foreign-born and U.S.-born adolescents' parents; significantly more foreign-born adolescents' parents believed the vaccine prevents HPV infection (77.9% vs. 69.6%), cervical cancer (75.7% vs. 66.1%), genital warts (63.6% vs. 48.8%), and that it is safe (69.7% vs. 62.9%; Table 4). Although significantly greater among foreign-born adolescents' parents, <50% among both groups believed the HPV vaccine prevents anal or throat cancers (Table 4). Among adolescents unvaccinated for HPV, the most common reason given for not vaccinating was the lack of a provider's recommendation (24.2% of foreign-born and 19.6% of U.S.-born; Table 4). Significantly more parents of foreign-born than U.S.-born reported a lack of knowledge about HPV as a reason for the adolescent not being vaccinated (24% vs. 15%; Table 4).

For both Tdap and MenACWY vaccines, both foreign-born and U.S.-born adolescents' parents most commonly reported a lack of provider recommendation as the reason for not receiving vaccination (Table 4). Significantly more unvaccinated U.S.-born adolescents' parents believed the vaccines were not needed or necessary (Table 4).

4. Discussion

We report that Tdap, MenACWY, and MMR coverage were comparable between the two groups. HepB vaccination coverage was high in both groups, but slightly lower in the foreign-born adolescents compared to the U.S.-born, while 2 dose-varicella and 3 dose-HPV vaccination coverage was low among both groups. Although previous studies have reported lower HPV vaccination coverage among ethnic minorities and low income populations compared to Caucasian and higher income populations [11–14], unadjusted coverage with 3 HPV vaccine doses was significantly higher among foreign-born males, compared with U.S.-born males, and comparable among females. Unadjusted coverage for 3 doses of HPV vaccine was < 38% in foreign-born girls, which is particularly concerning given this group's higher cervical cancer risk [15,16]. Adjustment for demographic and socioeconomic factors explained differences seen in HPV vaccine coverage in both boys and girls, but did not explain the lower coverage in HepB or varicella among foreign-born adolescents; future studies could consider other factors influencing these disparities.

Differences in vaccination coverage between foreign-born and U.S.-born adolescents can be due to differences in vaccination practices by country of origin [17]. In our evaluation by birth region, Latin American-born adolescents (who were the majority of foreign-born adolescents in this sample) had higher HPV vaccination coverage, compared with U.S.-born adolescents. This might have been attributable to the high proportion of adolescents from Mexico where the 2010 coverage rate for three HPV vaccine doses among females was 67% [18], and where, beginning in 2012, all females aged 9 years old were vaccinated against HPV [18,19]. Conversely, Asian adolescents had significantly lower coverage for varicella. This is likely due to varicella vaccine not routinely being recommended to children or adolescents in most Asian countries [20,21].

Parental knowledge, attitudes, and beliefs about vaccination influence the decision to vaccinate, and can differ by culture. We report that both foreign-born and U.S.-born adolescents' parents thought their provider's recommendation was important in deciding

whether to vaccinate their child with HPV, Tdap, and MenACWY vaccines. This information which supports previous findings, combined with previous reports that only 34% of providers among an immigrant-dominant population were recommending HPV vaccine to their eligible patients, highlights the importance of ensuring providers are recommending vaccinations [22–25]. Significantly more parents of foreign-born adolescents said a lack of knowledge about the HPV vaccine was a barrier to vaccination, supporting the findings of previous studies including a review which recommended providing more information to parents about vaccine safety, use, and benefits [23,26]. Our findings would further suggest enhanced education strategies specifically designed for foreign-born parents and their health care providers, such as language-appropriate educational materials available for providers who primarily treat foreign-born populations, are needed. Regardless, foreign-born adolescents' parents were more likely to endorse the safety and effectiveness of vaccines, indicating this population might be more receptive if given more information and provider recommendations. Enhanced education strategies should also address the concerning belief among parents of U.S.-born adolescents that Tdap and MenACWY vaccines are unnecessary for their children; this opinion was identified among approximately 13% of U.S.-born adolescents' parents.

Similarities in coverage between foreign-born and U.S.-born adolescents might result from immigration requirements, which differ by immigration status. Since adolescents applying for U.S legal permanent residence must provide proof of vaccination or receive the first dose of each series for the ACIP-recommended vaccines, except HPV vaccine [27,28], we might expect high coverage for at least the first dose of each vaccine. However, those requirements cannot be applied to international visitors, those with temporary resident or work visas, or unauthorized immigrants [27]. Because we lacked immigration status information, we were unable to determine if these requirements affected our findings. Having that information, along with the adolescent's age at immigration, would allow for determination of at what point during the immigration process vaccination most commonly occurs, which can guide outreach strategies to increase coverage among foreign-born adolescents.

HepB, MMR, Tdap, and varicella vaccination are required by most U.S. states for entry into kindergarten or middle school [29]. Several studies have reported that requiring vaccination for school attendance significantly increases coverage, compared with areas where it is not required [30–34], which might explain our observation that all adolescents had high vaccination coverage for HepB, MMR, and Tdap. Vaccination coverage for 2 doses of varicella vaccine was <80% among all adolescents, possibly because the 2-dose requirement was introduced more recently [35]. Coverage for 1 dose of varicella vaccine was ~90% in all adolescents.

Typically, access to preventive care, including vaccination, is limited for those who are uninsured, have lower income, or belong to minority groups [36–39]; however, even though foreign-born adolescents in our study were more likely to be uninsured and have lower household incomes, their coverage was comparable for MMR, MenACWY, and Tdap vaccines. Differences in HPV vaccination coverage estimates were no longer significant after controlling for access-to-care, socioeconomic, and demographic characteristics, indicating that these factors are contributing to the disparities in coverage. Controlling for

these characteristics did not reduce the disparity in vaccination coverage for 1 dose of varicella vaccine or 3 doses of HepB vaccine indicating that other factors are contributing to lower coverage among the foreign-born adolescents and should be considered in future studies.

A few limitations should be considered with our findings. First, the proportion of respondents who identified as foreign-born was not the same as the national population's proportion; this may affect the generalizability of our results to the greater foreign-born population in the U.S. Second, we did not have the birth country for U.S.-born adolescents' parents, which might have differed from that of the adolescent, and possibly influenced access-to-care and the decision to vaccinate based on cultural practices. This may have contributed to similarities in vaccination coverage between foreign-born and U.S.-born adolescents. Third, the adolescents' birth country was available for only one year of data (2014; n = 20,738 records), decreasing the sample size and requiring aggregation by region, possibly diluting the effect of within-region differences. Lastly, the criteria for adequate provider data used for inclusion into our study changed in 2014, resulting in more adolescents being included than in previous years [8]. However, our estimates were averaged over all three years and would not substantially have changed since neither foreign-born nor U.S.-born adolescents were captured disproportionately after the change. It is also possible that this inclusion criteria of adequate provider data introduced bias if those that did not meet the criteria (e.g. provider records could not corroborate parent's claim of vaccination) are markedly different from those who did.

5. Conclusions

Foreign-born and U.S.-born adolescents are comparably vaccinated with high coverage levels for several recommended vaccines, but gaps remain. Low vaccination coverage for HPV vaccine and 2 doses of varicella vaccine among both foreign-born and U.S.-born adolescents highlights the need for a multifaceted approach to increase coverage, including outreach to remind healthcare providers that their recommendation for vaccination is consistently acknowledged as influential in the decision to vaccinate and to use each visit as an opportunity for administering age-eligible and catch-up vaccinations. The observed disparity in HepB coverage has also been observed among foreign-born adults [5] and children aged 19–35 months [6], indicating a need for vaccination coverage plans specifically designed for foreign-born persons originating from or visiting HepB-endemic countries [40]. Also, reported barriers to vaccination may be reduced with improved patient education strategies that culturally and linguistically cater to the populations served. With this approach, we can work toward high coverage for all U.S. adolescents irrespective of nativity, protect national health, and reduce VPD burden.

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Demographic characteristics of foreign-born and U.S.-born adolescents - National Immunization Survey-Teen, 2012–2014.

Table 1.

Characteristics	Foreign-born		U.S.-born		p-value
N(%)	1936 (3.3)		56,154 (96.7)		
	% ^a	95% CI ^b	% ^a	95% CI ^b	
Adolescent					
Race/ethnicity ^c					<0.001
Hispanic	52.9	(48.9, 57.0)	20.5	(19.8, 21.2)	
Non-Hispanic					
White	17.9	(15.2, 20.5)	56.7	(55.9, 57.4)	
Black	13.0	(10.1, 16.0)	14.0	(13.5, 14.6)	
Other and multiple race	16.2	(13.4, 19.0)	8.8	(8.4, 9.3)	
Female	49.5	(45.5, 53.6)	48.8	(48.0, 49.6)	0.724
Age (years)					0.335
13–15	58.6	(54.6, 62.7)	60.6	(59.9, 61.4)	
16–17	41.4	(37.3, 45.5)	39.4	(38.6, 40.2)	
Grade level					0.027
6th–8th	23.5	(20.3, 26.8)	28.0	(27.3, 28.7)	
9th–12th	74.5	(71.2, 77.8)	70.5	(69.8, 71.2)	
Graduated from HS ^d or Enrolled in GED ^e or Completed GED ^e	1.1	(0.4, 1.8)	0.9	(0.8, 1.1)	
Not in school	0.9	(0.2, 1.5)	0.5	(0.4, 0.6)	<0.001
Health insurance status					
No insurance	20.6	(17.4, 23.7)	5.5	(5.1, 5.9)	
Private insurance	30.1	(26.6, 33.6)	53.2	(52.4, 54)	
Public insurance	45.1	(41.0, 49.1)	40.5	(39.7, 41.3)	
Other	4.3	(1.9, 6.7)	0.8	(0.6, 0.9)	
Number of vaccination providers					
1	57.4	(53.4, 61.4)	50.7	(49.9, 51.5)	<0.001
2	28.4	(24.9, 31.9)	29.1	(28.4, 29.8)	
3	14.2	(11.5, 16.9)	20.1	(19.5, 20.7)	

Characteristics		Foreign-born		U.S.-born		p-value
N(%)		1936 (3.3)		56,154 (96.7)		
		% ^a	95% CI ^b	% ^a	95% CI ^b	
N/A						
Region of birth ^f						
United States		–	–	100	–	
Asia		24.0	(18.0, 30.0)	–	–	
Europe		11.0	(7.5, 14.5)	–	–	
Latin America		49.9	(42.7, 57.0)	–	–	
Other		11.1	(7.4, 15.0)	–	–	
Missing		3.9	(0.8, 7.0)	–	–	
Mother						
Race/ethnicity ^g						<0.001
Hispanic		51.9	(47.9, 55.9)	17.9	(17.2, 18.6)	
Non-Hispanic						
White		19.8	(17.0, 22.6)	61.9	(61.1, 62.7)	
Black		12.6	(9.8, 15.5)	13.5	(13.0, 14.0)	
Asian		13.3	(10.8, 15.8)	3.5	(3.2, 3.9)	
Other		2.4	(1.0, 3.9)	3.2	(2.9, 3.4)	
Age (years)						0.297
<35		11.2	(8.3, 14.1)	9.7	(9.2, 10.2)	
35		88.8	(85.9, 91.7)	90.3	(89.8, 90.8)	
Married		77.1	(74.0, 80.3)	65.0	(64.2, 65.8)	<0.001
Education level						<0.001
<12 years		34.0	(29.9, 38.0)	12.8	(12.2, 13.4)	
12 years (high school graduate)		26.2	(22.6, 29.8)	24.1	(23.4, 24.8)	
>12 years, noncollege graduate		12.3	(9.9, 14.6)	26.9	(26.2, 27.6)	
College graduate		27.6	(24.3, 31.0)	36.2	(35.5, 36.9)	
Household						
Interview language						<0.001
English		42.0	(38.1, 45.9)	89.6	(89.0, 90.2)	
Spanish		44.1	(39.9, 48.2)	9.2	(8.6, 9.8)	

Characteristics	Foreign-born		U.S.-born		p-value
	% ^a	95% CI ^b	% ^a	95% CI ^b	
N(%)	1936 (3.3)		56,154 (96.7)		
Other	14.0	(11.3, 16.6)	1.2	(1.0, 1.4)	
Number of persons in household					<0.001
3	18.0	(15.1, 20.9)	25.6	(24.9, 26.3)	
4	27.6	(24.2, 30.9)	32.8	(32.1, 33.5)	
5	27.5	(23.7, 31.2)	23.0	(22.3, 23.7)	
6	27.0	(23.1, 30.9)	18.7	(18.0, 19.3)	
Income-to-poverty ratio ^h					<0.001
<133%	57.3	(53.4, 61.2)	32.5	(31.7, 33.3)	
133%–<300%	21.8	(18.6, 25.0)	27.2	(26.6, 27.9)	
300%	20.9	(18.1, 23.8)	40.3	(39.5, 41.0)	
U.S. census region of residence					<0.001
Northeast	21.9	(19.1, 24.7)	16.6	(16.3, 16.9)	
Midwest	12.8	(10.7, 14.9)	22.2	(21.9, 22.6)	
South	37.7	(33.9, 41.5)	37.5	(37.0, 38.0)	
West	27.7	(23.4, 31.9)	23.7	(23.2, 24.3)	

^aWeighted percentage; the data was weighted using previously described methodology to adjust for over- or undersampled subpopulations, nonresponse, or no household telephone [8,9].

^bCI: Confidence interval.

^cAdolescent's race/ethnicity was reported by parent or guardian. Adolescents identified in this report as white, black, or other were reported by the parent or guardian as non-Hispanic. 'Other' includes adolescents reported as American Indian/Alaska Native, Native Hawaiian/other Pacific Islander, Asian, other race, or of multiple races. Adolescents identified as Hispanic might be of any race.

^dHS: High school.

^eGED: General Educational Development, which is equivalent to a U.S. high school diploma.

^fRegion of birth data is for 2014 survey respondents only; n = 20,738.

^gMothers identified in this report as white, black, Asian, or other were reported as non-Hispanic. 'Other' includes mothers reported as American Indian/Alaska Native, Native Hawaiian/other Pacific Islander, other race, or of multiple races. Mothers identified as Hispanic might be of any race.

^hIncome-to-poverty ratio is calculated as the ratio of the total household income to the poverty level.

Table 2.

Unadjusted and adjusted vaccine coverage prevalence and coverage prevalence ratios among foreign-born and U.S.-born adolescents – National Immunization Survey-Teen, 2012–2014.

Vaccination	Unadjusted vaccination coverage prevalence (95% CI ^d)		Unadjusted prevalence ratio; ref: U.S.-born (95% CI ^d)	Adjusted vaccination coverage prevalence ^b (95% CI ^d)		Adjusted prevalence ratio ^b ; ref: U.S.-born (95% CI ^d)
	Foreign-born	U.S.-born		Foreign-born	U.S.-born	
Routinely recommended vaccines						
Tdap ^c 1 dose	91.7 (89.2, 94.2)	89.7 (89.2, 90.2)	1.02 (0.99, 1.05)	90.8 (88, 93.5)	89.8 (89.3, 90.3)	1.01 (0.98, 1.04)
MenACWY ^c 1 dose	80.6 (77.2, 84.0)	77.9 (77.3, 78.5)	1.04 (0.99, 1.08)	76.3 (72.2, 80.4)	78.1 (77.4, 78.7)	0.98 (0.93, 1.03)
	1 dose	67.5 (62.5, 72.5)	1.20 [*] (1.11, 1.29)	62.5 (57, 68.1)	56.8 (55.6, 57.9)	1.1 (1.00, 1.21)
HPV ^c ; Females	2 doses	55.6 (50.0, 61.2)	1.19 [*] (1.07, 1.32)	50.7 (44.9, 56.5)	46.9 (45.8, 48)	1.08 (0.96, 1.22)
	3 doses	37.7 (32.1, 43.3)	1.02 (0.88, 1.19)	33.7 (28.2, 39.2)	37.1 (36.0, 38.2)	0.91 (0.77, 1.08)
	1 dose	42.5 (36.8, 48.2)	1.33 [*] (1.16, 1.53)	32.7 (27.6, 37.8)	32.3 (31.3, 33.4)	1.01 (0.86, 1.19)
HPV ^c ; Males	2 doses	31.1 (25.6, 36.6)	1.41 [*] (1.17, 1.69)	23.6 (19.0, 28.1)	22.4 (21.5, 23.4)	1.05 (0.86, 1.28)
	>3 doses	21.8 (16.6, 27.0)	1.59 [*] (1.25, 2.04)	16.4 (12.2, 20.5)	13.9 (13.1, 14.7)	1.18 (0.91, 1.53)
Catch-Up Vaccines						
MMR ^c 2 doses	89.7 (87.5, 91.9)	91.4 (90.9, 91.9)	0.98 (0.96, 1.01)	90.3 (88.1, 92.6)	91.3 (90.9, 91.8)	0.99 (0.96, 1.02)
Hepatitis B 3 doses	89.0 (86.6, 91.4)	92.6 (92.2, 93.0)	0.96 [*] (0.94, 0.99)	89.6 (87.1, 92)	92.6 (92.2, 93.0)	0.97 [*] (0.94, 0.99)
Varicella vaccination among adolescents with no history of disease						
	1 dose	88.8 (85.8, 91.8)	0.94 [*] (0.91, 0.97)	89.6 (86.5, 92.7)	94.4 (93.9, 94.8)	0.95 [*] (0.92, 0.98)
	2 doses	73.6 (69.2, 78.0)	0.95 (0.9, 1.01)	71.6 (66.8, 76.3)	77.4 (76.7, 78.2)	0.92 [*] (0.86, 0.99)

^a CI: Confidence interval.

^b Adjusted for language of interview, adolescent race/ethnicity, adolescent and maternal education, health insurance, number of providers, maternal marital status, household size, income-to-poverty ratio, U.S. Census region.

^c Tdap: Tetanus, diphtheria, and acellular pertussis vaccine; MenACWY: quadrivalent meningococcal conjugate vaccine; HPV: human papillomavirus vaccine; MMR: measles, mumps, and rubella vaccine.

* Statistically significant at the $\alpha = 0.05$ level.

Table 3.

Vaccine coverage prevalence of foreign-born and U.S.-born adolescents by region of birth – National Immunization Survey-Teen, 2014, n = 20,738.

Region of birth	Coverage prevalence (95% CI) ^a			
	Latin America ^b	Asia	Europe	United States
<i>Routinely recommended vaccines</i>				
Tdap ^c 1 dose	93.9 (89.7, 98.2)	86.7 (78.2, 95.2)	82.1 (66.5, 97.6)	90.1 (89.3, 91)
MenACWY ^c 1 dose	85.5 (77.3, 93.7)	73.6 (61.1, 86.1)	73.6 (59.8, 87.3)	80.0 (78.9, 81.1)
1 dose	79.0 [*] (69.4, 88.6)	60.2 (42.2, 78.3)	47.9 (26.9, 69.0)	59.3 (57.4, 61.2)
HPV ^c ; Females	60.3 (46.4, 74.1)	45.4 (24.4, 66.5)	40.0 (20.3, 59.7)	50.0 (48, 51.9)
2 doses	39.4 (24.7, 54.2)	26.2 (11.3, 41.1)	23.6 (8.3, 39)	39.8 (37.9, 41.7)
3 doses	53.2 (37.5, 69.0)	34.7 (18.0, 51.4)	40.9 (18.2, 63.7)	41.4 (39.6, 43.3)
1 dose	36.5 (22.4, 50.5)	31.8 (15.6, 48.0)	32.5 (10.3, 54.8)	31.1 (29.3, 32.9)
2 doses	25.1 (13.4, 36.9)	28.2 (12.4, 43.9)	22.4 (2.6, 42.2)	21.3 (19.6, 22.9)
3 doses				
<i>Catch-Up Vaccines</i>				
MMR ^c 2 doses	90.5 (85.4, 95.7)	87.8 (80.7, 94.8)	77.6 (61.6, 93.6)	90.8 (90, 91.6)
Hepatitis B 3 doses	87.3 (78.7, 96)	85.0 (76.3, 93.7)	76.3 (60.4, 92.2)	91.6 (90.9, 92.4)
<i>Varicella vaccination among adolescents with no history of disease</i>				
1 dose	89.5 (82.6, 96.3)	76.2 [*] (60.2, 92.2)	94.8 (89, 100.0)	94.8 (94.2, 95.4)
2 doses	79.3 (70.3, 88.2)	45.7 [*] (28, 63.4)	85.5 (76.2, 94.8)	80.4 (79.2, 81.6)

^a CI: Confidence interval.

^b The Latin America category includes Mexico, Caribbean, Central America, and South America.

^c Tdap: Tetanus, diphtheria, and acellular pertussis vaccine; MenACWY: quadrivalent meningococcal conjugate vaccine; HPV: human papillomavirus vaccine; MMR: measles, mumps, and rubella vaccine.

^{*} Statistically significantly different from the United States category at the $\alpha = 0.05$ level.

Table 4.

Vaccination barriers and attitudes of the parents of foreign-born and U.S.-born adolescents for HPV^a, Tdap^a and MenACWY^a vaccines – National Immunization Survey-Teen, 2012–2013.

Attitudes supporting HPV vaccination	Foreign-born		U.S.-born	
	%	95% CI ^b	%	95% CI ^b
Prevents HPV infection [*]	77.9	(73.8, 82.0)	69.6	(68.6, 70.5)
Prevents cervical cancer [*]	75.7	(71.4, 79.9)	66.1	(65.1, 67.1)
It is safe [*]	69.7	(64.8, 74.5)	62.9	(61.9, 63.9)
Prevents genital warts [*]	63.6	(58.6, 68.5)	48.8	(47.7, 49.8)
Prevents anal cancer [*]	46.7	(41.4, 52.1)	31.9	(30.9, 32.9)
Prevents cancer of the throat [*]	39.0	(34.0, 44.0)	26.3	(25.4, 27.3)
<i>Reasons for not receiving vaccination</i>				
Lack of provider's recommendation (HPV ^a)	24.2	(18.9, 29.4)	19.6	(18.7, 20.6)
Lack of knowledge about HPV ^a [*]	23.6	(17.6, 29.6)	14.9	(14.1, 15.8)
Lack of provider's recommendation (Tdap ^a)	44.1	(27.8, 60.5)	28.7	(26.2, 31.2)
Not needed or necessary (Tdap ^a) [*]	7.1	(2.8, 11.4)	13.6	(11.9, 15.3)
Lack of provider's recommendation (MenACWY ^a)	33.9	(27.0, 40.7)	37.2	(36.0, 38.5)
Not needed or necessary (MenACWY ^a) [*]	7.2	(3.9, 10.5)	11.6	(10.7, 12.5)

^a HPV: human papillomavirus vaccine; Tdap: Tetanus, diphtheria, and acellular pertussis vaccine; MenACWY: quadrivalent meningococcal conjugate vaccine.

^b CI: Confidence interval.

^{*} Statistically significantly different at the $\alpha = 0.05$ level.