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HPV vaccination coverage of teen girls: The influence of health care providers

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Abstract

Background: Between 2010 and 2014, the percentage of 13–17 year-old girls administered ≥3 doses of the human papilloma virus (HPV) vaccine ("fully vaccinated") increased by 7.7 percentage points to 39.7%, and the percentage not administered any doses of the HPV vaccine ("not immunized") decreased by 11.3 percentage points to 40.0%.

Objective: To evaluate the complex interactions between parents' vaccine-related beliefs, demographic factors, and HPV immunization status.

Methods: Vaccine-related parental beliefs and sociodemographic data collected by the 2010 National Immunization Survey-Teen among teen girls ($n = 8490$) were analyzed. HPV vaccination status was determined from teens' health care provider (HCP) records.

Results: Among teen girls either unvaccinated or fully vaccinated against HPV, teen girls whose parent was positively influenced to vaccinate their teen daughter against HPV were 48.2 percentage points more likely to be fully vaccinated. Parents who reported being positively influenced to vaccinate against HPV were 28.9 percentage points more likely to report that their daughter's HCP talked about the HPV vaccine, 27.2 percentage points more likely to report that their daughter's HCP gave enough time to discuss the HPV shot, and 43.4 percentage points more likely to report that their daughter's HCP recommended the HPV vaccine ($p < 0.05$). Among teen girls administered 1–2 doses of the HPV vaccine, 87.0% had missed opportunities for HPV vaccine administration.

Conclusion: Results suggest that an important pathway to achieving higher ≥3 dose HPV vaccine coverage is by increasing HPV vaccination series initiation though HCP talking to parents

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Conflicts of interest

None of the authors have any conflicts of interest.

about the HPV vaccine, giving parents time to discuss the vaccine, and by making a strong recommendation for the HPV. Also, HPV vaccination series completion rates may be increased by eliminating missed opportunities to vaccinate against HPV and scheduling additional follow-up visits to administer missing HPV vaccine doses.

Keywords

HPV; Parental concerns; Provider influence; Attributable risk

1. Background

In 2007, the Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP) recommended routine administration of 3 doses of the human papilloma virus (HPV) vaccine be administered for girls between 11 and 12 years of age [1]. In 2006, the ACIP recommended 1 dose of tetanus and diphtheria toxoids and acellular pertussis vaccine (Tdap) for routine administration for all teens between 11 and 12 years of age and, in 2005,1 dose of the meningococcal vaccine (MenACWY) was recommended for routine administration to all teens between 11 and 12 years of age [2,3]. Compared to uptake of the recommended single doses of MenACWY and Tdap vaccines, uptake of ≥1 dose of HPV vaccine for 13–17 year-old teen girls ("teen girls") has been more slow [4]. In 2007, estimated national coverage for Tdap and MenACWY vaccines exceeded 30% [5] and, in the subsequent 4 years, coverage increased by 47.8 and 38.1 percentage points, respectively [6]. In comparison, the percentage of teen girls administered ≥3 doses of HPV vaccine did not exceed 30% until 2010 [7] and, in the subsequent 4 years, increased by only 7.7 percentage points [8]. In 2014, 39.7% (±1.9%) of all 13–17 year-old teen girls were administered ≥3 doses of HPV vaccine ("fully vaccinated"), 20.3% (±1.6%) were administered 1–2 doses, and 40.0% (±1.9%) of all teen girls were not administered any HPV vaccine doses [9].

Increasing coverage of the HPV vaccine requires understanding the dynamics of parents' decision-making around acceptance of the HPV vaccine and developing interventions based on these insights. The purpose of this manuscript is to explore how complex interactions between parents' vaccine-related beliefs and demographic characteristics are associated with whether teen girls are fully vaccinated against HPV, and to explore how the influence of health care providers affects parents' decision to vaccinate their teen daughter against HPV.

2. Methods

We analyzed the most recent psychosocial data on vaccine-related parental beliefs data collected from the parents of 4437 parents sampled in the 2010 National Immunization Survey-Teen (NIS-Teen), a survey of 13–17 year-old teens in the United States. Data from 2010 continue to be relevant because the percentage of teen girls who were fully vaccinated changed by only 7.7 percentage points between 2010 and 2014, and because data from the 2010 NIS-Teen include the most recent information on vaccine-related parental beliefs collected by the NIS-Teen that cover the 4 original domains of the Health Belief Model

[9,10], a behavioral conceptual framework for understanding the psychosocial determinants of parents' failure to vaccinate their children.

In 2010, the NIS-Teen used a list-assisted random-digit-dial survey of households with landline-phone numbers to identify households with age-eligible teens. Parental reports of teen, maternal, and household characteristics were collected during the telephone interviews. If consent was obtained to contact teens' vaccination providers, a mail survey was sent to providers to collect provider-recorded vaccination histories. In this paper, provider-recorded vaccination histories are used to evaluate vaccination status. Teen girls are "fully vaccinated" if provider records show that they were administered ≥3 doses of the HPV vaccine and "not vaccinated against HPV" if the records show that no doses of the HPV vaccine were administered. We define teen girls sampled by the NIS-Teen to have "missed opportunities" for HPV vaccine administration if

- they were not fully vaccinated against HPV by the time of the NIS-Teen telephone interview; and
- between their 11th birthday and the NIS-Teen telephone interview date, were administered at least 1 dose of either the Tdap, MenACWY, influenza, H1N1, Hepatitis A, Hepatitis B, measles containing vaccine, pneumococcal polysaccharide, or varicella vaccine on any calendar date when an HPV vaccine dose was not recorded as having been administered.

The response rate for the 2010 NIS-Teen landline phone survey is a product of the resolution rate, the screening completion rate, and the completion rate. The resolution rate is the number of telephone number determined to be a residence divided by the number of telephone numbers randomly sampled from a list of telephone numbers that are potentially residences. For the 2010 NIS-Teen survey, the resolution rate is 2,707,821/3,275,206 = 82.6%. The screening completion rate is the number of sampled households determined to have a 13–17 year-old teen from the sampled telephone numbers in the list divided by the number of telephone numbers sampled that were resolved to be households. For the 2010 NIS-Teen survey, the screening completion rate is 485,138/571,039 = 85.0%. The completion rate is the number of sampled households with a 13–17 year-old teen that completed the NIS-Teen telephone interview among households determined to have a 13–17 year-old teen. For the 2010 NIS-Teen survey, the completion rate is 35,004/42,414 = 82.5%. The product of these three rates is 58%. Among all households sampled by the 2010 NIS-Teen that completed the phone interview, the percentage with an adequate provider-reported vaccination history was 19,488/32,933 = 59.2%.

In the 3rd and 4th quarters of 2010, the NIS-Teen collected data on parents' vaccine-related beliefs for 4016 teen girls who had an adequate provider-reported vaccination history. To assess those beliefs, parents were read 15 statements and asked whether they agreed or disagreed with each statement on a scale of 0 (strongly disagree) to 10 (strongly agree). Numeric responses ≥7 were interpreted as in agreement. Also, parents were asked whether their teen daughter's health care provider (HCP) made their decision to vaccinate their daughter against HPV more likely or not, and we dichotomized parents' responses as either being "positively influenced" by their daughters' HCP or as being "not positively

influenced." Vaccine-related parental beliefs were organized using the Health Belief Model [11,12]. To explore how complex interactions between parents' vaccine-related beliefs and demographic characteristics are associated with whether teen girls are fully vaccinated or not, we conducted 2 analyses. The first analysis compares teen girls who were not vaccinated against HPV to teen girls who were fully vaccinated, and the second analysis compares teen girls who were administered either 1 or 2 doses of the HPV vaccine to teen girls who were fully vaccinated. We used multivariable recursive partitioning analysis [13,14], and attributable risk analysis [15] to evaluate the extent to which being undervaccinated was attributable to HCPs not being a positive influence on parents' decision to vaccinate their daughter.

Statistical analyses used the survey library [16] in the R statistical software package [17]. All estimates account for the surveys' sampling weights and sampling design of the NIS and NIS-Teen and are reported with 95% confidence intervals. Differences between estimated percentages were evaluated using z-tests and are declared to be statistically significant if $p < 0.05$. The NIS-Teen has been approved annually by Ethics and Research Review Board of the National Center for Health Statistics since 2005.

3. Results

Statistical analyses comparing teen girls who were fully vaccinated to teen girls not vaccinated against HPV.

In 2010, 50.1% (±2.7%) of all 13–17 year-old teen girls were not vaccinated against HPV. Among teen girls not vaccinated against HPV, 60.5% (±2.5%) had missed opportunities for HPV vaccine administration.

Bivariable analyses found that compared to teen girls who were fully vaccinated, teen girls not vaccinated against HPV (zero doses of HPV vaccine administered) were significantly less likely to have been vaccinated by a pediatrician; more likely to be entitled to publically purchased vaccines from the Vaccines for Children program (VFC) [18]; less likely to have a mother with less than a high school education; more likely to live in a household with an annual income in the third income quintile, and less likely to live in a central city metropolitan statistical area (Table 1). Also, compared to parents of teen girls who were fully vaccinated, parents of teen girls unvaccinated against HPV had many significant differences across all 4 domains of the Health Belief Model and had significantly lower assessments (1) of their teens's risk of getting a vaccine preventable disease (VPD), (2) of VPDs as a concern that make vaccinations relevant, (3) of vaccines' efficacy to reduce the threat of a VPD; and (4) were significantly less likely to report that their decision to vaccinate their child was favorably influenced by a health care provider, and significantly less likely to believe that vaccines are safe (Table 2).

Multivariable analysis found that none of the 12 demographic factors and only 3 of the 16 vaccine-related belief factors were independent predictors associated with whether teen girls are fully vaccinated against HPV (Fig. 1). The recursive partitioning analysis used the independent predictors to segment the U.S. population of teen girls into 4 groups (Fig. 1), across which the percentage of teen girls who were fully vaccinated against HPV decreases:

- Teen girls in **group 1** (Fig. 1) had a parent who reported being positively influenced by their daughters' HCP to vaccinate against HPV (Fig. 1). Among teen girls in group 1, 68.0% were fully vaccinated against HPV (≥3 doses of HPV vaccine administered).
- Teen girls in **group 2** had a parent who reported not being positively influenced by their daughter's HCP to vaccinate against HPV, reported that their daughters' HCP recommended the HPV vaccine, and reported that they believed that vaccines are safe. Among teen girls in group 2, 35.5% were fully vaccinated against HPV.
- Teen girls in **group 3** had a parent who reported not being positively influenced by their daughter's HCP to vaccinate against HPV, reported that their daughters' HCP recommended the HPV vaccine, and reported that they believed that vaccines are not safe. Among teen girls in group 3, 14.0% were fully vaccinated against HPV (Fig. 1).
- Teen girls in **group 4** had a parent who reported not being positively influenced by their daughter's HCP to vaccinate against HPV, and reported that their daughters' HCP did not recommend the HPV vaccine. Among teen girls in group 3, 10.2% of the girls in group 4 were fully vaccinated against HPV (Fig. 1).

Compared to teen girls whose parent (i) reported *not* being positively influenced by their daughter's HCP to vaccinate their daughter against HPV and (ii) reported receiving a recommendation by their daughter's HCP to vaccinate against HPV, teen girls whose parent was positively influenced to vaccinate their daughter against HPV were 39.4 percentage points more likely to be fully vaccinated against HPV (68.0% vs. 28.6%, $p < 0.05$) (Fig. 1).

Overall, compared to teen girls whose parent was not positively influenced to vaccinate against HPV, teen girls whose parent was positively influenced to vaccinate against HPV were 48.2 percentage points more likely to be fully vaccinated against HPV (68.0% vs. 19.8%, $p < 0.05$) (Fig. 1). Of all teen girls who were unvaccinated against HPV, the reason for not being fully vaccinated was attributed to parents not being positively influenced to vaccinate against HPV for 60.1% of the unvaccinated girls (95% confidence interval: 54.6%, 65.0%).

Compared to parents who did not report being positively influenced to vaccinate against HPV, parents who reported being positively influenced to vaccinate against HPV were

- 28.9 percentage points more likely to report that their daughter's health care provider (HCP) talked about the HPV vaccine (94.8% vs. 65.9%, $p < 0.05$),
- 27.2 percentage points more likely to report that their daughter's HCP gave enough time to discuss the HPV shot (95.9% vs. 68.7%, $p < 0.05$), and
- 43.4 percentage points more likely to report that their daughter's HCP recommended the HPV shot (93.8% vs. 50.4%, $p < 0.05$)

Statistical analyses comparing teen girls who were fully vaccinated to teen girls administered 1–2 doses of HPV vaccine.

In 2010, 15.6% (±2.0%) of all 13–17 year-old teen girls were administered 1–2 doses of HPV vaccine and, among those, 87.0% (±3.5%) had missed opportunities for HPV vaccine administration.

Bivariable analysis found that compared to teen girls who were fully vaccinated, teen girls administered 1–2 doses were significantly more likely to be entitled to publicly purchased vaccines from the Vaccines for Children Program (VFC) [19]; more likely to have a mother who had less than a high school education and less likely to have a college degree; more likely to live in a household with an annual income in the lowest income quintile, more likely to have 4 or more children 18 years of age or younger in their household, and less likely to have only one child 18 years of age or younger in their household (Table 1). Also, compared to teen girls who were fully vaccinated, teen girls administered 1–2 HPV vaccine doses had parents who were significantly less likely to report that vaccines do a good job in preventing the disease they are intended to prevent, and were significantly less likely to report that their daughter's health care provider (HCP) talked about the HPV vaccine (Table 2).

The multivariable analysis found that among all of the 12 demographic and 16 vaccine-related belief factors measured on parents of teen girls, there were no parental belief factors found to be independent predictors of being fully vaccinated against HPV, and only teen girls' VFC eligibility status was found to be independently associated with whether teen girls are fully vaccinated against HPV or administered only 1–2 doses. Compared to teen girls who were not VFC-entitled, those who were VFC-entitled were 8.0 percentage points less likely to be fully vaccinated against HPV (60.5% vs. 72.5%, $p < 0.05$).

4. Discussion

Because the percentage of teen girls who were fully vaccinated against HPV increased by only 7.7 percentage points between 2010 and 2014 to 39.7%, and because the percentage not vaccinated against HPV over that period decreased by only 11.3 percentage points to 40.0%, psychosocial data from the 2010 NIS-Teen survey continues to be relevant because they provide the most recent nationally representative data that enables us to explore how both vaccine-related parental beliefs and demographic factors explain why teen girls are undervaccinated against HPV. We found that the factors associated with being unvaccinated against HPV are different from the factors associated with being administered 1–2 doses of HPV vaccine.

In comparing teen girls who were unvaccinated against HPV to girls who were fully vaccinated, we found (i) that the most important independent predictor associated with being fully vaccinated against HPV was having an HCP who is a positive influence on parents' decision to vaccinate their teen daughter against HPV, (ii) that teen girls whose parent was positively influenced to vaccinate against HPV were 48.2 percentage points more likely to be fully vaccinated against HPV, and (iii) that among teens who were unvaccinated against HPV, 60.1% of the undervaccination was attributed to parents not being positively

influenced to vaccinate against HPV by their daughters HCP. Also, we found that parents who reported being positively influenced to vaccinate their daughter against HPV reported significantly and considerably higher levels of provider communication, with nearly all reporting that their daughter's HCPs talked to them about the HPV vaccine, gave them time to discuss the HPV vaccine, and recommended the HPV vaccination. Among parents reporting not being positively influenced to vaccinate, 34.1% reported that their daughter's HCP did not talk to them about the HPV vaccine.

Previous research has shown that spending time, discussion, and exchange of information are hallmarks of 'shared decision making' between providers and patients that has been found to be associated with significantly greater patient satisfaction [19], knowledge, and higher levels of patient adherence to provider recommendations [20]. Parents' report of lack of information about vaccines has been shown to be associated with negative attitudes about vaccines and vaccination providers [21], and concerns about vaccine safety have been shown to be associated with lower childhood vaccination coverage [22]. However, other literature has found vaccination coverage among children whose parent has concerns about vaccine safety can be as high as vaccination coverage among children whose parent does not have concerns, if parents with concerns are positively influenced by an HCP to vaccinate [23]. Advice for providers for talking with parents are available [24–32] that include vaccine fact sheets, schedules for parents and patients [33], and advice on time-savers for talking with parents about the HPV vaccine [34]. This advice includes listening to parents to understand and address their concerns [35,36]; and making a clear, strong, and unambiguous recommendation to vaccinate. Model encounters for showing providers how to talk to parents about the HPV vaccine are available [37,38].

In comparing teen girls who were administered 1–2 doses of HPV vaccine to girls who were fully vaccinated, we found that teen girls' entitlement to VFC was significantly associated with being administered only 1–2 HPV vaccine doses. Although financial barriers attributable to the cost of vaccines are eliminated for adolescents entitled to publicly purchased vaccines at no cost from providers enrolled in their state's Vaccines for Children Program, these adolescents live in lower socio-economic conditions and have lower vaccination coverage in general [39,40]. Other barriers to vaccination may remain among children and adolescent living in low-income households [41–43]. Also, we found that 87.0% of teen girls who were administered 1–2 doses of HPV vaccine had missed other opportunities for HPV vaccine administration, and among those only 7.8% reported refusing the HPV vaccine. These findings suggest that missed opportunities to vaccinate are a main factor associated with not being fully vaccinated against HPV, and support the use of standards of care for pediatric immunization practices that recommend that providers review teen's vaccination records at every visit to assess whether catch-up doses of HPV and other vaccines need to be administered [44].

Strengths and limitations.

Strengths of our study include statistical analyses conducted on nationally representative data. Limitations of our study include the annual surveys of the NIS-Teen used in our study collected data from households with landline-phones, none of those surveys collected data

from households with only cell-phone service. Other analyses have shown that the potential bias in our estimates of vaccination coverage resulting from not sampling households with cell phone service, only, in 2008–2010 is small [45].

5. Conclusion

Our findings suggest that a different intervention is required to transition teen girls from being unvaccinated against HPV to fully vaccinated, compared to the intervention that is required to transition teen girls administered 1–2 doses of the HPV vaccine to being fully vaccinated. Specifically, our results suggest that an important pathway to achieving higher ≥3 dose HPV vaccine coverage is by HCPs positively influencing parents' decision to initiate the 3 dose HPV vaccination series, by talking to parents about the HPV vaccine, giving parents enough time to discuss the HPV vaccine, and by making a strong recommendation for administration of the HPV vaccine. Also, our results suggest that a further pathway to achieving higher ≥3 dose HPV vaccine coverage is by increasing HPV vaccination series completion rates among teen girls administered 1–2 doses of HPV vaccine by eliminating missed opportunities to vaccinate against HPV. Our results support the use of standards of care for pediatric immunization practices that recommend that providers review teen's vaccination records at every visit to assess whether catch-up doses of the HPV and other vaccines recommended for teens need to be administered [44]. Client reminder and recall systems [46,47] have been shown to be effective as a part of a strategy to administer missed doses of all recommended childhood vaccines, and a systematic review of the literature has confirmed that client reminder and recall systems are effective for increasing HPV vaccination coverage, also [48]. Another systematic review found that educational interventions to increase HPV vaccination acceptance found that those interventions generally did not demonstrate effectiveness, however [49]. The results of our paper suggest that interventions focused on cultivating vaccination provider skill at being a positive influence on parents' decision to vaccinate against HPV will be important in increasing 3-dose HPV vaccination coverage rates. Finally, although we found that 58.6% of teen girls who were administered 1–2 doses of HPV vaccine had missed other opportunities for HPV vaccine administration, 41.4% did not have missed opportunities to vaccinate, but were eligible to receive HPV vaccine doses if visits were made. This suggests that in addition to taking advantage of every opportunity, HCPs need to create opportunities to vaccinate teen girls who are undervaccinated against HPV or who have not completed the 3 dose HPV vaccination series. This can happen by scheduling follow-up visits to administer the next HPV vaccine dose in the series before the teen leaves the office and sending reminder notices to parents and teens when vaccines are due.

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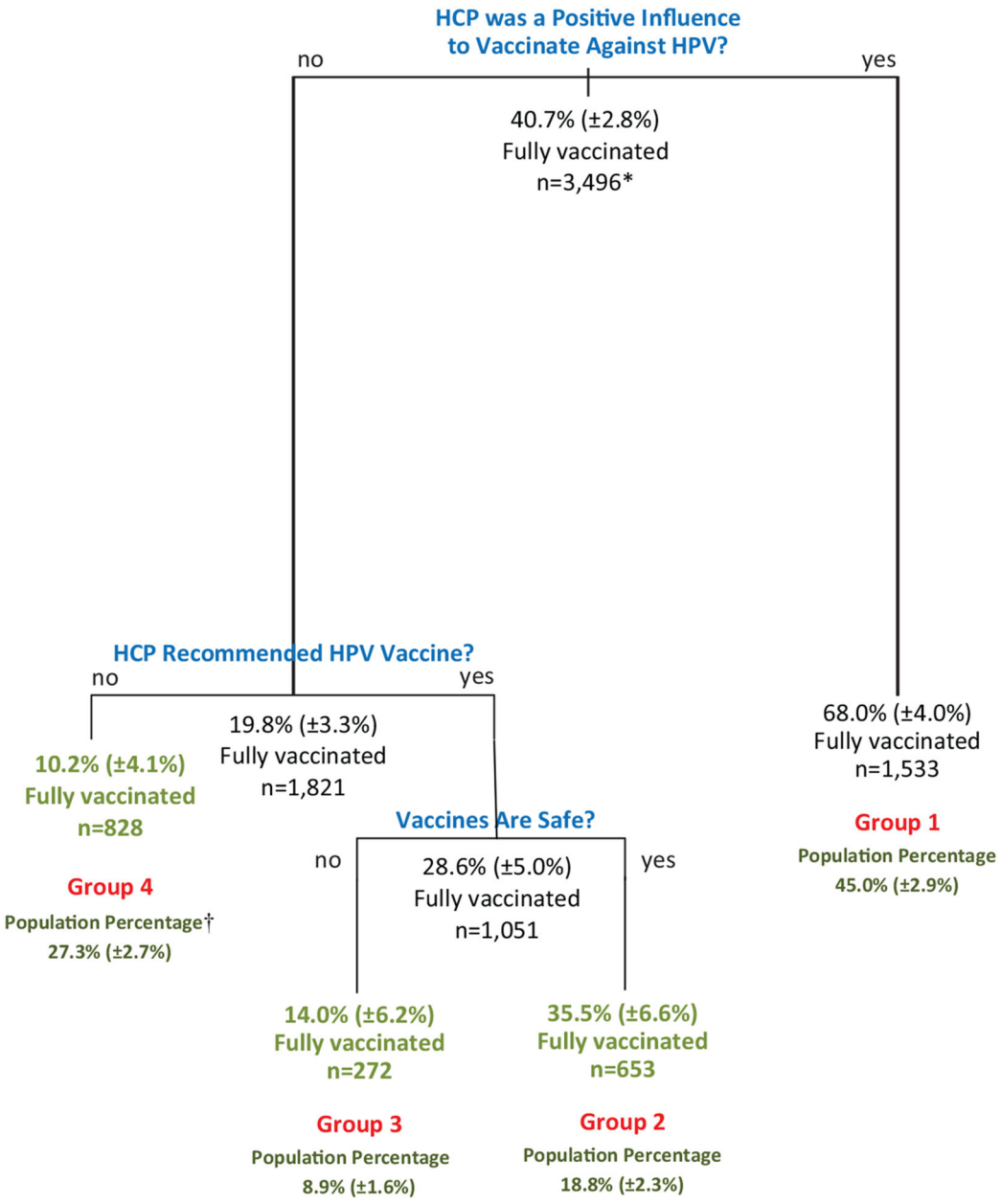

Fig. 1.

Estimated ≥3 dose HPV vaccination coverage from recursive partitioning analysis of statistically independent factors associated with being fully vaccinated vs. 0 doses. Q3 and Q4 2010 NIS-Teen. *Leaf sample sizes may not add to node sample size because of missing values. †Population percentage among teen girls in the terminal node among girls either fully vaccinated or unvaccinated against HPV.

Table 1

Estimated distribution across selected teen, maternal, and household demographic factors for 13–17 year-old girls by number of HPV doses administered. Q3 and Q4 2010 NIS-Teen.

	Unweighted sample size, *n*	Number of HPV vaccine doses administered		
		0 % (95%CI)	1–2 % (95%CI)	≥3 (95%CI)
Teen characteristics				
Race/ethnicity				
Hispanic	516	16.9 (±3.6)	23.6 (±7.8)	18.9 (±4.4)
White non-Hispanic	2812	59.5 (±3.8)	56.4 (±7.5)	58.6 (±4.6)
Black non-Hispanic	475	16.4 (±2.7)	15.1 (±5.1)	13.7 (±3.3)
Other[a]	329	7.2 (±2.2)	4.9 (±1.9)	8.7 (±2.5)
Number of vaccination providers				
1 provider	2196	52.8 (±3.7)	58.2 (±6.7)	58.4 (±4.3)
≥2 providers	1936	47.2 (±3.7)	41.8 (±6.7)	41.6 (±4.3)
Specialty types of teens' vaccination providers				
Pediatrician	2828	67.7 (±3.3)[b]	69.8 (±6.9)	73.5 (±3.9)
Family practitioner	1519	37.5 (±3.7)	38.3 (±7.5)	36.9 (±4.3)
General practitioner	518	14.6 (±3.2)	15.5 (±6.5)	15.7 (±4.0)
Internal medicine	627	17.6 (±3.4)	15.6 (±6.0)	18.5 (±3.7)
OB/GYN	556	16.0 (±3.4)	15.2 (±6.0)	15.6 (±3.5)
Other specialty	1158	27.5 (±2.9)[b]	23.3 (±5.2)	21.9 (±3.7)
Foreign born				
Yes	138	3.0 (±1.5)	5.3 (±3.8)	4.6 (±2.4)
No	8183	97.0 (±1.5)	94.7 (±3.8)	95.4 (±2.4)
Entitled to VFC[c] vaccines				
Yes	1169	34.4 (±3.8)[b]	39.4 (±7.3)[b]	27.5 (±3.9)
No	6007	65.6 (±3.8)[b]	60.6 (±7.2)	72.5 (±3.9)
Maternal characteristics				
Maternal age group				

	Unweighted sample size, *n*	Number of HPV vaccine doses administered		
		0 % (95%CI)	**1–2 % (95%CI)**	**≥3 (95%CI)**
≤34 years of age	295	7.5 (±2.2)	10.0 (±3.5)	7.9 (±2.7)
35 to 44 years of age	1646	43.5 (±3.8)	46.3 (±7.2)	41.4 (±4.5)
≥45 years of age	2191	49.0 (±3.7)	43.8 (±7.3)	50.8 (±4.5)
Marital status				
Married	3105	74.3 (±3.3)	69.3 (±6.7)	72.2 (±4.2)
Widowed	80	1.2 (±0.6)[b]	1.0 (±0.8)	3.5 (±1.9)
Divorced	469	11.5 (±2.3)	11.4 (±3.7)	9.8 (±2.1)
Separated	120	2.9(±1.1)	5.7 (±3.1)	4.4 (±2.3)
Never married	322	9.2 (±2.5)	11.9 (±5.7)	8.4 (±2.7)
Deceased	36	0.9 (±0.5)	0.7 (±0.6)	1.7 (±1.7)
Preferred language				
English	3930	93.8 (±2.7)	87.6 (±7.7)	90.8 (±3.6)
Spanish	165	4.4 (±2.3)	11.6 (±7.7)	7.7 (±3.5)
Other	37	1.8 (±1.5)	0.8 (±0.7)	1.5 (±1.1)
Maternal education				
Non-high school graduate	341	8.4 (±2.6)[b]	24.6 (±8.1)[b]	13.7 (±3.6)
High school graduate	835	27.8 (±3.4)	24.1 (±5.6)	25.0 (±4.4)
Some college training	1238	28.3 (±3.3)	24.4 (±5.3)	24.5 (±3.7)
College graduate	1718	35.6 (±3.5)	26.9 (±5.5)[b]	36.8 (±4.0)
FPL (Federal Poverty Level)				
1st quintile (lowest income)	775	17.1 (±2.9)	30.3 (±7.8)[b]	19.4 (±3.5)
2nd quintile	661	20.7 (±3.2)	16.1 (±4.9)	20.9 (±4.4)
3rd quintile	807	23.0 (±3.1)[b]	17.8 (±4.4)	17.1 (±3.1)
4th quintile	875	20.9 (±3.2)	16.6 (±4.8)	20.5 (±3.4)
5th quintile (highest income)	1014	18.3 (±2.5)	19.1 (±5.0)	22.1 (±3.3)
Number of children ≤18years of age in the household				
1	1630	32.4 (±3.3)	22.4 (±4.5)[b]	33.5 (±4.0)
2–3	2097	55.8 (±3.7)	58.6 (±7.1)	55.7 (±4.4)

	Unweighted sample size, *n*	Number of HPV vaccine doses administered		
		0 % (95%CI)	**1–2 % (95%CI)**	**≥3 (95%CI)**
≥4	405	11.8 (±2.8)	19.0 (±6.9)[b]	10.8 (±3.2)
Location of the household				
Central city metropolitan statistical area	1550	34.1 (±3.7)[b]	37.4 (±6.9)	39.9 (±4.5)
Non-central city metropolitan statistical area	1539	49.0 (±3.7)	47.9 (±7.2)	45.9 (±4.4)
Non-metropolitan statistical area	964	16.9 (±2.1)	14.7 (±3.9)	14.2 (±2.4)

[a]Includes Asian non-Hispanic, American Indian/Alaska Native non-Hispanic, other non-Hispanic, and other mixed race children.

[b]Estimated percentage is significantly different from the estimated percentage in the same row among teen girls administered ≥3 doses of HPV vaccine.

[c]VFC, Vaccines for Children Program. Children and teens 0–18 years of age are entitled to publically purchased vaccines from providers who are enrolled in their state's VFC program if they are eligible for Medicaid, not covered by health insurance, American Indian/Alaska Native, or covered by private health insurance that does not pay all of the costs vaccines and administered vaccine doses at a Federally Qualified Health Center or Rural Health Center. See http://www.cdc.gov/vaccines/programs/vfc/index.html.

Table 2

Percentage of parents agreeing to psychosocial statements by Group, among parents with a 13–17 year-old daughter either fully vaccinated or administered 0 doses of HPV vaccine. Q3 and Q4 2010 NIS-Teen, $n = 4132$.

Domain of the health belief model	Psychosocial statement	Number of HPV doses administered		
		0 % (95% CI)	1–2 % (95% CI)	≥3 % (95% CI)
Parents' assessment of their teen's risk of getting a VPD	Vaccines are necessary to protect the health of teenagers	84.4 (±2.8)[a]	95.5 (±2.2)	96.2 (±1.4)
Parents' assessment of whether VPDs are a sufficient health concern to make vaccinations relevant	If I do not vaccinate my teenager he/she may get a disease such as meningitis and cause other teenagers or adults also to get the disease	75.0 (±3.3)[a]	85.7 (±4.0)	89.1 (±2.7)
	I make a point to read and watch stories about health	79.2 (±3.0)	81.6 (±5.1)	82.9 (±3.2)
Parents' assessment of whether vaccinating their teen can reduce the threat of a VPD	Vaccines do a good job in preventing the disease they are intended to prevent	88.1 (±2.6)[a]	91.5 (±3.8)[a]	95.1 (±1.5)
	Teenagers receive too many vaccines	17.9 (±3.0)	19.3 (±7.0)	15.4 (±3.8)
Influences	Health care provider talked about HPV shot	68.4 (±3.7)[a]	85.1 (±6.1)[a]	91.7 (±2.6)
	Health care provider recommended the HPV shot	54.4 (±3.8)[a]	83.6 (±6.4)	89.7 (±3.4)
	Health care provider gave enough time to discuss the HPV shot	72.6 (±3.8)[a]	84.6 (±6.8)	91.1 (±3.9)
	Health care provider made parent's decision to vaccinate their teenager more likely	23.9 (±3.2)[a]	71.0 (±5.8)	73.1 (±4.2)
	My teenager helps to make the decisions about whether she will receive a vaccine	29.8 (±3.1)[a]	35.8 (±7.1)	40.3 (±4.6)
	I have a good relationship with my teenager's health care provider	92.0 (±2.5)[a]	94.4 (±3.1)	96.6 (±1.5)
	In general, medical professionals in charge of vaccinations have my teenager's best interest at heart	89.1 (±2.1)[a]	95.5 (±2.3)	95.7 (±1.5)
	Vaccines are safe	70.4 (±3.4)[a]	82.2 (±4.8)	86.0 (±2.7)
	At the time that your teen was vaccinated, did you have concerns about safety?	46.9 (±3.7)[a]	45.5 (±7.1)	40.6 (±4.4)
	If I vaccinate my teenager, she may have serious side effects	32.7 (±3.7)[a]	25.3 (±6.9)	24.5 (±3.9)
	Vaccination should be delayed if a teenager has a minor illness	65.7 (±3.7)[a]	59.0 (±7.5)	60.4 (±4.4)

[a]Percentage is significantly different from the percentage in the same row among teen girls administered ≥3 HPV doses.