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RESEARCH PAPER

Comparing human papillomavirus vaccine knowledge and intentions among parents of boys and girls

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ABSTRACT

Background/Objective: Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States. Previous research suggests some differences between male and female adolescents in correlates of vaccine receipt and reasons for non-vaccination; few studies examine both sexes together. This analysis assessed knowledge and attitudes related to HPV disease and vaccination, intention to vaccinate, and reasons for delayed vaccination or non-vaccination among parents of boys and girls 13–17 y old in 50 states, the District of Columbia, and selected local areas. Methods: National Immunization Survey-Teen 2013 data were analyzed and gender differences examined. Results: In this sample, adolescent boys were more likely than girls to be unvaccinated and less likely to have completed the HPV vaccination series ($p < 0.005$ for both). Parents of girls were more likely than parents of boys to report a provider recommendation for HPV vaccination (65.0% vs. 42.1%). Only 29% of girls' parents reported a provider recommendation to begin vaccination by 11–12 y old. Among unvaccinated teens, parental intention to vaccinate in the next 12 months did not differ by sex, but reasons for vaccination or non-vaccination did. Many parents do not know the recommended number of HPV doses. Conclusions: Gender differences in provider vaccination recommendations and reasons for vaccination might partially explain differential HPV uptake by male and female adolescents. Clinicians should offer strong recommendations for HPV vaccination at 11–12 y old for both girls and boys. To reduce missed opportunities, HPV vaccination should be presented in the context of, and given concurrently with, other routinely administered vaccines.

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States;[1] while most infections resolve on their own, persistent infections can progress to cancer. HPV infections result in almost 27,000 cancer cases annually including cervical, anal, vaginal, penile, vulvar, and oropharyngeal cancers.[2] Rates of cervical cancer are higher among African-American, Hispanic, and American Indian/Alaska Native women compared with white women, and higher among women in areas with the greatest proportion of people living in poverty compared with low-poverty areas.[3]

Currently, three safe and highly efficacious vaccines against HPV are licensed for use in the United States; all three vaccines target HPV types 16 and 18, which cause the majority of HPV-associated cancers.[4] The Advisory Committee on Immunization Practices (ACIP) recommends HPV vaccination for male and female adolescents at 11–12 y old, with catch-up vaccination recommended for unvaccinated females 13–26 y old, males 13–21 y old, and men who are immunocompromised or have sex with men through 26 y old.[5] Routine HPV vaccination has been recommended for females since 2006 and for males since 2011.[6] Relative to other vaccines routinely recommended for adolescents, HPV vaccination coverage is considerably lower, and coverage among teen girls in particular has increased more slowly than coverage for other vaccines.[7]

Numerous reasons have been identified for low HPV vaccination coverage in adolescents. Safety concerns are frequently cited by parents refusing HPV vaccination for their child[8-12]; other parents indicate they lack adequate knowledge about HPV vaccine.[8,9,11-15] Parents reporting a clinician recommendation for HPV vaccine are more likely to report intentions to vaccinate their children[13,15] and teens whose parents received a clinician recommendation are more likely to receive HPV vaccine.[14-20] Although HPV vaccination is recommended for adolescents 11–12 y old, clinicians may give stronger recommendations to older teens due to beliefs that HPV vaccination requires discussion of sexuality that is inapplicable to younger adolescents or may offend the preteen's parents.[9,12,21-24] Similarly, parents report – and clinicians perceive – greater parental acceptability of HPV vaccine for older teens.[9,12,21,25-27]

Vaccination coverage estimates for ≥1 and ≥3 doses of HPV vaccine are notably lower among boys than girls;[7] this is partially attributable to the fact that the routine recommendation for HPV vaccination of adolescent boys is comparatively recent. One

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previous study suggested differences between male and female adolescents in correlates of vaccine receipt and reasons for non-vaccination;[28] few studies have compared the sexes. To determine whether parental knowledge and intentions related to HPV vaccination differ by child's sex, we analyzed data from the 2013 National Immunization Survey-Teen (NIS-Teen) to assess knowledge and attitudes related to HPV disease and vaccination, intention to vaccinate, and reasons for delayed vaccination or non-vaccination among parents of adolescent boys and girls.

Results

In 2013, NIS-Teen data included 18,264 adolescents of which 8,710 (47.7%) were female. The Council of American Survey Research Organizations landline and cellular telephone response rates were 51.1% and 23.3%, respectively. Of those with completed household interviews, 54.5% (cellular telephones) and 59.5% (landline) had adequate provider data and were included in the analytic sample.

Adolescent boys were significantly more likely than girls to be unvaccinated against HPV (65.4% vs. 42.7%), and significantly less likely to be fully vaccinated (13.9% vs. 37.6%) or to report a provider recommendation for vaccination (42.1% vs. 65.0%) (Table 1). Among teen girls' parents who reported a provider recommendation for HPV vaccination, less than half said vaccination was recommended to begin at or before 11–12 y old; nearly half reported a recommendation to start vaccination at 13–16 y old. Among all parents of teen girls surveyed, only 29% reported receiving HPV vaccination recommendations in accordance with current national guidelines.

Among unvaccinated teens, intention to vaccinate in the next 12 months was similar among parents of boys and girls, although some reasons for vaccination or non-vaccination differed. Among those intending to vaccinate their teen in the next 12 months, provider recommendation was the most important factor for parents of both boys and girls, although parents of unvaccinated boys were more likely than parents of unvaccinated girls to report that provider recommendation was the most important factor determining when their teen would be vaccinated. Among those not intending to vaccinate, the most common reason cited by boys' parents was lack of a provider recommendation, while the most common reason cited by girls' parents was lack of knowledge about HPV vaccine. Parents of unvaccinated boys who did not intend to vaccinate in the next 12 months were more likely than parents of unvaccinated girls to report lack of provider recommendation as a reason for not vaccinating (Table 2). Among parents of unvaccinated teens who did not intend to vaccinate in the next 12 months, parents of girls were more likely than parents of boys to report safety concerns and teen's lack of sexual activity as reasons for non-vaccination, and more parents of girls than boys reported age of future HPV vaccination would be their teen's decision (Table 2).

Approximately one-third of parents reporting they were unlikely to vaccinate in the next 12 months said their teen would never receive HPV vaccine; this proportion did not differ among parents of boys and girls. Among parents who did not intend to vaccinate their teen in the next 12 months, those who stated their child would never be vaccinated were more likely than parents who did not state their child would never be vaccinated to report vaccination was not necessary (24.7% vs 18.3%, $p < 0.005$) and safety concerns (19.8% vs. 7.7%, $p < 0.005$) as reasons for non-vaccination, and were less likely to report lack of knowledge (13.5% vs. 21.8%, $p < 0.005$) or teen's lack of sexual activity (8.6% vs. 12.2%, $p = 0.01$) as reasons.

Among partially vaccinated teens, plans to have the teen fully vaccinated and reasons for current lack of all 3 doses did not differ by sex (Table 3). Nearly all parents (94.6%) of partially vaccinated teens reported intending for their teen to be fully vaccinated in the future; "intend to complete but have not yet" was the most commonly reported reason that teens had yet to receive all 3 HPV doses.

Table 1. Reported rates of HPV vaccination and clinician recommendation for HPV vaccination among teens 13–17 y old, by sex – National Immunization Survey-Teen, United States, 2013.

	Overall		Girls		Boys		
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	p-value
Number of HPV vaccine doses received	18264	100.0 (———)	8710	100.0 (———)	9554	100.0 (———)	
0 doses	10089	54.3 (52.9–55.7)	3723	42.7 (40.8–44.6)	6366	65.4 (63.5–67.3)	<0.005
1–2 doses	3474	20.2 (19.1–21.4)	1656	19.7 (18.2–21.3)	1818	20.7 (19.1–22.5)	0.37
≥3 doses	4701	25.5 (24.2–26.7)	3331	37.6 (35.7–39.6)	1370	13.9 (12.5–15.3)	<0.005
Received clinician recommendation to vaccinate teen for HPV	18060		8611		9449		
Yes	10068	53.3 (51.9–54.7)	5940	65.0 (63.1–67.0)	4128	42.1 (40.2–44.0)	<0.005
No/Don't know	7992	46.7 (45.3–48.1)	2671	35.0 (33.0–36.9)	5321	57.9 (56.0–59.8)	<0.005
Age clinician recommended HPV vaccination be started*			5939				
At or before 11–12 y old	–	–	2779	45.0 (42.7–47.4)	–	–	–
At 13–16 y old	–	–	2781	48.0 (45.6–50.3)	–	–	–
At 17–18 y old	–	–	41	0.4 (0.3–0.6)	–	–	–
After 18 y old	–	–	NA	NA	–	–	–
No specific age discussed	–	–	74	1.1 (0.8–1.5)	–	–	–
Don't know	–	–	262	5.5 (4.5–6.7)	–	–	–

NA = not available; estimates not reported due to small cell sizes. CI = confidence interval. HPV = human papillomavirus.
*Restricted to respondents reporting a clinician recommendation for HPV vaccination. Data from parents of boys were not analyzed due to the timing of the recommendation for routine HPV vaccination of males.

Table 2. Vaccine intentions and reasons for vaccination decision among unvaccinated vaccinated teens 13–17 y old, by sex – National Immunization Survey-Teen, United States, 2013.

	Overall		Girls		Boys		
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	p-value
Intention to vaccinate teen for HPV in the next 12 months*	9489		3447		6042		
Very/Somewhat likely	3739	40.1 (38.3–41.9)	1410	41.4 (38.5–44.4)	2329	39.3 (37.1–41.5)	0.26
Not too likely/Not likely at all	4995	50.8 (49.0–52.6)	1822	50.5 (47.5–53.5)	3173	51.0 (48.7–53.2)	0.81
Unsure/Don't know	755	9.1 (8.1–10.2)	215	8.1 (6.5–10.1)	540	9.8 (8.5–11.1)	0.14
Most important factor determining when teen will receive HPV shots**	3739		1410		2329		
Clinician recommendation	1432	36.8 (34.0–39.6)	443	30.5 (26.1–35.3)	989	40.8 (37.2–44.4)	<0.005
Other factor	370	10.7 (8.9–12.8)	157	10.7 (8.3–13.8)	213	10.7 (8.3–13.6)	0.97
Already scheduled appointment	388	10.2 (8.5–12.3)	162	11.3 (8.9–14.2)	226	9.6 (7.3–12.5)	0.38
About to become sexually active	295	7.6 (6.3–9.2)	121	9.1 (6.9–11.8)	174	6.7 (5.2–8.6)	0.12
When I know enough about HPV	270	7.4 (6.1–9.0)	112	9.3 (6.8–12.5)	158	6.2 (4.8–8.0)	0.06
Main reasons for not vaccinating teen†	5743		2034		3709		
Clinician did not recommend	1119	19.2 (17.6–20.8)	258	13.0 (10.8–15.5)	861	22.8 (20.6–25.0)	<0.005
Not needed or necessary	953	16.8 (15.2–18.4)	332	14.8 (12.5–17.3)	621	17.9 (15.9–20.1)	0.05
Lack of knowledge	839	15.5 (14.0–17.2)	273	15.6 (13.0–18.5)	566	15.5 (13.7–17.6)	0.99
Safety concern/side effects	548	9.6 (8.4–11.0)	300	14.2 (11.9–16.9)	248	6.9 (5.6–8.5)	<0.005
Not sexually active	541	9.0 (7.9–10.4)	232	11.3 (9.2–13.9)	309	7.7 (6.4–9.2)	0.01
Age at which vaccination planned††	4695		1793		2902		
≤1 year from age at interview	348	7.9 (6.7–9.2)	100	5.9 (4.4–7.8)	248	9.2 (7.5–11.1)	0.01
2–3 y from age at interview	465	10.1 (8.6–11.8)	202	11.3 (8.9–14.4)	263	9.2 (7.4–11.4)	0.22
4+ years from age at interview	97	1.9 (1.3–2.7)	49	2.0 (1.3–2.9)	48	1.8 (1.1–3.1)	0.82
Don't know	1353	28.3 (26.1–30.5)	434	23.8 (20.7–27.2)	919	31.2 (28.4–34.1)	<0.005
Never	1534	33.5 (31.2–35.9)	607	33.8 (30.1–37.7)	927	33.4 (30.5–36.4)	0.85
Teen's decision in the future	898	18.4 (16.6–20.4)	401	23.2 (19.9–26.9)	497	15.3 (13.3–17.4)	<0.005

CI = confidence interval. HPV = human papillomavirus.
*Analysis restricted to unvaccinated (zero-dose) teens. Excludes 600 respondents who did not answer the question.
**Restricted to respondents answering "very/somewhat likely" to vaccination intention question. Only the top 5 reported reasons are presented.
†Restricted to those answering "not too likely/not likely at all" or "unsure/don't know" to intention question. Only the top 5 reported reasons are presented.
††Restricted to those answering "not too likely/not likely at all" to intention question. Not asked of respondents answering "clinician did not recommend" as their main reason for nonvaccination.

Table 3. Vaccine intentions and reasons for vaccination decision among partially vaccinated teens 13–17 y old, by sex – National Immunization Survey-Teen, United States, 2013.

	Overall		Girls		Boys		
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	p-value
Do you plan to have your teen receive all 3 HPV shots?*	1959		910		1049		
Yes	1869	94.6 (92.1–96.4)	854	92.5 (88.6–95.2)	1015	96.4 (92.5–98.3)	0.07
No/Don't know	90	5.4 (3.6–7.9)	56	7.5 (4.8–11.4)	NA	NA	NA
Reasons why teen hasn't received all 3 shots yet**	1869		854		1015		
Intend to complete but have not yet	1228	60.7 (56.3–64.9)	538	59.3 (53.1–65.2)	690	61.8 (55.5–67.7)	0.57
Clinician did not recommend/did not know additional shots needed	199	12.3 (9.5–15.6)	94	15.0 (10.3–21.5)	105	10.0 (7.4–13.4)	0.12
Difficulty making/getting to appointments/ transportation problem	108	6.0 (4.3–8.3)	55	7.2 (4.6–10.9)	53	5.0 (3.0–8.4)	0.31
Forgot to return for additional shots	94	5.4 (3.7–8.0)	45	3.8 (2.3–6.2)	49	6.7 (4.0–11.1)	0.15
Other reason	85	5.2 (3.7–7.3)	43	4.8 (3.1–7.4)	42	5.5 (3.4–9.0)	0.67

NA = not available; estimates not reported due to small cell sizes. CI = confidence interval. HPV = human papillomavirus.
*Restricted to partially vaccinated (1- or 2-dose) teens. Parents who reported they were not likely at all to vaccinate their teen in the next 12 months and that their teen would never be vaccinated against HPV did not answer this question.
**Not asked of respondents who reported not planning to have their teen receive all 3 HPV doses (n = 90). Only the top 5 reported reasons are presented.

Table 4. Knowledge about HPV vaccination among parents of unvaccinated and partially vaccinated teens 13–17 y old, by sex – National Immunization Survey-Teen, United States, 2013.

	Overall		Girls		Boys		
	n	% (95% CI)	n	% (95% CI)	n	% (95% CI)	p-value
Know how many shots are in HPV vaccine series	13753		5725		8028		
Yes	4342	28.2 (26.9–29.6)	1940	31.0 (28.9–33.1)	2402	26.1 (24.5–27.9)	<0.005
No/Don't know	9411	71.8 (70.4–73.1)	3785	69.0 (66.9–71.1)	5626	73.9 (72.1–75.5)	<0.005
Number of HPV doses required*	4341		1940		2401		
0 dose	NA	NA	NA	NA	NA	NA	NA
1 dose	45	1.1 (0.7–1.7)	NA	NA	NA	NA	NA
2 doses	558	12.6 (11.0–14.4)	240	13.0 (10.5–16.1)	318	12.2 (10.3–14.3)	0.63
≥3 doses	3717	85.8 (83.9–87.5)	1674	85.0 (81.8–87.8)	2043	86.5 (84.2–88.4)	0.45
Don't know	NA	NA	NA	NA	NA	NA	NA
Parental awareness of HPV vaccine recommendations**	13752		5725		8027		
Aware	3717	24.2 (23.0–25.5)	1674	26.3 (24.4–28.4)	2043	22.6 (21.0–24.3)	<0.005
Not aware	10035	75.8 (74.5–77.0)	4051	73.7 (71.6–75.6)	5984	77.4 (75.7–79.0)	<0.005

NA = not available; estimates not reported due to small cell sizes. CI = confidence interval. HPV = human papillomavirus.
*Restricted to respondents stating they know the number of shots in the HPV vaccine series.
**Aware parents are those who reported knowing how many shots are in the HPV vaccine series and correctly responding "≥3 doses" when asked. Parents reporting not knowing how many shots were in the series, or not answering correctly when asked the number of shots required, were classified as "not aware."

Overall, more than two-thirds of parents whose teens were not fully vaccinated reported they did not know how many shots are in the HPV vaccine series (Table 4). Parents of teen girls not fully vaccinated were more likely than parents of boys to report awareness of HPV vaccine recommendations; however, regardless of their teen's gender, most parents who reported knowing the recommended number of shots correctly answered that ≥3 doses are required.

Parental attitudes about vaccine safety and efficacy differed by their teen's vaccination status (Table 5). Among parents of adolescent girls and boys, those whose teens had received ≥1 dose of HPV vaccine had significantly higher mean agreement scores on all items than parents of unvaccinated teens, regardless of whether the teen might be vaccinated in the future, with the exception of one item: scores for the statement, "It is more important for girls to get the HPV vaccine than for boys to get it" did not differ between parents of girls who had received ≥1 HPV dose and parents whose girls were unvaccinated but might be vaccinated in the future. Among parents of adolescent boys, parents of partially or fully vaccinated boys had significantly lower mean agreement scores for that statement than parents of unvaccinated boys; there was no significant difference in mean scores between parents of unvaccinated boys who might or who will not be vaccinated in the future. Comparing parents of boys and girls, mean scores for parents of boys were similar to or significantly higher than girls' parents' scores for all items in all vaccination status groups except for "It is more important for girls to get the HPV vaccine than for boys to get it." The belief that HPV vaccine is more important for girls than boys was more strongly endorsed by parents of girls who had received ≥1 HPV dose than parents of boys with ≥1 dose (p-values not shown).

Discussion

Among unvaccinated teens in 2013, parental intention to vaccinate in the next 12 months was similar for girls and boys, as was intention to complete the vaccination series among partially vaccinated teens. Among unvaccinated adolescents whose parents did not intend to vaccinate in the next 12 months, the proportion of parents reporting they never intend for their child to receive HPV vaccine was also similar for boys and girls. However, reasons for vaccination and non-vaccination differed among parents of boys and girls. Parents of adolescent girls were more likely than parents of boys to report a provider recommendation for HPV vaccination; among parents of girls reporting a recommendation, 45% reported receiving recommendations to begin vaccinating their daughter at the recommended ages of 11–12 y old, while 48% reported recommendations to begin vaccination at 13–16 y old. Attitudes about HPV vaccination varied by teen vaccination status for parents of teens of both sexes.

Although parental intention for HPV vaccination was similar for unvaccinated boys and girls in this sample, boys were significantly less likely to be vaccinated. Parents of boys also less frequently reported a provider recommendation for their sons to receive HPV vaccination; only 42% stated a provider had recommended HPV vaccine. One likely reason for these differences is the timing of the recommendation for male HPV vaccination: routine vaccination of boys 11–12 y old was not recommended by ACIP until October 2011, while the recommendation for females was made in June 2006.[6] NIS-Teen vaccination data reflect cumulative vaccine uptake; boys included in this sample may not have had a healthcare visit since recommendations were issued and therefore did not have the opportunity to obtain a clinician's recommendation for HPV vaccination or

Table 5. Parental knowledge and attitudes about HPV vaccination*, by sex and adolescent's HPV vaccination status – National Immunization Survey-Teen, United States, 2013.

Vaccination status**	Adolescent Girls						
	≥1 HPV doses		0 HPV doses; might be vaccinated		0 HPV doses; will not be vaccinated		
	n†	Mean (95% CI)	n†	Mean (95% CI)	n†	Mean (95% CI)	p-value††
How much do you agree/ disagree with the statement that the HPV vaccine is safe?	4805	8.3 (8.1–8.4)	2834	6.6 (6.4–6.8)	557	3.7 (3.3–4.1)	<0.0001
… the HPV vaccine prevents HPV infection?	4826	8.1 (8.0–8.2)	2879	7.1 (6.9–7.3)	556	5.0 (4.6–5.5)	<0.0001
… the HPV vaccine prevents genital warts?	4628	6.8 (6.6–7.0)	2747	5.6 (5.4–5.8)	541	4.0 (3.5–4.4)	<0.0001
… the HPV vaccine prevents cervical cancer?	4816	7.9 (7.8–8.0)	2877	7.0 (6.8–7.1)	560	4.8 (4.4–5.3)	<0.0001
… the HPV vaccine prevents anal cancer?	4407	5.3 (5.1–5.5)	2664	4.5 (4.3–4.7)	530	3.3 (2.8–3.7)	<0.0001
… the HPV vaccine prevents cancers of the throat?	4507	4.4 (4.2–4.6)	2720	3.8 (3.6–4.1)	537	2.8 (2.3–3.3)	<0.0001
… it is more important for girls to get the HPV vaccine than for boys to get it?	4842	5.2 (5.0–5.4)	2902	5.0 (4.8–5.3)	568	3.7 (3.1–4.3)	<0.0001
	Adolescent Boys						
How much do you agree/ disagree with the statement that the HPV vaccine is safe?	3052	8.2 (8.0–8.4)	4846	7.1 (6.9–7.2)	843	4.9 (4.5–5.3)	<0.0001
… the HPV vaccine prevents HPV infection?	3070	8.3 (8.2–8.4)	4986	7.4 (7.3–7.6)	859	5.9 (5.6–6.3)	<0.0001
… the HPV vaccine prevents genital warts?	2956	7.1 (6.9–7.3)	4749	6.1 (5.9–6.2)	811	4.7 (4.4–5.1)	<0.0001
… the HPV vaccine prevents cervical cancer?	3042	7.9 (7.8–8.1)	4940	7.0 (6.9–7.2)	867	5.7 (5.3–6.0)	<0.0001
… the HPV vaccine prevents anal cancer?	2862	6.0 (5.8–6.2)	4575	5.2 (5.0–5.3)	792	3.7 (3.4–4.0)	<0.0001
… the HPV vaccine prevents cancers of the throat?	2889	5.3 (5.1–5.6)	4637	4.7 (4.5–4.9)	814	2.9 (2.7–3.2)	<0.0001
… it is more important for girls to get the HPV vaccine than for boys to get it?	3103	4.3 (4.0–4.6)	5089	5.4 (5.2–5.5)	891	5.3 (4.9–5.7)	<0.0001

CI = confidence interval. HPV = human papillomavirus.

*Mean scores on a scale of 0–10, where 0 is "strongly disagree" and 10 is "strongly agree," are presented. Higher scores indicate stronger agreement with the statement.

**All respondents were categorized by the documented number of HPV vaccine doses their teen had received and their response to the question "At what age do you plan to have [TEEN] receive the HPV shots?" Parents of unvaccinated teens who responded "never" when asked the age at which their teen would receive HPV vaccine were categorized as "0 HPV doses; will not be vaccinated." Parents of all other unvaccinated teens were categorized as "0 HPV doses; might be vaccinated."

†The proportion of missing/refused responses ranged from 4.6% to 13.9%. For parents of girls and boys, the item with the lowest proportion of missing responses was "It is more important for girls to get the HPV vaccine than for boys to get it" (4.6% for girls, 4.9% for boys) and the item with the highest proportion of missing responses was "The HPV vaccine prevents anal cancer" (12.7% for girls, 13.9% for boys).

††P-value for difference across all 3 vaccination status groups. All between-group comparisons for both sexes are also statistically significant at $p < 0.001$ with the exception of the item "It is more important for girls to get the HPV vaccine than for boys to get it" (not shown). For this item, the mean score difference between parents of girls who had received at least one HPV dose and parents of girls who were unvaccinated but might be vaccinated in the future was not statistically significant ($p = 0.29$) and the mean score difference between parents of boys who were unvaccinated but might be vaccinated and parents of boys who were unvaccinated and will not be vaccinated was not statistically significant ($p = 0.69$).

to receive HPV vaccine. In a recent study, boys who had a well-child visit at 11–12 y old or had 1–3 contacts with physicians in the past 12 months were more likely than those who did not to have received at least one dose of HPV vaccine.[29] Lack of provider recommendation was the most common reason boys' parents reported for not vaccinating their sons, and among boys' parents intending to vaccinate in the next 12 months, was the most important factor for determining when their sons would be vaccinated. These findings are consistent with previous research indicating barriers like lack of clinician recommendation, rather than attitudes toward vaccination, were most commonly cited by parents who had not vaccinated their sons against HPV.[30] One potential explanation for the lower frequency of clinician recommendations is the misconception that there are fewer health benefits of HPV vaccination for boys than girls: approximately one-third of physicians in a small pre-licensure study reported stronger intentions to recommend HPV vaccination to girls versus boys for this reason.[22] Only 37% of physicians in a 2010 survey reported intentions to strongly recommend HPV vaccine to 11–12 year-old boys even if it were routinely recommended by ACIP.[24] Clinician recommendations for HPV vaccine are particularly important for male adolescents since parents may perceive less risk of HPV infection for boys and therefore have less intention to vaccinate sons than daughters.[31]

Only 65% of parents of teen girls reported a provider recommendation for HPV vaccination. The possibility that 35% of girls were not recommended HPV vaccine by their provider is concerning given the strong association between clinician recommendation and receipt of HPV vaccines.[14-19] It is also possible some parents do not perceive their child's provider as recommending HPV vaccination due to the way the recommendation is presented. Studies show clinicians may discuss HPV vaccines separately from other vaccines for adolescents, present HPV vaccine as optional while other recommended vaccines are described as necessary, or fail to provide parents with adequate information about HPV vaccines.[9,12,32] If a clinician treats HPV vaccines differently than other recommended vaccines for adolescents, parents may interpret these differing statements as something other than a recommendation to vaccinate. Conversely, prior research showed HPV vaccine uptake was higher among teens whose parents reported a provider talked about the vaccine with them and allowed enough time to discuss the vaccine, independent of vaccine recommendations.[16] Daughters of parents who receive a strong provider recommendation for HPV vaccination are more likely to complete the HPV series than those whose providers simply recommended HPV vaccination.[10] Strong, unambiguous clinician recommendations and clinical skills and knowledge for discussions to address any parental concerns are needed to improve HPV vaccine series initiation and completion and avoid missed opportunities for HPV vaccination. An analysis of the 2012 NIS-Teen estimated if all missed opportunities for HPV vaccination had been eliminated and vaccine administered, coverage with 1 or more HPV vaccine doses would have reached 92.6%.[33]

Even when clinicians recommend HPV vaccination to female patients, they may not do so at the recommended age of 11–12 y old. Less than one-third (29%) of girls' parents in this sample reported receiving a provider recommendation to begin HPV vaccination by 11 or 12 years, as is currently recommended by ACIP. This finding is consistent with previous studies indicating that clinicians often delay recommendations – and parents delay vaccination – against HPV based on perceived necessity (i.e., expected timing of sexual debut).[9,12,22] Parents who delay rather than refuse HPV vaccination for their daughters mostly intend eventually to vaccinate, often within the next 12 months.[9,34] However, delayed vaccination may lead to failure to vaccinate children against HPV due to decreases in frequency of healthcare visits by older adolescents, clinicians forgetting to revisit vaccination, or changes in health insurance coverage or eligibility.[9,12] In the current analysis, most parents of unvaccinated boys and girls who did not intend to vaccinate their child in the next 12 months did not report a specific age at which they anticipated vaccinating. It is important that clinicians strongly recommend vaccination of all adolescents at 11–12 y old and clearly explain to parents the necessity of protecting their teens well before potential HPV exposure, as this would result in greatest vaccine effectiveness.[35] Furthermore, vaccination of young adolescents induces higher antibody levels than vaccination at older ages.[36]

Findings from the current analysis indicate parents whose teens received at least one dose of HPV vaccine were more likely to report agreement with statements about HPV vaccine safety and efficacy against a variety of health outcomes than parents of unvaccinated teens, and parents of unvaccinated teens who intended to vaccinate them in the future were more likely than parents who stated their teens would never be vaccinated to endorse these statements. Furthermore, although parents of unvaccinated boys reported similar or greater agreement than parents of unvaccinated girls with statements about HPV vaccine safety and efficacy, they were also more likely to agree it is more important for girls to get HPV vaccine. Some prior research suggests parental knowledge about HPV and HPV vaccination is generally not associated with vaccine acceptability or vaccination initiation;[25,37] however, parental attitudes and beliefs related to HPV disease and vaccination are associated with acceptability and initiation.[18,25,26] Dorell et al. found concerns about HPV vaccine safety and effectiveness were reported more often by parents who refused HPV vaccination for their adolescents than parents who delayed but did not refuse vaccination.[34] Lack of knowledge about the recommended number of HPV vaccine doses may contribute to undervaccination; 12 percent of parents of partially vaccinated teens in our sample reported not knowing additional shots were needed or not having additional shots recommended as the reason their teens were not fully vaccinated. Our findings corroborate prior research and suggest interventions targeting vaccine-hesitant parents should address negative beliefs about HPV vaccination rather than focusing exclusively on increasing knowledge. Health messaging and clinician recommendations should emphasize the importance of HPV vaccination for girls and boys. However, there is a dearth of evidence-based strategies to address vaccine hesitancy via policies, parental education, or provider communication techniques.[38-39]

This analysis is subject to at least 2 limitations. First, the cellular phone household response rate was only 23%, and the landline household response rate was 51%. Sampling weights were designed to minimize nonresponse and noncoverage bias (from exclusion of households without telephones), but bias may remain in weighted estimates. Second, analyses included only teens whose providers submitted sufficient vaccination information for vaccination status determination; only 54.5% (cellular telephones) and 59.5% (landline) of those with completed household interviews had adequate provider data. Adjustments for bias cannot account for errors in vaccination status (e.g., incomplete vaccination provider identification or unknown medical record completeness).

Although future intention to vaccinate was similar among parents of unvaccinated adolescent boys and girls, boys were less likely to have initiated or completed the HPV vaccine series. One-third of adolescent girls and over half of boys did not report provider recommendations for HPV vaccination; less than half of girls receiving a recommendation were told to begin vaccination at the recommended age of 11–12 y old. Clinicians caring for adolescents should engage in discussions with parents and offer strong recommendations for HPV vaccination at 11–12 y old to male and female patients and their parents. To limit missed opportunities, HPV vaccination should be presented in the context of, and should be given concurrently with, other routinely administered vaccines for adolescents.[12,40] In addition, clinicians can encourage parents to schedule appointments for additional HPV doses before leaving the office.[41] The most common reason given by parents of

partially vaccinated teens for not completing the 3-dose HPV series was "intend to complete but have not yet;" scheduling future visits in advance could increase the likelihood of series completion. The Community Preventive Services Task Force has identified effective strategies at the patient, provider, and community levels to increase uptake of recommended vaccines;[42] future work could examine which of these strategies are most effective specifically for HPV vaccination. Finally, further research is needed to identify which strategies can successfully address vaccine hesitancy and lead to increased HPV vaccination coverage.

Materials and methods

Survey design and subjects

The NIS-Teen uses a random-digit-dialed sample of landline and cellular telephone numbers to collect immunization information for adolescents residing in 50 states, the District of Columbia, and selected local areas. Survey respondents are parents or guardians of adolescents 13–17 y old (referred to as "parents" throughout this report). Parents provide information on adolescents' vaccination histories, sociodemographics, reasons for vaccination or non-vaccination, future intentions to have their teens vaccinated, and HPV-related knowledge and beliefs. For teens whose parents provide consent during interviews, vaccination history questionnaires are mailed to all identified healthcare providers to gather vaccination data from medical records. Only provider-reported vaccine doses were used to calculate vaccination coverage in this analysis. Data were weighted to account for telephone non-coverage and survey non-response and to be representative of US adolescents nationally.

Measures

The primary outcome of interest was number of HPV vaccine doses received. Teens with zero recorded doses were classified as "unvaccinated," those with 1–2 doses as "partially vaccinated," and those with ≥3 doses as "fully vaccinated." All parents were asked "Has a doctor or other healthcare professional ever recommended that [TEEN] receive HPV shots?;" those reporting a recommendation were asked at what age the provider recommended the teen should start vaccination. Data on provider-recommended age were only analyzed for girls, as routine HPV vaccination of boys at 11–12 y old was not recommended until late 2011.[6]

Parents of partially vaccinated teens were asked "Do you plan to have [TEEN] receive all 3 shots of the HPV series?;" those responding "yes" were asked why the teen had not yet received all 3 doses. Parents of unvaccinated teens were asked "How likely is it that [TEEN] will receive HPV shots in the next 12 months?;" responses were combined into "very/somewhat likely," "not too likely/not likely at all," and "unsure/don't know." Respondents reporting intention to vaccinate in the next 12 months were asked about the most important factor that would determine when their teens were vaccinated, while those reporting no or unknown intention to vaccinate were asked the main reason why their teens would not be vaccinated in the next 12 months. Respondents with no or unknown intention to vaccinate were also asked at what age they planned to vaccinate their teens against HPV. (Respondents reporting "provider did not recommend" as their main reason for non-vaccination were not asked this question.)

Parents of teens who were not fully vaccinated were asked if they knew how many shots are included in the HPV vaccination series; those reporting yes were asked to provide this number. Parents were classified into "aware" and "not aware" of HPV vaccination recommendations based on responses to these 2 questions. All parents were asked to rate their agreement with 7 statements about HPV vaccine on a scale of 0 (strongly disagree) to 10 (strongly agree). These statements covered vaccine safety, efficacy against several health outcomes, and importance of vaccination for boys vs. girls.

Analysis

To account for the survey's complex sampling design, data were analyzed using SAS-callable SUDAAN 9.3 (Research Triangle Institute, Research Triangle Park, NC). Point estimates and 95% confidence intervals (CIs) were calculated for variables of interest; t-tests and ANOVA were used to assess differences in HPV-related knowledge, intentions, and vaccination coverage among parents of teen boys versus girls with a significance level of $p<0.05$. Responses of "missing" and "refused" were excluded from analysis; the proportion of these responses was <3.0% for most items analyzed. (Table footnotes identify any instances where missing/refused responses comprised ≥3.0%.) All analyses were weighted to account for unequal probabilities of selection and nonresponse; weighted proportions and unweighted sample sizes are presented.

Reported reasons for non-vaccination among parents reporting no intention to vaccinate in the next 12 months were analyzed by future intention to vaccinate. Mean agreement scores for the 7 HPV vaccine statements were calculated and analyzed based on current adolescent vaccination status and future intention to vaccinate and by sex.

Additional details regarding NIS-Teen methodology are published elsewhere.[43-44] The NIS-Teen was approved by the National Center for Health Statistics' Ethics Review Board; the current secondary data analysis is covered by this approval.

Abbreviations

ACIP	Advisory Committee on Immunization Practices
HPV	human papillomavirus
NIS-Teen	National Immunization Survey-Teen

Disclosure of potential conflicts of interest

All authors are employees of the federal government. 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.

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