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Longitudinal Predictors of Human Papillomavirus Vaccination Among a National Sample of Adolescent Males

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Abstract

Objectives—We conducted a longitudinal study to examine human papillomavirus (HPV) vaccine uptake among male adolescents and to identify vaccination predictors.

Methods—In fall 2010 and 2011, a national sample of parents with sons aged 11 to 17 years ($n = 327$) and their sons ($n = 228$) completed online surveys. We used logistic regression to identify predictors of HPV vaccination that occurred between baseline and follow-up.

Results—Only 2% of sons had received any doses of HPV vaccine at baseline, with an increase to 8% by follow-up. About 55% of parents who had ever received a doctor's recommendation to get their sons HPV vaccine did vaccinate between baseline and follow-up, compared with only 1% of parents without a recommendation. Fathers (odds ratio = 0.29; 95% confidence interval = 0.09, 0.80) and non-Hispanic White parents (odds ratio = 0.29; 95% confidence interval = 0.11, 0.76) were less likely to have vaccinated sons. Willingness to get sons HPV vaccine decreased from baseline to follow-up among parents ($P < .001$) and sons ($P = .003$).

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Contributors P. L. Reiter helped conceptualize the study, performed data analysis, and wrote the initial article draft. A. -L. McRee provided direction for data analysis and article writing. J. K. Pepper, M. B. Gilkey, and K. V. Galbraith assisted with conceptualizing and writing the article. N. T. Brewer conceptualized the study, supervised its implementation, provided guidance, and assisted with the writing. All authors helped to conceptualize ideas, interpret findings, and review drafts of the article.

Conclusions—Vaccination against HPV remained low in our study and willingness to vaccinate may be decreasing. Physician recommendation and education about HPV vaccine for males may be key strategies for improving vaccination.

Quadrivalent human papillomavirus (HPV) vaccine against types 6, 11, 16, and 18 is approved to protect against genital warts (caused mostly by HPV types 6 and 11¹) and anal cancer (caused mostly by HPV types 16 and 18²) in males.³ About 4% of men in the United States report a previous diagnosis of genital warts,⁴ and about 2250 new cases of anal cancer occur annually among males in the United States.⁵ Given the high levels of HPV concordance among sexual partners,⁶ vaccinating males may also have indirect health benefits for their partners.⁷ United States guidelines began including HPV vaccine for males in October 2009.⁸ The Advisory Committee on Immunization Practices first provided a permissive recommendation, recommending the 3-dose quadrivalent vaccine series for males aged 9 to 26 years but not making it part of their routine vaccination schedule.⁸ In October 2011, the Advisory Committee on Immunization Practices updated its stance on HPV vaccine for males and recommended routine vaccination of boys aged 11 to 12 years with catch-up vaccination for males aged 13 to 21 years.⁹ The updated recommendation continues to allow HPV vaccine to be given to males aged as young as 9 years and up to 26 years.⁹

Although numerous studies have examined HPV vaccine uptake among females,¹⁰ data on HPV vaccine uptake among males are sparse. Despite mostly encouraging early levels of parental acceptability of the vaccine for males,^{11–13} initial estimates found that only about 2% of male adolescents in the United States had received any doses of HPV vaccine by the end of 2010.^{14,15} Recent data suggest that this increased to about 8% by the end of 2011.¹⁶ We are not aware of any studies that have examined predictors of vaccine uptake among males.

Our study addresses several important gaps in the existing literature. We provide the first longitudinal examination of HPV vaccination among males and identify predictors of vaccine uptake. In doing so, we used data from both parents and their adolescent sons because many adolescents are involved in vaccination decisions.¹⁷ We also examined longitudinal changes in vaccine acceptability among parents and sons and parents' reasons for not getting their sons HPV vaccine, because these data may provide valuable insight about future HPV vaccine uptake among males.

METHODS

The HPV Immunization in Sons study was a longitudinal study of parents and their adolescent sons examining attitudes and beliefs about HPV vaccination for males.¹⁵ Parents and sons completed online surveys at baseline in August and September 2010 (when the permissive recommendation for administration of HPV vaccine to males was in effect) and at follow-up in November 2011 (just after the recommendation for routine administration went into effect).

Parents were existing members of an online national panel maintained by a survey company.¹⁸ To construct the panel, the company used a dual frame sampling approach (list-assisted, random-digit dialing supplemented by address-based sampling) to obtain a probability-based sample of US households. Panel members in non-Internet households received a laptop and free Internet access in exchange for completing multiple online surveys every month. Panel members who completed surveys by using existing computer and Internet access accumulated points that could be redeemed for small cash payments. Parents received these standard incentives for completing our surveys.

We asked participating parents to allow their sons to participate in our study. Sons were aged 11 to 17 years at baseline. Parents with multiple sons in this age range answered questions about the son with the most recent birthday, who then became eligible for possible participation in the study. Parents provided consent to participate for both themselves and their sons before the start of parent surveys. Sons provided assent before their surveys. Sons received 5000 points (about \$5 equivalent) for completing a baseline survey and 10 000 points (about \$10 equivalent) for completing a follow-up survey.

The survey company invited 1195 parents by e-mail to complete baseline surveys, of whom 752 responded to the invitation. Among those who responded, 73% (n = 547) were eligible and completed the baseline parent survey, and 56% (n = 421) had sons who completed the baseline son survey.¹⁹ About a year later, the survey company sent e-mail invitations to complete follow-up surveys to 421 parents who completed baseline surveys and were still part of the national panel. In total, 327 of these parents (78%) completed the follow-up parent survey; 54% (n = 228) had sons who completed the follow-up son survey. The survey company sent 3 reminder emails to parents between baseline and follow-up to maximize participation at follow-up. Our study had a national sample of parents and sons from 46 states and the District of Columbia at baseline.

Measures

Parent and son surveys are available online at <http://www.unc.edu/~ntbrewer/hpv.htm>. We developed survey items based on our previous HPV vaccine research.^{13,20–22} We cognitively tested survey items (baseline: 6 parents and 6 sons; follow-up: 6 parents) to assess parents' and sons' understanding of items and increase item clarity. After refining survey items following cognitive testing, we pretested the surveys (baseline: 31 parents and 23 adolescent sons; follow-up: 13 parents and 12 sons) before data collection. Because our past research indicated that most parents were unaware that HPV vaccine was available for males,¹³ we provided parents and sons with brief informative statements about HPV and HPV vaccine during surveys.

Outcome variables—Surveys assessed whether sons had received any doses of HPV vaccine (i.e., vaccine initiation) at baseline and follow-up. The primary outcome was HPV vaccine initiation at follow-up among sons not vaccinated at baseline. Vaccine initiation is an appropriate outcome for newly introduced health behaviors, such as HPV vaccination for males.²³ Baseline and follow-up surveys assessed the main reason why parents of unvaccinated sons had not gotten their sons HPV vaccine. Parents could indicate only 1 main reason; survey software rotated the order of response options. Surveys examined parents' and sons' willingness to get sons vaccinated against HPV (i.e., vaccine acceptability). Parent surveys assessed how willing parents of unvaccinated sons would be to get their sons free HPV vaccine, and son surveys assessed the willingness of unvaccinated sons to get HPV vaccine. Baseline and follow-up surveys used identical willingness items. Willingness items used a 5-point response scale with responses of “definitely not willing,” “probably not willing,” “not sure,” “probably willing,” and “definitely willing” (possible range = 1–5).

Predictors—As previously described,¹⁵ surveys assessed a wide range of beliefs and attitudes about HPV and HPV vaccine as potential predictors of HPV vaccine initiation. Potential predictors included constructs shown to be correlated with HPV vaccine acceptability or uptake in our past research,^{13,20,24–27} including constructs from the Health Belief Model.²⁸ Parent surveys included items addressing worry (possible range =1–4) and perceived likelihood (possible range =1–4) of sons getting HPV-related disease, perceived barriers to getting sons HPV vaccine (possible range =1–3), perceived harms of HPV

vaccine (possible range = 1–5), and perceived uncertainty of HPV vaccine (possible range = 1–5). We based the barrier, harm, and uncertainty items on the Carolina HPV Immunization Attitudes and Beliefs Scale.²⁹

Additional parent survey items assessed comfort in talking with sons about new vaccines (possible range = 1–5), amount parents had talked with sons about HPV vaccine (possible range = 1–4), perceived effectiveness of HPV vaccine (possible range = 1–4), anticipated regret (possible range = 1–4), and whether parents had ever received a doctor recommendation to get HPV vaccine for their sons. Son surveys examined some of these same constructs (e.g., perceived likelihood and anticipated regret), and also assessed perceived knowledge about HPV vaccine (possible range = 1–4), perceived peer acceptance of HPV vaccine (possible range = 1–5), and potential embarrassment of getting HPV vaccine (possible range = 1–5).

We collected information on several demographic characteristics (Table 1). We defined “urban” as living in a metropolitan statistical area and “rural” as living outside a metropolitan statistical area.³⁰ Data for all potential predictors came exclusively from baseline surveys except for 2 instances. First, follow-up surveys assessed whether sons saw their regular health care providers in the past year. Second, we combined data from baseline and follow-up to yield a combined doctor recommendation variable: ever received a doctor recommendation to get sons HPV vaccine (coded as 1) or not (coded as 0). We included data from follow-up surveys for these 2 variables because we believed health care visits and recommendations that occurred between baseline and follow-up surveys were relevant to our vaccination outcome.

Data Analysis

We used logistic regression models to identify statistically significant bivariate predictors ($P < .05$) of HPV vaccine initiation that occurred between baseline and follow-up. We entered these bivariate predictors into a multivariate logistic regression model to produce adjusted odds ratios (ORs) and 95% confidence intervals (CIs). We constructed a separate multivariate model for parents and sons.

Among parents of unvaccinated sons, we examined the main reasons why their sons had not gotten HPV vaccine and used the McNemar χ^2 test to compare baseline and follow-up data. We used the paired t -test to examine changes in (1) parents' willingness to get their sons free HPV vaccine (among parents of unvaccinated sons), and (2) sons' willingness to get HPV vaccine (among unvaccinated sons). We analyzed unweighted data by using SPSS version 17.0 (SPSS Inc, Chicago, IL), and all statistical tests were 2-tailed with a critical α of 0.05.

RESULTS

Most parents were younger than 45 years (59%), non-Hispanic White (68%), married or living with a partner (80%), had at least some college education (60%), and resided in urban areas (84%; Table 1). About half of parents were female (52%) and reported a household income of at least \$60 000 (54%). Parents reported that religion was fairly important (mean = 3.56; SD = 1.36) and held moderate political views (mean = 2.63; SD = 1.00). About 30% of sons were aged 11 to 12 years at baseline, 37% were aged 13 to 15 years, and 33% were aged 16 to 17 years. Most sons were non-Hispanic White (65%). Parents who completed follow-up surveys were more likely to have at least some college education and report a household income of at least \$60 000 than nonrespondents (both $P < .05$) but did not differ on other demographic characteristics. Additional characteristics of baseline participants have been published previously.¹⁵

Human Papillomavirus Vaccine Uptake

Initiation of the HPV vaccine regimen increased slightly among sons over time. At baseline, 2% (5 of 327) of parents had sons who had initiated the HPV vaccine regimen. Among parents whose sons were unvaccinated at baseline, 6% (20 of 322) had sons who received at least 1 dose of HPV vaccine by follow-up surveys. Thus, a total of 8% of sons (25 of 327) had initiated the HPV vaccine regimen by follow-up surveys, about half of which (52%; 13 of 25) had received all 3 doses.

The strongest parent-reported predictor of HPV vaccine initiation occurring between baseline and follow-up was whether parents had ever received a doctor's recommendation to get their sons vaccinated, in bivariate analyses of parent data ($n = 322$; Table 2). About 55% (18 of 33) of parents who had ever received a doctor's recommendation had vaccinated sons, compared with only 1% (2 of 289) of parents who had never received a doctor's recommendation (OR = 172.20; 95% CI = 36.54, 811.61). Parents were also more likely to have vaccinated sons if they reported at baseline that they had talked a greater amount with their sons about HPV vaccine or higher willingness to get their sons free HPV vaccine (both $P < .05$). Parents who were male or non-Hispanic White were less likely to have sons who had initiated the HPV vaccine series (both $P < .05$).

In multivariate analyses, only parent gender and race remained statistically significant. Fathers (OR = 0.29; 95% CI = 0.09, 0.80) were less likely to have sons who had initiated the HPV vaccine series, as were non-Hispanic White parents (OR = 0.29; 95% CI = 0.11, 0.76). The multivariate model for parent data did not include whether parents had ever received a doctor's recommendation to get their sons vaccinated because so few parents without a recommendation had vaccinated sons.

Only 1 characteristic predicted HPV vaccine initiation in analyses of son data (Table 3). Sons who were non-Hispanic White were less likely to have initiated the HPV vaccine series (OR = 0.24; 95% CI = 0.07, 0.79), findings similar to those from analyses of parent data.

Parents' Main Reasons for Not Vaccinating

Over time, parents reported different main reasons for not getting their sons HPV vaccine (among 302 parents whose sons remained unvaccinated at follow-up; Table 4). Parents reported less often at baseline than follow-up not knowing enough about HPV vaccine (11% vs 23%), not having received a doctor's recommendation to vaccinate (10% vs 17%), concerns that the vaccine might be unsafe (6% vs 10%), the vaccine being too new (4% vs 8%), and sons not having a recent doctor's appointment (3% vs 11%; all $P < .05$). Reasons that parents more frequently indicated at baseline were not knowing boys can get HPV vaccine (23% vs 5%) and believing their sons were too young for the vaccine (6% vs 2%; both $P < .05$).

Human Papillomavirus Vaccine Willingness

Among parents whose sons remained unvaccinated ($n = 302$), willingness to get their sons free HPV vaccine decreased from baseline (mean = 3.30; SD = 1.19) to follow-up (mean = 3.00; SD = 1.21; $P < .001$). About 42% of parents at baseline were definitely or probably willing to get their sons free HPV vaccine, compared with only 28% at follow-up (Figure 1a). We saw a similar decrease in willingness among sons who remained unvaccinated ($n = 211$). Mean levels of sons' willingness to get HPV vaccine decreased from baseline (mean = 2.99; SD = 1.11) to follow-up (mean = 2.76; SD = 1.06; $P = .003$). About 29% of sons at baseline were definitely or probably willing to get HPV vaccine, compared with 19% at follow-up (Figure 1b).

DISCUSSION

Our longitudinal study found that 2% of male adolescents had received any doses of HPV vaccine at baseline, a figure that increased to only 8% by follow-up in late 2011 (about 2 years after HPV vaccine was first recommended for males in the United States). These estimates are very similar to other national estimates, based on medical records, for male adolescents for 2010 and 2011.^{14,16} Rates for male adolescents are much lower than those among female adolescents in the first few years following vaccine licensure for them (25% in 2007 and more than 30% in 2008^{31–33}). This gender disparity may be partly attributable to the different HPV vaccine recommendations first provided for males and females. The Advisory Committee on Immunization Practices initially provided a permissive recommendation for males,⁸ while providing the stronger recommendation for routine administration from the start for females.³⁴ The permissive recommendation for males was updated to a recommendation for routine administration in October 2011,⁹ just before follow-up data collection for our study. It will be important to monitor how the updated recommendation affects HPV vaccine uptake among males in the upcoming years.

The strongest predictor of HPV vaccine uptake in analyses of data from parent surveys was whether parents had ever received a doctor's recommendation to get their sons vaccinated. Although the causal direction of the relationship between doctor's recommendation and vaccination is often unclear (e.g., some patients may request vaccination first and then receive a doctor's advice), our findings support those from studies among female adolescents^{20,35} and suggest that doctor's recommendation is an important determinant of HPV vaccination. More than half of parents in our study who had received a doctor's recommendation had vaccinated their sons, compared with only 1% of parents who had never received a doctor's recommendation. Unfortunately, only about 10% of parents had ever received a doctor's recommendation to get their sons vaccinated, which is noticeably lower than what parents with adolescent daughters reported about a year after HPV vaccine became available for females (22%²⁰).

It is interesting that studies conducted before HPV vaccine licensure for males showed that most physicians would recommend the vaccine for male adolescents, especially older male adolescents.^{11,36} It is possible that this did not translate into actual practice because of a lack of awareness that the vaccine was available for males, uncertainty about the permissive recommendation, or concerns about insurance coverage. Because more than 70% of parents reported that their sons had seen their regular health care providers in the past year, substantial missed opportunities are occurring for recommending and administering HPV vaccine. Future research is needed to better understand why health care providers are not recommending HPV vaccine for males, as interventions targeting health care providers to increase these recommendations will be key to improving HPV vaccine uptake among male adolescents.

Race and parent gender were the only other predictors of HPV vaccine initiation among sons. Sons who were non-White were more likely to have received HPV vaccine compared with non-Hispanic White sons, a difference that may be attributed in part to socioeconomic status (SES). Recent data suggest that HPV vaccination is more common among adolescents of lower SES,¹⁶ and, indeed, non-White parents in our study were more likely than non-Hispanic White parents to report household incomes of less than \$60 000 (61% vs 39%; $P < .001$). Vaccination results concerning race are somewhat encouraging because males from certain racial and ethnic groups (e.g., Hispanics) may be at greater risk for having multiple HPV infections.³⁷ Fathers were also less likely than mothers to report HPV vaccination among their sons. Past studies have shown that men have low knowledge about HPV and

HPV vaccine.^{26,38} Educational efforts are needed to improve fathers' and sons' knowledge about these topics so they can make informed decisions about HPV vaccination.

It is somewhat surprising that none of the health beliefs and attitudes examined among parents and sons predicted HPV vaccination. This contrasts with past research that identified predictors of HPV vaccine uptake among females²⁵ and correlates of HPV vaccine acceptability among parents with sons.^{12,15} Beliefs and attitudes may not be important determinants in the early adoption of behaviors that are not well understood by most individuals, such as HPV vaccination for males. As awareness of and knowledge about HPV vaccination for males increases, research will be needed to examine the potentially changing roles of beliefs and attitudes in predicting vaccine uptake.

Willingness to get sons HPV vaccine declined from baseline to follow-up among both parents of unvaccinated sons and their sons. Fewer than 30% of these parents and sons were willing to get sons HPV vaccine at follow-up, which is much lower than most estimates of parent acceptability of HPV vaccine for sons before or just after the vaccine was first recommended for males.^{11–13} This decrease, along with modest initial intentions, is concerning and suggests that large increases in HPV vaccine uptake among males may not occur in the near future. The reason for the decrease is unclear. We speculate that, as time passed since HPV vaccine licensure for males and vaccination awareness increased, parents became more realistic about the challenges vaccination presented and their need for more information. This “thinking it through” then dampened enthusiasm for vaccinating. Indeed, parents more commonly reported at follow-up that a lack of information about the vaccine or lack of a doctor's recommendation to get sons vaccinated was their main reason for not vaccinating. These findings again suggest that increasing health care provider recommendation for vaccination and parents' and sons' knowledge about HPV and HPV vaccine may be promising avenues for improving HPV vaccine uptake among male adolescents.

It is worth noting that virtually no parents were concerned about sexual disinhibition occurring among vaccinated males, results that support our past research showing this concern is not common among parents of female adolescents.³⁹ It was interesting that a few parents at follow-up reported that never hearing of HPV vaccine or not knowing boys can get HPV vaccine was their main reason for not vaccinating their sons. Although these parents completed baseline surveys and received brief informative statements about HPV and HPV vaccine during surveys, it is possible that some forgot about this information between baseline and follow-up surveys. A brief survey is unlikely to be a replacement for a thoughtful, focused health education effort.

Strengths and Limitations

Study strengths include the longitudinal study design, a national sample, collecting data on a wide range of potential predictors from both parents and their adolescent sons, and extensive survey refinement through cognitive testing and pretesting. Our estimate of HPV vaccine uptake was based on reports from participants, though most parents can accurately recall whether their children have received HPV vaccine.⁴⁰ Few sons had received any doses of HPV vaccine, and we did not examine vaccine completion (i.e., receipt of all 3 doses) as an outcome in logistic regression models.

Parent and son surveys differed on some of the measures examined. The online panel was very similar to the US population on many demographic characteristics,⁴¹ but most participants were non-Hispanic White and of high SES. Attrition from the online panel occurred between baseline and follow-up, and some individuals who completed baseline surveys simply did not complete follow-up surveys. Respondents and nonrespondents at

follow-up differed only on education and income. Participation was lower among sons than parents at baseline, though sons who completed baseline surveys had similar characteristics to noncompleters (all $P > .05$).

Conclusions

Uptake of HPV vaccine remains extremely low among male adolescents in the United States, with fewer than 10% having received any doses. Willingness to vaccinate against HPV may be decreasing among both parents and their adolescent sons in our study, a potential trend that is concerning and requires future monitoring. At this early stage of adoption of HPV vaccine for males, increasing physician recommendation and parents' and sons' knowledge about HPV and HPV vaccine for males may be useful strategies for improving vaccine uptake.

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Human Participant Protection The institutional review board at the University of North Carolina approved the study. Parents provided consent to participate for both themselves and their sons before the start of parent surveys. Sons provided assent before their surveys.

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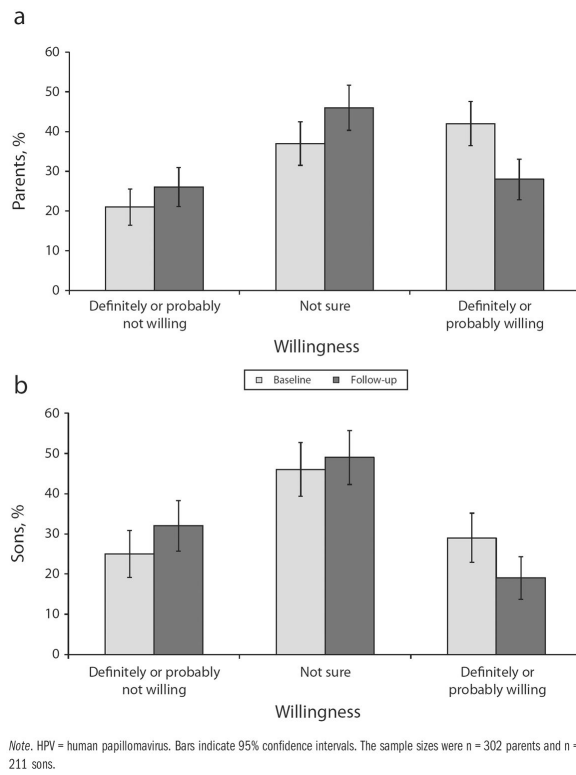


FIGURE 1. Willingness for sons to receive HPV vaccine among (a) parents and (b) sons: HPV Immunization in Sons study, United States, 2010–2011.

TABLE 1

Characteristics of Respondents and Nonrespondents in Follow-Up Surveys: HPV Immunization in Sons Study, United States, 2011

Characteristic	Respondents, No. (%) or Mean \pm SD	Nonrespondents, No. (%) or Mean \pm SD	P
Parents			
Female	170 (52)	124 (56)	.34
Aged < 45 y	192 (59)	140 (64)	.28
White, non-Hispanic ^a	221 (68)	145 (66)	.71
Married or living with partner	261 (80)	185 (84)	.22
some college education	196 (60)	109 (50)	.02
Born-again Christian	104 (32)	80 (36)	.27
Importance of religion ^b	3.56 \pm 1.36	3.66 \pm 1.33	.41
Political affiliation ^c	2.63 \pm 1.00	2.60 \pm 0.94	.7
Sons^d			
Age, y			.77
11–12	99 (30)	73 (33)	
13–15	120 (37)	78 (36)	
16–17	108 (33)	69 (31)	
White, Non-Hispanic ^e	211 (65)	138 (63)	.72
Households			
Household income \$60 000	176 (54)	92 (42)	.01
Urban	276 (84)	177 (80)	.25

Note. HPV = human papillomavirus. The sample sizes were n = 327 respondents and n = 220 nonrespondents.

^aNon-White respondents included 59 Hispanics (18%), 33 non-Hispanic Blacks (10%), and 14 participants who were non-Hispanic and of other races (4%). Non-White nonrespondents included 36 non-Hispanic Blacks (16%), 24 Hispanics (11%), and 15 participants who were non-Hispanic and of other races (7%).

^bFive-point response scale ranging from “not at all important” to “very important” (coded 1–5).

^cFive-point response scale ranging from “very conservative” to “very liberal” (coded 1–5).

^dData on son characteristics collected during parent survey.

^eNon-White respondents included 54 Hispanics (17%), 33 non-Hispanic Blacks (10%), and 29 participants who were non-Hispanic and of other races (9%). Non-White nonrespondents included 31 Hispanics (14%), 29 non-Hispanic Blacks (13%), and 22 participants who were non-Hispanic and of other races (10%).

TABLE 2

Parent Characteristics as Longitudinal Predictors of Human Papillomavirus Vaccine Initiation Among Their Adolescent Sons: HPV Immunization in Sons Study, United States, 2010–2011

Characteristic	No. Reporting Sons Initiated HPV Vaccine/Total No. (%) or Mean \pm SD	Bivariate OR (95% CI)	Multivariate OR (95% CI)
Parents			
Gender			
Female	16/166 (10)	1.00 (Ref)	1.00 (Ref)
Male	4/156 (3)	0.25* (0.08, 0.76)	0.29* (0.09, 0.80)
Age, y			
< 45	14/189 (7)	1.00 (Ref)	...
45	6/133 (5)	0.59 (0.22, 1.58)	...
Race/ethnicity			
White, non-Hispanic	8/219 (4)	0.29* (0.11, 0.73)	0.29* (0.11, 0.76)
Other ^a	12/103 (12)	1.00 (Ref)	1.00 (Ref)
Marital status			
Divorced, widowed, separated, or never married	7/65 (11)	1.00 (Ref)	...
Married or living with partner	13/257 (5)	0.44 (0.17, 1.16)	...
Education level			
high-school degree	10/128 (8)	1.00 (Ref)	...
some college	10/194 (5)	0.64 (0.26, 1.59)	...
Born-again Christian			
No	13/220 (6)	1.00 (Ref)	...
Yes	7/102 (7)	1.17 (0.45, 3.04)	...
Importance of religion ^b	3.56 \pm 1.36	1.04 (0.75, 1.47)	...
Political affiliation ^c	2.63 \pm 1.00	1.03 (0.65, 1.62)	...
Sons			
Age, y			
11–12	5/97 (5)	1.00 (Ref)	...
13–15	9/119 (8)	1.51 (0.49, 4.65)	...
16–17	6/106 (6)	1.10 (0.33, 3.74)	...
Saw regular health care provider in past y ^d			
No	1/84 (1)	1.00 (Ref)	...
Yes	19/238 (8)	7.20 (0.95, 54.65)	...
Households			
Household income, \$			
< 60 000	13/148 (9)	1.00 (Ref)	...
60 000	7/174 (4)	0.44 (0.17, 1.12)	...
Urbanicity			
Rural	3/51 (6)	1.00 (Ref)	...

Characteristic	No. Reporting Sons Initiated HPV Vaccine/Total No. (%) or Mean \pm SD	Bivariate OR (95% CI)	Multivariate OR (95% CI)
Urban	17/271 (6)	1.07 (0.30, 3.80)	...
HPV and HPV vaccine			
Had daughter who had received HPV vaccine			
No or did not have daughter	15/282 (5)	1.00 (Ref)	...
Yes	5/40 (13)	2.54 (0.87, 7.43)	...
Thinks son's insurance covers HPV vaccine			
No or don't know	13/259 (5)	1.00 (Ref)	...
Yes	7/63 (11)	2.37 (0.90, 6.20)	...
Ever received doctor recommendation to get son HPV vaccine ^e			
No	2/289 (1)	1.00 (Ref)	NA
Yes	18/33 (55)	172.20 ** (36.54, 811.61)	NA
Worry about son getting HPV-related disease ^f	1.38 \pm 0.68	1.64 (0.96, 2.80)	...
Perceived likelihood of son getting HPV-related disease ^g	2.20 \pm 0.61	1.33 (0.63, 2.81)	...
Comfort talking with son about new vaccines ^h	4.35 \pm 0.80	1.10 (0.61, 2.00)	...
Amount talked with son about HPV vaccine ^f	1.16 \pm 0.47	2.09 * (1.10, 3.96)	1.89 (0.96, 3.71)
Willingness to get son free HPV vaccine ⁱ	3.33 \pm 1.20	1.52 * (1.00, 2.32)	1.41 (0.92, 2.16)
Perceived effectiveness of HPV vaccine ^f	2.38 \pm 0.94	1.02 (0.63, 1.66)	...
Perceived uncertainty of HPV vaccine ^j	3.60 \pm 0.68	0.57 (0.30, 1.09)	...
Perceived harms of HPV vaccine ^k	3.05 \pm 0.53	0.52 (0.21, 1.29)	...
Perceived barriers to getting HPV vaccine ^l	1.35 \pm 0.45	0.54 (0.17, 1.71)	...
Anticipated regret if son got HPV vaccine and fainted ^f	2.70 \pm 1.04	0.78 (0.50, 1.21)	...
Anticipated regret if son didn't get HPV vaccine and later got HPV infection ^f	3.15 \pm 0.94	1.53 (0.87, 2.69)	...

Note. CI = confidence interval; HPV = human papillomavirus; NA = not available because of so few parents who had never received a doctor's recommendation having vaccinated sons; OR = odds ratio. Multivariate model did not include variables with ellipses. The sample size was n = 322 parents.

^aReports of HPV vaccine initiation among sons was 13% (4/32) among non-Hispanic Blacks, 11% (6/57) among Hispanics, and 14% (2/14) among non-Hispanic parents of other races.

^bFive-point response scale ranging from "not at all important" to "very important" (coded 1–5).

^cFive-point response scale ranging from "very conservative" to "very liberal" (coded 1–5).

^dData collected at follow-up.

^eCombined data from baseline and follow-up.

^fFour-point response scale ranging from "not at all" to "a lot" (coded 1–4).

^gFour-point response scale ranging from "no chance" to "high chance" (coded 1–4).

^hTwo-item scale; each item had a 5-point response scale ranging from "very uncomfortable" to "very comfortable" (coded 1–5).

ⁱ Five-point response scale ranging from “definitely not willing” to “definitely willing” (coded 1–5).

^j Three-item scale; each item had a 5-point response scale ranging from “strongly disagree” to “strongly agree” (coded 1–5).

^k Five-item scale; each item had a 5-point response scale ranging from “strongly disagree” to “strongly agree” (coded 1–5).

^l Two-item scale; each item had a 3-point response scale ranging from “not hard at all” to “very hard” (coded 1–3).

* $P < .05$;

** $P < .001$.

TABLE 3

Son Characteristics as Longitudinal Predictors of Human Papillomavirus Vaccine Initiation: HPV Immunization in Sons Study, United States, 2010–2011

Characteristic	No. Initiated HPV Vaccine/Total No. (%) or Mean \pm SD	Bivariate OR (95% CI)	Multivariate OR (95% CI)
Sons			
Age, y ^a			
11–12	3/69 (4)	1.00 (Ref)	...
13–15	7/90 (8)	1.86 (0.46, 7.45)	...
16–17	3/65 (5)	1.07 (0.21, 5.47)	...
Race/ethnicity ^a			
White, non-Hispanic	4/142 (3)	0.24* (0.07, 0.79)	0.24* (0.07, 0.79)
Other ^b	9/82 (11)	1.00 (Ref)	1.00 (Ref)
Saw regular health care provider in past y ^{a,c}			
No	1/58 (2)	1.00 (Ref)	...
Yes	12/166 (7)	4.44 (0.57, 34.94)	...
Households			
Urbanicity			
Rural	2/37 (5)	1.00 (Ref)	...
Urban	11/187 (6)	1.09 (0.23, 5.15)	...
HPV and HPV vaccine			
Had sister who had received HPV vaccine ^a			
No or did not have sister	11/199 (6)	1.00 (Ref)	...
Yes	2/25 (8)	1.49 (0.31, 7.13)	...
Perceived likelihood of getting HPV-related disease ^d	2.08 \pm 0.70	1.38 (0.64, 2.98)	...
Comfort talking with parents about new vaccines ^e	3.62 \pm 1.06	0.87 (0.52, 1.46)	...
Amount talked with parents about HPV vaccine ^f	1.10 \pm 0.33	0.83 (0.13, 5.35)	...
Willingness to get HPV vaccine ^g	3.02 \pm 1.10	1.51 (0.88, 2.61)	...
Perceived knowledge about HPV vaccine ^h	1.23 \pm 0.53	1.00 (0.34, 2.90)	...
Perceived peer acceptance of HPV vaccine ⁱ	3.07 \pm 0.55	0.83 (0.31, 2.25)	...
Potential embarrassment of getting HPV vaccine ^j	3.05 \pm 1.03	0.61 (0.35, 1.09)	...
Anticipated regret if got HPV vaccine and fainted ^f	2.86 \pm 1.08	0.99 (0.59, 1.66)	...
Anticipated regret if didn't get HPV vaccine and later got HPV infection ^f	3.24 \pm 0.93	1.55 (0.75, 3.21)	...

Note. CI = confidence interval; HPV = human papillomavirus; OR = odds ratio. Multivariate model did not include variables with ellipses. The sample size was n = 224 sons.

^aData collected during parent survey.

^b HPV vaccine initiation was 16% (4/25) among non-Hispanic Blacks, 11% (4/36) among Hispanics, and 5% (1/21) among non-Hispanic sons of other races.

^c Data collected at follow-up.

^d Four-point response scale ranging from “no chance” to “high chance” (coded 1–4).

^e Two-item scale; each item had a 5-point response scale ranging from “very uncomfortable” to “very comfortable” (coded 1–5).

^f Four-point response scale ranging from “not at all” to “a lot” (coded 1–4).

^g Five-point response scale ranging from “definitely not willing” to “definitely willing” (coded 1–5).

^h Four-point response scale ranging from “nothing at all” to “a lot” (coded 1–4).

ⁱ Four-item scale; each item had a 5-point response scale ranging from “strongly disagree” to “strongly agree” (coded 1–5).

^j Two-item scale; each item had a 5-point response scale ranging from “strongly disagree” to “strongly agree” (coded 1–5).

* $P < .05$.

TABLE 4

Main Reasons Why Parents Had Not Gotten Their Adolescent Sons Human Papillomavirus Vaccine: HPV Immunization in Sons Study, United States, 2010–2011

Reason	Baseline %	Follow-Up %
Did not know boys are allowed to get vaccine	23	5**
Son not having sexual intercourse yet	19	15
Never heard of vaccine	12	8
Did not know enough about vaccine yet	11	23**
Doctor did not recommend son get vaccine	10	17*
Vaccine might be unsafe	6	10*
Son was too young	6	2*
Vaccine was too new	4	8*
Son had not been to a doctor recently	3	11**
Boys do not need to get vaccine	1	1
Vaccine costs too much	< 1	1
Vaccine might make son have sexual intercourse	< 1	< 1

Note. Includes only parents who had not vaccinated their sons by follow-up. We used the McNemar χ^2 test to make comparisons between baseline and follow-up data. The sample size was $n = 302$ parents.

* $P < .05$;

** $P < .001$.