Research Article

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Parental Decision Making about the HPV Vaccine

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Abstract

Background: Prophylactic human papillomavirus (HPV) vaccines are available, but uptake is suboptimal. Information on factors influencing parental decisions regarding vaccination will facilitate the development of successful interventions.

Methods: Parents of girls ages 9 to 17 years (n = 476; cooperation rate = 67%) from a panel of U.S. households completed online surveys between September 2007 and January 2008, documenting vaccine knowledge, attitudes, and intentions.

Results: Among those aware of the vaccine, 19% had already vaccinated their daughter(s), 34% intended to, 24% were undecided, and 24% had decided against vaccination. Awareness of HPV was high but knowledge levels were suboptimal (mean 72%, SEM 0.8%). Black and Hispanic parents were significantly less likely to be aware of the vaccine compared with White parents. In multivariate analyses, compared with parents who opposed vaccination, those who had already vaccinated their daughter(s) or who intended to do so had more positive attitudes, reported fewer barriers, and were more likely to perceive that family and friends would endorse vaccination. They also reported higher levels of trust in pharmaceutical companies that produce the vaccine.

Conclusions: Despite limited knowledge, most parents had decided to vaccinate their daughter(s). Given evidence of diminished access to information among Black and Hispanic parents, programs should focus on reaching these groups. Interventions should address parental concerns about behavioral consequences, reduce structural barriers, and promote the perception that vaccination is endorsed by significant others. Moreover, interventions may need to address mistrust of pharmaceutical companies.

Impact Statement: This study documents factors associated with parental decisions about HPV vaccination for their daughter(s) and provides direction for intervention development. *Cancer Epidemiol Biomarkers Prev; 19(9); 2187–98. ©2010 AACR.*

Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States. The lifetime prevalence of HPV infection is estimated at 80%, with an estimated 6.2 million infections occurring each year (1). Although infections with "low-risk" HPV types (HPV 6,11) are generally benign, they can lead to low-grade cervical cell changes, genital warts, and respiratory papillomatosis. Persistent infection with "high-risk" oncogenic HPV types (HPV 16,18) can cause cervical, oropharyngeal, and anogenital cancers (2). Black and Hispanic women experience a disproportionate burden of cervical cancer. Compared with White women, Hispanic women have twice the incidence rate of cervical cancer and Black women have twice the mortality rate (3).

Two prophylactic HPV vaccines are now available. The Food and Drug Administration approved a quadrivalent vaccine (covering HPV types 6, 11, 16, 18) in June 2006 for use among girls and women 9–26 years of age and approved a second bivalent vaccine (covering HPV types 16 and 18) in October 2009. The vaccine is most efficacious if administered before sexual debut (4). The Advisory Committee for Immunization Practices recommends routine vaccination of girls ages 11 to 12 years, with "catch up" vaccination recommended to girls ages 13 to 26 years; vaccination is also approved for girls as young as 9 years. Among girls younger than 18 years, decision-making authority for vaccination is largely placed with parents or those responsible for their care. As such, the success of programs designed to maximize vaccine uptake will largely depend on parental attitudes, beliefs, and acceptance of the vaccine.

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A growing number of quantitative studies have examined parental willingness to vaccinate daughter(s). However, there are several limitations in the existing body of research, as noted in a recent review (5). First, most studies were conducted before vaccine licensure; thus, by necessity, these studies inquired about a hypothetical vaccine with unknown properties. Second, there are few population-based studies; most have been conducted in clinical settings or in schools. Other limitations are that the vast majority of studies have used samples of convenience, and with few exceptions, were comprised primarily of White parents.

The purpose of this cross-sectional study was to examine parental decisions about the HPV vaccine for their daughter(s). Specifically, among a diverse sample of parents, we sought to compare characteristics of those who had formed an intention regarding future vaccination (decided yes or no), completed the behavior [vaccinated their daughter(s)], or were in the process of deliberation (undecided). The integrative model of behavioral prediction guided our investigation (6). This conceptual framework incorporates constructs from several social and behavioral theories (7). Briefly, the model postulates that intention is the most potent predictor of behavior. At any one point in time, individuals may be in varying stages of formulating their intentions about a behavior. In this case, they may have already formed an intention (decided yes or no), completed the behavior [vaccinated their daughter(s)], or may be in the process of deciding (undecided). Intentions are the result of (*a*) attitudes about the behavior (e.g., evaluation of the benefits, barriers, or cost), which are, in turn, affected by awareness and knowledge; (*b*) social influences, including subjective norms - perceptions about behavioral endorsement by significant others and the extent to which they influence intentions; and (*c*) self-efficacy, or personal agency or confidence in one's ability to accomplish a behavior. The relative salience of each of these factors is dependent on the particular behavior of interest. Conceptually, parents' perceptions about their ability to access the health-care system to obtain the vaccine for their daughter(s) could potentially influence their intentons. However, believing that attitudes and social influences may be more relevant in this context, we did not examine self-efficacy in the current analyses.

Based on this framework, we selected key cognitive, attitudinal, and social factors hypothesized to play a role in parental decision making about the HPV vaccine. Specifically, we examined (*a*) HPV and vaccine knowledge; (*b*) attitudes about vaccines in general, and attitudes specifically related to the HPV vaccine, including potential benefits and barriers to vaccination; and (*c*) social influences (e.g., subjective norms). We hypothesized that parents with greater HPV and vaccine knowledge, more positive attitudes, and greater perceived support for vaccination from significant others would be more likely to have already vaccinated their daughter(s) or report the intention to do so within the near future.

Materials and Methods

This study was conducted in collaboration with Knowledge Networks, Inc. (KN; Menlo Park, CA), a national survey research firm that specializes in Internet-based surveys. KN uses multistage probability sampling and random-digit-dialing phone methodology to recruit a nationally representative panel of potential research participants. To maximize participation, they offer free Internet through WebTV to those without access to computers (8). The representativeness of the KN panel has been examined and substantiated in prior research (9). KN's panel of >60,000 U.S. households have been used in a number previous research studies, including peer-reviewed publications focused on health behaviors and decision making (10-12). It has also been shown that Internet data collection from a probability sample such as KN's can yield results at least as accurate as results from telephone interviewing (9).

Sample

To be eligible for study participation, respondents needed to self-identify as Black, Hispanic, or White, and have at least one daughter(s) or be the primary caregiver (hereafter called "parent") for a girl between the ages of 9 and 17 years. We selected 9 years of age as a minimum because the vaccine is approved for use at this age. KN identified a random sample of potentially eligible panelists and invited them to participate. Black and Hispanic parents were oversampled in an effort to achieve approximate balance across racial/ethnic groups. After reviewing the online consent form, those interested completed screening questions to confirm their eligibility. Among panelists selected to participate in the survey (n = 836), 563 consented to participate (67%). Among those who consented, 173 White (91%), 137 Hispanic (85%), and 166 Black (79%) parents were still eligible after completing the eligibility-screening questions (total n = 476). Electronic mail reminders and up to three reminder phone calls were made to nonrespondents (see Fig. 1 for sampling schema and response rates).

Data collection

Participants completed the survey through direct online key entry between September 2007 and January 2008. Participants provided responses to each question for each age-eligible daughter(s) for whom they were the primary caregiver. The study protocol was approved by the institutional review board at the Harvard School of Public Health in Boston, MA.

Measures

Survey development. Few existing validated measures exist (5). Therefore, we adapted items from existing surveys or constructed items to assess constructs as directed

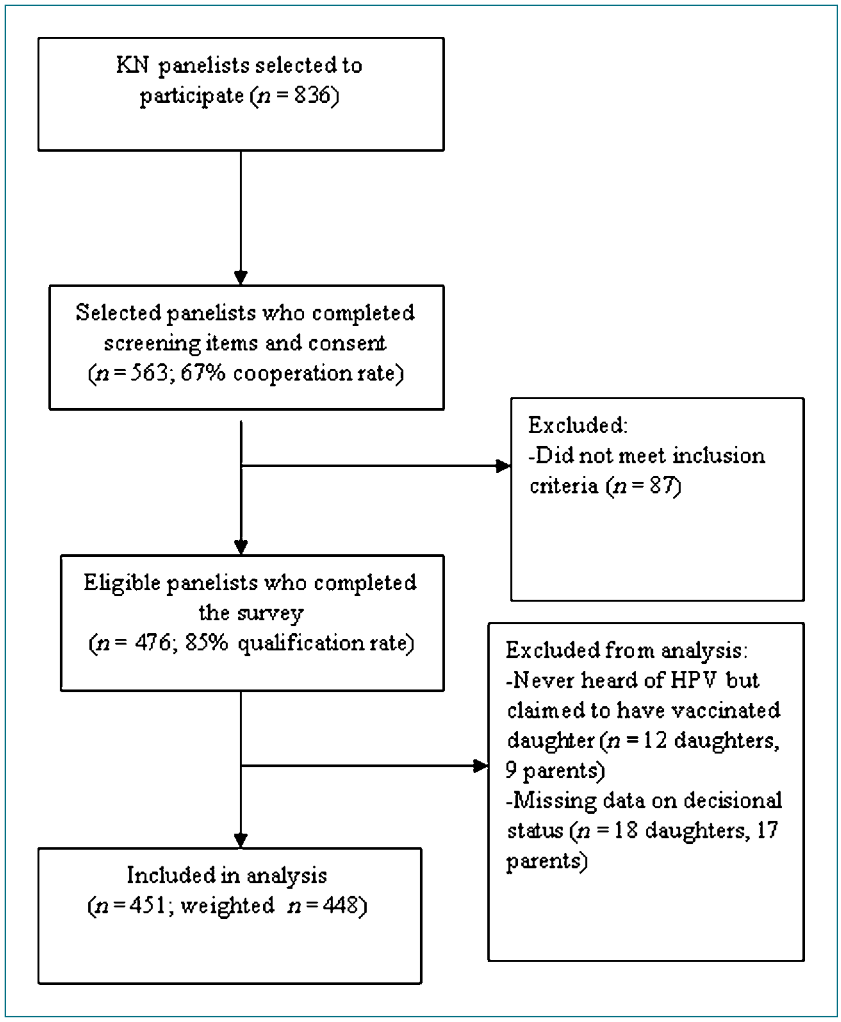

Figure 1. Sample selection, cooperation, and qualification rates among parents.

by the underlying theories in our conceptual framework, as described below.

First, we conducted an exhaustive literature review to identify potential survey items. Next, HPV vaccine investigators external to the study (n = 3) reviewed items to establish face and content validity. Subsequently, we conducted in-person cognitive interviews among 15 parent volunteers representative of the target audience to ensure item comprehension. Finally, we pretested the survey items online with 34 KN panelists who were eligible for the study. These data were not included in any final analyses. The final survey instrument had 113 items. Characteristics of measures are presented in Table 1.

Outcome measure. The primary outcome of interest was decisional status: whether the parent had already vaccinated their daughter(s), intended to vaccinate their daughter(s) within the next 12 months, were undecided, or had decided against vaccination. We first asked the parent, "Before taking this survey, had you ever heard of HPV (human papillomavirus)?" In the affirmative case, the parent was asked if their daughter(s) had received three doses of the HPV vaccine. If so, these daughter(s) were classified as "already vaccinated." A respondent whose daughter(s) had not received all three doses of the vaccine was then asked about future intentions to vaccinate their daughter(s) in the next 12 months. Parents who had not yet made a decision about vaccination were classified as "undecided." Parents reporting the intention to have their daughter(s) complete the three-dose vaccine series within the next year were categorized as "intending to vaccinate." Those who reported that they would *not* obtain the vaccine for their child were classified as "decided against" vaccination.

Potential correlates. As guided by our conceptual framework, we examined relationships between cognitive (HPV knowledge, vaccine awareness), attitudinal (beliefs, worry about adverse effects, perceived barriers), and social (subjective norms) factors theorized to be associated with vaccine decisions (see Table 1).

We assessed "HPV knowledge" with seven items that addressed awareness of HPV, risk factors for

Table 1. Constructs and measures

	Mean S.E. (Standard error)	Pseudo-R^{2*}	Overall $P^†$
Knowledge[‡]	72% (14.43)	12%	<0.01
Cronbach's α = 0.70; seven items	(0.8%; 16)		
Response options true/false (T/F) or multiple choice			
1. Which of the following health issues are related to HPV?			
2. How do you think HPV is transmitted or spread?			
3. How can HPV infection be prevented?			
4. HPV affects only women (T/F)			
5. HPV can occur without symptoms (T/F)			
6. HPV is one of the most common sexually transmitted infections in the United States (T/F)			
7. A Pap smear can detect the HPV virus (T/F)			
General vaccine attitudes[§]	12.51	28%	<0.01
Cronbach's α = 0.76; four items	(0.27)		
Response options very effective to not at all effective			
1. Vaccinating my children against diseases that can be spread person-to-person is important			
2. If there was a vaccine that prevented the common cold, I would want my daughter(s) to get vaccinated			
3. If there were a vaccine that prevented cancer, I would want my daughter(s) to get vaccinated			
4. I believe that vaccines should be required for contagious disease that can be spread person-to-person.			
Beliefs about HPV vaccine			
Vaccine efficacy[‖]	0.54 (0.14)		
Cronbach's α = 0.67; three items			
Response options very effective to not at all effective			
In your opinion, how effective is the HPV vaccine in preventing…			
1. HPV infection	0.27 (0.06)	Not fit	
2. Genital warts	−0.11 (0.06)	4%	0.01
3. Cervical cancer	0.38 (0.05)	Not fit	
Vaccine safety[§]	8.91 (0.17)		
Cronbach's α = 0.68; four items			
Response options strongly agree to strongly disagree			
1. Potential side effects of the HPV vaccine would prevent me from getting my daughter(s) vaccinated against HPV	2.01 (0.06)	14%	<0.01
2. I think that vaccines are well tested before being made available to the public.	2.48 (0.07)	18%	<0.01
3. In your opinion, how safe is the HPV vaccine?	2.30 (0.06)	Not fit	
4. In your opinion, how likely is it that the HPV vaccine causes health problems?	2.14 (0.06)	13%	<0.01
Potential barriers to vaccination			
Cost[‖]			
One item			
Response options very expensive to not very expensive	1.91 (0.09)	7%	0.01
1. In your opinion, how expensive do you think it would be to get the HPV vaccine?			
Beliefs about adverse behavioral consequences[¶]			
Cronbach's α = 0.88; two items			
Response options strongly agree to strongly disagree	2.39 (0.17)	24%	<0.01
Vaccinating my daughter(s) would send a message that…			

(*Continued on the following page*)

Table 1. Constructs and measures (Cont'd)

	Mean S.E. (Standard error)	Pseudo-R^{2}*	Overall P†
1. It is okay to have sex			
2. She doesn't have to use safe sex practices			
Trust in provider recommendation			
Response options strongly agree to disagree			
I trust the medical recommendations of my daughter's primary health care provider.	3.45 (0.05)	7%	<0.01
Trust in pharmaceutical industry			
Response options very confident to not very confident			
How confident are you that the pharmaceutical company that produces the HPV vaccine is trustworthy?	3.10 (0.05)	17%	<0.01
Social influences			
Response options strongly approve/influences to strongly disapprove/does not influence at all			
Subjective norms/family and friend endorsement			
Cronbach's α = 0.84; eight items	1.79 (0.57)	42%	<0.01
Thinking about each of the following individuals or groups, how much would they approve or disapprove of your daughter(s) getting the HPV vaccine?			
1. Spouse/partner			
2. Daughter			
3. Family			
4. Friends			
Thinking about each of the following individuals or groups, how much does the opinion of the following individuals or groups influence your decision about getting your daughter vaccinated against HPV?			
1. Spouse/partner			
2. Daughter			
3. Family			
4. Friends			
Provider endorsement‖	1.99 (0.15)	26%	<0.01
Thinking about your daughter's health-care provider, how much would he/she approve or disapprove of your daughter getting the HPV vaccine?			
Thinking about your daughter's health care provider, how much does his/her opinion influence your decision about getting your daughter vaccinated against HPV?			

NOTE: Results labeled "Not fit" were not fit due to lack of variability in responses.
*Psuedo-R^2 is from an unadjusted multinomial logistic regression model with stage as the outcome model.
†Overall univariate P value is from an unadjusted test of whether the item has any relationship with the outcome from a multinomial logistic regression model with decisional status as the outcome.
‡Items were developed based on the HPV "CDC Fact Sheet" (38).
§Informed by research on general attitudes toward vaccines (16, 39-41).
‖Adapted from Zimet et al. (40) and Ramirez et al. (42).
¶Adapted from Zimet et al. (40).

HPV infection, HPV-associated diseases, and methods of detection. We assessed "general vaccine attitudes" with four items that inquired about parents' global perceptions of vaccines. "Specific attitudes about the HPV vaccine" included a set of items that assessed vaccine efficacy and safety, as well as perceived barriers to vaccination. Barriers included vaccine cost, concerns about the potential for vaccination to send a message condoning risky sexual behaviors, trust in the medical recommendations of the daughter's medical provider, and trust in the pharmaceutical industry.

We assessed "social influence" of family and friends on decision making or subjective norms by asking parents whether salient others (spouse/partner, daughter(s), friends, and family) would approve of vaccination. We then multiplied that response with the extent to which these opinions would influence the respondent's decision. "Provider endorsement" was assessed in the same manner, by multiplying whether a provider would approve of vaccination with the extent to which the provider's opinion would influence the parent's decision. Additional survey items measured daughter's usual source of care, type of health insurance, and selected sociodemographic characteristics of respondents (13).

Statistical analysis

Parents were the unit of recruitment (unweighted and weighted, n = 476). Eighty-five parents had more than one daughter in the sample. Of these, 22 had made different decisions regarding vaccination for different daughter(s). To account for this variability clustered within parent, we used daughter(s) as the unit of analysis (unweighted n = 581; weighted n = 579).

Post-stratification (or "case") weights, which correct the sample distribution to reflect the U.S. population according to the 2008 Current Population Survey (14), were applied for age, education, census region, metropolitan residence, and Internet access (yes/no). This was done to account for the sampling design of the KN panel and to reduce bias due to noncoverage, nonresponse, and response error (8). Data were analyzed using SAS version 9.2 (SAS Institute, Inc.).

Those excluded from the analyses were parents who reported that they had not previously heard of the HPV vaccine but claimed to have vaccinated their daughter (parents excluded: unweighted n = 9, weighted n = 9). Participants who did not provide responses to questions about decisional status were also excluded (parents excluded: unweighted n = 17, weighted n = 20). A total of 545 (unweighted n = 551) daughter(s) were available for analysis from 448 parents (unweighted n = 451). Taylor series expansion was used to calculate SEMs, required due to the clustering of survey responses within parent. A sensitivity analysis removing fathers (unweighted n = 45, weighted n = 35) did not change results; thus, they were retained and we did not control for gender of the respondent.

Descriptive statistics were used to examine sociodemographic characteristics of the sample. We next examined the characteristics of each composite measure by computing an internal reliability coefficient (Cronbach's α). For composite measures that showed adequate internal reliability ($\alpha > 0.70$)—general vaccine attitudes, beliefs about adverse behavioral consequences, and subjective norms—we examined construct validity using principal factor analysis (PFA) and maximum likelihood factor analysis (MLFA). MLFA and PFA both seek the fewest number of factors that can account for the common variance (correlation) of a set of variables. PFA and MLFA yielded consistent results for all three composite measures. Only one factor was extracted, and all items included in the measures had positive loadings of similar magnitude. Residual correlations were small, indicating that the one factor explained the data well. For composite measures that showed inadequate internal reliability (i.e., perceived vaccine efficacy and safety), we analyzed the individual items separately.

We conducted bivariate and multivariate analyses of correlates of decisional status, a four-category outcome (already vaccinated, intend to vaccinate, undecided, and decided against vaccination), using multinomial logistic regression. SEMs in the regression models are adjusted for the complex survey design (11). We used a two-step procedure to find a parsimonious multiple regression model. First, we fit a model with all variables that were central to our conceptual framework, along with the sociodemographic variables that showed significant bivariate relationships with decisional status (overall $P < 0.05$). The model was further refined by then removing covariates in the adjusted model that had overall P values > 0.10. Pseudo-R^2 was used to determine the percent of variance explained in the multinomial regression models. The Rao-Scott χ^2 statistic was used to assess associations between race/ethnicity and the awareness of the vaccine, and between race/ethnicity and decisional status. Each analysis was done with all available (nonmissing) data.

Results

Figure 1 presents cooperation and qualification rates, as defined by the American Association for Public Opinion Research (15). In total, 67% of parents invited to participate completed the screening items, with the lowest cooperation rate among Black parents (61%) and the highest cooperation rate among White parents (74%). The qualification rate (those who were eligible and completed the survey divided by the number of people who completed screening items) was 85% overall.

Characteristics of the study sample

Demographic characteristics of the sample are provided in Table 2. The majority (88%) had heard of HPV infection before taking the survey, and 65% had heard of the vaccine. Not surprisingly, there were noticeable differences in decisional status by prior awareness of the vaccine. Among those who had previously heard of it, 19% had already vaccinated their daughter, 34% intended to vaccinate their daughter within the next 12 months, 24% remained undecided, and 24% had decided against vaccination. Among those who were previously unaware of the HPV vaccine, 26% said that they intended to vaccinate their daughter, 51% were undecided, and 23% said that they would not vaccinate their daughter.

There were significant differences in vaccine awareness across racial/ethnic groups. A quarter (25%) of White parents, nearly half (48%) of Black parents, and

Table 2. Characteristics of survey respondents (weighted n = 448 parents)

	Weighted n (%)
Race/ethnicity	
White	214 (48)
Black	134 (30)
Hispanic	100 (22)
Missing	
Household income	
<$25,000	113 (25)
$25,000–$49,999	120 (27)
$50,000–$75,000	93 (21)
>$75,000	121 (27)
Missing	
Education	
High school or less	123 (27)
Some college	174 (39)
College or more	150 (33)
Missing	
Marital status	
Married	299 (67)
Not married	149 (33)
Insurance status	
Private	256 (57)
Public	91 (20)
Out-of-pocket	33 (7)
Other	66 (15)
Missing	2 (<1)
Child has usual source of care	
Yes	424 (95)
No	23 (5)
Missing	1 (<1)
Type of primary care provider	
Pediatrician	244 (54)
Other	178 (40)
Missing	25 (6)

NOTE: Weighted n may not add up to 448, and percentages may not add up to 100% because of rounding. Fourteen respondents had three daughter(s) in the sample, 71 respondents had two daughter(s) in the sample, and 363 respondents had one daughter in the sample.

39% of Hispanic parents reported that they had not previously heard of the HPV vaccine ($P \leq 0.01$). However, actual rates of vaccination did not vary significantly across groups; 12% of White parents, 11% of Black, and 15% of Hispanic parents reported that they had already vaccinated their daughter ($P = 0.81$). Regardless of prior awareness, 24% of White parents, 25% of Black parents, and 20% of Hispanic parents reported that they had decided not to vaccinate their daughter(s) ($P = 0.77$). Other sociodemographic characteristics were not associated with decisional status.

Knowledge levels about the vaccine were modest (mean = 72% correct responses). There was some variation in mean knowledge score across race/ethnicity: the average among White parents was 74% [S.E. (Standard error) 1.29%], among Black parents was 69% [S.E. (Standard error) 1.28%], and among Hispanic parents was 72% (SEM 1.61%). White parents had significantly higher average knowledge scores ($P < 0.01$), but the differences between Black and Hispanic parents were not statistically significant.

Factors associated with decisional status

Bivariate analyses of the relationship between decisional status and correlates of interest are presented in Table 3. Variables found to be significantly associated with decisional status were parental knowledge and awareness of HPV and the HPV vaccine, general vaccine attitudes, and beliefs regarding whether the vaccine prevented genital warts, had few side effects, was well tested, or did not cause other health problems. In addition, the cost of vaccine, concerns about potential adverse changes in sexual behavior, the social influence of family and friends, and provider endorsement were also associated with decisional status. Trust in provider recommendation and trust in the pharmaceutical industry were also strongly associated with decisional status in bivariate analyses. Daughter's age was the only sociodemographic variable associated with decisional status in bivariate analyses.

We then conducted multivariate analyses and included all of the variables that showed a bivariate association with decisional status (overall $P < 0.05$). With all of these factors in the model, the odds ratios (OR) for the following variables were attenuated toward the null and no longer retained statistical significance: daughter's age, perceived vaccine efficacy in preventing genital warts, belief that the vaccine was not likely to cause other health problems, trust in provider recommendation, and provider endorsement. Variables retained in the final model (Table 4) included knowledge, general vaccine attitudes, low concern about potential side effects, belief that vaccine is well tested, barriers (cost, concerns about impact on sexual behaviors, trust in pharmaceutical industry), and social influences. There were minimal changes (<10%) in the ORs or confidence intervals (CI) for the remaining variables once nonsignificant factors were removed from the model. The relationships between decisional status and correlates of interest, adjusting for all other variables in the models, are presented below and in Table 4.

Knowledge about HPV and the vaccine. Compared with parents who had decided against vaccination, those who reported the intention to vaccinate daughter(s) (OR, 1.48; 95% CI, 1.00–1.63) and those who had already vaccinated their daughter(s) (OR, 1.79; 95% CI, 1.22–2.84) had higher levels of knowledge about HPV and the vaccine. All ORs are for a 10% increase in knowledge scores.

General attitudes toward vaccines. Parents who decided against vaccination had the most negative attitudes toward vaccines in general. Compared with these parents, those who had already vaccinated their daughter(s) had the most positive attitudes (OR, 2.45; 95% CI, 1.74–3.44). Parents who were undecided (OR, 1.29; 95% CI, 1.13–1.48) and parents who intended to vaccinate their daughter(s) (OR, 1.27; 95% CI, 1.09–1.49) also showed more positive attitudes toward vaccines in general than parents who had decided against vaccination.

Attitudes toward the HPV vaccine

Vaccine safety. Parents who intended to vaccinate were the least likely to report that side effects would deter them from vaccinating their daughter(s) (OR, 1.93; 95% CI, 1.15–3.25). However, believing that the vaccine had been well-tested before distribution was not statistically different between parents who intend to vaccinate their daughter and parents who had decided against vaccinating their daughter (OR, 1.17; 95% CI, 0.70–1.94).

Potential barriers. The extent to which cost was perceived as a barrier was considerably lower among parents whose daughter(s) were already vaccinated, compared with those who decided against vaccination (OR, 0.42; 95% CI, 0.27–0.67). Moreover, whereas cost also seemed to be less of a concern for other groups of parents, these differences in perceived cost barriers were not statistically significant.

In terms of the concern that vaccination would send a message to their daughter condoning risky sexual

Table 3. Bivariate relationships between decisional status and correlates

	Decided against	Undecided, OR (95% CI)	Intend, OR (95% CI)	Already vaccinated, OR (95% CI)	Overall *P*
Knowledge*	(Reference)	0.90 (0.35–1.10)	1.48† (1.10–1.79)	2.16† (1.63–2.59)	<0.01
General vaccine attitudes	(Reference)	1.40† (1.25–1.57)	1.52† (1.34–1.73)	2.27† (1.82–2.84)	<0.01
Attitudes about HPV vaccine					
Vaccine efficacy					
Prevent HPV	(Reference)	Unable to fit‡	Unable to fit‡	Unable to fit‡	
Prevent genital warts	(Reference)	1.23 (0.84–1.81)	1.97† (1.28–3.01)	1.86 (0.66–5.30)	0.01
Prevent cervical cancer	(Reference)	Unable to fit‡	Unable to fit‡	Unable to fit‡	
Vaccine safety					
Few side effects	(Reference)	1.12 (0.82–1.55)	2.26† (1.61–3.17)	2.92† (1.71–4.99)	<0.01
Vaccine well tested	(Reference)	1.80† (1.37–2.36)	3.08† (2.23–4.25)	2.97† (1.92–4.60)	<0.01
Vaccine safe	(Reference)	Unable to fit‡	Unable to fit‡	Unable to fit‡	
Vaccine not likely to cause other health problems	(Reference)	1.19 (0.76–1.86)	2.15§ (1.26–3.68)	4.27† (2.21–8.25)	<0.01
Perceived barriers					
Cost	(Reference)	0.96 (0.71–1.30)	0.88 (0.64–1.20)	0.51† (0.34–0.77)	0.02
Concerns about adverse behavioral consequences	(Reference)	0.79† (0.68–0.92)	0.64† (0.54–0.78)	0.36† (0.24–0.53)	<0.01
Trust in provider recommendation	(Reference)	2.82† (1.40–5.66)	2.18† (1.36–3.48)	1.86§ (1.12–3.09)	<0.01
Trust in pharmaceutical industry	(Reference)	2.31§ (1.37–3.87)	4.32† (2.34–7.56)	7.52† (3.63–15.58)	<0.01
Social influences					
Family and friend endorsement (subjective norms)	(Reference)	1.21† (1.14–1.29)	1.40† (1.32–1.55)	1.52† (1.38–1.72)	<0.01
Provider endorsement	(Reference)	1.13 (0.99–1.29)	1.60 (1.38–1.85)†	2.20† (1.38–1.85)	<0.01
Daughter's age	(Reference)	0.96 (0.87–1.07)	1.04 (0.93–1.16)	1.19† (1.06–1.33)	<0.01
Race/ethnicity					
White	(Reference)	(Reference)	(Reference)	(Reference)	0.69
Black	(Reference)	1.21 (0.55–2.69)	0.69 (0.30–1.58)	0.87 (0.26–2.86)	
Hispanic	(Reference)	1.36 (0.59–3.17)	1.08 (0.47–2.48)	1.46 (0.54–3.98)	
Household income	(Reference)	1.00 (0.54–3.98)	1.15 (0.80–1.64)	1.00 (0.70–1.78)	0.71
Education	(Reference)	0.87 (0.54–1.40)	0.80 (0.490–1.31)	1.02 (0.57–1.80)	0.73

NOTE: Data were from unadjusted multinomial logistic regression models.

*ORs represent a 10% increase in knowledge scores (range of scores 0–100%).

†$P < 0.01$.

‡Unable to fit model due to lack of variability in responses.

§$P < 0.05$.

Table 4. Multivariate relationships between decisional status and correlates [weighted n = 504 daughter(s)]

	Decided against	Undecided, OR (95% CI)	Intend, OR (95% CI)	Already vaccinated, OR (95% CI)	Overall *P*
Knowledge*	(Reference)	0.82 (0.66–1.10)	1.48 (1.00–1.63)	1.79† (1.22–2.84)	<0.01
General vaccine attitudes	(Reference)	1.29† (1.13–1.48)	1.27† (1.09–1.49)	2.45† (1.74–3.44)	<0.01
Attitudes about HPV vaccine					
Vaccine safety					
Few side effects	(Reference)	0.98 (0.63–1.55)	1.93‡ (1.15–3.25)	1.54 (0.78–3.08)	<0.01
Vaccine well tested	(Reference)	0.84 (0.56–1.27)	1.17 (0.70–1.94)	0.54 (0.78–3.08)	0.01
Perceived barriers					
Cost	(Reference)	0.91 (0.67–1.24)	0.74 (0.52–1.04)	0.42† (0.27–0.67)	<0.01
Concern about adverse behavioral consequences	(Reference)	0.85 (0.73–1.00)	0.75† (0.63–0.90)	0.50† (0.33–0.76)	0.01
Trust in pharmaceutical industry	(Reference)	2.04‡ (1.09–3.81)	2.09‡ (1.05,4.15)	4.48† (1.90–10.62)	0.01
Social influences					
Family and friend endorsement (subjective norms)	(Reference)	1.15† (1.07–3.81)	1.31† (1.20–1.42)	1.39† (1.24–1.56)	<0.01

NOTE: Data were from adjusted multinomial logistic regression models controlling for all variables listed in the leftmost table column. Weighted n = number of daughter(s) in weighted sample with complete data for all variables included in model.
*ORs represent a 10% increase in knowledge scores (range of scores 0–100%).
†$P < 0.01$.
‡$P < 0.05$.

behaviors, parents who intended to vaccinate their daughter (OR, 0.75; 95% CI, 0.63–0.90) or had already done so (OR, 0.50; 95% CI, 0.33–0.76) were considerably less likely to be worried about the potential for adverse behavioral consequences than parents who had decided against vaccination. Compared with the group of parents who had decided not to vaccinate their daughter(s), all other groups reported a higher level of trust in the pharmaceutical industry (already vaccinated: OR, 4.48; 95% CI, 1.90–10.62; intending to vaccinate: OR, 2.09; 95% CI, 1.05–4.15; and undecided: OR, 2.04; 95% CI, 1.09–3.81).

Social influences (subjective norms). Compared with parents who decided against vaccination, all other groups of parents were more likely to report that family and friends endorsed vaccination and that the opinions of these significant others played a role in their decisions (already vaccinated: OR, 1.39; 95% CI, 1.24–1.56; intending to vaccinate: OR, 1.31; 95% CI, 1.20–1.42; undecided: OR, 1.15; 95% CI, 1.07–1.23).

Discussion

The success of programs designed to maximize HPV vaccine uptake among girls and adolescents will likely be highly dependent on parental willingness to vaccinate their daughter(s). This study examined cognitive, attitudinal, and social correlates of vaccine decisions among a national sample of racially and ethnically diverse parents and caregivers. We found a high level of awareness about HPV infection and the HPV vaccine. Among those who had previously heard of the vaccine, more than half had either already obtained the vaccine for their daughter(s) or reported that would do so within the next year. However, nearly a quarter of parents across all racial and ethnic groups had decided against vaccination; thus, further efforts to improve vaccine acceptance will be necessary.

Despite our finding high levels of awareness, actual knowledge about the virus and the vaccine was suboptimal. Even with low levels of knowledge, however, 53% of those who had heard of HPV reported that they intended to vaccinate their daughter(s) or had already done so. Other studies that have examined the role of HPV knowledge in vaccine decisions have yielded inconsistent results, with some studies reporting that higher levels of HPV knowledge were associated with higher vaccine acceptability (16-18) whereas others did not (19-21). In one of the few intervention studies, parents randomized to receive written educational information about HPV had significant increases in knowledge, but this did not translate to greater acceptance of vaccination (21). In our study, although it explained relatively little of the variability in vaccine decisions, we found knowledge to be a significant correlate of vaccine decisions.

As predicted by our conceptual model, we found attitudes and social influences to be key correlates of vaccine decisions. Compared with parents who had decided against vaccination, those who intended to vaccinate their daughter or had already done so reported more positive attitudes and perceived fewer barriers. Parents who intended to vaccinate their daughter(s) were less likely to be worried about potential side effects of the vaccine, and those who had already vaccinated their daughter(s) were less likely to report that cost would be a barrier to receipt of the vaccine. The notion that vaccination could send a message condoning high-risk sexual behaviors was also significantly associated with parental decisions not to vaccinate. This finding corroborates a number of studies conducted before vaccine marketing that suggested that parental concerns about behaviors such as earlier age at sexual debut or less attention to safe sex were associated with lower rates of vaccine intentions (22, 23). The proportion of parents reporting concerns about sexual disinhibition varies considerably across studies, with low levels of concerns in some (19, 24) and high levels (25–30%) in others (25, 26). In this population-based sample, 22% agreed or strongly agreed that "vaccinating my daughter would send a message that it is okay to have sex."

With regard to the role of social influences in vaccine decision making, compared with parents who had decided against vaccination, all other groups of parents were more likely to report that family and friends endorsed vaccination—findings that are consistent with our hypothesis that social influences are associated with vaccine decisions. Prior studies conducted with school or clinic-based samples have also found that approval of the vaccine by significant others and a perception that vaccination is normative are both associated with vaccine acceptability (21, 24, 27). However, unlike other studies (18, 21), we found in multivariate analyses that provider endorsement was not associated with vaccine decisions, nor was trust in provider recommendation. This finding may relate to our use of a multiplicative measure of provider endorsement that incorporates self-reported weighting of the provider's opinion in vaccine decisions, which differs from the assessment in other studies. Our study also adds new information in that we found that lower levels of trust in the pharmaceutical industry were strongly associated with having decided against vaccination. The association between mistrust of pharmaceutical industries may have countered trust in one's own provider's recommendation.

In summary, our study results suggest that parents who have more positive attitudes toward vaccines (i.e., believe it to be safe) are less concerned about potential behavioral effects, perceive the endorsement of friends and family, and believe the pharmaceutical industry to be trustworthy are substantially more likely to report that they would vaccinate their daughter(s). Although we did not have adequate statistical power to test racial/ethnic differences in correlates of vaccine decisions, we found suggestive evidence that awareness of the HPV vaccine varied across groups. Twenty-five percent of White parents, compared with 48% of Black parents and 39% of Hispanic parents, reported not being aware of the HPV vaccine before the survey. This is concerning, given the disproportionate burden of HPV-related infections experienced by Black and Hispanic women. A few studies have reported racial/ethnic differences in HPV vaccine awareness and knowledge between White parents and nonwhite parents (28-30). These disparities suggest that racial and ethnic minority parents need greater access to information.

We must acknowledge study limitations. First, our data were cross-sectional; as a result, we cannot infer causation. Future research is needed to collect longitudinal data to identify predictors of vaccine uptake. Second, this sample was drawn from a national online panel of individuals selected by random-digit dialing who have agreed to participate in research; as a result, there is potential for selection bias. However, KN panel comparisons to the 2008 Current Population Survey suggest that the panel is reasonably representative of the overall U.S. population (8). Perhaps the most important limitation is that the survey was not offered in Spanish because at the time of data collection, KN did not recruit individuals in Spanish. This limitation likely means that these data underrepresent Hispanic parents with lower levels of English proficiency, possibly resulting in overestimates of vaccine awareness and acceptance among this group. Other limitations include insufficient statistical power to detect racial/ethnic differences in correlates of decision making and lack of variability in some items that resulted in our dropping them from the analyses.

Despite the limitations, this study has multiple strengths. This was a population-based sample of racially/ethnically diverse parents. Unlike previous studies, we did not categorize vaccine decisions or intentions as a dichotomous variable. Examination of decisional status allows a more in-depth assessment of parents' plans regarding vaccination. Moreover, these data were collected on a large number of cognitive, attitudinal, and social factors shortly after the release of the vaccine, which provides a snapshot of the initial "roll out" of this public health innovation. This information can help to inform comprehensive HPV intervention programs aimed at targeting multiple levels of influence, including individuals, social networks, and health-care systems (31).

Interventions to promote vaccine uptake should address the most salient barriers, which in our study, included issues of perceived safety, cost, and fears about the vaccine promoting sexual promiscuity. Parental concerns about general vaccine safety, such as the purported link between vaccines and autism (32), create a challenging environment for vaccination efforts. Because HPV vaccination is prophylaxis for a sexually transmitted infection, it may be all the more challenging to convince parents that they should vaccinate their daughter(s). HPV vaccine reactions have received a great deal of attention in the media. To counter misperceptions about the likelihood of serious vaccine side effects, educational efforts could compare the potential harms of developing a serious adverse vaccine reaction to other life experiences (e.g., having an abnormal Pap test or developing cervical cancer). Because of the high cost of the vaccine and the association between cost barriers and diminished likelihood of vaccinating one's daughter, parents should be made aware of insurance coverage where available and be notified about the availability of coverage by the Federal Vaccine for Children program.

Fears about the impact of vaccination on sexual behaviors may be more difficult to address. It is too early to tell whether the HPV vaccine will affect sexual behaviors in adolescents, although one risk compensation study using data from Lyme disease vaccinations suggests that vaccination does not increase risk-taking (33). Until more is known, parents need reassurance regarding the balance of hypothetical risks versus benefits of the vaccine. To address these concerns, providers need to engage parents in discussions of daughter(s) current or future sexual activity—something that is difficult for many providers to do (34). Interventions to help clinicians more effectively engage parents in this type of conversation are needed, as are interventions to prepare parents to communicate with their children about this sensitive issue.

Low levels of trust in pharmaceutical companies is another attitude that may be difficult to address. If confirmed through longitudinal studies, our findings suggest that interventions should emphasize the value of the vaccine as seen by those without any financial incentive for widespread vaccine distribution. One strategy that may work to nullify distrust of pharmaceutical companies, and consistent with our study findings that social influences are strongly associated with vaccine decisions, is to cultivate the trust that naturally exists in social networks. One such example is dissemination of information by community members, such as lay health advisors, who are able to reach out through informal networks (35). Exposing parents to educational campaigns through mass media—sponsored by nonpharmaceutical sources—may also be effective. Clearly, media strategies used by pharmaceutical industries have been successful in raising awareness about HPV (31).

Our finding that Black and Hispanic parents were less likely to be aware of the HPV vaccine is concerning, particularly in light of the disproportionate burden of cervical cancer in these populations. Differential levels of awareness may be due to documented inequities in access to health information (29, 36). Specific, targeted efforts to develop culturally relevant, linguistically and literacy-appropriate intervention strategies for these groups must be made a priority in public health interventions. Future research should also examine strategies for ensuring equitable access to high-quality health information from trusted sources. Again, our findings on the role of social influences could have implications for reaching at-risk populations. For example, engaging key community stakeholders, such as individuals and leaders across the spectrum of community, health, media, and faith-based organizations, could facilitate the delivery of HPV vaccine information within culturally relevant and trusted settings.

Prophylactic HPV vaccination offers the opportunity to virtually eliminate morbidity and mortality associated with cervical cancer. Yet, the maximum impact of the vaccine cannot be realized without widespread population uptake. As of 2008, the most recent year for which data are available, the National Immunization Survey found that only 37% of girls eligible to receive the vaccine had initiated the vaccine series, and completion of the three-dose series is much lower at 18% (37). To date, there are few published intervention studies (17, 21). Ultimately, a comprehensive approach to population-based vaccination will likely require actions directed at parents and caretakers, medical providers, social networks, as well as policy initiatives to provide access to information and the vaccine (31). Once interventions have been developed, future research should test the relative efficacy of varied strategies. Our findings provide suggested new directions for vaccination efforts, as well as areas for future research.

Disclosure of Potential Conflicts of Interest

No potential conflicts of interest were disclosed.

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