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Understanding how mothers of adolescent girls obtain information about the human papillomavirus vaccine: Associations between mothers' health beliefs, information seeking, and vaccination intentions in an ethnically diverse sample

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Abstract

We examined factors associated with information seeking about the human papillomavirus vaccine among mothers of adolescent girls by testing whether information seeking and vaccination intentions for their daughters are associated with perceived vulnerability, severity, and vaccine benefits in an ethnically diverse sample. Mothers (N = 256) of unvaccinated girls living in Dallas, Texas, were surveyed (49% Black, 29% Hispanic, and 18% White). Perceived vulnerability to human papillomavirus was associated with talking with others (odds ratio = 1.71, 95% confidence interval = 1.09, 2.66) and talking with a doctor about the vaccine (odds ratio = 1.42, 95% confidence interval = 1.01, 1.99), and perceived vaccine benefits were associated with vaccination intentions (odds ratio = 2.96, 95% confidence interval = 1.98, 4.42), but the perceived severity was not associated with any dependent measure. Beliefs about human papillomavirus risk are associated with seeking information from a doctor and interpersonal sources, but ethnic minorities are less likely to talk with others about the vaccine.

Keywords

human papillomavirus vaccine; information seeking; perceived benefits; perceived severity; perceived vulnerability

In the United States, an estimated 12,200 women are diagnosed with cervical cancer and 4210 die from the disease annually (American Cancer Society, 2010). Human papillomavirus (HPV), which is sexually transmitted, is a necessary but not sufficient cause

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of cervical cancer (Bosch and De Sanjose, 2003). Quadrivalent and bivalent HPV vaccines were approved by the US Food and Drug Administration (FDA) in 2006 and 2009, respectively (US FDA, 2006, 2009), and are efficacious in preventing infection with HPV types 16 and 18, respectively (Schiller et al., 2008). The HPV vaccines are preventive vaccines, not therapeutic; therefore, they are the most effective against cervical cancer if given before recipients become sexually active. The vaccines are recommended for 11–12-year-old females, and catch-up vaccinations are recommended for 13–26-year-old females (Centers for Disease Control and Prevention, 2010; Saslow et al., 2007).

In the United States, most HPV vaccines are delivered through opportunistic or voluntary programs (e.g., when a vaccine-eligible child visits a health-care provider), unlike other countries that have organized school-based programs (Desai et al., 2010; Ogilvie et al., 2010; Reeve et al., 2008). Consequently, it is incumbent on US parents of adolescents—typically mothers—to obtain information and make vaccine decisions. Obtaining information from sources such as mass media (e.g., television and Internet; Dutta-Bergman, 2004, Hay et al., 2009) and social networks (e.g., family and health-care providers; Christakis and Fowler, 2007, 2008; Colon-Ramos et al., 2009) has been shown to be associated with people's health beliefs and decisions. For example, Hay et al. (2009) reported that people who had recently searched the Internet for sun protection information were more likely to use sunscreen and sun-protective clothing. Given the media attention the HPV vaccine has received (Habel et al., 2009; Kelly et al., 2009), it is particularly important to understand factors associated with mothers' information seeking about the vaccine, and from which sources they seek information (Ford and Kaphingst, 2009; Redmond et al., 2010). Yet little is known about mothers' information seeking about the HPV vaccine.

In addition, despite evidence that both African Americans and Hispanics are more likely to be diagnosed with cervical cancer and more likely to die from it than White women (American Cancer Society, 2007; Centers for Disease Control and Prevention, 2007), other evidence suggests that they are less knowledgeable about HPV, perceive less risk of cervical cancer for their daughters, report lower intentions to have their daughters vaccinated, and have lower uptake rates for the HPV vaccine than Whites (Almeida et al., in press; Cates et al., 2009; Tiro et al., in press). Thus, it is also important to examine how information seeking may vary for ethnic minorities. This article addresses these empirical gaps by elucidating factors thought to be associated with vaccine information seeking and examining which information sources people use in an ethnically diverse sample. Better understanding of how mothers of adolescent girls obtain information about the vaccine could aid in the development of more effective public health campaigns and interventions.

What factors might be associated with obtaining information about the HPV vaccine?

Theoretical models of persuasion and information processing (Heuristic Systematic Model (Chaiken et al., 1989) and Elaboration Likelihood Model (Petty and Cacioppo, 1986)) suggest that personal relevance of a topic determines whether people will be motivated to attend to information about it. The more personally relevant the topic, the more likely people are to attend to information about it. Guided by these theoretical models, mothers of

adolescent girls should be more likely to obtain information about the HPV vaccine to the extent they perceive the threats of HPV infection and cervical cancer to be personally relevant to their daughters.

Personal relevance of HPV infection and cervical cancer is likely determined by two different beliefs: perceived severity and perceived vulnerability (Brewer and Fazekas, 2007; De Hoog et al., 2005). Severity is the perceived harm the threat would cause, whereas vulnerability is the perceived probability the threat would cause harm (Brewer and Fazekas, 2007). The more severe mothers perceive the risks of HPV infection and cervical cancer to be and the more vulnerable they perceive their daughter to be to those risks, the more likely they would obtain information about the vaccine because HPV infection and cervical cancer would be seen as personally relevant. Perceived severity and vulnerability are also key constructs in the Health Belief Model (HBM; Janz and Becker, 1984)—a theoretical model of preventive health behavior—and have been shown to be reliable predictors of health behaviors (Champion and Skinner, 2008).

There is evidence that perceived severity and vulnerability are associated with vaccination behavior in general (Brewer et al., 2007), and that perceived vulnerability is associated with HPV vaccination intentions and uptake (Friedman and Shepeard, 2007; Reiter et al., 2009). Contrary to theory, however, evidence indicates that perceived severity is not associated with HPV vaccination intentions or uptake (Brewer and Fazekas, 2007; Dempsey et al., 2010; Reiter et al., 2009). This may be because the consequences of HPV infection (i.e., cervical cancer) are widely perceived as quite severe, resulting in limited variability in perceived severity (Reiter et al., 2009). Thus, perceived severity may not be associated with information seeking about the HPV vaccine either.

When a health threat is personally relevant, people are also more likely to perceive ways of dealing with the threat (e.g., the vaccine) more favorably (Croyle et al., 1993; De Hoog et al., 2005). For example, De Hoog et al. (2005) demonstrated that people who felt vulnerable to chronic pain rated a stress management program designed to reduce vulnerability to the pain more favorably than people who felt less vulnerable. Perceiving the vaccine as an effective way to deal with the threats of HPV infection and cervical cancer can serve the function of allowing people to feel safer about those threats (see De Hoog et al., 2005). As with perceived severity and vulnerability, perceived benefit of a behavior is a key construct in the HBM and has been shown to be a reliable predictor of preventive behaviors (Champion and Skinner, 2008). Thus, it is possible that mothers' perceptions of vaccine benefits are also associated with whether they obtain information about it.

Different sources of information about the vaccine

Knowing what sources mothers rely on to get information about the HPV vaccine is also important in understanding their decision process. Current evidence suggests that different information sources can affect health behaviors differently (Ford and Kaphingst, 2009; Redmond et al., 2010). For example, Redmond et al. (2010) reported that the use of mass media sources, but not interpersonal sources, was associated with an increased likelihood of mammography; in contrast, use of interpersonal sources, but not mass media, was associated

with a greater likelihood of not smoking. Whether mothers get information about the HPV vaccine from mass media (e.g., Internet) or interpersonal sources (e.g., family and friends) could affect their vaccine beliefs and decisions, yet current evidence is lacking about whether mothers' perceptions of vulnerability, severity, or benefits of the vaccine are associated with seeking information from specific types of sources and whether these associations vary by race/ethnicity.

Current study

Based on existing evidence and theoretical models of information processing and health behavior, we tested the following hypotheses:

H1 Mothers' perceptions of their daughters' vulnerability to HPV infection and cervical cancer would be positively associated with HPV vaccine information seeking.

H2 Mothers' perceptions of severity would not be associated with information seeking.

H3 Mothers' perceptions of vaccine benefits would be positively associated with information seeking.

As exploratory analyses, we also examined which information sources were associated with perceptions of vulnerability and benefits, but we had no a priori prediction. We also examined whether perceived vulnerability, perceived severity, and perceived benefits of the vaccine were associated with vaccination intentions because there is evidence that these factors are associated with intention to vaccinate (Brewer and Fazekas, 2007; Friedman and Shepeard, 2007). Finally, we examined how these associations varied across Blacks, Hispanics, and Whites.

Methods

Participants

Participants (N = 312) were mothers or female guardians of girls aged 8–22 years living in the greater Dallas, Texas area. Mothers of young adult women aged 18–22 years were included because pilot data indicated that they tended to still be involved in vaccine decisions. Women were recruited from December 2008–May 2010 at three university-affiliated clinics (n = 216) and different local community health fairs (n = 96) as part of a larger study on beliefs about the HPV vaccine. Because people who have already been vaccinated should systematically (and accurately) perceive less vulnerability to HPV infection and cervical cancer, we limited these analyses to mothers of unvaccinated daughters (n = 256; 82% of total sample) in order to properly test the hypotheses.

Procedure

To ascertain eligibility, women who were either waiting for a clinic appointment or attending a community health fair were asked if they had a daughter or were a guardian of a female aged 8–22 years. If they responded "yes," they were invited to participate in the study. After obtaining informed consent, eligible women were invited to complete the

survey and received a small incentive (e.g., water bottle and tote bag). The institutional review board at the University of Texas Southwestern Medical Center approved this study.

Measures

In addition to sociodemographics, the survey measured the following variables.

Independent variables

Perceived vulnerability: We measured perceived vulnerability of HPV infection and cervical cancer separately. Items asked were as follows: "What is the chance that your daughter will be infected with [HPV/cervical cancer] in her lifetime?" and were measured on 5-point scales ranging from 1 (*no chance*) to 5 (*definitely will happen*). Although the items were strongly correlated (r = .85), we did not aggregate them in to a single scale because conceptually they are not intended to measure the same probability estimate.

Perceived severity: Two items measured perceived severity of HPV infection and cervical cancer. Items asked, "If your daughter became infected with [HPV/cervical cancer], how serious would that be?" and were measured on 5-point scales ranging from 1 (*not serious*) to 5 (*extremely serious*). As with vulnerability, we did not aggregate these items for conceptual reasons, although they were strongly correlated (r = .70).

Vaccine benefits: Participants were asked, "How strongly do you agree or disagree that the benefits of having your daughter(s) get the HPV vaccine are greater than any of the risks related to getting the vaccine?" This item was measured on a 5-point scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*).

Dependent variables

Talking with doctor about the HPV vaccine: Participants reported how often they had talked about the HPV vaccine with a doctor using a 5-point scale ranging from 1 (*never*) to 5 (*very often*). Given that more than half of participants had never spoken with a doctor about the vaccine, we created a dichotomized variable (talked with a doctor versus never talked).

Talking with close others about the HPV vaccine: Participants reported on five separate items whether they had talked about the HPV vaccine with any of the following people: spouse, daughter, friends, family members, and religious leader(s) using a 5-point scale ranging from 1 (*never*) to 5 (*very often*). Given that more than half of the participants had never spoken to the person indicated in each item, we created a dichotomous composite variable (talked with one or more close others versus never talked with anyone).

Information seeking from other sources: Participants reported whether they had ever looked for information about HPV or the HPV vaccine from any informational source (e.g., brochures/pamphlets, Internet, and newspapers) using yes/no response options.

Vaccination intention for daughter: Participants were asked, "If your daughter's doctor recommended the HPV shot or cervical cancer vaccine, would you have her get it?" (yes, no, and do not know). "Do not know" responses were coded as "No" in the models.

Analysis strategy

We ran bivariate logistic regression models to examine associations between independent variables (i.e., perceived vulnerability, severity, and benefits) and each of the dependent variables of interest (i.e., talking with a doctor, talking with close others, seeking information from other sources, and vaccination intention).[1] Then, we ran multivariate logistic regression models for each dependent variable where all independent variables were entered simultaneously. Because vulnerability to HPV infection and vulnerability to cervical cancer were highly correlated, we only included vulnerability to HPV in the multivariate models. We took the same approach for the perceived severity items. Multivariate models adjusted for mothers' race/ethnicity and daughter's age as evidence have shown that these variables are associated with HPV vaccine uptake (Chao et al., 2010; Dempsey et al., 2010). We also adjusted for recruitment site (clinic/community). An alpha level of .05 was considered statistically significant. For all outcomes, "do not know" and "no" responses were grouped together in the models. Analyses were conducted in Stata 11.1 (College Station, TX).

Results

Mean age of the mothers/guardians was 42.3 years (range: 22–88); most were non-White (49% Black, 29% Hispanic, and 18% White) and had at least some college education (71.9%). Most had heard about HPV prior to the survey (68.8%) and had accurate knowledge about the link between HPV and cervical cancer (66.0%). Table 1 contains additional information about sociodemographics and Table 2 contains descriptive information about independent and dependent variables.

Bivariate models

Perceptions of vulnerability—The first set of bivariate models tested whether perceptions of vulnerability to HPV were associated with talking with a doctor, talking with others, looking for information, and vaccination intentions (Table 3, Row 1). We found that mothers who had higher perceived vulnerability of HPV were more likely to talk about the HPV vaccine with a doctor (odds ratio (OR) = 1.36, 95% confidence interval (CI) = 1.00, 1.86, $p = .05$) and with close others (OR = 1.74, 95% CI = 1.18, 2.59, $p = .006$). Perceived vulnerability did not significantly predict looking for information from other sources or vaccination intentions. Models including perceptions of vulnerability to cervical cancer (data not shown) revealed that it was not significantly associated with any of the information seeking–dependent variables or vaccination intentions.

Perceptions of severity—In bivariate models, perceived severity of HPV was not significantly associated with any of the dependent variables (Table 3, Row 2). No

[1]The independent variables were considered as continuous variables. However, we reran all models with vulnerability, severity, and vaccine benefits coded as categorical variables with the first categorical level (no chance, not serious, and strongly disagree, respectively) as the referent group. The pattern of findings did not change from the logistic regressions that considered these variables as continuous. To simplify and ease the reporting of the findings, we have chosen to report the analyses that treat these variables as continuous.

associations were found between perceived severity of cervical cancer and any of the dependent variables (data not shown).

Benefits of the HPV vaccine—In bivariate models, benefits were not associated with any of the information-seeking variables (Table 3, Row 3). However, benefits were associated with greater vaccination intentions (OR = 2.88, 95% CI = 2.00, 4.14, $p < .001$).

Multivariate models

After adjusting for the other independent variables of interest and the covariates, the pattern of significant associations largely remained (see Table 3, Rows 4–6). Specifically, the effect of perceived vulnerability remained significant for talking with others and for talking with a doctor. For perceived benefits, the effect on vaccination intentions remained significant. Interestingly, non-White participants were significantly less likely to have talked with others and looked for information about the HPV vaccine than White participants. In addition, participants recruited from the community events were more likely to have talked with a doctor and talked with close others about the vaccine than participants recruited from clinics.

Discussion

We found that the more mothers perceived their daughters to be vulnerable to HPV infection, the more likely they were to have sought information about the HPV vaccine from talking with close others and from talking with a doctor. Perceptions of vulnerability to HPV infection were not significantly associated with looking for information from other sources or intentions. Moreover, mothers' perceptions of their daughters' vulnerability to cervical cancer were not significantly associated with any of the information-seeking variables or intentions. As expected, perceived severity was not associated with any of the dependent variables. Finally, perceived benefits were strong correlates of vaccination intentions, but were not associated with any of the information-seeking variables as we expected. To our knowledge, this is the first study that has tested the relations between these psychosocial constructs and information-seeking behavior about the HPV vaccine.

We observed two significant associations between perceived vulnerability (for HPV infection) and the three sources of information. Findings suggest that information mothers get from doctors and from close others may be more influential on their decisions to vaccinate than information from other sources. Why might this be the case? Regarding information from a doctor, evidence suggests that a physician's recommendation for the vaccine has a strong influence on vaccination decisions (e.g., Rosenthal et al., 2011). Our findings are consistent with this evidence in suggesting that physicians are an influential source of information about the vaccine. Regarding information from close others, it may be that the risk perception–information-seeking association about the vaccine is particularly strong in the context of people's close social networks. For example, people may seek out opinions about the vaccine from close others when they feel sufficiently at risk, or it may be that the opinion of close others most strongly influences how "at risk" they feel. This is consistent with recent findings that social norms were the strongest predictor of people's progression toward the decision to get the HPV vaccine (Allen et al., 2009). This

explanation should be interpreted cautiously, however, as only two of the six tests examining the vulnerability—information-seeking associations were significant. Interestingly, non-White participants were significantly less likely to talk with close others about the HPV vaccine. This may reflect an important difference in how information about the vaccine may be communicated among different racial/ethnic groups. Future research is needed to replicate and clarify this observation.

Perceived severity of HPV infection and cervical cancer did not predict any of the HPV vaccine outcomes. The distribution of perceived severity responses was skewed such that the vast majority of participants reported HPV infection (88%) and cervical cancer (95%) to be “very” or “extremely” serious with little variability in the responses (see Table 2). Consistent with a previous study (Reiter et al., 2009), this finding suggests that perceived severity may not have a reliable association with HPV vaccine outcomes, perhaps due to a ceiling effect. This does not mean that perceived severity is irrelevant to HPV vaccine decision-making. In fact, it seems likely that an individual who believed cervical cancer to be less than severe would be less likely to seek information about the vaccine or engage in other preventive behaviors. Given that such a small number of people appear to report cervical cancer to be less than very severe, a much larger sample would be needed to have sufficient statistical power to detect the effect of severity on behavior.

Mothers’ beliefs that the benefits of the vaccine outweigh the costs were not associated with any of the information-seeking variables. This suggests that increased perceived benefits do not consistently result from conversations with doctors, close others, or seeking information from other sources. Nor do increased benefits lead people to seek out information about vaccination. Consistent with prior evidence (Allen et al., 2009), however, beliefs about the benefits of the vaccine were strongly associated with vaccination intentions. There is also evidence that a similar construct, vaccine efficacy, is associated with greater intention and vaccine uptake (Brewer and Fazekas, 2007; Reiter et al., 2009). The observation that beliefs about the benefits of the vaccine, but not perceptions of vulnerability, were associated with vaccination intentions suggests that perceived benefits may be a more proximal predictor of vaccination intentions than perceived vulnerability. This is consistent with stage-based models of behavior change (De Hoog et al., 2005; Weinstein et al., 1998) that posit that knowledge or beliefs about how to address a health threat (e.g., beliefs about the benefits of the vaccine) are more temporally proximal to a decision to take action than are beliefs about vulnerability to the threat (e.g., risk perceptions). These cross-sectional data, however, preclude us from testing these temporal hypotheses.

The rates of talking with a doctor about the vaccine (44%) and talking with a close other about the vaccine (65%) were higher than the rates of ever having looked for information about the vaccine from other sources (28%; see Table 2). These rates are consistent with US data showing that people were more likely to passively encounter information about cancer prevention and screening behaviors than actively seek it out (Kelly et al., 2010). Although we cannot determine how passive or active mothers in this sample were in receiving or seeking information, the findings do suggest that for this sensitive health decision, women may be more likely to get information from interpersonal sources rather than seeking it from media sources.

In our convenience sample of Dallas-area mothers, we found that the recruitment site was associated with certain HPV vaccine outcomes. Participants recruited through community health fairs were more likely to talk with doctors and others about the HPV vaccine. It is unclear why there are differences by clinic and community, although mothers at health fairs may have been more motivated to participate because they may be more active/motivated about health issues in general, given that they chose to attend a health fair event (i.e., selection bias).

Limitations

There are a few limitations to this study. First, these are cross-sectional associations and causal conclusions cannot be drawn. For example, we cannot determine from these data whether heightened vulnerability drives people to talk with others about the vaccine or whether talking with others influences how vulnerable they perceive their daughter to be. Clarifying the nature of this relation is particularly important given that close social networks may be an effective means of intervention; disentangling the causal nature of this relation would be critical to inform intervention design. Second, we do not have information regarding the nature and content of the conversations that women had with others in their social network. It is possible that perceived risk influences people to seek out the opinion of others, but it is not clear whether the conversations women had with those in their social network were favorable toward vaccination.

A third limitation is that we used single-item measures for all the study variables due to concerns about participant burden. Therefore, we were unable to assess the reliability of the measures, and it raises the possibility that poor measurement may have restricted our ability to detect significant effects (Type II errors). Moreover, the wording of the measures of perceived vulnerability did not ask women to report the likelihood of HPV infection or cervical cancer *in the context of their daughter's vaccination status*. Some women may have reported low perceptions of vulnerability because they planned to get their daughter vaccinated. Researchers have recommended that measures of perceived vulnerability include a clause about the preventive behavior (e.g., in the event she never gets the vaccine) to reduce measurement error (Brewer et al., 2004; Brewer and Fazekas, 2007). Fourth, our study sample was racially and ethnically diverse (78% were non-White), highly educated (72% with some college or higher), and largely insured (87%), reflecting the population from which they were drawn. Given the unique sociodemographic characteristics of our sample, our findings need to be replicated with other samples. Moreover, our findings may be less relevant for countries that have organized school-based vaccination programs, as they have systematic processes to inform all parents about the HPV vaccine and invite adolescent girls to receive the vaccine.

Finally, almost one-third of mothers had not heard about HPV prior to the survey and did not know whether they intended to get their daughter vaccinated. Yet, being uninformed about a health threat does not preclude people from forming beliefs about it (Windschitl et al., 2002); however, their health beliefs would likely be less informed than other people. In addition, people who are undecided about vaccination may be more amenable to

interventions aimed at promoting the vaccine than those who have already decided against it.

Implications and conclusions

Findings reported here support existing evidence (Allen et al., 2009; Brewer and Fazekas, 2007; Reiter et al., 2009) that personal relevance of a health threat and associated health beliefs are important in HPV vaccine decision-making. Interventions targeting perceptions of vulnerability and benefits of the vaccine may be most effective in influencing decision-making behaviors. Findings also suggest that mothers' social networks (e.g., family and friends) may be a more important information source about the vaccine than mass media, but may operate differently among ethnic minorities. This has important implications for public health and educational campaigns about the HPV vaccine as it suggests that interventions targeting parents' social networks may need to be culturally tailored. To more completely understand these implications, however, future research needs to clarify how social networks might influence parents' HPV vaccine decision-making and why ethnic minority members may be less likely to talk with others about the vaccine. Finally, it is important that future studies examine these psychosocial factors and information-seeking behaviors at the point of the decision. For example, capturing these beliefs just prior to a clinic visit in which the vaccine is to be offered may provide clearer insight about how risk and other psychosocial processes actually influence the information people seek and their vaccination decisions than the current data allow.

These findings suggest that personal relevance of HPV is associated with obtaining information about the HPV vaccine, but the information may be more likely to be obtained from close others and from physicians rather than mass media. These findings have important implications about how to most effectively target public health campaigns and interventions about the vaccine to different ethnic groups.

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Table 1

Participant demographics and characteristics (N = 256).

	Value
Mothers	
Age, mean (SD)	42.3 (9.2)
Race/ethnicity, *n* (%)	
White, non-Hispanic	46 (18.0)
Black, non-Hispanic	125 (48.8)
Hispanic	75 (29.3)
Other/missing	10 (3.9)
Education, *n* (%)	
High-school graduate or less/missing	72 (28.1)
Some college/technical degree	95 (37.1)
College graduate	89 (34.8)
Type of health insurance, *n* (%)	
Uninsured	37 (14.5)
Public (e.g. Medicare and Medicaid)	49 (19.1)
Private/military	170 (66.4)
Adolescents	
Age, *n* (%)	
8–12 years	95 (37.1)
13–17 years	94 (36.7)
18–22 years	67 (26.2)
Type of health insurance, *n* (%)	
Uninsured	33 (12.9)
Public (e.g. Medicare, Medicaid, and children's health insurance program)	72 (28.1)
Private/military	151 (59.0)
Recruitment site, *n* (%)	
Clinics	176 (68.8)
Community events	80 (31.3)
Mothers' HPV knowledge and awareness, *n* (%)	
Heard of HPV prior to questionnaire (yes)	176 (68.8)
Knows HPV causes cervical cancer (yes)	169 (66.0)

SD: standard deviation; HPV: human papillomavirus.

Table 2

Descriptive information for independent and dependent variables.

Independent variables	Value
Perceived risk of daughter's HPV infection, mean (SD)	2.47 (0.89)
Perceived risk of daughter's cervical cancer, mean (SD)	2.36 (0.78)
Perceived severity of daughter's HPV infection, mean (SD)	4.52 (0.79)
Perceived severity of daughter's cervical cancer, mean (SD)	4.90 (0.47)
HPV vaccine benefits outweigh the risks, mean (SD)	3.37 (0.97)
Dependent variables	
Talked with doctor, *n* (%)	
Yes	112 (43.8)
No	129 (50.4)
Refused/missing	15 (5.8)
Talked with others, *n* (%)	
Yes	165 (64.5)
No	64 (25.0)
Refused/missing	27 (10.5)
Looked for information from other sources, *n* (%)	
Yes	71 (27.7)
No	178 (69.4)
Refused/missing	7 (2.7)
Intend to vaccinate, *n* (%)	
Yes	128 (50.0)
No	34 (13.3)
Do not know/refused/missing	94 (36.7)

SD: standard deviation; HPV: human papillomavirus.

Table 3

Bivariate and multivariate logistic regression models of perceived vulnerability to HPV, perceived severity of HPV, and perceived benefits of the vaccine on HPV vaccine outcomes among mothers of unvaccinated girls: Dallas, Texas, December 2008–May 2010.

Bivariate models	**Talk with doctor**	**Talk with others**	**Look for information**	**Intention**
	OR (95% CI)	**OR (95% CI)**	**OR (95% CI)**	**OR (95% CI)**
Perceived vulnerability of HPV (crude)	1.36 (1.00, 1.86)	**1.74 (1.18, 2.59)**	1.20 (0.87, 1.67)	1.33 (0.98, 1.81)
Perceived severity of HPV (crude)	0.97 (0.70, 1.35)	0.86 (0.58, 1.30)	1.20 (0.81, 1.77)	0.91 (0.66, 1.25)
Benefits of the vaccine (crude)	1.10 (0.85, 1.44)	1.18 (0.86, 1.61)	1.16 (0.87, 1.56)	**2.88 (2.00, 4.14)**
Multivariate models	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)	AOR (95% CI)
Perceived vulnerability of HPV (adjusted)	**1.42 (1.01, 1.99)**	**1.77 (1.13, 2.78)**	1.08 (0.74, 1.57)	1.10 (0.76, 1.57)
Perceived severity of HPV (adjusted)	1.03 (0.71, 1.48)	1.15 (0.72, 1.82)	1.33 (0.85, 2.08)	0.79 (0.51, 1.22)
Benefits of the vaccine (adjusted)	0.96 (0.71, 1.30)	1.03 (0.71, 1.51)	1.11 (0.79, 1.55)	**2.95 (1.97, 4.40)**
Recruitment site				
Clinic	Referent	Referent	Referent	Referent
Community	**2.01 (1.07, 3.78)**	**2.45 (1.03, 5.84)**	1.08 (0.55, 2.14)	0.68 (0.35, 1.32)
Daughter's age				
8–12 years	Referent	Referent	Referent	Referent
13–17 years	1.77 (0.92, 3.43)	2.04 (0.90, 4.64)	0.62 (0.30, 1.26)	1.33 (0.68, 2.66)
18–22 years	1.07 (0.51, 2.22)	1.25 (0.52, 3.01)	0.51 (0.22, 1.18)	1.39 (0.62, 3.09)
Mother's race/ethnicity				
White, non-Hispanic	Referent	Referent	Referent	Referent
Black, non-Hispanic	0.85 (0.40, 1.82)	**0.15 (0.03, 0.70)**	**0.43 (0.19, 0.97)**	0.57 (0.24, 1.34)
Hispanic	0.53 (0.23, 1.25)	**0.10 (0.02, 0.50)**	**0.39 (0.16, 0.97)**	0.47 (0.18, 1.21)
Other/missing	0.44 (0.08, 2.63)	**0.05 (0.01, 0.43)**	0.20 (0.02, 1.95)	0.78 (0.13, 4.90)

SD: standard deviation; HPV: human papillomavirus; OR: odds ratio; CI: confidence interval; AOR: adjusted odds ratio.

Note: Statistically significant effects are in bold. The term referent refers to the category that served as the comparison, or referent category in the analyses involving categorical predictors.