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## HPV Vaccine-Related Risk Perceptions Do Not Predict Sexual Initiation Among Young Women Over 30 Months Following Vaccination

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### Abstract

**Purpose**—We examined longitudinally the relationship between human papillomavirus (HPV) vaccine-related risk perceptions and initiation of sexual activity among adolescent women over 30 months after HPV vaccination.

**Methods**—Participants included 91 sexually inexperienced women aged 13–21 years receiving the HPV vaccine who completed at least 3 of 5 study visits. At every visit, participants completed surveys assessing HPV vaccine-related risk perceptions (perceived risk of sexually transmitted

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**NOTE:** The last name of the first author is "Mullins." "L. Kowalczyk" are middle names.

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infections (STIs) other than HPV, perceived need for safer sexual behaviors), and sexual initiation. Outcomes were sexual initiation and age of sexual initiation. Associations between risk perceptions and outcomes were examined using ordered logistic regression models for sexual initiation and interval censored survival analyses for age of sexual initiation.

**Results**—Mean age at baseline was 14.9 years (SD1.4). Most participants perceived themselves to be at risk of STIs other than HPV (mean scale score=4.0/10; SD2.1) and perceived a need for safer sexual behaviors (mean scale score=1.5/10; SD1.5). By 30 months, 65 participants (78%) initiated sex. Perceived risk of STIs and perceived need for safer sexual behaviors were not associated with sexual initiation or age of sexual initiation. Older age at baseline was associated with sooner sexual initiation ( $p=0.02$ ) and older age at sexual initiation ( $p<0.001$ ). Results of ordered logistic regression and survival analyses were unchanged when controlling for baseline age.

**Conclusions**—HPV vaccine-related risk perceptions were not associated with sexual initiation or age of sexual initiation, providing further support that HPV vaccine-related risk perceptions are unlikely to lead to riskier sexual behaviors.

### Keywords

Human papillomavirus vaccines; Adolescent; Sexual behavior; Longitudinal study; Survey study

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### Introduction

Since 2007, the U.S. Advisory Committee on Immunization Practice (ACIP) has recommended routine human papillomavirus (HPV) vaccination for girls 11–12 years-old and catch-up vaccination for 13–26 year-old young women.[1] However, rates of vaccination remain low. In one national study, only 63% of young women received one or more doses of the HPV vaccine and 42% completed the series.[2] Younger adolescent women are less likely to have initiated the series as compared to older adolescent women,[2 3] and only 8% of young women are vaccinated in accordance with ACIP recommendations (series completion by age 12 and within 6 months of the start of the series).[4] One possible contributing factor to these low vaccination rates may be concerns on the part of parents and/or clinicians that because HPV is a sexually transmitted infection (STI), vaccinated young women may feel protected against STIs and thus engage in riskier sexual behaviors, such as initiation of sexual activity.[5 6] Because of these concerns, as well as evidence that earlier initiation of sexual activity is associated with adverse health outcomes,[7 8] it is important to understand if there is a relationship between HPV vaccination and sexual initiation.

One key factor influencing sexual behaviors is a person's risk perception, or one's perceived risk of a negative outcome related to performing a particular behavior.[9 10] For example, a person's perceived risk of pregnancy or STI influences his/her use of condoms. According to risk homeostasis theory, individuals adjust their behaviors to maintain an overall level of risk that is acceptable to them.[11 12] Thus, if someone feels at low risk of a negative consequence (such as feeling at low risk of STIs other than HPV due to having received the HPV vaccine), he/she may engage in riskier sexual behaviors to offset feeling more

protected from STIs - thereby keeping his/her overall perceived level of risk the same. Although HPV vaccination offers protection against only one STI, vaccinated young women may inappropriately perceive themselves to be at lower risk of STIs other than HPV. Understanding whether post-HPV vaccination risk perceptions are associated with riskier sexual behaviors, such as initiation of sexual activity, is important to the design and implementation of interventions to help young women develop appropriate risk perceptions.

Prior studies have demonstrated no association between HPV vaccination and sexual behaviors and related outcomes, such as changes in rates of STI diagnoses, reported condom use, and other risky sexual behaviors.[13–17] To our knowledge, however, no studies have examined longitudinally the potential role of HPV vaccine-related risk perceptions in initiation of sexual activity among young women who are sexually inexperienced at the time of vaccination. Therefore, the aim of the current study was to examine associations between HPV vaccine-related risk perceptions (perceived risk of STIs other than HPV and perceived need for safer sexual behaviors following HPV vaccination) and both sexual initiation and age of sexual initiation over 30 months following HPV vaccination. We hypothesized that greater perceived risk of STIs other than HPV and greater perceived need for safer sexual behaviors – both protective attitudes - would be associated with lack of initiation of sexual activity and older age of sexual initiation over the duration of the study.

## Methods

Participants for this analysis were drawn from a larger longitudinal study that enrolled 339 13–21 year-old young women who were consecutively recruited from an urban, hospital-based adolescent primary care office.[18] All participants had received the first HPV vaccine dose within 2 days of enrollment. Participants were recruited from 2008 to 2010, and the study was completed in 2013. Mothers or female legal guardians of participants were invited to enroll in the parent study. Women who were 18 years of age or older provided consent; younger women provided assent and parental permission was obtained. Mothers provided consent for their own participation. Participants received compensation for their time: the young women received a \$15 gift card for the first study visit, \$25 cash for each of 4 follow-up visits, and an additional \$20 for completion of the 30 month study visit; and mothers received a \$15 gift card. The hospital institutional review board approved the study.

The current analysis includes the 91 young women who were sexually inexperienced at the baseline visit and completed at least 3 of 5 study visits (baseline, 2, 6, 18, 30 months), including the first and last study visits; 53 young women who were sexually inexperienced at baseline were excluded from this analysis because they did not meet this criterion. Young women who were included in this analysis did not differ from those who were excluded in terms of age, race, ethnicity, insurance status, or substance use (lifetime history of smoking, alcohol use, or marijuana use). Immediately after receiving the first HPV vaccine dose, young women who enrolled in the study completed a self-administered paper survey. Risk perceptions -perceived risk of STIs other than HPV and perceived need for safer sexual behaviors - were measured in relation to receiving the vaccine; i.e., for perceived risk of STIs other than HPV, “after getting vaccinated (the shot) against HPV... 1) I am less worried about getting a sexually transmitted infection or disease (STI or STD) other than

HPV” (Table 1). At each follow up visit, young women completed similar self-administered paper surveys that assessed HPV vaccine-related risk perceptions and whether the young woman had initiated sexual activity since the prior study visit. Mothers completed surveys at baseline. The survey items were informed by theories of health behavior, specifically the Theory of Planned Behavior[19] and the Health Belief Model.[20] Items and scales measuring knowledge and attitudes were adapted from surveys that were previously validated in adolescent women.[18] Primary predictor variables were HPV vaccine-related risk perceptions: perceived risk of STIs other than HPV and perceived need for safer sexual behaviors following HPV vaccination. Each of these predictors was measured with a 5-item scale. Responses to each of the 5 items were measured using a 10-point visual analog scale ranging from “strongly disagree” to “strongly agree”, and including a neutral mid-point (“neither agree nor disagree”). We calculated mean scale scores for both risk perceptions scales, which ranged from 0–10. Higher scale scores indicated more risky attitudes: lower perceived risk of STIs and less perceived need for safer sexual behaviors. Individual scale items were reverse scored as needed to preserve this interpretation. For analysis, mean scale scores for the risk perceptions scales were dichotomized into top tertile (riskiest attitudes: lowest perceived risk of STIs, lowest perceived need for safer sexual behaviors) vs. lower two tertiles (lower risk attitudes: greater perceived risk of STIs, greater perceived need for safer sexual behaviors). Covariates for analyses included age; race; insurance status; HPV and HPV vaccine knowledge; and lifetime alcohol, marijuana, and tobacco use. Additional predictor variables included maternal factors that were associated with young women’s perceived need for safer sexual behaviors in an analysis of baseline data from this cohort, specifically maternal knowledge about HPV and the HPV vaccine, maternal report of a doctor serving as a source of HPV vaccine information, and maternal report of communication with the daughter about the HPV vaccine.[18] Outcomes were 1) initiation of sexual activity over the course of the 30 months of the study (defined as answering “yes” to the item “Have you had sex with a male or female since the last study visit? (by sex we mean vaginal or anal sex)”) and 2) age at sexual initiation (defined as the age of the participant at the study visit at which sexual activity was first reported.)

Descriptive analyses were performed to examine participant characteristics, HPV vaccine-related risk perceptions, initiation of sexual activity during the course of the study, and visit at which sexual activity was first reported by the participant. Ordered logistic regression models were used to examine associations between predictors (i.e., perceived risk of other STIs other than HPV, perceived need for safer sexual behaviors), covariates, and the cumulative probabilities of sexual initiation over 2 months, 6 months, 18 months, or 30 months after HPV vaccination. Interval censored survival analyses were used to examine associations between predictors, covariates, and age of sexual initiation. The level of significance for associations between predictor variables and outcomes in univariable analyses was defined as  $p < 0.05$ . Analyses were conducted with SAS (version 9.3; Cary, NC).

## Results

### Demographics

The mean age of the young women included in this analysis was 14.9 years (SD 1.4; Table 1). The majority of young women (74%) self-reported Black race, and 85% were insured. At baseline, 34% of young women reported ever using alcohol, 2% reported ever using marijuana, and 1% reported ever smoking. Young women had fair knowledge about HPV and the HPV vaccine, with a mean knowledge score of 4.7 (SD 2.3; range 0–10). Mothers had slightly higher knowledge about HPV and the HPV vaccine, with a mean knowledge score of 7.1 (SD 2.5; range 0–12). By the end of the study, 65 young women had initiated sexual activity: 7 (11%) reported sexual initiation at the 2 month visit, 9 (14%) at the 6 month visit, 20 (31%) at the 24 month visit, and 17 (26%) at the 30 month visit; 12 (18%) had missing data for timing of sexual initiation.

### HPV Vaccine-Related Risk Perceptions

Following the first HPV vaccine dose, most of these sexually inexperienced women perceived themselves to be at continued risk of STIs other than HPV following vaccination, and the vast majority perceived a continued need for safer sexual behaviors. Baseline mean scale scores for these risk perception scales were as follows (lower numbers indicate more protective risk perceptions; i.e. higher perceived risk of STIs other than HPV and higher perceived need for safer sexual behaviors following vaccination): perceived risk of STIs 4.0 out of 10 (SD 2.0) and need for safer sexual behaviors 1.5 out of 10 (SD 1.5) (Table 1). Over the 30 months of the study, scale scores for perceived need for safer sexual behaviors did not change significantly. However, scale scores for perceived risk of STIs other than HPV decreased over time ( $p=0.027$ ), indicating that young women perceived themselves to be more at risk of STIs other than HPV over the 30 months following HPV vaccination.

### Factors Associated with Initiation of Sexual Activity at Any Visit

In univariable ordered logistic regression models, neither perceived risk of STIs other than HPV nor perceived need for safer sexual behaviors following HPV vaccination were associated with the cumulative probability of initiation of sexual activity at any visit ( $p=0.23$  and  $0.50$ , respectively; Table 2). Among the covariates, only older age at baseline was associated with sooner initiation of sexual activity after HPV vaccination. The results of subsequent ordered logistic regression analyses were unchanged when controlling for baseline age. Multivariable analyses were planned but were not completed due to the lack of statistically significant associations between predictor variables and outcomes in univariable analyses.

### Factors Associated with Age of Sexual Initiation

In univariable interval censored survival models, neither perceived risk of STIs other than HPV nor perceived need for safer sexual behaviors was associated with age of sexual initiation ( $p=0.15$  and  $0.22$ , respectively). Older age at baseline was associated with older age at sexual initiation ( $p<0.001$ ; Table 3). The results of subsequent survival analyses were unchanged when controlling for baseline age. Multivariable analyses were planned but were

not completed due to the lack of statistically significant associations between predictor variables and outcomes in univariable analyses.

## Discussion

We examined associations between HPV vaccine-related risk perceptions, initiation of sexual activity, and age at initiation of sexual activity over the 30 months following the first HPV vaccine dose among 13–21 year-old women who were sexually inexperienced at the time of vaccination. We found that neither perceived risk of STIs other than HPV nor perceived need for safer sexual behaviors following vaccination were associated with initiation of sexual activity or age at initiation of sexual activity. The current study is novel in that we examined the onset of sexual activity and the age of onset of sexual activity longitudinally following receipt of the HPV vaccine and included maternal factors as covariates.

In this study, we found that young women who were sexually inexperienced at the time of HPV vaccination generally perceived themselves to be at continued risk of STIs other than HPV and believed that safer sexual behaviors were still needed despite vaccination. These results are consistent with prior work demonstrating that few women who are vaccinated against HPV believe that the vaccine protects against STIs other than HPV [21 22] or believe that vaccination could lead them to participate in riskier sexual behaviors. [23] Although a decline in accurate HPV vaccine-related risk perceptions related to STIs might be expected over time, after young women receive education about the HPV vaccine at the time of vaccination, we found that vaccinated young women perceived themselves to be *more* at risk of STIs other than HPV over 30 months after vaccination. This evolution of risk perceptions over time was also seen in another study of vaccinated 11–12 year old girls: girls developed more accurate HPV vaccine-related risk perceptions over time, and this was related to improved knowledge about HPV and the HPV vaccine. [24] With time, young women are likely exposed to more messages about safer sex from parents [25 26] and may have formal education about sexual health, which may contribute to greater sexual health knowledge and thus greater perceived risk of STIs other than HPV. In addition, as they increasingly engage in sexual behaviors, they understandably and accurately may see themselves at increased risk for STIs.

We examined associations between risk perceptions after HPV vaccination and two primary outcomes: initiation of sexual activity and age at initiation of sexual activity. Neither greater perceived risk of STIs other than HPV nor greater perceived need for safer sexual behaviors was associated with initiation of sexual activity nor age of initiation of sexual activity in our cohort. Prior studies have shown no association between HPV vaccination status and various sexual behaviors and outcomes, including STIs, [13 15 22 27–29] condom use, [29 30] engaging in sex, [30] pregnancy, [15 22] number of sexual partners, [14 30] or age at sexual initiation. [14] A recent systematic review of 20 published studies found no publications reporting an association between HPV vaccination and riskier sexual behaviors. [16] In contrast, women who received the HPV vaccine demonstrated *more* protective behaviors - greater rates of condom use - as compared to non-vaccinated women. [14] In prior work by our group, we found no association between HPV vaccine risk perceptions and initiation of

sexual behavior within the first 6 months following HPV vaccination.[31] Our current results demonstrate that this lack of association persists for 30 months following vaccination in our cohort of young women. We included a number of covariates that may be associated with riskier behaviors (such as substance use) as well as maternal factors that were associated with young women's perceived need for safer sexual behaviors at baseline.[18] The only covariate associated with sexual initiation and age at sexual initiation was baseline age, such that older baseline age was associated with sooner initiation of sexual activity after HPV vaccination and older age at sexual initiation. None of the other covariates were significantly associated with either outcome. Taken together, our results and other current literature consistently suggest that the vast majority of young women who are vaccinated against HPV understand the limitations of the vaccine and the continued need for safer sexual behaviors, which should offer reassurance to parents and healthcare providers. In order to improve HPV vaccination rates, providers should inquire about the reasons behind parental vaccine hesitancy and provide education and reassurance to parents that HPV vaccination is not associated with riskier sexual behaviors.

The limitations of the study are as follows. First, sexual initiation was self-reported by participants; this could be influenced by social desirability bias, leading participants to not truthfully report their sexual behaviors. Second, the young women were recruited from a clinic serving a predominately low-income, urban population, which may limit the generalizability of the findings. Third, young women who were not eligible for the current analyses because they did not meet the inclusion criterion of completing at least 3 of 5 study visits may have differed from those who were included in this analysis in terms of initiation of sexual activity. Fourth, the study was not designed to assess risk perceptions pre- and post-HPV vaccination. Therefore, we cannot examine changes in risk perceptions from pre- to post-vaccination. Finally, this study included a relatively small sample of young women, which may limit the generalizability of our findings.

Among a cohort of sexually inexperienced adolescent women who received the HPV vaccine, the majority of young women perceived themselves to be at continued risk of STIs other than HPV and continued to perceive a need for safer sexual behaviors over 30 months following receipt of the first HPV vaccine dose. HPV vaccine-related risk perceptions were not associated with sexual initiation or age of sexual initiation over the 30 months following vaccination. This finding is consistent with the results of previous studies in the extant literature which have demonstrated that HPV vaccination does not lead to riskier sexual behaviors in adolescents. Although the young women in this study demonstrated appropriate risk perceptions, parents and health care providers should continue to provide education to young women about the limitations of protection afforded by the HPV vaccine in order to facilitate development of appropriate risk perceptions among vaccinated young women.

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## Abbreviations

<b>ACIP</b>	Advisory Committee on Immunization Practices
<b>HPV</b>	human papillomavirus
<b>STIs</b>	sexually transmitted infections

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### Implications and Contribution

Among sexually inexperienced adolescent women vaccinated against human papillomavirus (HPV), perceived risk of sexually transmitted infections other than HPV and perceived need for safer sexual behaviors following vaccination were not associated with initiating sexual activity, further demonstrating that HPV vaccine-related risk perceptions are unlikely to lead to riskier sexual behaviors.

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**Table 1**

Participant characteristics and covariates at baseline (n=91)

Characteristic	Number (%)	Mean (SD)
Age		14.9 (1.4)
Race <sup>a</sup>		
Black	67 (73.6)	
White	16 (17.6)	
Other	8 (8.8)	
Have health insurance	77 (84.6)	
Lifetime history of alcohol use	31 (34.1)	
Lifetime history of marijuana use	2 (2.2)	
Lifetime history of smoking	1 (1.1)	
HPV and HPV vaccine knowledge score <sup>b</sup>		4.7 (2.3)
Perceived risk of STI other than HPV after HPV vaccination <sup>c,d</sup>		4.0 (2.0)
Perceived need for safer sexual behaviors after HPV vaccination <sup>c,e</sup>		1.5 (1.5)
Maternal HPV and HPV vaccine knowledge score <sup>b</sup>		7.1 (2.5)
Maternal report of communication with daughter about HPV vaccine	53 (66.3)	
Maternal report that doctor is a source of information about the HPV vaccine	68 (85.0)	

SD=standard deviation; HPV=human papillomavirus; STI=sexually transmitted infection

<sup>a</sup>Race was self-reported.<sup>b</sup>The total possible score ranged from 0–13.<sup>c</sup>For both perceived risk of STI other than HPV and perceived need for safer sexual behaviors, the possible range of mean scale scores was 0–10, with higher scale scores indicate riskier attitudes. For example, a higher mean scale score for perceived risk of STIs indicates lower perceived risk of STIs other than HPV after vaccination, and a higher mean scale score for perceived need for safer sexual behaviors indicates lower perceived need for safer sexual behaviors following HPV vaccination.<sup>d</sup>Specific items comprising this scale included: “After getting vaccinated (the shot) against HPV... 1) I am less worried about getting a sexually transmitted infection or disease (STI or STD) other than HPV; 2) I am still just as concerned about getting an STI or STD other than HPV; 3) I think getting an STI or STD other than HPV will be less of a problem; 4) I am less worried that one of my sex partners could get an STI or STD other than HPV from me; and 5) There is less of a chance that I will get an STI other than HPV than there used to be.”<sup>e</sup>Specific items comprising this scale included: “After getting vaccinated (the shot) against HPV... 1) I think that condom use during sex is less necessary; 2) I feel it is still just as important to have as few sexual partners as possible; 3) I feel that it is not as important to talk to my sex partners about safe sex; 4) I think it is still just as important to use condoms every time I have sex; and 5) I will be less worried about having unprotected sex.”

**Table 2**  
 Predictor variables associated with the cumulative probabilities of sexual initiation over 2, 6, 18 and 30 months after HPV vaccination: Results of univariable ordered logistic regression models

Variable	Odds Ratio (95% confidence interval) <sup>a</sup>	P-value	Adjusted Odds Ratio (95% confidence interval) <sup>b</sup>	P-value
Perceived risk of STIs other than HPV, baseline (lower 2 tertiles vs. highest tertile)	1.91 (0.66–5.47)	0.23	0.40 (0.14–1.20)	0.10
Perceived need for safer sexual behaviors, baseline (lower 2 tertiles vs. highest tertile)	0.71 (0.26–1.95)	0.50	1.72 (0.61–4.87)	0.31
Age, baseline (years)	1.57 (1.07–2.29)	0.02		

STI: sexually transmitted infection; HPV: human papillomavirus

<sup>a</sup> Covariates included age; race; insurance status; HPV and HPV vaccine knowledge; lifetime alcohol, marijuana, and tobacco use; maternal knowledge about HPV and the HPV vaccine; maternal report of a doctor serving as a source of HPV vaccine information; and maternal report of communication with the daughter about the HPV vaccine. No other predictors were significantly associated with sexual initiation on univariable analyses at  $p < 0.10$ .

<sup>b</sup> Adjusted for age at baseline.

**Table 3** Predictor variables associated with age at sexual initiation: Results of unadjusted and adjusted interval censored survival analyses

Variable	Unadjusted estimate (standard error) <sup>a</sup>	P-value	Adjusted estimate (standard error) <sup>b</sup>	P-value
Perceived risk of STIs other than HPV, baseline (lowest 2 tertiles vs. highest tertile)	-0.033 (0.023)	0.15	-0.027 (0.016)	0.09
Perceived need for safer sexual behaviors, baseline (lowest 2 tertiles vs. highest tertile)	-0.028 (0.023)	0.22	0.01 (0.016)	0.54
Age, baseline (years)	0.046 (0.006)	<0.0001		

STI: sexually transmitted infection; HPV: human papillomavirus

<sup>a</sup> Covariates included age; race; insurance status; HPV and HPV vaccine knowledge; lifetime alcohol, marijuana, and tobacco use; maternal knowledge about HPV and the HPV vaccine; maternal report of a doctor serving as a source of HPV vaccine information; and maternal report of communication with the daughter about the HPV vaccine. No other predictors were significantly associated with age at sexual initiation on univariable analyses.

<sup>b</sup> Adjusted for age at baseline.