RESEARCH PAPER

Risk perceptions after human papillomavirus vaccination are not subsequently associated with riskier behaviors or sexually transmitted infections in HIV-infected young women

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ABSTRACT

Concerns have been raised that risk perceptions after human papillomavirus (HPV) vaccination may lead to riskier sexual behaviors or sexually transmitted infection (STI) diagnosis. The aims of this study were to determine whether risk perceptions immediately after HPV vaccination (perceived risk of HPV, perceived risk of STIs other than HPV, and perceived need for safer sexual behaviors, measured using 5-item scales) were associated with number of sexual partners, condom use at last sexual intercourse, or STI diagnosis over the subsequent 48 weeks in HIV-infected young women (N = 99, 17–24 years of age) participating in an HPV vaccine clinical trial. Generalized estimating equation models demonstrated that lower perceived need for safer sexual behaviors was associated subsequently with lower total number of sexual partners (adjusted odds ratio (AOR) = 1.05, 95% confidence interval (CI) = 1.01–1.09) and lower perceived risk of HPV was associated with subsequent report of having used condoms at last sex (AOR = 0.36, AOR = 0.14–0.92). Lower perceived risk of other STIs was not associated with subsequent sexual behaviors. None of the three risk perceptions was associated with subsequent risk of STIs. The findings suggest that inappropriate risk perceptions after HPV vaccination such as lower perceived need for safer sexual behaviors and lower perceived risk of HPV or other STIs were not subsequently associated with risky behaviors or STI diagnosis in HIV-infected young women.

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Introduction

Human papillomavirus (HPV) is the most common sexually transmitted virus, affecting both men and women. HPV infection causes genital warts and cancers involving the anogenital region, head, and neck.^{1,2} Individuals who are infected with human immunodeficiency virus (HIV) are at an increased risk of acquiring HPV and developing HPV-associated cancers.³ Despite the availability of safe, effective vaccines that prevent HPV infection, only about half of adolescents in the United States are up to date on the recommended HPV vaccination series, and only 60% of 13–17 year olds have received at least one dose.⁴ Common reasons for suboptimal vaccine uptake include lack of a strong clinician recommendation for vaccination and parental concerns about safety.⁵ However, some parents cite concern that vaccination may lead to adolescent beliefs that they are protected against HPV or other sexually transmitted infections (STIs), and that safer sexual behaviors are not as important, leading to riskier sexual behaviors.^{6–8} This concern has also been raised repeatedly in the media, although studies have shown no association between HPV vaccination and riskier sexual behaviors.^{9–15}

Examination of the association between risk perceptions after vaccination and subsequent sexual behaviors and STI diagnosis is important. If studies demonstrate no association, parents may be

reassured that risk perceptions after vaccination will not change behaviors and may be more likely to agree to vaccination. If studies do demonstrate an association, evidence-based educational interventions may be developed to correct misperceptions and prevent riskier behaviors after vaccination. These interventions would be especially important among HIV-infected young women, who may be more likely to transmit HIV if they practice riskier behaviors. In previous work, we have examined the association between risk perceptions and subsequent sexual behaviors in sexually experienced but HIV-uninfected young women 13–21 years of age, and found that over the 30 months after HPV vaccination, perceived beliefs about the need for safer sexual behaviors remained consistently high and lower perceived risk of STIs other than HPV did not predict riskier sexual behaviors or STI diagnosis.¹⁶ We have also characterized risk perceptions immediately after HPV vaccination in HIV-infected women, finding that most participants perceived themselves to be at lower risk for HPV, most perceived that they were not at lower risk for other STIs, and the vast majority reported that there was still a need for safer sexual behaviors after vaccination.¹⁷ In this study, we extend the findings of that study by examining the association between risk perceptions immediately after HPV vaccination and subsequent sexual behaviors and STI diagnosis in HIV-infected young

women. The aim of this study was to determine whether risk perceptions (perceived risk of HPV, perceived risk of other STIs, and perceived need for safer sexual practices) were associated with condom use, number of sexual partners, and STI diagnosis over the 48 weeks after HPV vaccination, controlling for baseline demographic, HIV-related, and behavioral characteristics.

Results

The mean age of participants ($N = 99$) was 21.4, 79 (79.8%) were non-Hispanic African American, 4 (4.0%) non-Hispanic White, and 16 (16.2%) were Hispanic; detailed descriptives are found in a previous manuscript.¹⁷ Most (85%) participants had a CD4 + T cell count >500 cells/mm³ and 39.4% had a viral load under 400 copies/mL. As noted above,¹⁷ most participants believed that they were at lower risk for HPV after vaccination, most believed that they were not at lower risk for STIs other than HPV, and the vast majority believed that there was still a need for safer sexual behaviors after vaccination. Overall, knowledge about HPV was poor, with participants answering fewer than 50% of the questions correctly. We measured multiple demographic and behavioral variables across the four study visits. Across the four visits, the mean number of lifetime male partners reported by participants ranged from 16.4 (standard deviation 24.0) at week 12 to 20.4 (standard deviation 38.9) at week 0, condom use at last sexual intercourse with a male partner ranged from 72.7% (week 0) to 80% (week 12), and STI positivity ranged from 0% (at week 12) to 17.4% (at week 24). There were no statistically significant differences in the prevalence of these outcome variables across the study visits.

Lower perceived risk of HPV was associated with subsequent report of having used condoms at last sex in a GEE model adjusted for all variables associated with condom use (adjusted odds ratio (AOR) = 0.36, 95% CI (confidence interval) = 0.14–0.92). In other words, lower perceived risk of HPV was not associated subsequently with a riskier outcome, but instead was associated with higher use of condoms at last sexual intercourse (Table 1). Other variables associated with no condom use included age (AOR = 0.82, 95% CI 0.68–0.99), indicating that older age was associated with higher use of condoms at last sexual intercourse, and race (unknown vs. White, AOR 0.12, 95% CI 0.02–0.93), indicating that unknown race was associated with higher use of condoms at last sexual intercourse. Higher perceived need for safer sexual behaviors was associated subsequently with higher total number of sexual partners (and conversely, lower perceived need for safer sexual behaviors were associated with lower number of sexual partners) in a GEE model adjusted for all variables associated with number of sexual partners (AOR = 1.05, 95% CI = 1.01–1.09); i.e. lower perceived need for safer sexual behaviors after vaccination was not associated with a riskier outcome. Race was also associated with higher number of sexual partners in the adjusted model (Black vs. White, AOR = 3.8, 95% CI 1.27–11.37). Lower perceived risk of other STIs was not associated with subsequent sexual behaviors, and none of the three risk perceptions was associated with subsequent risk of STIs, in multivariable models (Table 1).

Table 1. Association between risk perceptions at baseline and subsequent sexual behaviors: results of multivariable generalized estimating equation models^a.

Model	AOR ^b	95% CI ^c
Model predicting higher number of lifetime sexual partners^d		
Higher perceived need for safer sexual behavior after HPV vaccination (continuous)	1.05	1.01– 1.09
Race		
Black/African American	3.80	1.27– 11.37
White	1.00	
Other/Mixed race	2.26	0.50– 10.23
Unknown	1.77	0.27– 11.84
Model predicting no condom use at last sex^e		
Perceived risk of HPV after HPV vaccination		
Higher perceived risk (upper tertile)	1.00	
Lower perceived risk (lower two tertiles)	0.36	0.14– 0.92
Age (years)	0.82	0.68– 0.99
Race		
Black/African American	0.53	0.18– 1.54
White	1.00	
Other/Mixed race	0.69	0.07– 6.54
Unknown	0.12	0.02 – 0.93

Model predicting STI diagnosis^f

No variables were retained in the final model

^aCovariates with a $p < 0.05$ were retained in the final multivariable model for each outcome.

^bAOR = adjusted odds ratio

^cCI = confidence interval

^dVariables included in the initial model (all variables associated with number of sexual partners in univariable analyses at $p < .20$) were: all risk perceptions, African American race, Hispanic ethnicity, knowledge about HPV and HPV vaccines at baseline, STI diagnosis at baseline, and recent sex partners (time-varying).

^eVariables included in the initial model (all variables associated with no condom use in univariable analyses at $p < .20$) were: all risk perceptions, age, race, STI diagnosis at baseline, total sex partners (time-varying), and condom use at last sex (time-varying).

^fVariables included in the initial model (all variables associated with STI diagnosis in univariable analyses at $p < .20$) were: all risk perceptions, age, total sex partners (time-varying), recent sex partners (time-varying), and condom use at last sex (time-varying). No variables were retained in the final model for STI diagnosis.

Discussion

In this study, we examined whether risk perceptions after HPV vaccination were associated with subsequent sexual behaviors and STI diagnosis in HIV-infected young women. We demonstrated that inappropriate risk perceptions were not associated with riskier sexual behaviors or STI diagnosis: lower perceived risk of HPV was associated subsequently with higher use of condoms at last sexual intercourse, lower perceived need for safer sexual behaviors was associated subsequently with lower total number of sexual partners, lower perceived risk of STIs other than HPV was not associated with subsequent sexual behaviors, and none of the three risk perceptions was associated with subsequent risk of STIs.

Most participants in this study perceived themselves to be at lower risk for HPV after vaccination (an appropriate risk perception), as reported in a manuscript describing baseline data from this study, and as we found in a previous study of sexually experienced but HIV-uninfected young women.^{16,17} However, participants who perceived that they were at lower risk of HPV actually had a higher odds of condom use at last sexual intercourse. Perceived risk of HPV was not associated

with number of sexual partners or STI diagnosis. It is not clear why lower perceived risk of HPV after vaccination was associated subsequently with safer sexual behaviors, but one explanation may be that young women who held more appropriate risk perceptions about HPV were more educated about STI prevention, and therefore practiced safer behaviors. Regardless, the findings are reassuring in that lower perceived risk of HPV was not associated subsequently with riskier behaviors.

The vast majority of participants believed that safer sexual behaviors were still important after HPV vaccination, as previously reported¹⁷ and as we found in a previous study of HIV-uninfected women.^{16,18} In this sample, higher perceived need for safer sexual behaviors was associated subsequently with higher total number of sexual partners (and conversely, lower perceived need for safer sexual behaviors was associated with lower total number of sexual partners), but not with inconsistent condom use or with STI diagnosis. It is possible that women who practice safer sexual behaviors such as limiting number of sexual partners after HPV vaccination also practiced safer sexual behaviors before vaccination, and these women perceived themselves to be at lower risk for STIs and therefore perceived a lower need for safer sexual behaviors. Nevertheless, it is reassuring that those who perceived a lower need for safer sexual behaviors after vaccination did not practice riskier behaviors. In our previous study of HIV-uninfected women, lower perceived need for safer sexual behaviors was not associated with number of partners. However, this belief was associated with less consistent condom use, underscoring the importance of education during the vaccination visit about the importance of safer sexual behaviors.¹⁶

Finally, lower perceived risk of STIs other than HPV was not associated with subsequent sexual behaviors or STI diagnosis. This is consistent with the results of our previous study of HIV-uninfected young women.^{16,18} This finding is encouraging, as it suggests that even if young women hold the misperception that HPV vaccination protects them against other STIs, this belief is not associated with subsequent riskier sexual behaviors or STI diagnosis. Education is needed to ensure that young women receiving the HPV vaccine are not only educated about its benefits regarding HPV prevention, but also about the fact that it will not prevent other STIs and that safer sexual behaviors are still essential.

The findings of this study add to a growing literature demonstrating that HPV vaccination is not associated with the practice of riskier sexual behaviors or STI diagnosis.^{9–15,19} In contrast to our studies in HIV-infected and HIV-uninfected women, previous studies examined the association between HPV vaccination and sexual behaviors or outcomes but did not take into account risk perceptions. These studies, the results of which have been summarized in two recent systematic reviews^{11,13} have demonstrated that HPV vaccination was not associated with subsequent number of sexual partners; condom use; a composite measure of pregnancy/STI testing or diagnosis; or contraceptive counseling. In fact, evidence suggests that vaccinated vs. unvaccinated individuals were more likely to report condom use and contraception use, and to have lower rates of Chlamydia.^{11,13} Taken together

with the findings from our studies, evidence consistently demonstrates that HPV vaccination is not associated with subsequent riskier behaviors.

This study had several strengths, including its longitudinal design, use of validated risk perception scales, and use of GEE modeling to taken into account repeated measures. The study also has several limitations. Though patients were recruited from across the United States and Puerto Rico, the sample size was small. This may have limited the power to detect associations between risk perceptions and subsequent behaviors and STI diagnosis. In addition, participants were HIV-infected which could affect risk perceptions and awareness of the need for safer sexual behaviors. Therefore, the findings may not be generalizable to all young women. Despite these limitations, this longitudinal study provides novel information regarding the association between risk perceptions and subsequent sexual behaviors and STI diagnosis during the 48 weeks after HPV vaccination. The study provides reassuring findings that risk perceptions are not associated with riskier sexual behaviors or STI diagnosis after vaccination in this population of HIV-infected young women.

Patients and methods

Participants in this study were 16–23-year-old HIV-infected young women, enrolled in a phase II, open-label, multicenter trial of the quadrivalent (HPV6, 11, 16, 18) HPV vaccine (Gardasil, Merck & Co., Inc.). This study was conducted by the Adolescent Medicine Trials Network for HIV/AIDS Interventions. Young women were recruited from 14 primary care sites across the United States and Puerto Rico between July 2008 and February 2011. Three doses of the HPV vaccine were administered at day 0, week 8, and week 24, followed by pencil and paper surveys.

Participants completed a self-administered survey instrument assessing risk perceptions, sociodemographic characteristics, HIV-related characteristics, knowledge about HPV and HPV vaccines, and multiple behaviors at each visit (baseline, 12, 24, and 48 weeks); survey items are described in a previous manuscript.¹⁷ Surveys were completed immediately after participants received the first HPV vaccine dose and sealed in an envelope to protect confidentiality. Risk perceptions were assessed using three subscales measuring perceived risk of HPV, perceived risk of other STIs, and perceived need for safer sexual behaviors on 11-item continuous scales (0 = strongly disagree and 10 = strongly agree; each 5-item subscale had a possible score range of 0 to 50). Higher scores indicated higher risk perceptions and higher perceived need for safer sexual behaviors after vaccination. Development of the scales and psychometric characteristics are described in previous manuscripts.^{16,17} Risk perception scale scores were initially analyzed as both continuous and dichotomous variables; based on their distribution, perceived need for safer sexual behaviors was ultimately analyzed as a continuous variable, and perceived risk for HPV and other STIs were analyzed as dichotomous variables (top vs. lower two tertiles). Participants underwent testing for trichomonas, gonorrhea, and Chlamydia at baseline, week 24, and week 48. Participants were considered positive for an STI if testing was positive for at least one of the following: trichomonas, gonorrhea, or Chlamydia.

Descriptive statistics were examined for all variables across the study visits. In order to examine changes in predictor and outcome variables over time, we used mixed models – statistical models containing both fixed effects and random effects – for continuous variables. We used generalized linear models with repeated measures (at study entry and weeks 12, 24, and 48) using generalized estimating equations (GEE) for categorical variables: GEE modeling was used because we were estimating the parameters of a generalized linear model with a possible unknown correlation between outcomes.

We first used univariable regression modeling to examine the unadjusted associations between each of the three risk perceptions at baseline and each of the three outcome variables over the subsequent 48 weeks (no condom use at last sexual intercourse, total number of sexual partners, and STI diagnosis). We also used univariable regression modeling to examine the unadjusted associations between covariates (demographic, HIV-related, and behavioral variables) and each of the three outcome variables over the subsequent 48 weeks. We then used multivariable modeling to examine the associations between risk perceptions and outcomes, adjusted for selected covariates. Variables with an unadjusted p -value < 0.20 in univariable models were entered into the initial multivariable model for model selection, and risk perceptions were forced into the models throughout the model selection process, including into the final model. For the two sexual behavior outcomes (no condom use and number of sexual partners), risk perceptions as well as demographic and HIV-related factors associated with the outcomes in unadjusted models were included in the multivariable models predicting each outcome. For the third outcome (STI diagnosis), risk perceptions as well as demographic, HIV-related factors, and sexual behaviors were included in the multivariable models. Backward elimination was used to delete variables one at a time. Variables with a p -value < 0.05 were retained in the final multivariable models. Adjusted odds ratios, 95% confidence intervals, and p values were calculated.

Disclosure of potential conflicts of interest

Dr. Zimet received an honorarium from Sanofi Pasteur for his work on the Adolescent Immunization Initiative. Dr. Kahn has served as a co-chair of two NIH-funded clinical trials of HPV vaccine in HIV-infected individuals: vaccines and testing for HPV mean geometric titers were provided through the Investigator-Initiated Studies Program of Merck & Co., Inc. The other authors report no conflicts of interest.

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