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Correlates of human papillomavirus vaccination among female university students

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Abstract

Human papillomavirus (HPV) is the most frequently occurring sexually transmitted infection in the United States, but only one third of adolescent girls have received the HPV vaccine. Understanding correlates of vaccination behavior among young women has important implications for health care delivery and public service messages targeting HPV vaccination. Female college students ($N = 313$) completed web-based surveys during their sophomore (second) year of college, Fall, 2008. Surveys included questions about HPV vaccination, demographic factors (ethnicity/race, socioeconomic status [SES]), individual characteristics (romantic relationship status, grade point average, religiosity), and sexual behavior. Lifetime HPV vaccination was reported by 46.5% of participants. Being African-American/Black was associated with a lower likelihood of vaccination. Having a mother with more education, adhering to one's religion's teachings about sex-related principles, and having engaged in recent penetrative sex were associated with a higher likelihood of vaccination. Health care providers should consider young women to be an important group for HPV vaccine education and catch-up, particularly for African American/Black young women and young women from lower SES backgrounds. Providing vaccine education and access to young women before they become sexually active is critical.

Keywords

reproductive health; socioeconomic status; sexually transmitted infection; HPV

Introduction and Background

Human papillomavirus (HPV) is the most frequently occurring sexually transmitted infection (STI) in the United States (US; Baseman & Koutsky, 2005; Centers for Disease Control and Prevention, 2012; Gerend & Magloire, 2012; Weinstock, Berman, & Cates, 2000). HPV infection is highest among women aged 20 to 24 years (Dunne et al., 2007), an age range when many young Americans attend college. Spread through genital skin-to-skin contact during sexual activity, HPV is responsible for the development of genital warts and cervical cancer (Bosch, Lorincz, & Munoz, 2002; Centers for Disease Control and Prevention, 2012; Christian, Christian, & Hopenhayn, 2009; Walboomers et al., 1999). HPV is also responsible for less frequently occurring cancers, such as cancer of the anus, penis, vulva, and throat (Centers for Disease Control, 2012). The HPV vaccine, Gardasil® (Merck), was approved and released by the U.S. Food and Drug Administration in June 2006 and protects against HPV types 16 and 18, which are responsible for 70% of cervical cancer cases, and HPV types 6 and 11, which cause 90% of all genital warts (Centers for Disease Control and Prevention, 2012). Although this vaccine has been commercially available for several years, and is recommended at age 11 to 12 years in the US (Committee on Infectious Diseases, 2012), as recently as 2010 only one third of 11- to 17-year-old girls in the US had received at least one of the three-dose sequence of HPV vaccinations (Committee on Infectious Diseases, 2012; Laz, Rahman, & Berenson, 2012). Because many female adolescents are not vaccinated by the time they finish high school, the purpose of this study was to understand better the factors associated with vaccination after the age of 17 years.

Past research has predominantly focused on identifying correlates of vaccine intentions (Kessels et al., 2012), but less research has addressed actual vaccine uptake. Past work also has focused predominantly on younger adolescents (Kessels et al., 2012), whose vaccine decisions are likely primarily made by parents. By age 18 years, young women, particularly those who attend college, are more likely to live independently from their parents and to make more autonomous decisions about HPV vaccination. Therefore, the present research was designed to examine the demographic factors, individual characteristics, and sexual behavior correlates of HPV vaccination among female college students. Understanding correlates of vaccination behavior in this age range has important implications for health care delivery and public service messages targeting HPV vaccination among young women.

HPV vaccination may be linked to demographic factors, such as ethnicity/race and socioeconomic status (SES). In terms of ethnicity/race, HPV vaccination rates may be lower in African American and Asian American girls and younger women than in European American and/or Hispanic/Latino American girls and women (Keenan, Hipwell, & Stepp, 2012; Kessels et al., 2012; Lau, Lin, & Flores, 2012; Licht et al., 2010). Research results on associations between family SES including maternal education have been more mixed (Kessels et al., 2012; Rosenthal et al., 2008). Some research has suggested that more educated mothers of adolescent girls tend to have more favorable attitudes toward HPV vaccination (Rosenthal et al. 2008) and have daughters who are more likely to be vaccinated (Tiro, Tsui, et al., 2012). A literature review specific to HPV vaccination *behavior* reported mixed findings, with some studies reporting no association with maternal education, another

reporting higher maternal education linked to higher vaccination rates, and another reporting higher maternal education linked to lower vaccination rates (Kessels, 2012). Thus, past research has indicated lower rates of HPV vaccination in certain ethnic/racial groups, and provided inconclusive evidence about associations between HPV vaccination and family SES.

HPV vaccination also may be associated with individual characteristics, such as romantic relationship status, educational performance, and religiosity. Research on romantic relationship status has indicated that relationship status is not associated with HPV vaccination in 11- to 17-year-old girls (Rosenthal et al., 2008), but relationship status may be associated after age 18. That is, increased autonomy may lead to vaccination decisions more reflective of young women's own characteristics. In addition, relationship status has been associated with condom use, another sexually protective behavior; condom use is less frequent among individuals in committed relationships than those in non-committed relationships (Lam & Lefkowitz, 2013; Manlove et al., 2011; Prince & Bernard, 1998), possibly because individuals in committed relationships do not believe they are at risk of contracting STIs from their partners (Hammer, Fisher, Fitzgerald, & Fisher, 1996). Similarly, college students in committed relationships may not believe they are at risk of HPV infection, and therefore, may be less likely to get vaccinated.

In terms of academic achievement, we know of no work that has examined associations between educational *performance* and HPV vaccination or intentions, but past research has examined college attendance and HPV vaccination. This research has demonstrated that college-attending young women are more likely to be vaccinated than young women who do not attend college (Manhart et al., 2011; Rosenthal et al., 2011), and African American women who are college graduates are less likely to have an STI/HIV diagnosis than those without a college degree (Painter, Wingood, DiClemente, DePadilla, & Simpson-Robinson, 2012). Research on educational performance and sexual risk behaviors, such as condom use and casual sex, has suggested that young adults with lower grade point averages (GPAs) tend to engage in more sexual risk behaviors than those with higher GPAs (Bailey, Fleming, Henson, Catalano, & Haggerty, 2008). Thus, it is possible that women with lower GPAs, because they engage in sexual risk behavior more generally, may be less likely to engage in the protective behavior of HPV vaccination.

Evidence has suggested some links between HPV vaccination and religiosity. Intentions to get vaccinated are higher among women who grew up in non-religious or Protestant homes compared to those from other religious backgrounds (Manhart et al., 2011). Similarly, parents who attend religious services less frequently have greater intentions to get their children vaccinated than more religious parents (Barnack, Reddy, & Swain, 2010). In addition, young women who attend religious services more frequently are less likely to use sexual and reproductive health services (Hall, Moreau, & Trussell, 2012). However, religiosity is multifaceted, encompassing both public components, such as religious behavior, and private components, such as religious attitudes (King & Boyatzis, 2004). Most past work on HPV vaccination and religiosity has focused on the behavioral component, and we know of no research that has examined private indicators of religiosity, such as the extent to which women follow their religion's teachings about sex. Based on findings about

religious service attendance, it is possible that women who adhere to their religion's teachings less closely will be more likely to be vaccinated.

Finally, because HPV is transmitted sexually, HPV vaccination may be associated with sexual behavior. Intentions to get vaccinated are higher among sexually active young women (Gerend & Magloire, 2008; Liddon, Hood, & Leichliter, 2012) and those with more sexual partners (Manhart et al., 2011). Less work has examined associations between actual vaccination uptake and sexual behavior, but recent evidence has suggested that low income clinic-attending 11- to 17-year-old girls are more likely to get vaccinated if sexually active (Tiro, Pruitt et al., 2012), and that young women are more likely to get vaccinated if they have more sexual partners (Rosenthal et al., 2008). Thus, sexually active women may be more likely to get vaccinated.

In this paper we examined correlates of vaccination in traditionally aged female college students. Based on past research, we expected that young women who were African American or Asian American, whose mothers had fewer years of education, who were not in romantic relationships, who had lower educational performance, who were more religious, and who were not recently sexually active, would have lower rates of HPV vaccination.

Methods

Participants

Eligible first-year students at a large Northeastern state university received e-mail invitations to participate in the University Life Study, a seven-semester study of college student health behaviors. To determine eligibility, the registrar's office provided us with a list of all first year students, with demographic and contact information. We identified eligible students who met our criteria as first-year, first-time students who were U.S. citizens or permanent residents, age 20 years or younger and residing within 25 miles of campus in the first wave of data collection. We used a stratified random sampling procedure with replacement to achieve a diverse sample with respect to gender and ethnicity/race. For the purpose of the current paper, we include only female students, as HPV vaccination was not recommended for boys and men in 2008. Of the original 521 female students invited to participate, 73% ($N = 378$) completed surveys at Semester 1 (S1). Each semester participants received an email with a secure link to the study. Data for the current paper included all female participants who completed web-based surveys, including the question about HPV vaccination, in the third semester (S3, sophomore/second year) of data collection, Fall 2008, when HPV vaccination was first assessed ($N = 313$; 83% of the S1 female sample). Participants completed informed consent electronically. They received \$25 to complete the S1 survey and \$30 to complete the S3 survey. The Pennsylvania State University Institutional Review Board approved the study protocol.

Measures

Demographic factors—Participants answered demographic questions about their ethnicity/race and mother's education at S1. For ethnicity/race, they answered one question about Hispanic/Latino American ethnicity, and one question about race. Items were not

mutually exclusive, so participants could report on multiple races. Dummy coded variables were created for African American/Black, Asian American/Pacific Islander, and Hispanic/Latino American participants. For instance, for the African American/Black variable, participants who identified as African American/Black, regardless of whether they identified with an additional ethnicity/race, were coded as 1, and all other participants as 0. For mother's education, participants used the following response options: 0= grade school or less; 1=some high school; 2=completed high school; 3=some college; 4=completed college; 5=graduate or professional school). Mother's education was used as a proxy for family SES, because it tends to be more complete than, and highly correlated with, father's education (Entwisle & Astone, 1994). Parental education is the most frequently used indicator of family SES in studies of HPV vaccination (see Kessels et al., 2012 for a review).

Individual characteristics—Participants answered the following question about relationship status at S3: “Which of the following best describes you right now?” Based on classification of romantic relationships in prior research (Davila et al., 2009; Hand & Furman, 2009), answers to this question were coded into two categories, with 1 = in a committed relationship (serious and committed relationship; living with partner; engaged; married) and 0=not in a relationship (not dating; casually dating).

Participants reported their cumulative GPA at S3, with a possible range from 0.00 (equivalent to all F's) to 4.00 (equivalent to all A's).

Participants responded to two measures of religiosity at S3. Similar to prior work (e.g., Koenig, McGue, & Iacono, 2008; Uecker, Regnerus, & Vaaler, 2007), religious service attendance was based on one question, “How many times have you attended religious services during the past 12 months (52 weeks)?” In addition, participants responded to a four-item measure of adherence to religion's sex-related principles in four different sex-related domains: using birth control, premarital sex, extramarital sex, and abortion (Wyatt et al., 2000) on a five-point scale (not at all to completely). Participants who indicated “don't know” were coded as “not at all” because they could not be actively following a religion's beliefs. If they answered the questions using the five-point scale, we used their responses, even if they reported elsewhere in the survey that they did not affiliate with a particular religion. Reliability was acceptable ($\alpha=0.71$) and comparable to past work (Wyatt et al., 2000).

Recent sexual behavior—At S3, participants who had ever reported engaging in penetrative sex (at S1, S2, or S3) answered the following question: “In the past 12 weeks, have you had vaginal or anal sex with a partner?” with 1=yes, 0=no. We used a 12-week time frame because assessment of sexual behavior over moderate time durations provides more consistent data than assessment over shorter or longer durations (Jaccard, McDonald, Wan, Dittus, & Quinlan, 2002).

HPV vaccination—To assess lifetime HPV vaccination, participants answered the following question at S3: “Have you ever received a vaccine to help prevent HPV and cervical cancer (e.g., Gardasil®)?” Because Gardasil® was released only a few months

before data collection commenced, we did not have access to existing standardized questions for asking about HPV vaccination.

Data analyses

To assess prevalence of vaccination in this sample, we calculated the percentage of participants who reported lifetime HPV vaccination. To examine correlates of HPV vaccination, we used multiple logistic regression to compare vaccinated participants to non-vaccinated participants for all correlates. First, we performed bivariate logistic regressions separately for each correlate with vaccination status as the dependent variable. Second, we performed one multivariate logistic regression, including all correlates of vaccination in one model: ethnicity/race (three dummy coded variables), mother's education, romantic relationship status, cumulative GPA, religious service attendance, adherence to religion's sex-related principles, and recent penetrative sex. No interactions were tested. The goodness of fit in the final model was tested using the Hosmer-Lemeshow test.

Results

Participants were on average about 19 years of age at S3 ($M=19.24$, $SD=0.43$). Twenty-six percent of participants identified as African American/Black, 26% as Asian American/Pacific Islander, 42% as European American, and 28% as Hispanic/Latino American. Based on participant report, 7% of participants' mothers had not completed high school, 18% had completed high school, 19% had some college, 33% completed college, and 23% had a graduate degree. By S3, 62% of participants had engaged in vaginal sex in their lifetime. About half (47%) of the sample reported lifetime HPV vaccination by S3.

The Hosmer-Lemeshow test for the multivariate logistic regression, showing the associations between the correlates and HPV vaccination, was non-significant ($p>.05$), indicating acceptable model fit. Results from bivariate and multivariate analyses were nearly identical, showing four significant correlates of vaccination (see Table 1). African American/Black students had about 50% lower odds of being vaccinated than non-African American/Black students. Higher levels of maternal education were significantly associated with a higher likelihood of vaccination; an increase of one unit on the scale (e.g., from completed high school to some college, or completed college to graduate or professional) was associated with about 1.7 times greater odds of vaccination. Although religious service attendance was not associated with vaccination, adhering to one's religion's teachings about sex-related principles was significantly associated with a higher likelihood of being vaccinated, with a 1-unit increase on the scale associated with 1.25 times greater odds of vaccination. Finally, female students who had engaged in recent penetrative sex had nearly 1.9 times greater odds of being vaccinated compared to female students who had not engaged in penetrative sex recently.

Conclusions and Discussion

This research was designed to examine the demographic factors, individual characteristics, and sexual behavior correlates of HPV vaccination among female college students. Lifetime HPV vaccination was reported by almost half of participants. Being African American/

Black was associated with a lower likelihood of vaccination. Having a mother with more education, adhering to one's religion's teachings about sex-related principles, and having engaged in recent penetrative sex were significantly associated with a greater likelihood of vaccination. Hispanic/Latino American ethnicity, Asian American race, romantic relationship status, GPA, and religious service attendance were not associated with HPV vaccination.

The rate of about half of this sample of female college students reporting HPV vaccination in 2008 was higher than national rates in adolescent girls (Laz et al., 2012) and comparable to another university study conducted the same year (Daley, Vamos & Buhi, 2010). This rate meant that about half of these young women had not received even one HPV vaccine dose. In the US, vaccination is recommended at 11 to 12 years of age, and for 13- to 26-year-olds as catch-up vaccination (Committee on Infectious Diseases, 2012). Recent evidence had suggested that health care providers perceive parental beliefs and misconceptions about HPV vaccination as the largest barriers to vaccination of adolescent girls (Javanbakht et al., 2012). Thus, even when the HPV vaccine has been available for more years, if parents continue to resist vaccination of their daughters, young women will continue to be an important group for vaccine education and catch-up.

Given low rates of HPV vaccination in adolescent girls (Laz et al., 2010), it is important to identify the factors associated with vaccination after the age of 17 years. Consistent with past work with younger girls (Keenan et al., 2012; Kessels et al., 2012; Lau et al., 2012) and a convenience sample of college students (Licht et al., 2010), rates in our study were lower among African American/Black young women. Past research has suggested that 15- to 18-year-old African American women are less likely to have heard of HPV than similar-aged European Americans (Gelman, Nikolajski, Schwarz, & Borrero, 2011). Given high rates of HPV infection among African American young women (Seth, Wingood, Robinson, & DiClemente, 2009), and the fact that rates of cervical cancer and related deaths are higher among African Americans (McDougall, Madeleine, Daling, & Li, 2007), more effort must be made to provide African American young women with information about and access to vaccination. Mother's education, a marker of SES, also mattered for HPV vaccination, suggesting differential knowledge, attitudes, and/or access based on family socioeconomic background. These findings suggest the importance of continued vaccine education, particularly among lower SES populations, and when possible, easily accessible, free, or low-cost vaccination programs.

Although maternal education was significantly associated with HPV vaccination, participants' cumulative GPA was not associated in this college sample. It is possible that within a college sample, variability in educational performance was restricted, thus limiting the ability to find such associations. Thus, it will be important in future work to examine further associations between educational performance and HPV vaccination in samples of high school students as they transition to young adulthood.

Our finding that young women who adhered more closely to their religion's sexual teachings were more likely to be vaccinated contradicts past research on vaccine intentions (Manhart et al., 2011) and prior findings that more religious young women were less likely to use

sexual and reproductive health services (Hall et al., 2012). It is possible that young women in the current study received vaccination as part of primary preventive care and/or through student health, rather than through sexual or reproductive health services. More religious individuals are higher in the personality trait of conscientiousness (McCullough, Tsang, & Brion, 2008). The more religious young women in the current study therefore, may have been more conscientious overall, thus more likely to comply with physicians' recommendations. It is also possible that more religious young women were more concerned about the stigma of sexually transmitted infection, and thus were more likely to protect themselves.

Finally, recently sexually active young women were more likely to have been vaccinated, possibly because women who were not sexually active perceived themselves at lower risk (Liddon et al., 2012). Experimental evidence has suggested that sexually experienced women who received health messages emphasizing the efficacy of HPV vaccination before the onset of sexual activity subsequently had greater intentions to become vaccinated than those who received different messages (Baxter & Barata, 2011). Given low rates of vaccination among women in this sample who were not recently sexually active, and the importance of vaccination before initiation of sexual activity, university health clinics should reach out to all young women to encourage vaccination, using messages with demonstrated effectiveness like Baxter and Barata's (2011).

The current research had several limitations. First, vaccination was based on a newly created self-report measure. Now that more research has examined HPV vaccination, researchers can begin to use measures standardized across studies, including items about number of doses, which may ensure similar classification across studies. Past work has suggested that only about half of clinic-attending adolescent girls who have received one or two doses actually completed the three-dose series (Dempsey, Schaffer, & Cohn, 2012). Thus, future studies should examine the correlates of completion of the vaccination series, in addition to correlates of vaccination initiation. In addition, future work with adolescent and young adult samples should include medical record reviews to verify self-reported information. A second limitation was that we focused on one university, and vaccination rates may vary regionally, as well as by student, institutional, or regional characteristics. Third, because the study was cross-sectional, the findings were clearly correlational, and thus did not permit assessment of temporal relations and thus causal conclusions. It is possible that young women who were sexually active sought out HPV vaccination, that young women delayed sexual activity until they had completed HPV vaccination, or that these behaviors were not causally related. Fourth, although we examined some less studied correlates of HPV vaccination, such as GPA and religiosity, we did not include some factors known to relate to HPV vaccination, such as attitudes about HPV vaccination (Javanbakht, 2012; Kessels et al., 2009). Future studies should include the variables we assessed along with attitudinal measures. Finally, future work should examine correlates of HPV vaccination among young men, for whom vaccines are now recommended in the US (Centers for Disease Control and Prevention, 2012). Immunization of young men provides the direct benefits of prevention of anal cancer and genital warts in young men, as well as indirect benefits of lower infection rates in young women (Committee on Infectious Diseases, 2012).

Implications and Conclusions

Although our sample included only full-time female students attending one large primarily residential university, our results support others' calls for continued and enhanced efforts to improve vaccine uptake more generally (Committee on Infectious Diseases, 2012). Findings have important implications for young women's sexual health. Given that parental beliefs and misconceptions about HPV vaccination may be a barrier to vaccination of adolescent girls (Javanbakht et al., 2012), many young women may enter early adulthood without having received HPV vaccination during childhood. Therefore, health care providers should consider young women to be an important group for HPV vaccine education and catch-up. Based on findings from the current research, African American/Black young women are particularly important to consider for vaccine education and access. In addition, providing education, access, and when possible, free vaccination programs to young women from lower SES backgrounds is of particular importance. Given the higher effectiveness of vaccination received before the initiation of sexual activity (Centers for Disease Control and Prevention, 2012; Committee on Infectious Diseases, 2012), and the lower rates of vaccination among sexually inexperienced young women, health care providers, including university health clinics, should target these young women. HPV vaccination education and access should be provided to women through routine health care, rather than limiting these education and access efforts to reproductive health clinics and services. Providing vaccine education and access to these young women before they become sexually active, as recommended by the CDC and the American Academy of Pediatrics (Centers for Disease Control and Prevention, 2012; Committee on Infectious Diseases, 2012), is critical. Universities should consider such vaccine education at the start of college to best reach more young women before they become sexually active.

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Table 1

Logistic regression model results of odds ratios (OR) and 95% confidence intervals (CI) for correlates of lifetime HPV vaccination (at Semester 3)

	Vaccinated ^a (n = 146)		Not vaccinated ^b (n = 167)		Bivariate models ^c :		Multivariate model ^c :	
	Mean (SD)	%	Mean (SD)	%	OR	95% CI	OR	95% CI
African American/Black ^d	18%		32%		0.49**	(0.29–0.83)	0.49*	(0.21–0.94)
Asian American/Pacific Islander	25%		28%		0.86	(0.52–1.43)	0.98	(0.51–1.87)
Hispanic/Latino American	33%		24%		1.56	(0.95–2.55)	1.26	(0.62–2.39)
Mother's education ^e	3.80 (1.16)		3.10 (1.35)		1.56***	(1.29–1.89)	1.69***	(1.36–2.08)
Committed romantic ^f relationship	48%		41%		1.27	(0.81–1.99)	1.00	(0.56–1.79)
Cumulative GPA ^g	3.05 (.57)		3.04 (.61)		1.05	(0.72–1.54)	0.82	(0.52–1.30)
Religious service attendance ^h	12.74 (17.36)		16.22 (38.07)		1.00	(0.99–1.01)	0.99	(0.98–1.00)
Adherence to religion's sex-related principles ⁱ	1.72 (1.20)		1.53 (1.22)		1.25*	(0.95–1.37)	1.25*	(1.00–1.57)
Recent penetrative sex ^j	54%		43%		1.59*	(1.02–2.49)	1.89*	(1.07–3.34)

* $p < .05$;

** $p < .01$;

*** $p < .001$

^a Column presents (i) percents of vaccinated participants who responded yes (1) for categorical variables and (ii) means and standard deviations for vaccinated participants for continuous variables.

^b Column presents (i) percents of not vaccinated participants who responded yes (1) for categorical variables and (ii) means and standard deviations for not vaccinated participants for continuous variables.

^c Bivariate logistic regression models include one correlate, to indicate the full or unadjusted association between the correlate and vaccination status. Multivariate logistic regression model includes all correlates entered simultaneously, to indicate the partial or net associations.

^d African American/Black, Asian American/Pacific Islander, and Hispanic/Latino (assessed at S1) all coded as 1 = yes, 0 = no (e.g., 18% of vaccinated individuals and 32% of not vaccinated individuals are African American).

^e Maternal education was coded as 0 = grade school or less; 1 = some high school; 2 = completed high school; 3 = some college; 4 = completed college; 5 = graduate or professional school

^f Committed romantic relationship coded as 1 = in a committed relationship (serious and committed relationship; living with partner; engaged; married) and 0 = not in a relationship (not dating; casually dating)

^g GPA possible range was 0.00 (equivalent to all F's) to 4.00 (equivalent to all A's).

- h_i Religious service attendance indicates the number of weeks that participants attended services in the past year.
- i Adherence to religion's sex related principles is a mean of xx items coded on a 5-point scale from 1=not at all to 5=completely.
- j Recent penetrative sex coded as 1=yes, 0=no, for vaginal or anal sex in the prior 12 weeks.