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Human Papillomavirus Vaccine Intent and Uptake among Female College Students

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Abstract

Objective—To examine HPV vaccine intent and the effect of an educational intervention on vaccine uptake among female college students

Participants—Females 18–26 attending a university health service gynecology clinic (n=256)

Methods—Participants were randomized to receive either HPV-specific education with a mailed reminder, or standard care. Predictors of HPV vaccine intent and uptake at six months following enrollment were identified.

Results—At baseline, 41% intended to undergo HPV vaccination. Participants who were currently sexually active and lacked supplemental health insurance had decreased intent. Perceived parental approval regarding HPV vaccination, perceived vulnerability to HPV infection, and belief in health benefits of HPV vaccine were associated with increased intent. HPV vaccine uptake was low (5.5%) and did not differ by study group. However, baseline intent was significantly associated with HPV vaccine uptake.

Conclusions—Interventions to increase HPV vaccine uptake in college students should address HPV-related beliefs and broader barriers to vaccination.

Keywords

Human papillomavirus; vaccine acceptability; cervical cancer; vaccination; young adult

Introduction

Compared to older adults, sexually active adolescents and young adults are at higher risk of acquiring sexually transmitted infections (STI) due to a combination of biological,

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behavioral, social and cultural reasons. Of the estimated 6.2 million new STIs among individuals ages 14–44 years in the United States in 2000, approximately three-fourths (4.6 million) occurred among those ages 15–24 years (1). Genital human papillomavirus (HPV) is the most common viral STI in the U.S., with adolescents (ages 15–19) and young adults (ages 20–24) at highest risk. Persistent HPV infection is established as a necessary cause of virtually all cervical cancers and high-grade precancerous lesions (2, 3). Worldwide, cervical cancer is the second most common cancer among females and ranks first in many developing areas. An estimated 12,200 new cervical cancer cases and 4,210 associated deaths are expected among American women in 2010 (4). HPV also accounts for a substantial proportion of oropharyngeal, anal, vulvar, and vaginal cancers in women (5).

In June 2006, the U.S. Food and Drug Administration approved Gardasil® (Human Papillomavirus Quadrivalent [Types 6, 11, 16 and 18] Vaccine, Recombinant; Merck & Co., Inc., Whitehouse Station, NJ), a quadrivalent vaccine targeting oncogenic HPV types 16 and 18 and genital wart-associated HPV types 6 and 11. The Advisory Committee on Immunization Practices (ACIP) currently recommends Gardasil® for females ages 9 to 26 for the prevention of cervical, vulvar and vaginal cancers, and for precancerous lesions and genital warts caused by the four HPV types targeted by the vaccine (6). In October 2009, FDA licensed the quadrivalent HPV vaccine for use in males, and ACIP subsequently provided guidance that the vaccine series may be given to males aged 9 through 26 years to reduce their likelihood of acquiring genital warts; ACIP does not currently recommend the vaccine for routine use among males (7). The quadrivalent HPV vaccine was recently licensed by the FDA for the prevention of anal intraepithelial lesions and anal cancer caused by HPV types included in the vaccine for males and females 9 through 26 years of age (8). A bivalent HPV vaccine, Cervarix® (Human Papillomavirus Bivalent [Types 16 and 18] Vaccine, Recombinant; GlaxoSmithKline, Research Triangle Park, NC), was approved by FDA in October 2009 for the prevention of cervical pre-cancers and cervical cancer associated with oncogenic HPV types 16 and 18 (9) and subsequently recommended by ACIP for females ages 9 to 26. These vaccines provide an unparalleled opportunity to reduce acquisition of infection and clinical disease caused by common HPV types among both females and males, and have demonstrated high efficacy with very few side effects (10–12). However, national surveys conducted soon after Gardasil® vaccine recommendations were published indicate that only 10% of females aged 18–26 (13) had initiated HPV vaccination, though uptake has been somewhat higher (37.2%) in younger females ages 13–17 (14).

Studies of HPV vaccine acceptability have focused primarily on healthcare providers, parents, and younger adolescents, and have found general willingness to recommend or undergo vaccination (reviewed by Zimet et al. (15)). However, few studies have assessed HPV vaccine acceptability among college-age individuals, even though sexually active adolescents and young adults are at high risk of acquiring HPV. Cumulative prevalence rates of HPV infection have been estimated to be as high as 82% in selected adolescent populations (16). In a prospective study of female college students examined every six months for three years, an average of 14% became infected with genital HPV each year, for a three-year cumulative incidence of 43% (17).

A recent study of heterosexually active male university students ages 18–20 years found a cumulative incidence of new infection with any genital HPV type of 62.4% over two years (18). While the college environment may present new opportunities for exposure to STIs, particularly HPV, the few studies of HPV vaccine acceptability conducted in college populations have found sizeable proportions (range: 11.4–54.5%) of respondents who were uncertain regarding their intent to undergo HPV vaccination or had already decided against vaccination (19–23). Because several of these studies assessed acceptance of a hypothetical

HPV vaccine (i.e., prior to clinical availability) (19, 22, 23), we have limited understanding of HPV vaccine acceptability, specific post-licensure barriers to HPV vaccination and the effectiveness of interventions to improve HPV vaccine uptake in the college population. We conducted a randomized study to characterize potential barriers to HPV vaccination among female college students in the era of HPV vaccine availability and to evaluate the effect of an educational intervention on HPV vaccine uptake in this population.

Methods

Recruitment and study sample

Participants were recruited from the Gynecology Clinic at University Health Services (UHS), a healthcare clinic located on the central campus of the University of Michigan (UM). With approximately 70,000 visits per year, UHS is a highly utilized campus resource for students, faculty and staff. Approximately 31% of UM students make at least one health-related visit to UHS per semester (personal communication with Susan Ernst, MD, Director of Gynecology, UHS, December 2010). For students who are enrolled for the current semester, most UHS services (but not vaccination) are covered by the health service fee paid as part of tuition. Students at UM have the option to purchase the Aetna student health insurance plan to help cover products and services not covered by the health service fee. While this insurance plan provides full coverage for several other immunizations, the HPV vaccine series is not currently a covered benefit. The UHS Gynecology Clinic involves several clinicians, with an average of 100 visits per week that were potentially eligible for study recruitment. Trained study personnel recruited potential participants for an average of 1.5 days per week during the period of November 2007-January 2009. Potentially eligible study participants were identified by clinic staff at the start of each designated recruitment period. Identified women were approached in a private area of the waiting room by trained study coordinators using a detailed recruitment script. Women were considered eligible for study inclusion if they were between 18 and 26 years of age, enrolled full- or part-time at the university, attending the UHS Gynecology Clinic for a routine physical including gynecological examination, and had not received the first dose of HPV vaccine series. During the informed consent process, participants were told they were participating in a study of women's personal views regarding the HPV vaccine, but it was not disclosed that one aim of the study was to evaluate the effect of an educational intervention on vaccine uptake. Comprehensive written informed consent was obtained from all study participants. Study participants received \$5 in cash as a token of appreciation. Women who refused participation were asked a brief set of questions to characterize their basic sociodemographics (age, race, Hispanic ethnicity, student standing, and marital status). This study was approved by the Institutional Review Board of the University of Michigan Medical School (IRBMED #HUM00010719).

Baseline data collection

Prior to being seen by their health care provider, participants were asked to complete a self-administered survey assessing sociodemographic characteristics; knowledge regarding HPV vaccine; personal beliefs about HPV infection, cervical disease and HPV vaccination; and sexual and health history. Questionnaire elements were based on core assumptions of the Theory of Planned Behavior, which suggests that a person's behavior is determined by her intention to perform the behavior and that this intention is, in turn, a function of her attitude toward the behavior (24). The survey instrument was pre-tested for timing and comprehension, and revised before initiating data collection. HPV-related knowledge was assessed by a series of six statements with categorical true/false/don't know response options. HPV-related personal beliefs were assessed by a series of ten statements with 5-point Likert scale response options (strongly agree, agree, neutral, disagree, strongly

disagree). Participants' medical records were reviewed on the same day as study enrollment to ascertain date of birth, student standing, health insurance coverage, smoking status, current sexual activity, gender of sex partners, and current method of contraception. These items are routinely assessed by the nurse as part of the visit intake form.

Randomization process and intervention

In advance of study recruitment, a computer randomization program was used to assign half of participants to either the intervention (HPV-specific patient education plus reminder letter) or standard care group. Randomization assignments were placed in sequentially numbered, sealed, opaque envelopes that were then opened by the study coordinator after the informed consent process. For those participants randomized to the intervention group, the study coordinator discussed in detail a "HPV and Vaccination" fact sheet. This fact sheet was modeled after fact sheets available from the U.S. Centers for Disease Control and Prevention (CDC), and contained bulleted information on HPV and its link to cervical cancer, ways to reduce risk of HPV infection, quadrivalent vaccine administration, cost, and insurance coverage, who should get the vaccine, and contraindications to the vaccine. Approximately two weeks after their clinic visit, participants randomized to the intervention group were mailed a packet containing a reminder letter and another copy of the "HPV and Vaccination" fact sheet. The reminder letter contained a brief description of the HPV vaccine and information on how to schedule vaccination at UHS.

Standard care

According to routine practice for health maintenance examinations at the UHS Gynecology Clinic, HPV vaccination was briefly mentioned to all patients. A standard information sheet on HPV vaccine was distributed to all patients, which contained similar content as the "HPV and Vaccination" fact sheet and information on how to get the HPV vaccine at UHS. The standard care group did not receive a mailed packet containing a reminder letter or an additional copy of the fact sheet.

Outcome measures

The primary outcome measures were intent to undergo HPV vaccination at baseline and HPV vaccine uptake within six months of enrollment. Intent to undergo HPV vaccination was assessed by a single question in the baseline survey (Do you intend to get the HPV vaccine?) with categorical yes/no/don't know response options. HPV vaccine uptake was assessed via review of UHS medical records at six months following date of study enrollment. Medical records were abstracted for dates of HPV vaccination and three most recent clinic visits. If dates were unavailable, participants were mailed a brief questionnaire, telephoned, and emailed regarding their recent vaccination history.

Statistical analysis

Basic descriptive statistics were used to characterize the study population. *P* values less than 0.05 were considered statistically significant for all analyses. To assess potential non-response bias, sociodemographic characteristics were compared between study participants and those who were approached in the clinic but refused participation using chi-square and Student *t* tests. Bivariate associations of sociodemographic characteristics, sexual history, and health history with intent to undergo HPV vaccination were examined using logistic regression models, expressed as unadjusted odds ratios (OR) and 95% confidence intervals (CI). For logistic regression analyses, HPV vaccine intent was categorized as a dichotomous (yes/no) dependent variable, with "don't know" responses set to missing. Race was categorized as "Caucasian" and "other." Health insurance coverage was categorized as "some supplemental insurance" and "no supplemental insurance" beyond services covered

by the student health fee. Relationships of personal beliefs and HPV-related knowledge with intent to undergo HPV vaccination were then examined using multivariable logistic regression models which included supplemental health insurance coverage and current sexual activity, as these two factors were significantly associated with HPV vaccine intent in bivariate analyses ($p < 0.05$). To further assess the relationship between HPV-related knowledge and vaccine intent, the correct responses to individual HPV-related knowledge questions were summed for each participant, and included in separate multivariable logistic regression models as (1) a continuous variable, (2) a categorical variable using a threshold of at least four correct responses, and (3) a categorical variable using a threshold of at least five correct responses. To evaluate the impact of the intervention, the bivariate association of study group with HPV vaccine uptake was examined in a generalized linear model, and expressed as an unadjusted relative risk (RR) and 95% CI. Due to few outcomes for HPV vaccine uptake, associations of baseline intent, supplemental health insurance coverage, and current sexual activity with HPV vaccine uptake were examined in three separate generalized linear models including the covariate and adjusted for study group. All data analyses were conducted using SAS statistical software version 9.1 (SAS Institute, Inc., Cary, NC) (25).

Results

Study population

There were approximately 1300 scheduled appointments during the total recruitment period. Clinic staff identified 930 (71.5%) individuals who were potentially eligible for the study. Of these, 176 (18.9%) individuals were excluded based on predefined criteria of age, university enrollment, appointment type, or HPV vaccination status. Of the 754 eligible individuals, 492 (65.3%) were approached for study participation. We analyzed data from the 256 individuals who agreed to participate and completed all required components of the larger randomized study, for a response rate of 52.0% (256 participants/492 eligible individuals who were approached) and a participation rate of 34.0% (256 participants/754 eligible individuals). Study participants did not differ significantly from those who refused to participate with respect to age, race, Hispanic ethnicity, student standing, or marital status (all p values > 0.05).

Most of the 256 participants were Caucasian (67.2%), single (84.4%), undergraduates (70.7%), with mean age of 22.5 years (Table 1). Over half (62.1%) had some form of supplemental insurance coverage beyond services covered by the student health fee. Among the 233 participants who had ever engaged in sexual intercourse, most (91.4%) had male sex partners. The majority of participants were currently sexually active (73.6%), with most (75.5%) reporting five or fewer lifetime sex partners. Medical chart data indicated that most of the 187 currently sexually active participants were currently using some form of contraception, though only 24.1% reported current condom use.

Intention and reasons for undergoing HPV vaccination

One hundred and five (41.0%) participants indicated an intention to undergo HPV vaccination, 80 (31.3%) did not intend to undergo HPV vaccination, and 67 (26.2%) were unsure of their intention at the time of the survey (Table 2). Most commonly cited reasons among those who intended to undergo HPV vaccination included worry about getting cervical cancer (67.6%), HPV (65.7%), or genital warts (48.6%). Healthcare provider recommendation was cited by 40% of participants as a reason for intending to undergo HPV vaccination. Most common reasons cited by those not intending to undergo HPV vaccination included concerns about vaccine safety (48.8%), side effects (48.8%), high out-of-pocket

costs or insurance co-payments (41.3%), long term consequences (40.0%), and not being at risk for STI or genital warts (28.8%).

Correlates of intent to undergo HPV vaccination

Sociodemographic characteristics and sexual and medical history generally did not correlate with HPV vaccine intent (Table 3). However, those who lacked supplemental health insurance coverage beyond services covered by the student health fee were significantly less likely to intend to undergo HPV vaccination (unadjusted OR: 0.42; 95% CI: 0.22–0.80). Participants who were currently sexually active were also significantly less likely to intend to undergo HPV vaccination (unadjusted OR: 0.25; 95% CI: 0.09–0.69). Because of their statistical significance, supplemental health insurance coverage and current sexual activity were included in subsequent logistic regression models examining associations of personal beliefs and HPV-related knowledge with HPV vaccine intent.

Selected personal beliefs significantly predicted HPV vaccine intent (Table 4). After adjusting for supplemental health insurance coverage and current sexual activity, participants who believed that getting the HPV vaccine would help them stay healthy (adjusted OR: 16.52; 95% CI: 1.68–162.05), that they are likely to get genital HPV infection in their lifetime (adjusted OR: 3.63; 95% CI: 1.41–9.35), and that their parents would approve of them getting the HPV vaccine (adjusted OR: 6.71; 95% CI: 1.90–23.70) were significantly more likely to intend to undergo HPV vaccination compared to those not endorsing these beliefs.

After adjusting for supplemental health insurance coverage and current sexual activity, intent to undergo HPV vaccination was not significantly associated with any of the individual HPV-related knowledge items (Table 4). Study participants generally had a high level of HPV-related knowledge, with 66 (25.9%) answering all six questions correctly, 140 (54.9%) answering five or more of the questions correctly, and 198 (77.7%) answering four or more of the questions correctly. Overall, the mean HPV-related knowledge score was 4.46, and this did not differ significantly between those who did (mean: 4.81) and those who did not (mean: 4.43) intend to undergo HPV vaccination ($p=0.05$). After adjusting for supplemental health insurance coverage and current sexual activity, being “knowledgeable” about HPV (as a continuous variable indicating number of correct responses, or as categorical variables using thresholds of at least four or at least five correct responses) was not significantly associated with intent to undergo HPV vaccination.

HPV vaccine uptake

Overall, only 14 (5.5%) participants received at least one HPV vaccine dose within six months of study enrollment. The education-based intervention was not significantly associated with HPV vaccine uptake (RR: 0.84; 95% CI: 0.31–2.28). After adjusting for study group, the two variables identified as significantly associated with intention (supplemental health insurance coverage and current sexual activity) were not significantly associated with actual HPV vaccine uptake. However, intent to undergo HPV vaccination at baseline was significantly associated with HPV vaccine uptake; 22.8% of those who intended to undergo HPV vaccination received at least one dose of HPV vaccine within six months of study enrollment, compared to only 2.1% of those who did not intend to undergo vaccination ($p=0.0027$). After adjusting for study group, participants who intended to undergo HPV vaccination at baseline were over 10 times more likely to receive at least one dose of HPV vaccine within six months of enrollment (RR: 10.7; 95% CI: 1.45–78.96).

Comment

Several years after introduction of the HPV vaccine, in this study of female college students who had not yet initiated HPV vaccination and who sought routine gynecological care from a university health service at a large, public Michigan university, only 41% reported an intention to undergo HPV vaccination in the future. In Michigan, where rates of cervical cancer in situ (an immediate precursor to invasive cervical cancer) have been increasing since 1985 among women under 40 years of age (26), interventions to promote HPV vaccine uptake will play an important role in cervical cancer prevention. In our study, the sizeable proportions of participants who reported they did not intend to undergo vaccination (31.3%) or were undecided (26.2%) highlight target populations for intervention. Our findings are strikingly consistent with a study conducted among female college students at the University of Kentucky prior to HPV vaccine licensure, in which 45.3% of participants reported that they were likely to be vaccinated against HPV within the next 12 months, 26% were unlikely to get vaccinated, and 28.5% were unsure (19). In contrast, a study conducted by Boehner et al. in a similar sample size (n=256) of Midwestern undergraduate students found that 74% of male and female college students endorsed acceptance of a hypothetical vaccine against HPV (22). Other studies conducted in college populations after introduction of the HPV vaccine into clinical practice have also shown higher acceptability of HPV vaccination, ranging from 53% (20) to 65% (21). These studies were conducted relatively soon after Gardasil® became clinically available, and it is possible that the initial phase of high acceptability was related to the intensive marketing surrounding the vaccine. Our study measures more recent levels of acceptance which are likely influenced by a variety of intervening information sources including the media, scientific literature, and reports of adverse events.

The intervention evaluated in this study, which combined basic HPV information and a simple mailed reminder, was not found to be associated with HPV vaccine uptake in this population. Only 6% of the study population received at least one dose of HPV vaccine within six months of enrollment, and this did not differ significantly between the intervention and standard care groups. We hypothesize several possible explanations for our findings. As nearly a year of clinical availability of HPV vaccine had passed even for the earliest enrolled study participants, this population may represent women who face more barriers or are more resistant to undergoing HPV vaccination. The educational fact sheet was modeled after fact sheets available from the CDC and was not specifically geared toward college females. Future investigation of the effectiveness of individually tailored interventions, which first assess the participant's knowledge, perceptions and intentions and then incorporate this information into the intervention materials delivered, as a means of increasing HPV vaccine uptake in this population should be considered. Further, finding ways to implement these interventions via technologies acceptable to college students (e.g., text messaging, email, social networking media, etc.) could improve the efficacy of interventions aimed at this population.

Identifying and reducing barriers among individuals who intend to undergo HPV vaccination may be the most accessible opportunity to increase vaccination uptake. While only 14 participants received at least one dose of HPV vaccine within six months of study enrollment, the finding that uptake was significantly higher among those who intended to undergo HPV vaccination at baseline supports the importance of intention in the process of HPV vaccine uptake (24). Further, we found that selected personal beliefs were significantly associated with intent to undergo HPV vaccination in this population, and that sociodemographic characteristics and sexual and medical history generally did not predict this intention. Boehner et al. identified higher number of lifetime sex partners, perceived parental perceptions about the vaccine, universal vaccine endorsement, low cost, and

vaccine safety as significant predictors of acceptance of a hypothetical vaccine against HPV among Midwestern undergraduate students (22). In a survey of racially diverse students from two southeastern universities, Gerend and Magloire (21) found higher HPV vaccine interest among those women who were sexually active, had multiple sex partners, and perceived themselves to be vulnerable to HPV infection. In our study, perceived parental approval, perceived vulnerability to genital HPV infection, and belief that HPV vaccine is important for maintaining health were also significantly associated with HPV vaccine intent; however, a similar association with high lifetime number of sex partners was not observed. Most (74%) of our study population was currently sexually active; the lack of variability in sexual activity may, in part, explain the absence of findings between certain sexual history variables and intent to undergo HPV vaccination. Over three-fourths (78%) of study participants correctly answered at least four out of six HPV-related knowledge questions; however, the high level of HPV-related knowledge was not associated with intent to undergo HPV vaccination in this population. While the effectiveness of educational interventions on HPV vaccine acceptability has not been evaluated in the college population, findings from studies conducted among parents have been inconsistent. In a randomized intervention study conducted by Dempsey et al., the increased knowledge gained through written information about HPV did not translate to increased HPV vaccine acceptability among parents of preadolescent children (27). In contrast, Davis et al. found that, among parents of 10- to 15-year-old adolescents who were initially opposed to or undecided about the HPV vaccine, 37% and 65%, respectively, supported HPV vaccination for their children after a brief educational intervention (28). One of the few studies to assess HPV-related knowledge in university students generally did not find significant differences in vaccination status by HPV-related knowledge (29). The collective findings suggest that factors beyond HPV knowledge, such as personal beliefs, attitudes and life experiences, may influence HPV vaccine acceptability and should be addressed in the development of interventions.

Practical barriers to HPV vaccination may be particularly difficult to surmount in the college population, perhaps more pronounced due to a lack of established standards of preventive care for this age group. Individuals in their teens and early 20s make fewer visits to physicians' offices than at any other times in their lives and the majority fail to receive all recommended vaccines (30, 31). At the institution where this study was conducted, the health service fee paid as part of tuition covers basic services at the university-based health service but does not include vaccinations. Indeed, the high costs associated with the three-dose HPV vaccine series was identified as a barrier by 41.3% of our study population. Nearly two-thirds (62.1%) of study participants reported having supplemental insurance coverage, such as parental health insurance. This appeared to be an important factor in HPV vaccination intention as those who lacked health insurance beyond services covered by the student health fee were significantly less likely to intend to undergo HPV vaccination compared to those who had supplemental insurance [OR: 0.42 (95% CI: 0.22–0.80)]. It should be noted that the additional health insurance plan available to students for purchase through Aetna (included in the category of supplemental health insurance in this study) currently does not cover HPV vaccination, which complicates interpretation of this finding. As health care reform moves forward, changes in insurance coverage for routinely recommended vaccines could reduce cost as a barrier to HPV vaccination for young adult women. However, even with supplemental insurance, charges for services not covered by the health service fee may appear on parental insurance statements, potentially posing an additional barrier to HPV vaccine uptake for students concerned about parental notification of a vaccine against a STI. Still, a recent study by Conroy et al. identified coverage of the cost of HPV vaccination as the strongest predictor of actual HPV vaccine uptake among 13–26 year old females recruited from an urban, hospital-based adolescent primary care clinic (32). Other hypothesized barriers to HPV vaccination, such as inconvenience of the 3-dose vaccine series, uncertainty of remaining in the same geographic location throughout the

vaccine series, and general dislike of injections, were reported by fewer than 14% of participants. Instead, participants' foremost concerns centered on vaccine safety (48.8%), side effects (48.8%), and long term consequences (40.0%).

In contrast to a study of college students from two southeastern universities that found greater HPV vaccine interest among sexually active women (21), females in our study who were currently sexually active were significantly less likely to intend to undergo HPV vaccination compared to those who were not currently sexually active. A possible explanation is the perception that HPV vaccination is less effective (or even ineffective) after exposure to or infection with the virus. Indeed, of the 21 respondents who indicated "other" reason for not intending to undergo HPV vaccination, four (19.1%) specified that it was "too late" for them (due to previous HPV infection or number of sex partners). However, women already infected with a targeted HPV type still benefit from HPV vaccination because they are protected from infections and disease caused by HPV types for which they are naïve at the start of vaccination (33), and very few women appear to have been previously infected with all four HPV vaccine types covered by Gardasil® (34). With the accumulating data on prophylactic efficacy and safety comes a need to understand and address evolving perceptions and concerns surrounding HPV vaccination. Strikingly, nearly 29% of participants not intending to undergo HPV vaccination felt they were not at risk for STIs or genital warts. Moreover, of the 21 respondents who indicated "other" reason for not intending to undergo HPV vaccination, six (28.6%) specified they were in a monogamous sexual partnership. While only a small proportion (2.3%) of the study population had multiple sex partners, other risk factors for STI were prevalent including low condom use among those who were currently sexually active (24.1%) and greater than five lifetime sex partners (20.6%). These data highlight educational opportunities focusing on social and behavioral aspects of STI epidemiology (e.g., population-based estimates of new and lifetime sex partners) (35), as well as the high rates of genital HPV acquisition in young men (18) and women (17). Messages aimed at currently sexually active women that specifically address misconceptions about the value of vaccination after coitarche (e.g., it is not "too late" and the vaccine may protect against strains to which they have not been exposed) could be a valuable component of education-based and other public health interventions to improve HPV vaccine uptake. From a research perspective, gaining a better understanding of self-perceived STI risk in this population may inform the development of strategies to increase awareness and, ultimately, uptake of protective behaviors.

Limitations

Several limitations of this study should be considered. Because we focused on females seeking routine health maintenance at a university health service, the study population may not reflect the overall population of college-age women at our institution, women of the same age range in other university settings, or women of the same age range who do not attend college. Within the clinic, however, study participants were similar to those who refused participation on basic sociodemographic characteristics. The small number of participants (n=14) who received at least one dose of HPV vaccine within six months of study enrollment limited our ability to identify independent predictors of vaccine uptake or further subgroup analyses. It would have been useful to identify participants for whom HPV vaccination was a covered benefit, however, we did not collect detailed information on type of health insurance among those who reported having some type of supplemental health insurance. Completeness of HPV vaccination data remains a challenge in the college setting. Given that the vaccine series is administered in three doses over a six-month period, college students may receive some doses outside the UHS setting (for example, physician in home town). Further, as the cost of the vaccine series could be prohibitive, college students may seek alternative sites (for example, health department) for lower cost vaccine. In our study,

vaccines received outside the UHS system were not reliably captured in the medical record. While we attempted to enhance completeness of the uptake data through a combination of survey, telephone and email follow-up, vaccination history based on self-report is subject to bias and is unknown for those we could not contact.

Conclusions

This study provides some insight on factors influencing HPV vaccine intent and uptake, among female students attending a university-based gynecology clinic at a large, public Midwestern university. In contrast to earlier studies that identified practical barriers and sexual history as predictors of HPV vaccine intent in college age populations, findings from this study conducted three years after introduction of the HPV vaccine suggest that personal beliefs play an important role. In light of the sizeable proportion of women indicating intention to undergo HPV vaccination, identification of barriers to behavioral follow-through specific to the college setting could help reduce missed opportunities for HPV prevention. Perceived risk of STI and its relationship to preventive behaviors, particularly among those in committed or long term relationships, also warrants further study among college-age individuals. Interventions to increase HPV vaccine intention and, ultimately, uptake in the college population should address personal HPV-related beliefs in addition to broader barriers to vaccination.

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Table 1

Sample sociodemographic characteristics and sexual history (n=256).

	n (%)
<i>Sociodemographic Characteristics</i>	
Age (years)	
18–20	85 (33.2)
21–22	95 (37.1)
>22	76 (29.7)
Mean (standard deviation)	22.5 (2.1)
Race	
Caucasian	172 (67.2)
Asian	35 (13.7)
African American	23 (9.0)
Other	13 (5.1)
More than one race	13 (5.1)
Hispanic ethnicity	12 (4.7)
Marital status	
Single	216 (84.4)
Married	7 (2.7)
Living together	27 (10.6)
Other	2 (0.8)
Missing	4 (1.6)
Student standing	
Undergraduate	181 (70.7)
Graduate	70 (27.3)
Missing	5 (2.0)
Supplemental health insurance coverage ¹	
None	84 (32.8)
Parent's private insurance	58 (22.7)
Student's own private insurance	31 (12.1)
Other	70 (27.3)
Missing	13 (5.1)
<i>Sexual History</i>	
Ever had sexual intercourse	233 (91.0)
Lifetime number of sex partners, among those who ever had sexual intercourse (n=233)	
1	62 (26.6)
2–5	114 (48.9)
>5	48 (20.6)
Missing	9 (3.9)
Gender of sex partners, among those who ever had sexual intercourse ² (n=233)	
Sex partners are male	213 (91.4)
Sex partners are female	3 (1.3)

	n (%)
Sex partners are male and female	5 (2.2)
Missing	12 (5.2)
Currently sexually active ²	187 (73.6)
Current method of contraception, among those currently sexually active ² (n=187)	
Condoms	45 (24.1)
Oral contraceptives	71 (38.0)
Other	52 (27.8)
None	10 (5.4)
Missing	9 (4.8)
Currently has multiple sex partners	6 (2.3)

¹ All students pay a student health insurance fee as part of tuition which covers a broad range of health care services at the university-based clinic (excludes vaccinations)

² Abstracted from medical record

Table 2

Intentions and reasons for undergoing HPV vaccination (n=256).

HPV vaccine intent	n (%)
<i>Intend to undergo HPV vaccination (n=105; 41.0%)</i>	
Reasons ² :	
I am worried I might get cervical cancer	71 (67.6)
I am worried I might get HPV	69 (65.7)
I am worried I might get genital warts	51 (48.6)
My healthcare provider recommended it to me	42 (40.0)
Someone close to me had cervical cancer	12 (11.4)
Other ³	20 (19.1)
<i>Do not intend to undergo HPV vaccination (n=80; 31.3%)</i>	
Reasons ² :	
Concerns about vaccine safety	39 (48.8)
Concerns about vaccine side effects	39 (48.8)
Out of pocket cost or insurance co-pay is too high	33 (41.3)
Long term consequences of the vaccine	32 (40.0)
I am not likely to get sexually transmitted infections or genital warts	23 (28.8)
Insurance does not cover the vaccine	13 (16.3)
Inconvenience of getting three shots	11 (13.8)
I am not currently sexually active	10 (12.5)
I do not like shots	10 (12.5)
I am not likely to develop cervical cancer	6 (7.5)
I am moving/leaving the area	6 (7.5)
Religious beliefs	2 (2.5)
Worried that my parents would find out	2 (2.5)
Worried that my partner would find out	1 (1.3)
Other ⁴	21 (26.3)
<i>Do not know (n=67; 26.2%)</i>	

¹ 4 (1.6%) skipped the question "Do you intend to get the HPV vaccine?"

² Sum of columns >100% since respondents could select all reasons that applied

³ 6 (30.0%) of 20 respondents who indicated "other" specified parental recommendation

⁴ Of the 21 respondents who indicated "other," 6 (28.6%) specified they were in a monogamous sexual partnership, 4 (19.1%) specified need for more data on long term effectiveness of HPV vaccine, and 4 (19.1%) specified that it was "too late" for them (due previous HPV infection or number of sex partners)

Table 3

Odds of intent to undergo HPV vaccination, by sociodemographic characteristics and sexual and health history (n=256).

	Intend to Get HPV vaccine n (row %)	Unadjusted Odds Ratio	95% CI
<i>Sociodemographic Characteristics</i>			
Age (years)			
18–20 (n=85)	41 (48.2)	1.0 (reference)	
21–22 (n=95)	37 (39.0)	0.57	0.28–1.14
>22 (n=76)	27 (35.5)	0.79	0.54–1.16
Race			
Caucasian (n=172)	72 (41.9)	1.0 (reference)	
Other (n=84)	33 (39.3)	1.01	0.54–1.89
Student standing			
Undergraduate (n=181)	73 (40.3)	1.0 (reference)	
Graduate (n=70)	29 (41.4)	1.37	0.87–2.14
(Missing: 5)			
Supplemental health insurance coverage ¹			
Some supplemental insurance (n=159)	77 (48.4)	1.0 (reference)	
No supplemental insurance (n=84)	24 (28.6)	0.42	0.22–0.80
(Missing: 13)			
<i>Sexual and Health History</i>			
Ever had sexual intercourse			
No (n=19)	8 (42.1)	1.0 (reference)	
Yes (n=233)	96 (41.2)	1.47	0.66–3.27
(Missing: 4)			
Lifetime number of sex partners, among those who ever had sexual intercourse (n=233)			
1 (n=62)	28 (45.2)	1.0 (reference)	
2–5 (n=114)	44 (38.6)	0.69	0.32–1.50
>5 (n=48)	20 (41.7)	0.73	0.47–1.14
(Missing: 9)			
Currently sexually active ²			
No (n=42)	23 (54.8)	1.0 (reference)	
Yes (n=187)	74 (39.6)	0.25	0.09–0.69
(Missing: 43)			
Receive regular Papanicolaou tests			
No (n=62)	31 (50.0)	1.0 (reference)	
Yes (n=184)	72 (39.1)	0.76	0.39–1.48
(Missing: 10)			

¹ All students pay a student health insurance fee as part of tuition which covers a broad range of health care services at the university-based clinic (excludes vaccinations)

² Abstracted from medical record

Table 4

Odds of intent to undergo HPV vaccination, by personal beliefs and HPV-related knowledge (n=256).

	Intend to Get HPV vaccine n (row %)	Adjusted Odds Ratio ^I	95% CI
<i>Personal Beliefs²</i>			
Having genital HPV would be upsetting to me			
No (n=6)	3 (50.0)	1.0 (reference)	
Yes (n=241)	100 (41.5)	0.86	0.14–5.45
(Missing: 9)			
Having genital HPV would make it difficult for me to get a long term sex partner			
No (n=52)	19 (36.5)	1.0 (reference)	
Yes (n=123)	53 (43.1)	1.14	0.49–2.68
(Missing: 81)			
A vaccine that prevents a sexually transmitted infection is a good idea			
No (n=2)	0 (0)	1.0 (reference)	
Yes (n=240)	103 (42.9)	__3	--
(Missing: 14)			
A vaccine that prevents cervical cancer is a good idea			
No (n=2)	0 (0)	1.0 (reference)	
Yes (n=247)	104 (42.1)	__3	--
(Missing: 7)			
Getting the HPV vaccine would help me stay healthy			
No (n=10)	1 (10.0)	1.0 (reference)	
Yes (n=165)	96 (56.4)	16.52	1.68–162.05
(Missing: 81)			
I am likely to get genital HPV infection in my lifetime			
No (n=86)	29 (33.7)	1.0 (reference)	
Yes (n=58)	34 (58.6)	3.63	1.41–9.35
(Missing: 42)			
I am likely to get cervical cancer in my lifetime			
No (n=76)	26 (34.2)	1.0 (reference)	
Yes (n=14)	5 (35.7)	1.30	0.28–5.99
(Missing: 166)			
My parents would approve of me getting the HPV vaccine			
No (n=25)	4 (16.0)	1.0 (reference)	
Yes (n=160)	85 (53.1)	6.71	1.90–23.70
(Missing: 71)			
My healthcare providers would approve of me getting the HPV vaccine			
No (n=5)	1 (20.0)	1.0 (reference)	
Yes (n=191)	86 (45.0)	4.33	0.43–43.75
(Missing: 60)			
My religious institution would approve of me getting the HPV vaccine			
No (n=13)	3 (23.1)	1.0 (reference)	

	Intend to Get HPV vaccine n (row %)	Adjusted Odds Ratio ^I	95% CI
Yes (n=102) (Missing: 141)	50 (49.0)	4.40	0.87–22.18
<i>HPV-related Knowledge⁴</i>			
Genital warts are caused by HPV			
True (correct statement) (n=133)	54 (40.6)	1.0 (reference)	
False (n=34)	15 (44.1)	1.35	0.48–3.78
Don't know (n=88) (Missing: 1)	36 (40.9)	1.05	0.94–1.17
People who have been infected with HPV might not have symptoms			
True (correct statement) (n=239)	100 (41.8)	1.0 (reference)	
False (n=2)	1 (50.0)	__ ³	
Don't know (n=14) (Missing: 1)	4 (28.6)	1.0	0.76–1.30
HPV infection can cause abnormal Pap tests			
True (correct statement) (n=178)	70 (39.3)	1.0 (reference)	
False (n=14)	5 (35.7)	0.75	0.17–3.32
Don't know (n=63) (Missing: 1)	30 (47.6)	1.08	0.96–1.21
HPV can be spread through sexual intercourse			
True (correct statement) (n=218)	87 (39.9)	1.0 (reference)	
False (n=10)	6 (60.0)	__ ³	--
Don't know (n=27) (Missing: 1)	12 (44.4)	1.12	0.94–1.34
There is no "cure" for HPV infection			
True (correct statement) (n=122)	51 (41.8)	1.0 (reference)	
False (n=59)	25 (42.4)	1.53	0.67–3.49
Don't know (n=74) (Missing: 1)	29 (39.2)	1.02	0.91–1.15
People who get the HPV vaccine still need regular Pap tests			
True (correct statement) (n=248)	103 (41.5)	1.0 (reference)	
False (n=1)	0 (0)	0 ⁵	--
Don't know (n=6) (Missing: 1)	2 (33.3)	0.99	0.66–1.49

CI, confidence interval

¹ Odds ratios are adjusted for supplemental health insurance coverage (beyond student health fee coverage) and current sexual activity; 71 (27.7%) participants responded "don't know" or skipped the question regarding intention to get the HPV vaccine, and are not included in odds ratio calculations

² Missing category includes "don't know," "neutral" and missing responses

³ Model failed to converge

⁴ Missing category includes "don't know" and missing responses

⁵ Parameter estimate for odds ratio is zero since no participants answering “false” to this statement intended to undergo HPV vaccination