

Theory of Planned Behavior-based Correlates of HPV Vaccination Intentions and Series Completion among University Students in the Southeastern United States

Hannah Priest Catalano, Keith Richards, and Katherine Hyatt Hawkins

Abstract

This study tested a theory of planned behavior (TPB)-based model in predicting human papillomavirus (HPV) vaccination intentions and series completion among university students. A nonexperimental, cross-sectional design was utilized with a convenience sample of 281 university students, including 40.9% nonvaccinees, 19.6% vaccine initiators, and 39.5% series completers. The stepwise multiple regression model revealed that attitude and subjective norm were significant predictors of behavioral intention and collectively explained 60% of its variance. The logistic regression model identified behavioral intention and gender as significant predictors of series completion. Findings suggest that: (a) nonvaccinees with more positive attitudes and greater subjective norm have greater intentions to complete the series, and (b) college females and those who have greater intentions to get vaccinated have greater odds of completing the series. For those not vaccinated, practitioners should aim to increase students' positive attitudes and perceived social pressure regarding series completion. Health educators should aim to develop HPV-related programs that target college men and increase students' behavioral intention by applying implementation intention strategies that encourage series completion.

Keywords: HPV vaccination, university students, theory of planned behavior

Introduction

Human papillomavirus (HPV) is a significant public health burden. HPV is the most common sexually transmitted infection (STI) in the United States, with an overall prevalence of 45.2% among adults aged 18-59 (Centers for Disease Control and Prevention [CDC], 2017a; McQuillan, Kruszon-Moran, Unger, & Paulose-Ram, 2017). HPV is a known cause

of anogenital warts, recurrent respiratory papillomatosis, and cancers of the anus, cervix, oropharynx, penis, vagina, and vulva (CDC, 2017b). Individuals who have received a positive HPV diagnosis may also experience adverse psychosocial outcomes including stress, anxiety, depression, anger, guilt, frustration, and poor health-related quality of life (Daley et al., 2010; Daley et al., 2012; Dominiak-Felden et al., 2013).

Young adults (20–24 years) have the highest HPV prevalence rates (53.8%) of any age group in the United States (Satterwhite et al., 2013). Thus, university-age students are a high-risk population for becoming infected, and HPV is currently the most common STI among this population (Fontenot, Fantasia, Sutherland, & Lee-St. John, 2016). There is no cure for HPV, but the HPV vaccine protects against the most common strains that contribute to genital warts and a variety of cancers caused by HPV infection (CDC, 2017a). Prior to the implementation of the HPV vaccination, an estimated 350,000 men and women were affected by genital warts each year in the United States (CDC, 2017a). Each year an estimated 17,600 women and 9,300 men in the United States are affected by cancers caused by HPV (CDC, 2017a).

Three HPV vaccines have been approved by the United States Food & Drug Administration to protect against HPV infection: a bivalent vaccine (HPV2, Cervarix), a quadrivalent vaccine (HPV4, Gardasil), and a 9-valent (HPV9, Gardasil 9) vaccine (U.S. Food & Drug Administration, 2014, 2015a, 2015b). All three of the HPV vaccines protect against HPV types 16 and 18, which cause most HPV-associated cancers (Petrosky et al., 2015). The quadrivalent and 9-valent vaccines also offer protection against HPV types 6 and 11, which cause the majority of genital warts cases (Petrosky et al., 2015). The 9-valent vaccine provides additional protection against types 31, 33, 45, 52, 58, which cause various HPV-associated cancers (Petrosky et al., 2015). Effective since the end of the year in 2016, the 9-valent vaccine is the only HPV vaccine distributed in the United States (CDC, 2016).

The United States of America's Advisory Committee on Immunization Practices (ACIP) recommends a 2-dose HPV vaccination series for 11 or 12 year old girls and boys (Meites, Kempete, & Markowitz, 2016). Findings from rigorous scientific studies have consistently demonstrated that the HPV vaccine is safe for this age group and initiates a stronger immune response among younger adolescents compared to older adolescents (Markowitz et al., 2014; Petrosky et al., 2015). Consequently, the 2-dose HPV vaccination series is approved for use among 9-14 year old girls and boys (Meites et al., 2016). The ACIP recommends a 3-dose catch-up HPV vaccination for females ages 15-26 and males ages 15-21 who have not received the vaccine (Meites et al., 2016). Males ages 22-26 may also be vaccinated. Although the HPV vaccine is ideally recommended for younger adolescents, older adolescents and young adults who fall within the catch-up window still reap considerable benefits from the vaccination (Markowitz et al.,

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2014). Traditional college-age students are at high risk for HPV infection because the majority are currently sexually active (American College Health Association [ACHA], 2017). A total of 27,787 undergraduate students were included in the Fall 2016 National College Health Assessment (NCHA) II Reference Group analyses (ACHA, 2017). The NCHA II revealed that nearly two thirds (65.8%) of undergraduate students had oral, vaginal, or anal sex with one or more partners within the last 12 months. An estimated 46% of college undergraduates had vaginal intercourse within the last 30 days, 43.4% had oral sex within the last 30 days, and 5.2% had anal sex within the last 30 days (ACHA, 2017). HPV vaccination rates for college-age students fall considerably below the *Healthy People 2020* goal of 80% coverage for adolescent males and females (Office of Disease Prevention and Health Promotion, 2017). Based on findings from the Fall 2016 NCHA II, less than half of college men (47%) reported being vaccinated against HPV and less than two thirds (60%) of college women reported being vaccinated (ACHA, 2017). However, it is not possible to discern how many doses of the HPV vaccine the respondents completed based on the way the survey item was constructed. The item stem is written as follows “Have you received the following vaccinations (shots): Human Papillomavirus/HPV (cervical cancer vaccine)?” Six vaccines are listed in a column below the stem statement, including “human papillomavirus/HPV (cervical cancer vaccine)”. “Yes”, “no”, and “I don’t know” are provided as response options for each vaccine (ACHA, 2017, p. 41). Therefore, the HPV vaccination rates could have been inflated since respondents who selected “yes” may have only had one dose of the HPV vaccine (American College Health Association, 2017). University students are an important population for encouraging catch-up HPV vaccine uptake due to less than optimal vaccination rates and participation in sexual behaviors that increase the risk for HPV transmission (Thompson et al., 2016).

Several health behavior theories have been tested in predicting HPV vaccination intentions and uptake of college students, including protection motivation theory (Gainforth et al., 2012; Richards 2016a), extended parallel process model (Krieger & Sarge, 2013), transtheoretical model (Allen et al., 2009), health belief model (Richards, 2016b; Sundstrom et al., 2015), social cognitive theory (Priest, Knowlden, & Sharma, 2015; Catalano, Knowlden, Sharma & Franzidis, 2016), and theory of planned behavior (TPB) (Bennett, Buchanan, & Adams, 2012; Fisher, Kohut, Salisbury, & Salvadori, 2013; Gainforth et al., 2012; Krawczyk et al., 2012; Ratanasiripong, Cheng, & Enriquez, 2013; Ratanasiripong, 2015; Catalano, Knowlden, Birch, Leeper, Paschal & Usdan, 2017). Overall, the theory of planned behavior explained the greatest proportion of variance in college students’ HPV vaccination intentions and/or behavior, indicating that TPB is an effective theoretical framework for the development of HPV vaccination interventions targeting college students. However, most of the studies that tested TPB excluded vaccinated individuals (Bennett, Buchanan, & Adams, 2012; Fisher, Kohut, Salisbury, & Salvadori, 2013; Catalano, Knowlden, Birch, Leeper, Paschal, & Usdan, 2016), and/or did not report HPV vaccination status based on number of doses completed (Bennett, Buchanan, & Adams, 2012; Fisher, Kohut, Salisbury, & Salvadori, 2013; Krawczyk et al., 2012; Ratanasiripong, 2015; Catalano et al., 2017). All of these studies, except one (Catalano et al., 2017)

measured HPV vaccination intentions or vaccination status using ambiguous terms, not specifying the number of doses in the series or a time-frame. Additionally, all except one of these studies (Catalano et al., 2017) did not operationalize constructs based on Ajzen’s (2006) recommendations for construct measurement. Therefore, further testing of the TPB in predicting college students’ HPV vaccination intentions, initiation, and series completion is needed.

This study addresses a gap in the literature by assessing rates of HPV vaccine initiation and series completion among university students. Further, this study tests a theory of planned behavior-based model in predicting HPV vaccination intentions and series completion among this population. The theory of planned behavior posits that an individual’s attitudes toward a specific behavior, perceived social pressure to engage in that behavior (subjective norm), and perceived behavioral control to engage in that behavior predict one’s behavioral intention to perform the behavior (Ajzen & Driver, 1991). Behavioral intention is theorized to be the most immediate precursor to performance of a given behavior (Ajzen & Driver, 1991). In this study, the behavior of interest is receipt of three doses of the HPV vaccine within a 12 month time-frame.

The purpose of this study was to test a theory of planned behavior-based model in predicting HPV vaccination intentions and series completion among university students. Results from this study can contribute to health education efforts surrounding HPV vaccination. Identification of modifiable intrapersonal-level, theoretical factors that influence university students’ decision making regarding HPV vaccination can be used for the design of effective health education interventions.

Methods

Study Design and Sample

This study employed a nonexperimental, cross-sectional design. A non-probability based convenience sample was utilized in this study. The independent variables were the direct constructs of the theory of planned behavior; the dependent variables were behavioral intention, HPV vaccine uptake, and HPV vaccine series completion. For the purpose of this study, HPV vaccine uptake was defined as having received any doses of the HPV vaccine. HPV vaccine series completion was defined as receiving all three doses of the HPV vaccine. Participation was limited to undergraduate college students between the ages of 18-26, who had heard of the HPV vaccine prior to participating in this study, and who were enrolled at a large University in the Southeastern region of the United States during Spring 2016.

Procedures

All study procedures were approved by the University’s Institutional Review Board. The principal investigator contacted university instructors of communication courses via email to inform them of the study, and to request that they forward the email to students in their respective courses. University students in seven undergraduate communication courses received an invitation email detailing the study procedures and providing a link directing them to the web-based survey. Potential participants were offered extra credit as an incentive for completing the survey. The survey was delivered through the online survey software Qualtrics, which

allowed participants to anonymously complete the survey in a private setting. They were allowed to stop at any point without being penalized. The first page of the Qualtrics survey included the informed consent process and after agreeing to participate the students then completed the TPB-based survey. After the survey was completed respondents were directed to a separate survey to gather their contact information in order to provide extra credit. Students who attempted the survey but did not consent to the study, those who started but did not finish the survey, and those who did not meet the inclusion criteria were also granted extra credit. The survey was available in February 2016.

Measures

The theory of planned behavior-based items were adapted from an existing TPB-based HPV vaccination instrument designed for and validated with unvaccinated college males (Catalano et al., 2017). The instrument utilized in the current study measured the following constructs: HPV vaccine uptake, HPV vaccine series completion, behavioral intention to complete the HPV vaccine series, attitudes, subjective norm, and perceived behavioral control. Demographic and descriptive measures were also assessed on the instrument.

Behavioral intention to complete the HPV vaccine series. Behavioral intention is universally defined as a person's readiness to engage in a given behavior (Ajzen & Driver, 1991). Participants were asked three questions regarding their intent to receive three doses of the HPV vaccine in the next 12 months. One question was "I plan to get all three doses of the HPV vaccine in the next 12 months." The behavioral intention items were written in past tense for participants who had completed the series. These items were measured on a 7-point semantic Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) with a possible construct score range of 3 to 21.

Attitude. Attitude is generally described as a person's overall belief that a behavior is positive or negative (Ajzen & Driver, 1991). Participants were asked seven questions regarding their attitudes about getting the HPV vaccine series in the next 12 months. The stem statement was "I think getting all three doses of the HPV vaccine within 12 months is". Sample endpoints included *very bad – very good, extremely harmful – extremely beneficial, and unnecessary – necessary*. These items were measured with a 7-point semantic differential scale ranging from 1 to 7 with a possible construct score range of 7 to 49.

Subjective norm. Subjective norm is defined as the amount of social pressure that an individual perceives to engage or not engage in behavior (Ajzen & Driver, 1991). For the purpose of this study, participants were asked four questions regarding how people who are important to them would feel about them getting the HPV vaccine series in the next 12 months. Two sample questions were "Most people who are important to me think that I should get all three doses of the HPV vaccine in the next 12 months" and "My parent(s) or legal guardian(s) would like for me to get all three doses of the HPV vaccine in the next 12 months". The subjective items were written in past tense for participants who had completed the series. Each question was scored using a 7-point Likert scale ranging from 1 (*strongly disagree*) to 7 (*strongly agree*) with a possible construct score range of 4 to 28.

Perceived behavioral control. Perceived behavioral control is universally defined as the extent to which an individual believes they have control over performing a given behavior (Ajzen & Driver, 1991). Participants were asked six questions about how much control they believed they had in getting the HPV vaccine series in the next 12 months. One sample item was, "If I wanted to, I am sure I could get all three doses of the HPV vaccine in the next 12 months" with *completely unsure – completely sure* endpoints. These items were written in past tense for participants who had completed the series. Each item was scored using a 7-point semantic differential scale range from 1 to 7 with a possible construct score range of 6 to 42.

HPV vaccine uptake. HPV vaccine uptake was assessed with a single item, "Have you received the HPV vaccine?" with "yes", "no", or "I don't know" as response options. Since it is unlikely that college-age students would have received the HPV vaccine without knowing it (even prior to college), respondents who selected "I don't know" were coded as unvaccinated.

HPV series completion. Respondents who indicated that they had received the HPV vaccine were also asked about HPV series completion. This measure was assessed with one item, "How many doses (shots) of the HPV vaccine have you received?" with "1", "2", and "3" as response options. Respondents who indicated that they had not received any shots of the HPV vaccine in the HPV vaccine uptake item were coded as receiving "0" doses. "Nonvaccinees" were defined as participants who had never received any doses of the HPV vaccine. "Vaccine initiators" were defined as participants who had received one or two doses of the HPV vaccine. "Series completers" were those who had received all three doses of the HPV vaccine series. Participants who reported having received zero, one, or two doses were coded as non-series completers in the binary logistic regression analysis.

Demographic and descriptive measures. Participants were asked to report their gender, age, race, ethnicity, sexual orientation, primary source of health insurance, relationship status, prior awareness of HPV, past engagement in sexual activity, lifetime number of sexual partners, past year number of sexual partners, prior HPV diagnosis, and current or previous partner HPV diagnosis. Individuals who indicated that they had received the HPV vaccine were asked which HPV vaccine they had received.

Research questions. The research questions were as follows: (a) what are the HPV vaccine uptake and series completion rates for university students? (b) to what extent do attitude, subjective norm, and perceived behavioral control predict nonvaccinated university students' behavioral intentions to complete the HPV vaccine series within the next 12 months? and (c) to what extent do attitude, subjective norm, perceived behavioral control, behavioral intention, and gender predict HPV vaccine series completion among university students?

Data analyses. The data was analyzed using SPSS version 22.0. Descriptive statistics were reported for the demographic items, descriptive items, and TPB constructs. Pearson's product moment correlation coefficients were conducted to assess the relationships between each of the TPB constructs (attitude, subjective norm, perceived behavioral control, and behavioral intention) for the entire sample and for each of the subsamples. A stepwise multiple regression was conducted to determine the contribution of the TPB predictor variables (attitude, subjective norm, and perceived behavioral control) to the outcome

variable (behavioral intention to complete the HPV vaccine series) among nonvaccinees. A logistic regression analysis was computed to predict the likelihood of HPV vaccine series completion. Nonseries completers were coded as 0 and series completers were coded as 1 in logistic regression analysis. The Wald Chi-square test was applied to determine the significance of the TPB constructs and gender as predictors of HPV vaccine series completion. The *a priori* criteria of probability of Chi-square to retain predictors in the model was less than or equal to 0.05. The following fit indices were reviewed to assess model fit: Omnibus test of model coefficients, Hosmer and Lemeshow test, classification ratio, Cox & Snell R^2 , and Nagelkerke R^2 .

Results

Out of 497 students, a total of 424 students (85%) consented to participate in the research study. Of those who agreed to participate 142 students were ineligible because they had not previously heard of the HPV vaccine ($n=101$), were not between the ages of 18 and 26 years ($n=34$), or did not answer key survey questions ($n=7$). The final sample consisted of 281 participants including 115 (40.9%) nonvaccinees, 55 (19.6%) HPV vaccine initiators, and 111 (39.5%) HPV vaccine series completers.

Participant Characteristics

Demographic characteristics. The majority of the sample was female (74.9%, $n=209$), white (75.5%, $n=209$), straight/heterosexual (87.1%, $n=243$), and not in a relationship (52.7%, $n=147$). The mean age of the sample was 20.3 years and 74.9% ($n=209$) of participants were between the ages of 19-21. All of the participants (100%, $n=276$) had health insurance, and 87.3% ($n=241$) of the sample reported that their primary source of health insurance was through their parent(s)/guardian(s)' plan. Of the participants who had received one or more doses of the HPV vaccine, 77.7% ($n=129$) reported having received the Gardasil vaccine. A total of 19.3% ($n=32$) of participants who had received at least one dose of the HPV vaccine were not sure which vaccine type they had received. The majority of the sample (88.4%, $n=244$) had never been diagnosed with HPV by a primary care provider. Further, only 4% ($n=11$) of the sample indicated that a current or previous sexual partner had been diagnosed with HPV. The demographic characteristics of each subsample are presented in Table 1.

Sexual behavior. Approximately 91% ($n=251$) of the sample reported having ever engaged in oral, vaginal, and/or anal sex. The sample reported having approximately: 5 to 6 oral sex partners ($M=5.84$) in their lifetime, 6 to 7 vaginal sex partners ($M=6.33$) in their lifetime, and 0 to 1 anal sex partners ($M=0.60$) in their lifetime. Participants in the sample reported engaging in: oral sex with two partners ($M=2.0$) in the last 12 months, vaginal sex with approximately two to three partners ($M=2.08$) in the last 12 months, and anal sex with approximately zero to one partners ($M=0.25$) in the last 12 months.

Theory of Planned Behavior-based Descriptive Statistics

The descriptive statistics for each of the theoretical constructs are summarized by sub-sample (e.g., nonvaccinees, vaccine initiators, and series completers) and are presented in Table 2. All of the TPB constructs met the *a priori* Cronbach's

alpha level of .70. Pearson product moment correlation coefficients were calculated to ascertain the relationships between the independent and dependent variables.

Predictors of HPV Vaccination Series Completion Intentions among Non-Vaccinees

In univariate analyses, attitude ($r=.495$, $p<.01$), subjective norm ($r=.764$, $p<.01$), and perceived behavioral control ($r=.203$, $p<.05$) all significantly correlated with behavioral intention. Subjective norm was the strongest predictor of series completion. The final stepwise multiple regression model revealed that the constructs of attitude ($\beta=.175$; $p=.01$) and subjective norm ($\beta=.682$; $p=.001$) were significant predictors of behavioral intention to complete the HPV vaccine series in the next 12 months. At step 2 of the model, these statistically significant constructs collectively explained 60% of the variance in behavioral intention ($R^2_{\text{adjusted}}=0.60$, $F(2, 112)=86.635$, $p<.001$). Participants' behavioral intention to complete the HPV vaccine series within the next 12 months can be calculated through the following prediction equation: behavioral intention = $-1.321 + .094$ (attitude) + 0.597 (subjective norm). The parameter estimates of the final stepwise multiple regression model are provided in Table 3.

Predictors of HPV Vaccination Series Completion Intentions among Vaccine Initiators

Attitude ($r=.516$, $p<.01$), subjective norm ($r=.514$, $p<.01$), and perceived behavioral control ($r=.372$, $p<.01$) all significantly correlated with behavioral intention among the vaccine initiators. Given the small sub-sample size ($n=55$) for vaccine initiators, there was inadequate statistical power to conduct multiple linear regression.

Predictors of HPV Vaccine Series Completion

All of the TPB predictor variables (attitude, subjective norm, perceived behavioral control, and behavioral intention) were significantly correlated with one another. A cross-tabs analysis revealed a statistically significant association between gender and series completion (Chi-square [χ^2] = 22.6, $p<.001$; Cramer's $V=.285$). One-way ANOVA tests revealed significant gender differences for subjective norm (females' $M=19.1$; males' $M=16.6$, $p=.000$), perceived behavioral control (females' $M=30.3$; males' $M=32.9$, $p=.007$), and behavioral intention (females' $M=15.5$; males' $M=12.4$, $p=.000$) scores within the sample. Consequently, gender was included as a covariate in the binary logistic regression model.

HPV vaccine series completion prediction model. The full model (attitude, subjective norm, perceived behavioral control, behavioral intention, and gender) was tested against a constant-only model; the Omnibus Test of Model Coefficients revealed that the full model was statistically significant ($\chi^2=120.648$, $df=5$, $n=279$, $p=.000$) suggesting that the predictors reliability differentiated between series completers ($n=111$) and nonseries completers ($n=168$) in the sample. Classification was adequate with the model correctly predicting 81.1% of the sample completing the series and 81.5% of the sample not completing the series, for an overall successful prediction rate of 81.4%. Goodness of fit for the model was confirmed through the Hosmer and Lemeshow test ($\chi^2=8.307$, $df=8$, $n=279$, $p=.404$).

Table 1.

Demographic Characteristics of the Sample

	<i>Nonvaccinees (%)</i>	<i>Vaccine Initiators (%)</i>	<i>Series Completers (%)</i>
Age	<i>n</i> = 114 <i>M</i> = 20.3	<i>n</i> = 54 <i>M</i> = 20.2	<i>n</i> = 111 <i>M</i> = 20.4
Gender	<i>n</i> = 114	<i>n</i> = 54	<i>n</i> = 111
Male	41 (36.0)	18 (33.3)	11 (9.9)
Female	73 (64.0)	36 (66.7)	100 (90.1)
Race/ Ethnicity	<i>n</i> = 112	<i>n</i> = 54	<i>n</i> = 111
White	88 (78.6)	37 (68.5)	84 (75.7)
Black	13 (11.6)	13 (24.1)	11 (9.9)
Hispanic or Latino/a	3 (2.7)	1 (1.9)	4 (3.6)
Asian or Pacific Islander	2 (1.8)	2 (3.7)	3 (2.7)
American Indian, Alaskan Native, or Native Hawaiian	0 (0.0)	0 (0.0)	1 (0.9)
Biracial or Multiracial	6 (5.4)	1 (1.9)	7 (6.3)
Other	0 (0.0)	0 (0.0)	1 (0.9)
Sexual Orientation	<i>n</i> = 114	<i>n</i> = 54	<i>n</i> = 111
Straight/Heterosexual	103 (90.4)	41 (75.9)	99 (89.2)
Bisexual	3 (2.6)	4 (7.4)	1 (0.9)
Gay	0 (0.0)	3 (5.6)	0 (0.0)
Lesbian	0 (0.0)	1 (1.9)	1 (0.9)
Asexual	7 (6.1)	5 (9.3)	8 (7.2)
Pansexual	1 (0.9)	0 (0.0)	0 (0.0)
Another identity	0 (0.0)	0 (0.0)	2 (1.8)
Relationship Status	<i>n</i> = 114	<i>n</i> = 54	<i>n</i> = 111
Not in a relationship	58 (50.9)	31 (57.4)	58 (52.3)
In a relationship, but not living together	46 (40.4)	20 (37.0)	42 (37.8)
In a relationship and living together	10 (8.8)	3 (5.6)	11 (9.9)
Primary Source of Health Insurance*	<i>n</i> = 111	<i>n</i> = 54	<i>n</i> = 111
Parents'/guardians' plan	100 (90.1)	43 (79.6)	98 (88.3)
University sponsored plan	8 (7.2)	7 (13.0)	4 (3.6)
Another plan	3 (2.7)	4 (7.4)	9 (8.1)
Prior HPV Diagnosis	<i>n</i> = 112	<i>n</i> = 54	<i>n</i> = 110
Yes	12 (10.7)	7 (13.0)	4 (3.6)
No	100 (89.3)	47 (87.0)	97 (88.2)
Current or Previous Partner HPV Diagnosis	<i>n</i> = 112	<i>n</i> = 54	<i>n</i> = 110
Yes	6 (5.4)	2 (3.7)	3 (2.7)
No	82 (72.3)	44 (81.5)	79 (71.8)
Don't know	24 (21.4)	8 (14.8)	28 (25.5)
Ever Had Sex**	<i>n</i> = 112	<i>n</i> = 54	<i>n</i> = 110
Yes	95 (84.8)	52 (96.3)	104 (94.5)
No	17 (15.2)	2 (3.7)	6 (5.5)
Number of Sexual Partners in Last 12 Months	<i>n</i> = 111	<i>n</i> = 54	<i>n</i> = 110
Oral Sex Partners	<i>M</i> = 1.88	<i>M</i> = 1.87	<i>M</i> = 2.17
Vaginal Sex Partners	<i>M</i> = 2.03***	<i>M</i> = 1.80	<i>M</i> = 2.17
Anal Sex Partners	<i>M</i> = 0.23	<i>M</i> = 0.20	<i>M</i> = 0.29
Lifetime Number of Sexual Partners	<i>n</i> = 112	<i>n</i> = 54	<i>n</i> = 110
Oral Sex Partners	<i>M</i> = 5.58	<i>M</i> = 5.09	<i>M</i> = 6.48
Vaginal Sex Partners	<i>M</i> = 6.03	<i>M</i> = 4.00	<i>M</i> = 7.77
Anal Sex Partners	<i>M</i> = 0.50	<i>M</i> = 0.96	<i>M</i> = 0.53

Note. *All participants indicated that they had some form of health insurance. ** "Ever had sex" was assessed by asking participants, "Have you ever engaged in any of the following sexual activities: oral sex, vaginal sex, and/or anal sex?"

****n* = 112

Table 2.

Theory of Planned Behavior-based Construct Ranges, Means, Standard Deviations, and Cronbach's Alpha Coefficients for Nonvaccinees (n = 115), Vaccine Initiators (n = 55), and Series Completers (n = 111)

Construct	Possible Range	Observed Range	M	SD	Cronbach's Alpha
Attitude					
Nonvaccinees	7 – 49	7 – 49	32.4	9.6	0.93
Vaccine Initiators	7 – 49	12 – 49	34.7	9.4	0.92
Series Completers	7 – 49	19 – 49	39.8	7.5	0.91
Subjective Norm					
Nonvaccinees	4 – 28	4 – 28	15.1	5.9	0.95
Vaccine Initiators	4 – 28	5 – 28	18.9	5.1	0.90
Series Completers	4 – 28	4 – 28	21.5	4.2	0.82
Perceived Behavioral Control					
Nonvaccinees	6 – 42	6 – 42	39.1	7.5	0.88
Vaccine Initiators	6 – 42	21 – 42	33.0	6.8	0.89
Series Completers	6 – 42	21 – 42	34.3	6.1	0.83
Behavioral Intention					
Nonvaccinees	3 – 21	3 – 21	10.8	5.1	0.97
Vaccine Initiators	3 – 21	3 – 21	15.2	4.0	0.94
Series Completers	3 – 21	3 – 21	18.4	3.3	0.93

The model identified behavioral intention ($\beta = .303$, Wald $\chi^2 = 30.870$, $p = .000$), and gender ($\beta = 1.175$, Wald $\chi^2 = 8.053$, $p = .005$) as significant predictors. The model explained between 35.1% (Cox & Snell R^2) and 47.5% (Nagelkerke R^2) of the variance in HPV vaccine series completion. Analysis revealed that for each one unit increase in behavioral intention, the odds of completing the HPV vaccine series increased by 35.4%. Furthermore, analysis revealed that the odds of university females completing the HPV vaccine series is approximately 223.8% higher compared to university males. The parameter estimates and fit statistics for the model are summarized in Table 4.

Discussion

This study assessed university students' HPV vaccination initiation and series completion rates and tested a TPB-based model in predicting university students' HPV vaccination intentions and series completion. Nearly two thirds (60.5%) of the sample had not completed the HPV vaccine series. Furthermore, the majority (90%) of the sample had been sexually active, which indicates that the sample is already at risk for HPV infection. Self-reported personal (11.6%) and partner (4%) HPV diagnoses by a healthcare provider were fairly low, but it is unknown what proportion of the sample had ever been tested for HPV or when they were last tested. Therefore, catch-up HPV vaccination interventions with emphasis placed on series completion are strongly recommended for university students. The likelihood that university students will have sexual contact increases over the course of the college experience (Siegel, Klein, & Roghmann, 1999). Consequently, interventions should prioritize HPV vaccination programming for first-year university students. However, given that many upperclassmen remain unvaccinated or do not complete the series, educational booster sessions are recommended for all students.

The mean scores for the perceived behavioral control construct were highest among nonvaccinees, followed by vaccine initiators, and series completers, respectively. It should be noted that the TPB measures perceived behavioral control rather than actual control. Thus, those who have not completed the series may lack awareness about the financial, logistical, or other barriers associated with completing the series. In turn, this could lead the respondents in the nonvaccinees and vaccine initiators group to feel that they have more control over completing the series compared to those who have completed the series. In future programs, health educators should address the steps necessary to complete the HPV vaccine series along with strategies to overcome barriers to completing the series.

Among nonvaccinees, the findings suggest that university students who have more positive attitudes about completing the HPV vaccine series and more perceived social pressure to complete the HPV vaccine series have greater intentions to complete the HPV vaccine series. These results are consistent with other studies which found that attitude and subjective norm predicted college students' HPV vaccination intentions (Bennett et al., 2012; Catalano et al., 2017; Fisher et al., 2013; Ratanasiripong et al., 2013; Ratanasiripong, 2015). Interventions that aim to increase nonvaccinee university students' behavioral intention to complete the HPV vaccine series completion should strive to increase positive attitudes toward completing the series and greater subjective norms regarding series completion. Health educators may target attitudes by addressing university students' salient behavioral beliefs about completing the HPV vaccine. Health educators may emphasize that the HPV vaccine is effective, safe, healthy, preventive, and necessary. In particular, health educators should highlight the importance of receiving three doses within the recommended timeframe for maximum benefit (Giuliano et al., 2011). Subjective norm can be targeted in health education programs by addressing university students' salient normative

Table 3.

Stepwise Regression Model Predicting HPV Vaccination Series Completion Intentions of Unvaccinated University Students (n = 115)

Variable	B	SE B	β	T	p	R ² change
Step 1: Included Variables						
Constant	0.640	0.863		0.741	0.460	
Subjective norm	0.669	0.053	0.764	12.581	<.001	0.583
Step 1: Excluded Variables						
Attitude	0.175			2.613	0.010	
Perceived behavioral control	0.088			1.434	0.154	
Step 2: Included Variables						
Constant	-1.321	1.128		-1.171	0.244	
Subjective norm	0.597	0.059	0.682	10.165	<.001	
Attitude	0.094	0.036	0.175	2.613	0.010	0.024
Step 2: Excluded Variables						
Perceived behavioral control	0.046			0.736	.463	

Note. Total Adjusted R²=.60

beliefs about HPV vaccine series completion, which are theorized to form subjective norm. Normative beliefs involve what individuals think referent others/groups would want or expect them to do. Therefore, health educators may stress that healthcare providers, friends, parents/guardians, and other family members approve of university students' completing the HPV vaccine series within the recommended timeframe.

The logistic regression findings suggest that university students have greater odds of completing the HPV vaccine series in the next 12 months if they are female and have greater intentions to complete the series. Based on these findings, health educators should aim to increase university students' behavioral intention in an effort to facilitate series completion. These results are consistent with other studies which found that behavioral intention predicted HPV vaccine uptake (Gerend & Shepherd, 2012; Juraskova et al., 2012; Patel et al., 2012); however, number of doses received was not measured within these studies. Among participants who report some degree of behavioral intention to complete the HPV vaccine series, health educators may apply implementation intention strategies to encourage series completion within the next 12 months. This can be accomplished by asking participants to specify when, where, and how they plan to receive each dose of the series. This technique is highly effective at facilitating the transition from intention to action (Gollwitzer, 1999). Although attitude and subjective norm became nonsignificant in the logistic regression model due to statistical multicollinearity between variables, interventions should also emphasize increasing positive attitudes and subjective norm because these constructs are closely linked to intention. This relationship is supported by the TPB as well as the correlation coefficients among the variables. Given that university men had lower odds of completing the HPV vaccine series, this sub-population should be targeted more heavily for HPV vaccination programming.

Limitations and Future Research

This study has several limitations that should be taken into consideration when interpreting the results. This study utilized

a non-experimental, cross-sectional design which prohibits the ability to assert causation or demonstrate a temporal relationship between variables. Future studies should employ a prospective cohort design, collecting data from nonvaccinated and vaccine initiator university students at multiple points over 12 months to determine the extent to which TPB constructs accurately predict HPV vaccine series completion. Study participants were recruited using non-probability based convenience sampling, which is subject to sampling bias. Accordingly, the results cannot be generalized beyond the sample. Future studies should utilize probability-based sampling procedures to reduce sampling bias and improve internal validity. Further, this sample was drawn from one large, public institution located in the Southeast region of the United States. To improve external validity, future studies should consider including a larger sample of higher education institutions with diverse representation based on geographic location, size, student demographics, and other Carnegie classifications. The current sample did not have a large enough sub-sample of vaccine initiators to be able to conduct a multiple regression analysis for this group. Future studies should consider utilizing quota sampling procedures to ensure that each sub-group has adequate statistical power to conduct analyses.

The results of this study are based on self-report responses, which are subject to social desirability bias and recall bias. In an effort to reduce social desirability bias, the survey was delivered electronically so that respondents could complete it in a private, safe setting. Respondents were asked to recall details about their HPV vaccination status and sexual history, which may have dated back five to ten years; although individuals generally perform well remembering their past, it is possible that they misremembered important details, resulting in inaccuracies with the survey responses. Future investigations may assess the age that participants received their first and last dose of the vaccine. This will serve as a reliability check on number of doses reported and enable researchers to determine if the time frame was in line with ACIP guidelines. Additionally, future investigations should obtain copies of participants' vaccination

Table 4.

Parameter Estimates for Model of TPB-based Predictors and Gender Regressed on HPV Vaccine Series Completion (n = 279)

Predictor	β	SE β	Wald χ^2	p	OR	95% CI
Constant	-6.638	1.031	41.474	0.000*	0.001	
Behavioral Intention	.303	.054	30.870	0.000*	1.354	[1.216-1.506]
Gender (1= females, 0 = males)	1.175	0.414	8.053	0.005*	3.238	[1.943-8.751]
Attitude	0.032	0.022	2.155	0.142	.032	[0.989-1.078]
Subjective Norm	0.18	0.042	0.183	0.669	1.018	[0.938-1.105]
Perceived Behavioral Control	-0.032	0.028	1.314	0.252	0.968	[0.916-1.023]

Note. ** = $p < 0.01$, CI = Confidence interval for odds ratio (OR), Final model: Chi square = 120.648, df = 5, $p = 0.000$, Nagelkerke $R^2 = 0.475$, Cox & Snell $R^2 = 0.351$

records as a validity check for HPV vaccination status. The TPB is an intrapersonal-level theory; therefore, the theory does not take into account interpersonal, environmental, financial, or political influences that may impact a person's behavioral intention or decision to engage in a given behavior. The TPB assumes that decisions about behavior are grounded in logical thought processes; as a result, the TPB does not account for emotional factors (e.g., fear, threat, mood) that have the potential to influence behavioral decisions. This study only explored the proximal TPB constructs, which was deemed appropriate given the purpose of the study. To assist with the development of targeted messages for health education programs, future studies should also consider investigating the strength and salience of behavioral, normative, and control beliefs specific to HPV vaccine series completion among each of the sub-groups (nonvaccinees, vaccine initiators, and series completers).

Conclusion

This study was undertaken to assess university students' HPV vaccine initiation and series completion rates and to test a theory of planned behavior-based model in predicting HPV vaccination intentions and series completion among university students. Our findings support the utility of a theory of planned behavior-based framework in predicting HPV vaccine intentions and series completion among this population. This research can be used to inform the development of HPV vaccination interventions promoting vaccine initiation and series completion among university students.

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