
Human papillomavirus vaccination among diverse college students in the state of Georgia: who receives recommendation, who initiates and what are the reasons?

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Abstract

Young adulthood is a critical time for catch-up HPV vaccination. We assessed predictors of vaccine recommendation and initiation among college students. We analysed cross-sectional surveys from 2397 students using multivariable logistic regressions. Guided by the Socio-ecological and Health Belief Models, measures included socio-demographic characteristics, intrapersonal measures (e.g. vaccine beliefs), interpersonal measures (e.g. doctor's recommendation) and institutional-level measures (e.g. college settings). The sample included students from private, public, technical and historically black colleges/universities. Of the sample, 64.5% were White; additionally, 48.3% of women ($n = 750/1552$) and 18.8% of men ($n = 159/845$) received a doctor's recommendation. Among women, predictors included older age, US-born, higher parental education and attending private schools. Among men, predictors included younger age, being homosexual and attending private schools. HPV vaccine series initiation was low—43.3% of women ($n = 672$) and 16.7% of men ($n = 141$). Doctor's recommendation predicted initiation for both sexes. Younger women, women attending technical colleges and men of 'multiple/other' race had lower odds of initiation. Common initiation barriers for both sexes included a lack of

doctor recommendation and sexual inactivity. These barriers and the associations between nativity, race and socio-economic status with vaccine recommendation and initiation should be further investigated. Interventions should improve patient–provider communication around HPV vaccine.

Introduction

Human papillomavirus (HPV) vaccine is a safe and effective method for protection against genital warts and various different cancers caused by HPV [1]. Initially, the vaccine was recommended for routine vaccination of female adolescents at the age of 11 or 12 and with catch-up vaccination through the age of 26 [2]. In 2009, the HPV vaccine was approved for use in men [3], and in 2011, the vaccine was recommended for routine vaccination of male adolescents at the age of 11 or 12 and with catch-up vaccination for ages 13–21 [4].

For young adult college students in the United States who have not been vaccinated, the college years, particularly through college health centers and other resources, can provide timely opportunities for the recommended catch-up vaccinations [5]. Additionally, college-aged populations are at high risk for HPV infection [6–8], making this opportunity even more relevant. In recent years,

national data show a considerable increase in the rates of HPV vaccination among college students. For example, the National College Health Assessment (NCHA) II data from 2009 to 2013 showed that vaccine coverage history increased from 44.7% to 68.9% for women and from 17.5% to 42.9% for men [9]. This trend is promising and the NCHA II-reported rate for women exceeded the Healthy Campus 2020 goals (58.4% HPV vaccination coverage for both sexes) [10]. However, the NCHA II-reported rate for men was still below the Healthy Campus 2020 goals. Additionally, the rates for both sexes were still below the Healthy People 2020 goals of 80% HPV vaccination coverage for both sexes [11].

To increase HPV vaccination rates among college students, researchers need to understand determinants of HPV vaccine uptake in this population. Such information can provide insights into subgroups that are under-vaccinated, highlight reasons for individual decisions for or against HPV vaccination, and identify intervention targets to increase HPV vaccination uptake and completion. Studies have documented that Black and Asian female college students have lower HPV vaccination rates compared with Whites [9, 12, 13]. Foreign-born female students also are less likely to have received the HPV vaccine [14]. Additionally, a lack of insurance and perceived high costs are associated with a lower likelihood of initiating and/or completing the HPV vaccine among college students [14–16].

Although the body of literature on college students' vaccine uptake is growing, several issues within this area still benefit from additional examination. Little research has leveraged a socio-ecologic perspective [17] and assessed other contextual factors that might be related to HPV vaccination uptake. For example, at the community and/or organizational level, type of college can determine the kind of health services students have access to and consequently HPV vaccine uptake behaviors. Research has found that historically black colleges/universities (HBCUs) are less likely to offer HPV vaccine and Pap tests to college students compared with non-HBCUs [18]. Due to the lack of onsite clinics and/or health resources, students

attending community colleges also face access barriers to HPV vaccine that traditional university students may not [19]. Therefore, it is important to examine and compare vaccine behaviors and beliefs across different campus settings.

At the organizational and/or interpersonal level, a doctor's recommendation strongly predicts vaccine intention, initiation, and/or completion among female and male students [20–24]. However, the majority of studies have treated a doctor's recommendation as an independent rather than dependent variable. Most research has ignored the question of which group may have lower rates of provider recommendation. Importantly, many studies on HPV vaccine among college students often rely on data from a single college or university and/or only sample one sex (i.e. only women or men) [16, 20, 21, 23, 24]. Such designs preclude researchers from being able to examine whether vaccination rates vary in relation to these broader community, organizational and interpersonal contexts, limiting the extent to which such research can inform a broader conceptual framework for understanding and ultimately intervening to address HPV vaccination among college students.

To address these existing gaps in the literature, our study draws on a racially/ethnically diverse sample of female and male college students attending seven different schools in the state of Georgia and examines multiple socio-ecological predictors of (i) receiving doctor recommendation for HPV vaccine and (ii) initiation of HPV vaccine. Additionally, we also describe reasons why students (i) initiated HPV vaccine, (ii) initiated but did not completed HPV vaccine, or (iii) did not start the HPV vaccine series.

Materials and Methods

Study design and participants

Data for the current study came from Project DECOY [25]. Briefly, this is a six-wave cohort study that involves 3418 racially/ethnically diverse students (ages 18–25) from seven colleges and universities in Georgia. Schools are located in both

rural and urban settings and include two public schools, two private schools, two community/technical colleges and one HBCU. Project DECOY was approved by the Emory University Institutional Review Board and those of the participating schools as well as that of the company contracted for data collection services, ICF International. Data collection began in Fall 2014 and consisted of an online survey every 4 months for 2 years.

The registrar's office from each campus provided email addresses for English-speaking students ages 18–25. We randomly selected 3000 email addresses from each of the three largest campuses and emailed a census of students (i.e. everyone) at the four smaller campuses with fewer than 3000 students. We met our sampling quota in a short period of time (24 h at the private schools to 7 days at the technical colleges), and with an overall enrollment proportion of 22.9% (3574/15 607), which ranged from 12.0% to 59.4% at different campuses. We intended to enroll participants who were engaged in email and potentially more likely to be retained in the subsequent waves of the larger, multiwave longitudinal project.

The focus of Project DECOY was to examine the utility of using market research to identify and characterize young adults at high-risk for tobacco use, focusing on alternative and emerging tobacco products. In this study, we employed a graduated compensation schedule (\$30 for the first 2 assessments, \$40 for the second 2, \$50 for the final 2), with an additional \$100 incentive for participating in all assessments. The current analyses examined data from Wave 6 of the study (collected between July and August 2016), which, apart from survey items on tobacco use, also included measures on HPV vaccine behaviors and beliefs. For data analysis, we excluded individuals who did not identify as either male or female ($n = 4$), yielding a final sample of 2397 individuals. As described above, participants received \$50 for survey completion of Wave 6.

Theoretical framework

The socio-ecological model (SEM) [17, 26, 27] and the Health Belief Model (HBM) [28] guided the development of our research questions and

measurements. The SEM posits that health behaviors are influenced by factors at multiple levels, such as policy, institutional, community, interpersonal and intrapersonal levels. The HBM contains several constructs that predict whether and why people will engage in health behaviors. In the SEM, the intrapersonal level encompasses characteristics of the individual such as knowledge, attitudes, behaviors or the developmental history of the individual [17]. In the study, we used the HBM to develop several constructs assessing intrapersonal-level factors. For example, we examined relationships between the outcomes of HPV vaccine recommendation and initiation and individuals' perceived susceptibility to HPV, perceived seriousness of HPV and perceived benefit (i.e. effectiveness) of HPV vaccine. In addition, interpersonal-level measures (e.g. parental education or doctor's recommendation of HPV vaccine) as well as institutional-level predictors (i.e. college settings) were assessed as predictors of HPV vaccine recommendation and/or initiation. The 'cues to action' construct in HBM (i.e. internal or external factors that could trigger the behavior) [28] was also captured through doctor's recommendation of HPV vaccine. Finally, we asked participants to describe reasons underlying their HPV vaccine behaviors and provided options that encompassed multiple SEM levels (e.g. friends and family norms, religious influences, and access to vaccine). Reasons underlying HPV vaccine behaviors also captured the construct of 'perceived barriers' in HBM.

Measures

Outcomes: HPV vaccine recommendation and initiation

Participants were asked whether they had ever received a doctor's recommendation for HPV vaccine (1 = Yes, 2 = No, 3 = Do not know). They were also asked whether they had received any dose of the HPV vaccine (similar response options). These were the two main outcomes of the study. For data analysis, these outcome variables were dichotomized and those who responded 'Do not know' were recoded as answering 'No'. Data on whether

participants completed the three vaccine doses were also collected.

Socio-demographic characteristics

Socio-demographic factors included sex (1 = male, 2 = female), age, sexual orientation (1 = heterosexual, 2 = homosexual, 3 = bisexual), race [1 = Black, 2 = Asian Americans/Native Hawaiians/Pacific Islanders (AAPI), 3 = White, 4 = more than one/other race], ethnicity (1 = Hispanic, 2 = non-Hispanic) and nativity (1 = born in the United States, 2 = born outside of the United States).

Intrapersonal level measures

Drawing on the HBM [28] and recent studies on HPV vaccine [22, 29], we assessed perceived susceptibility to HPV, perceived seriousness of HPV and perceived benefit (i.e. effectiveness) of HPV vaccine. Each construct was assessed with one single item, all of which used the same 4-point Likert scale response options (1 = not at all, 2 = a little, 3 = somewhat, 4 = very). Perceived susceptibility was assessed through the question 'How likely do you think you are to get HPV?'. Perceived seriousness was assessed through the question 'How harmful to your health do you think HPV is?'. Perceived benefit was assessed through the question 'How effective do you think the HPV vaccine is for preventing HPV?'.

Other intrapersonal measures included vaccine-related and cancer-related health behaviors, such as receipt of the meningitis vaccine, receipt of the Tetanus, diphtheria and pertussis (Tdap) vaccine, and cigarette use. We assessed uptake of these routinely recommended vaccines to allow a more complete understanding of vaccination status in our study population. Cigarette smoking was included as a measure of cancer risk behaviors.

Interpersonal level measures

Highest level of education attained by parents (1 = below a bachelor's degree, 2 = bachelor's degree and above) was assessed. Additionally, we also included doctor's recommendation of HPV vaccine as an interpersonal level predictor of HPV vaccine initiation.

Institutional level measure

Type of school (1 = private, 2 = public/state, 3 = technical college and 4 = HBCU) was captured in the survey and analysed as predictors of HPV vaccine recommendation and initiation.

Reasons underlying HPV vaccine behaviors

In addition to including SEM predictors for the outcomes, we also used the SEM to inform the development of response options for reasons underlying HPV vaccine behaviors (e.g. reasons for initiation or lack thereof and reasons for incompleteness) among participants. Response options captured intrapersonal influences (e.g. HPV vaccine safety beliefs), interpersonal influences (e.g. social norms among family and friends, religious influences and conversations with doctors) and health system-related factors (e.g. costs or HPV vaccine scheduling).

Participants were asked about reasons for initiating among those who initiated the HPV vaccine. They were asked to select all reasons that applied among the following options: 'My doctor recommended it; My parents recommended it; My significant other recommended it; My friends talked about getting the vaccination; My friends talked about having HPV; or Other (open-ended response)'.

Those who had not initiated the HPV vaccine were asked for reasons why they had not started the vaccine. Similarly, they were asked to select all reasons that applied among the following options: 'Doctor never recommended HPV vaccine; Doctor indicated that HPV vaccine was optional or not necessary; Too expensive; It is against my religious beliefs to get HPV vaccine; It is against my religious beliefs to get any vaccines; I know someone who had a bad side effect; My significant other discouraged vaccination; My family members discouraged vaccination; My friend(s) discouraged vaccination; I do not think HPV-related diseases are serious; I am not sexually active; I don't think the vaccine is safe; I didn't want to have to commit to having three shots for the vaccination; or Other (open-ended response)'.

Finally, those who indicated that they had started the HPV vaccine but had not completed it were also

asked about reasons for incompleteness. They were provided with an instruction to select all reasons that applied among the following options: ‘Started the series too recently to finish; Didn’t know I needed more than 1 dose; Too expensive; No access to a doctor to complete the series; Doctor didn’t tell me I needed to come back for more doses; I had a bad side effect and stopped the series; I know someone who had a bad side effect; My significant other discouraged vaccination; My family members discouraged vaccination; My friend(s) discouraged vaccination; It was inconvenient to schedule additional visits; I forgot to finish the series; or Other (open-ended response)’.

Survey questions related to HPV vaccine beliefs and behaviors are included in Appendix A.

Data analysis

Survey data were downloaded in SAS 9.4 for analyses. Stratified analyses were conducted for females and males. We conducted stratified models due to the historical sex differences in rates of HPV vaccination as well as evidence showing that several correlates of HPV vaccine knowledge, beliefs and status differ by sex for young adults and college students [9, 30–33]. Participant characteristics were summarized using descriptive statistics. Bivariate analyses were conducted using chi-square and independent sample *t*-tests to examine socio-demographic characteristics and health beliefs and behaviors in relations to (i) a doctor’s recommendation for HPV vaccine and (ii) initiation of the HPV vaccine doses. Multivariable logistic regressions were conducted to examine correlates of each outcome. Predictors entered into the multivariable logistic regressions were age, sexual orientation, race/ethnicity, nativity, parental education and school type. An alpha level was set at 0.05 for all analyses.

Results

A total of 1552 women and 845 men completed the survey. The average age at the time of Wave 6 was 22.5, and the age range was 20–27 for both women and men (SD = 1.9 and 2.0, respectively). In the sample, 27.4% of women ($n = 419$) and 11.5% of

men ($n = 96$) were Black; 4.7% of women ($n = 72$) and 11.2% of men ($n = 93$) were AAPI; 62.2% of women ($n = 951$) and 71.6% of men ($n = 596$) were White; and 5.7% of women ($n = 87$) and 5.8% of men ($n = 48$) were of more than one race or other races. Additionally, 7.7% of women ($n = 119$) and 8.0% of men ($n = 67$) identified as Hispanic/Latino. Table I lists additional socio-demographic characteristics of participants in the study.

In the sample, 9.73% of women ($n = 151$) reported a past diagnosis of HPV. We did not exclude these individuals from the analysis because research has shown that someone exposed to HPV will still likely get protection or benefits from HPV vaccination [34].

Beliefs about HPV and HPV vaccine

Among women, while only 13.2% ($n = 205$) believed that they were likely to contract HPV, a large percentage (83.2%, $n = 1292$) perceived HPV as harmful (Table II). Among men, the pattern was similar: 8.4% ($n = 71$) believed that they were likely to contract HPV and 68.6% ($n = 580$) perceived HPV as harmful. The majority of participants, specifically 76.7% of women ($n = 1190$) and 80.3% of men ($n = 679$), rated the HPV vaccine as effective (Table II).

HPV vaccine recommendation

Among women, 48.3% ($n = 750$) reported receiving a doctor’s recommendation for HPV vaccine; among men, 18.8% ($n = 159$) reported a doctor’s recommendation. Bivariate analyses (Appendix B) show that among both sexes, factors associated with doctor’s recommendation included: US-born, higher parental education, private schools, higher perceived seriousness of HPV, higher perceived effectiveness of HPV vaccine, receipt of meningitis vaccine and receipt of Tdap vaccine. Additional correlates for doctor’s recommendation among women were older age and higher perceived susceptibility to HPV, while for men, those were younger age, being homosexual and smoking cigarettes.

Multivariable logistic regressions (Table III) show that among women, older age (OR = 1.2,

Table 1. Socio-demographic characteristics of female and male students in the sample

	Total sample	Women		Women: HPV vaccine recommendation receipt		Women: HPV vaccine initiation		Men		Men: HPV vaccine recommendation receipt		Men: HPV vaccine initiation	
		<i>n</i> (% of category in the total sample) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category in the total sample) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category in the total sample) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)
Overall	2397	1552 (64.7%)	750 (48.3%)	672 (43.3%)	845 (35.3%)	159 (18.8%)	141 (16.7%)	22.5 (1.9)	22.8 (1.9)	22.5 (2.0)	21.9 (1.8)	22.0 (1.9)	22.0 (1.9)
Age (at Wave 6)													
Sexual orientation ^a													
Heterosexual	2179	1408 (64.6%)	684 (48.6%)	611 (43.4%)	771 (35.4%)	135 (17.5%)	122 (15.8%)	76	38 (50.0%)	15 (39.5%)	13 (34.2%)	13 (34.2%)	13 (34.2%)
Homosexual	96	72 (75.0%)	33 (45.8%)	30 (41.7%)	24 (25.0%)	7 (29.2%)	4 (16.7%)	96	175 (41.8%)	96 (18.6%)	14 (14.6%)	12 (12.5%)	12 (12.5%)
Race ^b													
Black	515	419 (81.4%)	193 (46.1%)	175 (41.8%)	96 (18.6%)	14 (14.6%)	12 (12.5%)	165	72 (43.6%)	93 (56.4%)	11 (11.8%)	13 (14.0%)	13 (14.0%)
AAPI	165	72 (43.6%)	29 (40.3%)	27 (37.5%)	93 (56.4%)	11 (11.8%)	13 (14.0%)	1547	951 (61.5%)	596 (38.5%)	117 (19.6%)	107 (18.0%)	107 (18.0%)
White	1547	951 (61.5%)	472 (49.6%)	421 (44.3%)	596 (38.5%)	117 (19.6%)	107 (18.0%)	135	87 (64.4%)	48 (35.6%)	14 (29.2%)	7 (14.6%)	7 (14.6%)
More than one race/other	135	87 (64.4%)	46 (52.9%)	43 (49.4%)	48 (35.6%)	14 (29.2%)	7 (14.6%)	Ethnicity ^c					
Non-Hispanic	2194	1421 (64.8%)	686 (48.3%)	615 (43.3%)	773 (35.2%)	140 (18.1%)	125 (16.2%)	186	119 (64.0%)	67 (36.0%)	16 (23.9%)	14 (20.9%)	14 (20.9%)
Hispanic	186	119 (64.0%)	57 (47.9%)	52 (43.7%)	67 (36.0%)	16 (23.9%)	14 (20.9%)	Nativity					
US-born	2206	1449 (65.7%)	718 (49.6%)	643 (44.4%)	757 (34.3%)	151 (20.0%)	133 (17.6%)	191	103 (53.9%)	88 (46.1%)	8 (9.1%)	8 (9.1%)	8 (9.1%)
Foreign-born	191	103 (53.9%)	32 (31.1%)	29 (28.2%)	88 (46.1%)	8 (9.1%)	8 (9.1%)	Highest parental education ^d					
<Bachelor's degree	1074	790 (73.6%)	346 (43.8%)	318 (40.3%)	284 (26.4%)	37 (13.0%)	35 (12.3%)	≥Bachelor's degree					
≥Bachelor's degree	1295	747 (57.7%)	401 (53.7%)	348 (46.6%)	548 (42.3%)	119 (21.7%)	105 (19.2%)	School type					
Private	1072	626 (58.4%)	351 (56.1%)	311 (49.9%)	446 (41.6%)	110 (24.7%)	98 (22.0%)	HPV vaccine recommendation					
Public	674	381 (56.5%)	179 (47.0%)	160 (42.0%)	293 (43.5%)	37 (12.6%)	36 (12.3%)	by a doctor					
Technical	397	321 (80.9%)	120 (37.4%)	107 (33.3%)	76 (19.1%)	7 (9.2%)	5 (6.6%)	No					
HBCU	254	224 (88.2%)	100 (44.6%)	94 (42.0%)	30 (11.8%)	5 (16.7%)	2 (6.7%)	Do not know					
HPV vaccine recommendation by a doctor								Yes					
No	1111	575 (51.8%)		82 (14.3%)	536 (48.2%)		23 (4.3%)						
Do not know	377	227 (60.2%)		22 (9.7%)	150 (39.8%)		6 (4.0%)						
Yes	909	750 (82.5%)		568 (75.7%)	159 (17.5%)		112 (70.4%)						

^aData are missing for 46 participants.

^bData are missing for 35 participants.

^cData are missing for 17 participants.

^dData are missing for 28 participants.

Table II. Health beliefs and behaviors of female and male students in the sample

	Total sample	Women		Women: HPV vaccine recommendation receipt		Men		Men: HPV vaccine recommendation receipt	
		<i>n</i> (% of category in the total sample) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category in the total sample) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	<i>n</i> (% of category among women) or <i>M</i> (SD)	
Perceived susceptibility to HPV									
Not at all or a little	2121	1347 (63.5%)	635 (47.1%)	587 (43.6%)	774 (36.5%)	150 (19.4%)	135 (17.4%)		
Somewhat or very	276	205 (74.3%)	115 (56.1%)	85 (41.5%)	71 (25.7%)	9 (12.7%)	6 (8.5%)		
Perceived seriousness of HPV									
Not at all or a little	525	260 (49.5%)	92 (35.4%)	72 (27.7%)	265 (50.1%)	38 (14.3%)	31 (11.7%)		
Somewhat or very	1872	1292 (69.0%)	658 (50.9%)	600 (46.4%)	580 (31.0%)	121 (20.9%)	110 (19.0%)		
Perceived effectiveness of HPV vaccine									
Not at all or little	528	362 (68.6%)	126 (34.8%)	87 (24.0%)	166 (31.4%)	13 (7.8%)	6 (3.6%)		
Somewhat or very	1869	1190 (63.7%)	624 (52.4%)	585 (49.2%)	679 (36.3%)	146 (21.5%)	135 (19.9%)		
Meningitis vaccine receipt									
No	322	232 (72.0%)	76 (32.8%)	51 (22.0%)	90 (28.0%)	7 (7.8%)	7 (7.8%)		
Do not know	632	391 (61.9%)	115 (29.4%)	99 (25.3%)	241 (38.1%)	21 (8.7%)	21 (8.7%)		
Yes	1443	929 (64.4%)	559 (60.2%)	522 (56.2%)	514 (35.6%)	131 (25.5%)	113 (22.0%)		
Tdap vaccine receipt									
No	284	204 (71.8%)	69 (33.8%)	51 (25.0%)	80 (28.2%)	8 (10.0%)	9 (11.3%)		
Do not know	653	417 (63.9%)	142 (34.1%)	119 (28.5%)	236 (36.1%)	27 (11.4%)	29 (12.3%)		
Yes	1460	931 (63.8%)	539 (57.9%)	502 (53.9%)	529 (36.2%)	124 (23.4%)	103 (19.5%)		
Ever cigarette smoker									
No	1280	862 (67.3%)	408 (47.3%)	341 (39.6%)	418 (32.7%)	65 (15.6%)	60 (14.4%)		
Yes	1117	690 (61.8%)	342 (49.6%)	331 (47.7%)	427 (38.2%)	94 (22.0%)	81 (19.0%)		

Table III. Multivariable predictors of recommendation and initiation of HPV vaccine among female ($n = 1552$) and male ($n = 845$) college students

	Women: HPV vaccine recommendation receipt aOR (95% CI)	Women: HPV vaccine initiation aOR (95% CI)	Men: HPV vaccine recommendation receipt aOR (95% CI)	Men: HPV vaccine initiation aOR (95% CI)
Age	1.2 (1.2–1.3)	1.1 (1.1–1.2)	0.8 (0.7–0.9)	0.97 (0.8–1.1)
Sexual orientation				
Heterosexual	Reference	Reference	Reference	Reference
Homosexual	1.5 (0.8–3.1)	1.1 (0.5–2.5)	3.8 (1.8–7.7)	1.5 (0.5–4.2)
Bisexual	1.01 (0.6–1.7)	0.96 (0.5–1.8)	1.6 (0.6–4.3)	0.6 (0.1–2.7)
Race				
White	Reference	Reference	Reference	Reference
Black	1.2 (0.9–1.6)	0.91 (0.6–1.4)	1.00 (0.5–2.1)	1.4 (0.5–3.7)
AAPI	0.8 (0.4–1.4)	1.01 (0.5–2.2)	0.5 (0.2–1.1)	1.4 (0.5–3.6)
More than one race/other	1.2 (0.7–1.9)	1.2 (0.6–2.2)	1.8 (0.8–3.8)	0.4 (0.1–0.99)
Ethnicity				
Non-Hispanic	Reference	Reference	Reference	Reference
Hispanic	1.1 (0.7–1.7)	1.1 (0.6–2.0)	1.3 (0.6–2.5)	1.7 (0.6–4.6)
Nativity				
US-born	Reference	Reference	Reference	Reference
Foreign-born	0.4 (0.2–0.7)	0.6 (0.3–1.2)	0.5 (0.2–1.2)	0.6 (0.2–1.9)
Highest parental education				
< Bachelor's degree	Reference	Reference	Reference	Reference
≥ Bachelor's degree	1.3 (1.03–1.6)	0.96 (0.7–1.3)	1.5 (0.93–2.3)	0.95 (0.5–1.8)
School type				
Private	Reference	Reference	Reference	Reference
Public	0.6 (0.5–0.8)	0.9 (0.6–1.2)	0.4 (0.3–0.7)	0.8 (0.4–1.4)
Technical	0.4 (0.3–0.6)	0.6 (0.4–0.9)	0.4 (0.1–0.90)	0.4 (0.1–1.5)
HBCU	0.5 (0.3–0.8)	0.9 (0.5–1.6)	0.6 (0.2–2.0)	0.2 (0.03–1.6)
HPV vaccine recommendation by a doctor				
No or do not know	Reference	Reference	Reference	Reference
Yes	19.2 (14.5–25.3)	19.2 (14.5–25.3)	54.0 (31.2–93.4)	54.0 (31.2–93.4)

CI = [1.2–1.3], $P < 0.001$) and higher parental education (OR = 1.3, CI = [1.03–1.7], $P = 0.02$) were significant predictors of doctor's recommendation. Women born abroad had lower odds of doctor's recommendation (OR = 0.4, CI = [0.2–0.7], $P < 0.001$). Compared with women attending private schools, women attending state universities (OR = 0.6, CI = [0.5–0.8], $P = 0.002$), technical colleges (OR = 0.4, CI = [0.3–0.6], $P < 0.001$) and HBCU (OR = 0.5, CI = [0.3–0.8], $P = 0.003$) all had lower odds of doctor's recommendation.

Among men, younger age (OR = 0.8, CI = [0.7–0.9], $P < 0.001$) was a predictor of receiving a doctor's recommendation. Compared with heterosexual men, homosexual men had higher odds of doctor's recommendation (OR = 3.8, CI = [1.8–7.8], $P = 0.01$). Compared with men attending private schools, men attending state (OR = 0.4, CI = [0.3–0.7], $P < 0.001$) and technical schools (OR = 0.4, CI = [0.1–0.9], $P = 0.03$) all had lower odds of doctor's recommendation.

HPV vaccine initiation

Among women, 43.3% ($n = 672$) reported having initiated the HPV vaccine series; among men, 16.7% ($n = 141$) reported having initiated the HPV vaccine series. Bivariate analyses (Appendix B) found that among both sexes, the correlates included: US-born, higher parental education, private schools, receiving doctor's recommendation for HPV vaccine, higher perceived seriousness of HPV, higher perceived effectiveness of HPV vaccine, receipt of meningitis vaccine and receipt of Tdap vaccine. Additional correlates for vaccine initiation among women were older age and smoking cigarettes, while for men, those were younger age and being homosexual.

Multivariable logistic regressions (Table III) show that among women, older age (OR = 1.1, CI = [1.1–1.2], $P = 0.001$) was a predictor of initiation of HPV vaccine. Women attending technical colleges (OR = 0.6, CI = [0.4–0.9], $P = 0.03$) had lower odds of initiation of HPV vaccine. Among men, those of 'more than one/other' race (OR = 0.3, CI = [0.1–0.99], $P = 0.05$) had lower odds of

initiation of HPV vaccine. For both sexes, receiving a doctor's recommendation was associated with higher odds of initiation of HPV vaccine (for women: OR = 19.2, CI = [14.6–25.3], $P < 0.001$; for men: OR = 54.0, CI = [31.2–93.4], $P < 0.001$).

Reasons underlying HPV vaccine behaviors

Among women, 85.6% of initiators and 37.1% of the sample ($n = 575$), and among men, 81.6% of initiators and 13.6% of the sample ($n = 115$) completed the three-dose series. Among those who had not started the HPV vaccine, only 10.3% ($n = 60$) of women and 7.1% of men ($n = 31$) planned to get the HPV vaccine in the future (not shown in tables).

Table IV ranks reasons for (i) initiating HPV vaccine, (ii) having initiated but not completed HPV vaccine and (iii) not starting the HPV vaccine series among female and male students. Among women and men who had initiated the HPV vaccine series, receiving a doctor's recommendation and parental recommendation were common reasons. For those who had started but not completed the series, scheduling inconvenience and forgetfulness were the most common reasons. A lack of doctor's recommendation and being sexually inactive were common reasons for not initiating the vaccine for both women and men. Among women, additional common reasons for not initiating the vaccine included safety concerns as well as a doctor's advice that the vaccine was not necessary.

Discussion

This study of racially/ethnically diverse young adult college students in Georgia identified several contextual and HBM-related factors associated with HPV vaccine recommendation and initiation. Of particular note, there were low levels of vaccine initiation (43.3% for women and 16.7% for men). Past National Immunization Survey—Teen data show that for those with the same average age as our participants, the nationwide vaccine initiation rates should be between 46.0% and 62.8% for women [35–37]. Additionally, an analysis from the NCHA

Table IV. Common reasons (rank order) underlying HPV vaccine behaviors among men and women^a

Common reasons for initiation of HPV vaccine	
Women (<i>n</i> = 672)	My doctor recommended it (92.0%, <i>n</i> = 618) My parents recommended it (40.12%, <i>n</i> = 270)
Men (<i>n</i> = 141)	My doctor recommended it (87.9%, <i>n</i> = 124) My parents recommended it (32.6%, <i>n</i> = 46)
Common reasons for initiating but not completing three doses of HPV vaccine ^b	
Women (<i>n</i> = 97)	I forgot to finish the series (33.0%, <i>n</i> = 32) It was inconvenient to schedule additional visits (24.7%, <i>n</i> = 24) No access to a doctor to complete the series (13.4%, <i>n</i> = 13) My family members discouraged vaccination (11.3%, <i>n</i> = 11) Started the series too recently to finish (10.3%, <i>n</i> = 10)
Men (<i>n</i> = 26)	It was inconvenient to schedule additional visits (30.8%, <i>n</i> = 8) I forgot to finish the series (26.9%, <i>n</i> = 7) Started the series too recently to finish (23.1%, <i>n</i> = 6) Didn't know I needed more than 1 dose (15.3%, <i>n</i> = 4)
Common reasons for not yet initiating HPV vaccination ^c	
Women (<i>n</i> = 580)	Doctor never recommended HPV vaccine (36.3%, <i>n</i> = 211) I am not sexually active (24.1%, <i>n</i> = 240) Doctor indicated that HPV vaccine was optional or not necessary (20.7%, <i>n</i> = 120) I don't think the vaccine is safe (15.5%, <i>n</i> = 90) I didn't want to have to commit to having three shots for the vaccination (12.4%, <i>n</i> = 72) My family members discouraged vaccination (12.1%, <i>n</i> = 70)
Men (<i>n</i> = 442)	Doctor never recommended HPV vaccine (60.4%, <i>n</i> = 267) I am not sexually active (19.9%, <i>n</i> = 88) Doctor indicated that HPV vaccine was optional or not necessary (12.0%, <i>n</i> = 53)

^aCategories of reasons are not mutually exclusive. Refer to the Methods section for additional information on response options for reasons underlying HPV vaccine behaviors.

^bParticipants were asked about reasons for not yet completing HPV vaccination only if they indicated 'No' when asked about whether they have finished the HPV vaccine series. Those who indicated 'Don't know' (*n* = 23 for women and *n* = 12 for men) were not asked.

^cParticipants were asked about reasons for not yet initiating HPV vaccination only if they indicated 'No' when asked about whether they have gotten any HPV vaccine shot. Those who indicated 'Don't know' (*n* = 300 for women and *n* = 262 for men) were not asked.

II data in Fall 2013 reported vaccine uptake rates of 68.9% for female and 42.9% for male students [9].

On the basis of such data, students in our sample appeared to have lower initiation rates compared with nationwide adults of the same age group as well as other college students. The lower rates could be partly due to the context of students' geographical locations. Georgia currently lags behind in terms of HPV vaccination rates for adolescents (ranked 30th for girls and 19th for boys nationwide) [38]. There are limited school-based vaccination programs and limited concerted college-based efforts for vaccination in Georgia, and HPV vaccination is primarily opportunistic in primary care practices and public health clinics.

The HBM-related constructs of perceived seriousness of HPV and perceived vaccine effectiveness were correlates of vaccine initiation. Research among diverse populations has also highlighted associations between vaccine initiation or acceptability and perceived HPV severity and effectiveness of HPV vaccine [39–42]. Thus, these constructs are important short-term outcomes for interventions. Additionally, students had low perceptions of disease susceptibility and high perceptions of severity. Research has explored how the framing of HPV vaccine emphasizes the cancer prevention narrative over the discussion of protection against HPV infection [43, 44], which may explain these findings. We note, however, that due to the cross-sectional nature

of our data, we could not assess temporality (i.e. perceptions at the time of vaccine initiation).

Sexual inactivity was a common reason for not initiating the vaccine for both women and men. Therefore, interventions should emphasize how given the preventive nature of the vaccine, it needs to be administered prior to exposure to HPV (e.g. sexual activity), and that getting the vaccine when one is not sexually active is actually the best strategy. Moreover, it should also be highlighted that sexual activity is not the only possible source of exposure to HPV, as there are non-sexual and non-penetrative sources of HPV transmission [45].

We also highlight the importance of an interpersonal-level influence—a doctor’s recommendation—for HPV vaccine initiation for both sexes, which is consistent with previous literature [20–24]. Moreover, our sample had higher completion rates for Tdap and meningitis vaccines compared with HPV vaccine, despite the fact that all three vaccines are recommended to adolescents starting at the age of 11 or 12 [46]. Currently, more states require Tdap and meningitis vaccines for school entry compared with HPV vaccine requirements, which may account for this finding [47, 48]. It also suggests that, possibly, even though students had had medical encounters where they were able to receive vaccines, Tdap and meningitis vaccines were prioritized over HPV vaccine. Thus, providers need to communicate strong and consistent recommendation for HPV vaccine for those eligible at every medical encounter.

Efforts to increase vaccination rates should concentrate on understanding and overcoming barriers in provider communication about HPV vaccination. Using the SEM perspective, barriers can include those related to the provider’s characteristics, for instance, confidence in discussing the HPV vaccine and sexual health [49]. In such cases, it should be emphasized that HPV vaccination has been shown to provide protection against cervical cancer for up to 12 years post-vaccination [50], which highlights the need for vaccinating adolescents to provide protection into adulthood, and which may allay providers’ fears about vaccinating adolescents too early and facilitate communication about vaccine effectiveness. Training providers to use presumptive

‘announcements’ for vaccination (i.e. using provider-driven conversation where providers assume that parents are ready to get the HPV vaccination for their children) has also been documented to be effective [51]. Additionally, researchers can also focus on patient–provider communication barriers that have been identified at the policy- or clinic-level, such as perceived complexity in vaccine guidelines, time constraints or scheduling issues [52]. Moreover, as scheduling inconvenience and forgetfulness were common reasons for HPV vaccine incompleteness among those who had started the series, interventions should focus on methods to make HPV vaccine delivery more convenient (i.e. onsite college health services) and arrange provider and/or patient reminders.

We identified subgroups that were less likely to have received a doctor’s recommendation, such as women born abroad, women with lower parental education, women who did not attend private schools and men attending state schools or technical colleges (compared with men attending private schools). Contrary to previous reports [9, 12, 13], we did not find racial/ethnic disparities in HPV vaccine recommendation and initiation for women, and we only found lower odds of HPV vaccine initiation for men who identified as ‘more than one/other’ race. Furthermore, it appears that women attending technical colleges had lower odds of vaccine initiation compared with those attending private schools.

For women born abroad, different national vaccine guidelines and, possibly, limited access to preventive care [53] may explain our finding. Parental education and type of school were associated with a doctor’s recommendation, which points to possible socio-economic disparities in patient–provider communication about HPV vaccine and should be further investigated. The lower rates of HPV vaccine initiation among women attending technical colleges could point to disparities in healthcare resources in general and HPV vaccine resources in particular on technical college campuses. Although college students with insurance could generally access the HPV vaccine for low costs or for free, there is variability in terms of services that college health campuses in Georgia offer [unpublished].

Currently, no technical colleges in the Georgia system have on-campus health centers. In addition, students attending technical colleges may have lower socio-economic status compared with traditional university students and/or students at private universities, which may also partly explain this finding. Future research should examine these associations more closely.

Limitations

The limitations of the study include the cross-sectional nature of our data. We also rely on self-reports for receipts of vaccine recommendation and initiation, which may be subject to social desirability and recall bias [54], and may have biased our estimates. Although we did not consider multilevel modeling (students nested in colleges/universities) to examine how much variance in the outcome is explained by student-level versus school-level characteristics, future research can consider this method. We did not examine associations between HPV vaccine recommendation and initiation and sexual behaviors, due to not having data on the temporal relationships between these variables.

The generalizability of findings is restricted because our sample was drawn from young adult college students in Georgia. Additionally, although we used the SEM and HBM to guide the development of constructs and measurements, there could potentially be additional important factors or theoretical constructs that are relevant to the outcomes (e.g. policy-level variables in the SEM). As we mostly focused on interpersonal-level influences in terms of reasons for HPV vaccine initiation, we may have left out other factors across the SEM that may influence HPV vaccine initiation. Furthermore, each HBM construct was also examined with only one item in our study. Future research can consider incorporate multi-item scales to further assess the role of these constructs.

Conclusions

College campuses can offer opportunities for those eligible for HPV catch-up vaccination to initiate and

complete the vaccine. In particular, today's college students are tomorrow's parents who will make decisions about vaccines for their children. Therefore, college years are a prime time to promote the importance of HPV vaccination as well as addressing any hesitance or concerns around HPV vaccine safety. Our study highlights the need for HPV vaccine promotion for students, significant predictors of HPV vaccine recommendation and initiation, and key reasons underlying HPV vaccination behaviors. Interventions should focus on improving patient-provider communication around HPV vaccine to college students. Future studies should investigate associations between nativity, race, and socio-economic status with HPV vaccine recommendation and initiation. Perception of disease seriousness, HPV vaccine effectiveness and the lack of HPV vaccine initiation due to sexual inactivity should also be explored in depth.

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Conflict of interest statement

None declared.

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- ### Appendix A. Selected HPV vaccine-related questions used in the study
-
- ALL
 1. Have you received the Tdap (tetanus, diphtheria, pertussis) vaccine?
 - Yes
 - No
 - Don’t know
 - ALL
 2. Have you received the meningococcal (also called meningitis) vaccine?
 - Yes
 - No
 - Don’t know
 - ALL
 3. Has a doctor or other healthcare provider ever told you that you have HPV?
 - Yes
 - No
 - Don’t know
-

- Refuse

4. Have you had a physician recommend that you receive the HPV vaccine?

- Yes
- No
- Don't know

ALL

5. Have you received any doses of the HPV vaccine?

- Yes
- No
- Don't know

QUESTIONS 6 AND 7 APPEAR IF THE ANSWER TO QUESTION 5 IS YES.

6. Please tell us why you received the HPV vaccination: (choose all that apply)

- My doctor recommended it
- My parents recommended it
- My significant other recommended it
- My friends talked about getting the vaccination
- My friends talked about having HPV
- Other (please specify):

7. Have you completed the three-dose HPV vaccine series?

- Yes
- No
- Don't know

QUESTION 8 APPEARS IF THE ANSWER TO QUESTION 7 IS NO.

8. Please tell us why you have not completed the series: (choose all that apply)

- Started the series too recently to finish
- Didn't know I needed more than 1 dose
- Too expensive
- No access to a doctor to complete the series
- Doctor didn't tell me I needed to come back for more doses

- I had a bad side effect and stopped the series
- I know someone who had a bad side effect
- My significant other discouraged vaccination
- My family members discouraged vaccination
- My friend(s) discouraged vaccination
- It was inconvenient to schedule additional visits
- I forgot to finish the series
- Other (please specify):

QUESTIONS 9 AND 10 APPEAR IF THE ANSWER TO QUESTION 5 IS NO.

9. Do you intend to get the HPV vaccine?

- Yes
- No
- Don't know

10. Please tell us why you have not received any HPV vaccine doses: (choose all that apply)

- Doctor never recommended HPV vaccine
- Doctor indicated that HPV vaccine was optional or not necessary
- Too expensive
- It is against my religious beliefs to get HPV vaccine
- It is against my religious beliefs to get any vaccines
- I know someone who had a bad side effect
- My significant other discouraged vaccination
- My family members discouraged vaccination
- My friend(s) discouraged vaccination
- I do not think HPV-related diseases are serious
- I am not sexually active
- I don't think the vaccine is safe
- I didn't want to have to commit to having three shots for the vaccination
- Other (please specify):

ALL

11. How likely do you think you are to get HPV?

- Not at all
- A little
- Somewhat
- Very

ALL

12. How harmful to your health do you think HPV is?

- Not at all
- A little
- Somewhat
- Very

ALL

13. How effective do you think the HPV vaccine is for preventing HPV?

- Not at all
- A little
- Somewhat
- Very

Appendix B. Bivariate analyses of relationships between socio-demographic characteristics, health beliefs, behaviors, and HPV vaccine recommendation and initiation among female students (*n* = 1552)

	HPV vaccine recommendation (No) <i>n</i> (%) or <i>M</i> (SD)	HPV vaccine recommendation (Yes) <i>n</i> (%) or <i>M</i> (SD)	<i>P</i>	HPV vaccine initiation (No) <i>n</i> (%) or <i>M</i> (SD)	HPV vaccine initiation (Yes) <i>n</i> (%) or <i>M</i> (SD)	<i>P</i>
Age (at Wave 6)	22.2 (1.8)	22.8 (1.9)	<0.001	22.2 (1.8)	22.8 (1.9)	<0.001
Sexual orientation ^a			0.64			0.84
Heterosexual	724 (51.4%)	684 (48.6%)		797 (56.6%)	611 (43.4%)	
Homosexual	17 (44.7%)	21 (55.3%)		20 (52.6%)	18 (47.4%)	
Bisexual	39 (54.2%)	33 (45.8%)	0.25	42 (58.33%)	30 (41.7%)	
Race ^b						
Black	226 (53.9%)	193 (46.1%)		244 (58.2%)	175 (41.8%)	0.39
A-API	43 (59.7%)	29 (40.3%)		45 (62.5%)	27 (37.5%)	
White	479 (50.4%)	472 (49.6%)		530 (55.7%)	421 (44.3%)	
More than one race/other	41 (47.1%)	46 (52.9%)	0.94	44 (50.6%)	43 (49.4%)	0.93
Ethnicity ^c						
Non-Hispanic	735 (51.7%)	686 (48.3%)		806 (56.7%)	615 (43.3%)	
Hispanic	62 (52.1%)	57 (47.9%)	<0.001	67 (56.3%)	52 (43.7%)	0.001
Nativity						
US-born	731 (50.4%)	718 (49.6%)		806 (55.6%)	643 (44.4%)	
Foreign-born	71 (68.9%)	32 (31.1%)	<0.001	74 (71.8%)	29 (28.2%)	0.01
Highest parental education ^d						
< Bachelor's degree	444 (56.2%)	346 (43.8%)	<0.001	472 (59.8%)	318 (40.3%)	<0.001
≥ Bachelor's degree	346 (46.3%)	401 (53.7%)		399 (53.4%)	348 (46.6%)	
School type						
Private	275 (43.9%)	351 (56.1%)	<0.001	315 (50.3%)	311 (49.9%)	<0.001
Public	202 (53.0%)	179 (47.0%)		221 (58.0%)	160 (42.0%)	
Technical	201 (62.6%)	120 (37.4%)		214 (66.7%)	107 (33.3%)	
HBCU	124 (55.4%)	100 (44.6%)		130 (58.0%)	94 (42.0%)	
HPV vaccine recommendation by a doctor						
No				493 (85.7%)	82 (14.3%)	<0.001
Do not know				205 (90.3%)	22 (9.7%)	
Yes				182 (24.3%)	568 (75.7%)	

(continued)

Table B1. *Continued*

	HPV vaccine recommendation (No) <i>n</i> (%) or <i>M</i> (SD)	HPV vaccine recommendation (Yes) <i>n</i> (%) or <i>M</i> (SD)	<i>P</i>	HPV vaccine initiation (No) <i>n</i> (%) or <i>M</i> (SD)	HPV vaccine initiation (Yes) <i>n</i> (%) or <i>M</i> (SD)	<i>P</i>
Perceived susceptibility to HPV						
Not at all or a little	712 (52.9%)	635 (47.1%)	0.02	760 (56.4%)	587 (43.6%)	0.57
Somewhat or very	90 (43.9%)	115 (56.1%)		120 (58.5%)	85 (41.5%)	
Perceived seriousness of HPV						
Not at all or a little	168 (64.6%)	92 (35.4%)	<0.001	188 (72.3%)	72 (27.7%)	<0.001
Somewhat or very	634 (49.1%)	658 (50.9%)		692 (53.6%)	600 (46.4%)	
Perceived effectiveness of HPV vaccine						
Not at all or little	236 (65.2%)	126 (34.8%)	<0.001	275 (76.0%)	87 (24.0%)	<0.001
Somewhat or very	566 (47.6%)	624 (52.4%)		605 (50.8%)	585 (49.2%)	
Meningitis vaccine receipt						
No	156 (67.2%)	76 (32.8%)	<0.001	181 (78.0%)	51 (22.0%)	<0.001
Do not know	276 (70.6%)	115 (29.4%)		292 (74.7%)	99 (25.3%)	
Yes	370 (39.8%)	559 (60.2%)		407 (43.8%)	522 (56.2%)	
Tdap vaccine receipt						
No	135 (66.2%)	69 (33.8%)	<0.001	153 (75.0%)	51 (25.0%)	<0.001
Do not know	275 (66.0%)	142 (34.1%)		298 (71.5%)	119 (28.5%)	
Yes	392 (42.1%)	539 (57.9%)		429 (46.1%)	502 (53.9%)	
Ever cigarette smoker						
No	454 (52.7%)	408 (47.3%)	0.38	521 (60.4%)	341 (39.6%)	<0.001
Yes	348 (50.4%)	342 (49.6%)		359 (52.0%)	331 (47.7%)	

^aData are missing for 34 participants.

^bData are missing for 23 participants.

^cData are missing for 12 participants.

^dData are missing for 15 participants.

Table B11. Bivariate analyses of relationships between socio-demographic characteristics, health beliefs, behaviors, and HPV vaccine recommendation and initiation among male students (*n* = 845)

	HPV vaccine recommendation (No)	HPV vaccine recommendation (Yes)	<i>P</i>	HPV vaccine initiation (No)	HPV vaccine initiation (Yes)	<i>P</i>
	<i>n</i> (%) or <i>M</i> (SD)	<i>n</i> (%) or <i>M</i> (SD)		<i>n</i> (%) or <i>M</i> (SD)	<i>n</i> (%) or <i>M</i> (SD)	
Age (at Wave 6)	22.6 (2.0)	21.9 (1.8)	<0.001	22.6 (2.0)	22.0 (1.9)	0.002
Sexual orientation ^a			0.001			0.01
Heterosexual	636 (82.5%)	135 (17.5%)		649 (84.2%)	122 (15.8%)	
Homosexual	23 (60.5%)	15 (39.5%)		25 (65.8%)	13 (34.2%)	
Bisexual	17 (70.8%)	7 (29.2%)		20 (83.3%)	4 (16.7%)	
Race ^b			0.05			0.47
Black	82 (85.4%)	14 (14.6%)		84 (87.5%)	12 (12.5%)	
AAPI	82 (88.2%)	11 (11.8%)		80 (86.0%)	13 (14.0%)	
White	479 (80.4%)	117 (19.6%)		489 (82.1%)	107 (18.0%)	
More than one race/other	34 (70.8%)	14 (29.2%)		41 (85.4%)	7 (14.6%)	
Ethnicity ^c			0.24			0.32
Non-Hispanic	633 (81.9%)	140 (18.1%)		648 (83.8%)	125 (16.2%)	
Hispanic	51 (76.1%)	16 (23.9%)		53 (79.1%)	14 (20.9%)	
Nativity			0.01			0.04
US-born	606 (80.1%)	151 (20.0%)		624 (82.4%)	133 (17.6%)	
Foreign-born	80 (90.9%)	8 (9.1%)		80 (90.9%)	8 (9.1%)	
Highest parental education ^d			0.002			0.01
<Bachelor's degree	247 (87.0%)	37 (13.0%)		249 (87.7%)	35 (12.3%)	
≥Bachelor's degree	429 (78.3%)	119 (21.7%)		443 (80.8%)	105 (19.2%)	
School type			<0.001			<0.001
Private	336 (75.3%)	110 (24.7%)		348 (78.0%)	98 (22.0%)	
Public	256 (87.4%)	37 (12.6%)		257 (87.7%)	36 (12.3%)	
Technical	69 (90.8%)	7 (9.2%)		71 (93.4%)	5 (6.6%)	
HBCU	25 (83.3%)	5 (16.7%)		28 (93.3%)	2 (6.7%)	
HPV vaccine recommendation by a doctor						<0.001
No						
Do not know						
Yes						
No						
Do not know						
Yes						
Perceived susceptibility to HPV			0.17			0.05
Not at all or a little	624 (80.6%)	150 (19.4%)		639 (82.6%)	135 (17.4%)	
Somewhat or very	62 (87.3%)	9 (12.7%)		65 (91.6%)	6 (8.5%)	
Perceived seriousness of HPV			0.02			0.01
Not at all or a little	227 (85.7%)	38 (14.3%)		234 (88.3%)	31 (11.7%)	
Somewhat or very	459 (79.1%)	121 (20.9%)		470 (81.0%)	110 (19.0%)	

(continued)

Table B11. *Continued*

	HPV vaccine recommendation (No)	HPV vaccine recommendation (Yes)	<i>P</i>	HPV vaccine initiation (No)	HPV vaccine initiation (Yes)	<i>P</i>
Perceived effectiveness of HPV vaccine						
Not at all or little	153 (92.2%)	13 (7.8%)	<0.001	160 (96.4%)	6 (3.6%)	<0.001
Somewhat or very	533 (78.5%)	146 (21.5%)	<0.001	544 (80.1%)	135 (19.9%)	<0.001
Meningitis vaccine receipt						
No	83 (92.2%)	7 (7.8%)	<0.001	83 (92.2%)	7 (7.8%)	<0.001
Do not know	220 (91.3%)	21 (8.7%)	<0.001	220 (91.3%)	21 (8.7%)	<0.001
Yes	383 (74.5%)	131 (25.5%)	<0.001	401 (78.0%)	113 (22.0%)	<0.001
Tdap vaccine receipt						
No	72 (90.0%)	8 (10.0%)	<0.001	71 (88.8%)	9 (11.3%)	0.02
Do not know	209 (88.6%)	27 (11.4%)	<0.001	207 (87.7%)	29 (12.3%)	0.07
Yes	405 (76.6%)	124 (23.4%)	<0.001	426 (80.5%)	103 (19.5%)	0.07
Ever cigarette smoker						
No	353 (84.5%)	65 (15.6%)	0.02	358 (85.7%)	60 (14.4%)	0.07
Yes	333 (78.0%)	94 (22.0%)	0.02	346 (81.0%)	81 (19.0%)	0.07

^aData are missing for 12 participants.^bData are missing for 12 participants.^cData are missing for five participants.^dData are missing for 13 participants.