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Binge drinking, HIV/HPV co-infection risk, and HIV testing: Factors associated with HPV vaccination among young adults in the United States

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Abstract

Human papillomavirus (HPV) is a common sexually transmitted infection. Binge drinkers often engage in HIV/HPV co-infection high-risk behaviors. We examined the association between binge drinking, HIV/HPV co-infection risk, HIV testing and HPV vaccination among young adults. Data from the 2017 Behavioral Risk Factor Surveillance System survey were examined. Participants (N=430/450,016; 0.11%) were HPV vaccine-eligible young adults ages 18-26 years. Multivariable logistic regression examined the association between binge drinking in the past 30 days, HIV/HPV co-infection high-risk risk behaviors, HIV testing, and HPV vaccination (initiated/completed, unvaccinated) among young adults. Respondents were primarily cisgender (99.8%), non-Hispanic White (41.4%), employed (46.2%) or student (35.4%), and insured (68.2%). Most did not binge drink (55.2%). The majority did not engage in HIV/HPV co-infection high-risk risk behaviors (78.2%). More than one-half had never been tested for HIV (59%) nor vaccinated against HPV (60.6%). Although binge drinkers (44.8%) were significantly more likely to engage in HIV/HPV co-infection high-risk behaviors **(OR=2.1;95%CI:1.0-4.5)**, binge drinking was not positively associated with HIV testing (OR=0.98;95%CI:0.63-1.53). After adjusting for demographics and HIV/HPV co-infection high-risk behaviors, one **(aOR=2.71; 95% CI: 1.11-6.65)** and two

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episodes **(aOR=3.05; 95% CI: 1.26-7.41)** of binge drinking in the past 30 days were significantly associated with HPV vaccination uptake. Positive associations between HPV vaccination and participants having an HIV test in 2017 **(aOR=3.86;95%CI:1.42-10.55)** and before 2017 **(aOR=2.62;95%CI:1.23-5.56)** were also statistically significant. Because young adult binge drinkers are more likely to engage in HIV/HPV co-infection high-risk behaviors, promoting HPV vaccination and HIV testing are important public health objectives.

Keywords

Behavior Risk Factor Surveillance System (BRFSS); Human Papilloma Virus (HPV); Human Immunodeficiency Virus (HIV); HPV Vaccination; Binge drinking; HIV testing; HIV risk behaviors; Alcohol; Young Adults

INTRODUCTION

Annually, the Human Papilloma Virus (HPV) affects approximately 14 million individuals in the United States (U.S.), making it the most prevalent sexually transmitted infection (STI) (Center for Disease Control and Prevention, 2013; Satterwhite et al., 2013). Those between ages 15 to 24, in particular, account for 50% of all new STI cases each year (Markowitz et al., 2014; Shannon & Klausner, 2018). Although majority of HPV-related illnesses are low-grade lesions (e.g. genital warts) or resolve to virus-free, asymptomatic states (Gargano et al., 2017), persistence of oncogenic HPV subtypes in the human epithelium increases the risk for cancer development (Oh et al., 2015). Specifically, persistent infection with high-risk (HR) subtypes of HPV is primarily responsible for the development of cervical cancer (Bosch, Lorincz, Muñoz, Meijer, & Shah, 2002; Oh et al., 2015). Other malignancies associated with persistent HR-HPV include penile (de Sousa, Isaura Danielli Borges et al., 2015), head and neck cancers (Chen, Sun, & Jiang, 2016; Gillison et al., 2000), as well as, anal, vulvar, vaginal cancers (De Vuyst, Clifford, Nascimento, Madeleine, & Franceschi, 2009). These carcinogenic processes occur mostly as a result of the oncogenic proteins E6 and E7 of HR-HPV which include HPV 16 and HPV 18 (Chen et al., 2016). Accordingly, the World Health Organization describes HPV types 16 and 18 as the cause for 70% of cervical cancers (World Health Organization, 2019). Moreover, the occurrence of HPV-related cancers, especially in the oropharynx and anus, continue to rise significantly despite a reduction in cancer mortalities caused by most etiologies (Jemal et al., 2013). Consequently, the HPV vaccine is currently recommended by the Center for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP) as part of the vaccination schedule for boys ages 13 to 21 and girls 11 to 26 years old (Centers for Disease Control and Prevention, 2011).

Alcohol consumption severely impairs normal functioning of the immune system, which is the body's defense mechanism against infectious agents (Cook, 1998; Molina, Happel, Zhang, Kolls, & Nelson, 2010; Szabo, 1997). As a result, acute and/or chronic abuse of alcohol increase susceptibility to and severity of infectious diseases, such as the HPV infection. A prospective U.S. study observed that men who self-reported high levels of alcohol consumption per day had significantly higher prevalence of HPV infections

compared to men who consumed lower levels of alcohol ($P < 0.001$) (Schabath et al., 2015). Additionally, the association between alcohol use and HPV-related endpoints among other study populations (e.g. sexually active college women, uncircumcised Danish men) has been well documented in scientific literature (Ho, Bierman, Beardsley, Chang, & Burk, 1998; Nielsen et al., 2013). What is less frequently examined, however, are the links between alcohol use and HR-HPV *persistence* (Oh et al., 2015). Among the currently published literature, women who recently used alcohol had a higher risk of developing continuous cervical HPV positivity for 3 consecutive years [odds ratio (OR) 2.49, 95% confidence interval (CI) 1.32–4.71] (Oh et al., 2015). Similarly, a 12-year retrospective study found that advanced cancer stage among young patients suffering from oral squamous cell cancers (OSCC), was significantly associated with alcohol consumption, as well as tobacco use ($P=0.001$) (Hellen-Bandeira-de-Pontes Santos et al., 2016).

High-risk sexual behaviors, such as trading sex for money or drugs, engaging in sex with multiple partners and/or without a condom, and unprotected anal intercourse, as well as injection drug use, could potentially lead to acquiring the Human Immunodeficiency Virus (HIV) infection and other STIs (Cooperman, Arnsten, & Klein, 2007; Jenness et al., 2011; Ramirez-Valles, Garcia, Campbell, Diaz, & Heckathorn, 2008). These HIV risk behaviors have been shown to be significantly associated with high-risk drinking behaviors, such as binge drinking (≥ 5 drinks for men, or ≥ 4 drinks for women, on any one occasion in the past 30 days) (Wen, Balluz, & Town, 2012). For instance, 18- to 64-year old binge drinkers are twice as likely to report HIV risky behaviors compared to their non-binge drinking counterparts (Wen et al., 2012). The clustering of these specific risk factors - binge drinking, unsafe sexual practices, and HIV/STI infections - has been thoroughly reported in several scientific studies (Chersich, M. F. et al., 2007; Chersich, Matthew F., Bosire, King'ola, Temmerman, & Luchters, 2014; Chiao, Morisky, Rosenberg, Ksobiech, & Malow, 2006).

Current Investigation

To date, limited research has examined individual-level characteristics associated with HPV vaccine uptake (e.g., female gender and self-reported HIV testing) (Bass, Leader, Shwarz, Greener, & Patterson, 2015). Interestingly, some studies have shown a positive association between binge drinking and HIV testing (Bass et al., 2015); however, little is known about why this association might occur and whether an association exists between binge drinking and HPV vaccination status. The primary objective of our study, therefore, was to examine the association between HPV vaccination uptake and binge drinking among young adults. We also explored among this population the association between HPV vaccination uptake and HIV testing, as well as risky behaviors for HIV/HPV co-infection.

METHODS

Data Source

Secondary data from the 2017 Behavioral Risk Factor Surveillance System (BRFSS) survey were explored. BRFSS is a U.S. population-based interviewer-administered telephone survey that is conducted annually. Data are collected about health-related risk behaviors, chronic health conditions, and use of preventive services. Participants are selected via

random-digit-dialed landline and cell phone numbers and include adults aged 18+ years who reside in the 50 states, District of Columbia (DC), and two U.S. territories (i.e., Guam, Puerto Rico). The 2017 BRFSS includes data that were collected from $N = 450,016$ survey respondents (Centers for Disease Control and Prevention, 2017).

Study Design & Participants

Herein, we explored a subsample of the $N = 450,016$ survey respondents who completed the 2017 BRFSS survey. The subsample for this investigation represented the 430 (0.10%) survey respondents who were heterosexual females aged 18-26 years ($n = 260$), lesbian females aged 18-26 years ($n = 35$), heterosexual males aged 18-21 years ($n = 107$), or gay or bisexual males aged 18-26 years ($n = 28$). These respondents were specifically selected since adult HPV vaccinations are recommended by the ACIP for (a) all females aged 18-26 years, (b) heterosexual males aged 18-21 years, and (c) gay or bisexual males aged 18-26 years (Petrosky et al., 2015).

Variables

HPV vaccination.—Two items were used to measure HPV vaccination. The first question asked whether the participant ever had an HPV vaccination. For participants who had been vaccinated, a follow-up question asked how many doses of the HPV vaccine the participant received. In order to prevent HPV infections and other HPV-related endpoints, including cancers, ACIP recommends that adults and special populations get three doses of the HPV vaccine for maximum effectiveness (Petrosky et al., 2015), although only two doses are recommended for average risk adolescents ages 9 through age 14 years (Meites, 2016). Therefore, we combined these two variables to create a dichotomous HPV vaccination variable with the following levels: unvaccinated (0 doses), initiated (1-2 doses) / completed (3 doses), which is consistent with one of the four ways that the National Immunization Survey measures HPV vaccine coverage (defined as receipt of at least 1 dose) among adolescents (Centers for Disease Control and Prevention, 2015). This HPV vaccination variable was our primary outcome variable of interest.

Binge drinking.—BRFSS used the National Institute on Alcohol Abuse and Alcoholism's (NIAAA) 2004 gender-based definition of binge drinking (i.e., males having five or more drinks on one occasion, females having four or more drinks on one occasion). In the current study, this variable was used as both a continuous variable (i.e., number of days binge drank within the past 30 days) and to create a dichotomous variable (yes/no) establishing whether binge drinking occurred in the last month. We used the continuous variable to create a 4-level ordinal variable by recoding frequency of binge drinking as 0, 1, 2, or 3+ times.

HIV/HPV co-infection high-risk behaviors.—A single item was used to measure risk of acquiring or transmitting HIV infection. This question assessed whether (within the past year) the participant engaged in high-risk HIV infection behaviors, including injection drug use and/or high-risk sexual behaviors (i.e. having a sexually transmitted disease, exchanging sex for money/drugs, and unprotected anal sex). Participants did not have to specify which HIV infection high-risk behavior(s) they engaged in, just whether they had engaged in any of these behaviors within the past year.

HIV testing.—To reduce the spread of HIV, the CDC recommends routine HIV testing among adolescents, adults and pregnant women (Centers for Disease Control and Prevention, 2019). Two items were used to measure HIV testing. First, participants were asked if they had ever had an HIV test. Participants who had an HIV test were next asked the month and year of their last HIV test, which did not include any HIV testing that was done as part of a blood donation. We combined these two variables to create a new variable that distinguished HIV testing that was done in 2017, before 2017, or never.

Covariates.—A composite variable was created by combining sexual orientation, sex, and age to describe the sample based on ACIP's HPV different vaccination eligibility guidelines for heterosexual versus gay or bisexual males. The following four categories were created: (1) heterosexual females aged 18-26 years, (2) lesbian females aged 18-26 years, (3) heterosexual males aged 18-21 years, and (4) gay or bisexual males aged 18-26 years. Other variables that were used to describe the sample characteristics were: gender identity (cisgender, transgender or gender nonconforming), race/ethnicity, marital status, education, occupation, health insurance, smoking status, BMI, and U.S. Census region or territory).

Data Analysis

Stata/SE 15.1 (College Station, Texas, USA) was used to calculate crude and adjusted odds ratios, which were obtained by performing simple and multivariable logistic regression analysis on the weighted BRFSS data. A SVYSET statement was used to account for the complex survey design of the BRFSS data, in which an iterative proportional fitting or raking sampling method is used to weight the data using age, sex, categories of ethnicity, geographic regions within states, marital status, education level, home ownership, and type of phone ownership based on the five-year American Community Survey PUMS data set (2012-2016) (Centers for Disease Control and Prevention, n.d; U.S. Census Bureau, 2019).

HPV vaccination (outcome) was modeled as initiated/completed versus unvaccinated (referent). Our logistic regression model used a 4-level ordinal measure of frequency of binge drinking (referent=0). Covariates were added to the models one-by-one using a forward stepwise process in which only variables that changed the odds ratio for our exposure variable (i.e., binge drinking) by more than 10% were kept in the model as a potential confounder of the relationship between binge drinking and HPV vaccination. Race/ethnicity, geographical location, and health insurance were forced into the model because these are known predictors of HPV vaccination. (Bastani et al., 2011; Pourat & Jones, 2012). The statistical significance of each covariate in the final models was determined based on the 95% confidence intervals not including a value of 1.0, and also a P value < 0.05.

RESULTS

Participants' Demographics

Participants' characteristics and HPV vaccination uptake are represented in Table 1. Respondents were mostly cisgender (99.8%), non-Hispanic White (41.4%), unmarried (74.7%), educated with at least a GED or some college degree (78.9%), insured (68.2%), nonsmoking (71.1%), had neither received the HPV vaccine (60.6%) nor been tested for

HIV in their lifetime (59%). Participants described their sexual orientation as heterosexual females (61.1%), lesbians (7.9%), gay/bisexual males (4.8%) and heterosexual males (26.4%). Almost half of all respondents (44.8%) described having one or more self-reported episodes of binge drinking within the past 30 days; while an estimated 21.8% engaged in high-risk HIV behaviors such as injection drug use, exchange of sex for money/drugs, and unprotected anal sex. Overall, a greater proportion of participants were unvaccinated (61%) compared to those who had initiated (21%) or completed (18%) the HPV vaccine. Fewer than half of those unvaccinated were not binge drinkers (36.2%), did not engage in high-risk HIV behaviors (48.9%), had never been tested for HIV (42.1%), and were unmarried (46.3%).

Predictors of HPV Vaccination Uptake

Table 2 depicts crude odds ratio (OR), adjusted odds ratio (aOR) and predictors for HPV vaccine uptake among participants. After adjusting for age, sex, race/ethnicity, education etc., individuals who identified as Non-Hispanic Multiple race, were significantly more likely to initiate and/or complete HPV vaccination doses than other races/ethnicities **(aOR=5.18;95%CI: 1.13-23.65)**. Concurrently, acquiring “college or higher” education among respondents, was associated with a greater likelihood of HPV vaccine uptake **(aOR=3.96;95%CI: 1.57-9.96)**. On the contrary, heterosexual males **(aOR=0.14;95%CI:0.05-0.62)** and gay/bisexual males (aOR=0.18;95%CI:0.05-0.62) were less likely to have received the HPV vaccine. Participants’ marital status was not found to be significantly associated with HPV vaccination uptake.

In this study, participants’ HIV testing in 2017 (**aOR=3.86;95%CI:1.42-10.55**); before 2017 (a**OR=2.62;95%CI:1.23-5.56**); binge drinking i.e. 1 episode **(aOR=2.71;95%CI:1.11-6.65)** and 2 episodes **(aOR=3.05;95%CI:1.26-7.41)** within 30 days of self-report, were strong predictors for HPV vaccination uptake. HIV risky behavior was not found to be strongly linked with receiving at least one dose of the HPV vaccine. While binge drinking (44.8%) more than doubled the likelihood of participating in HIV risk behaviors **(OR=2.1;95%CI:l.0-4.5)**, it was not found to be predictive participants’ self-report of HIV testing (OR=0.98;95%CI:0.63-1.53).

DISCUSSION

This large-scale population-based study examined HPV vaccine uptake among a subsample of 430 respondents aged 18-26 years residing in 50 states, DC, and two US territories (i.e., Guam, Puerto Rico). Overall, approximately two out of every three respondents had not received the HPV vaccine. In addition, males (both heterosexual and gay) were least likely to be vaccinated. Binge drinking was found to be significantly associated with HIV risk behaviors; while respondents reporting 1 and 2 episodes in the past 30-days were more likely to have initiated or received the HPV vaccine, compared to those engaging in 3 or more episodes of binge drinking.

Despite ACIP’s recommendations for routine use of the quadrivalent HPV vaccine for boys ages 13 to 21 and girls 11 to 26 years old, HPV vaccine uptake remains sub-optimal. For instance, a minority of our sample (39%) reported coverage of at least one dose of HPV

vaccine. Parents' concerns on vaccine safety, belief that adolescents could engage in risky sexual behaviors, financial cost and multiple doctor's visits are some of the reasons responsible for poor vaccine uptake (Holman et al., 2014; Quinn, Vadaparampil, Johns, Alexander, & Giuliano, 2014). Given the high-risk sexual health behaviors reported among individuals aged 15-24 years (Markowitz et al., 2014; Shannon & Klausner, 2018), the college/university represents the ideal setting to promote catch-up vaccinations among a significant proportion of young individuals who have neither completed nor initiated the 3-dose HPV immunization schedule. In addition to relatively low HPV vaccinations rates, almost two-thirds (59%) of study participants stated they had never been tested for HIV in their lifetime. Despite rigorous campaign efforts to mitigate spread of HIV in the U.S., more than a quarter (30%) of new infections are transmitted by individuals oblivious to their HIV infectious state (Skarbinski et al., 2015). Infected individuals who have undergone medical testing to determine their disease state demonstrate lower transmission risk behaviors compared to those with an unknown disease state (Hall, Holtgrave, & Maulsby, 2012). Moreover, higher prevalence of HIV/AIDS diagnosis has been reported among young adults (Rangel, Gavin, Reed, Fowler, & Lee, 2006). Thus, further exploration is warranted on why individuals choose to refrain from getting tested for HIV.

Effective intervention approaches, which incorporate immunization, screening, early diagnosis and effective treatment, are crucial to control and prevent the transmission of HIV and/or HPV infections (Wallace, McLellan-Lemal, Harris, Townsend, & Miller, 2011). Novel strategies, which improve catch-up vaccination rates and increase HIV testing among college students, should be implemented. For instance, schools with mandatory insurance coverage could roll out campaigns outlining access, affordability, and efficacy of vaccinations and screenings to increase adoption rates. Colleges/universities could also promote effective messaging strategies that utilize videos, leaflets, and monthly reminders (Richman, Maddy, Torres, & Goldberg, 2016), as well as, provide disease information and resources on students' health websites (Fontenot, Fantasia, Sutherland, & Lee-St John, 2016).

In this population-based study, heterosexual and gay/bisexual males were less likely to have received the HPV vaccine. This finding is consistent with previous studies which cite low HPV coverage among young men (Reagan-Steiner, 2016). This is disconcerting given that heterosexual (15%) and gay (60%) males, as well as, gay men living with HIV (95%), disproportionately suffer from anogenital HPV infections (Newman, Logie, Doukas, & Asakura, 2013). Concurrently, average lifetime probability of acquiring the HPV infection with at least one sexual partner of the opposite sex in men exceeds that of their female counterparts (Chesson, Dunne, Hariri, & Markowitz, 2014). The prophylactic administration of the HPV vaccine among men is proven to be effective, safe and able to significantly minimize disease burdens occurring from HPV infections (i.e. anogenital warts), as well as, persistent infections and HPV-associated cancers (i.e. oropharyngeal, anal and penile cancers). Conversely, the vaccine is able to control spread of HPV infection from affected men to their respective sexual partners through herd immunity (Centers for Disease Control and Prevention, 2011; Giuliano et al., 2011). Therefore, the implementation of targeted health promotion campaigns may be warranted. Lessons learned from social marketing campaigns designed to increased HIV and STI testing among high-risk groups, such as men

who have sex with men, may be influential in the development and evaluation of these future programs (Guy et al., 2009; Wei et al., 2011; Wilkinson et al., 2016).

Similar to previous investigations (Wen et al., 2012), respondents engaging in binge drinking in the past 30-days were more likely to participate in HIV risk behaviors (i.e. injection drugs use, exchange of sex for money/drugs, and unprotected anal sex). Along with increased HIV risk behaviors, binge drinkers have been found to have elevated blood pressure and cholesterol values (Abramson, Lewis, & Murrah, 2010; Piano, Burke, Kang, & Phillips, 2018; Wellman et al., 2016); increased risk of suicide and self-inflicted harm (Brewer & Swahn, 2005); permanent disabilities and deaths occurring from drunk driving, violence, homicide and other forms of trauma (Courtney & Polich, 2009; Dawson, Li, & Grant, 2008); as well as, reduced cognitive processing and impulse control (Kuntsche, Kuntsche, Thrul, & Gmel, 2017). Among our sample, binge drinkers i.e. having 1 and 2 episodes were more likely to have initiated and/or received the HPV vaccine. Though seemingly counterintuitive, the co-occurrence of HPV vaccine uptake and HIV risky behaviors among binge drinkers has been previously documented in scientific literature (Bednarczyk, Birkhead, Morse, Doleyres, & McNutt, 2011). Additional, more explanatory, research should seek to further explore and unpack this association.

There were a number of limitations in this study that should be considered in unison with our results. Given the secondary nature of our data, these limitations are inherited from the BRFSS survey. Specifically, measurement variables for this study were self-reported. Collecting information on intimate and sensitive topics, such as HIV risk behaviors may be subject to recall bias, response bias, and social desirability bias. Secondly, sample sizes for some sub-categories (i.e., “underweight”) were found to be relatively small and as depicted by wide confidence intervals. Despite this limitation, this study provided strong evidence for other important variables. Additionally, HIV risk behavior was assessed using a single general item, which ultimately may not capture the entire scope of these behaviors. Similarly, the BRFSS does not obtain information on participants’ HIV status, or their intent to initiate or complete the 3-dose HPV vaccination schedule. Nevertheless, this large-scale nationally representative study has provided valid, reliable estimates on HPV, HIV and binge drinking prevalence among young adults aged 18-26 years in the U.S. This study also highlighted key implications for promoting HPV vaccination and HIV testing particularly among at-risk young adult binge drinkers.

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HIGHLIGHTS

- Approximately, two-thirds of respondents had neither been tested for HIV (59%) nor received the HPV vaccine (60.6%).
- Heterosexual **(aOR=0.14;95%CI:0.05-0.62)** and gay/bisexual males **(aOR=0.18;95%CI:0.05-0.62)** less likely to receive vaccine.
- Binge drinkers were more likely to engage in HIV/HPV co-infection high-risk behaviors **(OR=2.1;95%CI:1.0-4.5)**.
- Participant's HIV testing was a strong predictor for HPV vaccination uptake.

Table 1:

HPV Vaccine Uptake among young adults ages 18 to 26 years (N=430), BRFSS 2017

	Total sample (N=430)		Initiated (1-2 doses) *N*=90, 21%		Completed (3 doses) *N*=79, 18%		Unvaccinated (0 doses) *N*=261, 61%	
Characteristics	***n***	***(%)***	***n***	***(%)***	***n***	***(%)***	***n***	***(%)***
No. times binge drinking, past 30 days [a]								
None	237	55.2	39	9.0	43	9.9	155	36.2
1	86	20.2	30	7.0	21	4.8	36	8.4
2	46	10.8	13	2.9	7	1.6	28	6.4
3 or more times	61	13.8	10	2.2	10	2.2	42	9.6
HIV/HPV co-infection risk behavior, past year [b]								
High	96	21.8	26	6.1	18	4.0	52	11.7
Low	334	78.2	64	15.0	61	14.3	209	48.9
Year of most recent HIV test								
2017	53	14.9	17	4.6	12	3.5	24	6.8
Before 2017	117	26.1	35	7.7	30	6.8	52	11.6
Never	260	59.0	39	8.8	36	8.1	185	42.1
Sexual orientation, sex (age, years) [c]								
Heterosexual, female (18-26)	260	61.1	80	18.7	57	13.4	123	29.0
Lesbian, female (18-26)	35	7.9	7	1.5	13	3.0	15	3.4
Heterosexual, male (18-21)	107	26.4	2	0.5	7	1.6	98	24.3
Gay or bisexual, male (18-26)	28	4.8	2	0.4	3	0.5	23	3.9
Gender identity								
Cisgender	428	99.8	90	21.1	79	18.3	259	60.4
Transgender or gender nonconforming	2	0.2	0	0.0	0	0.0	2	0.2
Race/ethnicity								
Non-Hispanic White	220	41.4	57	10.7	33	6.3	130	24.4
Non-Hispanic Black/African American	78	17.7	12	2.7	14	3.1	52	11.9
Non-Hispanic Other	16	3.4	6	1.3	2	0.4	8	1.7
Non-Hispanic Multiple Races	17	3.0	1	0.2	11	1.9	5	0.9
Hispanic	99	34.5	16	6.3	20	6.6	63	21.6
Marital status								
Married	96	25.3	21	5.5	21	5.5	54	14.3
Unmarried	334	74.7	69	15.5	59	12.9	206	46.3
Education								

	Total sample (N=430)		Initiated (1-2 doses) *N*=90, 21%		Completed (3 doses) *N*=79, 18%		Unvaccinated (0 doses) *N*=261, 61%	
Characteristics	***n***	***(%)***	***n***	***(%)***	***n***	***(%)***	***n***	***(%)***
Less than grade 12	26	6.1	2	0.5	4	0.9	20	4.7
Grade 12 or GED	140	32.5	14	3.3	29	6.7	97	22.5
Some college	198	46.4	33	7.8	38	9.0	127	29.7
College or higher	66	15.0	41	9.4	8	1.8	17	3.8
Occupation								
Student	151	35.4	36	8.5	27	6.5	88	20.5
Non-student	279	64.6	55	12.6	51	11.8	173	40.1
Smoking status								
Current smoker	78	21.4	17	4.4	17	4.8	44	12.11
Former smoker	29	7.5	2	0.5	4	1.0	23	6.0
Non-smoker	323	71.1	73	16.1	57	12.5	193	42.4
BMI								
Underweight	16	3.9	2	0.6	10	2.3	4	1.0
Normal	226	53.9	56	13.4	25	5.9	145	34.7
Overweight	90	19.8	20	4.4	17	3.7	53	11.8
Obese	98	22.4	12	2.7	28	6.5	58	13.2
Health insurance								
Insured	344	68.2	85	17.0	67	13.2	192	38.0
Uninsured	86	31.8	11	4.0	14	5.2	61	22.6

[1] Unweighted;

[2] weighted;

[3] adjusted model included sexual orientation/sex, race/ethnicity, and education

[a] Males ≥ 5, females ≥ 4;

[b] used injection drugs, treated for a sexually transmitted infection, exchanged sex for money or drugs, had unprotected anal sex, and/or had four or more sex partners in the past year;

[c] based on 2017 HPV vaccination guidelines;

Abbreviations: OR (odds ratio); aOR (adjusted odds ratio); CI (confidence interval).

Data Source: *2017 Behavioral Risk Factor Surveillance System*

Table 2:

Predictors for HPV vaccine uptake among young adults ages 18 to 26 years (n=430), BRFSS 2017

Characteristics	OR (95% CI)	aOR (95% CI) *
No. times binge drinking, past 30 days [a]		
None	Ref	Ref
1	2.70 (1.15-6.36)	2.71 (1.11-6.65)
2	1.32 (0.50-3.51)	3.05 (1.26-7.41)
3 or more times	0.84 (0.36-1.97)	0.80 (0.25-2.59)
HIV/HPV co-infection risk behavior, past year [b]		
High	1.43 (0.67-3.04)	---
Low	Ref	---
Year of most recent HIV test		
2017	2.94 (1.11-7.78)	3.86 (1.42-10.55)
Before 2017	3.12 (1.54-6.30)	2.62 (1.23-5.56)
Never	Ref	Ref
Sexual orientation, sex (age, years) [c]		
Heterosexual, female (18-26)	Ref	Ref
Lesbian, female (18-26)	1.21 (0.41-3.63)	1.39 (0.40-4.84)
Heterosexual, male (18-21)	0.08 (0.03-0.17)	0.14 (0.05-0.35)
Gay or bisexual, male (18-26)	0.19 (0.06-0.63)	0.18 (0.05-0.62)
Race/ethnicity		
Non-Hispanic White	Ref	Ref
Non-Hispanic Black/African American	0.70 (0.32-1.50)	0.79 (0.32-1.97)
Non-Hispanic Other	1.47 (0.03-7.15)	2.31 (0.51-10.57)
Non-Hispanic Multiple Races	3.42 (0.63-18.56)	5.18 (1.13-23.65)
Hispanic	0.86 (0.40-1.83)	1.04 (0.45-2.39)
Marital status		
Married	1.26 (0.58-2.74)	---
Unmarried	Ref	---
Education		
Less than grade 12	0.54 (0.16-1.82)	0.63 (0.17-2.34)
Grade 12 or GED	0.79 (0.36-1.76)	0.74 (0.33-1.65)
College or higher	5.15 (2.36-11.25)	3.96 (1.57-9.96)
Some college	Ref	Ref
Occupation		
Student	1.2 (0.63-2.27)	---
Non-student	Ref	---

Characteristics	OR (95% CI)	aOR (95% CI) *
Smoking status		
Current smoker	1.13 (0.47-2.69)	1.51 (0.58-3.91)
Former smoker	0.37 (0.12-1.12)	1.13 (0.32-4.07)
Non-smoker	Ref	Ref
BMI		
Normal	Ref	Ref
Underweight	5.50 (0.99-30.45)	7.86 (0.92-67.40)
Overweight	1.24 (0.57-2.72)	1.49 (0.66-3.36)
Obese	1.25 (0.58-2.73)	0.90 (0.39-2.08)
Health insurance		
Insured	Ref	Ref
Uninsured	0.51 (0.23-1.15)	0.78 (0.34-1.78)

*Model adjusted for sexual orientation/sex, race/ethnicity, and education.

[a]Males ≥ 5, females ≥ 4;

[b]used injection drugs, treated for a sexually transmitted infection, exchanged sex for money or drugs, had unprotected anal sex, and/or had four or more sex partners in the past year;

[c]based on 2017 HPV vaccination guidelines;

Abbreviations: OR (odds ratio); aOR (adjusted odds ratio); CI (confidence interval).

Data Source: *2017 Behavioral Risk Factor Surveillance System*