



Human Papillomavirus-Associated Sexual Risks Among High School Students in the U.S.: Does Sexual Orientation Play a Role?

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Abstract

We examined the association between sexual orientation and human papillomavirus (HPV)-related risky sexual behaviors among high school students in the U.S. We used the 2015 Youth Risk Behavior Survey, a three-stage cluster sample, nationally representative, cross-sectional study. Participants were sexually active students (Grades 9–12) in public, private, and Catholic schools in 50 states and the District of Columbia ($n = 5,958$). Sexual orientation dimensions were: sexual self-identity (heterosexual, gay, lesbian, bisexual, and not sure) and sex of sexual contacts. HPV-associated risky sexual risk behaviors selected a priori were early sexual debut (≤ 12 or ≥ 13 years old) and number of lifetime partners (≥ 2 or ≥ 4). Separate multiple logistic regression analyses estimated association between sexual orientation and sex of sexual contacts, and HPV-associated risky sexual behaviors. Among the 5,958 high school students, a quarter had ≥ 4 , and two-thirds had ≥ 2 sexual partners. Students who self-identified as bisexual (aOR = 2.43, 99% CI 1.19–4.98) or “not sure” (aOR = 4.56, 99% CI 2.54–8.17) were more likely to have sexual debut before 13 years. Similarly, students whose sexual contacts were adolescent females who had sex with females and males were more likely to have sexual debut before they turned 13 years of age (aOR = 3.46, 99% CI 1.83–6.48), or had ≥ 4 sexual partners (aOR = 2.66, 99% CI 1.74–4.08), or had ≥ 2 sexual partners (aOR = 3.09, 99% CI 1.91–5.00). In conclusion, HPV-associated risky sexual behavior is prevalent among high school students, especially sexual minorities. Interventions tailored to this population could increase HPV vaccine uptake and prevent future HPV-associated cancers and other negative outcomes.

Keywords High school students · HPV-associated sexual risk behavior · Sexual minorities · Youth Risk Behavior Survey · Sexual orientation

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Introduction

Around 14 million individuals become infected with the human papillomavirus (HPV) yearly in the U.S. (Satterwhite et al., 2013). Among the oncogenic types, HPV 16 and 18 are associated with several malignancies, including cervical, oropharyngeal, anal, vulvar, vaginal, and penile cancers (Viens et al., 2016). About three-quarters of the nearly 40,000 new cases of HPV-associated cancers that occur annually are attributable to the vaccine-preventable HPV types (Viens et al., 2016) as well as second primary cancers (Adjei Boakye et al., 2018, 2020; Suk et al., 2018; Wang et al., 2020).

The primary risk factors for HPV infection include early sexual debut, having multiple sexual partners, and engaging in other risky sexual practices, including oral and anal sexual behaviors (Leichliter et al., 2007). HPV peak prevalence is between 15 and 24 years, sometimes within months of sexual contact (Moscicki, 2005). Despite *Healthy People* 2020 goal of abstinence among 80% of adolescents aged 15 to 17 years (Bruera & Hui, 2012), over 40% of high school students in Grades 9–12 in the U.S. are sexually active (Kann et al., 2016a, 2016b), increasing their HPV infection risk.

While most sexually active individuals will become infected with one or more strains of the HPV in their lifetime, higher rates have persisted among sexual minorities, especially gay and bisexual men (Reiter et al., 2010). The U.S. Advisory Committee on Immunization Practices has recommended routine HPV vaccination for adolescents; however, the vaccination rate is still low (Meites et al., 2019). Gay men have a significantly greater incidence of HPV and anal cancer, while lesbians/bisexual women have increased risks of cervical cancer (Agenor et al., 2017; Glick et al., 2014). Besides gay and bisexual students, a unique group of sexual minority adolescents are those not sure of their sexual identity (Zaza et al., 2016). Sexual identity and sexual partners' gender can change throughout the lifespan (Kann et al., 2016b; Riskind et al., 2014). In some cases, there is discordance between sexual identity declaration and sex of sexual contacts (Igartua et al., 2009). For instance, some adolescents who identify as gay, lesbian, or bisexual or not being sure of their sexual identity might have had sexual contact with only the opposite sex. Sexual minority adolescents have earlier sexual debut, more sexual partners, unintended pregnancy, alcohol and substance abuse, tobacco use, obesity, chronic disease, anxiety, depression, suicide, and viral infections such as HPV compared to nonsexual minority adolescents (Coble et al., 2017; Kann et al., 2016a, 2016b).

While studies indicate that adolescent females who are sexual minorities may have a higher risk of risky sexual behaviors and unintended pregnancy compared with the nonsexual minority (Agenor et al., 2017; Riskind et al., 2014), there is a paucity of data examining the role of sexual identity

and sex of sexual contacts in increasing the risk of HPV-related sexual behaviors in sexual minority adolescent males. There is also a lack of data specifically on HPV-related sexual behaviors among adolescents not sure of their sexual identity. Additionally, recent studies on sexual identity, partner gender, and sexual health among high school students have focused only on females (Riskind et al., 2014). However, two HPV-associated cancers, oropharyngeal and anal cancers, are found in both males and females, with increasing incidence of anal cancer in males ≤ 40 years (Shiels et al., 2015) as well as in males ≤ 50 years for oropharyngeal cancer (Chaturvedi et al., 2008). These cancers are both linked to initiating sexual behaviors at an earlier age (Marur et al., 2010), anal cancer being high among men who have sex with men (Shiels et al., 2015). This significant burden of HPV-associated cancers in both genders warrants a study that describes the potential association of sexual orientation and HPV-association sexual risk behaviors among adolescents. This study examined how sexual orientation described by sexual self-identity and sex of sexual contacts affect HPV-associated sexual behaviors among high school students in a nationally representative sample.

Method

Participants

The national school-based Youth Risk Behavior Survey (YRBS), biennially implemented in odd-numbered years since 1991 by CDC, provides cross-sectional data for monitoring priority health-risk behaviors among youth in the U.S. The YRBS uses a three-stage cluster sample design including primary sampling units (PSUs), schools, and classes to produce a nationally representative sample of students attending public, Catholic, and private schools in grade 9 through 12 in the 50 states and the District of Columbia. Details about the YRBS methodology are described elsewhere (Brener et al., 2013). We used data from the 2015 national YRBS which had a 60% overall response rate and an unweighted sample size of 15,624 (Centers for Disease Control & Prevention, 2016). We restricted our analysis to 5958 boys and girls in Grades 9 through 12 who reported to have had sexual intercourse. Because the YRBS study protocol was approved by the CDC Institutional Review Board (IRB), IRB approval was not applicable.

Measures

Sexual Orientation Dimensions: Sexual Self-Identity and Sex of Sexual Partners

Two main sexual orientation dimensions—self-identity and sex of sexual partners—were selected based on previous studies (Tornello et al., 2014). Responses in our study included “heterosexual (straight),” “gay or lesbian,” “bisexual,” or “not sure.” Sex of sexual partners was ascertained as follows: “During your life, with whom have you had sexual contact?” Responses included “I have never had sexual contact,” “females,” “males,” or “females and males.” Sex and sex of sexual partners were used to group participants as females who have sex with male partners only (FSM), female partners only (FSF), or both female and male partners (FSFM); adolescent males who have sex with female partners only (MSF), male partners only (MSM) or both male and female partners (MSMF).

Sexual Risk Behaviors

A priori, we selected three sexual risk factors that have been identified in the literature to be strongly associated with HPV infection: sexual debut, and number of lifetime partners (≥ 2 partners or ≥ 4 partners) (Erickson et al., 2013). Sexual debut was assessed with the following question: “How old were you when you had sexual intercourse for the first time?” Responses included “I have never had sexual intercourse,” and “11 through 17 years old.” We dichotomize sexual debut as ≤ 12 or ≥ 13 years old (Coble et al., 2017). We used aged 13 as a cut-point because according to the CDC, only 4% of US high school students engaged in sexual intercourse for the first time before 13 years old (Markowitz et al., 2014). The number of lifetime partners were assessed based on the question “During your life, with how many people have you had sexual intercourse?” Having multiple sexual partners is a risk factor for HPV and nearly a quarter of high school students reported having sex with 2 or more persons during their life while 11.5% of them reported 4 or more lifetime sexual partners (Kann et al., 2016a, 2016b). Thus, we chose to examine 2 cut-off points based on the number of sexual partners: 2 or more partners (≤ 1 or ≥ 2) and 4 or more partners (≤ 3 or ≥ 4) in reference to CDC Surveillance Summaries (Kann et al., 2016a, 2016b).

Covariates

Variables (with their categorization in Table 1) selected based on previous literature (Kann et al., 2016a, 2016b; Riskind et al., 2014; Schabath et al., 2014) included age, gender, race/ethnicity, ever cigarette use, ever alcohol use and ever electronic vapor product use. Smoking has been proven as an

environmental cofactor of prevalent HPV infection in men and women (Schabath et al., 2014). Nearly two-thirds of U.S. high school students used alcohol and 1 in 5 (20.6%) sexually active adolescents drank alcohol or used drugs before last sexual intercourse, while 45% of students in grade 9–12 had ever used electronic vapor products in 2015 (Kann et al., 2016b).

Statistical Analysis

We used SAS version 9.4 (SAS Institute, Cary, NC) procedures to account for the complex survey design of YRBS. Descriptive analysis and χ^2 tests were performed to assess sample characteristics among different sexual orientation groups. Subsequently, three separate multiple logistic regression models (one for each of three sexual risk behavior outcomes) were conducted to individually examine the association between sexual self-identity and the outcomes, controlling for age, gender, race/ethnicity, ever cigarette use, ever alcohol use and ever electronic vapor product use. Similarly, three separate multiple logistic regression models controlling for covariates mentioned above were also conducted to individually examine the association between sex of sexual partner and each of the three sexual risk behaviors. Given different rates in HPV acquisition as well as patterns in sexual behavior by sex during adolescence, we also stratified all the analyses by gender. Statistical significance was set at $p < 0.01$, and all tests were two-tailed.

Results

A total of 5958 high school students were included in the study, of whom 9.34% reported having made their sexual debut before 13 years of age. Approximately 60% had ≥ 2 sexual partners, and 27.82% had ≥ 4 sexual partners. Majority self-identified as FSM/MSF (90.12%) (Table 1). Figure S1 illustrates the intersection between these self-identified sexual identity and gender of sexual partner(s) in the study population. There was some discordance between the sexual identity reported by students and the sex of their sexual partners. Over a quarter of high school students who self-identified as gay or lesbian reported having opposite-sex-only or both-sex sexual contacts. Additionally, over half of the students who self-identified as not sure of their sexual identity had both-sex partners.

In the weighted adjusted logistic regression model estimating the odds of early sexual debut (before 13 years) based on sexual identity, students who self-identified as bisexual (aOR = 2.43, 99% CI 1.19–4.98) and “not sure” (aOR = 4.56, 99% CI: 2.54–8.17) were more likely to have early sexual debut compared with heterosexual students (Table 2). Students were less likely to have early sexual debut if they were

Table 1 Demographic characteristics of sexually active adolescents by sexual identity

Characteristics	Total N (Weighted %)	Heterosexual (Weighted %)	Gay or lesbian (Weighted %)	Bisexual (Weighted %)	Not sure (Weighted %)
<i>Sexual orientation based on sexual contacts</i>	5831		Missing = 127		
FSM/MSF	5189 (90.12)	97.84	7.21	32.99	40.46
MSMF	101 (1.59)	0.43	8.34	6.53	25.78
FSFM	381 (5.84)	1.17	11.69	53.73	30.59
FSF/MSM	160 (2.45)	0.56	72.76	6.75	3.17
<i>Age</i>	5848		Missing = 110		
≤ 14 years old	298 (4.38)	3.90	2.51	8.42	11.83
15 years old	955 (16.97)	16.35	23.70	22.81	16.86
16 years old	1539 (25.45)	25.59	22.63	26.27	20.13
17 years old	1885 (31.68)	31.99	26.93	28.86	32.43
≥ 18 years old	1171 (21.52)	22.17	24.23	13.64	18.75
<i>Gender</i>	5839		Missing = 119		
Female	2781 (46.83)	43.59	50.03	83.32	54.34
Male	3058 (53.17)	56.41	49.97	16.68	45.66
<i>Race/ethnicity</i>	5772		Missing = 119		
Non-Hispanic white	2554 (53.86)	54.36	36.02	53.56	51.00
Non-Hispanic black	698 (14.97)	14.81	27.91	13.78	13.79
Hispanic	1984 (22.79)	22.88	23.35	20.01	27.27
Others	536 (8.38)	7.95	12.72	12.65	7.94
<i>Ever cigarette use</i>	5287		Missing = 671		
Yes	2874 (54.05)	52.49	64.33	68.55	60.47
No	2413 (45.95)	47.51	35.67	31.45	39.53
<i>Ever alcohol use</i>	5694		Missing = 264		
Yes	4814 (84.90)	84.58	81.25	87.44	92.44
No	880 (15.10)	15.42	18.75	12.56	7.56
<i>Ever electronic vapor use</i>	5741		Missing = 217		
Yes	3955 (67.75)	67.88	64.35	66.59	69.08
No	1786 (32.25)	32.12	35.65	33.41	30.92
<i>Early sexual debut (before Age 13 years)</i>	5829		Missing = 129		
Yes	631 (9.34)	8.36	15.89	13.77	28.13
No	5198 (90.66)	91.64	84.11	86.23	71.87
<i>≥ 2 Lifetime sexual partners</i>	5808		Missing = 150		
Yes	3440 (59.57)	58.70	67.56	64.65	70.37
No	2368 (40.43)	41.30	32.44	35.35	29.63
<i>≥ 4 Lifetime sexual partners</i>	5808		Missing = 150		
Yes	1576 (27.82)	27.39	30.57	28.20	40.87
No	4232 (72.18)	72.61	69.43	71.80	59.13

FSM/MSF adolescent females who have sex with males/adolescent males who have sex with females, MSMF adolescent males who have sex with males and females, FSFM adolescent females who have sex with females and males, FSF/MSM adolescent females who have sex with females/adolescent males who have sex with males

girls (aOR = 0.40, 99% CI: 0.25–0.63), but more likely to have early sexual debut if they had ever smoked cigarettes (aOR = 1.82, 99% CI: 1.32–2.51).

In the weighted adjusted regression model estimating odds of early sexual debut based on the sex of sexual partners, compared with students whose sexual contacts were FSM/MSF, those whose sexual contacts were MSMF (aOR = 3.25,

99% CI: 1.31–8.08), FSFM (aOR = 3.46, 99% CI: 1.83–6.48), or FSF/MSM (aOR = 3.94, 99% CI: 1.37–11.36) were more likely to have early sexual debut before they turned 13 years of age (Table 3). Students were less likely to have early sexual debut if they were girls (aOR = 0.37, 99% CI: 0.22–0.63), but more likely to have had early sexual debut if they had ever smoked cigarettes (aOR = 1.75, 99% CI: 1.26–2.43).

Table 2 Logistic regressions predicting sexual behaviors from sexual identity

Sexual habits Covariates	Sexual intercourse before age 13 years			Sexual intercourse with ≥ 4 partner			Sexual intercourse with ≥ 2 partner		
	Model 1			Model 3			Model 5		
	aOR	99%CI		aOR	99%CI		aOR	99%CI	
		Lower bound	Upper bound		Lower bound	Upper bound		Lower bound	Upper bound
<i>Sexual identity</i>									
Heterosexual	Ref			Ref			Ref		
Bisexual	2.43	1.19	4.98	1.25	0.83	1.89	1.48	0.95	2.30
Gay or lesbian	1.32	0.37	4.73	1.09	0.44	2.74	1.13	0.56	2.29
Not sure	4.56	2.54	8.17	1.70	0.86	3.36	1.69	0.85	3.35
<i>Age</i>									
≤ 14 years old	2.30	0.97	5.50	0.55	0.28	1.08	0.50	0.27	0.90
15 years old	1.58	1.01	2.46	0.40	0.26	0.61	0.59	0.40	0.87
16 years old	1.41	0.91	2.18	0.65	0.46	0.92	0.68	0.49	0.95
17 years old	0.75	0.50	1.13	0.83	0.60	1.15	0.84	0.61	1.15
≥ 18 years old	Ref			Ref			Ref		
<i>Gender</i>									
Male	Ref			Ref			Ref		
Female	0.40	0.25	0.63	0.62	0.49	0.80	0.64	0.51	0.81
<i>Race/ethnicity</i>									
Non-Hispanic white	Ref			Ref			Ref		
Non-Hispanic black	2.78	1.72	4.49	2.58	1.77	3.77	2.49	1.71	3.63
Hispanic	1.99	1.23	3.22	1.08	0.83	1.41	1.10	0.87	1.40
Others	1.54	0.69	3.46	1.45	0.94	2.24	1.30	0.86	1.97
<i>Ever cigarette use</i>									
No	Ref			Ref			Ref		
Yes	1.82	1.32	2.51	2.30	1.74	3.06	2.08	1.63	2.64
<i>Ever alcohol use</i>									
No	Ref			Ref			Ref		
Yes	1.09	0.62	1.90	1.52	1.01	2.27	1.41	1.01	1.97
<i>Ever electronic vapor use</i>									
No	Ref			Ref			Ref		
Yes	0.99	0.74	1.32	1.96	1.45	2.64	1.55	1.19	2.02

In the regression model estimating odds of having multiple sexual partners based on sexual identity, there was no statistically significant association between sexual orientation and having ≥ 4 or ≥ 2 sexual partners. Compared with boys, girls were less likely to have ≥ 4 (aOR = 0.62; 99% CI: 0.49–0.80) or ≥ 2 (aOR = 0.64; 99% CI: 0.51–0.81) lifetime sexual partners, whereas ever smokers were more likely to have ≥ 4 (aOR = 2.30, 99% CI: 1.74–3.06) or ≥ 2 (aOR = 2.08, 99% CI: 1.63–2.64) lifetime sexual partners compare with never smokers (Table 2).

In the regression model estimating odds of having multiple sexual partners based on sex of sexual contacts, compared with students whose sexual contacts were FSM/MSF, FSMF (aOR = 2.66, 99% CI: 1.74–4.08) were more likely to have ≥ 4 lifetime sexual partners. Similarly, students whose sexual contacts were FSMF (aOR = 3.09; 99% CI: 1.91–5.00) were

more likely to report having ≥ 2 lifetime sexual partners than FSM/MSF. Compared with boys, girls were less likely to have ≥ 4 (aOR = 0.57; 99% CI: 0.44–0.74) or ≥ 2 (aOR = 0.61; 99% CI: 0.48–0.77) lifetime sexual partners whereas ever smokers were more likely to have ≥ 4 (aOR = 2.23, 99% CI: 1.68–2.97) or ≥ 2 (aOR = 2.02, 99% CI: 1.57–2.58) lifetime sexual partners compare with never smokers (Table 3).

The analyses stratified by gender are presented in Supplemental Tables. Among adolescent boys, there were no statistical significance between sexual identity and each of the three outcomes (Supplement Table 1). However, among adolescent girls, students who self-identified as bisexual or “not sure” were more likely to have early sexual debut than heterosexual counterparts (Supplement Table 2). Among adolescent boys, students whose sexual contacts were MSMF were more likely to have early sexual debut (Supplement

Table 3 Logistic regressions predicting sexual behaviors from sexual orientation based on sexual contacts

Sexual Habits	Sexual intercourse before age 13 years			Sexual intercourse with ≥ 4 partner			Sexual intercourse with ≥ 2 partner		
	Model 2			Model 4			Model 6		
	aOR	99%CI		aOR	99%CI		aOR	99%CI	
Covariates		Lower bound	Upper bound		Lower bound	Upper bound		Lower bound	Upper bound
<i>Sexual contacts</i>									
FSM/MSF	Ref			Ref			Ref		
MSMF	3.25	1.31	8.08	1.98	0.90	4.35	1.64	0.68	3.96
FSFM	3.46	1.83	6.48	2.66	1.74	4.08	3.09	1.91	5.00
FSF/MSM	3.94	1.37	11.36	0.90	0.41	1.98	0.84	0.45	1.54
<i>Age</i>									
≤ 14 years old	2.20	0.92	5.22	0.53	0.27	1.03	0.47	0.25	0.87
15 years old	1.49	0.92	2.43	0.39	0.26	0.60	0.58	0.40	0.86
16 years old	1.38	0.88	2.16	0.63	0.44	0.90	0.68	0.49	0.94
17 years old	0.73	0.48	1.10	0.81	0.59	1.11	0.83	0.60	1.13
≥ 18 years old	Ref			Ref			Ref		
<i>Gender</i>									
Male	Ref			Ref			Ref		
Female	0.37	0.22	0.63	0.57	0.44	0.74	0.61	0.48	0.77
<i>Race/ethnicity</i>									
Non-Hispanic white	Ref			Ref			Ref		
Non-Hispanic black	2.74	1.66	4.53	2.60	1.78	3.80	2.50	1.72	3.64
Hispanic	1.92	1.18	3.12	1.07	0.82	1.41	1.09	0.86	1.39
Others	1.57	0.72	3.43	1.50	0.98	2.30	1.32	0.88	1.99
<i>Ever cigarette use</i>									
No	Ref			Ref			Ref		
Yes	1.75	1.26	2.43	2.23	1.68	2.97	2.02	1.58	2.58
<i>Ever alcohol use</i>									
No	Ref			Ref			Ref		
Yes	1.06	0.60	1.89	1.52	1.02	2.28	1.42	1.02	1.98
<i>Ever electronic vapor use</i>									
No	Ref			Ref			Ref		
Yes	0.99	0.74	1.32	1.95	1.44	2.64	1.53	1.17	1.99

FSM/MSF adolescent females who have sex with males/adolescent males who have sex with females, MSMF adolescent males who have sex with males and females, FSFM adolescent females who have sex with females and males, FSF/MSM adolescent females who have sex with females/adolescent males who have sex with males

Table 3). Among adolescent girls, students whose sexual contacts were MSMF were more likely to have early sexual debut, have ≥ 4 sexual partners, or have ≥ 2 sexual partners (Supplement Table 4).

Discussion

This study provides insight into the association between sexual orientation dimensions (sexual self-identity and the sex of sexual contacts) and risky behaviors that are associated with HPV infection among a nationally representative high school student

population. The key findings contribute to broader sexual transmitted infections and sexual health research. We found greater odds of risky sexual behaviors such as sexual debut before age 13 years and multiple sexual partners among sexual minority high school students, compared with heterosexuals. We also found that boys were more likely to have early sexual debut and have multiple sexual partners than girls. It should be noted that this study did not measure HPV-related behaviors (e.g., screening, diagnoses) but rather risky behaviors that are associated with acquiring HPV infection.

We found that high school students who were not sure of their sexual identity were almost five times more likely to have

early sexual debut. Additionally, students who identified as bisexuals were more likely than their heterosexual peers to have early sexual debut. Consistent with previous findings (Coble et al., 2017; Zaza et al., 2016), our study identifies high school students unsure of their sexual orientation as a “red-flag” group in need of tailored support and interventions to mitigate risks of HPV infection and its sequelae, as well as other negative sex-related outcomes (Smulian et al., 2016). Targeting these adolescents with better communication and educational initiatives to increase HPV vaccination uptake is particularly important since HPV infection prevalence peaks following coitus.

We found a high level of discordance between self-identified sexual identity and sex of sexual partners among high school students who were minorities. In our study, one in two high school students who were not sure of their sexual identity had sexual contacts with both sexes and were classified as FSMF or MSMF. The American Academy of Pediatrics guideline and previous studies (Igartua et al., 2009) recommend that adolescents should be asked multiple questions to address the dimensions of sexual orientation including sexual identity and sexual behavior in both research and clinical settings. Discordance between heterosexual identity and same-sex behavior plays an important role in risky sexual behaviors when people who have both sexes partners may act as bridges for the transmission of sexually transmitted infections, particularly to their opposite-sex partners (Nield et al., 2015).

We found that sexual minority students had increased odds of engaging in HPV-related risky sexual behaviors. Students whose sexual contacts were MSMF or FSMF were more likely than MSF/FSM to have early sexual debut. In addition, students whose sexual contacts were FSMF were more likely to have ≥ 4 or ≥ 2 lifetime sexual partners than MSF/FSM. These findings were similar when stratified by sex especially adolescent girls. A previous study by Riskind et al. (2014) found significant effects on all the sexual health outcomes regardless of sexual orientation dimensions (sexual identity and partner gender). It is important to note, however, that Riskind et al. only examined adolescent girls in 13 U.S. jurisdictions while our analysis included both boys and girls in the entire U.S. Adolescent boys are more likely than females to engage in same-sex behavior before identifying as gay (Savin-Williams & Diamond, 2000).

Irrespective of the sexual orientation dimension, our study showed that adolescent boys had significantly greater odds of both early sexual debut and sex with ≥ 4 partners. Early sexual debut and multiple partners are both risk factors for HPV infection and HPV-associated cancers (Erickson et al., 2013). HPV is associated with several cancers in men, including penile, oropharyngeal, and anal cancers. HPV-positive oropharyngeal cancer, 75% of which is found in men, may have surpassed cervical cancer as the leading HPV-associated cancer in the U.S. (Osazuwa-Peters et al., 2018). However, there is a lower rate of HPV vaccine initiation and completion among males, and there is still very poor knowledge of HPV’s role in cancers

among men, many of whom still feminize HPV and HPV vaccines (Adjei Boakye et al., 2017; Osazuwa-Peters et al., 2017). Therefore, our findings support the recommendations for administering routine HPV vaccination for not only females but also males aged 11 or 12 years, before they are sexually active (Markowitz et al., 2014).

Our study was not without limitations. First, the cross-sectional nature of our data prevents us from establishing a causal inference. Second, the self-reported nature creates a potential recall/social desirability bias which could result in either underreporting or overreporting of sexual behaviors. However, the survey questions demonstrated good test–retest reliability (Brener et al., 2002). Third, there was residential confounding; the National YRBS did not measure if what type of sex (vaginal, oral, anal) students engaged in. Likewise, the survey did not include questions related to the history of HPV vaccination, which could be associated with sexual behaviors among youth. We recommend that future YRBS surveys include these questions as they may help healthcare professionals have a deeper understanding of adolescents’ sexual and reproductive health and their association with HPV vaccine uptake. Notwithstanding these limitations, our study had some important strengths, including assessing HPV risk factors among sexual minorities, in a sufficiently large, weighted, nationally representative, racially diverse sample of high school students. Furthermore, the YRBS data are considered to be high-quality data with validated questions and high response rates (Brener et al., 2013).

Public Health Implications

This study adds to the knowledge of sexual orientation and association with HPV risky behaviors among U.S. high school students. While it is critical that the messaging for improving HPV vaccine uptake remains gender-neutral, we have identified specific subsets of the adolescent population of the U.S. that may benefit from targeted interventions aimed at preventing cancer through HPV vaccination and decreasing risky sexual practices. The interventions could focus on HPV education such as mobile health for sexual minorities as these have been shown to be effective (Lee et al., 2016; Reiter et al., 2011, 2018). Since sexually discordant individuals and those not sure of their sexual identity may be subject to discrimination (Igartua et al., 2009), such targeted education interventions must be well planned, and culturally sensitive to best meet the needs of this “red-flag” group of sexual minorities. Additionally, young adults who identify as lesbian, gay, or bisexual, and other sexual minorities who are not in high school but still within the HPV vaccine catch-up range of 18–26 years should also be the focus of HPV vaccine catch-up interventions as they are an often-overlooked population who may engage in more HPV risk behaviors (Cochran et al., 2002). A previous study (Glick et al., 2014) has shown that a large number of self-identified young adult males

who have sex with men, while already sexually active, may remain naive to HPV 16 or 18, the high-risk strains of HPV responsible for up to 90% of oropharyngeal and anal cancers (Lowy & Schiller, 2012; Medford & Salit, 2015). Since the current HPV vaccine protects against both HPV 16 and 18 (Viens et al., 2016), it is critical that eligible individuals are provided opportunities to receive the HPV vaccine. Finally, in view of the prevalence of adverse sexual risks among high school students as described in this study, it may be important to revisit current adolescent HPV vaccination policies in the U.S. (Glick et al., 2014; Osazuwa-Peters, 2013). Future strategies might include expanding mobile health education, establishing HPV vaccine school-entry requirements and improving HPV vaccine initiation and timely completion among both female and male adolescents regardless of sexual orientation (Calo et al., 2016; Glick et al., 2014; McRee et al., 2014; Osazuwa-Peters, 2013).

Conclusion

Approximately 1 in 10 sexually active high school students in the U.S. had their sexual debut before they were 13 years old, and 60% had two or more sexual partners. Among sexual minorities, those not sure of their sexual identity are especially at a greater risk of HPV-associated risky sexual behaviors. These findings could help shape future interventions aimed at decreasing HPV-risky behaviors among adolescents, especially among sexual minority high school students in the U.S.

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Declarations

Ethical Approval For this type of study, formal consent is not required. This article does not contain any studies with human participants or animals performed by any of the authors.

Conflict of interest We have no potential conflicts of interest to disclose.

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