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Sex of Sexual Partners and Human Papillomavirus Vaccination Among U.S. Girls and Women

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Abstract

Introduction—Girls and women are at risk of human papillomavirus (HPV) infection and cervical cancer from male and female sexual partners throughout the life course. However, no study has assessed how sex of sexual partners, a dimension of sexual orientation, may relate to HPV vaccination among girls and women.

Methods—In 2014, data from the 2006–2010 National Survey of Family Growth were used to conduct logistic regression analyses estimating the relationship between sex of lifetime and past-year sexual partners and HPV vaccine awareness and initiation among U.S. girls and women aged 15–25 years (N=3,253).

Results—Among U.S. girls and women aged 15–25 years, the prevalence of HPV vaccine awareness and HPV vaccine initiation was 84.4% and 28.5%, respectively. Adjusting for sociodemographic factors, participants with only female past-year sexual partners had

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significantly lower odds of initiating HPV vaccination relative to those with only male past-year sexual partners (OR=0.16, 95% CI=0.05, 0.55). Similarly, respondents with no lifetime (OR=0.65, 95% CI=0.46, 0.92) or past-year (OR=0.69, 95% CI=0.50, 0.94) sexual partners had significantly lower adjusted odds of HPV vaccine initiation compared with those with only male sexual partners. No difference was apparent in the odds of initiating HPV vaccination between participants with male and female sexual partners and those with only male sexual partners.

Conclusions—Medical and public health professionals should ensure that girls and women with only female or no sexual partners are included in HPV vaccine education and promotion efforts.

Introduction

Human papillomavirus (HPV) is the most common sexually transmitted infection in the U.S.[1,2] Each year, approximately seven million U.S. women are newly infected with HPV,[2] and about 17,000 develop new HPV-associated cancers.[3] Three vaccines, which are indicated for use prior to sexual debut,[4] effectively prevent HPV infection among girls and boys aged 11 and 12 years—with catch-up vaccination recommended for adolescent and young adult women and men aged 13–26 years.[1,4,5] All vaccines target HPV16 and HPV18,[4] high-risk types that cause the majority of cervical cancers.[6] Although the HPV vaccine provides a notable opportunity for the primary prevention of cervical cancer, uptake of the vaccine has been slow and pronounced disparities exist.[1,7,8]

Women who have sex with women (WSW) are at risk of HPV acquisition and cervical cancer from both female and male sexual partners throughout the life course.[9–18] However, despite their risk of cervical cancer, WSW are significantly less likely to have received regular Pap tests compared with women who have sex with men only.[15,19–21] Additionally, the two studies that have investigated cervical cancer screening among women with no past-year sexual partners suggest that this understudied population is also significantly less likely to receive regular Pap tests than those with only male past-year sexual partners.[20,21] However, women with no past-year sexual partners may have engaged in sexual activity earlier in life and may thus be at risk of cervical cancer from prior exposure to HPV. Moreover, girls and women who report having no sexual partners may have engaged in behaviors that they do not conceptualize as sex[22,23] but that nonetheless increase their risk of cervical cancer.[9]

Research investigating sexual orientation disparities in HPV vaccination is scarce. Only one published study has examined the relationship between sexual orientation identity, one of the main dimensions of sexual orientation,[24] and HPV vaccination in a national probability sample of U.S. girls and women.[25] Additionally, one other study has assessed the predictors of HPV vaccination in a national non-probability sample of predominately white lesbian and bisexual young adult U.S. women.[26] However, to the authors' knowledge, no study has assessed how sex of sexual partners, another dimension of sexual orientation,[24] may relate to HPV vaccine uptake among U.S. adolescent and young adult women. Thus, this study was designed to investigate the association between sex of lifetime and past-year sexual partners and HPV vaccine awareness and initiation in a national probability sample of U.S. girls and women.

Methods

Study Participants

This study analyzed data from the 2006–2010 National Survey of Family Growth (NSFG), which used a stratified, three-stage cluster sampling strategy to establish a national probability sample of 12,279 civilian, non-institutionalized U.S. women aged 15–44 years (response rate, 78%).[27] The analysis was restricted to girls and women aged 15–25 years at the time of the survey who participated in Years 2 (2007–2008), 3 (2008–2009), or 4 (2009–2010) of the NSFG (N=3,253), as older respondents were not asked about their HPV vaccination history and those who participated in Year 1 were not asked about their HPV vaccine awareness or utilization.

Measures

The outcomes of interest were HPV vaccine awareness and HPV vaccine initiation; the predictors were sex of lifetime and past-year sexual partners. The 2006–2010 NSFG assessed HPV vaccine awareness by asking girls and women if they had ever heard of the *cervical cancer vaccine, HPV shot, or Gardasil*. The survey asked girls and women aged 15–25 years who reported having ever heard of the HPV vaccine (*n*=2,698) if they had ever received the cervical cancer vaccine, also known as the HPV shot or Gardasil. Possible responses for both questions included *yes*, *no*, or *don't know* (coded as missing). During the Audio Computer-Assisted Self-Interview portion of the survey, respondents were asked about the number of male and female sexual partners they had in their life and in the past 12 months. Using these data, two categorical variables were created, sex of lifetime and past-year sexual partners, which had the following four categories: only male, both male and female, only female, and none.

This study's conceptualization and selection of covariates were based on ecosocial theory[28–32] and research on the social determinants of HPV vaccination. Ecosocial theory—which focuses on how the social environment is embodied in the form of population health outcomes, including health inequities, through specific pathways—helps guide epidemiologic research by asking the question: "Who and what drives current and changing patterns of social inequalities in health?"[28–32] Covariates, which were conceptualized as social determinants of health per ecosocial theory, are shown with their categorization in Table 1. They included sociodemographic factors, which were conceptualized as potential confounders based on existing research,[33–35] and healthcare access and utilization indicators, which were assessed as potential mediators per ecosocial theory's focus on pathways of embodiment, prior studies,[20,21,33–36] and statistically significant ($p<0.05$) associations with sex of sexual partners and HPV vaccine awareness and initiation. No data were missing for HPV vaccine awareness; among women who had heard of the HPV vaccine, 0.23% (*n*=6) lacked data on HPV vaccine initiation. Missing data for age, race/ethnicity, religion in which raised, place of residence, relationship status, educational attainment, household poverty level, employment status, and health insurance status were imputed by NSFG staff using the sequential regression imputation method.[37] The proportion of women missing data on covariates that were not imputed by NSFG staff was small (<0.20%).

Statistical Analysis

After generating descriptive statistics for all covariates by sex of lifetime and past-year sexual partners, the prevalence of HPV vaccine awareness and initiation was estimated for the total sample and by both measures of sex of sexual partners. Multivariable logistic regression was used to model the association between sex of lifetime and past-year sexual partners and the age-adjusted odds of HPV vaccine awareness and initiation. Then, ORs adjusted for age as well as other sociodemographic factors (i.e., race/ethnicity, nativity, religion in which raised, place of residence, relationship status, educational attainment, household poverty level, and employment status) were estimated. Healthcare access and utilization indicators (i.e., health insurance status and receiving a contraceptive method or prescription for a method in the past year) were further included in order to assess whether these factors may help explain any association between sex of lifetime and past-year sexual partners and HPV vaccine awareness and initiation among U.S. girls and women aged 15–25 years. All analyses were conducted in December 2014 and accounted for the complex survey design using the weights provided by the NSFG staff and the “svy” commands in Stata, version 13.

Results

Table 1 shows that although most girls and women with only female lifetime and past-year sexual partners identified as lesbian, a substantial proportion identified as bisexual or heterosexual. Respondents with only female lifetime and past-year sexual partners were more likely to be aged 15–17 years, be living in a metropolitan area, and have been raised in a non-religious household relative to those with only male sexual partners. Girls and women with only female lifetime sexual partners were more likely than those with only male lifetime sexual partners to be enrolled in a private health plan. By contrast, girls and women with only female past-year sexual partners were more likely than those with only male past-year sexual partners to be uninsured or underinsured (i.e., enrolled in a single service plan or the Indian Health Service only). Girls and women with no lifetime or past-year sexual partners, the vast majority of whom identified as heterosexual, were more likely than those with only male sexual partners to be aged 15–17 years, have been raised in a household that practiced a religion other than Catholicism or Protestantism, and be enrolled in a private health plan. Additionally, girls and women with only female or no lifetime and past-year sexual partners were considerably less likely to have received contraception in the past year compared with those with only male sexual partners.

Among U.S. women aged 15–25 years, the prevalence of HPV vaccine awareness and HPV vaccine initiation was 84.4% and 28.5%, respectively. HPV vaccine awareness and initiation levels were similar across sex of lifetime sexual partner groups. On the contrary, girls and women with only female past-year sexual partners had a lower prevalence of HPV vaccine awareness and initiation than those with only male past-year sexual partners (Table 2).

Adjusting for sociodemographic factors, no difference was apparent in the odds of HPV vaccine awareness between participants with only female lifetime or past-year sexual partners and those with only male sexual partners (Table 3, Model 2). By contrast, girls and women with no lifetime (OR=0.63, 95% CI=0.44, 0.91) or past-year (OR=0.65, 95%

CI=0.46, 0.93) sexual partners had significantly lower adjusted odds of HPV vaccine awareness than those with only male sexual partners (Table 3, Model 2). Including health insurance status and contraception receipt completely attenuated these ORs (Table 3, Model 3).

Table 4 shows that girls and women with only female past-year sexual partners who had heard of the HPV vaccine had significantly lower adjusted odds of HPV vaccine initiation than their counterparts with only male past-year sexual partners (OR=0.16, 95% CI=0.05, 0.55) (Table 4, Model 2). This OR was attenuated but remained statistically significant after the inclusion of health insurance status and contraception receipt into the model (Table 4, Model 3). Similarly, girls and women with no lifetime (OR=0.65, 95% CI=0.46, 0.92) or past-year (OR=0.69, 95% CI=0.50, 0.94) sexual partners who had heard of the HPV vaccine had significantly lower adjusted odds of HPV vaccine initiation compared with their counterparts with only male sexual partners (Table 4, Model 2). Including health insurance status and contraception receipt completely attenuated these ORs (Tables 4, Model 3). No difference was apparent in the odds of initiating HPV vaccination between participants with male and female lifetime or past-year sexual partners who had heard of the vaccine and their counterparts with only male sexual partners (Table 4, Model 2).

Discussion

This study—which used data from the 2006–2010 NSFG, a national probability sample—is the first to investigate the relationship between sex of sexual partners and HPV vaccination among girls and women. The findings show that, adjusting for sociodemographic factors, U.S. adolescent and young adult women with only female past-year and no lifetime or past-year sexual partners who had heard of the HPV vaccine had significantly lower odds of initiating vaccination relative to their counterparts with only male sexual partners. These findings have important implications for the design and implementation of HPV vaccination programs, which should include girls and women with only female and no past or current sexual partners. Indeed, the HPV vaccine is indicated for use regardless of sexual behavior and is most effective when administered prior to sexual debut.[4] Additionally, adolescent and young adult women with no lifetime sexual partners will likely have sex and be exposed to HPV later in life,[38] and those who report having no sexual partners may have engaged in sexual behaviors that they may not conceptualize as sex[22,23] but nonetheless increase their risk of HPV acquisition.[9]

Given its focus on the pathways through which the social environment is embodied in the form of population health outcomes, including health inequities, ecosocial theory[28–32] led the authors to investigate the factors potentially driving HPV vaccination disparities by sex of sexual partners among U.S. girls and women.[28–32] As suggested by prior research,[20,21,33–36] this study's results indicate that health insurance status and contraception receipt may partially explain the difference in HPV vaccine initiation between girls and women with only female past-year sexual partners and those with only male past-year sexual partners, and completely explain the difference in HPV vaccine initiation between girls and women with no lifetime or past-year sexual partners and their counterparts with only male sexual partners.

Other studies have shown that sexual orientation identity[39–42] and being in a same-sex relationship[43–46] are related to health insurance status among U.S. women. The present findings contribute to this literature by indicating that girls and women with only female past-year sexual partners were more likely to be uninsured or underinsured and girls and women with no lifetime or past-year sexual partners were more likely to be enrolled in a private health plan than those with only male sexual partners. Research indicates that having health insurance is an important predictor of HPV vaccination initiation among young U.S. women.[33–35] Moreover, before President Obama signed the Affordable Care Act in 2010, private health plans were not required to cover preventive health services with no cost sharing by beneficiaries,[47] which may have hindered access to the HPV vaccine among adolescents and young adults enrolled in these plans.[48] Research is needed to determine whether the Affordable Care Act, which expanded Medicaid coverage and requires new private health plans and insurance policies (beginning on or after September 23, 2010) to cover a range of recommended preventive services such as the HPV vaccine with no cost sharing by enrollees,[47] has helped decrease HPV vaccine initiation disparities by sex of sexual partners among U.S. girls and women.

Additionally, as the authors have shown in other analyses,[20,21] this study's findings indicate that girls and women with only female past-year or no lifetime or past-year sexual partners had a considerably lower prevalence of receiving contraception compared with their counterparts with only male sexual partners. Given that reproductive health represents an important entry point into the healthcare system for girls and women, those who are less likely to seek contraception from a healthcare provider, including girls and women with only female or no sexual partners, may have fewer opportunities to receive other health services, such as the HPV vaccine, compared with those who obtain regular contraceptive services.[21] Healthcare facilities can help ensure that girls and women with only female or no sexual partners have additional opportunities to receive HPV vaccination by offering the vaccine not only during contraception counseling sessions, which are often geared towards unintended pregnancy prevention among girls and women with a male sexual partner, but also through other mechanisms. For example, clinicians can provide the HPV vaccine during routine primary care visits[48] and offer monthly walk-in HPV vaccination clinics held at times that are convenient for adolescents and young adults.[49]

Research on the determinants of HPV vaccination among predominately white lesbian and bisexual young adult U.S. women suggests that receiving a healthcare provider recommendation for HPV vaccination and beliefs and attitudes pertaining to the HPV vaccine may also play a role in explaining HPV vaccination disparities between girls and women with only female past-year sexual partners and those with only male past-year sexual partners.[26] Further, it is possible that the factors potentially driving cervical cancer screening disparities between WSW and non-WSW, including heterosexism in the healthcare system[15,16,19,50] and misperceptions among women and healthcare providers that WSW are not at risk of HPV or cervical cancer,[15–17,19,51] also underlie the lower odds of HPV vaccine initiation between girls and women with only female past-year sexual partners and those with only male past-year sexual partners. Moreover, other studies have shown that healthcare providers' and parents' endorsement of the HPV vaccine, which may vary based

on girls' and young women's sexual orientation,[26] was positively associated with HPV vaccine initiation among young U.S. women.[26,48,52–55]

Additional quantitative and qualitative research is needed to understand the extent to which these social factors contribute to disparities in HPV vaccine initiation by sex of sexual partners among U.S. girls and women in order to inform evidence-based interventions. However, in the meantime, healthcare facilities, schools, and public health departments and organizations can implement programs that promote knowledge of HPV and cervical cancer risk from male and female sexual partners throughout the life course among young women, caregivers, and healthcare providers[15–17,19,51] and facilitate access to opt-out HPV vaccination services among adolescent and young adult women with only female and no sexual partners.

Strengths and Limitations

This study has important strengths, including the use of a large national probability sample with very little missing data, adjustment for potential confounders, and evaluation of the role of healthcare access and utilization indicators as potential mediators. However, the findings should be interpreted in light of some limitations. First, this study used self-report, cross-sectional data, which prevented the authors from making causal inferences. Second, the 2006–2010 NSFG measured only HPV vaccine initiation; thus, the authors had no information about HPV vaccine completion, which may be the indicator of HPV vaccine uptake that is most relevant to cervical cancer prevention. Third, the findings may not be generalizable to time periods other than 2006– 2010 because societal changes that may affect sexual orientation disparities in HPV vaccination among U.S. girls and women (e.g., the Affordable Care Act) have occurred since then or to all U.S. girls and women with only female sexual partners because of the small number of participants in this group.

Conclusions

Although U.S. women with only female or no sexual partners are at risk of HPV infection and cervical cancer from sexual behaviors throughout the life course,[12] adolescent and young adult women with only female past-year sexual partners and those with no lifetime or past-year sexual partners may have lower odds of HPV vaccine initiation relative to their counterparts with only male sexual partners. Given low rates of Pap test use among women with only female and no past-year sexual partners,[15,19–21] these groups may be at particularly elevated risk of cervical cancer. Further, girls and young women with no lifetime sexual partners, who will likely engage in sexual activity later in life,[38] represent the ideal population for HPV vaccination, which is most effective before sexual debut.[4] Thus, medical and public health professionals should ensure that HPV vaccine education and promotion efforts are not limited to those with past or current male sexual partners. Instead, they should promote opportunities to learn about and receive the HPV vaccine among girls and women with only female and no sexual partners, such as during routine primary care visits and through hospital-, clinic-, and school-based opt-out HPV vaccination services that address their specific needs and concerns.

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References

1. Dunne EF, Markowitz LE, Saraiya M, et al. CDC grand rounds: reducing the burden of HPV-associated cancer and disease. MMWR Morb Mortal Wkly Rep. 2014; 63(4):69–72. [PubMed: 24476977]
2. Satterwhite CL, Torrone E, Meites E, et al. Sexually transmitted infections among US women and men: prevalence and incidence estimates, 2008. Sex Transm Dis. 2013; 40(3):187–193. http://dx.doi.org/10.1097/OLQ.0b013e318286bb53. [PubMed: 23403598]
3. Jemal A, Simard EP, Dorell C, et al. Annual report to the nation on the status of cancer, 1975-2009, featuring the burden and trends in human papillomavirus (HPV)-associated cancers and HPV vaccination coverage levels. J Natl Cancer Inst. 2013; 105(3):175–201. http://dx.doi.org/10.1093/jnci/djs491. [PubMed: 23297039]
4. Markowitz L, Hariri S, Lin C, et al. Reduction in human papillomavirus (HPV) prevalence among young women following HPV vaccine introduction in the United States, National Health and Nutrition Examination Surveys, 2003-2010. J Infect Dis. 2013; 208(3):385–393. http://dx.doi.org/10.1093/infdis/jit192. [PubMed: 23785124]
5. Markowitz L, Dunne EF, Saraiya M, Lawson HW, Chesson H, Unger ER. Quadrivalent human papillomavirus vaccine: recommendations of the Advisory Committee on Immunization Practices (ACIP). MMWR Morb Mortal Wkly Rep. 2007; 56(RR02):1–24. [PubMed: 17218934]
6. Schiffman M, Castle PE, Jeronimo J, Rodriguez AC, Wacholder S. Human papillomavirus and cervical cancer. Lancet. 2007; 370(9590):890–907. http://dx.doi.org/10.1016/S0140-6736(07)61416-0. [PubMed: 17826171]
7. CDC. National and state vaccination coverage among adolescents aged 13-17 years -- United States, 2012. MMWR Morb Mortal Wkly Rep. 2013; 62(34):685–693. [PubMed: 23985496]
8. President's Cancer Panel. A report to the President of the United States from the President's Cancer Panel. National Cancer Institute; Bethesda, MD: 2014. Accelerating HPV vaccine uptake: urgency for action to prevent cancer.. http://deainfo.nci.nih.gov/advisory/pcp/annualReports/HPV/index.htm
9. Singh D, Marrazzo JM. Sexually transmitted infections and associated conditions among women who have sex with women. Open Infect Dis J. 2009; 3:128–134. http://dx.doi.org/10.2174/1874279301004010128.
10. Gorgos LM, Marrazzo JM. Sexually transmitted infections among women who have sex with women. Clin Infect Dis. 2011; 53(Suppl 3):S84–S91. http://dx.doi.org/10.1093/cid/cir697. [PubMed: 22080273]
11. Marrazzo JM. Dangerous assumptions: lesbians and sexual death. Sex Transm Dis. 2005; 32(9): 570–571. http://dx.doi.org/10.1097/01.olq.0000175368.82940.61. [PubMed: 16118606]
12. Marrazzo JM, Gorgos LM. Emerging sexual health issues among women who have sex with women. Curr Infect Dis Rep. 2012; 14(2):204–211. http://dx.doi.org/10.1007/s11908-012-0244-x.
13. Marrazzo JM, Koutsky LA, Stine KL, et al. Genital human papillomavirus infection in women who have sex with women. J Infect Dis. 1998; 178(6):1604–1609. http://dx.doi.org/10.1086/314494. [PubMed: 9815211]
14. Marrazzo JM, Stine KL, Koutsky LA. Human papillomavirus in women who have sex with women: a review. Am J Obstet Gynecol. 2000; 183(3):770–774. http://dx.doi.org/10.1067/mob.2000.106681. [PubMed: 10992207]

15. Marrazzo JM, Koutsky LA, Kiviat NB, Kuypers JM, Stine KL. Papanicolaou test screening and prevalence of genital human papillomavirus among women who have sex with women. Am J Public Health. 2001; 91(6):947–952. http://dx.doi.org/10.2105/AJPH.91.6.947. [PubMed: 11392939]
16. McNair R. Risks and prevention of sexually transmissible infections among women who have sex with women. Sex Health. 2005; 2(4):209–217. http://dx.doi.org/10.1071/SH04046. [PubMed: 16402667]
17. Bauer GR, Welles SL. Beyond assumptions of negligible risk: sexually transmitted diseases and women who have sex with women. Am J Public Health. 2001; 91(8):1282–1286. http://dx.doi.org/10.2105/AJPH.91.8.1282. [PubMed: 11499119]
18. Lindley LL, Walsemann KM, Carter JV. Invisible and at risk: STDs among young adult sexual minority women in the United States. Perspect Sex Reprod Health. 2013; 45(2):66–73. http://dx.doi.org/10.1363/4506613. [PubMed: 23750620]
19. Kerker BD, Mostashari F, Thorpe L. Health care access and utilization among women who have sex with women: sexual behavior and identity. J Urban Health. 2006; 83(5):970–979. http://dx.doi.org/10.1007/s11524-006-9096-8. [PubMed: 16897415]
20. Agénor M, Krieger N, Austin SB, Haneuse S, Gottlieb BR. At the intersection of sexual orientation, race/ethnicity, and cervical cancer screening: assessing Pap test use disparities by sex of sexual partners among black, Latina, and white U.S. women. Soc Sci Med. 2014; 116:110–118. http://dx.doi.org/10.1016/j.socscimed.2014.06.039. [PubMed: 24996219]
21. Agénor M, Krieger N, Austin SB, Haneuse S, Gottlieb BR. Sexual orientation disparities in Papanicolaou test use among U.S. women: the role of sexual and reproductive health services. Am J Public Health. 2014; 104(2):e68–e73. http://dx.doi.org/10.2105/AJPH.2013.301548. [PubMed: 24328650]
22. Peterson ZD, Muehlenhard CL. What is sex and why does it matter? A motivational approach to exploring individuals' definitions of sex. J Sex Res. 2007; 44(3):256–268. http://dx.doi.org/10.1080/00224490701443932. [PubMed: 17879169]
23. Mehta CM, Sunner LE, Head S, Crosby R, Shrier LA. “Sex isn't something you do with someone you don't care about:” young women's definitions of sex. J Pediatr Adolesc Gynecol. 2011; 24(5):266–271. http://dx.doi.org/10.1016/j.jpag.2011.03.003. [PubMed: 21715191]
24. Sell, RL. Defining and measuring sexual orientation for research.. In: Meyer, IH.; Northridge, ME., editors. The health of sexual minorities: public health perspectives on lesbian, gay, bisexual, and transgender populations. Springer; New York, NY: 2007. p. 355-374.http://dx.doi.org/10.1007/978-0-387-31334-4_14
25. Agénor M, Peitzmeier S, Gordon AR, Potter JE, Haneuse S, Austin SB. Sexual orientation identity disparities in awareness and initiation of the human papillomavirus vaccine among U.S. women and girls: a national survey. Ann Intern Med. 2015; 163(2):99–106. http://dx.doi.org/10.7326/M14-2108. [PubMed: 25961737]
26. McRee A, Katz ML, Paskett ED, Reiter PL. HPV vaccination among lesbian and bisexual women: findings from a national survey of young adults. Vaccine. 2014; 32(37):4736–4742. http://dx.doi.org/10.1016/j.vaccine.2014.07.001. [PubMed: 25038312]
27. Lepkowski JM, Mosher WD, Davis KE, Groves RM, Van Hoewyk J. The 2006-2010 National Survey of Family Growth: sample design and analysis of a continuous survey. Vital Health Stat. 2010; 2(150):1–36.
28. Krieger N. A glossary for social epidemiology. J Epidemiol Commun H. 2001; 55(10):693–700. http://dx.doi.org/10.1136/jech.55.10.693.
29. Krieger N. Epidemiology and the web of causation: Has anyone seen the spider? Soc Sci Med. 1994; 39:887–903. http://dx.doi.org/10.1016/0277-9536(94)90202-X. [PubMed: 7992123]
30. Krieger N. Theories for social epidemiology in the 21st century: an ecosocial perspective. Int J Epidemiol. 2001; 30(4):668–677. http://dx.doi.org/10.1093/ije/30.4.668. [PubMed: 11511581]
31. Krieger, N. Epidemiology and the people's health: theory and context. Oxford University Press; New York: 2011. http://dx.doi.org/10.1093/acprof:oso/9780195383874.001.0001

32. Krieger N. Got theory? on the 21st c CE rise of explicit use of epidemiologic theories of disease distribution: a review and ecosocial analysis. Current Epidemiol Reports. 2014; 1(1):45–56. http://dx.doi.org/10.1007/s40471-013-0001-1.
33. Fisher H, Trotter CL, Audrey S, MacDonald-Wallis K, Hickman M. Inequalities in the uptake of human papillomavirus vaccination: a systematic review and meta-analysis. Int J Epidemiol. 2013; 42(3):896–908. http://dx.doi.org/10.1093/ije/dyt049. [PubMed: 23620381]
34. Polonijo AN, Carpiano RM. Social inequalities in adolescent human papillomavirus (HPV) vaccination: a test of fundamental cause theory. Soc Sci Med. 2013; 82:115–125. http://dx.doi.org/10.1016/j.socscimed.2012.12.020. [PubMed: 23337830]
35. Chao C, Velicer C, Slezak JM, Jacobsen SJ. Correlates for human papillomavirus vaccination of adolescent girls and young women in a managed care organization. Am J Epidemiol. 2010; 171(3): 357–367. http://dx.doi.org/10.1093/aje/kwp365. [PubMed: 20047978]
36. Charlton BM, Corliss HL, Missmer SA, et al. Influence of hormonal contraceptive use and health beliefs on sexual orientation disparities in Papanicolaou test use. Am J Public Health. 2013; 104(2):319–325. http://dx.doi.org/10.2105/AJPH.2012.301114. [PubMed: 23763393]
37. Lepkowski JM, Mosher WD, Davis KE, et al. National Survey of Family Growth, Cycle 6: sample design, weighting, imputation, and variance estimation. Vita Health Stat 2. 2006; (142):1–82.
38. Addis IB, Van Den Eeden SK, Wassel-Fyr CL, et al. Sexual activity and function in middle-aged and older women. Obstet Gynecol. 2006; 107(4):755–764. http://dx.doi.org/10.1097/01.AOG.0000202398.27428.e2. [PubMed: 16582109]
39. Cochran SD, Mays VM, Bowen D, et al. Cancer-related risk indicators and preventive screening behaviors among lesbians and bisexual women. Am J Public Health. 2001; 91(4):591–597. http://dx.doi.org/10.2105/AJPH.91.4.591. [PubMed: 11291371]
40. Diamant AL, Wold C, Spritzer K, Gelberg L. Health behaviors, health status, and access to and use of health care: a population-based study of lesbian, bisexual, and heterosexual women. Arch Fam Med. 2000; 9(10):1043–1051. http://dx.doi.org/10.1001/archfami.9.10.1043. [PubMed: 11115206]
41. Solarz, AL. Lesbian health: current assessment and directions for the future. IOM; National Academy Press; Washington, DC: 1999.
42. Committee on Lesbian, Gay. The health of lesbian, gay, bisexual, and transgender people: building a foundation for better understanding. IOM; National Academy Press; Washington, DC: 2011. Bisexual, and Transgender Health Issues and Research Gaps and Opportunities, Board on the Health of Select Populations.
43. Ponce NA, Cochran SD, Pizer JC, Mays VM. The effects of unequal access to health insurance for same-sex couples in California. Health Affairs. 2010; 29(8):1539–1548. http://dx.doi.org/10.1377/hlthaff.2009.0583. [PubMed: 20576694]
44. Heck JE, Sell RL, Gorin SS. Health care access among individuals involved in same-sex relationships. Am J Public Health. 2006; 96(6):1111–1118. http://dx.doi.org/10.2105/AJPH.2005.062661. [PubMed: 16670230]
45. Buchmueller T, Carpenter CS. Disparities in health insurance coverage, access, and outcomes for individuals in same-sex versus different-sex relationships, 2000-2007. Am J Public Health. 2010; 100(3):489–495. http://dx.doi.org/10.2105/AJPH.2009.160804. [PubMed: 20075319]
46. Gonzales G, Blewett LA. National and state-specific health insurance disparities for adults in same-sex relationships. Am J Public Health. 2014; 104(2):e95–e104. http://dx.doi.org/10.2105/AJPH.2013.301577. [PubMed: 24328616]
47. Koh HK, Sebelius KG. Promoting prevention through the Affordable Care Act. N Engl J Med. 2010; 363:1296–1299. http://dx.doi.org/10.1056/NEJMp1008560. [PubMed: 20879876]
48. Conroy K, Rosenthal SL, Zimet GD, et al. Human papillomavirus vaccine uptake, predictors of vaccination, and self-reported barriers to vaccination. J Womens Health. 2009; 18(10):1679–1686. http://dx.doi.org/10.1089/jwh.2008.1329.
49. Klein JD, Slap GB, Elster AB, Schonberg SK. Access to health care for adolescents: a position paper of the Society for Adolescent Medicine. J Adolesc Health. 1992; 13(2):162–170. http://dx.doi.org/10.1016/1054-139X(92)90084-O. [PubMed: 1627584]
50. Clark MA, Bonacore L, Wright SJ, Armstrong G, Rakowski W. The cancer screening project for women: experiences of women who partner with women and women who partner with men.

Women Health. 2003; 38(2):19–33. http://dx.doi.org/10.1300/J013v38n02_02. [PubMed: 14655792]

51. Eaton L, Kalichman S, Cain D, et al. Perceived prevalence and risks for human papillomavirus (HPV) infection among women who have sex with women. J Womens Health. 2008; 17(1):75–83. http://dx.doi.org/10.1089/jwh.2006.0256.
52. Caskey R, Lindau ST, Alexander GC. Knowledge and early adoption of the HPV vaccine among girls and young women: results of a national survey. J Adolesc Health. 2009; 45(5):453–462. http://dx.doi.org/10.1016/j.jadohealth.2009.04.021. [PubMed: 19837351]
53. Rosenthal SL, Weiss TW, Zimet GD, Ma L, Good MB, Vichnin MD. Predictors of HPV vaccine uptake among women aged 19–26: importance of a physician's recommendation. Vaccine. 2011; 29(5):890–895. http://dx.doi.org/10.1016/j.vaccine.2009.12.063. [PubMed: 20056186]
54. Bednarczyk RA, Birkhead GS, Morse DL, Doleyres H, McNutt L. Human papillomavirus vaccine uptake and barriers: association with perceived risk, actual risk and race/ethnicity among female students at a New York state university, 2010. Vaccine. 2011; 29(17):3138–3143. http://dx.doi.org/10.1016/j.vaccine.2011.02.045. [PubMed: 21376797]
55. Roberts ME, Gerrard M, Reimer R, Gibbons FX. Mother-daughter communication and human papillomavirus vaccine uptake by college students. Pediatrics. 2010; 125(5):982–989. http://dx.doi.org/10.1542/peds.2009-2888. [PubMed: 20385645]

Table 1

Distribution of Sotio-Demographic and Healthcare Factors by Sex of Sexual Partners (N=3,253)

Variable (%)	Total	Sex of lifetime sexual partners				Sex of past-year sexual partners			
		Only male	Both male and female	Only female	None	Only male	Both male and female	Only female	None
	N=3,253	*n*=1,889	*n*=493	*n*=46	*n*=798	*n*=1,973	*n*=192	*n*=60	*n*=989
Total	100.0	58.0	14.4	1.2	26.4	61.0	5.5	1.8	31.7
Age (years)									
15-17	27.4	15.3	13.4	42.4	60.8	13.2	17.6	16.2	56.6
18-21	41.5	46.5	42.2	36.1	30.7	45.9	52.8	37.6	32.0
22-25	31.2	38.2	44.5	21.6	8.5	40.6	29.6	46.2	11.4
Sexual orientation identity									
Heterosexual	91.4	97.7	59.5	39.6	97.1	95.2	42.9	10.0	97.0
Bisexual	6.7	2.2	31.8	17.4	2.6	4.7	47.3	24.5	2.6
Lesbian	1.9	0.2	8.7	42.9	0.4	0.2	9.7	65.5	0.4
Race/ethnicity									
White	58.0	55.7	66.7	54.1	59.7	58.4	63.3	50.2	58.4
Black	14.8	16.2	15.0	19.8	11.6	15.2	17.1	21.2	13.4
Latina	17.8	19.2	9.1	19.9	18.4	17.9	8.5	20.6	17.8
Another race or multiracial	9.3	8.9	9.2	6.2	10.4	8.6	11.1	8.0	10.5
U.S. born: yes	89.9	89.4	93.6	81.8	90.6	90.7	97.2	71.7	89.4
Place of residence									
MSA, central city	35.6	37.7	36.8	36.5	29.8	37.1	32.0	55.8	31.9
MSA, other	46.7	43.7	44.7	57.2	54.5	42.9	48.2	41.5	53.7
Non-MSA	17.7	18.7	18.6	6.3	15.7	20.0	19.7	2.7	14.5
Relationship status									
Never married	78.3	70.6	68.4	100.0	100.0	67.0	76.4	93.6	99.2
Currently married	8.1	11.2	11.4	0.0	0.0	12.7	7.9	0.0	0.0
Not married, living with a male partner	11.9	15.9	17.9	0.0	0.0	18.1	14.9	1.2	0.0
Separated, divorced, or widowed	1.6	2.3	2.3	0.0	0.0	2.2	0.8	5.3	0.6
Religion in which raised									
No religion	11.3	10.9	18.5	17.4	8.2	11.9	18.0	27.2	8.5
Catholic	31.3	33.7	23.2	39.0	29.7	32.7	21.4	25.6	29.4
Fundamentalist Protestant	4.6	4.1	6.9	4.0	4.1	4.2	9.5	6.0	4.5
Another type of Protestant	44.3	44.5	45.2	33.9	44.3	44.4	47.2	34.0	44.8
Another religion	8.6	6.8	6.3	5.7	13.7	6.8	3.9	7.2	12.9
Educational attainment									
< High school degree	42.3	32.6	35.1	56.3	66.0	31.8	36.7	30.8	62.5
High school diploma or GED	22.8	26.0	28.7	14.6	12.7	26.9	30.7	29.4	13.5

Variable (%)	Total	Sex of lifetime sexual partners				Sex of past-year sexual partners			
		Only male	Both male and female	Only female	None	Only male	Both male and female	Only female	None
	N=3,253	*n*=1,889	*n*=493	*n*=46	*n*=798	*n*=1,973	*n*=192	*n*=60	*n*=989
Some college/associate's degree	26.8	30.5	30.4	17.1	17.9	30.7	30.1	30.1	19.5
Bachelor's degree or higher	8.1	10.9	5.8	12.0	3.4	10.7	2.5	9.7	4.5
Household poverty level (%)									
< 100	29.7	29.3	28.9	39.2	30.2	28.7	31.7	28.9	30.7
100-199	25.4	24.3	30.1	13.5	24.8	26.1	28.7	18.9	23.7
200-299	17.6	18.5	16.5	31.6	16.0	18.1	15.6	33.2	16.4
> 300	27.4	27.8	24.6	15.8	29.0	27.1	23.9	19.1	29.3
Employment status									
Working	51.4	59.6	54.8	49.8	31.8	60.7	49.7	62.5	33.4
Not working	25.6	24.0	33.2	16.8	25.8	24.9	35.0	24.0	25.8
Student	23.1	16.4	12.0	33.4	42.3	14.4	15.3	13.5	40.8
Health insurance status									
Private	55.3	55.4	40.6	72.9	62.9	53.6	41.4	48.0	61.8
Public	24.5	23.8	28.0	11.7	25.2	25.0	26.4	14.2	24.3
Uninsured or underinsured	20.3	20.9	31.5	15.4	11.9	21.4	32.3	37.8	13.9
Received contraception in the past year: yes	40.8	52.9	52.8	8.6	9.8	56.9	52.8	5.4	10.7

Note: MSA, Metropolitan Statistical Area; GED, General Education Development.

Analyses were restricted to women who participated in Years 2-4 of the survey. Sample sizes (N, n) refer to observed counts. All prevalence estimates (%) account for the complex survey design. Percentages may not add to 100% due to rounding error.

Table 2

Prevalence of HPV Vaccine Awareness and Initiation by Sex of Sexual Partners

Variable	Total	Ever heard of HPV vaccine (N=3,253)			Ever received HPV vaccine[a] (N=2,698)		
		n	Prevalence estimate (%)	95% CI	*n*	Prevalence estimate (%)	95% CI
Total	3,253	2,698	84.4	81.5, 86.9	790	28.5	25.4, 31.8
Sex of lifetime sexual partners							
Only male	1,889	1,569	85.3	82.5, 87.8	458	28.5	24.5, 32.9
Both male and female	493	440	88.9	84.1, 92.3	108	26.8	21.0, 33.6
Only female	46	37	84.8	64.5, 94.5	9	27.7	11.1, 54.1
None	798	637	81.1	76.8, 84.7	212	30.0	25.4, 35.0
Sex of past-year sexual partners							
Only male	1,973	1,663	85.9	83.2, 88.3	471	28.3	24.4, 32.5
Both male and female	192	172	92.8	87.5, 95.9	43	27.1	18.0, 38.5
Only female	60	47	79.1	58.7, 91.0	6	6.2	1.8, 19.3
None	989	794	81.7	77.7, 85.1	266	30.6	26.2, 35.5

Notes: HPV, human papillomavirus.

Analyses were restricted to women who participated in Years 2-4 of the survey. Sample sizes (N, n) refer to observed counts. All prevalence estimates (%) and 95% CI account for the complex survey design.

[a]Only applies to those who reported having ever heard of the HPV vaccine.

Table 3

Adjusted Odds of HPV Vaccine Awareness by Sex of Sexual Partners (N=3,253)

Variable	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Sex of lifetime sexual partners			
Only male (reference)	1.00	1.00	1.00
Both male and female	1.39 (0.92, 2.10)	1.15 (0.78, 1.71)	1.25 (0.84, 1.86)
Only female	1.01 (0.36, 2.83)	1.14 (0.45, 2.86)	1.26 (0.49, 3.24)
None	0.79 (0.58, 1.07)	**0.63 (0.44, 0.91)**	0.71 (0.47, 1.05)
Sex of past-year sexual partners			
Only male (reference)	1.00	1.00	1.00
Both male and female	**2.08 (1.12, 3.85)**	1.90 (0.93, 3.88)	**2.10 (1.02, 4.33)**
Only female	0.63 (0.25, 1.61)	0.76 (0.36, 1.59)	0.92 (0.43, 1.97)
None	0.79 (0.59, 1.07)	**0.65 (0.46, 0.93)**	0.75 (0.50, 1.14)

Notes: Analyses were restricted to women who participated in Years 2-4 of the survey. Sample size (N) refers to the observed sample. Model 1 is adjusted for age. Model 2 is further adjusted for race/ethnicity, nativity, religion in which raised, place of residence, relationship status, educational attainment, household poverty level, and employment status. Model 3 also includes health insurance status and receiving contraception in the past year. Boldface indicates statistical significance ($p<0.05$). All OR and 95% CI account for the complex survey design.

Table 4

Adjusted Odds of HPV Vaccine Initiation by Sex of Sexual Partners (N=2,698)

Variable	Model 1	Model 2	Model 3
	OR (95% CI)	OR (95% CI)	OR (95% CI)
Sex of lifetime sexual partners			
Only male (reference)	1.00	1.00	1.00
Both male and female	0.92 (0.67, 1.27)	0.99 (0.70, 1.39)	1.02 (0.73, 1.43)
Only female	0.96 (0.31, 3.02)	0.70 (0.25, 1.96)	0.99 (0.34, 2.84)
None	1.07 (0.78, 1.48)	**0.65 (0.46, 0.92)**	0.95 (0.67, 1.34)
Sex of past-year sexual partners			
Only male (reference)	1.00	1.00	1.00
Both male and female	0.87 (0.53, 1.42)	0.81 (0.48, 1.37)	0.91 (0.51, 1.62)
Only female	**0.17 (0.05, 0.59)**	**0.16 (0.05, 0.55)**	**0.28 (0.09, 0.90)**
None	0.80 (0.59, 1.09)	**0.69 (0.50, 0.94)**	1.06 (0.77, 1.46)

Notes: Analyses were restricted to women who participated in Years 2-4 of the survey and reported having ever heard of the HPV vaccine. Sample size (N) refers to the observed sample. Model 1 is adjusted for age. Model 2 is further adjusted for race/ethnicity, nativity, religion in which raised, place of residence, relationship status, educational attainment, household poverty level, and employment status. Model 3 also includes health insurance status and receiving contraception in the past year. Boldface indicates statistical significance ($p<0.05$). All OR and 95% CI account for the complex survey design.