**Evaluating Sexual Orientation and Gender Identity Differences in Human Papillomavirus and Related Cancer Preventive Interventions**

by

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BS in Chemistry, University of Pittsburgh, 2016

Submitted to the Graduate Faculty of

The Department of Epidemiology

Graduate School of Public Health in partial fulfillment

of the requirements for the degree of

Master of Public Health

University of Pittsburgh

2019

Committee Membership Page

UNIVERSITY OF PITTSBURGH

Graduate School of Public Health

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**Abstract**

**Background**: Sexual and gender minorities (SGM) are at unique risk for contracting Human Papillomavirus (HPV) and developing related cancers (cervical, anal, head/neck, vulvar, penile) compared to their heterosexual cisgender peers. This risk is attributed to riskier sexual practices, lack of SGM-specific cancer education, and delay in routine cancer screenings. Incidence of HPV and late-stage cancer diagnoses can be reduced with HPV vaccines and routine screening. Minimal research has assessed if there are disparities in preventive interventions between SGM and non-SGM individuals. Therefore, this study examined gender and sexuality differences in HPV preventive interventions to inform the understudied field of SGM cancer prevention.

**Methods**: From 2015-2016, the Allegheny County Health Department (Pittsburgh, PA) commissioned a health survey of 9,026 adults aged 18-99 years using probability-based sampling. We examined differences by gender identity (cisgender women versus cisgender men and transgender) and sexual identity (heterosexual versus gay/lesbian, bisexual, and other) for lifetime receipt of HPV vaccine and number of HPV vaccines. Among cisgender women, we also examined sexuality differences in HPV and Pap tests. Weighted logistic and multinomial logistic regression analyses were adjusted for age, race/ethnicity, education, marital status, and income.

**Results**: Compared with cisgender women, transgender individuals had higher odds (AOR: 13.97; 95% CI: 1.13, 172.53) of never receiving an HPV vaccine. Compared with heterosexual cisgender women: lesbians had higher odds (AOR 3.99; 95% CI: 1.02, 15.63) of never receiving the HPV vaccine; bisexual women had higher odds (AOR: 2.90; 95% CI: 1.09, 7.71) of not receiving an HPV test within the recommended screening guidelines; and cisgender women who reported their sexuality as ‘other’ had higher odds (AOR: 7.33; 95% CI: 1.24, 43.30) of never receiving an HPV test and (AOR: 10.74; 95% CI: 2.39, 48.21) never receiving a Pap Test.

**Conclusion**: Transgender people as well as sexual minority cisgender women are less likely to engage in some cancer preventive interventions. These findings highlight existing health disparities between SGM and their heterosexual cisgender counterparts in Allegheny County and solidify the public health significance of creating SGM-specific interventions. Future interventions should assess SGM’s current barriers to HPV and related cancer care, evaluate health care provider’s knowledge and practices involving SGM patients, and increase education efforts to specifically target SGM.

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Preface

I would like to acknowledge the tremendous amount of support I have received throughout my graduate program at the University of Pittsburgh Graduate School of Public Health. The education and training I have received has solidified my love for public health and helping underserved communities.

I could not have completed this work without the incredible help from my colleagues and mentoring staff. Thank you to Dr. Soliman and the Cancer Epidemiology Education in Special Population program, and the Allegheny County Health Department for allowing me to first create this project. Thank you to Dr. Bear and Lynda Jones for all their informative support throughout my essay. Finally, I could not have executed this project without the overwhelming support from my closest mentors, Dr. Haggerty and Dr. Coulter. I am so appreciative of the guidance you provided throughout my entire graduate program.

My continued passion for research and education has been fueled by the support of my friends and family. A special thanks to the LGBT Wednesday morning meetings group who provided professional and personal support throughout my program. Lastly, I would especially like to acknowledge my partner, Alia, and best furry friend, Baedo, for all your love and support while I continue to pursue my professional and personal goals.

# Background

Human papillomavirus (HPV) is the most prevalent sexually transmitted infection (STI) in the United States [1]. The Center for Disease Control and Prevention (CDC) estimates that 79 million Americans are currently infected with at least one of the 170 strains of the virus and approximately 80% of people will be infected with HPV within their lifetime [1-3]. Although many HPV infections are asymptomatic and naturally resolve without complication, high risk strain HPV infections can have devastating consequences. HPV is responsible for nearly all cases of cervical cancer, 95% of anal cancer, 70% of oropharyngeal cancer, 65% of vaginal cancer, 50% of vulvar cancer, and 35% of penile cancer [4]. HPV vaccinations, regular HPV tests, and routine cancer screenings have been shown to greatly reduce the risk of HPV infection as well as detect cancer in earlier stages [1]. Despite these widely available prevention strategies, sexual and gender minorities (SGM) continue to be an underserved population in HPV education and related cancer prevention and treatment programs. Sexual minorities are individuals who identify their sexual orientation as any identity other than heterosexual (gay, lesbian, bisexual, queer/questioning, etc.). Gender minorities are individuals who identify their gender as any identity other than cisgender (transgender, non-binary, gender nonconforming, genderqueer, etc.).

SGM are at increased risk for contracting HPV infections and developing HPV related cancers given increased risk factors, limited SGM-specific education, and barriers to comprehensive and inclusive healthcare [2]. According to the Williams Institute, SGM are estimated to comprise 4% of the United States population [5]. Despite this population consisting of approximately 12 million Americans, their health disparities continue to largely go unnoticed. Limited sexual orientation and gender identity screening procedures have made it difficult to accurately assess the burden of HPV and related cancers amongst SGM. However, studies suggest that this population is disproportionality affected by access to cancer care barriers [6]. SGM often fear stigmatization regarding disclosure of sexual orientation or gender identity, experience difficulty affording health insurance, are limited in available resources, and have trouble locating a professional that is knowledgeable of SGM health issues [6].

While these concerns are most frequently thought to represent all SGM individuals, subgroups of this population experience unique barriers to cancer prevention and care. When compared to heterosexual men, sexual minority men (SMM) are at greater risk for contracting HPV and developing related cancers given an increased number of sexual partners, riskier sexual practices, co-occurrence of other STIs, and increased tobacco usage [2]. The National LGBT Cancer Network estimates that human immunodeficiency virus (HIV)-negative SMM are 20 times more likely to be diagnosed with anal cancer compared to heterosexual men [7]. Additionally, the risk of developing anal cancer is 40 times higher for HIV-positive SMM compared to heterosexual men [7]. Despite these increased risks, many SMM report having limited knowledge of the consequences of HPV as well as availability of the HPV vaccine [2].

By the same token, sexual minority women (SMW) are disproportionality burdened by HPV and cervical cancer. The California Health Interview Surveys from 2001-2005 found that the pooled prevalence of cervical cancer was greater in lesbian and bisexual women (16.1% and 41.2%, respectively) when compared to heterosexual women (14.0%) [2]. Likewise, a national survey of young adults aged 18-26 found that 25% of lesbian and bisexual women reported cervical abnormalities as a result of HPV infection. SMW were also slightly less likely (45%) to have received at least one dose of HPV vaccine compared to heterosexual women (51%) [8]. Furthermore, sexual minority women were less likely to participate in routine cancer screenings [9]. This delay of care could result in diagnosis of cancer at a later stage. With earlier detection greatly improving an individual’s prognosis, it is critical to increase routine cancer screenings in sexual minority women [9].

Lastly, there is limited research on the burden of HPV and related cancers in gender minorities in the United States. However, these individuals are at unique risk given their elevated risk of HIV and discrimination within the healthcare setting [10, 11]. The CDC reported that the number of transgender people newly diagnosed with HIV was three times the national average as of 2017 [10]. Additional risk factors include limited medical providers knowledgeable about SGM need’s specifically pertaining to gender minorities, high rates of uninsured individuals, and severe discrimination within the healthcare system [12]. For example, a secondary analysis of two Transgender Need’s Assessment in Philadelphia found that approximately 26% of participants had been denied access to healthcare due to their transgender identity [11]. Although researchers can likely assume that transgender individuals are disproportionality impacted by HPV and related cancers, additional studies solely focusing on gender minorities are needed [10].

While much of the previous evidence was produced on a national scale, findings from the Allegheny County Health Survey can be used to evaluate the uptake of HPV and related cancer preventive interventions on SGM in Allegheny County (Pittsburgh, Pennsylvania). Allegheny County comprises approximately 1.3 million Americans and is the second most populous county in Pennsylvania [13]. Based on national estimates, there are likely anywhere from 36,000 to 49,000 SGM-identified individuals living within Allegheny County [14]. Given the established barriers to care, it is crucial to evaluate if a disparity exists in preventative care for HPV and related cancers in SGM individuals, and if so, how to best address this disparity.

# Methods

A secondary analysis of the Allegheny County Health Department (ACHD) Health Survey was performed to assess potential differences in cancer prevention interventions by gender identity and sexual orientation in Allegheny County, Pittsburgh, PA. Adopting the CDC’s Behavioral Health Risk Factor Surveillance System (BRFSS) model, the ACHD partnered with The University of Pittsburgh and commissioned a county-wide health survey from 2015-2016. Using probability-based sampling, random digit dialing identified adults residing in Allegheny County via landlines and mobile phone numbers. Participants aged 18-99 years were asked to complete a cross-sectional health survey over the phone [15]. With a 71% participation rate, the final sample comprised 9,026 completed surveys. Participants were included in the secondary analyses if they had complete data for the gender identity and sexual orientation measures. Participants with missing data for an outcome measure were excluded from that corresponding analysis. However, missing data for one outcome did not exclude those individuals from the remaining data analyses. Responses that were ‘don’t know’, ‘refused’ or missing were excluded from all data analyses.

## Measurement of Key Variables

### Gender Identity and Sexual Orientation

Participant gender identity was determined by response to the question ‘Do you consider yourself to be transgender?’ Cisgender women (n=5,179) were categorized as those that answered this question as ‘No’ and whose sex was categorized as female by the interviewers based on voice timbre. Cisgender men (n=3,753) contained participants that answered this question as ‘No’ and whose sex was categorized as male by the interviewers based on voice timbre. Transgender individuals were those who answered this question as one of the following: ‘Yes, Transgender, male-to-female’ (n=16), ‘Yes, Transgender, female-to-male’ (n=9), and ‘Yes, Transgender, gender nonconforming’ (n=11). Transgender people’s sexes were categorized as either female or male by the interviewers based on voice timbre. Due to small sample sizes, the three transgender identities were collapsed into a single transgender category. Sexual orientation for cisgender women and cisgender men was categorized as heterosexual, lesbian/gay, bisexual, and other.

### Demographic Characteristics

Participants’ ages were categorized as: 18-29, 30-44, 45-64, and 65+ years old. Race was characterized as White, Black or African American, Asian, or other. Ethnicity was assessed as Non-Hispanic/Latino or Hispanic/Latino. The highest level of education completed was categorized as high school degree or less, some college, and college degree or more. Marital status was defined as married, divorced/separated, widowed, or never married/member of unmarried couple. Annual household income was reported as the following: <$15,000, $15,000-$24,999, $25,000-$49,999, $50,000-$74,999, or $75,000+.

*Hysterectomy*

Cisgender women were asked if they ever had a hysterectomy. However, participants were not asked to identify if the type of hysterectomy or medical history pertaining to the results of past screenings. Women who have had a total hysterectomy (a complete removal of the cervix), and no history of precancerous lesions within the past 20 years are no longer recommended to receive Pap Tests. Women with partial hysterectomies (the cervix is left intact) or those with recent precancerous lesions are still recommended to receive routine Pap Tests [16-18]. A review of cervical cancer incidence correcting for hysterectomy prevalence from 2000-2009 BRFSS data estimated that less than 2% of all hysterectomies left the cervix intact [19].

### Outcome Measures

#### Screening guidelines

*HPV Vaccine and Dosing*

Following the United States’ HPV vaccine release in 2006, the vaccine guidelines have changed numerous times throughout the subsequent years [20]. From 2006-2015, females aged 11 and 12 were recommended to receive a 3 dose vaccine series (could begin as early as 9 years and up until 26 years). While female HPV vaccine guidelines remained the same throughout this time period, formal routine recommendations for males didn’t begin until a several years later. From 2009-2010, males could be vaccinated starting at 9 years through 26 years of age; although this type of vaccination was viewed as guidance rather than routine. Starting in 2011, male routine vaccination guidelines stated that males from 9-21 years of age should be vaccinated, males aged 22-26 years may be vaccinated but not recommended unless at a high risk group (men who have sex with men, immunocompromised, and HIV-positive men) [20]. The same recommendations were in place at the time of data collection.

*Pap Test and HPV Test*

Women should begin receiving routine Pap Tests at 21 years of age [17, 18]. From the ages of 21-29 years, women should receive a Pap Test every 3 years. Women are not recommended to receive HPV Tests prior to 30 years of age. However, at 30 years old, women may begin co-testing (receiving a Pap and HPV Test at the same visit). Co-testing should be completed every 5 years up to age 65. However, if co-testing with the HPV test is not completed, women should remain receiving a Pap Test every 3 years until age 65. These routine guidelines are assuming that the results of both tests are normal. If pre-cancerous or cancerous cells are found, an individual’s new screening guidelines are determined by the health care provider [17, 18].

All participants were asked if they had ever received the HPV vaccine. Individuals who responded ‘No’ were coded as having received zero HPV vaccine shots within their lifetime. For those who answered ‘Yes’, the total number of lifetime HPV vaccine shots was dichotomized 1 or 2 shots versus 3+ shots. Cisgender women were asked if they had ever received an HPV test. If participants responded ‘Yes’, they were then asked to identify the time since the last test. Those two questions were then combined to inform the ‘time since last HPV test’ outcome. Individuals who answered ‘No’ to ever having an HPV test were coded as ‘never’. Individuals who answered ‘Yes’ to ever having an HPV test were coded as receiving in within the past 5 years or greater than 5 years. Similarly, cisgender women were asked if they had every received a Pap test. Individuals who answered ‘Yes’ were then asked to identify the time since the last test. Those questions were combined to create the ‘time since last Pap test’ outcome. Individuals who answered ‘No’ to ever having a Pap test were coded as ‘never’. Those who answered ‘Yes’ were subsequently categorized as receiving the test within the past 3 years or greater than 3 years.

#### Weighting

The ACHD utilized the BRFSS’ weighting methodology to calculate weighted variables for the survey data. The ACHD marginally adjusted the national weighted variables to create these county-level weighted variables: district by age and gender, district by race, district by education, district by income, district by marital status, cell-phone status, and Hispanic ethnicity [15].The survey weights were then applied to the data throughout all levels of analyses.

#### Data Analysis

Bivariate descriptive statistics were performed to determine which demographic characteristic variables to use in the regression models. Unweighted data were used to inform all sample sizes presented in Tables 1, 4, and 7 containing the demographic characteristics by gender identity, sexual orientation among cisgender women, and sexual orientation among cisgender men accordingly. The displayed percentages in all tables reflect weighted data. The Rao-Scott Chi-square test, Fisher’s exact tests, and Monte-Carlo approximation tests were implemented to obtain bivariate p-values. While statistically significant variables were defined as those with a p-value <0.05, variables that did not meet this threshold were included in the regression analyses if they met a priori presumption for potentially confounding the association between gender identity/sexual orientation and outcome measures.

Six separate analyses were completed to determine differences in preventive interventions by gender identity and sexual orientation. Non-age-specific analyses were performed to assess differences in the total sample. Age-specific recommendations were performed to assess differences by gender identity and sexual orientation among those within age-appropriate cancer prevention recommendation categories according to clinical guidelines.

The non-age-specific gender identity analyses can be found in Table 2 and included all cisgender women, cisgender men, and transgender people aged from 18-64 years who answered the health screening questions related to HPV vaccines. Age-specific gender identity analyses can be found in Table 3 and only contained those aged between 18-36 years old. The cutoff point of 36 years contained individuals who would have been in the recommended age group of 9-26 years following the initial HPV vaccine release in 2006 through the time of data collection [20]. Cisgender women were used as a referent group given that initial recommendations were tailored to this group for approximately 5 years longer than cisgender men [20].

The non-age-specific sexual orientation among cisgender women analyses can be found in Table 5. Ever receiving an HPV Vaccine and number of lifetime HPV vaccines analyses contained individuals aged 18-64 years old. Ever receiving an HPV test or Pap Test, and time since the last HPV and Pap Test analyses contained individuals aged 18-99 years old.

The age-specific sexual orientation among cisgender women analyses can be found in Table 6. The lifetime receipt of HPV vaccines and number of lifetime HPV vaccines contained individuals aged 18-36. The cutoff point of 36 years contained individuals who would have been in the recommended age group of 9-26 years following the initial HPV vaccine release in 2006 through the time of data collection. The HPV Test Ever was limited to individuals aged 30-82 years of age. The lower boundary reflects the recommended starting age to receive HPV testing. The upper boundary of 82 reflects the women who would have been within the 65 years of age window to receive the HPV test following its release in the late 1990s [21]. The Pap Test Ever included individuals aged 21-99 due to these individuals being in the 21-65 year recommendation timeframe following Pap Test’s becoming routinely recommended in the 1960s [22].

Age-specific sexual orientation analyses for Time Since Last HPV Test contained individuals 30-69 years of age. Following the HPV Test guidelines of receiving a test every five years until age 65, these individuals would have been recommended to receive an HPV test at some point within the 5 years prior to data collection. Similarly, the Time Since Last Pap Test contained individuals 21-67 years. Following the Pap Test guidelines for receiving a test every three years until 65, these individuals would have been recommended to receive a Pap Test at some point within the 3 years prior to data collection. A conservative four years for HPV Test and two years for Pap Test were used when deciding cutoff points for time since last test to increase the likelihood that these women were not past the cutoff point of no longer receiving these screenings.

Non-age-specific sexual orientation among cisgender men analysis can be found in Table 8 and contained participants aged from 18-64 years who answered health screening questions related to HPV Vaccines. Age-specific gender identity analyses can be found in Table 9 and contained individuals aged between 18-32 years old. The cutoff point of 32 years contains individuals who would have been in the recommended age group of 9-26 years old between 2010 and data collection at 2015.

As a result of being unable to determine a participant’s sex assigned at birth and recommended corresponding physiological health screenings due to the interviewer assigning participant’s sex by voice timbre, individuals who reported their gender identity as transgender were excluded from the sexual orientation analyses. Bivariate descriptive statistics were executed to determine associations between sexual orientation and gender identity and outcomes. Weighted logistic regression analyses were performed to determine associations between gender identity/sexual orientation and binary health screening measures (HPV vaccine ever, HPV test ever, Pap Test ever). Weighted multinomial logistic regression analyses were implemented to assess categorical outcomes (number of lifetime HPV vaccine, time since HPV test, time since Pap Test). All regression models controlled for age, race, ethnicity, education, marital status, and income. Additionally, the multinomial logistic regression model assessing time since Pap Test controlled for history of ever having a hysterectomy. Adjusted odds ratios were calculated with 95% confidence intervals. All analyses were performed in SAS 9.4 Statistical Software.

# Results

Table . Demographic Characteristics by Gender Identity (n=8,968)

|  |  |
| --- | --- |
|  | **Gender Identity** |
| **Characteristic** | Cisgender womenn=5,179n (Wt. %) | Cisgender menn=3,753n (Wt. %) | Transgendern=36n (Wt. %) | P-Value |
| **Age (years)** |  |  |  |   |
| 18-29 | 481 (19.18) | 489 (23.06) | 8 (38.55) | 0.0002 |
| 30-44 | 846 (19.29) | 672 (20.13) | 10 (30.33) |  |
| 45-64 | 2082 (36.76) | 1496 (36.56) | 9 (17.83) |  |
| 65+ | 1726 (24.77) | 1076 (20.25) | 9 (13.28) |  |
| **Race**  |  |  |  |  |
| White | 4318 (83.99) | 3117 (84.20) | 27 (77.82) | 0.0007 |
| Black or African American | 681 (13.37) | 422 (11.06) | 4 (16.16) |  |
| Asian | 98 (1.61) | 145 (3.57) | 1 (1.44) |  |
| Other | 63 (1.04) | 51 (1.17) | 2 (4.57) |  |
| **Hispanic**  |  |  |  |  |
| No | 5098 (98.23) | 3665 (98.09) | 34 (95.21) | 0.6335 |
| Yes | 64 (1.77) | 72 (1.91) | 2 (4.79) |  |
| **Education**  |  |  |  |  |
| High school or Less | 1505 (37.05) | 986 (35.96) | 9 (25.80) | 0.0443 |
| Some College | 1432 (26.77) | 926 (25.17) | 13 (47.49) |  |
| College Degree or More | 2235 (36.18) | 1838 (38.87) | 14 (26.71) |  |
| **Marital Status** |  |  |  |  |
| Married | 2427 (45.11) | 2053 (48.56) | 14 (28.81) | <0.0001 |
| Divorced or Separated | 813 (10.80) | 459 (8.17) | 8 (12.61) |  |
| Widowed | 849 (11.26) | 211 (3.53) | 2 (4.17) |  |
| Never Married/ Member of Unmarried Couple | 1066 (32.83) | 1018 (39.74) | 12 (54.42) |  |
| **Income (US Dollars)** |  |  |  |  |
| <15,000 | 415 (14.41) | 218 (10.20) | 6 (19.12) | <0.0001 |
| 15,000-24,999 | 694 (11.44) | 376 (8.82) | 2 (7.92) |  |
| 25,000-49,999 | 1115 (23.06) | 747 (20.61) | 9 (19.85) |  |
| 50,000-74,999 | 691 (16.15) | 613 (19.31) | 5 (22.80) |  |
| 75,000+ | 1533 (34.93) | 1415 (41.05) | 9 (30.31) |  |

Notes:P-values were determined using Rao-Scott Chi-squared tests.

Table . Weighted Logistic Regression and Multinomial Logistic Regression Models of Receipt of Health Screening by Gender Identity (n=8,968)

|  |  |
| --- | --- |
|  | **Gender Identity** |
| **Health Screening** | Cisgender Women  | Cisgender Men | Transgender | P-Value |
| **HPV Vaccine Ever (n=2,787)**  |  |  |  |  |
| No, n (%) | 1150 (65.25) | 1092 (86.05) | 15 (85.25) | <0.001a |
| Yes, n (%) | 396 (34.75) | 132 (13.95) | 2 (14.75) |  |
| AOR (95% CI) |  |  |  |  |
| Modeled Outcome = ‘No’ | Ref. | **5.54 (4.07-7.55)** | **13.97 (1.13-172.53)** |  |
| **Number of Lifetime HPV Vaccines (n=2,728)** |  |  |  |  |
| 0 Shots, n (%) | 1150 (66.46) | 1092 (88.83) | 15 (91.43) | <0.000$0^{b}$ |
| 1 or 2 Shots, n (%) | 87 (7.27) | 38 (4.10) | 0 (0.00) |  |
| 3+ Shots, n (%) | 280 (26.27) | 65 (7.07) | 1 (8.57) |  |
| AOR (95% CI) |  |  |  |  |
| 0 Shots vs. 3+ Shots | Ref. | **9.81 (6.66-14.46)** | N/A |  |
| 1 or 2 Shots vs. 3+Shots | Ref. | **2.36 (1.13-4.24)** | 1.24 (0.61-2.55) |  |

Notes: AOR – Adjusted Odds Ratio, 95% CI – 95% Confidence Intervals, NA – Not Applicable due to n=0 in one or more categories. Adjusted odds ratio models controlled for age, race, ethnicity, education, marital status, and income. aP-values were determined using Rao-Scott Chi-squared tests. bP-values were determined using Fisher’s exact test.

Table .Weighted Logistic Regression and Multinomial Logistic Regression Models of Receipt of Health Screening Aligned with Age Appropriate Recommendations by Gender Identity (n=1,565)

|  |  |
| --- | --- |
|  | **Gender Identity** |
| **Health Screening** | Cisgender Women | Cisgender Men | Transgender | P-Value |
| **HPV Vaccine Ever (n=1,388)** |  |  |  |  |
| No, n (%) | 387 (47.57) | 511 (78.21) | 9 (81.81) | <0.0001a |
| Yes, n (%) | 360 (52.43) | 119 (21.79) | 2 (18.29) |  |
| AOR (95% CI) |  |  |  |  |
| Modeled Outcome = 'No' | Ref. | **5.80 (4.19-8.03)** | **13.67 (1.24-150.84)** |  |
| **Number of Lifetime HPV Vaccines (n=1,339)** |  |  |  |  |
| 0 shots, n (%) | 387 (48.70) | 511 (82.35) | 9 (89.18) | <0.0001b |
| 1 or 2 shots, n (%) | 74 (10.31) | 33 (6.32) | 0 (0.00) |  |
| 3+ shots, n (%) | 266 (40.99) | 58 (11.33) | 1 (10.82) |  |
| AOR (95% CI) |  |  |  |  |
| 0 Shots vs. 3+ Shots | Ref. | **10.94 (7.24-16.53)** | N/A |  |
| 1 or 2 Shots vs. 3+ Shots | Ref. | **2.31 (1.23-4.34)** | 1.19 (0.50-2.85) |  |

Notes: AOR – Adjusted Odds Ratio, 95% CI – 95% Confidence Intervals, NA – Not Applicable due to n=0 in one or more categories. Adjusted odds ratio models controlled for age, race, ethnicity, education, marital status, and income. aP-values were determined using Rao-Scott Chi-squared tests. bP-values were determined using Fisher’s exact test.

#### Gender Identity

Among the participants included in the gender identity analyses, cisgender women (n=5,179) accounted for 57.8%, cisgender men (n=3,753) accounted for 41.8%, and transgender individuals (n=36) accounted for 0.4%. The demographic characteristics of these gender identities significantly differed across all demographic variables expect ethnicity. Most notably, transgender people were younger than cisgender women and men. For example, 38.55% of transgender people were 18-29 years old compared with 19.18% and 23.06% among cisgender women and men respectively. Additionally, participants who identified as white comprised of greater proportions of cisgender women (83.99%) and cisgender men (84.20%) categories compared to transgender people (77.82%).

Findings from the non-age-specific logistic and multinomial logistic regression analyses by gender identity can be found in Table 2. Compared to cisgender women, cisgender men (AOR: 5.54; 95% CI: 4.07, 7.55) and transgender people (AOR: 13.97; 96% CI: 1.13, 172.53) had significantly greater odds of never receiving an HPV vaccine. Likewise, cisgender men had higher odds of receiving zero HPV shots (AOR: 9.81, 95% CI: 6.66, 14.46) or 1 or 2 HPV shot (AOR: 2.36; 95% CI: 1.13, 4.24) compared to cisgender women who received all three HPV shots. The small sample size of transgender people did not allow for the zero vs. 3 lifetime shot analysis. However, there was no significant difference between transgender individuals receiving 1 or 2 shots vs. 3+ lifetime shots when compared to cisgender women (AOR: 1.24; 95% CI: 0.61, 2.55).

 Age-specific analyses revealed similar results to non-age-specific comparisons by gender identity. Cisgender men had 5.80 greater odds of never having received an HPV vaccine compared to cisgender women (AOR: 5.80, 95% CI: 4.19, 8.03). Furthermore, cisgender men were found to have 10.94 higher odds of never receiving an HPV vaccine and 2.31 higher odds of only receiving 1 or 2 shots compared to cisgender women receiving all 3 shots (AOR: 10.94, 95% CI: 7.24, 16.53), (AOR: 2.31, 95% CI: 1.23, 4.34). Lastly, compared to cisgender women, transgender people had 13.67 greater odds of never receiving an HPV vaccine (AOR: 13.67, 95% CI: 1.24-150.84).

Table . Demographic Characteristics by Sexual Orientation among Cisgender Women (n=5,114)

|  |  |
| --- | --- |
|  | **Sexual Orientation** |
| **Characteristic** | Heterosexualn=4,920n (Wt. %) | Lesbiann=65n (Wt. %) | Bisexualn=107n (Wt. %) | Othern=22n (Wt. %) | P-Value |
| **Age (years)** |  |  |  |  |
| 18-29 | 424 (17.87) | 20 (49.55) | 33 (48.12) | 4 (29.48) | <0.000$1^{a}$ |
| 30-44 | 789 (19.01) | 10 (12.39) | 33 (30.57) | 5 (27.31) |  |
| 45-64 | 2011 (37.85) | 28 (32.46) | 29 (16.53) | 4 (16.44) |  |
| 65+ | 1658 (25.28) | 7 (5.60) | 12 (4.77) | 9 (26.77) |  |
| **Race** |  |  |  |  |
| White | 4119 (84.57) | 45 (64.83) | 83 (76.16) | 18 (81.95) | $$0.0016^{c}$$ |
| Black or African American | 632 (12.72) | 19 (34.54) | 20 (22.17) | 3 (15.68) |  |
| Asian | 95 (1.68) | 0 (0.00) | 0 (0.00) | 0 (0.00) |  |
| Other | 57 (1.03) | 1 (0.63) | 4 (1.67) | 1 (2.37) |  |
| **Hispanic** |  |  |  |  |
| No | 4850 (98.32) | 63 (99.36) | 104 (95.85) | 22 (100.00) | $$0.3288^{b}$$ |
| Yes | 58 (1.68) | 1 (0.64) | 3 (4.15) | 0 (0.00) |  |
| **Education** |  |  |  |  |
| High School or Less | 1416 (36.61) | 17 (41.17) | 28 (36.46) | 9 (34.36) | 0.885$2^{a}$ |
| Some College | 1374 (27.03) | 14 (18.47) | 30 (29.72) | 5 (32.60) |  |
| College Degree or More | 2125 (36.40) | 34 (40.36) | 49 (33.81) | 8 (33.04) |  |
| **Marital Status** |  |  |  |  |
| Married | 2357 (46.83) | 9 (9.22) | 36 (23.89) | 5 (13.75) | <0.000$1^{a}$ |
| Divorced or Separated | 779 (11.04) | 6 (3.12) | 15 (6.42) | 3 (9.65) |  |
| Widowed | 819 (11.46) | 2 (2.33) | 4 (1.26) | 3 (9.53) |  |
| Never Married/ Member of Unmarried Couple | 948 (30.67) | 47 (85.33) | 51 (68.44) | 11 (67.06) |  |
| **Income (US Dollars)** |  |  |  |  |
| <15,000 | 373 (13.41) | 12 (28.10) | 17 (27.03) | 2 (17.96) | $$0.004^{c}$$ |
| 15,000-24,999 | 645 (11.25) | 11 (10.93) | 20 (14.06) | 6 (21.08) |  |
| 25,000-49,999 | 1070 (23.31) | 17 (26.66) | 16 (16.69) | 5 (17.46) |  |
| 50,000-74,999 | 672 (16.60) | 2 (5.38) | 15 (13.82) | 0 (0.00) |  |
| 75,000+ | 1477 (35.42) | 16 (28.93) | 29 (28.40) | 6 (43.51) |  |

Notes: aP-values were determined using Rao-Scott Chi-squared tests. bP-values were determined using Fisher’s exact test. cP-values were determined using Monte-Carlo Approximation.

Table . Weighted Logistic Regression and Multinomial Logistic Regression Models of Receipt of Health Screenings by Sexual Orientation among Cisgender Women (n=5,114)

|  |  |
| --- | --- |
|  | **Sexual Orientation** |
| **Health Screening** | Heterosexual  | Lesbian | Bisexual | Other | P-Value |
| **HPV Vaccine Ever (n=1,533)** |  |  |  |  |  |
| No, n (%) | 1079 (65.99) | 13 (63.73) | 43 (56.85) | 4 (37.38) | 0.316$7^{a}$ |
| Yes, n (%) | 359 (34.01) | 10 (36.27) | 20 (43.15) | 5 (62.62) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome = ‘No’ | Ref | **3.99 (1.02-15.63)** | 1.05 (0.41-2.70) | 0.43 (0.07-2.55) |  |
| **Number of Lifetime HPV Vaccines (n=1,504)** |  |  |  |  |  |
| 0 Shots, n (%) | 1079 (67.07) | 13 (64.91) | 43 (59.55) | 4 (41.58) | $$0.0045^{b}$$ |
| 1 or 2 Shots, n (%) | 81 (7.48) | 2 (3.03) | 0 (0.00) | 2 (22.94) |  |
| 3+ Shots, n (%) | 253 (25.45) | 7 (32.06) | 18 (40.45) | 2 (35.48) |  |
| AOR (95% CI) |  |  |  |  |  |
| 0 Shots vs. 3+ Shots | Ref | 3.52 (0.75-16.43) | 0.94 (0.36-2.47) | 0.62 (00.06-6.23) |  |
| 1 or 2 Shots vs. 3+ Shots | Ref | 0.42 (0.06-2.91) | N/A | 2.78 (0.23-34.44) |  |
| **HPV Test Ever (n=3,432)** |  |  |  |  |  |
| No, n (%) | 1753 (51.15) | 25 (61.02) | 33 (52.56) | 12 (68.96) | 0.427$8^{a}$ |
| Yes, n (%) | 1538 (48.85) | 22 (38.40) | 44 (47.44) | 5 (31.04) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome = ‘No’ | Ref | 1.70 (0.83-3.51) | 1.24 (0.69-2.26) | **3.57 (1.08-11.79)** |  |
| **Time Since HPV Test (n=3,354)** |  |  |  |  |  |
| Never, n (%) | 1753 (52.51) | 25 (61.02) | 33 (52.95) | 12 (72.37) | 0.457$2^{a}$ |
| <5 Years, n (%) | 1213 (40.72) | 17 (31.63) | 34 (37.40) | 2 (12.36) |  |
| >5 Years, n (%) | 249 (6.76) | 5 (7.34) | 9 (9.65) | 2 (15.27) |  |
| AOR (95% CI) |  |  |  |  |  |
| Never vs. <5 Years | Ref | 1.76 (0.82-3.78) | 1.42 (0.75-2.69) | **7.33 (1.24-43.30)** |  |
| >5 Years vs. 5 Years | Ref | 1.64 (0.56-5.87) | **2.90 (1.09-7.71)** | 8.30 (0.54-127.16) |  |
| **Pap Test Ever (n=4,789)** |  |  |  |  |  |
| No, n (%) | 226 (8.06) | 8 (17.38) | 13 (21.73) | 4 (35.15) | 0.023$4^{a}$ |
| Yes, n (%) | 4383 (91.94) | 54 (82.62) | 85 (78.27) | 16 (64.85) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome = ‘No’ | Ref | 0.85 (0.25-2.88) | 1.28 (0.52-3.15) | **7.70 (2.17-27.37)** |  |
| **Time Since Pap Test (n=4,731)** |  |  |  |  |  |
| Never, n (%) | 226 (8.15) | 8 (17.48) | 13 (21.73) | 4 (35.15) | 0.021$8^{a}$ |
| <3 Years, n (%) | 3112 (69.38) | 40 (66.00) | 63 (63.14) | 10 (34.11) |  |
| >3 Years, n (%) | 1214 (22.47) | 13 (16.52) | 22 (15.14) | 6 (30.73) |  |
| AOR\* (95% CI) |  |  |  |  |  |
| Never vs. <3 Years | Ref | 0.82 (0.24-2.79) | 1.58 (0.62-4.02) | **10.74 (2.39-48.21)** |  |
| >3 Years vs. <3 Years | Ref | 1.22 (0.54-2.78) | 1.62 (0.87-3.02) | 2.73 (0.36-20.61) |  |

Notes: AOR – Adjusted Odds Ratio, 95% CI – 95% Confidence Intervals, NA – Not Applicable due to n=0 in one or more categories. Adjusted odds ratio models controlled for age, race, ethnicity, education, marital status, and income. AOR\* model additionally controlled for ever having a hysterectomy. aP-values were determined using Rao-Scott Chi-squared tests. bP-values were determined using Fisher’s exact test.

Table . Weighted Logistic Regression and Multinomial Logistic Regression Models of Receipt of Health Screenings Aligned with Age Appropriate Recommendations by Sexual Orientation among Cisgender Women (n=5,114)

|  |  |
| --- | --- |
|  | **Sexual Orientation** |
| **Health Screening** | Heterosexual | Lesbian | Bisexual | Other | P-Value |
| **HPV Vaccine Ever (n=749)** |  |  |  |  |  |
| No, n (%) | 353 (47.62) | 9 (63.19) | 23 (47.79) | 3 (32.88) | 0.5933a |
| Yes, n (%) | 329 (52.38) | 7 (36.81) | 20 (52.21) | 5 (67.12) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome= 'No' | Ref. | **5.27 (1.15-24.09)** | 1.02 (0.40-2.59) | 0.61 (0.12-3.17) |  |
| **Number of Lifetime Vaccines (n=728)** |  |  |  |  |  |
| 0 Shots, n (%) | 353 (48.64) | 9 (63.19) | 23 (50.57) | 3 (36.86) | 0.1419b |
| 1 or 2 Shots, n (%) | 71 (11.06) | 1 (1.69) | 0 (0.00) | 2 (24.79) |  |
| 3+ Shots, n (%) | 240 (40.30) | 6 (35.12) | 18 (49.43) | 2 (38.35) |  |
| AOR (95% CI) |  |  |  |  |  |
| 0 Shots vs. 3+ Shots | Ref. | 3.97 (0.78-20.31) | 0.95 (0.37-2.48) | 0.91 (0.11-7.85) |  |
| 1 or 2 Shots vs. 3+ Shots | Ref. | 0.23 (0.02-2.71) | N/A | 0.26 (0.26-33.91) |  |
| **HPV Test Ever (n=2,825)** |  |  |  |  |  |
| No, n (%) | 1388 (47.87) | 15 (47.68) | 14 (27.41) | 7 (62.64) | 0.0693a |
| Yes, n (%) | 1342 (52.13) | 18 (53.32) | 38 (72.59) | 3 (37.36) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome= 'No' | Ref. | 1.17 (0.52-2.62) | 0.70 (0.31-1.57) | 2.50 (0.54-11.56) |  |
| **Time Since HPV Test (n=2,237)** |  |  |  |  |  |
| Never, n (%) | 970 (42.97) | 12 (43.99) | 12 (26.48) | 4 (49.86) | 0.571a |
| <5 Years, n (%) | 988 (48.76) | 14 (47.21) | 29 (60.19) | 2 (28.26) |  |
| >5 Years, n (%) | 195 (8.27) | 3 (8.80) | 7 (13.33) | 1 (32.88) |  |
| AOR (95% CI) |  |  |  |  |  |
| Never vs. <5 Years | Ref. | 1.23 (0.51-2.97) | 0.78 (0.31-1.92) | 3.70 (0.31-44.47) |  |
| >5 Years vs. <5 Years | Ref. | 1.61 (0.37-6.96) | 1.90 (0.59-6.07) | 8.11 (0.33-1.99) |  |
| **Pap Test Ever (n=4,660)** |  |  |  |  |  |
| No, n (%) | 165 (4.73) | 5 (9.89) | 6 (10.00) | 2 (18.29) | 0.2912a |
| Yes, n (%) | 4331 (95.27) | 53 (90.11) | 82 (90.00) | 16 (81.71) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome= 'No' | Ref. | 0.67 (0.16-2.78) | 1.34 (0.39-4.65) | **5.65 (1.03-31.02)** |  |
| **Time Since Pap Test (n=3,379)** |  |  |  |  |  |
| Never, n (%) | 94 (4.15) | 5 (10.44) | 6 (10.45) | 2 (25.86) | 0.2477a |
| <3 Years, n (%) | 2520 (78.60) | 38 (74.18) | 58 (73.17) | 6 (42.94) |  |
| >3 Years, n (%) | 622 (17.25) | 9 (15.37) | 16 (16.37) | 3 (31.20) |  |
| AOR\* (95% CI) |  |  |  |  |  |
| Never vs. <3 Years | Ref. | 0.65(0.15-2.80) | 1.80 (0.49-6.56) | **19.80 (1.64-239.16)** |  |
| >3 Years vs. <3 Years | Ref. | 1.06 (0.39-2.87) | 1.59 (0.79-3.16) | 4.60 (0.39-54.54) |   |

Notes: AOR – Adjusted Odds Ratio, 95% CI – 95% Confidence Intervals, NA – Not Applicable due to n=0 in one or more categories. Adjusted odds ratio models controlled for age, race, ethnicity, education, marital status, and income. AOR\* model additionally controlled for ever having a hysterectomy. aP-values were determined using Rao-Scott Chi-squared tests. bP-values were determined using Fisher’s exact test.

#### Sexual Orientation Among Cisgender Women

The cisgender women in the sexual orientation analyses comprised of 96.2% heterosexuals (n=4920), 1.3% lesbians (n=65), 2.1% bisexuals (n=107), and 0.45% other (n=22). Ethnicity and education distributions were similar among sexual orientation categories. However, demographic characteristics of these groups were significantly different by age, race, marital status, and income. Heterosexual cisgender women had significantly fewer participants in the 18-29 age category compared to lesbian, bisexual, and other women (17.87% vs. 49.55%, 48.12%, 29.48%, respectively). Similarly, white cisgender women comprised of 85.57% of heterosexual women, while only accounting for 64.84% of lesbians, 76.16% of bisexuals, and 81.85% of other women.

Table 5 displays the results of the non-age-specific weighted logistic regression and multinomial logistic regression models by sexual orientation among cisgender women. When compared to heterosexuals, lesbians had significantly higher odds (AOR: 3.99; 95% CI: 1.02, 15.63) of never receiving an HPV vaccine in their lifetime. Similarly, bisexual women had higher odds of receiving their most recent HPV test greater than five years vs. within the past five years when compared to heterosexual women (AOR: 2.90; 95% CI: 1.09, 7.71). Lesbians and bisexuals were not found to have any other significant differences in health screenings compared to heterosexual cisgender women. The ‘other’ women had similar outcomes to heterosexual women in ever having an HPV test and number of total HPV vaccines received. However, ‘other’ women had significantly greater odds of never receiving an HPV Test (AOR: 3.57; 95% CI: 1.08, 11.79) and Pap Test (AOR: 7.70, 95% CI: 2.17, 27.37) than their heterosexual counterparts.

The age-specific logistic regression and multinomial logistic regression models can be found in Table 6. Bisexual women were found to have no significant differences in any of the cancer prevention interventions when compared to heterosexual women. However, lesbian women were found to have 5.27 higher odds of never receiving an HPV vaccine compared to heterosexual women (AOR: 5.27, 95% CI: 1.15, 24.09). While these analyses did not reveal significant differences in the ‘other’ women’s receipt of HPV Test or times since last HPV test, significant differences in Pap Tests remained. Compared to heterosexual women, the ‘other’ women had 5.65 greater odds of never receiving a Pap Test (AOR: 5.65, 95% CI: 1.03, 31.02). Furthermore, the ‘other’ women had 19.80 greater odds of never receiving a Pap Test compared to the odds of heterosexual women receiving a Pap test within the past three years (AOR: 19.80, 95% CI: 1.64, 239.16).

Table . Demographic Characteristics by Sexual Orientation among Cisgender Men (n=3,716)

|  |  |  |
| --- | --- | --- |
|  | **Sexual Orientation** |  |
| **Characteristic** | Heterosexualn=3,552n (Wt. %) | Gayn=103n (Wt. %) | Bisexualn=52n (Wt. %) | Othern=9n (Wt. %) | P-Value |
| **Age (years)** |  |  |  |  |  |
| 18-29 | 454 (23.07) | 22 (26.65) | 11 (25.73) | 0 (0.00) | $$0.0019^{c}$$ |
| 30-44 | 632 (19.80) | 25 (29.42) | 10 (27.67) | 1 (12.47) |  |
| 45-64 | 1420 (36.80) | 40 (33.13) | 15 (25.05) | 2 (15.90) |  |
| 65+ | 1028 (20.33) | 15 (10.80) | 16 (21.56) | 6 (71.63) |  |
| **Race**  |  |  |  |  |  |
| White | 2956 (84.05) | 91 (91.87) | 37 (80.74) | 8 (87.53) | $$0.2104^{c}$$ |
| Black or African American | 403 (11.33) | 8 (4.75) | 9 (11.23) | 0 (0.00) |  |
| Asian | 128 (3.39) | 4 (3.38) | 4 (7.40) | 1 (12.47) |  |
| Other | 50 (1.23) | 0 (0.00) | 1 (0.63) | 0 (0.00) |  |
| **Hispanic**  |  |  |  |  |  |
| No | 3472 (98.15) | 101 (98.07) | 48 (95.67) | 8 (100.00) | $$0.1960^{b}$$ |
| Yes | 66 (1.85) | 2 (1.93) | 3 (4.33) | 0 (0.00) |  |
| **Education**  |  |  |  |  |  |
| High School or Less | 935 (35.85) | 21 (31.86) | 14 (41.98) | 4 (55.86) | 0.556$7^{a}$ |
| Some College | 883 (25.46) | 22 (21.49) | 13 (23.17) | 1 (4.36) |  |
| College Degree or More | 1731 (38.68) | 60 (46.65) | 25 (34.85) | 4 (39.77) |  |
| **Marital Status**  |  |  |  |  |  |
| Married | 1995 (49.80) | 18 (18.65) | 18 (32.12) | 3 (28.31) | <0.000$1^{a}$ |
| Divorced or Separated | 443 (8.33) | 4 (2.63) | 7 (7.59) | 2 (28.60) |  |
| Widowed | 203 (3.59) | 1 (0.55) | 2 (1.73) | 2 (21.39) |  |
| Never Married/ Member of Unmarried Couple | 901 (38.28) | 80 (78.18) | 25 (58.56) | 2 (21.71) |  |
| **Income (US Dollars)** |  |  |  |  |  |
| <15,000 | 201 (9.89) | 8 (12.76) | 7 (24.90) | 2 (62.07) | $$<0.0001^{c}$$ |
| 15,000-24,999 | 335 (8.30) | 15 (11.88) | 13 (22.62) | 2 (18.41) |  |
| 25,000-49,999 | 708 (20.72) | 29 (24.86) | 6 (9.39) | 0 (0.00) |  |
| 50,000-74,999 | 577 (19.32) | 18 (18.38) | 8 (14.01) | 1 (19.51) |  |
| 75,000+ | 1363 (41.77) | 30 (32.12) | 15 (29.07) | 0 (0.00) |  |

Notes: aP-values were determined using Rao-Scott Chi-squared tests. bP-values were determined using Fisher’s exact test. cP-values were determined using Monte-Carlo Approximation.

Table . Weighted Logistic Regression and Multinomial Logistic Regression Models of Receipt Health Screenings by Sexual Orientation among Cisgender Men (n=3,716)

|  |  |
| --- | --- |
|  | **Sexual Orientation** |
| **Health Screenings** | Heterosexual | Gay | Bisexual | Other | P-Value |
| **HPV Vaccine Ever (n=1,214)**  |  |  |  |  |  |
| No, n (%) | 1019 (86.13) | 44 (89.55) | 18 (69.75) | 1 (100.00) | 0.2988 |
| Yes, n (%) | 123 (13.87) | 4 (10.45) | 5 (30.25) | 0 (0.00) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome = ‘No’ | Ref | 1.12 (0.35-3.52) | 0.35 (0.07-1.88) | N/A |  |
| **Number of Lifetime HPV Vaccines (n=1,185)** |  |  |  |  |  |
| 0 Shots, n (%) | 1019 (88.83) | 44 (89.55) | 18 (82.87) | 1 (100.00) | 0.6710 |
| 1 or 2 Shots, n (%) | 36 (4.10) | 1 (2.43) | 1 (10.33) | 0 (0.00) |  |
| 3+ Shots, n (%) | 60 (7.08) | 3 (8.02) | 2 (6.80) | 0 (0.00) |  |
| AOR (95% CI) |  |  |  |  |  |
| 0 Shots vs. 3+ Shots | Ref | 0.52 (0.14-1.87) | 0.89 (0.08-4.48) | N/A |  |
| 1 or 2 Shots vs. 3+Shots | Ref | 0.39 (0.04-3.92) | N/A | N/A |  |

Notes: AOR – Adjusted Odds Ratio, 95% CI – 95% Confidence Intervals, NA – Not Applicable due to n=0 in one or more categories. Adjusted odds ratio models controlled for age, race, ethnicity, education, marital status, and income. P-values were determined using Fisher’s exact test.

Table . Weighted Logistic Regression and Multinomial Logistic Regression Models of Receipt Health Screenings Aligned with Age Appropriate Recommendations by Sexual Orientation among Cisgender Men (n=620)

|  |  |
| --- | --- |
|  | **Sexual Orientation** |
| **Health Screening** | Heterosexual | Gay | Bisexual | Other | P-Value |
| **HPV Vaccine Ever (n=498)** |  |  |  |  |  |
| No, n (%) | 359 (75.41) | 19 (84.76) | 8 (60.60) | 1 (100.00) | 0.6766 |
| Yes, n (%) | 105 (24.59) | 3 (15.23) | 3 (39.40) | 0 (0.00) |  |
| AOR (95% CI) |  |  |  |  |  |
| Modeled Outcome= 'No' | Ref. | 1.25 (0.35-4.50) | 0.70 (0.13-3.85) | N/A |  |
| **Number of Lifetime HPV Vaccines (n=473)** |  |  |  |  |  |
| 0 Shots, n (%) | 359 (79.73) | 19 (84.76) | 8 (68.58) | 1 (100.00) | 0.9612 |
| 1 or 2 Shots, n (%) | 29 (7.06) | 1 (4.76) | 1 (20.26) | 0 (0.00) |  |
| 3+ Shots, n (%) | 52 (13.21) | 2 (10.48) | 1 (11.15) | 0 (0.00) |  |
| AOR (95% CI) |  |  |  |  |  |
| 0 Shots vs. 3+ Shots | Ref. | 0.63 (0.15-2.74) | 0.53 (0.05-6.48) | N/A |  |
| 1 or 2 Shots vs. 3+ Shots | Ref. | 0.55 (0.05-6.20) | N/A | N/A |  |

Notes: AOR – Adjusted Odds Ratio, 95% CI – 95% Confidence Intervals, NA – Not Applicable due to n=0 in one or more categories. Adjusted odds ratio models controlled for age, race, ethnicity, education, marital status, and income. P-values were determined using Fisher’s exact test.

#### Sexual Orientation Among Cisgender Men

Heterosexual cisgender men (n=3552) accounted for 95.6%, gay men (n=103) were 2.8%, bisexual men (n=52) were 1.4%, and ‘other’ men (n=9) were 0.2% of the cisgender men and sexual orientation analyses. The demographic characteristics of these groups were similar by race, ethnicity, and education. However, significant differences existed in age, marital status, and income. Age distributions varied among these groups with the 18-29 years age group accounting for 23.07% of heterosexuals, 26.65% of gays, and 25.73% of bisexuals and 0.00% of ‘other’ men. Moreover, 71.63% of the ‘other’ men were 65 years or older while this age group accounted for 20.33%, 10.80%, and 21.56% of heterosexual, gay, and bisexual categories respectively.

Results of the non-age-specific and age-specific weighted logistic regression and multinomial logistic regression models by sexual orientation among cisgender men can be found in Tables 8 and 9. When compared to heterosexual cisgender men, there were no significant differences among any SMM groups for ever receiving an HPV vaccine or number of lifetime HPV vaccines in either analyses.

# Discussion

These findings highlight current health disparities in use of HPV and related cancer preventive interventions between SGM and their heterosexual cisgender counterparts in Allegheny County. By gender identity, cisgender women were the most likely to engage in receiving the HPV vaccine and fully complete the recommended three doses. These results imply that there are current gaps in HPV promotion, uptake, and education between cisgender women, cisgender men, and transgender people. As previously mentioned, the HPV vaccine initiative has targeted cisgender women longer than cisgender men and transgender individuals. While this may explain the differences in ever receiving an HPV vaccine, it does not account for differences in vaccination completion rates. Future interventions should assess barriers to completing the series as well as patient’s perceptions surrounding the importance of receiving all doses. Lastly, analyses including a larger sample of transgender people will further aid in evaluating the needs of this underserved population.

Analyses evaluating differences by sexual orientation among cisgender women revealed lower uptake in cancer prevention interventions in SMW compared to heterosexual women. Although the differences in bisexual women were not present in the age-specific analyses, the disparities in receival of HPV Vaccines and Pap Tests among lesbians and ‘other’ women persisted. Both analyses, non-age-specific and age-specific, offer valuable insight into current gaps in cancer care. The non-age-specific analyses revealed that intervention uptake differed by sexual orientation despite some women being outside of the ages for recommended screenings. For example, some women under the age of 21 and 30 years had reported having received a Pap Test and HPV test respectively. Additionally, women who were in their thirties at the time of the introduction of the HPV vaccine had reported having been vaccinated. While those partaking in prevention interventions may have been recommended to do so based on individual medical history, it may also indicate misinformation surrounding current cancer screening guidelines. Identifying reasons behind why these women are receiving these interventions outside of the guidelines may better inform how healthcare utilization differs across these groups. Future interventions assessing knowledge of current screening guidelines may help explain the outliers seen in the non-age-specific analyses.

Moreover, additional interventions are needed to address the cancer prevention utilization disparities in lesbians and ‘other’ women. Assessing SMW’s attitudes and beliefs, in conjunction with access to care barriers, will inform the field on SMW-specific healthcare needs that need to be addressed in the public health sector. Future research should also obtain participant’s medical history to identity screening recommendations at an individual level.

 Heterosexual men and SMM were found to have similar results in lifetime receipt of HPV vaccine and number of completed doses. While these results suggest that there are not current HPV related health disparities for SMM in Allegheny County, further surveillance of this high-risk group is warranted. As health care providers continue to increase the promotion of the HPV vaccination to cisgender men, a health disparity may emerge if SMM’s unique risks and needs are not included in the tailored messaging. Likewise, future comparison of heterosexual and SMM’s rates of anal cancer screenings may reveal potential differences in preventive intervention uptake.

## Limitations

There are several limitations to consider when interpreting the above findings. The ACHD health survey reflects cross-sectional data and contributing factors to these health disparities cannot be determined from these analyses. Likewise, the data were self-reported, and the results may be subject to response bias. Additionally, interviewers conducting the survey assigned the sex of the participants based upon the individual’s vocal timbre. Participants were only asked to self-identify their sex if the interviewer deemed it necessary. However, a secondary analyses of the BRFSS 2014 study found that identifying participant’s sex via vocal timbre resulted in approximately one third of transgender respondents receiving sex-specific questions that opposed their natal sex [23]. Due to the inability to accurately determine the recommended physiological screenings for individuals who identified as transgender, gender identity analyses were limited to non-sex-specific preventive interventions. Future research should require all participants to self-identify their sex.

Additionally, the recommended screening guidelines for a Pap Test change according to an individual’s receipt of an HPV test [17]. Due to being unable to determine if a participant received an HPV and Pap Test concurrently, ‘Time since last Pap Test’ did not account for an individual’s ‘time since last HPV test’. Lastly, while cisgender women participants responded to ever having a hysterectomy, they were not asked to identify the type of procedure or previous medical history. Although ‘Time since Pap Test’ controlled for history of hysterectomy, future studies should measure participant’s individual recommended screening timeline based on these factors. Future studies assessing SGM disparities beyond Allegheny County should account for these limitations to accurately assess SGM health pertaining to HPV and related cancer prevention interventions.

## Conclusion

Despite the above limitations, this analysis was one the first studies to assess HPV and related cancer prevention interventions in a sample size of this magnitude in Allegheny County. These results not only add to the limited SGM cancer literature, but also identity possible points of interventions. Future interventions should qualitatively assess the beliefs and attitudes of SGM pertaining to HPV and related screenings. Furthermore, identifying SGM’s barriers to accessing care, as well as the types and sources of HPV education they have received will better inform creating SGM tailored cancer interventions. By the same token, additional interventions should evaluate the current health care provider’s knowledge and understanding of SGM specific-cancer risks and needs. Continued efforts evaluating the reasons driving these health disparities between SGM and their heterosexual and cisgender peers will further highlight the needs of this marginalized community and help decrease the gap in SGM cancer care.

Bibliography

1. Services, U.S.D.o.H.a.H. *Genital HPV Infection-Fact Sheet*. [Web Site] 2017 November 16, 2017 [cited 2017 December 30, 2017]; Available from: <https://www.cdc.gov/std/hpv/stdfact-hpv.htm>.

2. Quinn GP, S.J., Sutton SK, Vadaparampil ST, Nguyen GT, Green BL, Kanetsky PA, Schabath MB, *Cancer and Lesbian, Gay, Bisexual, Transgender/Transsexual and Queer/Questioning Poulations (LGBTQ).* A Cancer Journal for Clinicians, 2015. **65**(5): p. 384-400.

3. Services, U.S.D.o.H.a.H. *Reasons to get Vaccinated*. 2019 March 26, 2019 [cited 2019 April 10, 2019]; Available from: <https://www.cdc.gov/hpv/parents/vaccine/six-reasons.html>.

4. Services, U.S.D.o.H.a.H. *HPV and Cancer*. 2015 February 19, 2015 [cited 2017 December 30, 2017]; Available from: <https://www.cancer.gov/about-cancer/causes-prevention/risk/infectious-agents/hpv-fact-sheet>.

5. Gates, G.J. *How many people are lesbian, gay, bisexual, and transgender?* 2011.

6. Tamargo C, Q.G., Sanchez J, Schabath M., *Cancer and the LGBTQ Population: Quantitative and Qualitative Results from an Oncology Providers' Survey on Knowledge, Attitude, and Practice Behaviors.* Journal of Clinical Medicine, 2017. **6**(10).

7. Margolies L, G.B. *Anal Cancer, HIV, Gay and Bisexual Men*. 2009 [cited 2017 December 30, 2017]; Available from: <http://cancer-network.org/cancer-information/gay-men-and-cancer/anal-cancer-hiv-and-gaybisexual-men/>.

8. McRee AL, K.M., Paskett ED, Reiter PL, *HPV vaccination among lesbian and bisexual women: Findings from a national survey of young adults.* Vaccine, 2014. **32**(37): p. 4736-4742.

9. Brown JP, T.J., *Lesbians and cancer: an overlook health disparity.* Cancer Causes Control, 2008. **19**(10): p. 1009-1020.

10. Services, U.S.D.o.H.a.H. *HIV Among Transgender People*. 2017 August 3, 2017 [cited 2017 December 17, 2017]; Available from: <https://www.cdc.gov/hiv/group/gender/transgender/index.html>.

11. Kenagy, G.P., *Transgender Health: Findings from Two Needs Assessment Studies in Philadelphia.* Health and Social Work, 2005. **30**(1): p. 19+.

12. Network, N.L.C. *Trangender/Gender Non-conforming People and Cancer*. 2019 4/25/19]; Available from: <https://cancer-network.org/cancer-information/transgendergender-nonconforming-people-and-cancer/>.

13. Commerce, U.S.D.o. *Quick Facts Allegheny County, Pennsylvania*. 2016 July 1, 2016 [cited 2017 December 30, 2017]; Available from: <https://www.census.gov/quickfacts/fact/table/alleghenycountypennsylvania/PST045216>.

14. Leonhardt D, M.C. *The Metro Areas with the Largest, and Smallest, and Gay Populations*. 2015 December 30, 2017; March 20, 2015:[Available from: <https://www.nytimes.com/2015/03/21/upshot/the-metro-areas-with-the-largest-and-smallest-gay-population.html>.

15. Hacker K, B.L., Jones L, Monroe C, *Resulst from the 2015-2016 Allegheny County Health Survey (ACHS): Measuring the Health of Adults Residents*. 2017, Allegheny County Health Department.

16. Saslow D, S.D., Lawson H, et. al., *American Cancer Society, American Society for Colposcopy and Cervical Pathology, and American Society for Clinical Pathology Screening Guidelines for the Prevention and Early Detection of Cervical Cancer.* A Cancer Journal for Clinicians, 2013. **62**(3): p. 147-172.

17. Society, A.C. *The American Cancer Society Guidelines for the Prevention and Early Detection of Cervical Cancer*. 2016 December 28, 2018 [cited 2019 March 8, 2019]; Available from: <https://www.cancer.org/cancer/cervical-cancer/prevention-and-early-detection/cervical-cancer-screening-guidelines.html>.

18. Gynecologists, A.C.o.O.a. *Cervical Cancer Screening*. 2017 [cited 2019 April 10]; Available from: <https://www.acog.org/Patients/FAQs/Cervical-Cancer-Screening#often>.

19. Rositch A, N.R., Gravitt P, *Increased Age and Race-Specific Incidence of Cervical Cancer After Correction for Hysterectomy Prevalence in the United States from 2000 to 2009.* Cancer, 2014. **120**(13): p. 2032-2038.

20. Saslow D, A.K., Manassaram-Badptiste D, et al., *Human papillomavirus vaccination guideline update: American Cancer Society Guidelines endorsement* A Cancer Journal for Clinicians, 2016. **66**(5): p. 375-385.

21. Uphoff, T. *The Evolving Role of HPV Testing in Cervical Cancer Screening*. 2014 [cited 2019; Available from: <https://www.aacc.org/publications/cln/articles/2014/april/cervical-cancer>.

22. Shaw, P.A., *The History of Cervical Screening I: The Pap. Test.* Journal of Obstetrics and Gynaecology Canada, 2000. **22**(2): p. 110-14.

23. Riley N, B.J., Bear T, Reisner S, *Vocal Timbre and the Classification of Respondent Sex in US Phone-Based Surveys.* American Journal of Public Health, 2017. **107**(8): p. 1290-1294.