



Correlates of human papillomavirus vaccination intent for oropharyngeal cancer prevention among gay and bisexual men living in the United States

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Supplemental material is available online.

ABSTRACT

Background. Gay and bisexual men (GBM) are at increased risk of developing human papillomavirus (HPV)–associated oropharyngeal cancer (OPC). Vaccination may prevent OPC in GBM; however, vaccination rates are low. The authors explored the correlates associated with HPV vaccination intent for OPC prevention among GBM.

Methods. The authors conducted a cross-sectional study in which they surveyed 1,700 adult GBM with a profile on 2 online dating sites. Eligibility criteria included self-identified GBM living in the United States, aged 18 through 45 years who had sex with a man in the past 5 years. Factors associated with participants' HPV vaccination status and intent to vaccinate were assessed via the online questionnaire using the Health Belief Model.

Results. Most of the 1,108 eligible GBM had not received 1 dose or more of the HPV vaccine (54.2%), were aged 27 through 37 years (52.3%), were White (58.3%), identified as cisgender men (93.4%), were gay (79.3%), were in a monogamous relationship (99.4%), and had a bachelor's degree (29.4%) or higher college education (26.1%). Among unvaccinated GBM, 25.3% reported intent to receive the vaccine. In the multivariable model, independent associations ($P < .05$) were found for the Health Belief Model constructs (perceived benefits and perceived barriers) with HPV vaccine intent, after adjusting for all other predictor variables in the model.

Conclusions. The benefits of HPV vaccination for the prevention of OPC is associated with intent to vaccinate among GBM. Dental care providers can use this information to educate patients in this high-risk population on prevention of HPV–associated OPC.

Practical Implications. Dentists can advocate for HPV vaccination uptake among GBM patients by means of discussing the benefits of vaccination in the prevention of HPV-associated OPC.

Key Words. Oropharyngeal cancer; human papillomavirus; HPV; gay and bisexual men; vaccination; HPV vaccine.

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Human papillomavirus (HPV) is the most common sexually transmitted infection in the United States and the leading cause of anal cancer and oropharyngeal cancer (OPC) in men.¹ Although most HPV infections are transient, persistent high-risk types, mainly type 16, can lead to cancer at several anatomic sites in men, including anal and penile cancers and OPCs.²

OPC rates among men living in the United States have increased rapidly over the past several decades and can be attributed to HPV.³⁻⁵ HPV-positive OPC (HPV-OPC) is the most common HPV-associated cancer among men and accounts for 82% of new HPV-associated cancer cases ($n = 17,222$) each year. Annual incidence of HPC-OPC ($n = 17,222$) accounts for 71% of new-HPV associated cancers, far outpacing anal cancer ($n = 2,425$).⁶ HPV-OPC incidence exceeds tobacco- and alcohol-related OPC incidence, mirroring the decline in tobacco use over the past several decades among the general adult population.⁷

Oral HPV infections affect gay and bisexual men (GBM) disproportionately. In a 2017 US study⁸ using data from the 2011-2014 National Health and Nutritional Examination Surveys, researchers found the prevalence of oral oncogenic types was highest among GBM with 2 or more same-sex oral sex partners (22.2%; 95% CI, 9.6% to 34.8%). Researchers have consistently reported higher oral, genital, and concordant oral and genital HPV infections in men who have sex with men than men who have sex with women exclusively.^{9,10}

Similarly, the risk of OPC increases among men with a history of same-sex contact, a greater number of sexual partners, younger age at sexual debut, receptive oral sex, and tobacco smoking.^{8,11,12} Tobacco use among GBM remains substantially higher than among heterosexual men, which may increase their risk of persistent oral infections with high-risk HPV types.^{13,14}

In the United States, a nonavalent vaccine (Gardasil, Merck) is available to prevent infection with 9 HPV types associated with anal and genital warts and cancers, notably type 16, which account for up to 96% of all HPV-OPC.¹⁵ The US Food and Drug Administration licensed the vaccine for males in 2009, and the Advisory Committee on Immunization Practices recommended it for boys aged 11 through 12 years and catch-up vaccination for GBM through age 26 years for the prevention of HPV-associated anogenital warts and cancers.^{15,16} In 2019, the US Food and Drug Administration approved the nonavalent vaccine for men and women aged 26 through 45 years, through shared clinical decision making between patient and provider.¹⁷

Researchers have reported favorable attitudes toward HPV vaccination and increasing HPV vaccination coverage among young GBM since 2011.¹⁸⁻²⁰ However, results of a meta-analysis showed the average HPV vaccination completion rate, as self-reported by adult GBM, was 47% (median, 45%; range, 12%-89%), well below the Healthy People 2030 target of 80%.^{21,22} Associations with HPV vaccine uptake among GBM have focused mainly on prevention of anal cancer.^{20,23} With the rising incidence of HPV-OPC, it is important to understand the factors associated with HPV vaccination uptake among GBM for prevention of HPV-OPC.

Recommendations from health care providers remain the strongest predictor of HPV vaccine uptake.^{24,25} The American Dental Association and American Academy of Pediatric Dentistry have suggested and supported the role of oral health care providers in HPV-OPC prevention, including vaccine advocacy.^{26,27} Although adult dental patients have reported comfort in discussing HPV-OPC, sexual behaviors, and HPV vaccines with dental care providers,²⁸⁻³⁰ dental care providers have reported discomfort in discussing a sexually transmitted infection with their patients.³⁰⁻³²

The Health Belief Model (HBM) is a health behavior theory that has been used to identify psychosocial correlates associated with vaccination uptake. In addition, it has been used to identify correlates of vaccination intent, particularly among the GBM population, to inform targeted public health interventions for the prevention of anal cancer.³³⁻³⁵ Understanding the psychosocial and sociodemographic correlates of HPV vaccine uptake among GBM can inform oral health care providers' efforts to reduce the disproportionate burden of oral HPV among GBM and improve their comfort in discussing HPV with GBM patients during routine dental visits. To our knowledge, no researchers have reported on the correlates associated with HPV vaccine uptake among GBM for the prevention of HPV-OPC. The aim of our study was to identify the factors associated with HPV vaccination status and intent to vaccinate among the HPV vaccine-eligible adult GBM population for the prevention of HPV-OPC using the HBM as a framework.

METHODS

The University of Minnesota Human Research Protection Program approved this study and determined that it involved no greater than minimal risk. The patients and participants provided informed consent to participate in this study.

We aimed to recruit 1,700 GBM from 2 online dating sites (Scruff and Jack'd; Perry Street Software) for our cross-sectional study; this number was based on a sample size calculation of expected 80% power to detect the statistically significant differences between groups on the basis of an anticipated high dropout rate. GBM in the United States with a profile on either site were shown a single advertisement with an embedded link to the survey (available online) during the 5-day recruitment period (February-March 2022). Interested people were directed to a screening questionnaire (Qualtrics) to determine eligibility. Self-identified GBM 18 years or older living in the United States, who had sex with a man in the past 5 years, and who identified as a man were recruited to complete 1 online survey. Transgender men, nonbinary people, and other masculine-

ABBREVIATION KEY

- GBM:** Gay and bisexual men.
- HBM:** Health Belief Model.
- HPV:** Human papillomavirus.
- NA:** Not applicable.
- OPC:** oropharyngeal cancer.

identifying people self-identifying as men were eligible to participate. If deemed eligible, they were directed to the informed consent process, after which they were able to immediately access the main survey. Participants who completed the survey were compensated with a \$50 gift card.

Surveys were reviewed to determine uniqueness using a cross-validation and deduplication (removal of duplicate submissions) protocol adapted for our study.³⁶ The University of Minnesota institutional review board reviewed and approved all study materials.

Measurement

The research team developed the survey instrument (available online), which included multiple discrete sections, using the HBM as a framework. Our analysis used data from select survey items related to demographic characteristics, HPV vaccination status, knowledge related to HPV vaccination and HPV-OPC, and items that served as proxies for the HBM constructs, including perceived susceptibility, severity, benefits, barriers, and self-efficacy.

Outcome variables

The primary outcome variable in our study was intent to vaccinate, as measured using the following item: "I intend to make an appointment with a health care provider (like a doctor or pharmacist) to get the HPV vaccine in the next 30 days." Responses were recorded on a 5-point Likert-type scale (agree-disagree). A secondary outcome variable was self-reported HPV vaccination to explore correlates related to vaccine initiation assessed using the following item (yes, no, unsure): "Have you received at least one dose of the human papillomavirus (HPV) vaccine?" Receipt was defined as 1 dose because a considerable number of respondents could not remember how many doses they had received. The secondary outcome was operationalized as dichotomous and no and unsure responses were categorized as unvaccinated. Researchers have reported moderate through high sensitivity (79.5%-93.2%) and specificity (76.1%-83.3%) estimates of self-reported HPV vaccination status.³⁷

Predictor variables

Predictors for vaccination intent and vaccine receipt included age, race, education, relationship status, knowledge, and the HBM constructs of perceived susceptibility, severity, benefits, barriers, and self-efficacy.

Demographic and knowledge variables

Race was classified as White, Asian, Black, other, and 2 or more. Education was categorized as high school or General Educational Development credential or less; some college, but no degree; associate's degree; bachelor's degree; and graduate or professional degree. Age group was constructed by means of categorizing the continuous age into the following 3 levels: those in the catch-up vaccination age range (aged 18-26 years), those who had been in the recommended age range since 2011 (aged 27-37 years), and those who had never been in the recommended age range but were eligible (aged 38-45 years) to explore differences in variables according to vaccine eligibility status. Knowledge was measured using 12 true or false items, including 10 OPC knowledge items and 2 HPV vaccination knowledge items.

HBM constructs

Questionnaire items used as proxies for the HBM constructs are provided in the [eTable](#) (available online at the end of the article). Perceived susceptibility, defined as the respondent's perception of the risks of acquiring an HPV infection or OPC, was measured using 5 items related to perceptions of personal risk factors. Two items were used to measure perceived severity, defined as the respondent's perception of the severity of HPV oral infection and OPC. Three items were used to measure perceived benefits, defined as the respondent's perception of the personal benefit of receiving the HPV vaccine. Two items were used to measure perceived barriers, defined as the respondent's perceptions of obstacles preventing HPV vaccination receipt. One item was used to measure self-efficacy, defined as the respondent's perceived confidence and ability to decide to receive the HPV vaccine. A 5-point Likert-type scale (ranging from 1 disagree through 5 agree) was used for responses to the item "There are so many health hazards out there it is too exhausting to consider them all." An exploratory factor analysis (ie, principal components analysis followed by a varimax rotation) confirmed these latent dimensions of the HBM.

Table 1. Characteristics summary for all respondents (n = 1,108).

CHARACTERISTIC	DATA
Age Category, Y, No. (%)	
18-26	184 (16.6)
27-37	579 (52.3)
38-45	345 (31.1)
Race, No. (%)	
White	628 (58.3)
Asian	45 (4.2)
Black	246 (22.8)
Other	61 (5.7)
≥ 2	97 (9.0)
Sex Assigned at Birth, No. (%)	
Male	1,088 (98.5)
Female	17 (1.5)
Self-identity, No. (%)	
Cisgender man	1,026 (93.4)
Nonbinary, gender nonconforming	46 (4.2)
Transgender man	16 (1.5)
Transmasculine nonbinary	3 (0.3)
Two spirit, Hijra	2 (0.2)
Other	6 (0.5)
Think of Self as . . . , No. (%)	
Gay	875 (79.3)
Bisexual	193 (17.5)
Demisexual	2 (0.2)
Queer	14 (1.3)
Pansexual	12 (1.1)
Other	7 (0.6)
Relation, No. (%)	
Monogamy	1,095 (99.4)
Nonmonogamy	7 (0.6)
Education, No. (%)	
High school or General Educational Development credential or less	117 (10.6)
Some college, no degree	290 (26.4)
Associate's degree	82 (7.5)
Bachelor's degree	324 (29.5)
Graduate or professional	287 (26.1)
Have Health Insurance, No. (%)	
No	97 (11.3)
Yes	758 (88.7)
Have Dental Insurance, No. (%)	
No	230 (26.9)
Yes	624 (73.1)

* IQR: Interquartile range.

Table 1. Continued

CHARACTERISTIC	DATA
Have a Regular Primary Care Provider, No. (%)	
No	250 (23.8)
Yes	800 (76.2)
Have a Dentist, No. (%)	
No	422 (40.3)
Yes	626 (59.7)
Comfort Telling a Dentist Sexual History, No. (%)	
Comfortable	618 (64.5)
Not comfortable	340 (35.5)
Comfort Receiving Vaccinations From Dentist, No. (%)	
Comfortable	682 (79.1)
Not comfortable	180 (20.9)
Perceived Susceptibility, Median (IQR)*	4.00 (3.60-4.40)
Perceived Severity, Median (IQR)	4.00 (4.00-4.50)
Perceived Benefits, Median (IQR)	4.33 (3.67-5.00)
Perceived Barriers, Median (IQR)	1.00 (1.00-1.00)
Self-Efficacy, Median (IQR)	3.00 (2.00-4.00)
All Knowledge, Median (IQR)	5.00 (2.00-8.00)

Statistical analysis

Participants' demographic characteristics and perceptions of the HPV vaccine were summarized as median and interquartile ranges for continuous variables and frequencies and percentages for categorical variables. Summaries were based on total participant population and stratified according to HPV vaccination receipt and intent. For participants' vaccine receipt, associations between this outcome and all predictor variables, including demographic characteristics, were assessed using both univariate and multivariable logistic regression models. For participants' intent of receiving the HPV vaccine, associations between this outcome and all predictor variables were assessed using both univariate and multivariable proportional odds logistic regression models. In both of the logistic regression and proportional odds logistic regressions, results were presented as unadjusted odds ratios (ORs) and their corresponding 95% CI for univariate models and adjusted ORs and their corresponding 95% CI for multivariable models. All analyses were conducted using the R (R Core Team) environment, Version 4.2.1 and at a significance level of .05.

RESULTS

There were 4,192 and 5,072 unique clicks for Scruff and Jack'd, respectively, for a total of 9,264 clicks. Among these clicks, 4,464 people commenced and 1,836 completed the informed consent process (19.86% of unique clicks); 114 participants were removed during the deduplication process. After validation, deduplication, and internal consistency protocols, 1,722 consenting participants remained and were eligible and 1,699 completed the first question of the main survey. For this analysis, participants older than 45 years were excluded from analyses due to ineligibility for HPV vaccine receipt, resulting in 1,108 participants.

Sample demographic characteristics

Overall demographic data are presented in [Table 1](#). Most respondents were aged 27 through 37 years (52.3%), were White (58.3%), identified as cisgender men (93.4%), were gay (79.3%), were in a monogamous relationship (99.4%), and had a bachelor's degree (29.4%) or higher college education (26.1%). Most of the participants reported having health (88.7%) and dental (73.1%) insurance coverage and having a regular primary care provider (76.2%) and dentist (59.7%). Most respondents (64.5%) agreed with the item, "I would feel comfortable telling a dentist about my sexual history as part of a routine cancer screening" compared with those who reported discomfort

Table 2. Characteristics summary stratified according to vaccination receipt.

CHARACTERISTIC	NOT VACCINATED (n = 601)	VACCINATED (n = 447)
Age Category, Y, No. (%)		
18-26	62 (36.3)	109 (63.7)
27-37	300 (54.5)	250 (45.5)
38-45	239 (73.1)	88 (26.9)
Race, No. (%)		
White	359 (59.3)	246 (40.7)
Asian	22 (50.0)	22 (50.0)
Black	129 (57.1)	97 (42.9)
Other	32 (55.2)	26 (44.8)
≥ 2	46 (50.5)	45 (49.5)
Sex Assigned at Birth, No. (%)		
Male	596 (57.9)	434 (42.1)
Female	4 (25.0)	12 (75.0)
Relation, No. (%)		
Monogamy	597 (57.4)	443 (42.6)
Nonmonogamy	3 (42.9)	4 (57.1)
Education, No. (%)		
High school or General Educational Development credential or less	71 (63.4)	41 (36.6)
Some college, no degree	162 (60.4)	106 (39.6)
Associate's degree	39 (51.3)	37 (48.7)
Bachelor's degree	168 (53.5)	146 (46.5)
Graduate or professional	159 (57.6)	117 (42.4)
Perceived Susceptibility, Median (IQR)*	4.00 (3.50-4.40)	4.00 (3.80-4.40)
Perceived Severity, Median (IQR)	4.00 (3.00-4.50)	4.00 (4.00-4.50)
Perceived Benefits, Median (IQR)	4.00 (3.33-4.67)	5.00 (4.50-5.00)
Perceived Barriers, Median (IQR)	1.00 (1.00-1.50)	1.00 (1.00-1.00)
Self-Efficacy, Median (IQR)	2.00 (2.00-4.00)	3.00 (2.00-4.00)
All Knowledge, Median (IQR)	5.00 (2.00-7.00)	6.00 (3.00-8.00)

* IQR: Interquartile range.

(35.5%). Most (79.1%) reported comfort in receiving vaccines from dentists. Overall knowledge scores were low (median score, 5.00 [interquartile range, 2.00-8.00] of 12).

Vaccination status

The summaries of demographic variables stratified according to vaccination status (not vaccinated, vaccinated) are presented in Table 2. Most participants reported never having received the HPV vaccine (n = 601 [54.2%]). When examining vaccination status for each age group, a higher percentage of participants aged 18 through 26 years (n = 109 [52.2%]) reported receiving the vaccine (defined as receiving ≥ 1 dose of the HPV vaccine) than those aged 27 through 37 years (n = 250 [45.5%]) and 38 through 45 years (n = 88 [26.9%]).

Predictor variables associated with HPV vaccine receipt

Logistic regression results for predictor variables of HPV vaccine receipt (≥ 1 doses of the HPV vaccine) are summarized in Table 3. In the univariate model, all HBM constructs and knowledge were positively associated with vaccine receipt. Perceived barriers was negatively associated with vaccine receipt. Additional significant differences in vaccine receipt were found for age and assigned female vs male at birth. In the multivariable model, independent associations (P < .05) were found

Table 3. Logistic regression results for vaccination receipt.

VARIABLE	UNADJUSTED OR* (95% CI)	P VALUE† OF UNADJUSTED OR	ADJUSTED OR (95% CI)	P VALUE‡ OF ADJUSTED OR
Age [§]	0.921 (1.320 to 0.940)	<.001	0.894 (0.867 to 0.923)	<.001
Sex Assigned at Birth				
Male	1.000	NA [¶]	1.000	NA
Female	4.120 (0.400 to 12.860)	.015	3.630 (0.790 to 16.689)	.098
Relation				
Monogamy	1.000	NA	1.000	NA
Nonmonogamy	1.797 (0.791 to 8.069)	.444	0.672 (0.067 to 6.688)	.734
Race				
White	1.000	NA	1.000	NA
Asian	1.459 (0.805 to 2.693)	.227	1.070 (0.436 to 2.627)	.883
Black	1.097 (0.689 to 1.495)	.556	2.001 (1.219 to 3.284)	.006
Other	1.186 (0.918 to 2.039)	.538	1.281 (0.584 to 2.808)	.537
≥ 2	1.428 (0.718 to 2.221)	.114	1.345 (0.696 to 2.600)	.378
Education				
High school or General Educational Development credential or less	1.000	NA	1.000	NA
College, no degree	1.133 (0.909 to 1.787)	.591	0.581 (0.274 to 1.230)	.156
Associate's degree	1.643 (0.966 to 2.969)	.100	1.095 (0.405 to 2.961)	.858
Bachelor's degree	1.505 (0.810 to 2.346)	.071	0.661 (0.320 to 1.362)	.261
Graduate	1.274 (1.226 to 2.004)	.294	0.509 (0.242 to 1.074)	.076
Susceptibility	1.529 (1.834 to 1.906)	<.001	0.870 (0.584 to 1.296)	.493
Severity	2.246 (4.061 to 2.749)	<.001	3.180 (2.262 to 4.471)	<.001
Benefits	5.159 (0.396 to 6.554)	<.001	5.075 (3.732 to 6.901)	<.001
Barriers	0.495 (1.007 to 0.617)	<.001	0.532 (0.389 to 0.728)	<.001
Self-Efficacy	1.107 (1.034 to 1.218)	.036	1.111 (0.971 to 1.272)	.126
Knowledge	1.078 (1.320 to 1.124)	<.001	0.994 (0.939 to 1.052)	.837

* OR: Odds ratio. † P value from univariate logistic regression. ‡ P value from multivariable logistic regression. § Age was regressed on a per-year continuous scale. ¶ NA: Not applicable.

between HPV vaccine receipt and HBM constructs (perceived severity, benefits, barriers), age, and Black race, after adjusting for all other predictor variables in the model. Figure 1 shows distributions of responses according to HBM constructs.

Intent to vaccinate

Table 4 shows a summary of characteristics stratified according to vaccination intent. Of those who had not received the vaccine, 79 (13.7%) responded somewhat agree and 73 (12.7%) responded strongly agree to the item “I intend to make an appointment with a health care provider (like a doctor or pharmacist) to get the HPV vaccine within the next 30 days.” Participants aged 18 through 26 years had the least intent to vaccinate, with 8 (10.1%) responding somewhat agree and 11 (15.1%) responding strongly agree compared with 35 (44.3%) and 35 (47.9%) participants, respectively, among those aged 27 through 37 years and 36 (45.6%) and 27 (37.0%) participants, respectively, among those aged 38 through 45 years, respectively.

Predictor variables associated with HPV vaccination intent

Proportional odds logistic regression results for predictor variables of HPV vaccination intent (next 30 days) are summarized in Table 5. Results of the univariate logistic regression indicated statistically significant associations between vaccination intent for race (Black, other), having associate's

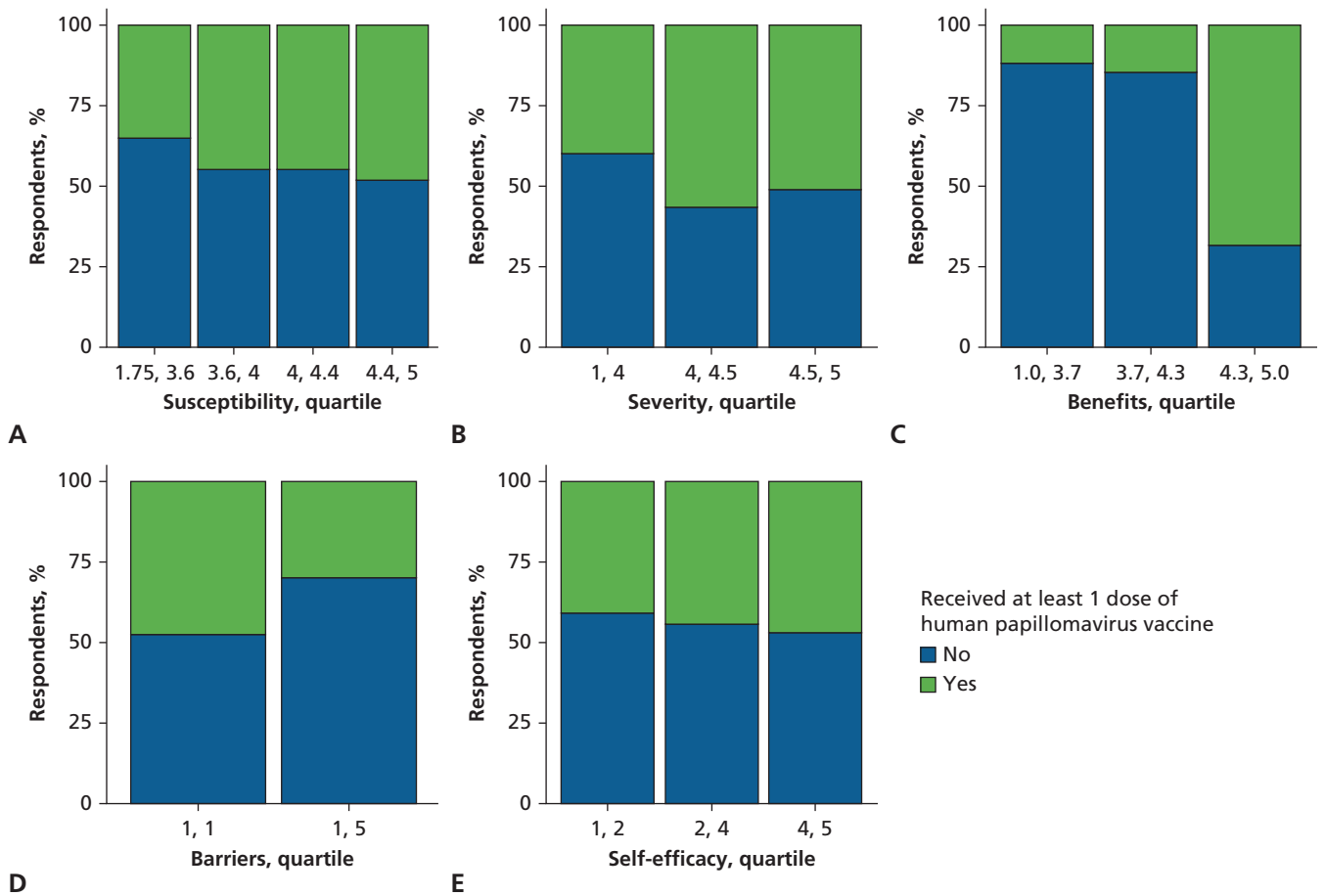


Figure 1. Stacked bar plot for human papillomavirus vaccine receipt. **A.** Susceptibility. **B.** Severity. **C.** Benefits. **D.** Barriers. **E.** Self-efficacy.

degree and graduate levels of education compared with less than high school level of education, and all HBM constructs. In the multivariable model, independent associations ($P < .05$) were found for Black and other race, bachelor's degree, and graduate levels of education; and HBM constructs (perceived benefits, perceived barriers), with HPV vaccination intent, after adjusting for all other predictor variables in the model. Figure 2 shows distributions of responses according to HBM constructs.

DISCUSSION

Although others have studied HPV vaccination intent and receipt for anal cancer in GBM, we are the first researchers, to our knowledge, to explore the correlates associated with HPV vaccination intent and receipt, specifically for the prevention of OPC among GBM. Our findings indicate that intent to receive the HPV vaccine among GBM was motivated predominantly by the perceived personal benefit of OPC prevention. In this large national sample, 40.3% of GBM participants aged 18 through 45 years reported receiving 1 dose or more of the HPV vaccine. Among unvaccinated GBM, intent to vaccinate was low; only 25.3% reported an intent to vaccinate. Most concerning is that only 30.6% of adults in the catch-up age range (18-26 years) reported an intent to receive the HPV vaccine.

Provider recommendation has been found to be the strongest factor associated with HPV vaccine receipt among GBM in the United States for the prevention of anogenital warts and anal cancer.³⁸⁻⁴¹ Although most participants (76.2%) reported having a regular primary care provider and health insurance (88.7%), more than one-half (53.6%) indicated that the main reason they had not received the vaccine was they had not received a physician's recommendation. This finding aligns with results from other studies that showed low HPV vaccine uptake among GBM despite high health care use.^{19,40} In addition to not receiving a provider recommendation, the results from our

Table 4. Characteristics summary stratified by vaccination intent.

CHARACTERISTIC	STRONGLY DISAGREE (n = 136)	SOMEWHAT DISAGREE (n = 71)	NO PREFERENCE (n = 218)	SOMEWHAT AGREE (n = 79)	STRONGLY AGREE (n = 73)
Age Category, Y, No. (%)					
18-26	12 (8.8)	8 (11.3)	20 (9.2)	8 (10.1)	11 (15.1)
27-37	65 (47.8)	35 (49.3)	114 (52.3)	35 (44.3)	35 (47.9)
38-45	59 (43.4)	28 (39.4)	84 (38.5)	36 (45.6)	27 (37.0)
Race, No. (%)					
White	91 (67.9)	54 (76.1)	129 (60.6)	47 (62.7)	26 (36.6)
Asian	6 (4.5)	3 (4.2)	4 (1.9)	6 (8.0)	3 (4.2)
Black	18 (13.4)	12 (16.9)	53 (24.9)	11 (14.7)	28 (39.4)
Other	5 (3.7)	2 (2.8)	13 (6.1)	5 (6.7)	6 (8.5)
≥ 2	14 (10.4)	0 (0.0)	14 (6.6)	6 (8.0)	8 (11.3)
Sex Assigned at Birth, No. (%)					
Male	135 (100.0)	71 (100.0)	216 (99.1)	77 (97.5)	73 (100.0)
Female	0 (0.0)	0 (0.0)	2 (0.9)	2 (2.5)	0 (0.0)
Relation, No. (%)					
Monogamy	136 (100.0)	71 (100.0)	216 (99.1)	77 (98.7)	73 (100.0)
Nonmonogamy	0 (0.0)	0 (0.0)	2 (0.9)	1 (1.3)	0 (0.0)
Education, No. (%)					
High school or General Educational Development credential or less	12 (8.8)	5 (7.0)	27 (12.4)	7 (9.0)	15 (20.5)
Some college, no degree	29 (21.3)	12 (16.9)	61 (28.1)	29 (37.2)	20 (27.4)
Associate's degree	12 (8.8)	2 (2.8)	15 (6.9)	3 (3.8)	3 (4.1)
Bachelor's degree	38 (27.9)	26 (36.6)	61 (28.1)	22 (28.2)	20 (27.4)
Graduate or professional	45 (33.1)	26 (36.6)	53 (24.4)	17 (21.8)	15 (20.5)
Perceived Susceptibility, Median (IQR)*	3.80 (3.40-4.25)	4.00 (3.60-4.40)	3.80 (3.60-4.25)	4.20 (3.75-4.50)	4.00 (3.50-4.40)
Perceived Severity, Median (IQR)	4.00 (3.00-4.00)	4.00 (3.50-4.50)	4.00 (3.00-4.50)	4.00 (4.00-4.50)	4.00 (3.00-4.50)
Perceived Benefits, Median (IQR)	3.67 (3.00-4.00)	4.00 (3.33-4.33)	3.67 (3.33-4.33)	4.33 (4.00-5.00)	4.33 (4.00-5.00)
Perceived Barriers, Median (IQR)	1.00 (1.00-1.00)	1.00 (1.00-1.50)	1.00 (1.00-2.00)	1.00 (1.00-1.00)	1.00 (1.00-2.00)
Self-Efficacy, Median (IQR)	2.00 (2.00-4.00)	2.00 (2.00-4.00)	3.00 (2.00-4.00)	2.00 (2.00-4.00)	3.00 (2.00-5.00)
All Knowledge, Median (IQR)	5.00 (2.00-7.00)	6.00 (3.00-8.75)	5.00 (2.00-7.00)	6.00 (2.00-7.00)	5.00 (2.00-8.00)

* IQR: Interquartile range.

study indicated there may be factors other than access to health care that influence HPV vaccine uptake among GBM for the prevention of OPC.

Two of the HBM constructs were found to be independently associated with HPV vaccine intent among participants in the multivariable model. Those who reported intent to vaccinate were nearly 3 times more likely to perceive personal benefit from receiving a vaccine that prevents OPC than those who reported no intent to vaccinate. In contrast, Gerend and colleagues⁴¹ found that perceived benefit was a weak predictor among a similar target population. Alternatively, Wheldon and colleagues³³ found perceived benefits (adjusted OR, 1.91; 95% CI, 1.19 to 3.07), perceived severity (unadjusted OR, 1.45; 95% CI, 1.02 to 2.06), and perceived self-efficacy (unadjusted OR, 1.57; 95% CI, 1.17 to 2.11) were positively associated with HPV vaccination intent among GBM, and negative associations were found between concern for cost and potential adverse effects and intent to vaccinate. Although perceived barriers were low among all participants who had not received the vaccine, those who reported intent to receive the vaccine perceived higher barriers to vaccination. As participants raised their intent to receive the HPV vaccine, they may have begun to realize the barriers they may face, including cost, transportation, and access.

Table 5. Proportional odds logistic regression results for vaccination intent.

VARIABLE	UNADJUSTED OR* (95% CI)	P VALUE† OF UNADJUSTED OR	ADJUSTED OR (95% CI)	P VALUE‡ OF ADJUSTED OR
Age[§]	0.998 (0.975 to 1.022)	.873	1.006 (0.977 to 1.036)	.682
Sex				
Male	1.000	NA [¶]	1.000	NA
Female	2.433 (0.504 to 11.534)	.252	3.786 (0.735 to 19.860)	.105
Relation				
Monogamy	1.000	NA	1.000	NA
Nonmonogamy	1.958 (0.311 to 12.090)	.456	1.687 (0.245 to 11.672)	.585
Race				
White	1.000	NA	1.000	NA
Asian	1.488 (0.655 to 3.357)	.339	1.093 (0.384 to 3.050)	.866
Black	2.085 (1.433 to 3.042)	<.001	1.679 (1.045 to 2.703)	.032
Other	2.174 (1.119 to 4.229)	.022	2.329 (1.058 to 5.150)	.036
≥ 2	1.453 (0.781 to 2.695)	.236	1.428 (0.736 to 2.756)	.289
Education				
High school or General Educational Development credential or less	1.000	NA	1.000	NA
College, no degree	0.858 (0.506 to 1.455)	.570	0.762 (0.389 to 1.492)	.428
Associate's degree	0.430 (0.201 to 0.911)	.028	0.418 (0.168 to 1.031)	.059
Bachelor's degree	0.601 (0.356 to 1.013)	.056	0.434 (0.224 to 0.837)	.013
Graduate	0.450 (0.265 to 0.764)	.003	0.313 (0.156 to 0.625)	.001
Susceptibility	1.337 (1.031 to 1.737)	.029	0.976 (0.686 to 1.391)	.893
Severity	1.242 (1.027 to 1.504)	.026	1.209 (0.948 to 1.542)	.125
Benefits	1.865 (1.561 to 2.237)	<.001	2.716 (2.082 to 3.561)	<.001
Barriers	1.276 (1.085 to 1.501)	.003	1.435 (1.172 to 1.760)	<.001
Self-Efficacy	1.173 (1.044 to 1.319)	.007	1.123 (0.984 to 1.283)	.085
Knowledge	0.999 (0.950 to 1.051)	.973	0.999 (0.945 to 1.056)	.970

* OR: Odds ratio. † P value from univariate logistic regression. ‡ P value from multivariable logistic regression. § Age was regressed on a per year continuous scale. ¶ NA: Not applicable.

Most of the GBM were comfortable discussing their sexual history with dentists as part of routine OPC screening (64.5%) and with receiving vaccines from dentists (79.1%). This is consistent with other researchers who found GBM have shown interest in receiving provider recommendations^{21,40,41} and education for the HPV vaccine and are comfortable discussing sexual history with their oral health care providers, including dentists and dental hygienists.²⁹ Nearly two-thirds of the participants in our study reported seeing a dentist regularly. This points to the unique role oral health care providers could play in improving HPV-OPC knowledge and increasing vaccination rates for preventing HPV-OPC, particularly when considering the lack of medical provider recommendations reported in our study. Understanding GBM's comfort and using evidence-based communication strategies may improve oral health care providers' comfort, confidence, and efficacy in HPV conversations.

Dental care providers with training in HPV-related topics and skills-based communication training report greater comfort in HPV discussions with patients.^{42,43} Brief motivational interviewing is a patient-centered, evidence-based communication technique that has been reported to improve providers' comfort and confidence in HPV conversations.^{43,44} Oral health care providers trained in motivational interviewing can empower patients' decisions to receive the vaccine by means of eliciting patients' beliefs and guiding the conversation toward factors found to be

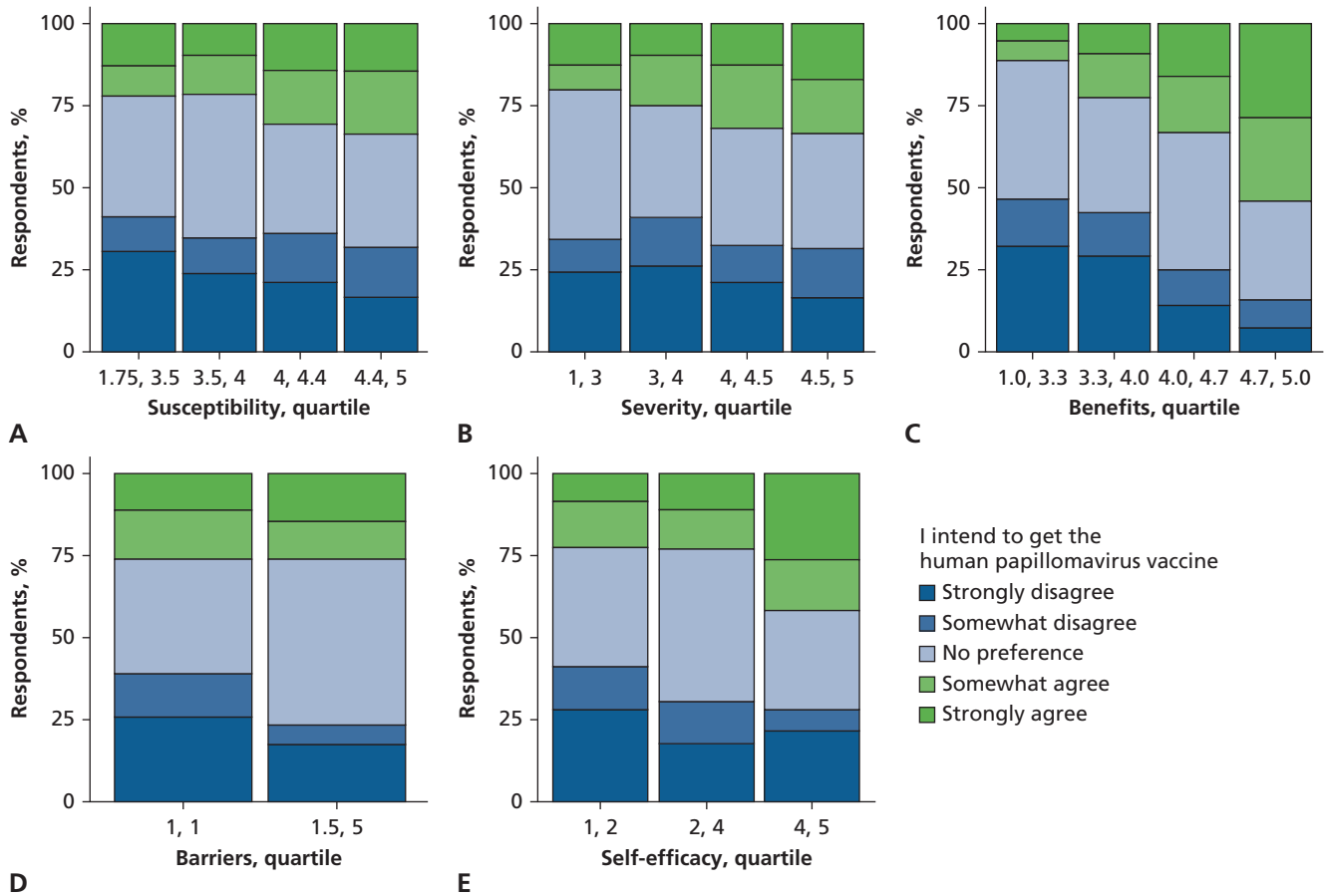


Figure 2. Stacked bar plot for human papillomavirus vaccine intent. A. Susceptibility. B. Severity. C. Benefits. D. Barriers. E. Self-efficacy.

associated with HPV vaccine receipt among GBM in our study. Providers can frame guiding questions and provide education focused on HPV-OPC, benefits of vaccination, and supporting patients' ability to make a plan to receive the vaccine. Additional training to improve health care providers' comfort when obtaining sexual histories include role play and scripting.^{45,46} Educational materials and posters in the dental office may prompt interest in patients, opening up discussions.

Strengths of our study include a large national sample of GBM respondents. However, the sample was limited to only those GBM with a profile on 2 online dating sites. In addition, multiple items were used to measure each of the HBM constructs, strengthening validity. These items were loaded onto dimensions of the HBM on the basis of an exploratory factor analysis. A limitation of our study was self-reported vaccination status. Some participants may not have accurate recall of their vaccination history. However, only 17.42% reported they were unsure whether they had received the vaccine. Because it is difficult to get a representative sample of GBM, we limit generalization to men who access dating sites.

CONCLUSIONS

HPV vaccination rates among GBM are short of national goals. We explored the correlates of HPV vaccination intent among GBM for the prevention of OPC. HPV vaccination intent among vaccine-eligible, unvaccinated GBM was found to be correlated with several demographic characteristics and the perceived benefits of vaccination for the prevention of HPV-OPC. GBM were found to be comfortable discussing HPV with their oral health care providers. As collaborators in an integrated health care system, oral health care providers can use these findings to support HPV vaccine uptake among the GBM population. Future research should explore perceptions of GBM on receiving vaccine administration at routine dental visits and ways dental care providers can improve HPV vaccine uptake among GBM. ■

DISCLOSURE

None of the authors reported any disclosures.

SUPPLEMENTAL DATA

Supplemental data related to this article can be found at: <http://doi.org/10.1016/j.adaj.2023.09.016>.

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eTable. Survey items used as proxies for Health Belief Model constructs.

CONSTRUCT	SURVEY ITEM	RESPONSE
Perceived Susceptibility	"I believe I have several risk factors for oropharyngeal cancer" "It is worthwhile checking for oropharyngeal cancer" "People are just trying to attack gay and bisexual men by frightening them about sexual health risks, like oropharyngeal cancer"	5-point Likert-type scale (1 = strongly disagree through 5 = strongly agree)
	"Compared to the average person, I believe my risk of getting oropharyngeal cancer is"	5-point Likert-type scale (1 = much lower through 5 = much higher)
Lack of	"What is the main reason you have not received the HPV vaccine?"	"Rarely have sex/abstinence"
Perceived Severity	"Compared to other cancers, I believe that the severity of oropharyngeal cancer is"	5-point Likert-type scale (1 = much lower through 5 = much higher)
Lack of	"What is the main reason you have not received the HPV vaccine?"	"HPV is just another sexually transmitted infection"
Perceived Benefits	"I would get the HPV vaccine to prevent oropharyngeal cancer even if I had to pay around \$350 out of pocket" "I believe the benefits of the HPV vaccine outweigh the potential risks of the vaccine" "In general, I believe that vaccines do a good job preventing the diseases that they are meant to prevent"	5-point Likert-type scale (1 = strongly disagree through 5 = strongly agree)
Perceived Barriers	"What is the main reason you have not received the HPV vaccine?"	"Cost of the HPV vaccine" "I don't have transportation to get the HPV vaccine" "I don't know where to get the HPV vaccine" "I haven't had time" "I don't know how to schedule an appointment to get the HPV vaccine" "Insurance coverage issues"
Self-Efficacy	"There are so many health hazards out there it is too exhausting to consider them all"	5-point Likert-type scale (1 = strongly disagree through 5 = strongly agree)