



Short communication

How do beliefs about different human papillomavirus-related diseases vary among young gay, bisexual, and other men who have sex with men in the United States?

Paul L. Reiter^{a,b,*}, Amy L. Gower^c, Abigail B. Shoben^{a,b}, Annie-Laurie McRee^{c,d}

^a College of Public Health, The Ohio State University, Columbus, OH, United States

^b Comprehensive Cancer Center, The Ohio State University, Columbus, OH, United States

^c Division of General Pediatrics and Adolescent Health, Department of Pediatrics, University of Minnesota Medical School, Minneapolis, MN, United States

^d Center for Scientific Review, National Institutes of Health, Bethesda, MD, United States

ARTICLE INFO

Keywords:

Human papillomavirus
Gay
Bisexual
MSM
Young adult

ABSTRACT

Purpose: To determine how beliefs about various disease outcomes caused by human papillomavirus (HPV) infection differ among young gay, bisexual, and other men who have sex with men (YGBMSM).

Methods: From 2019 to 2021, we recruited cisgender YGBMSM ages 18–25 in the United States who were unvaccinated against HPV ($n = 1,227$). Survey items examined three disease outcomes (genital warts, anal cancer, and oropharyngeal cancer) for each of three different beliefs (perceived vulnerability, perceived severity, and worry)

Results: Participants reported lower perceived vulnerability to and worry about anal cancer and oropharyngeal cancer compared to genital warts (all $p < 0.001$). Participants also reported greater perceived severity of anal cancer and oropharyngeal cancer compared to genital warts (all $p < 0.001$). Some patterns of beliefs differed by participant characteristics.

Conclusions: The beliefs of YGBMSM varied by HPV-related disease outcome. Findings can guide future HPV vaccination communication efforts for YGBMSM by informing how to better frame messages and increase relevance.

1. Introduction

Routine human papillomavirus (HPV) vaccination is currently recommended for individuals ages 11–12, with vaccination also recommended through age 26 for those who are still unvaccinated (Meites et al., 2019). For males, HPV vaccination has been approved by the United States (US) Food and Drug Administration to prevent anal cancer, oropharyngeal cancer (and other head and neck cancers), and genital warts (U.S. Food and Drug Administration, 2020). Gay, bisexual, and other men who have sex with men (GBMSM) have high rates of HPV infection and HPV-related disease, including anal cancer (Smith et al., 2011; Clifford et al., 2021). Ensuring HPV vaccination among young GBMSM (YGBMSM) is key to helping prevent HPV-related disease and address current health disparities. However, only about 40% of age-eligible YGBMSM have started the multidose HPV vaccine series

(Nadarzynski et al., 2021).

Beliefs about HPV-related disease (e.g., perceived vulnerability, perceived severity) are important correlates of HPV vaccine acceptability and uptake (Nadarzynski et al., 2014; Wheldon et al., 2011; Reiter et al., 2015), and a past study suggests that the effects of message framing on HPV vaccine acceptability vary across different disease outcomes (McRee et al., 2010). However, this past study included primarily older men outside of the recommended age range for routine HPV vaccination (McRee et al., 2010). A better understanding of how YGBMSM's beliefs may vary across different HPV-related disease outcomes is therefore needed to help improve the content of communication efforts about HPV vaccination for this age group. The current study addresses this research gap by examining how such beliefs differ among cisgender YGBMSM within the recommended age range for routine HPV vaccination.

* Corresponding author at: Division of Health Behavior and Health Promotion, College of Public Health, The Ohio State University, 1841 Neil Ave., Room 359B, Columbus, OH 43210, United States.

E-mail address: reiter.36@osu.edu (P.L. Reiter).

<https://doi.org/10.1016/j.pmedr.2024.102780>

Received 20 February 2024; Received in revised form 29 May 2024; Accepted 31 May 2024

Available online 31 May 2024

2211-3355/© 2024 The Authors. Published by Elsevier Inc. This is an open access article under the CC BY-NC license (<http://creativecommons.org/licenses/by-nc/4.0/>).

2. Methods

2.1. Participants and procedures

Data in this report stem from the baseline timepoint of a randomized controlled trial of an online intervention to increase HPV vaccination among YGBMSM, which has been described in detail previously (Reiter et al., 2020). Briefly, we recruited a convenience sample of YGBMSM in the US via advertisements on social media/dating sites, existing research panels, and university-based organizations. Individuals were linked to a mobile-friendly project website to complete an eligibility screener. Eligibility criteria included: (a) cisgender man; (b) 18–25 years of age; (c) either self-identify as gay, bisexual, or queer; report ever having oral or anal sex with a male; or report being sexually attracted to males; (d) lives in the US; (e) has not received any doses of HPV vaccine; and (f) not a previous study participant.

Eligible individuals provided informed consent and created a project website account. These individuals then completed a baseline survey prior to receiving any intervention content. Thus, the baseline data included in this report are pre-intervention data. A total of 1,227 participants completed the baseline survey between October 2019 and June 2021, with study activities paused from March–August 2020 due to the coronavirus disease 2019 pandemic. Participants received \$40 for completing study activities at the baseline timepoint. The Institutional Review Board at The Ohio State University approved this study and determined that it met guidelines for the protection of human subjects.

2.2. Measures

Guided by our past work (Reiter et al., 2015), the baseline survey included items focused on three different belief constructs: perceived vulnerability, perceived severity, and worry. These beliefs are included in multiple theories of health behavior (Becker, 1974; Rogers et al., 1983) and were also key theoretical constructs of the online intervention (Reiter et al., 2020). For each belief construct, survey items assessed three different HPV-related disease outcomes separately: genital warts, anal cancer, and oropharyngeal cancer (which was called “throat cancer” in the survey items). Thus, there were a total of nine survey items assessing beliefs (i.e., three belief constructs with each having items for three different disease outcomes). The ordering of the disease outcome survey items was randomized within each belief construct.

Since some participants may not have been familiar with the disease outcomes, the survey provided a brief informative statement about each disease outcome: “Genital warts are growths that form on the genitals or anus. Genital warts usually do not cause pain.”; “Anal cancer forms in the anus, which is the opening of the rectum. Anal cancer is different from colon cancer and rectal cancer.”; and “Throat cancers form in the throat just behind the mouth (also called oral or oropharyngeal cancer).” Responses options ranged from “no chance” to “high chance” for perceived vulnerability items (coded 1–4), “not at all” to “a lot” for worry items (coded 1–4), and “not at all” to “very” for perceived severity items (coded 1–4). Items were coded so that higher values indicate greater levels of the belief. The baseline survey also assessed several participant characteristics (Table 1).

2.3. Data analysis

We first examined the mean and standard deviation (SD) of each of the nine belief items. We then used generalized estimating equations (GEE) with robust standard errors to determine if each belief differed across the three disease outcomes, with separate models for perceived vulnerability, perceived severity, and worry. For each model, the overall test of the null hypothesis that the belief was the same across all three disease outcomes was tested with a multivariate Wald test, using a Bonferroni-corrected type I error rate of 0.017. For each belief, we also considered post-hoc pairwise comparisons of the three group means.

Table 1

Descriptive characteristics of young gay, bisexual, and other men who have sex with men in the United States who were recruited from 2019 to 2021 ($n = 1,227$).

	n (%)
Age (years)	
18–21	437 (36)
22–25	790 (64)
Race/ethnicity	
Non-Hispanic white	579 (47)
Non-Hispanic black	129 (11)
Hispanic	352 (29)
Another race / ethnicity	167 (14)
Relationship status	
Single and not having sex	170 (14)
Single and having sex or casually dating	793 (65)
In a relationship	264 (22)
Education level	
High school or less	380 (31)
Some college or more	847 (69)
Employment status	
Employed full time or part time	349 (28)
Other	878 (72)
Sexual identity	
Gay	815 (66)
Bisexual	317 (26)
Another identity	95 (7)
Ever had sex with a male	
No	85 (7)
Yes	1,142 (93)
Lifetime number of sexual partners who were male	
10 or fewer	695 (57)
11 or more	532 (43)
Ever had genital warts	
No	1,184 (96)
Yes	43 (4)

Note. Percentages may not sum to 100% due to rounding.

We then used GEE to determine if patterns in beliefs differed across key participant characteristics that we thought were relevant to the beliefs (i.e., race/ethnicity, relationship status, sexual identity, history of ever having sex with a male partner, and lifetime number of sexual partners who were male). These models included an interaction term between each participant characteristic and disease outcome. We used the Holm correction (Holm, 1979) to maintain an overall type I error rate of 0.05 for the interactions. We did not examine an interaction with history of genital warts due to few participants reporting a prior history. All analyses were performed with Stata version 15.0 (Statacorp, College Station, TX).

3. Results

3.1. Participant characteristics

A majority of participants were ages 22–25 (64%), indicated a minoritized racial or ethnic identity (53%), and had at least some college education (69%; Table 1). Fewer than a quarter of participants (22%) indicated they were in a relationship, and 28% of participants were employed either full-time or part-time. Most participants identified as gay (66%) and reported a history of ever having sex with a male partner (93%). Fewer than half of participants (43%) reported a history 11 or more male sexual partners during their lifetime, and only 4% reported ever having genital warts.

3.2. Beliefs about HPV-related disease outcomes

Participants reported lower perceived vulnerability to anal cancer (mean = 2.34; SD = 0.78) and oropharyngeal cancer (mean = 2.33; SD = 0.75) compared to genital warts (mean = 2.49; SD = 0.80) (both $p < 0.001$). Participants also reported lower worry about anal cancer (mean

= 1.84; SD = 1.00) and oropharyngeal cancer (mean = 1.84; SD = 0.97) compared to genital warts (mean = 2.10; SD = 1.00) (both $p < 0.001$). Conversely, participants viewed anal cancer (mean = 3.66; SD = 0.77) and oropharyngeal cancer (mean = 3.69; SD = 0.74) as being more severe than genital warts (mean = 3.14; SD = 0.90) (both $p < 0.001$). Beliefs about anal cancer and oropharyngeal cancer were not statistically different and were qualitatively similar to one other.

3.3. Interactions with participant characteristics

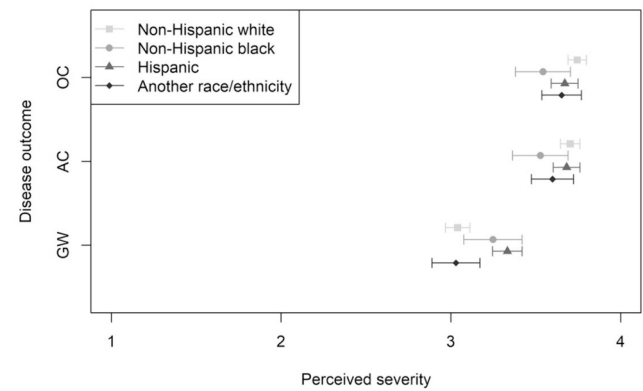
Analyses identified three interactions. The first was between perceived severity and race/ethnicity ($p < 0.001$). All racial/ethnic groups reported similar perceived severity for anal cancer and oropharyngeal cancer, but heterogeneity existed for genital warts (Fig. 1, Panel A). Hispanic participants reported higher perceived severity of genital warts (mean = 3.33) than non-Hispanic white participants (mean = 3.04) and those who reported another race/ethnicity (mean = 3.03). The second interaction was between worry and relationship status ($p = 0.001$; Fig. 1, Panel B). Worry about oropharyngeal cancer and anal cancer was similar regardless of relationship status, but participants who were single and having sex or casually dating reported greater worry about genital warts (mean = 2.20) than participants who were single and not having sex (mean = 1.78) and those in a relationship (mean = 2.00). The last interaction was between worry and sexual identity ($p < 0.001$; Fig. 1, Panel C). Participants who identified as gay reported greater worry about anal cancer (mean = 1.88) compared to those who indicated another identity (i.e., other than gay or bisexual; mean = 1.56). A similar pattern was observed between participants who identified as bisexual and those who indicated another identity. Worry about genital warts and oral cancer was similar regardless of sexual identity.

4. Discussion

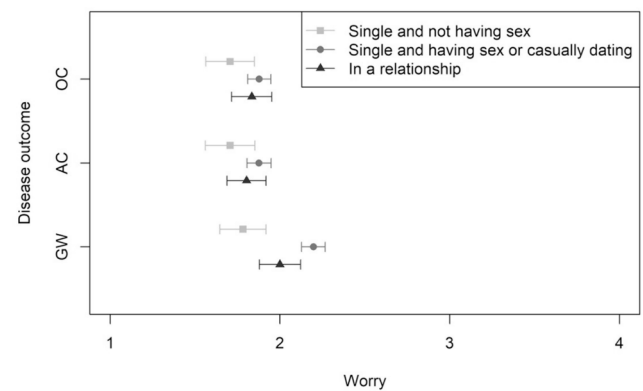
To help improve communications efforts for YGBMSM that encourage HPV vaccination, a better understanding of how their beliefs differ across various HPV-related disease outcomes is needed. In the current study, participants overall reported higher perceived severity of anal cancer and oropharyngeal cancer compared to genital warts, which coincides with past research (McRee et al., 2010). However, participants in our study also reported higher perceived vulnerability to and greater worry about genital warts compared to the cancer types examined. This differs from a past study among mostly older men (where perceived vulnerability did not vary across disease outcomes (McRee et al., 2010) and likely reflects that the YGBMSM in our study may have viewed genital warts as a more proximal and relevant health outcome. Indeed, epidemiological data show that there is a meaningful disease burden of genital warts among young adults in the US (Camenga et al., 2013). Taken together, these findings have important implications for future HPV vaccination communication efforts for YGBMSM. Multiple health behavior theories posit that greater perceived vulnerability, perceived severity, and worry should increase the chances of an individual engaging in a health behavior (Becker, 1974; Rogers et al., 1983; Leventhal et al., 2003). Thus, our results suggest that future communication efforts for YGBMSM should include messages and content that highlight the occurrence of genital warts among young adults (i.e., perceived vulnerability and worry) and the morbidity and mortality associated with HPV-related cancers (i.e., perceived severity).

We also found that patterns in some beliefs differed across participant characteristics. Hispanic participants reported especially high levels of perceived severity of genital warts, participants who identified as gay or bisexual reported especially high levels of worry about anal cancer, and participants who were single and having sex or casually dating reported especially high levels of worry about genital warts. Differences in worry about anal cancer by sexual identity may be partly attributable to a higher prevalence of a history of 11 or more male sexual partners among gay (54%) or bisexual (31%) participants compared to

A: Perceived severity and race/ethnicity



B: Worry and relationship status



C: Worry and sexual identity

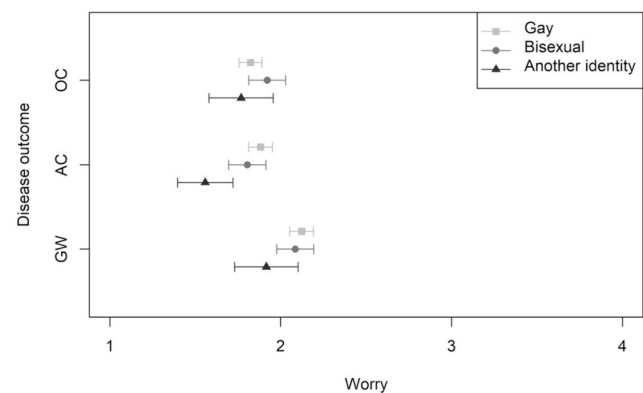


Fig. 1. Interactions between beliefs about HPV-related disease outcomes and characteristics of young gay, bisexual, and other men who have sex with men in the United States who were recruited from 2019 to 2021: perceived severity and race/ethnicity (panel A); worry and relationship status (panel B); and worry and sexual identity (panel C). OC = oropharyngeal cancer; AC = anal cancer; GW = genital warts. Bars indicate 95 % confidence intervals.

those who indicated another sexual identity (24%). The finding concerning relationship status and worry about genital warts is similar to past research that showed GBMSM not in a monogamous relationship or who were HIV-positive tended to report higher perceived threat to HPV-related diseases or other sexually transmitted infections (Nadarzynski et al., 2021; Wheldon et al., 2018). The subgroup differences identified in the current study represent potential opportunities for the use of additional targeting and/or tailoring of content in future HPV vaccination communication efforts for YGBMSM. For example, additional

content that focuses on the risk of genital warts could be provided to men who are single and sexually active, whereas additional content centered around anal cancer risk could be provided to men who identify as gay or bisexual. Such targeted and/or tailored strategies are likely to be an affordable and sustainable approach for increasing perceived message relevance, which in turn can affect the effectiveness of communication efforts (Williams-Piehotu et al., 2003; Kreuter et al., 1999).

Study strengths include a large national sample of YGBMSM within the recommended age range for routine HPV vaccination, examining multiple belief constructs, and randomizing the order of survey items within each belief construct to reduce the potential for order effects. Potential study limitations include a convenience sample of participants recruited via social media and other online avenues, though about 99 % of US young adults were online when our study occurred (Pew Research Center, 2021). There is also a risk of fraudulent accounts with web-based research, though we previously described (Reiter et al., 2020) the recommended strategies (Teitcher et al., 2015) that we used to minimize this risk. The study survey did not specify an exact timeframe when assessing beliefs (e.g., perceived vulnerability of anal cancer in the next 10 years vs. perceived vulnerability of anal cancer in lifetime), and it also did not collect additional detailed information on sexual behaviors (e.g., frequency of receptive anal sex and receptive oral sex). Lastly, our study included only cisgender individuals, and future research is needed to examine this topic among transgender and gender diverse individuals.

5. Conclusions

Public health efforts are needed to better communicate information about HPV vaccination to YGBMSM. Our results suggest it may be advantageous for content for YGBMSM overall to focus on the perceived vulnerability and worry of genital warts and the perceived severity of HPV-related cancers. Additionally, it may be important for future efforts to further target and/or tailor content about HPV-related disease outcomes based on certain demographic characteristics.

6. Financial support

This research was supported by the National Cancer Institute of the National Institutes of Health under Award Number R37CA226682. Additional support was provided from the Center for Health Communications Research at the University of Michigan (P30CA046592) and the Recruitment, Intervention, and Survey Shared Resource at The Ohio State University Comprehensive Cancer Center (P30CA016058). This work was prepared while Dr. McRee was employed at the University of Minnesota. The opinions expressed in this article are the authors' own and do not reflect the view of the National Institutes of Health, the Department of Health and Human Services, or the United States government.

CRedit authorship contribution statement

Paul L. Reiter: Writing – original draft, Visualization, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization. **Amy L. Gower:** Writing – review & editing, Visualization, Project administration, Methodology, Data curation, Conceptualization. **Abigail B. Shoben:** Writing – review & editing, Visualization, Methodology, Formal analysis, Conceptualization. **Annie-Laurie McRee:** Writing – review & editing, Visualization, Project administration, Methodology, Funding acquisition, Data curation,

Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

References

- Becker, M.H., 1974. The health belief model and personal health behavior. *Health Educ. Monogr.* 2, 324–473.
- Camenga, D.R., Dunne, E.F., Desai, M.M., et al., 2013. Incidence of genital warts in adolescents and young adults in an integrated health care delivery system in the United States before human papillomavirus vaccine recommendations. *Sex. Transm. Dis.* 40 (7), 534–538.
- Clifford, G.M., Georges, D., Shiels, M.S., et al., 2021. A meta-analysis of anal cancer incidence by risk group: Toward a unified anal cancer risk scale. *Int. J. Cancer* 148 (1), 38–47.
- Holm, S., 1979. A simple sequentially rejective multiple test procedure. *Scand. J. Stat.* 6, 65–70.
- Kreuter, M.W., Strecher, V.J., Glassman, B., 1999. One size does not fit all: The case for tailoring print materials. *Ann. Behav. Med.* 21 (4), 276–283.
- Leventhal, H., Brissette, I., Leventhan, E.A., 2003. The common-sense model of self-regulation of health and illness. In: Cameron, L.D., Leventhal, H. (Eds.), *The Self-Regulation of Health and Illness Behaviour*. Routledge, London.
- McRee, A.L., Reiter, P.L., Chantala, K., Brewer, N.T., 2010. Does framing human papillomavirus vaccine as preventing cancer in men increase vaccine acceptability? *Cancer Epidemiol. Biomark. Prev.* 19 (8), 1937–1944.
- Meites, E., Szilagyi, P.G., Chesson, H.W., Unger, E.R., Romero, J.R., Markowitz, L.E., 2019. Human papillomavirus vaccination for adults: Updated recommendations of the advisory committee on immunization practices. *MMWR Morb. Mortal. Wkly Rep.* 68 (32), 698–702.
- Nadarzynski, T., Smith, H., Richardson, D., Jones, C.J., Llewellyn, C.D., 2014. Human papillomavirus and vaccine-related perceptions among men who have sex with men: A systematic review. *Sex. Transm. Infect.* 90 (7), 515–523.
- Nadarzynski, T., Frost, M., Miller, D., et al., 2021. Vaccine acceptability, uptake and completion amongst men who have sex with men: A systematic review, meta-analysis and theoretical framework. *Vaccine* 39 (27), 3565–3581.
- Pew Research Center. Internet/broadband fact sheet. 2021. Available at: <https://www.pewresearch.org/internet/fact-sheet/internet-broadband/>.
- Reiter, P.L., McRee, A.L., Katz, M.L., Paskett, E.D., 2015. Human papillomavirus vaccination among young adult gay and bisexual men in the United States. *Am. J. Public Health* 105 (1), 96–102.
- Reiter, P.L., Gower, A.L., Kiss, D.E., et al., 2020. A web-based human papillomavirus vaccination intervention for young gay, bisexual, and other men who have sex with men: Protocol for a randomized controlled trial. *JMIR Res Protoc.* 9 (2), e16294.
- Rogers, R.W., 1983. Cognitive and physiological processes in fear appeals and attitude change: A revised theory of protection motivation. In: Cacioppo, J.T., Petty, R.E. (Eds.), *Social Psychophysiology: A Source Book*. Guilford Press, New York, pp. 153–176.
- Smith, J.S., Gilbert, P.A., Melendy, A., Rana, R.K., Pimenta, J.M., 2011. Age-specific prevalence of human papillomavirus infection in males: A global review. *J. Adolesc. Health* 48 (6), 540–552.
- Teitcher, J.E., Bockting, W.O., Bauermeister, J.A., Hoefler, C.J., Miner, M.H., Klitzman, R. L., 2015. Detecting, preventing, and responding to “fraudsters” in internet research: Ethics and tradeoffs. *J. Law Med. Ethics* 43 (1), 116–133.
- U.S. Food and Drug Administration. Gardasil 9. 2020. Available at: <https://www.fda.gov/vaccines-blood-biologics/vaccines/gardasil-9>.
- Wheldon, C.W., Daley, E.M., Bui, E.R., Nyitray, A.G., Giuliano, A.R., 2011. Health beliefs and attitudes associated with HPV vaccine intention among young gay and bisexual men in the southeastern United States. *Vaccine* 29 (45), 8060–8065.
- Wheldon, C.W., Daley, E.M., Walsh-Buhi, E.R., Baldwin, J.A., Nyitray, A.G., Giuliano, A. R., 2018. An integrative theoretical framework for HPV vaccine promotion among male sexual minorities. *Am. J. Mens Health* 12 (5), 1409–1420.
- Williams-Piehotu, P., Schneider, T.R., Pizarro, J., Mowad, L., Salovey, P., 2003. Matching health messages to information-processing styles: Need for cognition and mammography utilization. *Health Commun.* 15 (4), 375–392.