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Maternal Factors and Sexual Orientation-Related Disparities in Cervical Cancer Prevention

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Abstract

Objectives: Our objective was to explore how mothers' attitudes and relationships with their daughters may impact the cervical cancer prevention behaviors of daughters with diverse sexual orientations.

Methods: We examined 8,143 mother–daughter dyads from the Nurses' Health Study 2 and Growing Up Today Study. During the daughter's adolescence, each mother reported her beliefs about the importance of regular Pap testing for her daughter, the frequency of communication with her daughter about Pap testing, her beliefs about Pap testing and human papillomavirus (HPV) vaccines, and her acceptance of sexual minorities (e.g., bisexuals, lesbians). Mothers and daughters separately reported relationship satisfaction. Log-binomial models were used to

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examine the longitudinal association between maternal factors and daughter's receipt of a Pap test and HPV vaccination.

Results: Nearly all maternal factors predicted the daughter's likelihood to have a Pap test and HPV vaccination. Higher levels of acceptance for sexual minorities and better relationship quality were also positively associated with these cervical cancer prevention behaviors. Yet, after adjusting for the maternal factors, there was little attenuation of the existing sexual orientation-related disparities in Pap tests or HPV vaccination.

Conclusions: Mothers can play an important role in their daughters' cervical cancer prevention behaviors through novel processes like being more accepting of sexual minorities and having a good relationship quality. However, in this study, maternal factors did not explain much of the sexual orientation-related disparities in cervical cancer prevention. Efforts to ensure a mother is accepting of sexual minorities and has a good relationship quality with her daughter may improve that daughter's reproductive health.

Compared with their heterosexual peers, sexual minority young women (e.g., lesbian, bisexual) are particularly vulnerable to having poor reproductive health. For example, sexual minority young women are significantly less likely than their heterosexual peers to have a Pap test; numerous studies estimate sexual minorities are less than half as likely as heterosexuals to have ever had such a test (Agénor, Krieger, Austin, Haneuse, & Gottlieb, 2014a, 2014b; Brown, McNair, Szalacha, Livingston, & Hughes, 2015; Buchmueller & Carpenter, 2010; Charlton et al., 2011; McNair, Szalacha, & Hughes, 2011; Tjepkema, 2008). These sexual orientation-related Pap test disparities are partially explained (Charlton et al., 2014) by sexual minorities having lower levels of awareness of HPV risk factors, vulnerability, and prevention than heterosexual peers (Ben-Natan & Adir, 2009; Diamant, Schuster, & Lever, 2000; Marrazzo, 2000; O'Hanlan & Crum, 1996; Price, Easton, Telljohann, & Wallace, 1996) as well as less health insurance and access than heterosexuals (Austin & Irwin, 2010; Badgett & Ash, 2006; Buchmueller & Carpenter, 2010; Charlton et al., 2018; Diamant, Wold, Spritzer, & Gelberg, 2000; Gonzales & Blewett, 2014; Gonzales & Henning-Smith, 2017; Heck, Sell, & Gorin, 2006; Pals & Warren, 2014). However, little is known about other potential explanations.

It has been well-documented that contextual factors, in particular a mother's influence, can impact a young woman's reproductive health. For instance, a mother with positive beliefs about the human papillomavirus (HPV) vaccine is more likely than a mother who does not hold such beliefs to vaccinate her daughter against HPV (Reiter, Brewer, Gottlieb, McRee, & Smith, 2009). Other maternal influences (Guilamo-Ramos et al., 2012), including good relationship quality, also predict a daughter's improved reproductive health.

Maternal factors—including relationship quality—may differ for sexual minority compared with heterosexual daughters. A previous study demonstrated that mothers reported showing less affection and being less attached to their sexual minority daughters than to their heterosexual daughters (Rosario et al., 2014). Consequently, maternal factors that influence reproductive health may differ by a daughter's sexual orientation and could explain some of the observed sexual orientation-related reproductive health disparities.

To investigate this possibility, we used longitudinal data from two intergenerational cohort studies to examine whether maternal factors are associated with a daughter's reproductive health care, in particular cervical cancer prevention methods of Pap tests and HPV vaccinations. Additionally, we examined whether maternal factors explain any sexual orientation-related disparities in these health behaviors. We hypothesized that 1) a mother's positive beliefs about Pap tests and HPV vaccines would be positively associated with her daughter's cervical cancer prevention behaviors (i.e., more Pap tests and HPV vaccination); 2) similarly, more maternal acceptance of diverse sexual orientations and better quality mother–daughter relationships would be positively associated with a daughter's cervical cancer prevention behaviors; and 3) these maternal factors would partially explain the sexual orientation-related disparities in a daughter's cervical cancer prevention behaviors.

Material and Methods

Study Population

The Nurses' Health Study 2 (NHS2) is a longitudinal cohort study that was established in 1989 among 116,609 female registered nurses, 25–42 years of age, from across the United States. Participants are followed with biennial questionnaires to update information on their medical history and health-related behaviors. In 1996, NHS2 participants enrolled their female and male children ($N = 27,793$), 9–14 years of age, into a longitudinal cohort study known as the Growing Up Today Study (GUTS).

The current analysis was limited to mother–daughter dyads, in which the daughter reported her sexual orientation and reproductive health behaviors as well as relationship quality, and the mother reported on maternal attitudes and relationship quality. The current analysis was also limited to participants who met the existing American College of Obstetrician and Gynecologists Pap test eligibility guidelines (American College of Obstetricians and Gynecologists, 2003) for screening women who were 21 years of age or older, or 3 or more years had passed since sexual initiation, resulting in an analytic sample of 8,143 dyads. Follow-up for this analysis started from GUTS baseline in 1996 through the latest questionnaire with relevant data in 2007. This study was approved by the Brigham and Women's Hospital Institutional Review Board.

Measures

Sexual orientation—Detailed information about sexual orientation has been collected on every GUTS questionnaire starting in 1999 using an item adapted from the Minnesota Adolescent Health Survey (Remafedi, Resnick, Blum, & Harris, 1992), which asks about feelings of attraction and sexual orientation identity. The item reads, “Which of the following best describes your feelings?”, with the following response options: completely heterosexual (attracted to persons of the opposite sex), mostly heterosexual, bisexual (equally attracted to men and women), mostly homosexual, completely homosexual (gay/lesbian, attracted to persons of the same sex), and not sure. Sexual orientation groups were modeled using data from the 2007 questionnaire (closest to the mother's questionnaire with data on the maternal factors) and, if data were missing, they were imputed from questionnaires prior to 2007 (i.e., carried forward from the participant's most recent report).

Participants were excluded who responded with “not sure.” In sensitivity analyses, sexual orientation was also modeled in other ways (e.g., using 2002 data from before the mother’s questionnaire and modeling participants’ movement between sexual orientation groups, also known as mobility [Ott, Corliss, Wypij, Rosario, & Austin, 2011]).

Maternal factors

In addition to biennial questionnaires, NHS2 participants who had children in the GUTS cohort completed mother-specific surveys in 2004 and 2006. Those questionnaires included the following items: (1) attitudes and behaviors about Pap tests and HPV vaccines, including measures of a) the belief that her daughter should get a Pap test, b) communication with her daughter about Pap testing, c) Pap testing beliefs scale, and d) HPV vaccine beliefs scale; 2) acceptance of diverse sexual orientations; and 3) mother–daughter relationship quality.

In 2006, each mother reported her belief about the importance of regular Pap testing for her daughter, categorized as definitely/probably should, no opinion, or definitely/probably should not. The frequency of communication with her daughter about Pap testing in the last year was categorized as several times, once, or never.

Two scales to assess the mother’s personal beliefs about Pap testing (a four-item scale) and beliefs about HPV vaccines (a seven-item scale) were adopted in 2006 from previous GUTS work and informed by a conceptual model guided by theories of health behavior, including the theory of planned behavior, social cognitive theory, and the health belief model (Kahn et al., 2005, 2007; Kahn, Rosenthal, Hamann, & Bernstein, 2003). The Pap testing beliefs scale included items assessing the mother’s belief that a Pap test decreases the risk of cervical cancer, gives peace of mind to know result, helps to take control of her health, and is painful. The HPV vaccine beliefs scale included items assessing the mother’s belief about the vaccine being the best protection against cervical cancer, vaccinated girls not practicing riskier sex, HPV being a serious threat to her daughter’s health, how at risk her daughter is for HPV, whether her daughter’s health care provider will recommend an HPV vaccine, and vaccines being a good way to protect her daughter’s health. NHS2 participants indicated from 1 (strongly disagree) to 5 (strongly agree) their level of agreement with each scale item. These items were summed within each scale, with higher scores indicating more positive beliefs.

Two items in 2004 assessed the mother’s acceptance of sexual minorities. NHS2 participants indicated on a 1 (strongly disagree) to 5 (strongly agree) scale the extent to which they “feel uneasy around people who are very open in public about being gay, lesbian, or bisexual” and “whether it is important that their child(ren) be heterosexual.” Responses were summed to create a score ranging from 2 to 10; higher scores indicated greater maternal acceptance and more positive attitudes toward sexual minorities.

Mother–daughter relationship quality was assessed separately in mothers and daughters using a validated scale (Jaccard & Dittus, 2000; Jaccard, Dittus, & Gordon, 1996). In 2005, GUTS participants reported the degree of satisfaction with their maternal relationship across nine items (e.g., general communication, affection, emotional support, respect, shared time, and interests). An additional measure was collected from the mothers in 2006 when they

reported their relationship satisfaction with their child (a proxy for affectional bond) across the same nine items completed by their daughters. Daughter and mother items were added together and scored using a 5-level Likert scale (strongly agree to strongly disagree). Mothers with more than one GUTS child completed this measure for each child. Reports from both mother and daughter were categorized as low (i.e., poor relationship quality; bottom 25%), or medium-high (i.e., good relationship quality; top 75%). As has been done previously, mother–daughter dyads were then categorized as either mutual low (low child–low mother) or all other combinations (low child–medium-high mother, medium-high child–low mother, or mutual medium-high; Cerdá et al., 2014).

Outcome: Daughter’s Pap test—Starting in 1999 and continuing on each subsequent questionnaire through 2007, an item was included that read, “Have you ever had a Pap test?” Participants who responded affirmatively were categorized as having a Pap test in their lifetime. All of the participants in our sample were either at least 21 years of age by the time they completed their 2007 survey or had initiated sexual activity 3 or more years before and therefore met the existing Pap test eligibility guidelines.

Outcome: Daughter’s HPV vaccination—A two-part question on the 2014 questionnaire was included about HPV vaccination initiation and completion. An introductory paragraph stated: “A vaccine to prevent the HPV infection is available and is called the cervical cancer vaccine, HPV shot, GARDASIL, or CERVARIX. It is given in 3 separate doses over 6 months.” The survey then asked if participants had ever had the HPV vaccination and how many doses they had received (ranging from one to three). Vaccination was defined as having received at least one vaccine dose (yes; no).

Confounders

Potential confounders included baseline age in years, race/ethnicity (White, another race/ethnicity), and region of residence in 2007, coded as West, Midwest, South, or Northeast. If data were missing for potential confounders, they were imputed from previous questionnaire years; if no such data were available, multiple imputation procedures were used.

Statistical Analysis

We examined the longitudinal associations between maternal factors in 2004/2006 and daughter’s cervical cancer prevention behaviors (i.e., Pap tests and HPV vaccination) in 2007 across sexual orientation groups using bivariate models. Then, we used multivariable regression from log-binomial models adjusted for potential confounders. To account for sibling clusters, we estimated the variance using generalized estimating equations with a compound symmetry working correlation matrix (Fitzmaurice, Laird, & Ware, 2004; Zeger & Liang, 1986). We started by fitting models for each individual maternal factor to examine if it was associated with the daughter’s behaviors, resulting in risk ratios and 95% confidence intervals. Then, we examined sexual orientation-related disparities in the outcomes by fitting a model examining the association between sexual orientation and each behavior. To explore attenuation by the maternal factors, we then adjusted this model where sexual orientation was the primary predictor for each of the maternal factors individually and

then again simultaneously with all of the maternal factors together. All analyses were conducted using SAS 9.3 (SAS Institute, Cary, NC).

Results

NHS2 mothers were born between 1947 and 1964; their GUTS daughters were born between 1982 and 1987. At the end of follow-up in 2007, the mothers were 43–60 years of age and GUTS daughters were 20–25 years of age. Of the 8,143 daughters in our mother–daughter dyad sample, 81% ($n = 6,562$) identified as completely heterosexual, 16% ($n = 1,302$) identified as mostly heterosexual, 2% ($n = 173$) identified as bisexual, and 1% ($n = 106$) identified as lesbian. Participants resided across the United States with 33% ($n = 2,687$) in the Midwest, 32% ($n = 2,606$) in the Northeast, 18% ($n = 1,466$) in the South, 17% ($n = 1,384$), and in the West; 94% ($n = 7,575$) reported a White race/ethnicity (Table 1).

Compared to a mother with a heterosexual daughter, a mother with a daughter in certain sexual minority subgroups (noted in parentheses) was more likely to believe her daughter should get a Pap test (mostly heterosexual and bisexual), hold more positive beliefs about the HPV vaccine (all sexual minority groups: mostly heterosexual, bisexual, and lesbian), and be more accepting of sexual minorities (all sexual minority groups). However, mothers with sexual minority daughters were more likely to hold less positive beliefs about Pap tests (bisexual) and mother–daughter dyads with a sexual minority daughter were more likely than dyads with a heterosexual daughter to report a lower relationship quality (bisexual and lesbian; Table 1).

As we hypothesized, nearly all of the maternal factors longitudinally predicted the daughter's cervical cancer prevention behaviors. For example, a daughter was twice as likely (risk ratio, 2.10; 95% confidence interval, 1.81–2.45) to have had a Pap test in 2007 if her mother believed she should do so in 2004/2006. Higher levels of acceptance for sexual minorities and better relationship quality, to a lesser extent, were also positively associated with the daughter's future cervical cancer prevention behaviors (Table 2).

Table 3 models the sexual orientation-related disparities in Pap tests and HPV vaccination. When adjusting for potential confounders and comparing with heterosexual daughters, mostly heterosexuals were more likely to have had a Pap test, whereas lesbians were less likely to have had a Pap test. After further adjusting these models for the prospective maternal factors (individually and simultaneously), there is little attenuation; therefore, maternal factors explain little of the sexual orientation-related disparities. Among the mostly heterosexual and bisexual daughters, the Pap test risk ratios were no longer significantly different from those of the completely heterosexual daughters after adjusting for all of the maternal factors, but this attenuation was small and the lesbians were still less likely than completely heterosexuals to have had a Pap test. With regard to HPV vaccination, bisexuals were less likely than completely heterosexuals to have received the HPV vaccine after adjustment for potential confounders. There was little attenuation when these HPV vaccine models were adjusted for the maternal factors. Results were similarly consistent when modeling sexual orientation in other ways (e.g., before the mother's questionnaire, sexual orientation mobility).

Discussion

Mothers can play an important role in helping their daughters to prevent cervical cancer by being more accepting of sexual minorities and having a better relationship quality with their daughters. However, maternal factors did not play a strong role in explaining the sexual orientation-based disparities in cervical cancer prevention behaviors among GUTS participants.

Previous research has shown that a mother's willingness to encourage her daughter to get a Pap test or vaccinate her daughter against HPV can be hampered by many factors; these include a mother not communicating with her daughter about Pap tests, not perceiving her daughter as being vulnerable to acquiring HPV, and holding negative beliefs about the vaccine (Allen et al., 2010; Dempsey, Abraham, Dalton, & Ruffin, 2009; Gamble, Klosky, Parra, & Randolph, 2010; Kahn et al., 2009; Marlow, Waller, & Wardle, 2007; Rosenthal et al., 2008; Waller, Marlow, & Wardle, 2006). To our knowledge, no research has explored how these factors may be associated with cervical cancer prevention behaviors among daughters across sexual orientation groups.

Negative maternal attitudes about sexual minorities, regardless of whether a mother knows of her child's sexual orientation, represent prejudice (Meyer, 2003), which may manifest as a sexual orientation-related stressor for sexual minorities. These attitudes may be overtly or subtly communicated and are related to adverse health outcomes for the child (e.g., depressive symptoms; Floyd, Stein, Harter, Allison, & Nye, 1999; Ryan, Huebner, Diaz, & Sanchez, 2009). These factors have not been explored previously as predictors of a daughter's cervical cancer prevention behaviors.

Research has also shown that a child's sense of self-worth is shaped by attachment to caregivers (Bowlby, 1969, 1988a, 1988b) and this self-worth influences a child's health throughout life. For example, Rosario et al. (2014) documented that sexual minorities in the GUTS cohort report a less secure maternal attachment than completely heterosexuals, which partially mediates their increased risk of depression. The rich literature of maternal influences (Guilamo-Ramos et al., 2012) on daughters' reproductive health has revealed that relationship quality is one such influence, but this factor has not been explored across different sexual orientation groups.

In the present study, maternal factors—attitudes and beliefs about Pap tests and HPV vaccines, acceptance of sexual minorities, and mother–daughter relationship quality—were positively associated with a daughter's likelihood of getting a Pap test and HPV vaccine. Health care providers and parents may be able to leverage this influence by communicating with young women and having a better relationship quality to encourage adolescents to practice preventive health behaviors. Interventions could also focus on these modifiable factors to increase uptake in Pap testing and HPV vaccination. The American College of Obstetrics and Gynecology now recommends that women 21–29 years of age should have a Pap test every 3 years. Women 30–65 years of age should have a Pap test every 3 years or, when it is paired with HPV test (co-testing), every 5 years. Pap testing in the United States is underused, even among GUTS participants whose mothers are health care providers

themselves (Charlton et al., 2011), so more awareness of these guidelines and different ways to positively influence adolescent sexual and reproductive health-related behaviors are needed.

The Centers for Disease Control and Prevention recommend that the HPV vaccine be routinely administered to 11- and 12-year-old boys and girls, with catch-up vaccination in 13- to 26-year-olds. However, vaccination uptake in the United States is far below the 80% vaccination for boys and girls that is needed for full herd immunity (Brisson et al., 2016). Across all sexual orientation groups, fewer than one-half of GUTS participants are fully vaccinated. GUTS participants were 19–25 years of age in 2006 when the U.S. Food and Drug Administration approved the first HPV vaccine. Although all GUTS participants were eligible to receive the catch-up vaccine, the vaccine was not available to all of them as a routine vaccine owing to their age. Therefore, uptake is lower in GUTS participants than in adolescents today who are also eligible for routine vaccination. Nonetheless, given that vaccination uptake is still so low, it is important that we identify factors, such as maternal factors, that can increase vaccine uptake.

Health care providers, parents, and young people should be aware of Pap testing and HPV vaccination guidelines to ensure that all young people get the recommended care, regardless of sexual orientation. Although maternal factors did not explain the existing sexual orientation-related disparities in the present study, these factors still predicted improved cervical cancer prevention among all female GUTS participants and, therefore, may be able to improve the reproductive health of all young women, regardless of sexual orientation.

Although the present study has strengths, it also has some limitations. The mothers were all nurses and, as an extension, their daughters were all children of a health care provider, so results from this sample may not generalize to other populations. The participants in these cohorts also have a predominantly White race/ethnicity so the results may not generalize to racial/ethnic minorities, who already have less access to cervical cancer screenings than White women (Fisher, Trotter, Audrey, MacDonald-Wallis, & Hickman, 2013). HPV vaccination and Pap test information was limited to self-reported data. Daughters were born between 1982 and 1986, meaning their adolescence took place before policies like the Affordable Care Act were in place, which broadens access to reproductive health care. GUTS participants also came of age before the latest laws related to sexual minorities came into effect, including the Supreme Court ruling in *Obergefell v Hodges* granting marriage rights to all adults in the United States. Data were limited to measures of ever having a Pap test, so it is possible that some participants received a Pap test before the mothers reported on the maternal factors; lifetime HPV vaccinations were not susceptible to this temporality issue given the vaccine's debut in 2006, after the reported maternal factors. We also lacked data on maternal influences on their sons' reproductive and sexual health as well as the timing of the daughters' HPV vaccination, which could have allowed for more nuanced analyses by sex/gender and vaccine timing. Additionally, we lacked data about whether the daughters had disclosed their sexual orientation to their mothers by the time of the reported maternal factors. Data on the mother's sexual orientation are available, but we did not explore these; data from 1995 and 2009 are restricted to sexual orientation identity, which limits their statistical power. Nonetheless, the intergenerational, longitudinal data allowed us

to examine a number of novel factors. This is the first study, to our knowledge, to examine a mother's influence on her daughter's cervical cancer prevention behaviors across a sample of adolescent girls of diverse sexual orientations. Robust data on the maternal factors as well as on the daughter's sexual orientation and cervical cancer prevention behaviors made these analyses possible.

Implications for Practice and/or Policy

Efforts to ensure that a mother is accepting of sexual minorities and has a good relationship quality with her daughter may improve that daughter's cervical cancer prevention behaviors. Because these maternal factors did not explain much of the existing sexual orientation-related disparities, future research should explore other potential factors. These additional factors might include the level of sexual minority "outness" to providers or sexual orientation-related differences in health care provider recommendations for cervical cancer prevention.

Conclusions

Efforts to ensure a mother is accepting of sexual minorities and has a good relationship quality with her daughter may improve that daughter's reproductive health.

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Age-Standardized Characteristics in a Cohort of U.S. Daughters and Mothers by Daughter's Sexual Orientation ($N = 8,143$ Mother–Daughter Dyads)

	Daughter's Sexual Orientation			
	Completely Heterosexual (81%; $n = 6,563$)	Mostly Heterosexual (16%; $n = 1,302$)	Bisexual (2%; $n = 173$)	Lesbian (1%; $n = 106$)
Daughters				
Age at baseline (1996), years (range, 9–15)	11.6 ± 1.6	11.6 ± 1.6	11.6 ± 1.7	1.9 ± 1.7
White race/ethnicity	93.8 (6,134)	92.1 (1,192)	89.5 (154)	89.6 (95)
Pap test in lifetime	80.5 (5,105)	88.7 (1,131)	85.2 (144)	72.8 (75)
HPV vaccine (1 dose) [†]	43.0 (1,340)	46.0 (319)	30.9 (25)	29.8 (17)
Mothers				
Age at baseline (1989), years (range, 25–42)	40.9 ± 3.5	41.5 ± 3.5	41.9 ± 3.7	41.8 ± 3.0
Attitudes and beliefs about Pap tests and HPV vaccines				
Belief daughter should get Pap test				
Definitely/probably should	93.0 (4,594)	96.1 (976)	96.1 (124)	93.9 (77)
No opinion	1.9 (96)	1.6 (16)	3.1 (4)	3.7 (3)
Definitely/probably should not	5.1 (251)	2.4 (24)	0.8 (1)	2.4 (2)
Communication with daughter about Pap testing in past year				
Several times/frequently	24.8 (1,224)	25.5 (259)	17.2 (22)	26.8 (22)
Once	45.4 (2,241)	46.5 (472)	53.1 (68)	45.1 (37)
Never	29.8 (1,471)	28.0 (284)	29.7 (38)	28.1 (23)
Pap testing beliefs scale [‡]	4.3 ± 0.7	4.2 ± 0.7	4.1 ± 0.8	4.2 ± 0.7
HPV vaccine beliefs scale [‡]	3.8 ± 0.7	3.9 ± 0.6	<.001 3.9 ± 0.6	.08 3.9 ± 0.5
Acceptance of diverse sexual orientations				
Two-item combined score [§]	5.7 ± 2.1	6.6 ± 2.1	7.0 ± 2.4	7.0 ± 2.2
Mother–daughter relationship quality				
Mutual low (maternal and child report in bottom 25%)	10.7 (452)	12.9 (116)	24.8 (30)	18.6 (13)
All other combinations (maternal and/or child report in top 75%)	89.3 (3,757)	87.1 (784)	75.2 (91)	81.4 (57)

Abbreviation: HPV, human papillomavirus.

Note: Values are mean $\pm$ standard deviation or percent (*n*).

* Age-adjusted *p* value, compared with the completely heterosexual group.

[†] The Centers for Disease Control and Prevention recommend that the HPV vaccine be routinely administered to 11- and 12-year-old girls, with catch-up vaccination in 13- to 26-year-olds. Growing Up Today Study participants were 19–25 years of age in 2006 when the U.S. Food and Drug Administration approved the first HPV vaccine. Although all Growing Up Today Study participants were eligible to receive the catch-up vaccine, uptake is likely lower than in adolescents now who are also eligible for routine vaccination.

[‡] Range, 1–5; higher scores indicate more positive beliefs.

[§] Range, 1–5; higher scores indicate greater maternal acceptance of, or more positive attitudes toward, sexual minorities.

^{||} Relationship reports from both mother and daughter were categorized as low (bottom 25%) or medium-high (top 75%). Therefore, mother–daughter dyads were categorized as either mutual low (low child–low mother) or all other combinations (low child–medium-high mother, medium-high child–low mother, or mutual medium-high).

Table 2

Multivariable Models Estimating Risk Ratios of Daughter's Pap Testing and HPV Vaccination by Maternal Factors in a U.S. Cohort of Women ($N = 8,143$ Mother–Daughter Dyads)

	Risk Ratio* (95% Confidence Interval)
Daughter Pap Test (Lifetime)	
Attitudes and beliefs about Pap tests and HPV vaccines	
Belief daughter should get Pap test [†]	2.10 (1.81–2.45)
Communication with daughter about Pap testing [‡]	1.12 (1.09–1.16)
Pap testing beliefs scale [§]	1.05 (1.03–1.07)
HPV vaccine beliefs scale [§]	1.14 (1.11–1.16)
Acceptance of diverse sexual orientations [§]	1.02 (1.02–1.03)
Mother–daughter relationship quality	1.03 (0.99–1.06)
Daughter HPV Vaccination (dose)	
Attitudes and beliefs about Pap tests and HPV vaccines	
Belief daughter should get Pap test [†]	1.16 (0.97–1.38)
Communication with daughter about Pap testing [‡]	1.16 (1.04–1.30)
Pap testing beliefs scale	1.11 (1.04–1.18)
HPV vaccine beliefs scale	1.53 (1.43–1.63)
Acceptance of diverse sexual orientations	1.07 (1.05–1.08)
Mother–daughter relationship quality	0.88 (0.76–1.00)

Abbreviation: HPV, human papillomavirus.

* Adjusted for age, race/ethnicity, and geographic region.

[†] Definitely/probably should vs. definitely/probably should not.

[‡] Frequently/several times vs. never.

[§] Continuous variable, regression result for every 1-unit increase in positive belief (e.g., a 1-unit increase from 0 to 1).

^{||} Mutual low (maternal and child report in bottom 25%) vs. all other combinations (maternal and/or child report in top 75%).

Table 3

Multivariable Models Estimating Risk Ratios of Daughter's Pap Testing and HPV Vaccination by Daughter's Sexual Orientation in a U.S. Cohort of Women (N = 8,143 Mother–Daughter Dyads)

	Risk Ratio* (95% Confidence Interval) by Daughter's Sexual Orientation				
	Completely Heterosexual (N = 6,563)	Mostly Heterosexual (N = 1,302)	Bisexual (N = 173)	Lesbian (N = 106)	[†] p
Daughter Pap Test (Lifetime)					
Model 1: Daughter's sexual orientation	Reference	1.10 (1.07–1.12)	<.001	1.06 (1.00–1.13)	.06
Model 2a: Model 1 + belief daughter should get Pap test	Reference	1.05 (1.03–1.08)	<.001	1.04 (0.98–1.11)	.23
Model 2b: Model 1 + communication with daughter about Pap testing	Reference	1.07 (1.05–1.10)	<.001	1.08 (1.01–1.15)	.03
Model 2c: Model 1 + Pap testing beliefs scale	Reference	1.08 (1.05–1.10)	<.001	1.08 (1.01–1.16)	.03
Model 2d: Model 1 + HPV vaccine beliefs scale	Reference	1.05 (1.03–1.08)	<.001	1.06 (0.99–1.13)	.10
Model 2e: Model 1 + acceptance of diverse sexual orientations	Reference	1.07 (1.04–1.09)	<.001	1.03 (0.96–1.10)	.44
Model 2f: Model 1 + relationship quality	Reference	1.06 (1.04–1.09)	<.001	1.04 (0.97–1.11)	.23
Model 2g: Model 1 + all of the above maternal factors	Reference	1.02 (1.00–1.05)	.10	0.97 (0.90–1.05)	.51
Daughter HPV Vaccination (1 dose)					
Model 3: daughter's sexual orientation	Reference	1.05 (0.97–1.15)	.24	0.68 (0.48–0.96)	.03
Model 4a: Model 3 + belief daughter should get Pap test	Reference	1.06 (0.96–1.17)	.23	0.70 (0.49–1.01)	.05
Model 4b: Model 3 + communication with daughter about Pap testing	Reference	1.07 (0.98–1.18)	.14	0.69 (0.48–1.01)	.06
Model 4c: Model 3 + Pap testing beliefs scale	Reference	1.09 (0.99–1.19)	.08	0.71 (0.49–1.03)	.07
Model 4d: Model 3 + HPV vaccine beliefs scale	Reference	1.00 (0.91–1.10)	.96	0.66 (0.46–0.95)	.02
Model 4e: Model 3 + acceptance of diverse sexual orientations	Reference	1.00 (0.91–1.10)	.97	0.68 (0.48–0.97)	.03
Model 4f: Model 3 + relationship quality	Reference	1.10 (1.00–1.21)	.04	0.72 (0.50–1.04)	.08
Model 4g: Model 3 + all of the above maternal factors	Reference	1.03 (0.93–1.14)	.53	0.70 (0.48–1.02)	.06

Abbreviation: HPV, human papillomavirus.

* Adjusted for age, race/ethnicity, and geographic region.

[†]p-value, compared with the completely heterosexual group.