Published in final edited form as:
Cancer Causes Control. 2013 March ; 24(3): 539–547. doi:10.1007/s10552-012-9991-0.

An Examination of Sexual Orientation Group Patterns in Mammographic and Colorectal Screening in a Cohort of U.S. Women

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Abstract

Purpose—Underutilization of cancer screening has been found especially to affect socially marginalized groups. We investigated sexual orientation group patterns in breast and colorectal cancer screening adherence.

Methods—Data on breast and colorectal cancer screening, sexual orientation, and sociodemographics were gathered prospectively from 1989 through 2005 from 85,759 U.S. women in the Nurses' Health Study II. Publicly available data on state-level health care quality and sexual orientation-related legal protections were also gathered. Multivariable models were used to estimate sexual orientation-group differences in breast and colorectal cancer screening, controlling for sociodemographics and state-level health care quality and legal protections for sexual minorities.

Results—Receipt of a mammogram in the past two years was common though not universal and differed only slightly by sexual orientation: heterosexual 84%; bisexual 79%; lesbian 82%. Fewer than half of eligible women had ever received a colonoscopy or sigmoidoscopy, and rates did not differ by sexual orientation: heterosexual 39%; bisexual 39%; lesbian 42%. In fully adjusted models, state-level health care quality score, though not state-level legal protections for sexual minorities, was positively associated with likelihood of being screened for all women regardless of sexual orientation.

Conclusions—Concerns have been raised that unequal health care access for sexual orientation minorities may adversely affect cancer screening. We found small disparities in mammography and none in colorectal screening, though adherence to colorectal screening recommendations was

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uniformly very low. Interventions are needed to increase screening in women of all sexual orientation groups, particularly in areas with poor health care policies.

Keywords

breast cancer; colorectal cancer; screening; sexual orientation; bisexual; lesbian

Introduction

Breast and colorectal cancer are two of the most common cancers affecting U.S. women. In 2007 in the United States, incidence rates of a new diagnosis of breast and colorectal cancer, respectively, were 1204 and 397 per 1,000,000 women (1). In addition, 228 and 141 per 1,000,000 U.S. women died of breast and colorectal cancers, respectively, in that same year (1). Although regular screening improves early detection and treatment and potentially reduces mortality (2-5), many U.S. women are not meeting recommendations for routine screening. The American Cancer Society (ACS) recommends that women receive a mammogram once a year beginning at age 40 years (6), and, until 2009, the U.S. Preventive Services Task Force also recommended that annual mammographic screening begin at age 40 (7). To detect colorectal polyps or cancer, ACS recommends that women and men receive either a virtual colonoscopy, double contrast barium enema, or flexible sigmoidoscopy every five years or a colonoscopy every 10 years beginning at age 50 years (6). Recent data from the National Health Interview Survey (NHIS), a representative sample of U.S. women, indicates only 53% of women 40 years and older received a mammogram in the past year (8) and 67% in the past two years (9), though among women ages 50-74 years, the percentage screened in the past two years reached 81% (10). The percentage of eligible women receiving regular sigmoidoscopies and/or colonoscopies is even smaller. NHIS data from 2008 show that among women ages 50 or older, 53% have ever received a sigmoidoscopy (9), and 50% have received either a sigmoidoscopy in the past five years or a colonoscopy in the past 10 years (8).

Underutilization of cancer screening has been found especially to affect socially marginalized and economically disadvantaged groups. Women with minority sexual orientation, such as lesbian and bisexual women, have been found in some studies to have lower screening rates than their heterosexual counterparts (11-13), though other studies have not found differences (14, 15). A recent review article found the literature to be mixed as to whether there are sexual orientation group disparities in mammographic screening (16). In a large sample of 93,311 women in the Women's Health Initiative (WHI), bisexual women aged 50 to 79 years were found to be slightly less likely to have received a mammogram in the past two years than same-age heterosexuals (82% vs. 84%) (11). Similarly, in a combined sample of 12,000 women from seven U.S. surveys of sexual minority women, 73% of women ages 40-49 years and 83% of women ages 50-75 years who described themselves as lesbian or bisexual reported ever receiving a mammogram, compared to an estimated 87-90% of women in U.S. general population surveys (13). One study examining colorectal screening rates by sexual orientation using data from the 2001-2008 Massachusetts Behavioral Risk Behavior Surveillance System (BRFSS) found no difference across sexual orientation groups in women ages 50 years and older having ever received colorectal screening (15).

Disparities in breast and colorectal screening rates also have been associated with household income, ethnicity, and state of residence. Women with lower household income have lower rates of breast and colorectal screening relative to higher household income (10, 17, 18). Lower rates of mammography have been found in Latina and American Indian/Alaskan Native women relative to white women (9, 10) and lower rates of colorectal screening have been found in Black and Asian women relative to white women (17, 19). Similarly, differences in health service use have been found to vary by geographic location within the United States due to the accessibility of care, state funding for health programs, and state policies on health insurance. The percentage of eligible women who received a mammogram in the past two years or ever received a colorectal screening varies by state. Among women ages 40 years and older, in general, those living in the Northeastern states, Florida, Minnesota, and Michigan have the highest rates of mammography in the past two years (range of 79%-85%) and women living in states in the South and West have the lowest rates (range 67%-73%) (18). Among women 50 years or older, lifetime colorectal screening rates are highest along the East Coast (62-74%), especially in the Northeast (68-74%), and lowest in the South and some Western states (53-58%) (17). Because household income, ethnicity, and state of residence are known to be important determinants of screening disparities, they must be accounted for in studies of sexual orientation patterns in screening adherence.

Institutionalized discrimination against sexual minority populations varies widely by state and includes state laws banning same-sex marriage and adoption of children by same-sex couples and the absence of laws protecting sexual minorities against hate crimes or employment discrimination (20, 21). These types of state-level institutionalized discrimination have been shown to negatively affect mental health of sexual minorities in nationally representative studies (22, 23), though it is not known if they also affect other health indicators, such as cancer screening.

Few studies have examined sexual orientation group differences in cancer screening, particularly colorectal screening, nor have they examined whether state of residence may modify any observed sexual orientation-related screening disparities. We undertook the present study to investigate sexual orientation group differences in breast and colorectal cancer screening in a large cohort of U.S. women and to assess whether screening adherence patterns are affected by state of residence.

Method

Study sample

In 1989, a baseline questionnaire for the Nurses' Health Study (NHS) II was sent to approximately 520,000 registered nurses living in 14 of the most populous U.S. states, leading to the enrollment of 116,430 women ages 25-42 years old (http://www.channing.harvard.edu/nhs/). Receipt of a completed questionnaire served as indication of informed consent for participation. Biennial questionnaires have since been sent to the cohort to gather data on disease risk factors, screening behavior, and disease incidence. Human subjects research approval was received from Brigham and Women's Hospital and Harvard School of Public Health.

Outcome Measures

Mammography—Almost every NHSII questionnaire asked participants to indicate if they have had a mammogram in the past two years and, if so, if the mammogram was for routine screening or follow-up due to an abnormal finding. In 1989, the wording of this question was slightly different, asking if participants had ever had a mammogram and, if yes, the age at first mammogram, how many years since their last mammogram, and the reason for the last mammogram.

Colonoscopy/Sigmoidoscopy—An item on colorectal screening was included on each NHSII cohort questionnaire from 1991 to the present. These questions asked participants if they had had a colonoscopy or sigmoidoscopy in the past two years and for what reason (routine screening or follow-up due to an abnormal finding).

Individual-Level Predictors

Sexual Orientation—In 1995, a measure of sexual orientation identity was added to the NHSII questionnaire (24). The item read: “Whether or not you are currently sexually active, what is your sexual orientation or identity? (Please choose one answer)” with possible responses: 1) Heterosexual; 2) Lesbian, gay or homosexual; 3) Bisexual; 4) None of these; 5) Prefer not to answer. Our analyses included participants who described their sexual orientation identity as heterosexual; bisexual; or lesbian, gay, or homosexual.

Ethnicity—On the baseline questionnaire, women were asked to describe their ancestry choosing from a list of provided categories (25).

Socioeconomic Status—Participants reported annual household income in 2001, which we then used to create five categories: Less than \$50,000; \$50,000 to less than \$75,000; \$75,000 to less than \$100,000; \$100,000 or greater; and missing income.

State-Level Predictors

We used two indicators of state-level factors that where hypothesized to affect screening disparities. One was an indicator recently developed and tested by Hatzenbuehler et al. (22) representing the presence in 2005 on the state level of laws specifying sexual orientation as a protected category in hate crimes statutes and banning sexual orientation-related employment discrimination. We created a binary variable for each U.S. state reflecting the presence or absence of these legal protections, coded 1 or 0, respectively. The second state-level variable we used was a composite measure developed in 2008 by the U.S. Agency for Healthcare Research and Quality (AHRQ) to rate the overall health care quality available in a state. The measure was continuous and ranged from 0 (worse than average of other states on all health indicators assessed by AHRQ) to 100 (better than average of other states on all health indicators assessed by AHRQ) (26).

Statistical Analyses

To address study aims related to adherence to screening recommendations, we used all available data from study inception in 1989 though the 2005 wave of data collection to calculate the proportion of heterosexual, bisexual, and lesbian women age 40 to 60 years who had received a mammogram in the two years prior to a survey wave and calculated the proportion of women age 50 to 60 years in each sexual orientation group who had ever received a colonoscopy or sigmoidoscopy since age 50. Women reporting a new cancer occurrence were excluded from analyses of screening behavior from that point on. State of residence is updated each questionnaire cycle, so state of residence at the time of screening report was used in analyses.

We then examined orientation group differences in adherence to mammographic screening recommendations using generalized estimating equation methods to generate prevalence ratios (PR) and 95% confidence intervals (CI) using log-binomial regression and Poisson regression with robust error variance (27, 28) and accounting for repeated measures from participants over multiple waves of data collection using a compound symmetry working correlation matrix. Partially adjusted models controlled for age at time of screening, ethnicity, and household income. Fully adjusted models controlled for these same covariates in addition to the two state-level covariates: presence or absence of sexual-orientation-related legal protections and mean AHRQ score for overall health care quality available in a participant's state of residence. We examined sexual orientation group differences in colorectal screening since age 50 years using multivariable models to estimate PR and 95% CI. Partially adjusted models controlled for age at time of screening, ethnicity, and household income. Fully adjusted models controlled for these covariates and the two state-level covariates. In addition, we examined possible effect modification of the relationship between sexual orientation and mammographic and colorectal screening by the two state-level indicators by introducing to statistical models interaction terms between sexual orientation and state-level indicators.

Results

From age 40 to 60 years, 85,756 women from the NHSII cohort (73% of original cohort) provided 360,264 observations included in our repeated measures analyses of mammographic screening (Table 1). From age 50 to 60 years, 32,831 women (87% of age-eligible women from the original cohort) contributed data to cross-sectional analyses of ever receipt of colonoscopy/sigmoidoscopy during this age period (Table 2). Approximately 1% of the cohort described themselves as lesbian or bisexual and 94% as white, and annual household income ranged from less than $50,000 (17%) to greater than $100,000 (35%). Sixty-two percent (n=31) of U.S. states had sexual-orientation-related protections in state law, and AHRQ overall health care quality rating scores in the states ranged from 26 to 69 with a mean of 48 (standard deviation=10), where lower score indicated worse overall health care quality in a state (not in table).

Overall, receipt of a mammogram in the past two years among women aged 40 and older was common though not universal and differed slightly by sexual orientation: heterosexual 84%; bisexual 79%; lesbian 82% (Table 1). Receipt of a mammogram in the past two years was similarly high across age, ethnicity, and income groups, though some disparities were observed. On the other hand, fewer than half of eligible women had ever received a colonoscopy or sigmoidoscopy during the age interval 50 to 60 years, and rates did not differ by sexual orientation: heterosexual 39%; bisexual 39%; lesbian 42% (Table 2). In addition, rates of colonoscopy and sigmoidoscopy were low across all age, ethnicity, and income groups and in only the older age group did more than half of women report this type of cancer screening (60% of women ages 55-60 years).

Results of a set of three multivariable models for mammography are shown in Table 3. Bisexual (prevalence ratio [PR] 0.94; 95% confidence interval [CI] 0.90, 0.98) and lesbian (PR 0.97; 95% CI 0.95, 1.00) women were slightly less likely to have had a mammogram in the past two years compared to heterosexual women, and these differences were essentially unchanged when the other individual-level and state-level covariates were added to models. Differences in mammographic screening by ethnicity and household income were similarly modest. Each 10-unit elevation of state-level AHRQ health care quality score was associated with a 2% higher likelihood of having had a mammogram in the past two years. Interaction terms between sexual orientation and state-level indicators were not statistically significant ($P>0.05$).

Table 4 shows results of a set of three multivariable models for colonoscopy/sigmoidoscopy. No significant differences in screening by sexual orientation or ethnicity were found with the exception of African American women, who were almost 30% more likely than white women to have ever received colorectal screening. Household income showed a strong positive association with likelihood of colorectal screening. Interestingly, living in a state with sexual orientation-related legal protections was associated with 8% higher likelihood of having received colorectal screening (age-adjusted model, Table 4), but this protective effect was completely attenuated in the fully adjusted model (Table 4). With each 10-unit elevation of state-level AHRQ health care quality score, likelihood of having had a colonoscopy/

sigmoidoscopy increased by 9%. Interaction terms between sexual orientation and state-level indicators were not statistically significant ($P>0.05$).

Discussion

Breast and colorectal cancer are among the most prevalent cancers in U.S. women, and screening technologies widely available in the United States offer effective methods for early detection. Adherence to regular screening guidelines, however, falls well short of recommendations, particularly for colorectal screening. Concerns have been raised that unequal health care access for sexual orientation minorities may affect screening, perhaps due to actual and anticipated discrimination in health care settings or to inequities in health insurance coverage due to discriminatory marriage laws at the state and federal level in the United States (29). In our large, national cohort of women, we found that mammographic screening was only slightly lower in sexual minority compared to heterosexual women. In addition, for colorectal screening, we did not find screening disparities by sexual orientation, though adherence to colorectal screening recommendations was low in women of all groups. Furthermore, we did not find evidence that the presence or absence of sexual orientation-related protections in state laws modified associations between sexual orientation and mammographic or colorectal screening adherence.

Findings from previous studies on disparities in mammographic screening have been mixed, with some reporting rates that were several percentage points lower in sexual minority women compared to heterosexuals (11-13) and some finding no group differences (14, 15). The only other study we are aware of that has examined colorectal screening in women by sexual orientation did not find differences, similar to our study (15). For the NHSII cohort overall, the percent receiving a mammogram in the past two years (approximately 84%) was only slightly higher than the percent (81%) among women ages 50-74 years in a nationally representative NHIS (10). In addition, for the NHSII cohort overall, the percent of women ages 50 to 60 years reporting having ever received a colonoscopy or sigmoidoscopy (approximately 40%) was somewhat lower than the percent of women in NHIS ages 50 and older having received sigmoidoscopy in the past five years or colonoscopy in the past 10 years (8, 9). In sum, though NHSII is made up of nursing professionals, we did not find evidence that mammographic or colorectal screening rates were notably higher in our cohort compared to nationally representative estimates.

We found lower rates of mammography in Latina and Asian women but not African-American women compared to white women, which is consistent with some previous research (9, 10). We found higher rates of colorectal screening in African American women compared to white women but no other ethnic differences. Our findings for colorectal screening are different from prior studies finding lower rates of colorectal screening in Black and Asian women relative to white women (19). Perhaps this difference in findings is due to the composition of NHSII, which is made up of women who are current or former nursing professionals. As expected based on previous studies (9, 17, 18), we found a positive gradient by household income for both screening types, where higher income was associated with higher likelihood of screening. We also found higher quality state health care rating, as per AHRQ, to be positively associated with likelihood of a woman receiving colorectal screening. This finding suggests that despite existence of colorectal screening technologies throughout the country, a woman's state of residence strongly predicts her likelihood of benefiting from this type of life-saving technology. Given that all participants in NHSII are or were professional nurses, and therefore might be relatively advantaged compared to the general population in terms of knowledge of and access to medical screening, these state-level differences are all the more disturbing.

The proportion of NHSII participants who described themselves as lesbian or bisexual make up roughly 1.2% of the cohort, which is similar to the proportion (1.4%) found in the WHI cohort, made up of women ages 50-79 years (11), though lower than the proportion (2.9%) found in the representative sample of women ages 18-64 years responding the Massachusetts BRFSS survey (15). As the Massachusetts BRFSS includes many women who are younger than those enrolled in NHSII or WHI, it is possible that these differences in proportion lesbian or bisexual represent historical cohort changes in the prevalence of sexual minority identity in U.S. women (30) or discomfort among the older cohorts of women with disclosing a minority sexual orientation identity on a survey.

Our study has several limitations. Our colorectal screening analyses included only colonoscopy and sigmoidoscopy, so colorectal screening rates in the cohort may have been higher if nonendoscopic screening were also included. Data were self-report. Because NHSII is composed predominantly of white women, and the socioeconomic range found in the cohort is narrower than in the country as a whole, generalizability may be reduced, though confounding by uncontrolled factors associated with ethnicity and socioeconomic status is also diminished. Women participating in NHSII were all registered nurses at enrollment and so may be expected to have higher rates of screening adherence than women not working in a health care profession. It is possible that the magnitude of sexual orientation disparities in screening could be different in a sample not made up of health professionals. Importantly, though, because all women in the cohort were registered nurses, comparisons across subgroups within the cohort are not biased by involvement in the nursing profession. In addition, sexual orientation was not a factor in recruitment into the cohort, therefore findings are not affected by this type of enrollment bias.

Concerns have been raised that unequal health care access for sexual orientation minorities may adversely affect cancer screening. These concerns are well-founded given the strong evidence of actual and anticipated discrimination in health care settings and inequities in health insurance coverage resulting from discriminatory marriage laws in U.S. states and in the federal government (29). Nevertheless, we found only slight disparities across sexual orientation groups in mammography and none in colorectal screening. It is important to note, however, that rates of colorectal screening were unacceptably low in women across all groups. The absence of sexual orientation disparities in a context of universally poor utilization of potentially life-saving colorectal screening technologies is not a reassuring finding. Rather, interventions are needed to increase screening in women of all social and income groups and across all states.

Acknowledgments

The authors would like to the participants and staff of the Nurses' Health Study II for their valuable contributions as well as the following state cancer registries for their help: AL, AZ, AR, CA, CO, CT, DE, FL, GA, ID, IL, IN, IA, KY, LA, ME, MD, MA, MI, NE, NH, NJ, NY, NC, ND, OH, OK, OR, PA, RI, SC, TN, TX, VA, WA, and WY. The work reported in this manuscript was supported by the American Cancer Society grant RSGT-07-172-01-CPPB, NIH grants HL64108 and CA50385. NHSII is supported for other specific projects by the following NIH grants: CA67262, AG/CA14742, CA67883, CA65725, DK52866, HL64108, HL03804, DK59583, and HD40882. In addition, the Channing Laboratory has received modest additional resources at various times and for varying periods since January, 1, 1993, from the Alcoholic Beverage Medical Research Foundation, American Cancer Society, Amgen, California Prune Board, Centers for Disease Control and Prevention, Ellison Medical Foundation, Florida Citrus Growers, Glaucoma Medical Research Foundation, Hoffmann-LaRoche, Kellogg's, Lederle, Massachusetts Department of Public Health, Mission Pharmacal, National Dairy Council, Rhone Poulenc Rorer, Robert Wood Johnson Foundation, Roche, Sandoz, U.S. Department of Defense, U.S. Department of Agriculture, Wallace Genetics Fund, Wyeth-Ayerst, and private contributions. S. Bryn Austin is supported by the Leadership Education in Adolescent Health project, Maternal and Child Health Bureau, HRSA grant T71-MC00009. Deborah J. Bowen is supported by Centers for Disease Control and Prevention grant U48DP001922.

References

1. Centers for Disease Control and Prevention USCSWG. United States Cancer Statistics: 1997-2007 Incidence and Mortality Web-Based Report. Centers for Disease Control and Prevention. 2010. Available from: www.cdc.gov/uscs
2. Jonsson H, Bordas P, Wallin H, Nystrom L, Lenner P. Service screening with mammography in Northern Sweden: effects on breast cancer mortality - an update. J Med Screen. 2007; 14(2):87–93. [PubMed: 17626708]
3. Moss SM, Cuckle H, Evans A, Johns L, Waller M, Bobrow L, et al. Effect of mammographic screening from age 40 years on breast cancer mortality at 10 years' follow-up: a randomised controlled trial. Lancet. 2006 Dec 9; 368(9552):2053–60. [PubMed: 17161727]
4. Edwards BK, Ward E, Kohler BA, Eheman C, Zauber AG, Anderson RN, et al. Annual report to the nation on the status of cancer, 1975-2006, featuring colorectal cancer trends and impact of interventions (risk factors, screening, and treatment) to reduce future rates. Cancer. 2010 Feb 1; 116(3):544–73. [PubMed: 19998273]
5. Zauber AG, Lansdorp-Vogelaar I, Knudsen AB, Wilschut J, van Ballegooijen M, Kuntz KM. Evaluating test strategies for colorectal cancer screening: a decision analysis for the U.S. Preventive Services Task Force. Ann Intern Med. 2008 Nov 4; 149(9):659–69. [PubMed: 18838717]
6. [cited Aug. 11, 2010] American Cancer Society Guidelines for the Early Detection of Cancer [database on the Internet]. American Cancer Society. 2010. Available from: http://www.cancer.org/Healthy/FindCancerEarly/CancerScreeningGuidelines/american-cancer-society-guidelines-for-the-early-detection-of-cancer
7. U.S. Preventive Services Task Force. Screening for breast cancer: U.S. Preventive Services Task Force recommendation statement. Ann Intern Med. 2009; 151:716–26. [PubMed: 19920272]
8. Smith RA, Cokkinides V, Brooks D, Saslow D, Brawley OW. Cancer screening in the United States, 2010: A review of current American Cancer Society guidelines and issues in cancer screening. CA Cancer J Clin. 2010 Mar-Apr;60(2):99–119. [PubMed: 20228384]
9. [cited April 6, 2010] DATA 2010: The Healthy People 2010 Database [database on the Internet]. Centers for Disease Control and Prevention. 2010. Available from: http://wonder.cdc.gov/data2010
10. Centers for Disease Control and Prevention. Vital signs: Breast cancer screening among women aged 50-74 years - United States, 2008. MMWR Morb Mortal Wkly Rep. 2010 Jul 9; 59(26):813–6. [PubMed: 20613705]
11. Valanis BG, Bowen DJ, Bassford T, Whitlock E, Charney P, Carter RA. Sexual orientation and health: Comparisons in the Women's Health Initiative sample. Arch Fam Med. 2000; 9(9):843–53. [PubMed: 11031391]
12. Kerker BD, Mostashari F, Thorpe L. Health care access and utilization among women who have sex with women: Sexual behavior and identity. J Urban Health. 2006; 83(5):970–9. [PubMed: 16897415]
13. Cochran SD, Mays VM, Bowen D, Gage S, Bybee D, Roberts SJ, et al. Cancer-related risk indicators and preventive screening behaviors among lesbians and bisexual women. Am J Public Health. 2001 Apr; 91(4):591–7. [PubMed: 11291371]
14. Brandenburg DL, Matthews AK, Johnson TP, Hughes TL. Breast cancer risk and screening: A comparison of lesbian and heterosexual women. Women Health. 2007; 45(4):109–30. [PubMed: 18032170]
15. Conron KJ, Mimiaga MJ, Landers SJ. A population-based study of sexual orientation identity and gender differences in adult health. Am J Public Health. 2010 Oct; 100(10):1953–60. [PubMed: 20516373]
16. Brown JP, Tracy JK. Lesbians and cancer: An overlooked health disparity. Cancer Causes Control. 2008; 19(10):1009–20. [PubMed: 18551371]
17. [cited May 11, 2011] Percent of women age 50 or older who report ever having had a colorectal screening, 2008 [database on the Internet]. Kaiser Family Foundation. 2008. Available from: http://www.statehealthfacts.org/comparemaptable.jsp?ind=484&cat=10&sub=113&sort=a

18. [cited May 11, 2011] Percent of women age 40 and older who report having had a mammogram within the last 2 years, 2008 [database on the Internet]. Kaiser Family Foundation. 2008. Available from: http://www.statehealthfacts.org/comparemaptable.jsp?cat=10&ind=479
19. Trivers KF, Shaw KM, Sabatino SA, Shapiro JA. Trends in colorectal cancer screening disparities in people aged 50-64 years, 2000-2005. Am J Prev Med. 2008; 35(3):185–93. [PubMed: 18617355]
20. Eskridge, WN.; Spedale, D. Gay marriage: For better or for worse?. Oxford: Oxford University Press; 2006.
21. Badgett, MVL. Discrimination based on sexual orientation: A review of the literature in economics and beyond. In: Rodgers, WMI., editor. Handbook on the economics of discrimination. Northampton, MA: Edward Elgar Publishers, Inc.; 2006. p. 161-86.
22. Hatzenbuehler ML, Keyes KM, Hasin DS. State-level policies and psychiatric morbidity in lesbian, gay, and bisexual populations. Am J Public Health. 2009; 99(12):2275–81. [PubMed: 19833997]
23. Hatzenbuehler ML, McLaughlin KA, Keyes KM, Hasin DS. The impact of institutional discrimination onpsychiatric disorders in lesbian, gay, and bisexual populations: A prospective study. Am J Public Health. 2010; 100:452–9. [PubMed: 20075314]
24. Case P, Austin SB, Hunter DJ, Manson JE, Malspeis S, Willett WC, et al. Sexual orientation, health risk factors, and physical functioning in the Nurses' Health Study II. J Women's Health. 2004; 13(9):1033–47.
25. Holmes MD, Stampfer MJ, Wolf AM, Jones CP, Spiegelman D, Manson JE, et al. Can behavioral risk factors explain the difference in body mass index between African-American and European-American women? Ethn Dis. 1998 Autumn;8(3):331–9. [PubMed: 9926903]
26. U S Department of Health and Human Services. [cited May 13, 2013] National healthcare quality report [database on the Internet]. Agency for Healthcare Research and Quality. 2008. Available from: http://statesnapshots.ahrq.gov/snaps09/index.jsp
27. Spiegelman D, Hertzmark E. Easy SAS calculations for risk or prevalence ratios and differences. Am J Epidemiol. 2005; 162(3):199–200. [PubMed: 15987728]
28. Zou G. A modified Poisson regression approach to prospective studies with binary data. Am J Epidemiol. 2004; 159(7):702–6. [PubMed: 15033648]
29. Jillson IA. Opening Closed Doors: Improving Access to Quality Health Services for LGBT Populations. Clinical Research & Regulatory Affairs. 2002; 19(2/3):153.
30. Butler AC. Gender differences in the prevalence of same-sex sexual partnering: 1988-2002. Soc Forces. 2005; 84(1):421–49.

Table 1

Individual-Level Sample Characteristics and Percent Receiving Mammogram in Past Two Years Among Women Participating in the Nurses' Health Study (NHS) II, Ages 40-60 Years (N=85,756)

	Number of Observations in NHSII Ages 40-60 Years % (of Observations)	Percent Receiving Mammogram in Past Two Years at Ages 40-60 Years (of Observations)
Total	# Obs. = 360,171	
Sexual Orientation		
Heterosexual	98.8 (355831)	83.6% (297446)
Bisexual	0.4 (1314)	79.2% (1040)
Lesbian	0.8 (3026)	82.2% (2486)
Age Group (years)		
40-44	46.1(165929)	77.6% (128705)
45-49	33.0(118726)	86.9% (103115)
50-54	16.6(59860)	91.4% (54691)
55-60	4.4(15656)	92.4% (14461)
Ethnicity		
African-American	1.5 (5145)	83.4% (4291)
Asian-American	1.5 (5263)	79.3% (4172)
Latina	1.3 (4615)	78.7% (3634)
White (non-Latina)	94.1 (334519)	83.7% (279922)
Other	1.7 (6056)	83.8% (5073)
Missing	1.3 (4573)	84.9% (3880)
Income		
<50k	16.3 (45204)	79.9% (36126)
50-75k	27.5 (76210)	83.3% (63452)
75-100k	20.8 (57823)	84.5% (48853)
100k+	35.5 (98427)	86.6% (85238)
Missing	22.9 (82507)	81.6% (67303)

Table 2

Individual-Level Sample Characteristics and Percent Receiving Colonoscopy or Sigmoidoscopy Since Age 50 Among Women Participating in NHSII, Ages 50-60 Years (N=32,831)

	Women in NHSII Ages 50-60 Years % (N)	Percent Ever Receiving Colonoscopy/Sigmoidoscopy at Ages 50-60 Years % (N)
Total	N=32,831	
Sexual Orientation		
Heterosexual	98.7 (32405)	39.3% (12747)
Bisexual	0.4 (124)	38.7% (48)
Lesbian	0.9 (302)	42.4% (128)
Age Group (years)		
50-54	74.2 (24373)	32.2% (7858)
55-60	25.8 (8458)	59.9% (5065)
Ethnicity		
African-American	1.6 (512)	47.7% (244)
Asian-American	1.4 (460)	44.1% (203)
Latina	1.3 (406)	38.2% (155)
White (non-Latina)	94.1 (30528)	39.3% (11991)
Other	1.7 (539)	36.2% (195)
Missing	1.2 (386)	35.0% (135)
Income		
<50k	16.6 (4283)	31.7% (1357)
50-75k	27.7 (7118)	37.0% (2633)
75-100k	20.3 (5232)	40.0% (2094)
100k+	35.4 (9103)	46.0% (4191)
Missing	21.6 (7095)	37.3% (2648)

Table 3

Multivariable Prevalence Ratios and 95% Confidence Intervals of Receiving Mammogram in Past Two Years Associated With Individual- and State-Level Characteristics in Women Ages 40-60 Years in NHSII (N=85,756)

	Age-Adjusted Models	Partially Adjusted Model	Fully Adjusted Model
	Mammogram in Past Two Years at Ages 40-60 Years PR (95% CI)[a]	Mammogram in Past Two Years at Ages 40-60 Years PR (95% CI)[b]	Mammogram in Past Two Years at Ages 40-60 Years PR (95% CI)[c]
Sexual Orientation			
Heterosexual	Referent	Referent	Referent
Bisexual	0.94 (0.90, 0.98)	0.94(0.90, 0.98)	0.94 (0.90, 0.98)
Lesbian	0.97 (0.95, 1.00)	0.97(0.95, 1.00)	0.97 (0.95, 1.00)
Age (years)			
40-44	Referent	Referent	Referent
45-49	1.12 (1.12, 1.12)	1.12 (1.12, 1.12)	1.12 (1.12, 1.12)
50-54	1.18 (1.18, 1.18)	1.18 (1.17, 1.18)	1.18 (1.17, 1.18)
55-60	1.19 (1.19, 1.20)	1.19 (1.18, 1.20)	1.19 (1.18, 1.20)
Ethnicity			
African-American	0.99 (0.98, 1.01)	1.00 (0.98, 1.02)	1.00 (0.98, 1.02)
Asian-American	0.95 (0.93, 0.96)	0.95 (0.93, 0.96)	0.95 (0.93, 0.97)
Latina	0.94 (0.92, 0.96)	0.94 (0.92, 0.96)	0.95 (0.93, 0.97)
White (non-Latina)	Referent	Referent	Referent
Other	1.01 (0.99, 1.02)	1.01 (0.99, 1.03)	1.01 (0.99, 1.03)
Missing	1.02 (1.00, 1.03)	1.02 (1.00, 1.04)	1.02 (1.00, 1.04)
Income			
<50k	Referent	Referent	Referent
50-75k	1.04 (1.04, 1.05)	1.04 (1.04, 1.05)	1.04 (1.04, 1.05)
75-100k	1.06 (1.05, 1.07)	1.06 (1.05, 1.07)	1.06 (1.05, 1.07)
100k+	1.08 (1.08, 1.09)	1.08 (1.08, 1.09)	1.08 (1.08, 1.09)
Missing	1.03 (1.02, 1.03)	1.03 (1.02, 1.03)	1.02 (1.02, 1.03)
Presence of Sexual-Orientation-Related Protections in State Law	1.00 (1.00, 1.01)		0.99 (0.99, 0.99)
Agency for Healthcare Research and Quality (AHRQ) Overall Rating for State (per 10-unit increase)	1.01 (1.01, 1.02)		1.02 (1.02, 1.02)

[a]Age-adjusted models: Prevalence ratios from separate multivariate regression models for each variable in table adjusted for age and baseline age.

[b]Partially adjusted model: Prevalence ratios from multivariate regression model controlling for sexual orientation, age group, ethnicity, and income.

[c]Fully adjusted model: Prevalence ratios from multivariate regression model controlling for all variables in table simultaneously.

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Table 4

Multivariable Prevalence Ratios and 95% Confidence Intervals of Ever Receiving Colonoscopy/Sigmoidoscopy Associated With Individual- and State-Level Characteristics in Women Ages 50-60 Years in NHSII Cohort (N=32,831)

	Age-Adjusted Models	Partially Adjusted Model	Fully Adjusted Model
	Ever Colonoscopy/ Sigmoidoscopy at Ages 50-60 Years PR (95% CI)[a]	**Ever Colonoscopy/ Sigmoidoscopy at Ages 50-60 Years PR (95% CI)[b]**	**Ever Colonoscopy/ Sigmoidoscopy at Ages 50-60 Years PR (95% CI)[c]**
Sexual Orientation			
Heterosexual	Referent	Referent	Referent
Bisexual	1.00 (0.75, 1.33)	1.02 (0.77, 1.36)	1.03 (0.78, 1.37)
Lesbian	1.10 (0.92, 1.31)	1.11 (0.93, 1.32)	1.11 (0.94, 1.33)
Age Group (years)			
50-54	Ref	Ref	Ref
55-60	2.59(2.47, 2.72)	2.57 (2.45, 2.70)	2.57 (2.45, 2.69)
Ethnicity			
African-American	1.22 (1.07, 1.38)	1.25 (1.10, 1.42)	1.27 (1.12, 1.44)
Asian-American	1.12 (0.98, 1.29)	1.11 (0.97, 1.27)	1.11 (0.97, 1.28)
Latina	0.96 (0.82, 1.13)	0.97 (0.83, 1.13)	0.99 (0.84, 1.16)
White (non-Latina)	Referent	Referent	Referent
Other	0.93 (0.81, 1.07)	0.94 (0.82, 1.08)	0.94 (0.82, 1.08)
Missing	0.89 (0.75, 1.05)	0.89 (0.75, 1.05)	0.89 (0.75, 1.06)
Income			
<50k,	Referent	Referent	Referent
50-75k,	1.16 (1.09, 1.24)	1.16 (1.09, 1.24)	1.16 (1.08, 1.24)
75-100k	1.25 (1.17, 1.34)	1.25 (1.17, 1.34)	1.25 (1.17, 1.34)
100k+	1.42 (1.34, 1.51)	1.43 (1.34, 1.52)	1.42 (1.33, 1.50)
Missing	1.19 (1.11, 1.27)	1.19 (1.11, 1.27)	1.19 (1.11, 1.27)
Presence of Sexual-Orientation-Related Protections in State Law	1.08 (1.04, 1.11)		1.00 (0.97, 1.04)
Agency for Healthcare Research and Quality (AHRQ) Overall Rating for State (per 10-unit increase)	1.10 (1.08, 1.12)		1.09 (1.07, 1.12)

[a] Age-adjusted models: Prevalence ratios from separate multivariate regression models for each variable in table adjusted for age and baseline age.

[b] Partially adjusted model: Prevalence ratios from multivariate regression model controlling for sexual orientation, age group, ethnicity, and income.

[c] Fully adjusted model: Prevalence ratios from multivariate regression model controlling for all variables in table simultaneously.