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ABSTRACT

INTERVENTIONS TO INCREASE AWARENESS ABOUT ALCOHOL HARMS AMONG BISEXUAL AND LESBIAN WOMEN

By

ADELAIDE BALENGER

4/22/22

Purpose: This research has two aims: (1) assess how often bisexual and lesbian women are screened for alcohol use and offered brief counseling in primary care settings compared to their heterosexual peers; and (2) understand how bisexual and lesbian women respond to information that alcohol increases breast cancer risk compared to heterosexual women.

Methods: The study population consisted of 5,027 adult U.S. women who responded to an online, cross-sectional Qualtrics survey. The survey included the Alcohol Use Disorders Identification Test (AUDIT), questions about alcohol screening and brief counseling in primary care, and questions to assess awareness of the link between alcohol and breast cancer. Bivariate analyses and logistic regression were conducted.

Results: Bisexual and lesbian women had higher odds of harmful drinking (based on an AUDIT score ≥ 8) compared to heterosexual women (adjusted odds ratio [AOR] = 1.25, 95% confidence interval [CI] = 1.00-1.56 for bisexual women; AOR = 1.72; 95% CI = 1.19-2.48 for lesbian women). However, bisexual and lesbian women were no more likely to be advised about drinking in primary care compared to heterosexual women, but women across all groups (33.29% of non-harmful drinkers and 51.05% of harmful drinkers) indicated they would talk to a medical professional about this association.

Conclusion: Alcohol screening and brief counseling in primary care is an under-utilized opportunity to inform bisexual and lesbian women about the harms of drinking. After seeing information on the association between alcohol and breast cancer, many women agreed they would talk to a health care professional about this link.

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WOMEN**

By

ADELAIDE BALENGER

B.A., DAVIDSON COLLEGE

A Thesis Submitted to the Graduate Faculty
of Georgia State University in Partial Fulfillment of the Requirements of the Degree

MASTER OF PUBLIC HEALTH

ATLANTA, GEORGIA 30303

APPROVAL PAGE

**INTERVENTIONS TO INCREASE AWARENESS ABOUT ALCOHOL HARMS AMONG BISEXUAL AND LESBIAN
WOMEN**

By

ADELAIDE BALENGER

Approved by:

Dr. Lia Scott, Ph.D., M.P.H.
Committee Chair

Dr. Monica Swahn, Ph.D., M.P.H.
Committee Member

Dr. Ritu Aneja, Ph.D.
Committee Member

4/25/22
Date

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Author's Statement Page

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Adelaide Balenger

Signature of Author

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Chapter I – Introduction

Alcohol use is associated with a myriad of diseases and injuries, including both communicable diseases (HIV/AIDS, tuberculosis), non-communicable diseases (cancers, heart disease, stroke, and cirrhosis), and unintentional and intentional injuries (World Health Organization, 2018). Regarding cancer, researchers have documented a causal link between alcohol use and many cancers, including breast cancer (Global Burden of Disease Risk Factors Collaborators, 2016; Rehm et al., 2017; Runggay et al., 2021). Most recently, researchers estimated that 4.1% of new cases of cancer in 2020 globally were attributable to alcohol use, including 98,300 cases of breast cancer (Runggay et al., 2021). The association between alcohol and breast cancer is well-established as a dose-response relationship (Allen et al., 2009; Bagnardi et al., 2015; Collaborative Group on Hormonal Factors in Breast Cancer, 2002; Scoccianti et al., 2014). Meaning, even light or moderate drinking increases the risk of breast cancer.

Despite this burden, alcohol use and binge drinking among adults in the U.S. are increasing, particularly so among adult women (Keyes, 2022). While men still consume more alcohol than women overall, the gender gap has been closing over time (Keyes, 2022; Slade et al., 2016). A recent systematic review has also suggested that alcohol use increased during the COVID-19 pandemic (Roberts et al., 2021), so this trend of increased alcohol use among adult women has likely escalated in recent years, becoming even more urgent to address both alcohol use and the alcohol-related harm as a result.

While most people likely understand the link between alcohol use and short-term, acute consequences of alcohol like traffic accidents and injuries, it is less obvious to make the connection between alcohol use and long-term health consequences, such as breast cancer. About three in four women in the U.S. remain unaware that even light or moderate alcohol consumption can increase the risk of breast cancer (Khushalani et al., 2020). While all women urgently need to learn about the potential long-term health effects of alcohol (such as cancers on several sites, including breast cancer),

this is especially true for lesbian and bisexual women who may be at increased risk of alcohol harm. Lesbian, bisexual, and women who otherwise do not identify as straight or heterosexual often drink more frequently, engage in riskier drinking patterns like binge drinking, experience more alcohol-related harm, and are diagnosed with alcohol use disorders at higher rates compared with straight or heterosexual women (Fish et al., 2018; Gonzales & Henning-Smith, 2017; Greene et al., 2020; Hughes et al., 2020; McCabe et al., 2013; Trinh et al., 2017; Wilson et al., 2016). Researchers point to the sexual minority stress model, capturing the stigma, prejudice, and discrimination that these groups experience and the need for a coping strategy such as drinking, as a reason for these higher rates of risky drinking (Meyer, 2003; Meyer, 2013).

With the higher and riskier alcohol consumption among these groups, bisexual and lesbian women may be particularly susceptible to the long-term consequences of alcohol consumption, such as breast cancer. Recent Census survey data estimates that among adults in the U.S., about 4% identify as bisexual, and 3% identify as lesbian or gay, thereby making up a sizeable portion of the U.S. population (Human Rights Campaign Foundation, 2021). So, it is important to consider the risks and unique needs among these groups. Greater alcohol use among sexual minority women aligns with patterns for other health behaviors, including sexual minority women being more likely to be current smokers than heterosexual women (Trinh et al., 2017). Related, key disparities in health outcomes appear among sexual minority women compared to heterosexual women, including sexual minority women being more likely to have obesity, hypertension, cancer, and stroke (Trinh et al., 2017).

While research has documented the increased alcohol use among sexual minority women and low awareness of the link between alcohol and breast cancer among all women, my thesis examines interventions that could increase awareness of the long-term health consequences of alcohol, like an increased risk of breast cancer, specifically among bisexual and lesbian women. No studies to date have analyzed the level of awareness of the association between breast cancer and alcohol among these two

sexual minority groups. This thesis addresses this gap and examines potential interventions to increase awareness, including alcohol use and brief counseling in primary care settings and health education messages. In a systematic review of alcohol and other drug use among sexual minority women, Hughes and colleagues (2020) note the absence of intervention research in the current literature on alcohol use among sexual minority women and asserts that this is a “gaping hole” in the literature. While this thesis looks at interventions to increase awareness, awareness is a requisite for behavior change (De Vries, 2003). As such, this study begins to fill this gap.

This first intervention considered in this study is the self-reported prevalence of alcohol screenings and brief counseling in primary care settings. The U.S. Preventive Services Task Force recommends alcohol screening and brief counseling in primary care settings for all adults (Curry et al., 2018). This intervention can connect women who screen positive with alcohol treatment and support services. However, the counseling must follow the screening for those who indicate problematic drinking for this intervention to be effective. McKnight and colleagues (2020) note that the counseling entails “a conversation about the dangers of excessive drinking on the patient’s health, and development of a plan to reduce drinking if the patient chooses to do so.” Beyond screening for problematic drinking, conversations in primary care settings could also serve as key touchpoints to increase awareness about alcohol’s long-term health effects, even among women who partake in light or moderate consumption.

Next, this study also considers the effectiveness of social media health education messages to increase awareness among bisexual and lesbian women about the long-term health effects of alcohol, specifically the association between alcohol use and breast cancer. Prior studies in Denmark, England, and Australia have shown that mass media campaigns can increase knowledge that alcohol is linked to cancer (Buykx et al., 2016; Christensen et al., 2019; Dixon et al., 2015). Examples from tobacco research also indicate that social media campaigns are a cost-effective strategy to increase knowledge about the

harms of cigarettes and improve cessation efforts (Lazard, 2021; Luo et al., 2020; Naslund et al., 2017).

These best practices can be translated to alcohol-focused social media campaigns as well.

In summary, my thesis examines two research questions:

(1) Are bisexual and lesbian women more or less likely to be asked alcohol-related questions and advised about harmful drinking by primary care providers compared to their heterosexual peers?

(2) Do bisexual and lesbian women differ in their response to health education social media messages highlighting the increased risk of breast cancer due to alcohol consumption compared to their heterosexual peers?

Answering both these questions can inform interventions tailored to bisexual and lesbian women.

Chapter II – Literature Review

Alcohol use among sexual minority women

Bisexual and lesbian women are more likely to be current drinkers, engage in riskier drinking patterns, experience more alcohol-related consequences, and are diagnosed with alcohol use disorders at higher rates compared to heterosexual women (Fish et al., 2018; Gonzales & Henning-Smith, 2017; Hughes et al., 2020; McCabe et al., 2013; Trinh et al., 2017; Wilson et al., 2016). For example, Fish and colleagues (2018) found that bisexual and lesbian women were more likely to consume 4+ drinks on one occasion, the standard cut-off for binge drinking for women (adjusted Odds Ratio = 1.57 for lesbian women and adjusted Odds Ratio = 1.83 for bisexual women), compared to heterosexual women. Similarly, using data from the Behavioral Risk Factor Surveillance System, another study found that bisexual women had 1.84 greater odds of binge drinking (consuming four or more drinks on one occasion for women in the last 30 days) compared to heterosexual women, and for lesbian women, 1.49 greater odds (Gonzales & Henning-Smith, 2017). Lastly, McCabe et al. (2013) found that compared to heterosexual women, lesbian women had 3.2 times greater odds of a lifetime alcohol use disorder and for bisexual women, 2.2 times greater odds. In contrast, other studies have found that bisexual women, compared to other sexual minority subgroups, have the highest risk of alcohol-related outcomes (Hughes et al., 2020). Related, sexual minority women also have higher rates of a family history of substance use problems (McCabe et al., 2013).

The sexual minority stress model serves as a conceptual model to understand why sexual minority women often engage in riskier drinking patterns (Meyer, 2003; Meyer, 2013). As displayed in Figure 1, this model connects the stigma, prejudice, and discrimination experienced by sexual minorities to a higher prevalence of mental health problems in this population. Hughes et al. (2020) define sexual minority stress as “including both individual and institutional forms of prejudice and discrimination that likely contribute to alcohol and other drug-related health disparities among sexual minority women” (p. 6). Green and Feinstein (2012) also note how lesbian, gay, and bisexual individuals experience social

pressures that can result in “limited social support and feelings of isolation,” two contributing factors for substance use (p. 12).

Differences in alcohol use align with other differences in health behaviors and health disparities previously documented among sexual minority women. In the study by Trinh and colleagues (2017), White, Black, and Latina/Hispanic sexual minority women were more likely be current smokers compared to the heterosexual comparison groups. In addition, Black sexual minority women had a higher prevalence of stroke compared to Black heterosexual women, and White sexual minority women had a higher prevalence than White heterosexual women of obesity, cancer, and stroke (Trinh et al., 2017).

As the sexual minority stress model notes, sexual orientation interweaves with other identities, including race/ethnicity and socioeconomic status. The Institute of Medicine (2011) released a seminal report on directions for future research on sexual minority populations, emphasizing the impact of minority stress, but also highlighting intersectionality. While stigma arising from sexual orientation is critical to consider, researchers must also consider interweaving sexual, racial/ethnic, socioeconomic, and geographic identities (Institute of Medicine, 2011). While sexual orientation is an important dimension, it must be considered alongside other elements of a person’s identity.

Association between alcohol and breast cancer

Many epidemiologic studies have established that alcohol consumption increases the risk of breast cancer (Allen et al., 2009; Bagnardi et al., 2015; Collaborative Group on Hormonal Factors in Breast Cancer, 2002; Runggay et al., 2021; Scoccianti et al., 2014). In the Million Women study in the United Kingdom, Allen and colleagues (2009) estimated that one additional drink regularly consumed daily may be associated with a 12% increase risk of breast cancer. Another older study estimated a 7.1% increased risk for breast cancer for each additional alcoholic drink consumed daily (Collaborative Group on Hormonal Factors in Breast Cancer, 2002). Bagnardi et al. (2015) disaggregated the risk by level of

alcohol consumption, finding the relative risk for breast cancer among light drinkers compared to abstainers/occasional drinkers was 1.04, for moderate drinkers compared to abstainers/occasional drinkers 1.23, and for heavy drinkers compared to abstainers/occasional drinkers 1.61. Other studies included in a literature review reinforce the dose-response relationship between alcohol and breast cancer risk (Scoccianti et al., 2014). Thus, even light or moderate alcohol consumption raises breast cancer risk, meaning there is no safe level of alcohol consumption in relation to breast cancer. The American Institute for Cancer Research lists consumption of alcoholic drinks (with no threshold of drinking defined) as a probable cause of premenopausal breast cancer and a convincing cause of postmenopausal breast cancer, the two categories of strongest evidence (World Cancer Research Fund International and American Institute for Cancer Research, 2018). Globally, this translates to an estimate for the alcohol-attributable cases of breast cancer of 4.4%, or 98,300 alcohol attributable breast cancer cases (Rumgay et al., 2021).

Awareness about this link

Despite this documented association between alcohol and breast cancer, many women remain unaware about this modifiable risk behavior for breast cancer. Few studies have examined the awareness in the U.S., but Khushalani et al. (2020) found that only 25% of U.S. women ages 15 to 44 who participated in the National Survey of Family Growth identified alcohol consumption as a risk factor for breast cancer. Of note, current drinkers (defined as consumed at least one alcoholic drink in the last 30 days) more frequently believed that alcohol use was associated with breast cancer. No significant differences in level of awareness emerged among women from different socioeconomic groups. Awareness was lower among non-Hispanic Whites compared to Hispanics and other non-Hispanic races, and the researchers did not find any significant differences by education, income, insurance, rural vs. urban, marital status, or family history of breast cancer. However, women lacking a high school

education were more likely to indicate that they did not know or did not have an opinion on if alcohol consumption increases the risk of breast cancer.

Other researchers have assessed this level of awareness in the United Kingdom. Researchers Buykx and team (2016) reported that only 18% of women in a representable sample knew that alcohol use increases the risk of breast cancer in the United Kingdom. However, this proportion was higher among women from Northeast England, where a mass media campaign ran educating women about this association. Another mixed-methods study in the United Kingdom among women who attended a breast screening program found that only 19.5% of attendees labeled alcohol as a risk factor for breast cancer (Sinclair et al., 2019). Once again, this percentage was higher (25.2%) among women who drank in the last year. Women who visited the breast clinic with symptoms and were drinkers had the highest proportion of labeling alcohol as a risk factor for breast cancer (33%). No studies to date have examined the level of awareness about alcohol as a risk factor for breast cancer among sexual minority women.

Interventions to Increase Awareness

Despite increased alcohol consumption among sexual minority women, little research has examined interventions to increase awareness about the long-term effects of alcohol consumption, like breast cancer, specifically among these groups. Two potential interventions to consider include alcohol use screenings and counseling in a primary care setting and health education messages. While both these interventions alone are insufficient to fully address alcohol-related harm among sexual minority women, they represent two opportunities to inform women about the long-term harms of alcohol like breast cancer.

The I-Change Model, the integrated model for explaining motivational and behavioral change, highlights the role of awareness factors, including knowledge, risk perceptions, and cues to action, for changes in health behaviors (De Vries, 2003), as depicted in Figure 2. However, predisposing factors, such as behavioral, psychological, biological, and social/cultural factors, in addition to information

factors like the message, channel, and source, also affect a person's motivation and resulting intention and behavior. Researchers have used this model to understand factors that impact smoking cessation (De Vries, 2003; Smit et al., 2018), but the model is also applicable to behavioral changes in alcohol consumption based on increased awareness of alcohol's health effects. Previous research has linked risk perception to alcohol consumption patterns, finding that beliefs denying or rationalizing cancer risks related to alcohol are associated with harmful drinking (Bocquier et al., 2017). One way to combat these risk denial and rationalization beliefs is to increase awareness about the deleterious effects of alcohol.

Second, screening and counseling for risky alcohol use in primary care settings is recommended for all adults by the U.S. Preventive Services Task Force and offers an opportunity for primary care professionals to engage in a dialogue with patients about alcohol-related harm (Curry et al., 2018). In 2017, 13 states and the District of Columbia reported on the percentage of adults asked about alcohol use, how much they drink, if they engage in binge drinking, if they were advised about a harmful level of drinking, and if they were advised to reduce or quit drinking at their last check-up (McKnight-Eily et al., 2020). In 2017, 81.8% of female U.S. adults reported that they were asked about alcohol use at a check-up in the last two years, and among those who reported binge drinking, only 33.8% were advised about the harms associated with drinking too much, and only 13.7% were advised to reduce or quit drinking (McKnight-Eily et al., 2020). While the researchers noted that males, persons with disability, individuals with less than a high school education, individuals with income <100% of the federal poverty level, and those lacking health insurance were more likely to be advised to reduce drinking, they did not disaggregate their results by sexual orientation. Given the higher prevalence of risky alcohol consumption among sexual minority women, this is a key gap in reporting.

Despite their effectiveness, alcohol screenings and brief counseling pose several challenges, especially in light of using this opportunity to educate women about the long-term health risks of alcohol use like breast cancer. In a qualitative study of both staff and patients at a breast clinic in the

United Kingdom, Sinclair et al. (2019) found that health professionals were often hesitant to raise alcohol as a risk factor for breast cancer. Staff members described their confusion regarding this link, saying they “needed evidence about alcohol consumption and its specific links to breast cancer to feel more comfortable advising patients” (p. 7). Since alcohol consumption is a modifiable risk factor, some feared that bringing up this link could imply blaming or stigmatizing women with breast cancer. However, patients often expressed needing information about the alcohol and breast cancer link from a trusted source, such as a health professional, and many viewed health education as a key role of the health professional. This study highlights the nuances of alcohol screenings and counseling for the purpose of educating women on the long-term risks of drinking in a health care setting.

Beyond these noted challenges, alcohol screenings and brief counseling for sexual minority women have additional considerations. In line with the sexual minority stress model, bisexual and lesbian women may face stigma and discrimination in a health care setting. Health care providers may be inadequately trained to competently treat and interact with sexual minority women and may not be comfortable asking about sexual orientation (Aisner et al., 2020). Researchers have also documented that sexual minority women do not access health care at the same rates as straight/heterosexual women, with one study finding that White and Latina/Hispanic sexual minority women were less likely to have a “usual health care place” compared to heterosexual white women (Trinh et al., 2017). In addition, sexual minority individuals may not feel comfortable disclosing their sexual orientation to health care providers (Law et al., 2015). Research among men who have sex with men suggests that disclosure of sexual orientation was associated with a higher likelihood of disease screening and preventive health measures by primary care providers, so creating an environment that supports disclosure is important (Petroll & Mosack, 2011). Moreover, the lack of adequate training for health care professionals, differential access to usual places of care, and non-disclosure of sexual orientation

translate into additional barriers to educating sexual minority women about the harmful effects of alcohol in a primary care setting.

In addition to screenings in primary care, health education messages are another opportunity to increase awareness about the risk of cancer from alcohol. In a Danish study, a social media campaign on Facebook and Instagram, complemented with a website and digital/print/radio stories over two weeks, imparted the message that alcohol increases the risk of cancer (Christensen et al., 2019). The percentage of respondents who were aware that alcohol increases cancer rose from 22.2% to 27.0% of respondents when unprompted. As noted previously, Buykx et al. (2016) found that greater awareness of the association between alcohol and breast cancer existed in northeast England, where a mass media campaign ran, compared to other regions in England. A study in Australia found that after a mass media campaign targeted women informing them of the link between alcohol and cancer, the odds ratio of knowing that drinking alcohol consistently can increase cancer risk compared to baseline was 4.88 (Dixon et al., 2015). In the related field of tobacco research, social media campaigns have been shown to increase knowledge about the harms of cigarettes and improve cessation efforts (Lazard, 2021; Luo et al., 2020; Naslund et al., 2017). These cost-effective strategies and best practices from tobacco prevention could be adapted for alcohol behavior modifications as well. Collectively, these studies indicate that awareness campaigns can effectively inform women about the association between alcohol consumption and increased risk of breast cancer. However, research on these macro-level interventions are largely lacking within the sexual minority women population (Kidd et al., 2022).

Figures

Figure 1: Sexual Minority Stress Model (Meyer, 2003; Meyer, 2013)

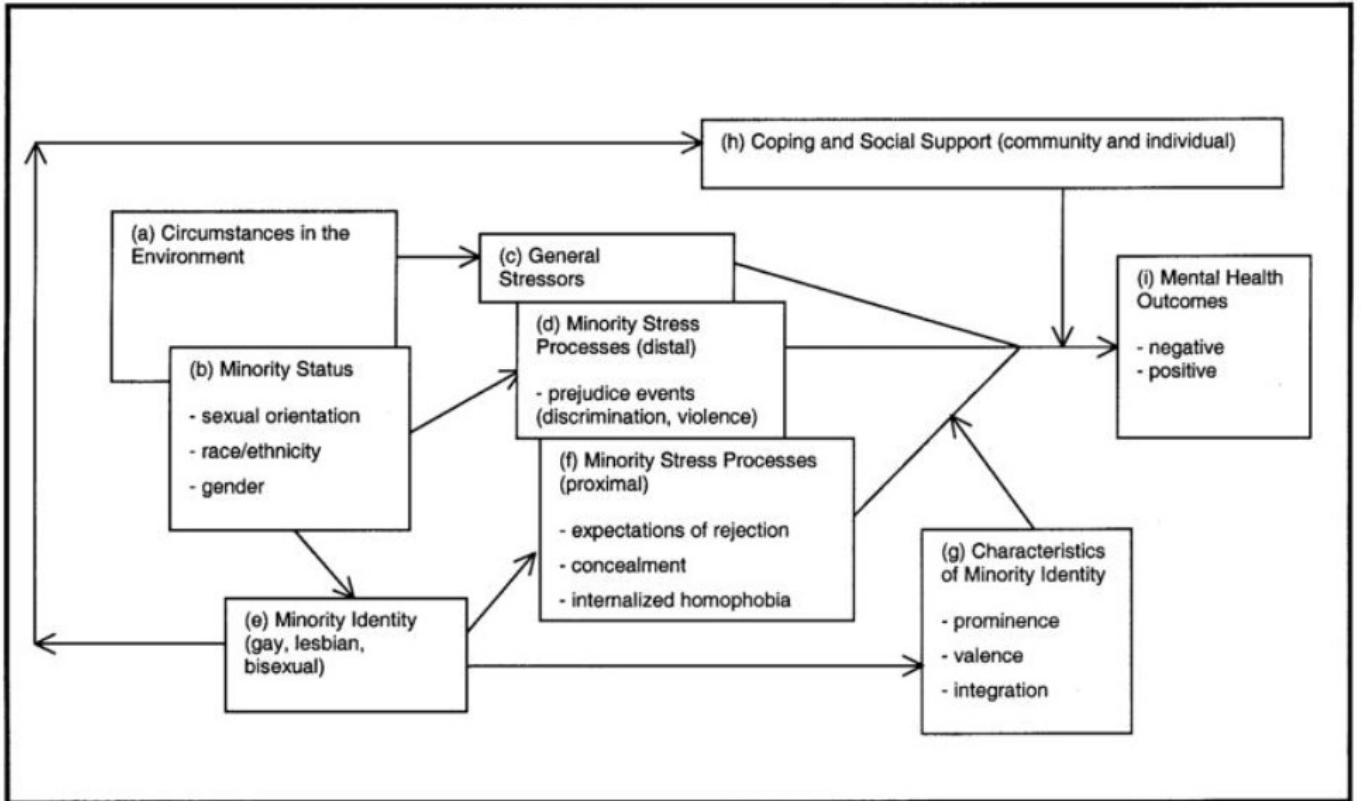
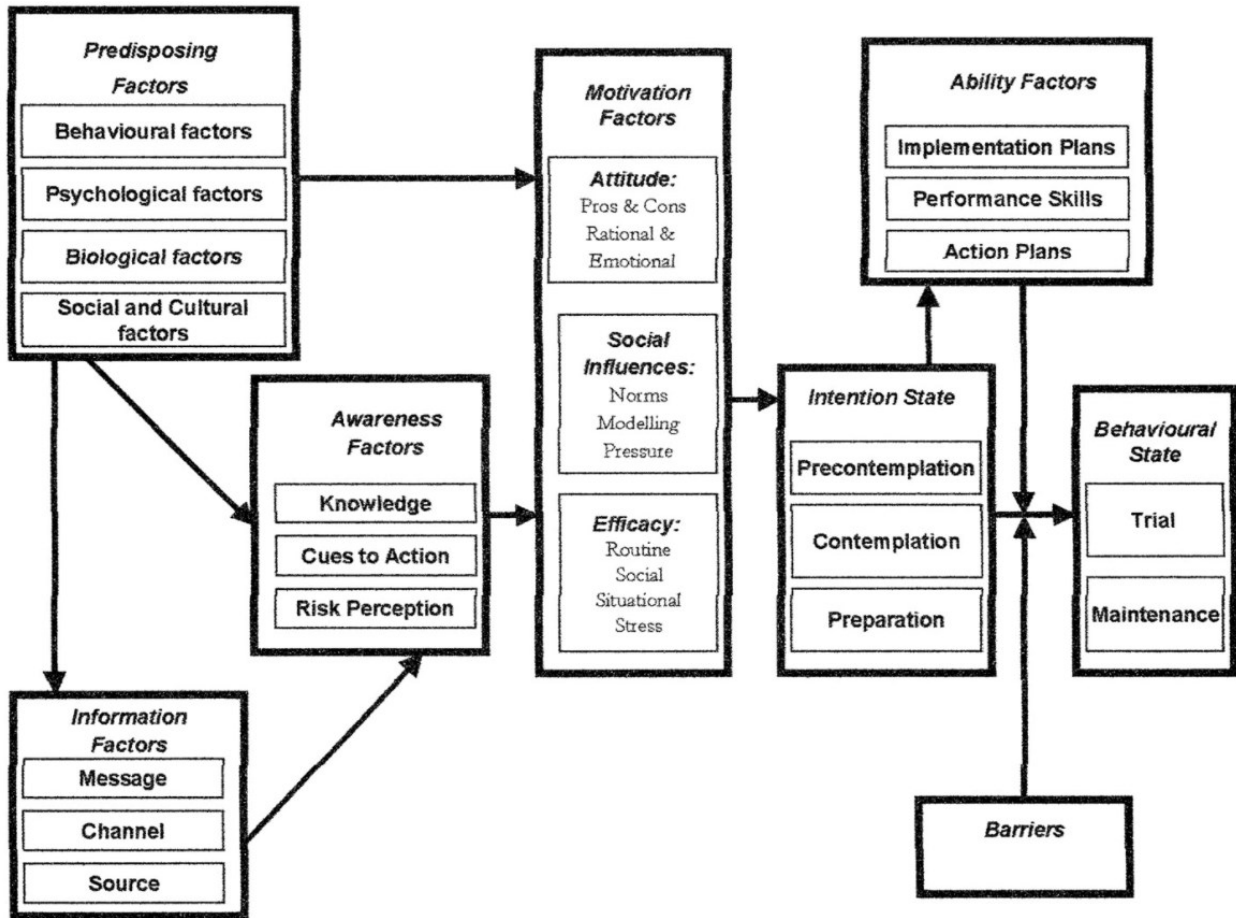


Figure 2: I-Change Model – Integrated Model for Change (De Vries, 2003)



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Chapter III – Manuscript

Abstract

Purpose: This research has two aims: (1) assess how often bisexual and lesbian women are screened for alcohol use and offered brief counseling in primary care settings compared to their heterosexual peers; and (2) understand how bisexual and lesbian women respond to information that alcohol increases breast cancer risk compared to heterosexual women.

Methods: The study population consisted of 5,027 adult U.S. women who responded to an online, cross-sectional Qualtrics survey. The survey included the Alcohol Use Disorders Identification Test (AUDIT), questions about alcohol screening and brief counseling in primary care, and questions to assess awareness of the link between alcohol and breast cancer. Bivariate analyses and logistic regression were conducted.

Results: Bisexual and lesbian women had higher odds of harmful drinking (based on an AUDIT score ≥ 8) compared to heterosexual women (adjusted odds ratio [AOR] = 1.25, 95% confidence interval [CI] = 1.00-1.56 for bisexual women; AOR = 1.72; 95% CI = 1.19-2.48 for lesbian women). However, bisexual and lesbian women were no more likely to be advised about drinking in primary care compared to heterosexual women, but women across all groups (33.29% of non-harmful drinkers and 51.05% of harmful drinkers) indicated they would talk to a medical professional about this association.

Conclusion: Alcohol screening and brief counseling in primary care is an under-utilized opportunity to inform bisexual and lesbian women about the harms of drinking. After seeing information on the association between alcohol and breast cancer, many women agreed they would talk to a health care professional about this link.

Word count: 250

Keywords: Alcohol, Substance Use, Bisexual; Lesbian, Sexual Minority Women, Breast Cancer

Introduction

Alcohol use is associated with a myriad of diseases and injuries, including a causal link between alcohol use and many cancers.¹⁻³ Despite this burden, alcohol use and binge drinking among adults in the U.S. are increasing, particularly so among adult women.⁴ This trend calls for greater attention on the unique risks that alcohol poses to women, including breast cancer. Alcohol consumption increases the risk of breast cancer in a dose-response relationship, meaning even light or moderate drinking can increase breast cancer risk.⁵⁻⁸ Despite this well-established association, three in four women in the U.S. remain unaware of this link.⁹ While all women urgently need to learn about this association, bisexual and lesbian women often drink more frequently, engage in riskier drinking patterns, experience more alcohol-related consequences, and are diagnosed with alcohol use disorders at higher rates compared to heterosexual women.¹⁰⁻¹⁶ Previous research has pointed to the sexual minority stress model, connecting the stigma, prejudice, and discrimination experienced by sexual minorities as the reason for the increased substance use among these groups.^{10, 17, 18} As a result, bisexual and lesbian women may be disproportionately impacted by the long-term health consequences of drinking, like breast cancer.

Most research to date on alcohol use among sexual minority populations has focused on interventions for heavy alcohol consumption, predominantly among sexual minority men.¹⁹ Scarce research has assessed interventions to increase awareness about the long-term harms of alcohol among bisexual and lesbian women. To address this gap, we considered two interventions for bisexual and lesbian women: (1) alcohol use screenings and brief counseling in primary care settings and (2) health education messages highlighting that alcohol increases breast cancer risk. Both interventions represent two opportunities to educate bisexual and lesbian women about the long-term health risks associated with drinking.

Screening and counseling for alcohol use in primary care settings is recommended for all adults by the U.S. Preventive Services Task Force and provides a chance for health care professionals to inform

patients about both the short-term and long-term effects of alcohol.²⁰ In 2017, 81.8% of female U.S. adults reported that they were asked about alcohol use at a check-up in the last two years, and among those who reported binge drinking, only 33.8% were advised about the harms associated with drinking too much, and only 13.7% were advised to reduce or quit drinking.²¹ Yet, the researchers did not disaggregate their results by sexual orientation. Other research has found that sexual minority women are less likely to access usual places of care compared to their heterosexual peers, and health care professionals often are inadequately trained on the unique needs of sexual minority women.^{11, 22} Meaning, alcohol use screening and brief counseling in primary care may require additional considerations for sexual minority women.

Health education messages, including mass media campaigns, are another opportunity to increase awareness about the risk of cancer from alcohol. A handful of studies in Denmark, England, and Australia have found that mass media campaigns, including via social media and television, about the link between alcohol and cancer can increase knowledge about this association.²³⁻²⁵ In the related field of tobacco research, social media campaigns have been shown to increase knowledge about the harms of cigarettes and improve cessation efforts.²⁶⁻²⁸ These cost-effective strategies and best practices from tobacco prevention could be adapted for alcohol behavior modifications as well. However, no research to date has examined their effectiveness among bisexual and lesbian women related to drinking.

Objective

The purpose of this research was to: (1) assess how often bisexual and lesbian women are screened for alcohol use and offered brief counseling in primary care compared to their heterosexual peers and (2) understand how bisexual and lesbian women respond to health education messages highlighting that alcohol increases the risk of breast cancer compared to heterosexual women.

Methods

Study Population and Survey Distribution

The study population consisted of 5,027 adult U.S. women who responded to an anonymous, internet-based Qualtrics survey. Online samples recruited by Qualtrics typically include individuals who agreed to be contacted by a market research service.²⁹ Since Qualtrics handled participant recruitment and distribution of the survey, no response rate can be computed. Women received compensation for the survey based on Qualtrics' discretion. Previous research has recognized the value of online samples in other populations due to their efficiency in gathering epidemiologic data.^{30, 31}

Eligibility criteria included residence in the U.S., at least 18 years of age, and identification as female. Qualtrics adhered to the following quotas in its distribution: for age, 20% aged 18-24, 20% aged 25-34; 20% aged 35-44; 20% aged 45-54, and 20% aged 55+; for race, at least 15% Black/African American; for ethnicity, at least 10% Spanish/Hispanic/Latino origin. All fifty U.S. states and Washington D.C. are represented in the survey. However, 21 states represented about 80% of the survey respondents. Qualtrics distributed the online survey from September 16, 2021 to October 14, 2021. The study was approved by the Georgia State University Institutional Review Board (H21673).

Measures

Sociodemographic Characteristics

The survey included questions on demographic and socioeconomic variables, including sexual orientation, age, race/ethnicity, health insurance status, marital status, education, and income. For sexual orientation, respondents chose from heterosexual or straight, gay or lesbian, bisexual, other, or prefer not to say. Respondents also indicated if they had a family history of a drug or alcohol use disorder.

Harmful drinking

We used the Alcohol Use Disorders Identification Test (AUDIT), a well-recognized and validated instrument, to assess level of alcohol consumption.³² The research team used a cut-off score of 8 or

more to indicate harmful or hazardous drinking, as recommended by the World Health Organization.³²

In this paper, we refer to those who score 8 or above on the AUDIT as harmful drinkers.

Alcohol Screening and Brief Counseling in Primary Care Settings

Questions about how often primary care professionals ask alcohol-related questions were taken from the 2017 Behavioral Risk Factor Surveillance System (Module 24).³³ The first question asked how long it had been since their last routine check-up. If the respondent answered that their checkup was within the last year or two years, they then responded to if they were asked by their health care provider whether they drink alcohol and how much at that check-up. If affirmative, another question followed about if they were specifically asked about binge drinking (consuming four or more drinks on at least one occasion in the last 30 days). Lastly, if they answered that their check-up was within the last year or two years, two questions asked if they were advised about a harmful level of alcohol or advised to reduce/quit their drinking.³³

Belief that alcohol increases breast cancer risk and reactions to this information

Women were asked to indicate if they thought alcohol increased the risk of eight types of cancer, an approach used by a previous study.²⁴ The question read: “Do you think your risk of developing the following types of cancer is increased by drinking alcohol?” where women indicated yes, no, or don’t know for 8 types of cancer: bladder, brain, breast, colon, liver, mouth, ovarian, and stomach. After this question, the survey randomized respondents to see one of three interventions – (1) an Instagram post from the “Drink Less for Your Breasts” campaign that says, “Just one drink a day can increase your risk of breast cancer by 14%”; (2) an excerpt from the CDC website on the association between alcohol and cancers; or (3) both the Instagram post and the CDC website excerpt.^{34, 35} These survey intercepts are displayed in Figure 1.

After the survey interventions, respondents answered: “Do you think your risk of developing breast cancer is increased by drinking alcohol?” where they could say yes, no, or don’t know.

Respondents also indicated their level of agreement on a Likert scale with their intentions to search for

more information online about the link between alcohol and breast cancer and to talk to a medical professional about the link between alcohol and breast cancer. These intentions were loosely adapted from another study assessing intentions related to HPV vaccinations after seeing messages on Facebook.^{36, 37}

Statistical Analyses

Among the 5,027 women who responded to the survey, 136 women were excluded for not disclosing their sexual orientation or identifying as other. The final analysis dataset consisted of 4,891 women who identified as bisexual, lesbian, or heterosexual. The research team conducted bivariate analyses using Chi-square tests to detect statistically significant differences among the three groups for sociodemographic characteristics, harmful/hazardous drinking, AUDIT scores, pre and post-intervention beliefs that alcohol increases breast cancer risk, the prevalence of alcohol screening and brief counseling in primary care settings, and the proportion who agreed with the intentions post-intervention. Logistic regression was used to obtain unadjusted and adjusted odds ratios for the outcome harmful drinking and the outcomes related to alcohol screening and brief counseling in a primary care setting. All statistical analyses were performed in SAS version 9.4.

Results

Among the 4,891 women in the analysis dataset, 554 (11.33%) identified as bisexual, 157 (3.21%) as lesbian, and 4,180 (85.46%) as heterosexual. Table 1 summarizes sociodemographic descriptive results. The age distribution skewed younger among bisexual and lesbian respondents compared to heterosexual respondents. Fewer bisexual and lesbian women were married or living with a partner, and more bisexual and lesbian women had yearly income <\$25K, compared to heterosexual women.

Harmful drinking and family history of alcohol/drug use disorder

As shown in Table 1, both bisexual and lesbian women had higher rates of harmful drinking, based on an AUDIT score ≥ 8 (27.08% among bisexual women; 29.94% among lesbian women; 15.91%

among heterosexual women). Bisexual and lesbian women had higher rates of a family history of drug/alcohol use disorder (64.86% among bisexual women; 59.24% among lesbian women; 48.47% among heterosexual women). Logistic regression results for harmful drinking are presented in Table 2. Both bisexual and lesbian women had higher odds of harmful drinking compared to heterosexual women, after adjusting for age, race/ethnicity, education, family history of drug/alcohol use disorder, and marital status (adjusted odds ratio [AOR] = 1.25, 95% confidence interval [CI] = 1.00-1.56 for bisexual women; AOR = 1.72; CI=1.19-2.48 for lesbian women). Black/African American Non-Hispanic women also had a higher odds of harmful drinking (AOR = 1.42; CI = 1.13-1.78). Income was excluded as a co-variate given the missing data.

Alcohol Screening and Brief Counseling in Primary Care Setting

Table 3 summarizes the bivariate analysis for the questions related to alcohol screening and brief counseling in primary care. Bisexual and lesbian women had a lower prevalence of visiting a doctor for a routine check-up within the past year (question 1; 56.14% among bisexual women; 54.14% among lesbian women; 63.53% among heterosexual women). Bisexual women had a slightly higher proportion of their doctor advising them about a harmful level of drinking (question 5; 15.42% among bisexual women; 13.91% among lesbian women; 13.48% among heterosexual women).

Table 4 presents the logistic regression results for these same outcomes. Lesbian women had a slightly lower odds of being asked in person or on a form if they drank alcohol (AOR = .64; CI = 0.42-0.98) compared to heterosexual women, after adjusting for age, race/ethnicity, education level, harmful drinking, health insurance status, and a family history of an alcohol/drug use disorder. Otherwise, we found no evidence that bisexual or lesbian women are more likely to be advised about alcohol use compared to heterosexual women. However, women who engaged in harmful drinking had lower odds of visiting a doctor for a routine check-up in the last two years (AOR = .81; CI = .67-.99), but higher odds for if they were asked how much they drink (AOR = 1.37; CI = 1.04-1.80), if they were asked about binge

drinking (AOR = 2.41; CI = 1.91-3.04), if they were offered advice about harmful drinking (AOR = 3.50; CI = 2.82-4.36), and if they were advised to reduce or quit their drinking (AOR = 6.98; CI = 5.46-8.91).

CDC and Drink Less for Your Breasts Interventions

As presented in Table 5, bisexual, lesbian, and heterosexual women had similar levels of awareness that alcohol increases breast cancer risk, even after disaggregating by harmful drinking, both before and after the survey intervention. Table 6 displays the percentage of respondents who indicated they would search for more information online or talk to a medical professional after the survey intervention broken down by both sexual orientation and harmful drinking. Among non-harmful drinkers, bisexual women indicated greater agreement with the intention to search for more information online about the link between alcohol and breast cancer (51.12% among bisexual women vs. 43.64% among lesbian women and 43.38% among heterosexual women). Otherwise, no statistically significant differences emerged by sexual orientation. However, for both intentions, bisexual, lesbian, and heterosexual women who engaged in harmful drinking indicated greater agreement to take action after the survey intervention compared to women who did not report harmful drinking. For example, 33.29% of non-harmful drinkers agreed they would talk to a medical professional about the link between alcohol and cancer compared to 51.05% of harmful drinkers.

Discussion

This study adds to the growing literature that bisexual and lesbian women engage in harmful drinking more frequently compared to their heterosexual peers. While previous literature has largely found that bisexual women have the highest risk of harmful drinking, our results showed that lesbian women had a slightly higher odds of harmful alcohol consumption than bisexual women.¹⁰ However, the confidence intervals for bisexual and lesbian women overlapped, so our results are in line with another study that found no significant difference in problematic drinking between lesbian and bisexual women.³⁸ Regardless, our study reinforces that both bisexual and lesbian women engage in riskier

drinking patterns compared to heterosexual women. In addition, both bisexual and lesbian women had higher rates of family histories of alcohol and substance use disorders, also in line with previous research.¹³ This finding suggests that in addition to the potential stress associated with sexual minority status, bisexual and lesbian women often contend with a family history of substance use, another risk factor for harmful drinking.³⁹ This bolsters the urgent need to target alcohol prevention efforts toward bisexual and lesbian women.

However, both bisexual and lesbian women were no more likely than their heterosexual peers to be offered advice about harmful drinking or advised to quit or reduce drinking by a primary care professional, evidenced by the largely null results in Table 4 for sexual orientation. Notably in our survey, the percentage of women asked about alcohol use in primary care settings is lower than what the CDC reported (81.8%).²¹ This is compared to our findings for bisexual (70.98%), lesbian (57.39%), and heterosexual women (67.23%). However, primary care providers are much more likely to ask and offer advice about harmful drinking to women who reported harmful drinking compared to women who did not. Since our study confirms that bisexual and lesbian women more often engage in riskier drinking, it is surprising that we find that bisexual and lesbian women are not more likely to be offered advice about drinking in primary care in the unadjusted logistic regression analysis. However, this may be a result of bisexual and lesbian women comprising only a small subset of the analysis dataset, therefore we could not detect statistically significant differences.

While it is encouraging that primary care providers are more likely to advise women who are harmful drinkers, ideally this intervention could also target women who may be at risk for harmful drinking but have not yet started to engage in risky drinking. Given the sexual minority stress model that explains greater substance use among these groups, bisexual and lesbian women would benefit from advice about risky drinking, and perhaps this intervention could prevent harmful drinking among these high-risk groups in the future. Additionally, women who partake in light or moderate drinking would still

benefit from learning about the risk, particularly given the dose-response relationship of alcohol and breast cancer risk. Furthermore, many women indicated that they would want to talk to a medical professional about the link between alcohol and breast cancer (across all sexual orientations, about 1 in 3 women who were not harmful drinkers and about 1 in 2 women who were harmful drinkers). This willingness to engage with health care providers about the potential long-term harms of alcohol implies the acceptability of screening of and counseling on alcohol use in primary care settings, even among women who do not currently engage in excessive drinking.

While alcohol screening and brief counseling are promising strategies, health care professionals must be equipped with the knowledge and competencies required for this intervention. A qualitative study in the U.K. found that health care professionals often lacked confidence and were fearful of offering incorrect information about alcohol's link to breast cancer.⁴⁰ Given the low awareness that alcohol increases breast cancer risk in the U.S., many health care professionals likely are unaware of this link themselves.⁹ In addition, health care professionals frequently lack training to care for sexual minority patients, and sexual minority individuals may not feel comfortable disclosing their sexual orientation to health care providers.^{22, 41} Given recent evidence among black sexual minority men and sexual minority youth that disclosure of sexual orientation to health care providers can lead to greater health care utilization, creating welcoming environments for sexual minority patients is needed.^{42, 43}

Lastly, no significant differences emerged in the reactions to the survey interventions conveying the association between alcohol use and breast cancer when comparing bisexual, lesbian, and heterosexual women. This finding is perhaps expected, given that both the Drink Less for Your Breasts post and CDC website excerpt were not tailored to a specific sexual orientation. Regarding awareness, the proportion of women who indicated that alcohol is a risk factor for breast cancer increased from about one in four pre-intervention (in line with previous research)⁹ to one in two post-intervention. Women who are harmful drinkers more frequently indicated that they plan to seek out more information, whether online

or from a medical professional. This reaffirms that health education messages can educate women about the risks of drinking alcohol, as evidenced by earlier studies.²³⁻²⁵ Future research could examine health education messages that are tailored for bisexual and lesbian women and target women who are only light or moderate drinkers.

Limitations

Since Qualtrics handled the distribution of the survey, we cannot assert that our sample is a representative sample of U.S. adult women. Women who chose to respond to an online survey presumably differ from women who did not, although we improved external validity by providing quotas for age, race, and ethnicity. Our findings are further strengthened since they align with previous research on level of awareness of the link between alcohol and cancer and the higher prevalence of harmful drinking among bisexual and lesbian women.^{9, 10} Our cross-sectional survey was limited in that it showed one social media post and/or CDC website excerpt to respondents and immediately asked for their reactions, as opposed to a longer exposure to this information over time. Both interventions were not tailored specifically to bisexual or lesbian women. Lastly, bisexual and lesbian women made up only a small subset of the sample, and sexual orientations other than bisexual and lesbian are excluded.

Conclusion

Our study aligns with previous research that bisexual and lesbian women engage in riskier drinking compared to heterosexual women. Yet, bisexual and lesbian women are no more likely to be offered advice about harmful alcohol consumption or advised to reduce or quit drinking in a primary care setting compared to heterosexual women. This represents a key opportunity to educate bisexual and lesbian women about the risks of drinking, but care must be taken to properly train primary care professionals on both the risks of drinking and the unique considerations of bisexual and lesbian women. When shown messages highlighting that alcohol is a risk factor for breast cancer, bisexual, lesbian, and heterosexual women had similar reactions, but women across all three sexual orientations

who are harmful drinkers more often agreed to search for more information online or talk to a medical professional compared to women who do not engage in risky alcohol use. Future research should examine messages tailored to bisexual and lesbian women, as well as consider differences in messaging for women who engage in harmful drinking compared to those who do not, about the link between alcohol and breast cancer.

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Figures & Tables

Figure 1: Drink Less for Your Breasts and CDC Website Excerpt Survey Interventions on the Breast Cancer and Alcohol Survey*

a.) “Drink Less for Your Breasts” Instagram campaign³⁴ b.) CDC website excerpt³⁵



Cancer Risks Linked with Alcohol Use

Excessive alcohol use is associated with many health and social problems. Alcohol is a *carcinogen* (something that can cause cancer).^{2,3,4} Regardless of drink type (beer, wine, or liquor), the risk of cancer increases with the number of drinks consumed, and even one drink a day increases the risk of developing cancers of the female breast, mouth, and esophagus.³ Reducing alcohol use may reduce the risk of cancer.²

*Survey respondents were randomized to see (a), (b), or both (a) and (b).

Table 1: Sociodemographic characteristics, AUDIT scores and categories, and family history of alcohol/drug use by sexual orientation from the Breast Cancer and Alcohol Survey (n=4,891)

Variable (Total N=4,891)	Bisexual N=554	Lesbian N=157	Heterosexual N=4,180	Chi-Square, df, p-value
Age				
18-25	280 (50.54%)	60 (38.22%)	688 (16.46%)	504.95, 8, p<.0001
26-35	155 (27.98%)	35 (22.29%)	796 (19.04%)	
36-45	78 (14.08%)	23 (14.65%)	882 (21.10%)	
45-55	34 (6.14%)	24 (15.29%)	876 (20.96%)	
56+	7 (1.26%)	15 (9.55%)	938 (22.44%)	
Race/Ethnicity				
White, Non-Hispanic	413 (74.55%)	99 (63.06%)	2,887 (69.07%)	32.03, 10, p=.0004
Black/African American, Non-Hispanic	47 (8.48%)	27 (17.20%)	568 (13.59%)	
White, Hispanic	36 (6.50%)	7 (4.46%)	309 (7.39%)	
Asian	11 (1.99%)	0 (0.00%)	88 (2.11%)	
American Indian/Alaska Native/Native Hawaiian/Pacific Islander	14 (2.53%)	7 (4.46%)	78 (1.87%)	
Other	33 (5.96%)	17 (10.83%)	250 (5.98%)	
Health Insurance Status				
Medicare or Medicaid	262 (47.29%)	62 (39.74%)	1,967 (47.11%)	7.35, 4, p=.12
Private insurance	204 (36.82%)	69 (44.23%)	1,662 (39.81%)	
No health insurance	88 (15.88%)	25 (16.03%)	546 (13.11%)	
Missing	0	1	5	
Marital Status				
Married/living with partner	248 (44.77%)	69 (43.95%)	2,158 (51.63%)	12.09, 2, p=.002
Single/divorced/widowed	306 (55.23%)	88 (56.05%)	2,022 (48.37%)	
Education				
Did not graduate high school	50 (9.09%)	11 (7.01%)	230 (5.52%)	49.95, 4, p<.0001
Graduated high school	429 (78.00%)	114 (72.61%)	2,868 (68.89%)	
Bachelor's degree	71 (12.91%)	32 (20.38%)	1,065 (25.58%)	
Missing	4	0	17	
Income				
Yearly income \$0 to <\$25K	279 (53.55%)	77 (52.03%)	1,490 (38.27%)	57.59, 4, p<.0001
Yearly income \$25K to <\$50K	138 (26.49%)	34 (22.97%)	1,178 (30.26%)	
Yearly income \$50K+	104 (19.96%)	37 (25.00%)	1,225 (31.47%)	

Missing	33	9	287	
Harmful drinking				
Abstainer/low-risk Consumption	404 (72.92%)	110 (70.06%)	3,515 (84.09%)	58.95, 2, p<.0001
Harmful drinking	150 (27.08%)	47 (29.94%)	665 (15.91%)	
AUDIT	Mean = 5.61 Median = 3 Std. dev. = 6.68 Range = 0 to 32	Mean = 5.87 Median = 4 Std. dev. = 6.79 Range = 0 to 31	Mean = 3.76 Median = 1 Std. dev. = 5.69 Range = 0 to 38	ANOVA F-value = 32.45, p<.0001
Family history of drug/alcohol use disorder				
Yes	358 (64.86%)	93 (59.24%)	2,018 (48.47%)	57.07, 2, p<.0001
No	194 (35.14%)	64 (40.76%)	2,145 (51.53%)	
Missing	2	0	17	

Table 2: Logistic regression results for harmful drinking outcome from the Breast Cancer and Alcohol Survey (n=4,851)

Variable	Unadjusted Odds Ratio (95% CI)	Adjusted Odds Ratio (95% CI) (N=4,851)**
Sexual Orientation		
Heterosexual	1.00	1.00
Bisexual	1.96 (1.60-2.41)*	1.25 (1.00-1.56)*
Lesbian	2.26 (1.59-3.21)*	1.72 (1.19-2.48)*
Age		
18-25	0.97 (0.79-1.18)	0.96 (0.78-1.18)
26-35	1.00	1.00
36-45	0.70 (0.57-0.86)*	0.74 (0.60-0.92)*
45-55	0.33 (0.26-0.43)*	0.36 (0.28-0.47)*
56+	0.14 (0.10-0.19)*	0.15 (0.10-0.20)*
Race/ethnicity		
White, Non-Hispanic	1.00	1.00
Black/African American, Non-Hispanic	1.24 (1.00-1.53)*	1.42 (1.13-1.78)*
White, Hispanic	0.90 (0.67-1.22)	0.88 (0.64-1.20)
Asian	1.34 (0.82-2.19)	1.21 (0.70-2.07)
American Indian/Alaska Native/Native Hawaiian/Pacific Islander	1.77 (1.12-2.80)*	1.60 (0.99-2.59)
Other	1.35 (1.01-1.80)*	1.23 (0.90-1.67)
Education		
Did not graduate high school	1.05 (0.74-1.49)	0.75 (0.52-1.07)
Graduated high school	1.18 (0.99-1.42)	0.97 (0.80-1.17)
Bachelor's degree	1.00	1.00
Family history of drug/alcohol use disorder		
No	1.00	1.00
Yes	1.40 (1.21-1.63)*	1.33 (1.14-1.56)*
Marital Status		
Single/divorced/widowed	0.93 (0.80-1.08)	0.90 (0.77-1.05)
Married/living with partner	1.00	1.00

*Significant at p<.05

**Adjusted for all other variables listed in this table

Table 3: Alcohol screening and brief counseling in primary care setting questions by sexual orientation from the Breast Cancer and Alcohol Survey (n=4,891)

Variable (N=4,891)	Bisexual N=554	Lesbian N=157	Heterosexual N=4,180	Chi-Square, df, p-value
Question 1: About how long has it been since you last visited a doctor for a routine checkup?				
Within the past year	311 (56.14%)	85 (54.14%)	2,653 (63.53%)	28.71, 10, p=.001
Within the past 2 years	106 (19.13%)	30 (19.11%)	620 (14.85%)	
Within the past 5 years	59 (10.65%)	16 (10.19%)	288 (6.90%)	
5 or more years ago	37 (6.68%)	7 (4.46%)	248 (5.94%)	
Don't know/not sure	22 (3.97%)	10 (6.37%)	208 (4.98%)	
Never	19 (3.43%)	9 (5.73%)	159 (3.81%)	
Missing*	0	0	4	
Question 2: At that checkup, were you asked in person or on a form if you drink alcohol? (within the past year or 2 years to question 1)				
Yes	296 (70.98%)	66 (57.39%)	2,195 (67.23%)	8.78, 4, p=.07
No	91 (21.82%)	35 (30.43%)	822 (25.18%)	
Don't know / not sure	30 (7.19%)	14 (12.17%)	248 (7.60%)	
Missing*	137	42	915	
Question 3: Did the health care provider ask you in person or on a form how much you drink? (affirmative to question 2)				
Yes	200 (67.57%)	48 (72.73%)	1,574 (72.07%)	4.02, 4, p=.402
No	74 (25.00%)	12 (18.18%)	478 (21.89%)	
Don't know / not sure	22 (7.43%)	6 (9.09%)	132 (6.04%)	
Missing*	258	91	1,996	
Question 4: Did the health care provider specifically ask whether you drank 4 or more alcoholic drinks on an occasion? (affirmative to question 3)				
Yes	96 (32.43%)	23 (34.85%)	697 (31.84%)	0.78, 4, p=.94
No	158 (53.38%)	32 (48.48%)	1,177 (53.77%)	
Don't know / not sure	42 (14.19%)	11 (16.67%)	315 (14.39%)	
Missing*	258	91	1,991	
Question 5: Were you offered advice about what level of drinking is harmful or risky for your health? (within the past year or 2 years to question 1)				

Yes	64 (15.42%)	16 (13.91%)	440 (13.48%)	11.18, 4, p=.02
No	304 (73.25%)	92 (80.00%)	2,587 (79.28%)	
Don't know / not sure	47 (11.33%)	7 (6.09%)	236 (7.23%)	
Missing*	139	42	917	
Question 6: Were you advised to reduce or quit your drinking? (within the past year or 2 years to question 1)				
Yes	44 (10.55%)	15 (13.16%)	298 (9.11%)	6.36, 4, p=.17
No	350 (83.93%)	91 (79.82%)	2,833 (86.61%)	
Don't know / not sure	23 (5.52%)	8 (7.02%)	140 (4.28%)	
Missing*	137	43	909	

*Note that missing values were excluded from the analysis.

Table 4: Logistic regression results for alcohol screening and brief counseling in primary care setting questions from the Breast Cancer and Alcohol Survey (sample size n specified for each model in the table)

	Doctor visit for routine checkup in the last two years ¹	Asked in person or on a form if you drink alcohol ²	Asked in person or on form how much you drink ³	Asked about binge drinking specifically ⁴	Offered advice about harmful drinking ⁵	Advised to reduce or quit your drinking ⁶
Unadjusted Odds Ratios						
Sexual Orientation	N=4,647*	N=3,505*	N=2,386*	N=2,183*	N=3,503*	N=3,631*
Heterosexual	1.00	1.00	1.00	1.00	1.00	1.00
Bisexual	0.77 (0.62-0.96)**	1.22 (0.95-1.56)	0.82 (0.62-1.09)	1.03 (0.78-1.35)	1.24 (0.93-1.65)	1.20 (0.86-1.67)
Lesbian	0.76 (0.51-1.14)	0.71 (0.47-1.07)	1.22 (0.64-2.31)	1.21 (0.71-2.09)	1.02 (0.60-1.76)	1.57 (0.90-2.74)
Adjusted Odds Ratios***						
Sexual Orientation	N=4,604*	N=3,482*	N=2,376*	N=2,172*	N=3,475*	N=3,602*
Heterosexual	1.00	1.00	1.00	1.00	1.00	1.00
Bisexual	0.96 (0.75-1.23)	1.09 (0.83-1.43)	0.98 (0.72-1.34)	0.87 (0.65-1.17)	0.77 (0.56-1.06)	0.69 (0.47-1.01)
Lesbian	0.844 (0.55-1.30)	0.64 (0.42-0.98)**	1.23 (0.64-2.38)	1.05 (0.60-1.86)	0.71 (0.40-1.25)	1.04 (0.57-1.91)
Unadjusted Odds Ratios						
Harmful drinking	N=4,647					
Abstainers/Low-risk drinkers	1.00	1.00	1.00	1.00	1.00	1.00
Harmful drinkers	.72 (0.60-0.87)**	1.14 (0.93-1.39)	1.33 (1.02-1.72)**	2.67 (2.15-3.33)**	4.23 (3.44-5.21)**	8.31 (6.59-10.49)**
Adjusted Odds Ratios****						
Harmful drinking						
Abstainers/Low-risk drinkers	1.00	1.00	1.00	1.00	1.00	1.00
Harmful drinkers	0.81 (0.67-0.99)**	0.98 (0.79-1.22)	1.37 (1.04-1.80)**	2.41 (1.91-3.04)**	3.50 (2.82-4.36)**	6.98 (5.46-8.91)**

*Respondents who indicated “don’t know/not sure” are excluded from this analysis

**Statistically significant p<.05

***Adjusted for age, race/ethnicity, education, harmful drinking, health insurance status, family history of substance use disorder

****Adjusted for age, race/ethnicity, education, sexual orientation, health insurance status, family history of substance use disorder

¹ About how long has it been since you last visited a doctor for a routine checkup? A routine check-up is a general physical exam, not an exam for a specific injury, illness, or condition

² At that checkup, were you asked in person or on a form if you drink alcohol?

³ Did the health care provider ask you in person or on a form how much you drink?

⁴ Did the health care provider specifically ask whether you drank 4 or more alcoholic drinks on an occasion?

⁵ Were you offered advice about what level of drinking is harmful or risky for your health?

⁶ Health care providers may also advise patients to drink less for various reasons. At your last routine checkup, were you advised to reduce or quit your drinking?

Table 5: Percentage of respondents who believe that alcohol increases breast cancer risk pre and post survey intervention from the Breast Cancer and Alcohol Survey (n=4,891)

Variable (N=4,891)	Harmful drinking = no				Harmful drinking = yes			
	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value
Belief that alcohol increases breast cancer risk (pre-intervention)								
Yes	105 (26.45%)	32 (29.63%)	812 (23.33%)	6.77, 4, p=.15	42 (28.19%)	7 (15.56%)	193 (29.29%)	4.62, 4, p=.33
No	118 (29.72%)	38 (35.19%)	1,192 (34.25%)		61 (40.94%)	24 (53.33%)	264 (40.06%)	
Don't know	174 (43.83%)	38 (35.19%)	1,476 (42.41%)		46 (30.87%)	14 (31.11%)	202 (30.65%)	
Missing	7	2	35		1	2	6	
Belief that alcohol increases breast cancer risk (post-intervention)								
Yes	202 (50.25%)	62 (56.88%)	1,788 (51.35%)	8.25, 4, p=.08	75 (50.68%)	20 (44.44%)	326 (49.92%)	1.83, 4, p=.77
No	107 (26.62%)	28 (25.69%)	780 (22.40%)		41 (27.70%)	17 (37.78%)	188 (28.79%)	
Don't know	93 (23.13%)	19 (17.43%)	914 (26.25%)		32 (21.62%)	8 (17.78%)	139 (21.29%)	
Missing	2	1	33		2	2	12	
Difference in belief=yes pre/post	+23.80%	+27.25%	+28.02%		+22.49%	+28.88%	+20.63%	

Table 6: Percentage of respondents who agree with action intentions post survey intervention from the Breast Cancer and Alcohol Survey (n=4,891)

Variable (N=4,891)	Harmful drinking = no				Harmful drinking = yes					
	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value	Bisexual, Lesbian, and Heterosexual Women	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value	Bisexual, Lesbian, and Heterosexual Women
Search for more information online about the link between alcohol and breast cancer										
Agree	206 (51.12%)	48 (43.64%)	1,517 (43.38%)	10.62, 4, p=.03	1,771 (44.16%)	93 (62.00%)	29 (63.04%)	428 (64.56%)	1.80, 4, p=.77	550 (64.03%)
Neither agree/disagree	135 (33.50%)	38 (34.55%)	1,372 (39.23%)		1,545 (38.53%)	43 (28.67%)	13 (28.26%)	161 (24.28%)		217 (25.26%)
Disagree	62 (15.38%)	24 (21.82%)	608 (17.39%)		694 (17.31%)	14 (9.33%)	4 (8.70%)	74 (11.16%)		92 (10.71%)
Missing	1	0	18		19	0	1	2	3	
Talk to a medical professional about the link between alcohol and breast cancer										
Agree	147 (36.57%)	43 (39.09%)	1,139 (32.73%)	6.03, 4, p=.20	1,329 (33.29%)	70 (46.67%)	24 (52.17%)	345 (51.96%)	3.47, 4, p=.48	439 (51.05%)
Neither agree/disagree	156 (38.81%)	36 (32.73%)	1,458 (41.90%)		1,650 (41.33)	49 (32.67%)	17 (39.96%)	211 (31.78%)		277 (32.21%)
Disagree	99 (24.63%)	31 (28.81%)	883 (25.37%)		1,013 (25.38%)	31 (20.67%)	5 (10.87%)	108 (16.27%)		144 (16.74%)
Missing	2	0	35		37	0	1	1		2

Appendix

Table 7: Percentage of respondents who agree with additional action intentions post survey intervention from the Breast Cancer and Alcohol Survey (n=4,891)

Variable (N=4,891)	Harmful drinking = no				Harmful drinking = yes			
	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value
Stop following alcohol brands on social media								
Agree	114 (28.43%)	29 (26.36%)	920 (26.48%)	1.84, 4, p=.7655	50 (33.33%)	18 (39.13%)	263 (39.79%)	4.36, 4, p=.3598
Neither agree/disagree	208 (51.87%)	61 (55.45%)	1,925 (55.41%)		60 (40.00%)	21 (45.65%)	255 (38.58%)	
Disagree	79 (19.70%)	20 (18.18%)	629 (18.11%)		40 (26.67%)	7 (15.22%)	143 (21.63%)	
Missing	3	0	41		0	1	4	
Stop posting or sharing alcohol posts on my personal social media accounts								
Agree	124 (31.00%)	36 (32.73%)	1,033 (29.80%)	.78, 4, p=.9413	48 (32.88%)	22 (47.83%)	270 (41.03%)	14.92, 4, p=.0049
Neither agree/disagree	205 (51.25%)	56 (50.91%)	1,831 (52.81%)		51 (34.93%)	21 (45.65%)	243 (36.93%)	
Disagree	71 (17.75%)	18 (16.36%)	603 (17.39%)		47 (32.19%)	3 (6.52%)	145 (22.04%)	
Missing	4	0	48		4	1	7	

Table 8: Perceived message effectiveness of survey interventions from the Breast Cancer and Alcohol Survey (sample size n specified for each model in the table)

Drink Less for Your Breasts								
	Harmful drinking = no				Harmful drinking = yes			
Variable (N=3,226)	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value
This post makes drinking seem unpleasant to me								
Agree	150 (55.76%)	38 (57.58%)	1,248 (54.19%)	0.80, 4, p=.9396	67 (68.37%)	15 (50.00%)	255 (58.76%)	5.54, 4, p=.2362
Neither agree/disagree	93 (34.57%)	21 (31.82%)	802 (34.82%)		22 (22.45%)	12 (40.00%)	57 (13.13%)	
Disagree	26 (9.67%)	7 (10.61%)	253 (10.99%)		9 (9.18%)	3 (10.00%)	122 (288.11%)	
Missing	3	0	19		2	0	2	
This post makes me concerned about the health problems caused by drinking								
Agree	156 (57.78%)	41 (62.12%)	1,415 (61.95%)	2.85, 4, p=.5827	65 (65.66%)	15 (50.00%)	287 (66.59%)	4.95, 4, p=.2926
Neither agree/disagree	84 (31.11%)	17 (25.76%)	660 (28.90%)		22 (22.22%)	12 (40.00%)	99 (22.97%)	
Disagree	30 (11.11%)	8 (12.12%)	209 (9.15%)		12 (12.12%)	3 (10.00%)	45 (10.44%)	
Missing	2	0	38		1	0	5	
This post discourages me from wanting to drink								
Agree	131 (49.25%)	35 (53.85%)	1,145 (50.35%)	3.19, 4, p=.5267	51 (51.00%)	9 (30.00%)	210 (49.41%)	4.97, 4, p=.2901
Neither agree/disagree	109 (40.98%)	21 (32.31%)	845 (37.16%)		32 (32.00%)	13 (43.33%)	146 (34.35%)	
Disagree	26 (9.77%)	9 (13.85%)	284 (12.49%)		17 (17.00%)	8 (26.67%)	69 (16.24%)	
Missing	6	1	48		0	0	11	
CDC								
	Harmful drinking = no				Harmful drinking = yes			
Variable (N=3,284)	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value	Bisexual	Lesbian	Heterosexual	Chi-Square, df, p-value
This post makes drinking seem unpleasant to me								
Agree	153 (54.64%)	37 (50.68%)	1,205 (51.58%)	1.85, 4, p=.7629	70 (69.31%)	17 (54.84%)	247 (56.78%)	5.57, 4, p=.23
Neither agree/disagree	101 (36.07%)	26 (35.62%)	880 (37.67%)		22 (21.78%)	10 (32.26%)	131 (30.11%)	
Disagree	26 (9.29%)	10 (13.70%)	251 (10.74%)		9 (8.91%)	4 (12.90%)	57 (13.10%)	
Missing	1	0	23		1	1	2	

This post makes me concerned about the health problems caused by drinking								
Agree	158 (56.43%)	37 (51.39%)	1,345 (57.75%)	1.87, 4, p=.7589	67 (67.00%)	12 (38.71%)	266 (61.01%)	8.52, 4, p=.0744
Neither agree/disagree	97 (34.64%)	26 (36.11%)	758 (32.55%)		23 (23.00%)	14 (45.16%)	114 (26.15%)	
Disagree	25 (8.93%)	9 (12.50%)	226 (9.70%)		10 (10.00%)	5 (16.13%)	56 (12.84%)	
Missing	1	1	30		2	1	13	
This post discourages me from wanting to drink								
Agree	135 (48.56%)	34 (47.22%)	1,118 (48.13%)	.40, 4, p=.98	50 (50.00%)	17 (54.84%)	212 (49.19%)	1.04, 4, p=.9043
Neither agree/disagree	107 (38.49%)	27 (37.50%)	876 (37.71%)		35 (35.00%)	9 (29.03%)	140 (32.48%)	
Disagree	36 (12.95%)	11 (15.28%)	329 (14.16%)		15 (15.00%)	5 (16.13%)	79 (18.33%)	
Missing	3	1	36		2	1	6	