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Sexual Orientation Differences in the Association Between Cancer Diagnosis and Mental Health Outcomes

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SEXUAL ORIENTATION DIFFERENCES IN THE ASSOCIATION BETWEEN CANCER DIAGNOSIS AND MENTAL HEALTH OUTCOMES

A Thesis Presented

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DEDICATION

To Maria E. Garcia,

A strong independent mother.

You taught me the power of hard work.

ACKNOWLEDGMENTS

First, I would like to thank Nicole VanKim for being the chair of my committee. She has provided me with guidance and challenged me to apply all my knowledge to complete this project. Dr.VanKim has taught me the power of statistical programming to advance queer research. I knew I had to work with her during my time at the University of Massachusetts Amherst. She is truly amazing and inspiring.

Second, I would like to thank Katherine Reeves for being my second reader on my committee. She taught me the advanced statistical methods and critical thinking skills that were essential to producing the best work possible. She brings life to every classroom she teaches.

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¡Viva Latinoamérica!

ABSTRACT

SEXUAL ORIENTATION DIFFERENCES IN THE ASSOCIATION BETWEEN CANCER DIAGNOSIS AND MENTAL HEALTH OUTCOMES

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Background: Since the early 1960s, survival rates among cancer survivors have been increasing. Surviving cancer can be a stressful experience due to the multifaceted changes that come with diagnosis, treatment, and recovery. Therefore, studying the mental health of cancer survivors is vital for their well-being. Among queer groups (including those identifying as gay, lesbian, or bisexual), poor mental health is more prevalent than among heterosexuals. However, cancer survivorship among queer populations is not well studied. This study examines the association between cancer survivorship and poor mental health, focusing on potential sexual orientation differences.

Methods: Data are from the 2019-2021 National Health Interview Survey. Participants identified as straight (n=65,006), gay or lesbian (n=1,271), or bisexual (n=1,100). Diagnosis of anxiety and depression as well as the frequency of anxiety and depressive symptoms were regressed on cancer survivorship (assessed based on cancer diagnosis) using logistic models. Using a subsample of 2019 rotating core participants, we assessed anxiety, using the Generalized Anxiety Disorder-7 (GAD-7) scale, and depression, using the Patient Health Questionnaire-8 (PHQ-8) symptoms, to account for a potential lack

of diagnosis. Models were adjusted for sociodemographic covariates and were stratified by sex.

Results: After adjusting for sociodemographic characteristics there was no significant association between cancer diagnosis and mental health in the overall sample. However, when examining sexual identity-specific estimates, among bisexual males, cancer survivors had higher odds of "daily" anxiety [OR=8.07 CI (1.23,52.81)] and "weekly or monthly" depressive symptoms [OR=15.23 CI (3.17, 73.22)]. While among bisexual females, cancer survivors had significantly higher odds of anxiety diagnosis [OR=3.03 CI (1.37, 6.71)] than those who never had cancer. Moreover, bisexual male cancer survivors had higher GAD-7 [β =10.39 (4.03, 16.75)] and PHQ-8 [β =13.59 (6.03, 21.16)] scores than those who never had cancer. No other significant associations were found for other sexual identity groups. Our test for effect modification based on sexual identity on the association between cancer diagnosis and mental health outcomes suggested that the association between cancer diagnosis and mental health outcomes were similar across sexual identity groups. The p-values ranged from 0.11 to 0.92.

Conclusion: Bisexual cancer survivors may experience poorer mental health than those who have not had cancer, suggesting a potential need for more targeted mental health intervention and cancer survivorship support. However, small sample sizes suggest that additional work with larger samples of cancer survivors is needed to corroborate these findings.

TABLE OF CONTENTS

Page

LIST OF TABLES

Table Page

LIST OF FIGURES

Figure Page

CHAPTER 1

INTRODUCTION

Anxiety and depression are the most common mental health concerns in the United States.[1] Over 40 million adults, 19.1% of the adult population, have an anxiety disorder. One in six adults will have depression at some point in their life.[1] Several studies consistently observed sexual identity disparities in mental health, more specifically individuals who identify as lesbian, gay, or bisexual, (LGB) have a greater risk of poor mental health compared to heterosexual individuals.[2–8] One study found sexual minority individuals were two times more likely to have moderately severe to severe depression compared to straight people.[8] Another found that bisexual people are 2.7 times more likely to report a lifetime diagnosis of anxiety disorder.[7] It is important to comprehend which groups are disproportionally at risk for mental health disorders to achieve health equity, improve public health outcomes, and promote well-being.

Disparities in mental health across sexual identity groups are likely due to experiencing additional stress from sexual identity-based stigma and discrimination. According to the Minority Stress Model, the framework for explaining sexual orientation-based health disparities, these stressors are a result of both external and internal factors.[9] External factors include discrimination and prejudice that individuals may face in their daily lives.[9] For example, a previous traumatic experience, such as abuse, or violence can elevate stress. Internal factors include internalized oppression and negative self-image that individuals may develop due to their marginalized identity.[9] The Minority Stress Model proposes that these stressors over time can lead to negative outcomes, such as mental health disorders.[9]

Individuals who identify as bisexual face comparable levels of stress caused by discrimination and stigma based on their sexual identity as their lesbian and gay counterparts. However, recent research shows that bisexual individuals experience additional stress that is unique to their bisexual identity.[10] This includes prejudice from both heterosexual and gay or lesbian individuals, which contributes to a higher risk for poor mental health.[11] Several studies have additionally observed that bisexual individuals report higher rates of anxiety and depression than heterosexual, lesbian, and gay individuals, indicating significant discrepancies in mental health outcomes among sexual minority groups, as well as disparities between sexual minority and heterosexual populations.[7,12–15]

Anxiety disorders and depression share many similar risk factors. Research has shown that genetic, biological, environmental, and psychological factors all play a role in the development of anxiety and depression.[16] More recently, studies have shown that a potential risk factor for anxiety and depression is a chronic illness diagnosis, more specifically a cancer diagnosis.[17,18]

A cancer diagnosis can drastically alter an individual's physical, emotional, and psychological well-being. Surviving cancer can be a particularly stressful experience as patients navigate the multifaceted changes that come with diagnosis, treatment, and recovery. The psychosocial distress theory asserts that an unpleasant physical, psychological, social, or spiritual experience can hinder a person's ability to cope effectively.[19] Additionally, prolonged periods of high mental distress can impede patients' coping mechanisms during treatment and may lead to adverse mental health outcomes, such as anxiety and depression.[19] Even after successful treatment, anxiety and depression remain prevalent among cancer survivors.[20–24]

Studies indicate that cancer survivors are two to four times more likely to experience mood disorders than the general public.[20,24] The American Cancer Society Cancer Facts & Figures report of 2023 stated that since the early 1960s, there has been a significant improvement in the 5-year relative survival rate for all types of cancers, emphasizing importance of studying the physiological and psychological effects of living with cancer.[25]

While there has been an increase in recognition of mental health disparities among cancer survivors compared to the general population, less attention has been given to the potential differences in mental health outcomes between heterosexual and sexual minority cancer survivors.[26] The United States Cancer Statistics, (USCS) is the official federal cancer statistics report and compiles estimates among various sociodemographic groups, however, they fail to provide information regarding sexual identity.[27] USCS collects cancer information through a variety of regional cancer registries.[27] These registries compile cancer diagnoses through medical records where they also capture other sociodemographic characteristics. A limitation of the use of medical records is that most do not capture sexual identity, and those that do are often inconsistent in language.[28] Due to the lack of data, it has become difficult to estimate sexual identity health disparities in cancer research.[29]

At the national level, five behavior-based surveys have collected information on sexual orientation: National Health Interview Survey (NHIS), Behavior Risk Factor Surveillance System (BRFSS), National Health and Nutrition Examination Survey (NHANES), National Survey of Family Growth (NSFG), and the National Survey on Drug Use and Health (NSDUH).[30] Among these, three collect information on cancer diagnosis, NHIS, BRFSS, and NHANES).[31–33] Apart from the

national surveys, cancer researchers have relied on local and state data registries, often limiting their ability to better quantify the unique needs of LGB cancer survivors.[34]

Nevertheless, scientists have attempted to describe the mental health challenges faced by LGB cancer survivors, but the results are often inconsistent. Two studies found no significant difference in depression symptoms among heterosexual and lesbian breast cancer survivors.[35,36] While a small randomized controlled trial conducting an exercise intervention among cancer survivors found that gay and lesbian participants reported having significantly greater depression symptoms compared to heterosexual participants at baseline.[37] Additionally, one study found that among males, LGB cancer survivors had a significantly higher prevalence of self-reported depression but found no relationship among women.[38]. However, a few studies show that sexual minority female cancer survivors have poorer access to health care which negatively impacts their mental health.[29,39–41] Understanding the complex relationship between sexual orientation, cancer survivorship, and mental health is critical for developing effective interventions and support services for this understudied population.

Despite the growing recognition of these disparities, there is still a lack of consistent research on how sexual orientation influences the relationship between cancer survivorship and mental health outcomes. We propose to assess the relationship between cancer survivorship and anxiety and depression outcomes across sexual orientation groups. We hypothesize that the association between cancer diagnosis and mental health outcomes is modified by sexual orientation, such that the association is stronger among sexual minority individuals compared to

heterosexual individuals.

CHAPTER 2

METHODS

2.1 Study Population

The study population is from the 2019-2021 National Health Interview (NHIS), a nationally representative survey of the civilian noninstitutionalized population in the United States. The survey is conducted continuously throughout the year by the National Center for Health Statistics (NCHS) and utilizes a multistage probability design to permit a representative sampling. Trained U.S. Census Bureau interviewers' sample and select households and noninstitutional group quarters (i.e., military bases) to be interviewed face-to-face. Within each selected household, families are identified and asked to complete a brief questionnaire regarding selected demographics and multiple health measures and health risk factors. Then, from within each family, one "sample adult" aged 18 years or older is randomly selected to provide information on personal health status, health care services, and health related behaviors. In 2019, NHIS updated the content and structure of the survey preventing the merging of prior years. A structure of annual and rotating content was implemented in 2019.[32] The annual core contains the same questions from year to year, and these questions focus on demographic characteristics, health insurance, chronic conditions, health care access and use, health-related behaviors, and functioning and disability.[32] The rotating core consists of questions that will be included in the interview periodically and include expanded content on mental health, service utilization, preventive services, health-related behaviors, injuries, and chronic pain.[32] Participants were asked the Patient Health Questionnaire (PHQ-8) Depression Scale and the Generalized Anxiety Disorder Scale-7 (GAD-7) as part of the mental health rotating content in 2019.[32]

The household response rates from 2019 to 2021 ranged from 50.7% (2020) to 61.1% (2019).[42] Due to the restrictions regarding the COVID-19 pandemic, in March 2020

NHIS shifted from in-person to all-telephone interviewing. The survey response rates during this period declined upon using this strategy.[42] In July 2020, NHIS was able to resume in-person interviewing, but adopted a hybrid model where most interviews were conducted by telephone for the remainder of the year.[42] In response to the shift in interviewing strategy and decline in participation in 2020, NHIS created unique weights to produce a nationally representative sample. Generally, the public data of NHIS consist of an annual file that is created by combining four quarterly files each with their own weights.[42] The 2020 quarterly weights were different from previous years as each quarter used different interview strategies. Quarter one consisted of in-person, in quarter two they used telephone interviewing, and in quarter three and four they used a combination of in-person and telephone.[42] The NHIS bias assessment of the 2020 sample revealed that weighting adjustment led to an 80% reduction in observed bias.[42] The combined file retained some biases after weighting most notably an underrepresentation of adults living alone and those in the lowest income category.[42] Lastly, they observed an overrepresentation of adults living in households with both landline and cellphones.[42]

2.2 Sexual Orientation

Sexual identity was measured as part of the annual core using the question "How do you think of yourself?" Response options were "Lesbian or gay", "Straight, that is, not lesbian or gay", "Bisexual", "Something else", "I don't know the answer" and "Refused". This question has been cognitively tested to improve estimates of the lesbian, gay, and bisexual population for use in the National Health Interview Survey.[43]

2.3 Outcome Variables

2.3.1 Annual Core Measures of Anxiety and Depression

Both anxiety and depression were measured using separate questions as part of the annual core using by asking about whether the participant had received a diagnosis of an

anxiety disorder or depression disorder in their lifetime from a doctor of other health professional. Participants were also asked, how often they felt "worried, nervous, or anxious" or "depressed." Response options were "Daily", "Weekly", "Monthly", "A few times a year", and "Never". Consistent with previous studies using NHIS data, we collapsed "never" and "a few times a year". However, due to small sample sizes because sexual identity stratification the categories of "weekly" and "monthly" were collapsed.[44]

2.3.2 Rotating Core Measures of Anxiety and Depression (2019 only)

The Generalized Anxiety Disorder Scale-7 (GAD-7) was utilized within the rotating Mental Health core that was administered in 2019.[1] Participants were asked "Over the last two weeks, how often have you been bothered by the following problems…" and provided with 7 common anxiety symptoms. Responses were ranked on a 0-to-3-point scale ranging from "Not at all" (0 points) to "Nearly every day" (3 points) for a total score of 21 points.[45] For this analysis GAD-7 score was kept continuous to provide data on symptom severity across a spectrum of levels of anxiety. Spitzer et al. assessed the validity of GAD-7 in 15 primary care clinics across the United States from November 2004 to June 2005. These participants took part in a telephone one-on-one interview where researchers administered GAD-7 and compared results with the independent diagnosis made by mental health professionals using a structured clinical interview for *DSM-IV*. A cut point of 15 was identified to have an optimized sensitivity of 89% and a specificity of 82% providing evidence that the GAD-7 is a valid and effective tool for screening generalized anxiety disorder.[45]

The Patient Health Questionnaire (PHQ-8) Depression Scale was utilized within the rotating Mental Health core. Participants were asked "Over the last two weeks, how often have you been bothered by…" and provided eight experiences, such as "trouble falling or

staying asleep or sleeping too much?" or "feeling tired or having little energy?" Responses options ranged from "not at all" to "nearly every day". Consistent with guidelines, responses were scored from 0 to 3 and summed for a total of 24 points. For this analysis, the PHQ-8 score was kept continuous to provide data on symptom severity across a spectrum of levels of depression. Kroenke et al. assessed the concurrent validity of PHQ-8 in a random digit dialing telephone survey from participants in the 2006 Behavioral Risk Factor Surveillance Survey (BRFSS). Participants were asked to complete both the PHQ-8 questions and health-related quality of life (HRQoL) questions for mental health. The prevalence of current depression was similar whether defined by the (HRQoL) or a PHQ-8 score with a $\geq$ 10 cut point (9.1% vs. 8.6%) indicating that PHQ-8 is a valid and effective tool for screening current depression.[46]

2.4 Explanatory Variables

2.4.1 Cancer Status

Cancer status was measured as part of the annual core using the question: "Have you ever been told by a doctor or other health professional that you had cancer or a malignancy of any kind?" Those responding "Yes" were then asked, "What kind of cancer was it?" and then presented with 30 cancer diagnoses. To be consistent with studies that produce aggregate cancer reporting, those that reported non-melanoma skin cancers were excluded from this analysis.[25]

2.4.1 Demographic Characteristics

Several demographic characteristics that may be linked to cancer survival and mental health outcomes were included in analyses. These characteristics include age (18 years +), sex (male and female), race and ethnicity (non-Hispanic white, non-Hispanic Black, Hispanic, and non-Hispanic other), educational attainment (high school or less, some college, and bachelor's or greater), employment status (full-time, part-time, unemployed, and not in the labor force), region residence (Northeast, Midwest, South, and West), relationship status (married or living with a partner, separated, divorced, widowed, or never married), insurance status (as private, public, uninsured, and other coverage), body mass index (calculated from self-reported height and weight), and overall health status (excellent, very good, good, and fair or poor).

2.5 Analytic Sample

Adults of all sexes and aged 18 and over who participated in the adult sample were included in this analysis. As shown in Figure 1 (next page), participants were excluded if they were under 18 years of age (n=23,244) and if their sexual identity was reported as "Refused" (n=543), "Not Ascertained" (n=2,265), "I don't know the answer" (n=747) or if

they reported “Something else” (n=388). After exclusions 78,689 participants [44,784 women (592 lesbian or gay; 952 bisexuals; 41,011 straight) and 37,842 men (848 gay; 317 bisexuals; 34,966 straight)] remained in the primary analytic sample.

Additionally, a secondary analysis was conducted with participants of the mental health rotating core. Participants were excluded if their PHQ-8 categorization was reported as “Not Ascertained” (n=744) or did not participate in the mental health rotating core (n=48,328), or if their GAD-7 categorization was reported as “Not Ascertained” (n=757) or as missing (n=48,328). After exclusions 30,461 participants remained. 16,395 females (188 lesbian or gay; 322 bisexuals; 15,884 straight) and 14,066 males (259 gay; 259 bisexuals; 13,717 straight) remained the secondary analytic sample.

Sample sizes may vary based on outcomes because participants who “Refused”, reported “I don’t know”, or answers were not ascertained were not included in the analyses. This accounted for <1% of the analytic sample.

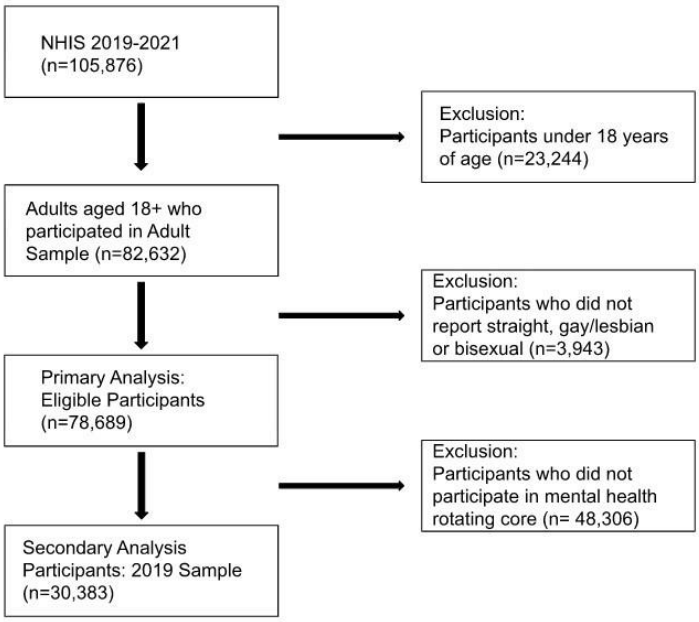

Figure 1. Exclusions for Analytic Sample

CHAPTER 3

RESULTS

3.1 Sociodemographic Characteristics by Sex and Sexual identity

Tables 1 and 2 list weighted percentages of sociodemographic characteristics by sex and sexual identity. In the primary analytic sample 3.2% of males and 3.6% of females identified as gay, lesbian, or bisexual. Compared to straight males, gay and bisexual males had the highest percentage of never being married, unemployed. The highest percentage of non-Hispanic Black and Hispanics was among straight males. Bisexual males had the lowest percentage of non-Hispanic other racial/ ethnic identities and self-reported excellent health. Bisexual males had the highest percentage of poverty and uninsured insurance status. Gay males had the highest percentage of obtaining at least a bachelor's degree and people living in the northeast. Lastly, gay males, on average, had lower body mass index scores on average younger than straight males.

Compared to straight females, lesbian and bisexual females, on average, were younger. Lesbian and bisexual females represented the highest percentages of unemployed, never married, and current smokers. The largest percentage of non-Hispanic Black racial/ethnic identity, obtaining a bachelor's degree, and living in the northeast was reported among lesbian individuals. Lesbian females had the smallest percentage of Hispanic and non-Hispanic racial/ethnic identities. Lesbian females on average had higher body mass index scores. Lastly, bisexual females had the highest percentage of poverty and “other” health insurance coverage and the lowest percentage of self-reporting excellent health.

3.2 Mental Health Outcomes and Cancer Diagnosis by Sex and Sexual identity

Table 3 and 4 examine the weighted percentages of anxiety and depression outcomes as well as cancer diagnosis by sex and sexual identity. In terms of the exposure, cancer diagnosis, compared to straight males, gay males had a significantly higher percentage of self-reported cancer diagnosis (6.3% v 4.0%) The percentages were similar among straight and bisexual men.

In terms of outcomes, the percentage of gay males that reported ever being told by a physician they had anxiety was approximately two and a half times that of straight males (24.4% v 9.9%), while the percentage of bisexual males was 3.27 times that of straight males (32.4% v 9.9%). Similarly, a statistically significantly higher percentage of gay and bisexual men (25.8% and 40%, respectively) reported lifetime depression diagnosis compared to straight men (11.1%).

Regarding the frequency of anxiety and depression, a significantly higher percentage of gay and bisexual males (18.8% and 27.6%, respectively) reported experience anxiety “daily” compared to straight males (9.4%). Similarly, more gay and bisexual males (5.3% and 11.5%, respectively) reported experiencing depression “daily” compared to their straight counterparts (11.5%).

Among females, both lesbian and bisexual individuals had significantly higher percentage of self-reported cancer diagnosis compared to straight females (8.2% and 4.8% v 3.7%, respectively).

In terms of outcomes, the percentage of lesbian females that reported ever being told by a physician they had anxiety was approximately 1.66 times that of straight females (30% v 18.1%), while the percentage of bisexual females was 2.98 times that of

straight males (54% v 18.1%). Similarly, a statistically significant higher percentage of lesbian and bisexual females (34.5% and 57.5%, respectively) reported lifetime depression diagnosis compared to straight females (19.6%).

Regarding the frequency of anxiety and depression, a significantly higher percentage of lesbian and bisexual females (25.4% and 42.2%, respectively) reported experiencing "daily" anxiety frequency compared to straight females (14.3%). Similarly, more lesbian, and bisexual females (8.7% and 14.2%, respectively) reporting experiencing depression "daily" compared to their straight counterparts (4.2%).

Among male participants of the 2019 sample, the mean GAD-7 score for both gay and bisexual males (2.1 and 4.3, respectively) was significantly higher than straight males (1.6) (Table 3). However, the mean PHQ-8 score for gay males like straight males (2.5 v 2.0), while the mean score for bisexual males significantly different compared to straight males (2.0 v. 5.6).

Among female, the mean GAD-7 score for lesbian and bisexual females (3.5 and 6.1, respectively) was significantly higher compared to straight females (2.3) (Table 4). The mean PHQ-8 score for lesbian females marginally different compared to straight females (2.7 v 3.5) while the mean score for bisexual females was significantly different (6.3).

3.3 Multivariate Association of Lifetime Mental Health Outcomes

Among males, we observed 1.32 [95% CI (1.12, 1.57)], times higher odds of lifetime anxiety diagnosis and a 1.43 [95% CI (1.22, 1.66)] times higher odds of lifetime depression diagnosis among cancer survivors compared to the those who have never had cancer (Table 5). However, after adjusting for potential confounders, there was no longer a

statistically significant association between cancer diagnosis and mental health outcomes.

When examining sexual identity-specific estimates of the association between cancer diagnosis and mental health outcomes, we found that the positive association between cancer diagnosis and mental health outcomes was only statistically significant among straight males (Table 6). After adjusting for covariates, results remained similar, however, among bisexual males, the association between cancer diagnosis and lifetime depression diagnosis was the strongest [OR=3.11 CI (0.28, 34.96)], followed by gay males [OR=1.58 CI (0.68,3.64)]. These results were not statistically significant given the wide confidence intervals.

Among females, we observed 1.16 [95% CI (1.03, 1.28)] times higher odds of lifetime anxiety diagnosis and 1.37 times higher odds of lifetime depression diagnosis among cancer survivors compared to those who have never had cancer (Table 5). However, after adjusting for potential confounders, there was no longer a statistically significant association between cancer diagnosis and lifetime mental health outcomes.

When examining sexual identity-specific estimates of the association between cancer diagnosis and mental health outcomes, we found that the positive association between cancer diagnosis and mental health outcomes was only statistically significant among straight females (Table 6). After adjusting for covariates, results remain similar, however, among bisexual females, the association between cancer diagnosis and lifetime anxiety diagnosis was strongest among bisexual females [OR=3.03 CI (1.37, 6.71)], followed by lesbian females [OR=1.79 CI (0.65, 4.89)]. These results were not statistically significant given the wide confidence intervals.

3.4 Multivariate Association of Mental Health Frequency

Among males, we observed 1.53 [95% CI (1.14, 2.06)], times higher odds of “daily” depression frequency and 1.17 [95% CI (1.12, 1.57)], times higher odds of “weekly or monthly”

depression frequency compared to “Never or a few times a year” among cancer survivors compared to those who have never had cancer (table 5). However, after adjusting for potential confounders, there was no longer a statistically significant association between cancer diagnosis and frequency mental health outcomes.

When examining sexual identity-specific estimates of the association between cancer diagnosis and frequency mental health outcomes, we found that the positive association between cancer diagnosis and frequency of mental health outcomes was only statistically significant among bisexual males (Table 6). After adjusting for covariates, results remained similar, however, among bisexual males the association between cancer diagnosis and “daily” anxiety frequency was the strongest [OR=8.07 CI (1.23,52.81)]. In terms of depression frequency, the association between cancer diagnosis and “daily” depression frequency was strongest among bisexual males [OR=11.19 CI (0.19,673.24)], followed by gay males [OR=1.64 CI (0.42, 6.43)]. Lastly the association between cancer diagnosis and “weekly or monthly” depression frequency was the strongest among bisexual males [OR=15.23 CI (3.17, 73.22)], followed by gay males [OR=2.29 CI (0.86, 6.11)]. These results were not statistically significant given the wide confidence intervals.

Among females, we observed 1.68 [95% CI (1.39, 2.02)], higher odds of “daily” depression frequency compared to “never of a few times a year” among cancer survivors compared to those who have never had cancer (Table 5). However, after adjusting for potential confounders, there was no longer a statistically significant association between cancer diagnosis and frequency mental health outcomes.

When examining sexual identity-specific estimates of the association between cancer diagnosis and frequency mental health outcomes, we found that the positive association between cancer diagnosis and frequency of mental health outcomes was only statistically significant among straight females (Table 6). After adjusting for covariates, results frequency of mental health outcomes remained similar. However, among lesbian females the association between cancer diagnosis and “daily” anxiety frequency was the strongest [OR=3.06 95% CI (0.87, 10.80)], followed by straight females [OR=1.07 CI (0.93, 1.23)].

3.5 Multivariate Association of Mental Health Scores

Among male participants, cancer survivors have a significantly higher PHQ-8 score compared to those who never had cancer [β =0.72 (95% CI 0.30, 1.13)], however after adjusting for covariates, this relationship was no longer statistically significant (Table 5). There did not appear to be a statistically significant association between cancer diagnosis and GAD-7 and PHQ-8 scores.

When examining sexual identity-specific estimates, bisexual males had significantly higher GAD-7 and PHQ-8 scores among cancer survivors compared to those who never had cancer [β =8.71 (5.19, 12.24)] and [β =11.69 (7.82, 15.56)], respectively (Table 7). The association was attenuated, but still statistically significant after adjusted for covariates [β =10.39 (4.03, 16.75)] and [β =13.59 (6.03, 21.16)], respectively. There was not a statistically significant association between cancer diagnosis and GAD-7 and PHQ-8 scores for other sexual identity groups.

Among female participants, cancer survivors have a significantly higher GAD-7 score and PHQ-8 score [β =0.36 (0.05, 0.68)] and [β =0.78 (0.44, 1.11)], respectively (Table 5). However, after adjusting for covariates, this relationship was no longer statistically significant. There did not appear to be a statistically significant association between cancer diagnosis and GAD-7 and PHQ-8 scores.

When examining sexual identity-specific estimates, straight females had significantly higher GAD-7 scores among cancer survivors compared to those who never had cancer [β =0.76 (0.43, 1.09)] (Table 7). After adjusting for covariates, this relationship was no longer statistically significant. There was not a statistically significant association between cancer diagnosis and GAD-7 and PHQ-8 scores for other sexual identity groups.

Our test for effect modification based on sexual identity on the association between cancer diagnosis and mental health outcomes suggested that the association between cancer diagnosis and mental health outcomes were similar across sexual identity groups. The p-values ranged from 0.11 to 0.92.

CHAPTER 4

DISCUSSION

This study used data from NHIS 2019-2021 to examine differences in the association between cancer diagnosis and mental health outcomes. In this nationally representative sample, LGB males and females were found to have the highest rates of lifetime diagnosis of anxiety and depression as well as "daily" anxiety and depression frequency. Additionally, bisexual males and females had the highest average GAD-7 and PHQ-8 scores. These findings support previous research regarding sexual orientation-based disparities in mental health.[5,37–40,47]

The multivariate associations between cancer diagnosis and mental health outcomes showed complex results. We observed no significant values in the association between cancer diagnosis and anxiety and depression outcomes in either males or females in our main sample. Although we generally found no statistically significant association, when examining sexual identity-specific estimates there were significant results among bisexual individuals.

We observed 3.03 times increase in the odds of bisexual cancer survivors reporting lifetime diagnosis of anxiety compared to bisexual people that never had cancer. These results are particularly interesting as previous studies have shown that assessing lifetime diagnosis of mental health outcomes are not the most reliable way of assessing mental health disparities in cross-sectional studies due to recall and social desirability bias causing underreporting in individuals with chronic conditions .[48] This differential in reporting would suggest that the association may be even stronger than observed. We additionally observed among bisexual men those who are cancer survivors have 8.07 times increase in odds of reporting "daily" anxiety frequency and a 15.23 increase in odds of reporting

"weekly or monthly" depression.

To address differences in access to mental health diagnosis, in our sub-analysis we used validated scales that provisionally diagnosis anxiety and depression through grading severity of symptoms. We observed no significant values in the association between cancer diagnosis and GAD-7 and PHQ-8 scores in either males or females. However, once we stratified our results by sexual identity, we estimated that bisexual male cancer survivors have a significantly 10.39 points higher GAD-7 score, and 13.59 points higher PHQ-8 score. Lastly, we observed a 13.59-point higher PHQ-8 score among female bisexual survivors of cancer. These results are consistent with previous studies also assessing anxiety and depression using PHQ-8 and GAD-7 by sexual orientation, adding to research regarding the unique experiences of bisexual individuals. .[49,50]

The lack of statistically significant associations among other sexual identity subgroups could be due to the prevalence of cancer diagnosis being notably small for some sexual identity subgroups. The number of LGB cancer survivors was 0.2% of the study sample and in a sample of 78,689 only 61 were bisexual female cancer survivors. However, the finding for bisexual males highlights important heterogeneity among sexual minority groups and further underscores the impact of minority stress on bisexual individuals that may be above and beyond that experienced by lesbian/gay individuals. Future work should consider cancer survivorship among bisexual males and the challenges that may be unique to this group.

Several limitations should be considered when interpreting the findings of this study. First, this study combined data from before and after the COVID-19 pandemic. Studies are finding that US adults reported elevated adverse mental health conditions after the announcement of COVID-19 as a pandemic.[51] Using covid mental data runs the risk of

null results as the general population had elevated poor mental health. Additionally, NHIS switched from in-person to phone interviews after the initiation of COVID-19 restriction which decreased response rates in 2020. In response to the shift in interviewing strategy and decline in participation in 2020, NHIS created unique weights to produce a nationally representative sample.[32] In addition of accounting for a potential lack of diagnosis, the sub-analysis also served to exclude years that used hybrid interviewing methods. Second, the use of self-reported health measures in the National Health Interview Survey (NHIS) raises the risk of reporting bias, particularly about sexual orientation, previous medical diagnosis, and poor mental health, which require disclosure face-to-face with an interviewer. Consequently, the analysis results may be biased due to underreporting of queer individuals, cancer survivors, and those with poor mental health.

Third, using aggregated cancer survivors may introduce survival bias as survival time vary by cancer types. People who are severally ill due to diagnosis or treatment may have not been included in this analysis due to not being home to qualify for the survey. In order to adjust for survival time, we would have to limit our analysis to only cancer survivors which was avoided due to sample sizes of sexual minority individuals with cancer. Additionally, the cross-sectional design of this study is a limitation. Due to assessing both cancer diagnosis and mental health outcomes at the same time we cannot determine the temporal relationship. However, we conducted a sub-analysis using validated scales that screen anxiety and depression symptoms within the past two weeks. Additionally, the average age of study participants across all sex and sexual orientation groups was under 50 years, which may have resulted in lower reporting of cancer diagnosis due to the typical age of onset. Although all analyses were adjusted for age, the age distribution of the study sample may affect the true relationship between cancer diagnosis

and mental health outcomes among LGB individuals. Lastly, we did not account for a behavioral factor that may influence the association such alcohol consumption and physical activity as they were not obtained in the National Health Interview survey between 2019 to 2021.

Despite the limitations, the findings of this study hold significant implications for public health. In a clinical setting, the disproportional rates of psychological distress in sexual minority communities suggest that mental health care providers require more specialized training to better cater to the needs of these populations. In contrast to previous studies, this study indicates that cancer survivors do not have higher rates of poor mental health outcomes compared to those without cancer, it does highlight a stronger association between cancer diagnosis and poor mental health in certain sexual minority groups. This emphasizes the need for healthcare providers to comprehend this relationship and tailor medical advice and treatments accordingly. Such as early screening and culturally relevant care and resources. Healthcare providers must communicate the connection between mental health and the unique risks that patients' sexual orientation may pose in this relationship. Though queer individuals cannot change their sexual minority status, it is important to acknowledge the additional stressors they may face in society and that there are resources available to help.

At the policy level, stronger federal and state laws are needed to protect individuals from healthcare discrimination and ensure that everyone receives appropriate and comprehensive care, regardless of their sexual identity. In addition to protecting sexual minorities from discrimination in housing, employment, assistance program, and any future legislation rooted in hate.

Lastly, at the individual level, addressing stigma related to sexual identity in both

straight and LGB populations. As previously mentioned, stigma is a major driver of mental health disparities among queer individuals.[9] It is not enough addressing stigma among straight individuals as bisexual individuals have reported additional stress caused by prejudice from both straight and gay or lesbian individuals, which contributes to a higher risk for poor mental health.[11] There are various effective intervention strategies such as increasing education, encouraging dialogue, and challenge stereotypes.[52] It's important to remember that addressing sexual identity stigma is an ongoing process that requires continued effort and commitment. This effort and commitment are important to create an inclusive and accepting society. As emphasized by the Minority Stress Model and the Socio-Ecological Model, the stigma that sexual minorities encounter across multiple aspects of their lives leads to chronic stress, and clinical application, anti-discriminatory legislation, and addressing interpersonal stigma is essential to safeguard the mental health of queer communities.[9,53]

The findings of this study align with previous research indicating that mental health disparities within queer communities require a distinct approach. They also highlight the need for further investigation into the factors influencing the relationship between cancer diagnosis and mental health outcomes in this population. Moreover, additional research is necessary to identify optimal methods for evaluating mental health outcomes among queer communities. These insights have important implications, but addressing the needs of queer communities will require a multifaceted approach.

APPENDIX: TABLES

Table 1: Sociodemographic characteristics by sexual identity among Males, National Health Interview Survey 2019-2021 (n= 36,131)

	Straight		Gay			Bisexual		
	34,966		848			317		
	mean	SE	mean	SE	p-value[a]	mean	SE	p-value[a]
Age (n=35,030)	46.7	0.1	42.7	0.8	0.000	34.0	1.0	0.000
Body Mass Index (n= 33,530)	28.1	0.0	26.8	0.2	0.000	28.1	0.4	0.987
	n	wtd %	n	wtd %	p-value[b]	n	wtd %	p-value[b]
Race/ Ethnicity (n= 36,131)					0.514			0.607
Non-Hispanic White	24,306	63.9 %	613	67.5 %		224	68.1 %	
Non-Hispanic Black	3,304	10.8 %	62	8.8 %		23	8.3 %	
Hispanic	4,556	16.7 %	113	15.1 %		42	16.2 %	
Non-Hispanic Other	2,800	8.5 %	60	8.7 %		28	7.4 %	
Family Income Level (n= 36,131)[c]					0.005			0.002
<100%	2,828	8.4 %	43	5.7 %		41	16.1 %	
100-209%	5,364	16.6 %	99	13.6 %		62	18.3 %	
210-409%	10,309	30.5 %	228	27.9 %		98	30.9 %	
>=410%	16,465	44.5 %	478	52.8 %		116	34.8 %	
Education Level (n=35,360)					0.000			0.000
High school or less	12,285	41.2 %	138	23.7 %		77	27.9 %	
Some college	9,508	28.4 %	234	31.9 %		112	41.3 %	
Bachelor's degree or greater	12,428	30.3 %	456	44.4 %		122	30.8 %	
Employment Status (n= 35,861)					0.004			0.000
Full time	19,509	59.6 %	507	56.6 %		181	54.1 %	
Part time	3,366	10.5 %	109	13.4 %		45	16.2 %	
Unemployed	777	3.1 %	27	6.5 %		24	9.9 %	
Not in work force	11,046	26.8 %	203	23.6 %		67	19.8 %	
Region (n= 36,131)					0.006			0.258
Northeast	5,869	17.5 %	165	20.7 %		47	14.5 %	
Midwest	7,858	21.2 %	136	15.8 %		85	27.1 %	
South	12,378	37.2 %	285	34.0 %		100	36.1 %	
West	8,861	24.1 %	262	29.6 %		85	22.3 %	
Relationship Status (n= 36,099)					0.000			0.000
Married or living with partner	18,083	55.3 %	187	24.3 %		61	18.1 %	
Separated, divorced, widowed	2,395	8.6 %	110	15.8 %		34	12.4 %	
Never married	14,456	36.1 %	551	59.9 %		222	69.5 %	
Insurance Status (n= 36,029)					0.030			0.611
Private	21,904	63.2 %	592	66.1 %		201	59.9 %	
Public	6,865	18.2 %	161	21.0 %		57	19.6 %	
Uninsured	2,735	6.4 %	42	5.4 %		23	8.7 %	
Other Coverage	3,361	12.2 %	52	7.5 %		36	11.8 %	
General Health Status (n= 36,118)					0.037			0.036
Excellent	8,147	25.1 %	247	29.8 %		53	16.6 %	
Very Good	11,951	34.0 %	309	35.5 %		121	36.8 %	
Good	9,744	27.5 %	189	23.7 %		97	33.8 %	
Fair or Poor	5,112	13.3 %	103	11.0 %		45	12.8 %	

[a] p-values generated by two-sample T-tests using weighted means with straight as referent group

[b] p-values generated by Pearson $\chi 2$ tests using weighted percentages with straight as referent group

[c] Federal poverty guidelines

Table 2: Sociodemographic characteristics by sexual identity among females, National Health Interview Survey 2019-2021 (n= 42,555)

	Straight		Lesbian			Bisexual		
	41,011		592			952		
	mean	SE	mean	SE	p-value[a]	mean	SE	p-value[a]
Age (n= 40,692)	48.4	0.1	39.8	1.0	0.000	31.4	0.5	0.000
Body Mass Index (n=33,530)	27.7	0.1	28.7	0.4	0.004	27.8	0.3	0.805
	n	wtd %	n	wtd %	p-value[b]	n	wtd %	p-value[b]
Race/ Ethnicity (n= 42,555)					0.010			0.736
Non-Hispanic White	27,700	62.9 %	400	65.4 %		627	64.5 %	
Non-Hispanic Black	4,690	12.2 %	85	16.3 %		86	10.7 %	
Hispanic	5,354	16.5 %	69	12.5 %		144	16.1 %	
Non-Hispanic Other	3,267	8.4 %	38	5.8 %		95	8.7 %	
Family Income Level (n= 42,555)[c]					0.002			0.000
<100%	4,629	11.5 %	63	11.3 %		160	16.9 %	
100-209%	7,808	19.2 %	85	12.7 %		226	24.1 %	
210-409%	12,089	30.0 %	187	37.5 %		269	30.3 %	
>=410%	16,485	39.3 %	257	38.4 %		297	28.7 %	
Education Level (n= 41,881)					0.003			0.000
High school or less	13,333	37.7 %	121	28.4 %		272	35.1 %	
Some college	12,187	30.9 %	188	34.4 %		324	38.4 %	
Bachelor's degree or greater	14,840	31.4 %	274	37.2 %		342	26.5 %	
Employment Status (n= 42,272)					0.000			0.000
Full time	16,503	42.6 %	342	58.5 %		498	48.5 %	
Part time	5,792	16.3 %	87	16.4 %		210	24.9 %	
Unemployed	705	2.2 %	21	4.9 %		39	6.0 %	
Not in work force	17,740	38.9 %	139	20.1 %		196	20.5 %	
Region (n= 42,555)					0.008			0.003
Northeast	6,884	17.4 %	131	22.3 %		150	15.9 %	
Midwest	9,086	21.0 %	81	14.0 %		214	24.6 %	
South	15,098	38.7 %	216	38.3 %		297	32.0 %	
West	9,943	22.9 %	164	25.4 %		291	27.6 %	
Relationship Status (n= 42,504)					0.000			0.000
Married or living with partner	18,691	52.0 %	173	31.3 %		217	23.0 %	
Separated, divorced, widowed	2,334	7.7 %	99	20.1 %		191	24.4 %	
Never married	19,935	40.3 %	320	48.6 %		544	52.5 %	
Insurance Status (n= 42,448)					0.077			0.000
Private	24,802	61.5 %	414	68.6 %		571	58.2 %	
Public	11,222	24.9 %	116	19.4 %		219	21.5 %	
Uninsured	2,005	4.3 %	22	3.6 %		35	3.1 %	
Other Coverage	2,881	9.3 %	38	8.4 %		123	17.2 %	
General Health Status (n= 42,537)					0.028			0.000
Excellent	9,305	24.1 %	149	25.2 %		158	16.4 %	
Very Good	14,172	34.0 %	226	39.2 %		343	35.8 %	
Good	11,341	27.4 %	154	25.7 %		294	32.1 %	
Fair or Poor	6,176	14.4 %	63	9.9 %		156	15.7 %	

[a] p-values generated by two-sample T-tests using weighted means with straight as referent group

[b] p-values generated by Pearson $\chi 2$ tests using weighted percentages with straight as referent group

[c] Federal poverty guidelines

Table 3: Anxiety and Depression by sexual identity among males, National Health Interview Survey 2019-2022 (n= 36,131)

	Straight		Gay			Bisexual		
	34,966		848			317		
	n	wtd %	n	wtd %	p-value[a]	n	wtd %	p-value[a]
Anxiety								
Ever had Anxiety (n= 36,083)					0.000			0.000
No	31,308	90.1 %	647	75.6 %		216	67.6 %	
Yes	3,611	9.9 %	201	24.4 %		100	32.4 %	
Anxiety frequency (n= 35,981)					0.000			0.000
Daily	3,307	9.4 %	137	18.8 %		78	27.6 %	
Weekly or Monthly	7,255	21.4 %	271	31.8 %		126	42.8 %	
A few times a year or Never	24,260	69.2 %	435	49.4 %		112	29.6 %	
Depression								
Ever had Depression (n= 36,074)					0.000			0.000
No	30,742	88.9 %	623	74.2 %		198	60.0 %	
Yes	4,168	11.1 %	225	25.8 %		118	40.0 %	
Depression frequency (n= 35,968)								
Daily	1,157	3.0 %	48	5.3 %	0.000	30	11.5 %	0.000
Weekly or Monthly	3,472	9.9 %	150	18.9 %		108	36.0 %	
A few times a year or Never	30,176	87.1 %	650	75.9 %		177	52.5 %	
Ever had Cancer Status (n=36,101)					0.004			0.248
No	32,151	93.7 %	793	96.0 %		303	95.8 %	
Yes	2,786	6.3 %	55	4.0 %		13	4.2 %	
	mean	SE	mean	SE	p-value[b]	mean	SE	p-value[b]
Validated Scales[c]								
GAD-7 Score (n= 14,066)[d]	1.6	0.0	2.1	0.3	0.044	4.3	0.8	0.000
PHQ-8 Score (n= 14,022)[e]	2.0	0.0	2.5	0.3	0.056	5.6	0.8	0.000

[a] p-values generated by Pearson $\chi 2$ tests using weighted percentages with straight as referent group

[b] p-values generated by two-sample T-tests using weighted means with straight as referent group

[c] 2019 Sample Only

[d] Measured using 7-Item General Anxiety Disorder Scale (range 0-21)

[e] Measured using 8-Item Patient Health Questionnaire depression scale (range 0-24)

Table 4: Anxiety and Depression by sexual identity among females, National Health Interview Survey 2019-2022 (n= 42,555)

	Straight		Lesbian			Bisexual		
	41,011		592			952		
	n	wtd %	n	wtd %	p-value[a]	n	wtd %	p-value[a]
Anxiety								
Ever had Anxiety (n= 42,505)					0.000			0.000
No	33,446	81.9 %	421	70.0 %		455	46.0 %	
Yes	7,518	18.1 %	169	30.0 %		496	54.0 %	
Anxiety frequency (n= 42,356)					0.000			0.000
Daily	5,539	14.3 %	122	25.4 %		388	42.2 %	
Weekly or Monthly	11,225	28.2 %	205	33.7 %		381	39.3 %	
A few times a year or Never	24,051	57.4 %	263	41.0 %		182	18.5 %	
Depression								
Ever had Depression (n= 42,502)					0.000			0.000
No	32,583	80.4 %	386	65.5 %		410	42.5 %	
Yes	8,376	19.6 %	206	34.5 %		541	57.5 %	
Depression frequency (n= 42,327)								
Daily	1,782	4.2 %	40	8.7 %	0.000	127	14.2 %	0.000
Weekly or Monthly	5,813	14.4 %	130	23.2 %		407	45.7 %	
A few times a year or Never	33,193	81.4 %	419	68.1 %		416	40.1 %	
Ever had Cancer Status (n= 42,515)					0.000			0.001
No	36,838	91.8 %	560	96.3 %		891	95.2 %	
Yes	4,134	8.2 %	31	3.7 %		61	4.8 %	
	mean	SE	mean	SE	p-value[b]	mean	SE	p-value[b]
Validated Scales[c]								
GAD-7 Score (n= 16,394)[d]	2.3	0.0	3.5	0.4	0.006	6.1	0.4	0.000
PHQ-8 Score (n= 16,362)[e]	2.7	0.0	3.5	0.4	0.085	6.3	0.4	0.000

[a] p-values generated by Pearson $\chi 2$ tests using weighted percentages with straight as referent group

[b] p-values generated by two-sample T-tests using weighted means with straight as referent group

[c] 2019 Sample Only

[d] Measured using 7-Item General Anxiety Disorder Scale (range 0-21)

[e] Measured using 8-Item Patient Health Questionnaire depression scale (range 0-24)

Table 5: Multivariate associations between cancer diagnosis and mental health outcomes by sex

Overall Model								
	Males				Females			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Anxiety								
Lifetime Anxiety Diagnosis								
No	1.00	_ _	1.00	_ _	1.00	_ _	1.00	_ _
Yes	1.32	(1.12 1.57)	1.08	(0.90 1.30)	1.14	(1.02 1.28)	0.99	(0.88 1.12)
Anxiety Frequency								
A few times a year or Never	1.00	_ _	1.00	_ _	1.00	_ _	1.00	_ _
Daily	1.04	(0.85 1.26)	0.95	(0.77 1.19)	1.09	(0.96 1.23)	1.09	(0.95 1.25)
Weekly or Monthly	0.84	(0.73 0.97)	1.15	(0.99 1.34)	0.77	(0.70 0.86)	0.93	(0.83 1.03)
Depression								
Lifetime Depression Diagnosis								
No	1.00	_ _	1.00	_ _	1.00	_ _	1.00	_ _
Yes	1.42	(1.22 1.66)	1.07	(0.90 1.27)	1.36	(1.23 1.50)	1.06	(0.95 1.18)
Depression Frequency								
A few times a year or Never	1.00	_ _	1.00	_ _	1.00	_ _	1.00	_ _
Daily	1.53	(1.14 2.07)	0.95	(0.71 1.29)	1.68	(1.39 2.02)	1.14	(0.93 1.40)
Weekly or Monthly	1.07	(0.90 1.28)	1.04	(0.86 1.27)	1.03	(0.91 1.16)	1.01	(0.89 1.15)
	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Validated Scales								
GAD-7 Score	0.09	(-0.24 0.42)	-0.22	(-0.53 0.10)	0.31	(-0.01 0.62)	0.06	(-0.23 0.36)
PHQ=8 Score	0.69	(0.27 1.11)	-0.02	(-0.38 0.35)	0.72	(0.39 1.05)	0.11	(-0.19 0.42)

[a] Adjusted for sociodemographic covariates (age, body mass index, race/ ethinicity, family income, educational level, employment status, region, relationship status, insurance status, and general health status)

Table 6: Multivariate associations between cancer diagnosis and mental health outcomes by sex and sexual orientation

	Males											
	Straight				Gay				Bisexual			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Anxiety												
Lifetime Anxiety Diagnosis												
No	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Yes	1.35	(1.13 1.61)	1.08	(0.89 1.31)	1.22	(0.53 2.84)	1.08	(0.37 3.19)	1.51	(0.32 7.02)	0.74	(0.12 4.48)
Anxiety Frequency												
A few times a year or Never	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Daily	1.04	(0.85 1.27)	0.93	(0.74 1.16)	0.57	(0.20 1.65)	0.67	(0.21 2.19)	2.56	(0.38 17.08)	6.18	(1.02 37.53)
Weekly or Monthly	0.86	(0.75 0.99)	1.16	(0.99 1.35)	0.65	(0.30 1.39)	1.13	(0.47 2.72)	0.43	(0.06 3.13)	1.00	(0.10 9.87)
Depression												
Lifetime Depression Diagnosis												
No	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Yes	1.43	(1.22 1.67)	1.04	(0.87 1.23)	1.66	(0.83 3.33)	1.53	(0.65 3.57)	3.53	(0.53 23.74)	2.70	(0.28 25.86)
Depression Frequency												
A few times a year or Never	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Daily	1.56	(1.15 2.12)	0.94	(0.69 1.28)	1.79	(0.58 5.47)	1.65	(0.43 6.27)	2.60	(0.19 35.55)	8.18	(0.11 616.64)
Weekly or Monthly	1.05	(0.87 1.26)	0.98	(0.80 1.19)	1.40	(0.60 3.29)	2.21	(0.84 5.80)	5.33	(0.67 42.60)	11.53	(2.57 51.76)

	Females											
	Straight				Gay				Bisexual			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Anxiety												
Lifetime Anxiety Diagnosis												
No	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Yes	1.16	(1.04 1.30)	0.95	(0.84 1.08)	1.00	(0.37 2.72)	1.72	(0.64 4.63)	3.16	(1.54 6.48)	3.14	(1.42 6.95)
Anxiety Frequency												
A few times a year or Never	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Daily	1.13	(1.00 1.28)	1.07	(0.94 1.23)	1.08	(0.32 3.60)	3.13	(0.88 11.22)	0.96	(0.37 2.48)	0.96	(0.23 4.04)
Weekly or Monthly	0.80	(0.72 0.88)	0.93	(0.83 1.04)	0.71	(0.23 2.20)	1.31	(0.46 3.73)	0.39	(0.13 1.15)	0.53	(0.11 2.47)
Depression												
Lifetime Depression Diagnosis												
No	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Yes	1.42	(1.28 1.57)	1.05	(0.94 1.18)	0.53	(0.20 1.37)	0.45	(0.11 1.88)	1.83	(0.85 3.94)	1.20	(0.56 2.58)
Depression Frequency												
A few times a year or Never	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _	1.00	_ _ _
Daily	1.78	(1.48 2.15)	1.15	(0.93 1.41)	0.12	(0.01 1.02)	0.02	(0.00 1.45)	2.01	(0.71 5.69)	1.20	(0.37 3.89)
Weekly or Monthly	1.08	(0.95 1.22)	1.00	(0.88 1.13)	0.62	(0.20 1.92)	0.62	(0.15 2.54)	1.08	(0.52 2.26)	1.15	(0.54 2.48)

[a] Adjusted for sociodemographic covariates (age, body mass index, race/ ethinicity, family income, educational level, employment status, region, relationship status, insurance status, and general health status)

Table 7: Multivariate associations between cancer diagnosis and mental health validated scores by sex and sexual orientation

	Males											
	Straight				Gay				Bisexual			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Validated Scales												
GAD-7 Score	0.04	(-0.29 0.36)	-0.28	(-0.58 0.02)	2.11	(-0.46 4.68)	2.11	(-0.13 4.35)	8.71	(5.19 12.24)	9.01	(3.06 14.96)
PHQ-8 Score	0.65	(0.23 1.06)	-0.08	(-0.43 0.28)	1.19	(-0.65 3.02)	0.62	(-0.88 2.12)	11.69	(7.82 15.56)	12.45	(5.28 19.61)
	Females											
	Straight				Gay				Bisexual			
	Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]		Unadjusted		Adjusted[a]	
	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI	β	95% CI
Validated Scales												
GAD-7 Score	0.33	(0.02 0.64)	0.04	(-0.25 0.34)	0.53	(-2.28 3.34)	1.94	(-1.00 4.88)	0.56	(-2.94 4.06)	0.40	(-2.51 3.31)
PHQ-8 Score	0.76	(0.42 1.09)	0.11	(-0.19 0.42)	-0.98	(-3.47 1.50)	-0.92	(-3.66 1.83)	0.83	(-2.55 4.22)	0.60	(-2.26 3.46)

[a] Adjusted for sociodemographic covariates (age, body mass index, race/ ethinicity, family income, educational level, employment status, region, relationship status, insurance status, and general health status)

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