**RESOLUTION OF DISPARITIES IN OBESITY AND DEPRESSION PREVALENCE BETWEEN LESBIAN AND HETEROSEXUAL WOMEN IN PITTSBURGH: RESULTS FROM THE ESTHER STUDY**

by

Ashley J. Simenson

BS, Oklahoma State University, 2017

Submitted to the Graduate Faculty of

Epidemiology

Graduate School of Public Health in partial fulfillment

of the requirements for the degree of

Master of Public Health

University of Pittsburgh

2019

UNIVERSITY OF PITTSBURGH

GRADUATE SCHOOL OF PUBLIC HEALTH

This essay is submitted

by

Ashley J. Simenson

on

April 22, 2019

and approved by

Essay Advisor:

Nancy W. Glynn, PhD

Assistant Professor

Epidemiology

Graduate School of Public Health

University of Pittsburgh

Essay Readers:

Nina Markovic, PhD

Assistant Professor

Epidemiology

Graduate School of Public Health

University of Pittsburgh

Suzanne Kinsky, MPH, PhD

Adjunct Assistant Professor

Behavioral and Community Health Sciences

Graduate School of Public Health

University of Pittsburgh

**ABSTRACT**

Copyright © by Ashley Simenson

2019

Compared to heterosexual adult women, lesbian women experience higher rates of many chronic disease outcomes including depression, obesity, hypertension, and diabetes. Additionally, lesbian women report higher rates of risky health behaviors such as hazardous drinking and cigarette smoking. However, little longitudinal research has been done to examine changes in disparities between lesbian and heterosexual adult women. The aim of this study was to compare chronic disease outcomes and risk behaviors in lesbian and heterosexual women across two data collection points roughly ten years apart and to characterize any health disparities and changes in those disparities over time. A total of 1084 women were initially recruited from Pittsburgh, PA to participate in the Epidemiologic Study of HEalth Risk in women (ESTHER) study, and N=483 women, 270 of whom were lesbian, ultimately completed a baseline survey between 2003 and 2006 and a follow-up survey in 2015 or 2016. Participants completed a questionnaire at both baseline and follow-up and completed a clinic visit for the baseline study to provide biometric data. At baseline, lesbian participants reported higher rates of obesity (*p*=0.03), depression (*p*=0.02), smoking (*p*=0.04), and elevated C-reactive protein levels (*p*=0.05). By the time of the follow-up survey ten years later, lesbian women continued to have higher rates of smoking (*p*=0.04), but the disparity in depression (*p*=0.53) and obesity (*p*=0.24) rates had resolved. To our knowledge, this is the first study to report a resolution in obesity or depression disparities between lesbian and heterosexual women. Future research is necessary to determine if other disparities, such as respiratory conditions, appear over time and how lesbian women's health may continue to improve relative to heterosexual women and stem this public health inequity.

Nancy W. Glynn, PhD

**RESOLUTION OF DISPARITIES IN OBESITY AND DEPRESSION PREVALENCE BETWEEN LESBIAN AND HETEROSEXUAL WOMEN IN PITTSBURGH: RESULTS FROM THE ESTHER STUDY**

Ashley Simenson, MPH

University of Pittsburgh, 2019

TABLE OF CONTENTS

[preface viii](#_Toc6408883)

[1.0 Introduction 1](#_Toc6408884)

[1.1 Burden of Chronic Disease 1](#_Toc6408885)

[1.2 Impact of risky Health behaviors and chronic disease 1](#_Toc6408886)

[1.3 health disparities in sexual minority women 2](#_Toc6408887)

[1.4 gaps in knowledge 5](#_Toc6408888)

[1.5 public health significance 5](#_Toc6408889)

[2.0 objective 6](#_Toc6408890)

[3.0 methods 7](#_Toc6408891)

[3.1 study population 7](#_Toc6408892)

[3.2 study measurements 8](#_Toc6408893)

[3.2.1 Demographics and anthropometric measurements 8](#_Toc6408894)

[3.2.2 Health behaviors 9](#_Toc6408895)

[3.2.3 Health outcomes 10](#_Toc6408896)

[3.3 statistical analysis 12](#_Toc6408897)

[4.0 Results 13](#_Toc6408898)

[5.0 discussion 18](#_Toc6408899)

[bibliography 23](#_Toc6408900)

List of tables

[Table 1 ESTHER Sample Characteristics at Baseline and Follow-up by Sexuality 14](#_Toc6421726)

[Table 2 Health Outcomes for ESTHER Participants at Baseline and Follow-up by Sexuality 17](#_Toc6421727)

# preface

Thank you to all the members of my essay committee, Dr. Nancy W. Glynn, Dr. Nina Markovic, and Dr. Suzanne Kinsky for helping with the practical things: writing, editing, researching, coding, and more. But beyond this essay, thank you for bringing me to Pitt, encouraging me, pushing me when I needed it, setting high expectations and lifting me up to meet them, and being wonderful human beings who I am honored to know.

Thank you to my friends who have been an amazing support network. I am so grateful to know and love each and every one of you.

Thank you to my parents, who did not always know what I was doing but still said it was really cool. Thanks for turning me into a good human, without your support I would be floundering and lost. I am so thankful for your unending love.

One of my favorite sayings is, "Here's to strong women; may we know them, may we be them, may we raise them." Thank you to all the strong women in my life. Knowing you is an honor. I hope you realize you are part of, and you are raising a generation of strong women who will remake health in their images.

And to Simon: I did this so you can have a better life.

# Introduction

## Burden of Chronic Disease

Caring for people with chronic health conditions accounts for 90% of 3.3 billion dollars in total health care spending in the United States annually.1-3 In 2014, 60% of Americans reported living with at least one chronic disease.2 Overall, 42% of US adults reported having multiple chronic health conditions, but this percentage rises to 50% of adults ages 45-64.2 Having multiple chronic conditions is associated with poorer overall health, increased use of health services, and increased healthcare spending compared to individuals with one or no chronic conditions.2 The most commonly reported chronic conditions are hypertension, dyslipidemia, and mood disorders including depression.2 Worldwide, rising rates of overweight and obesity continue to cause concern as obesity is strongly associated with increased risk for type 2 diabetes and cardiovascular disease.4

## Impact of risky Health behaviors and chronic disease

Risky health behaviors add to chronic disease and economic burdens. Binge eating, hazardous drinking, and cigarette smoking all contribute to poor health. Excessive alcohol use in the forms of binge drinking and heavy drinking poses a major threat to an individual's physical and mental health and cost the United States $249 billion in 2010.5 Smoking and tobacco use are consistently and strongly connected to a myriad of poor health outcomes including increasing mortality risk by approximately three times,6 and 34 million Americans reported being current cigarette smokers in 2017.6 Compared to smoking and hazardous alcohol use, binge eating is less common.7 Binge eating disorder affects approximately 2.6% of US adults, and it is associated with increased potential for obesity, metabolic syndrome, and psychiatric diagnoses.7 Additionally, binge eating disorder is estimated to increase an individual's annual healthcare expenditure by about $10,000 annually.7

The burden of chronic disease disproportionately affects some groups in the US. For example non-Hispanic black adults are more likely to die from heart disease or stroke prematurely than non-Hispanic white adults.8 Individuals with low levels of education are at higher risk for obesity compared to their counterparts who have completed more schooling.8 Women are nearly twice as likely as men to have depression.9 Depression has been further linked to an increased risk of all-cause and cardiovascular disease-related mortality in women.10

## health disparities in sexual minority women

Lesbian women face their own health disparities when they are compared to heterosexual women. These health disparities begin to appear in adolescence, when sexual minority adolescents report engaging in more risky health behaviors, including substance use, eating disorders, and risky sexual behaviors, than heterosexual youth.11 Sexual minority youth report more depressive symptoms and suicidality than heterosexual young people.12 Additional disparities appear as women age. Sexual minority women have higher rates of frequently poor mental health, hypertension, arthritis, and diabetes.13-15 Lesbian women are less likely to describe their overall health status as excellent or very good.16,17 Sexual minority older adults report higher rates of disability, mental distress, and depression than heterosexual adults.14,16,18

Several studies have reported higher rates of risky health behaviors or lack of preventive measures in lesbian women compared to heterosexual women. Throughout the life course, lesbian and bisexual women consistently report higher rates of smoking and hazardous drinking behaviors than heterosexual women and have higher odds of being diagnosed with any substance use disorder.13,15,17,19-22 Sexual minority women are also less likely to receive preventive care including screening for breast and cervical cancer.23

Disparities in obesity between sexual minority and heterosexual women begin to appear in adolescence, with sexual minority women at increased risk of developing obesity and having higher rates of obesity than their heterosexual counterparts24. However, Nurses’ Health Study II, which included almost 100,000 women, found no difference in physical activity or diet by sexual orientation.25,26 Another recently published large-scale study reported lesbian women were 1.4 times more likely to be overweight or obese compared to heterosexual women, yet the lesbian women were also 1.4 times more likely to report being physically active.23

Social stigma and unwelcoming environments contribute to many of the health inequities observed in sexual minority women. Beginning in adolescence, sexual minority youth report victimization due to their sexual orientation, and this victimization mediates the relationship between sexual minority status and experiencing depressive symptoms.12 In one study, headaches were a common manifestation of stress following exposure to homophobic comments.27 Another study demonstrated a positive correlation between high levels of minority stress, including discrimination and internalized homophobia, and physical health problems.28 Lick et al. describe a pathway linking negative social environment to poor health outcomes for sexual minority adults.29 In this pathway, social environments that stigmatize homosexuality lead to environments where rates of victimization are high and psychological distress occurs.29 Discriminatory social policies, including recently overturned policies restricting marriage to only heterosexual couples and excluding sexual minority folks from the military, lead to additional stigma and preclude sexual minority folks from accessing services.29 Finally, institutional factors within healthcare systems, such as providers who are not trained during their schooling to have discussions about sexual health with people who have same-sex partners, diminish the quality of healthcare available for sexual minority individuals.29 These circumstances result in poor health on their own and may create risk for additional health concerns.29

Inaccurate beliefs on the part of healthcare providers also contribute to health disparities between lesbian and heterosexual women. Healthcare providers often underestimate lesbian women’s risk of cervical cancer because they assume they are not engaging in heterosexual intercourse.30 Healthcare providers frequently make heteronormative assumptions when seeing patients and negatively impact sexual minority women’s health by creating barriers to discussing sexual health and failing to provide relevant sexual health information.31 This is not to say health care providers are at fault. One survey conducted in 2010 found the median time spent teaching LGBT-related health in US medical schools was 5 hours.32 Medical schools fail to educate future providers who are then ill-equipped to care for sexual minority patients.

## gaps in knowledge

The bulk of this research is cross-sectional in nature and often characterizes health-related behaviors and substance use. Very little research has analyzed lesbian women’s health beyond asking about HIV status and sexual health. Between 1989 and 2011, the National Institutes of Health funded over 125,000 studies.33 Only 113, or 0.09%, of those studies focused on LGBT health outside of HIV/AIDS or other sexual health issues.33 Even fewer studies worked with lesbian-identifying women or women who had sex with women.33 Here, we present results from the Epidemiologic Study of Health Risk in Women (ESTHER) study, which began studying the health of sexual minority women in 2003.

## public health significance

Studies such as ESTHER represent an important effort to understand the health of sexual minority women and to describe the ways in which their health differ from the health of heterosexual women. Lesbian and heterosexual women do not have the same risk factors or health outcomes. This is not an insignificant issue; estimates suggest approximately 3.5% of adults in the US belong to a sexual minority group.34 If half of those adults are women, then roughly four million adults, or the approximate population of the state of Oregon, are lesbians. Additionally, this research contributes to better understanding of how minority stress, in this case the stress of being a member of a sexual minority community, impacts overall health and chronic disease outcomes. Public health will greatly benefit from increased understanding of the unique nature of lesbian women’s health.

# objective

The aim of this study was to compare chronic disease outcomes and risk behaviors in lesbian and heterosexual women across two data collection points roughly ten years apart and to characterize any health disparities and changes in those disparities over time.

# methods

## study population

Data for this analysis are from the Epidemiologic Study of HEalth Risk in Women (ESTHER), a cardiovascular risk study of a convenience sample of women from Pittsburgh, PA and surrounding areas. For the baseline survey, conducted between 2003-2006, participants were recruited through newspaper and radio advertisements, community health events, LGBT events, and the University of Pittsburgh broadcast phone-message system.35 A total of 1084 women were recruited; approximately half were lesbian.36 Due to the disproportionate number of recruited black heterosexual women compared to black lesbian women, a random sample of black heterosexuals was selected to match the proportion of black lesbians for analysis. Also, to account for the disproportionate number of older heterosexuals compared to lesbians, women over age 65 were excluded from analysis. The final baseline sample consisted of 479 lesbian and 400 heterosexual women.

In 2015-2016, participants were mailed a short follow-up survey. Due to known deaths and participants who declined to be contacted for follow-up, the outreach sample consisted of 820 women. Participants were contacted up to three times to maximize responses. Slightly more than half (N=483) responded, for a final follow-up sample of 270 lesbian and 213 heterosexual women. Approximately similar proportions of lesbian and heterosexual women completed the follow-up survey, with 56.3% of lesbian women and 53.3% of heterosexual women completing follow-up. Participants were offered a $50 incentive for their participation in the baseline survey. The research was approved by the University of Pittsburgh Institutional Review Board (approval number 0404147).

## study measurements

### Demographics and anthropometric measurements

Sexual orientation: Women were classified as lesbian at baseline if they 1) identified as anything other than heterosexual, and 2) reported either being only or primarily emotionally, physically, and romantically attracted to women in the past five years or having only or primarily female sexual partners in the past five years. Heterosexual women were those who identified as “heterosexual/straight” and reported only male sexual partners since the age of 18. Women who reported attraction to men and women and/or men and women sexual partners in the past five years were excluded. The sexual orientation identity participants chose at baseline was retained for follow-up analysis. Sexual orientation was a dichotomous variable.

Age: Age was categorized using participants’ dates of birth and was entered as dummy variables.

Race: Participants reported their race at baseline as Black, Native American, Asian or Pacific Islander, White or Other. After removing Native American, Asian or Pacific Islander, or Other respondents from the original baseline analytic sample due to small numbers (n=32), race was recoded into a dichotomous variable (White/Black).

Education: Education was assessed using a 5-point scale and collapsed to a dichotomous variable according to the following categories: completed less than a college degree or completed a college degree or more.36

Relationship status: Because marriage was not legal for lesbian participants at the time, relationship status at baseline was instead self-reported as in a committed relationship, single, or other. There were additional options at follow-up, which were: married, committed, divorced, widowed, separated, single, and other. To make categories congruent at baseline and follow-up, married and committed were collapsed into “committed”. Other, divorced, widowed, and separated were collapsed into “other”.

Body Mass Index (BMI): Height and weight were measured by a standardized research protocol at the baseline clinic visit. BMI was categorized using the formula *weight (lb) / [height (in)]2 x 703.*37 Using the National Heart, Lung, and Blood Institute (NHLBI) standards, we categorized BMI as <18.5=underweight, 18.5-24.9=normal weight, 25-29.9=overweight, and >30=obese38 and created dummy variables. At follow-up, participants self-reported weight. BMI was calculated using height at baseline and self-reported weight at follow-up.

### Health behaviors

Current smoking: Current smoking status was assessed at both baseline and follow-up. Respondents who answered “yes” to “Do you currently smoke cigarettes” were coded as current smokers. Those who smoked previously but not currently, were still coded as not current smokers.

Hazardous drinking: Hazardous drinking was assessed at both time-points with four types of questions that assessed drinking behaviors over the past 12 months. Participants were asked about: heavy episodic drinking (“During the last 12 months, how often did you have 6 or more drinks of wine, beer, or liquor in a single day?”); intoxication (“About how often in the last 12 months did you drink enough to feel drunk”); consequences of drinking (driving drunk, accident in the home, harmful effect on housework, partner/spouse, friends or relatives complained about drinking, hurt chances of getting a job or promotion, people annoyed you by criticizing your drinking, guilt about drinking, and not remembering things done/said while drinking); and, possible alcohol dependence (drinking fast for quicker effect, morning drinking, inability to stop drinking before intoxication, inability to quit or cut down drinking, and surreptitious drinking).39 Responses were summed and dichotomized for each of the four types of questions (0 = no behaviors, 1 = any behaviors) to create an index of 0-4. Hazardous drinking was dichotomized using a cutoff of 2 or more on the index.40

Binge eating: Binge eating behaviors were assessed at both baseline and at follow-up ten years later with three questions that examined binge eating behavior. Participants were asked “During the past six months, did you often eat within any two-hour period what most people would regard as an unusually large amount of food?” “During the times when you ate this way, did you often feel you couldn’t stop eating or control what or how much you were eating” and “During the past six months, how often, on average, did you have times when you ate this way?” Responding “yes” to both of the first two questions and endorsing at least one occurrence of eating in this way in the past six months led to the participant being identified as exhibiting binge eating behavior.

### Health outcomes

Depression: Depression was assessed at both time-points using the Center for Epidemiologic Studies Depression (CES-D) scale (Cronbach’s alpha = .86).41 The scale has the same reliability for lesbians compared to heterosexuals.42 Depression was coded as a dichotomous variable where any participant with a score of 16 or greater was characterized as reporting depressive symptoms. Depression was also assessed by using the chronic disease diagnosis questions described below.

Chronic condition diagnoses: Chronic disease outcomes were measured in two steps. At baseline the survey assessed any lifetime diagnosis of certain conditions, and participants were coded as having the condition if they endorsed either “Has a doctor or other health care provider ever diagnosed you as having any of the following?” or indicated they were being treated for that condition. At follow-up participants were asked if they had been diagnosed with a condition since their first survey. Participants at follow-up were coded as having the condition if they endorsed one of the following: “Since your participation in ESTHER about ten years ago, has a doctor or other health care provider ever diagnosed you as having any of the following?” or “Are you currently being treated with medication or some other therapy for [condition]?” Following the first question, participants could choose any of the following health conditions: high blood pressure, stroke, heart attack, cancer, cardiovascular disease, chronic obstructive pulmonary disease (COPD), cancer. The second item was asked specifically for each of the previously listed conditions.

Menopause and parity: Menopausal status and parity were only assessed at baseline. Menopause was defined as not having a period within the last 12 months.43 Parity was defined as ever having given birth. Given the mean age of the sample at baseline, the majority of women were assumed to be in menopause at follow-up, and parity was assumed to be the same as at baseline.

C-reactive protein: C-reactive protein (CRP) was assessed only at baseline as funding was not available to obtain blood samples at follow-up. Individuals with CRP levels above 3 mg/L are at higher risk of cardiovascular disease than individuals with CRP levels below 3 mg/L,44-46 therefore we analyzed proportions above and below the cutoff level of 3 mg/L.

## statistical analysis

The final analytic sample was limited to women who completed both the baseline and follow-up surveys. This sample included 483 women, 270 of whom self-identified as lesbian and the remaining 213 identified as heterosexual. Data were analyzed using SAS version 9.4 (SAS Institute, Cary, N.C.). Descriptive statistics were used to assess the entire sample and chi-square tests were used to assess differences between heterosexual and lesbian women. Two-tail t-tests were used to evaluate differences between heterosexual and lesbian women for continuous outcome measures.

# Results

At baseline, ESTHER participants were similar in age; the mean age of lesbian participants was 48.3 (± 7.1) years and the mean age of heterosexual participants was 48.3 (± 7.6) years (*p*=0.96) (Table 1). A much larger proportion of heterosexual respondents (71.8%) than lesbian respondents (24.8%) had given birth (*p*<0.0001). Education levels (*p*=0.21) and menopausal status (*p*=0.54)were similar for both sexual orientation groups. Participants most frequently reported a baseline income of greater than $74,000 per year with 40% of all participants in this category. An additional 22.5% of participants reported income between $40,000 and $59,000 annually at the time of the first survey. The proportion of participants in each income category differed significantly by sexual orientation with a larger proportion of lesbian women than heterosexual women in the top three income categories (*p*=0.04). By the time of the follow-up survey income no longer differed by sexual orientation and the majority of participants reported an annual income of at least $75,000 (*p*=0.59). Similar proportions of lesbian (75.6%) and heterosexual (73.2%) women reported being in committed relationships at baseline (*p*=0.70). When the follow-up survey was administered, relationship status differed significantly by sexual orientation and a larger proportion of lesbian participants described themselves as single compared to heterosexual women (*p*=0.0002).

Table ESTHER Sample Characteristics at Baseline and Follow-up by Sexuality

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Total (N=483)  n (%) | Lesbian (n=270)  n (%) | Heterosexual (n=213)  n (%) | p-value |
| **Baseline**  Age |  |  |  |  |
| 35-39 | 57 (11.8) | 32 (11.9) | 25 (11.7) | 0.97 |
| 40-44 | 106 (22.0) | 59 (21.9) | 47 (22.1) |  |
| 45-49 | 122 (25.3) | 67 (24.8) | 55 (25.8) |  |
| 50-54 | 86 (17.8) | 51 (18.9) | 35 (16.4) |  |
| 55+ | 112 (23.2) | 61 (22.6) | 51 (23.9) |  |
| Race |  |  |  |  |
| White | 459 (95.0) | 262 (97.0) | 197 (92.5) | 0.02\* |
| Black | 24 (5.3) | 8 (3.0) | 16 (7.5) |  |
| Education |  |  |  |  |
| < BS | 138 (28.6) | 71 (26.3) | 67 (31.5) | 0.21 |
| ≥ BS | 345 (71.4) | 199 (73.7) | 146 (68.5) |  |
| Has given birth | 220 (45.6) | 67 (24.8) | 153 (71.8) | <0.0001\* |
| Reached menopause | 285 (59.0) | 156 (55.9) | 129 (60.6) | 0.54 |
| Annual Household Income |  |  |  |  |
| < $25,000 | 46 (9.68) | 21 (7.87) | 25 (12.02) | 0.04\* |
| $25,000 - $39,999 | 75 (15.8) | 38 (14.23) | 37 (17.79) |  |
| $40,000 – $59,999 | 107 (22.5) | 62 (23.2) | 45 (21.6) |  |
| $60,000 – $74,999 | 57 (12.0) | 42 (15.7) | 15 (7.2) |  |
| ≥ 75,000 | 190 (40.0) | 104 (39.0) | 86 (41.2) |  |
| Relationship Status |  |  |  |  |
| Committed | 360 (74.5) | 204 (75.6) | 156 (73.2) | 0.70 |
| Single | 103 (21.3) | 54 (20.0) | 49 (23.0) |  |
| Other | 20 (4.1) | 12 (4.4) | 8 (3.8) |  |
| **Follow-up** |  |  |  |  |
| Annual Household Income |  |  |  |  |
| ≤ $25,000 | 53 (11.6) | 28 (10.9) | 25 (12.4) | 0.59 |
| $25,000 - $39,999 | 42 (9.2) | 21 (8.2) | 21 (10.5) |  |
| $40,000 – $59,999 | 77 (16.8) | 46 (17.9) | 31 (15.4) |  |
| $60,000 – $74,999 | 53 (11.6) | 26 (10.1) | 27 (13.4) |  |
| ≥ 75,000 | 233 (50.9) | 136 (52.9) | 97 (48.3) |  |
| Relationship Status |  |  |  |  |
| Committed | 330 (68.9) | 190 (70.9) | 140 (66.4) | 0.0002\* |
| Single | 86 (18.0) | 57 (21.3) | 29 (13.7) |  |
| Other | 63 (13.2) | 21 (7.8) | 42 (19.9) |  |

\*p<0.05, Proportions differ significantly between categories based on a chi-square test of equal proportions

The lesbian and heterosexual ESTHER participants had similar health outcomes at both baseline and follow-up (Table 2). While the BMI means were similar for the lesbian and heterosexual groups at baseline (mean BMI=28.5 vs. 27.8 respectively, *p*=0.29) and follow-up (mean BMI=28.2 vs. 28.1 respectively, *p*=0.97) rates of obesity differed. At baseline the proportion of lesbian women who were classified as obese was higher than the proportion of heterosexual women who were obese (34.1% vs 25.4%), respectively, *p*=0.03). However, the disparity in obesity was not apparent at the time of the follow-up survey when 31.0% of heterosexual women and 31.1% of lesbian women were classified as obese (*p*=0.24). A significantly higher proportion of lesbian women than heterosexual women had C-reaction protein (CRP) levels higher than 3 mg/L at baseline as 29.7% of lesbian women had CRP levels above the cutoff compared to 21.6% of heterosexual women (*p*=0.049).

Binge eating did not differ by sexual orientation at either baseline or follow-up. Likewise, hazard drinking was not different for lesbian participants compared to heterosexual participants at either time point. The overall rate of hazardous drinking in both groups did decrease from 56.9% of participants at baseline to 13.4% of participants at follow-up. The sexual orientation-specific hazard drinking rates were 54.6% at baseline and 11.5% at follow-up for heterosexual respondents, and 58.8% at baseline and 14.8% at follow-up for lesbian respondents. Lesbian women reported being current smokers at higher rates than heterosexual women at both baseline (11.5% vs. 6.2%, *p*=0.04) and follow-up (8.5% and 3.8%, *p*=0.04).

Similarly, the proportion of lesbian women (42.2%) self-reporting a depression diagnosis at baseline was higher than the proportion of heterosexual women (31.6%) (*p*=0.02). At the time of the follow-up survey, the rates of depression diagnoses had been reduced by at least half for both groups. Again, when the follow-up survey was conducted, there was no significant difference in rates of depression diagnoses between the heterosexual and lesbian groups. At follow-up, 14.4% of heterosexual women reported a depression diagnosis since the first survey compared to 16.5% of lesbian women (*p*=0.53). However, at both survey time points, the proportions of participants above the cutoff indicating depressive symptoms were not different between heterosexual and lesbian participants. At baseline, 4.2% of heterosexual and 7.0% of lesbian participants had CES-D scores of at least 16 (*p*=0.19), and at follow-up 5.4% of heterosexual and 5.9% of lesbian participants had scores of 16 or more (*p*=0.55).

We found no differences between lesbian and heterosexual participants in rates of diagnosis with hypertension, stroke, heart attack, cancer, cardiovascular disease, COPD, or diabetes at either survey time point. With the exception of hypertension, we had very low prevalence for each of these outcomes (Table 2).

Table Health Outcomes for ESTHER Participants at Baseline and Follow-up by Sexuality

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Baseline (2003-2006) | | | | Follow-up (2015-2016) | | | |
|  | Total (N=483) | Lesbian (n=270) | Heterosexual (n=213) | p-value | Total (N=483) | Lesbian (n=270) | Heterosexual (n=213) | p-value |
| BMI, mean (SD)† | 28.19 (7.1) | 28.49 (7.5) | 27.81 (6.5) | 0.29 | 28.15 (6.7) | 28.16 (6.7) | 28.14 (6.62) | 0.97 |
| Obesity, n (%) | 146 (30.2) | 92 (34.1) | 54 (25.4) | 0.03\* | 150 (31.1) | 84 (31.1) | 66 (30.99) | 0.24 |
| CRP > 3 mg/L, n (%) | 118 (26.1) | 74 (29.7) | 44 (21.57) | 0.05\* | --- | --- | --- | --- |
| Binge eating,  n (%) | 54 (11.7) | 25 (9.8) | 29 (13.9) | 0.17 | 35 (7.3) | 20 (7.4) | 15 (7.04) | 0.88 |
| Hazard drinking, n (%) | 230 (56.9) | 130 (58.8) | 100 (54.6) | 0.40 | 63 (13.4) | 39 (14.8) | 24 (11.54) | 0.31 |
| Current smoker, n (%) | 44 (9.2) | 31 (11.5) | 13 (6.2) | 0.04\* | 30 (6.4) | 22 (8.5) | 8 (3.83) | 0.04\* |
| CES-D score ≥ 16, n (%) | 28 (5.8) | 19 (7.0) | 9 (4.2) | 0.19 | 26 (5.4) | 16 (5.9) | 10 (4.7) | 0.55 |
| Ever diagnosed with… n (%) |  |  |  |  |  |  |  |  |
| Hypertension | 84 (17.4) | 48 (17.8) | 36 (16.9) | 0.80 | 141 (29.2) | 80 (29.6) | 61 (28.64) | 0.81 |
| Stroke | 1 (0.2) | 0 (0) | 1 (0.5) | 0.44 | 5 (1.0) | 2 (0.7) | 3 (1.41) | 0.66 |
| Heart attack | 1 (0.2) | 0 (0) | 1 (0.5) | 0.441 | 5 (1.0) | 1 (0.4) | 4 (1.88) | 0.18 |
| Cancer | 35 (7.3) | 15 (5.6) | 20 (9.6) | 0.10 | 63 (13.0) | 38 (14.1) | 25 (11.74) | 0.45 |
| Cardiovascular disease | 19 (3.9) | 11 (4.1) | 8 (3.8) | 0.86 | 21 (4.4) | 11 (4.1) | 10 (4.69) | 0.74 |
| COPD | 21 (4.4) | 12 (4.4) | 9 (4.3) | 0.92 | 15 (3.1) | 7 (2.6) | 8 (3.76) | 0.46 |
| Diabetes | 16 (3.3) | 12 (4.4) | 4 (1.9) | 0.12 | 43 (8.9) | 25 (9.3) | 18 (8.45) | 0.76 |
| Depression | 181 (37.6) | 114 (42.2) | 67 (31.6) | 0.02\* | 73 (15.5) | 43 (16.5) | 30 (14.35) | 0.53 |

Note: BMI is Body Mass Index, CRP is C-reactive protein, CES-D is Center for Epidemiologic Studies Depression scale

\*p<0.05, Proportions differ significantly between categories based on a chi-square test of equal proportions

† Continuous variables were compared using a two-tail t-test

# discussion

ESTHER sought to examine differences in the health of lesbian and heterosexual adult women in the Pittsburgh, PA area. In many areas, the groups had similar outcomes. Mean BMI was not different between the lesbian and heterosexual women at baseline or follow-up, although the proportions of women in each group who were obese did differ at baseline. A significantly larger proportion of lesbian women had C-reactive protein levels above 3 mg/L which is the cutoff above which CRP levels indicate higher risk of cardiovascular disease. This finding agrees with previous literature that has clearly linked higher lifetime stress, psychological disorders, and depression to increased CRP levels.47-49 Binge eating rates were similar in both groups at both survey times. The literature is equivocal about the differing rates of disordered eating in sexual minority women,50-52 however binge eating is the most common form of disordered eating found in lesbian and bisexual women.51,53 At both baseline and follow-up, we found no differences in rates of hazardous drinking between our lesbian and heterosexual participants. This is not consistent with the bulk of literature which finds higher rates of binge drinking among sexual minority women.54,55

In this sample, significantly larger proportions of lesbian women had obesity or depression at the time of the first survey compared to heterosexual women at the same time. When the women were surveyed again roughly 10 years later, there were no significant differences in the proportions of lesbian women who were obese or depressed compared to heterosexual women. To our knowledge, this is the first study to report the resolution of a disparity in obesity rates between lesbian and heterosexual women has been reported. Given that researchers consistently report high rates of obesity in sexual minority women,14,26,53,56-59 this finding is encouraging. Future research is necessary to determine if this finding is replicable in a larger, more-diverse sample. Our data agree in part with Jun et al. who published data from Nurses’ Health Study II and noted lesbian women were more likely than heterosexual women to have an obese-to-overweight weight loss trajectory over more than 15 years.60 However, Jun et al. also reported lesbian women having higher odds of rapid weight gain.60 In a study of more than 120,000 adults in California, Deputy and Boehmer found white and African-American lesbian women were more likely than their same-race heterosexual peers to be overweight at age 18 and were more likely to remain overweight during adulthood.58

To our knowledge, this is also the first study to report the resolution of a disparity in diagnosed depression rates between heterosexual and lesbian adult women. Previous research on depression disparities between lesbian and heterosexual women have sometimes yielded conflicting results,61 but the majority of studies agree lesbian women of all ages have greater risk factors for poor mental health and higher rates of depression compared to their heterosexual peers.62-64 Additional studies have established an inverse relationship between age and prevalence of depression.65 Thus, our findings that both groups of women reported fewer diagnoses of depression ten years after they began the ESTHER study echo previous studies. However, we found no difference in rates of depression at the time of the follow-up survey. Other authors have posited that improvements in legal protections, including the right to marriage, and increased societal acceptance for sexual minority adults may contribute to improving health.66 Therefore, it is possible that the changes in depression disparities may be related to larger social changes that have taken place since the time of the baseline ESTHER survey. Between 2006 when the baseline survey ended and 2015 when the follow-up survey began, monumental shifts in LGBT rights occurred in the United States. These advances include President Obama signing the Matthew Shepard and James Byrd, Jr. Hate Crimes Prevention Act which expanded Federal Hate Crime Law to include crimes motivated by a victim’s gender identity or sexual orientation,67 the repeal of the US military’s “Don’t Ask, Don’t Tell” policy,68 the Obama administration’s decision to no longer support the Defense of Marriage Act (DOMA) and the eventual overturning of DOMA by the US Supreme Court which then established federally recognized rights for gay couples to secure Social Security benefits and family leave,69 and finally the US Supreme Court striking down state bans on same-sex marriage and legalizing marriage between same-sex couples throughout the United States.70

We are also reporting significantly higher smoking rates for lesbian participants than their heterosexual counterparts at both the baseline and follow-up survey. This disparity is consistent with other literature that has demonstrated higher rates of substance use in sexual minority adults.71-73 Both groups demonstrated dramatic decreases in smoking rates from baseline to follow-up, but the decrease was less notable in lesbian respondents. Some authors have suggested this may be due to the relatively low number of smoking cessation programs targeted toward sexual minority individuals.72,73 However, the smoking rates reported here are lower than in many other studies.71-73 This may be due to the relatively high socioeconomic status (SES) of our sample as smoking prevalence decreases as SES increases.74 Future research is necessary to determine if these changes in disparities can be seen in more diverse samples. Additional studies should also consider how disparate smoking rates impact the incidence and prevalence of lung diseases among sexual minority women.

Limitations of the present study include a lack of generalizability due to the convenience sampling design utilized to recruit participants. Participants were drawn from a small geographic area and were highly educated compared to the general population. In our sample, 71.4% of participants reported having a bachelor’s degree or higher compared to 42% of all adults in Pittsburgh.75 There is also an element of selection bias affecting both survey time points, as women who elected to take part in the study may be fundamentally different than women who chose not to participate, although we expect this bias to affect both lesbian and heterosexual participants similarly and thus to be non-differential. There may also be a response bias in the follow-up participants as they may have been healthier or have more stable lives than women who were unable to complete the follow-up survey. Additionally, women who had poorer health may have died between the baseline and follow-up survey.

Our sample also contained few participants of color. African American women have persistently higher rates of risk factors for negative chronic health outcomes compared to women of other races.76-79 The lack of African American women in this sample may mean the overall rates of risk factors and health outcomes may be lower than another study conducted in a more racially diverse sample. Additionally, findings may be impacted by the need to use self-reported weight information from participants at the time of the follow-up survey rather than having research staff independently weigh participants. However, there is no reason to believe that lesbian and heterosexual women self-report their weight differently, therefore the bias would be non-differential and differences between the groups can still be analyzed. It is also important to note that ESTHER excluded women who identified as bisexual, especially because bisexual women have worse health outcomes and greater health disparities than lesbian women.50,80-82

This study presents important longitudinal data on a large sample of women. The nature of the ESTHER study allows us to describe changes in participants’ health over a decade in a population that has often been hard to reach and research. Additionally, ESTHER reached both lesbian and heterosexual-identifying women and therefore provides a direct comparison against which we can measure lesbian women’s health.

The first step to eliminating health inequities is understanding what inequities exist. In this paper, we described the overall health status of lesbian women in Pittsburgh, PA compared to their heterosexual peers. Although the lesbian participants had higher rates of depression and obesity compared to heterosexual participants at baseline, these disparities were no longer present in the follow-up data. Overall, the burden of chronic disease present in our follow-up study did not differ by sexual orientation. This is an important and encouraging finding that the health of lesbian women may be improving relative to previously conducted studies. It is critical for public health to continue to recognize the unique health risks faced by lesbian and sexual minority women so we can protect and improve the wellbeing of this population.

# bibliography

1. Centers for Disease Control and Prevention. Health and Economic Costs of Chronic Diseases. <https://www.cdc.gov/chronicdisease/about/costs/index.htm#ref1>. Published 2018. Accessed November 15, 2018.

2. Buttorf C, Ruder T, Bauman M. *Multiple Chronic Conditions in the United States.* RAND Corporation;2017.

3. Center for Medicare and Medicaid Services. National Health Expenditures 2016 Highlights. In:2017.

4. Hruby A, Manson JE, Qi L, et al. Determinants and consequences of obesity. *Am J Public Health.* 2016;106(9):1656-1662.

5. Sacks JJ, Gonzales KR, Bouchery EE, Tomedi LE, Brewer RD. 2010 National and State Costs of Excessive Alcohol Consumption. *Am J Prev Med.* 2015;49(5):e73-79.

6. U.S. Department of Health and Human Services. The Health Consequences of Smoking: 50 Years of Progress. In: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, eds. Atlanta, GA. 2014.

7. Ling YL, Rascati KL, Pawaskar M. Direct and indirect costs among patients with binge-eating disorder in the United States. *Int J Eat Disord.* 2017;50(5):523-532.

8. Frieden TR. CDC Health Disparities and Inequalities Report - United States, 2013. *MMWR.* 2013;62(3).

9. Brody DJ, Pratt LA, Hughes JP. *Prevalence of depression among adults aged 20 and over: United States, 2013-2016.* 2018.

10. Butnoriene J, Bunevicius A, Saudargiene A, et al. Metabolic syndrome, major depression, generalized anxiety disorder, and ten-year all-cause and cardiovascular mortality in middle aged and elderly patients. *Int J Cardiol.* 2015;190:360-366.

11. Coker TR, Austin SB, Schuster MA. The health and health care of lesbian, gay, and bisexual adolescents. *Annu Rev Public Health.* 2010;31:457-477.

12. Burton CM, Marshal MP, Chisolm DJ, Sucato GS, Friedman MS. Sexual minority-related victimization as a mediator of mental health disparities in sexual minority youth: A longitudinal analysis. *J Youth Adolesc.* 2013;42(3):394-402.

13. Case P, Austin SB, Hunter DJ, et al. Sexual orientation, health risk factors, and physical functioning in the Nurses’ Health Study II. *J Womens Health.* 2004;13(9):1033-1047.

14. Fredriksen-Goldsen K, Hyun-Jun K, Barkan S, Muraco A, Hoy-Ellis C. Health disparities among lesbian, gay, and bisexual older adults: results from a population-based study. *Am J Public Health.* 2013;103(10):1802-1809.

15. Ward BW, Joestl SS, Galinsky AM, Dahlhamer JM. Selected diagnosed chronic conditions by sexual orientation: a national study of US adults, 2013. *Prev Chronic Dis.* 2015;12:e192.

16. Wallace SP, Cochran SD, Durazo EM, Ford CL. The health of aging lesbian, gay and bisexual adults in California. *Policy Brief UCLA Cent Health Policy Res.* 2013;PB2011-12:1-8.

17. Ward BW, Dahlhamer JM, Galinsky AM, Joestl SS. *Sexual orientation and health among U.S. adults: National Health Interview Survey, 2013.* Hyattsville, MD.: National Center for Health Statistics;2014.

18. Fredriksen-Goldsen K. Resilience and disparities among lesbian, gay, bisexual, and transgender older adults. *Public Policy Aging Rep.* 2016;21(3):3-7.

19. Diamant AL, Wold C, Spritzer K, Gelberg L. Health behaviors, health status, and access to and use of health care: a population-based study of lesbian, bisexual, and heterosexual women. *Arch Fam Med.* 2000;9(10):1043-1051.

20. Kerridge BT, Pickering RP, Saha TD, et al. Prevalence, sociodemographic correlates and DSM-5 substance use disorders and other psychiatric disorders among sexual minorities in the United States. *Drug Alcohol Depend.* 2017;170:82-92.

21. McCabe SE, Matthews AK, Lee JGL, Veliz P, Hughes TL, Boyd CJ. Tobacco use and sexual orientation in a national cross-sectional study: age, race/ethnicity, and sexual identity-attraction differences. *Am J Prev Med.* 2018;64(6):736-745.

22. Drope J, Liber AC, Cahn Z, et al. Who’s still smoking? Disparities in adult cigarette smoking prevalence in the United States. *CA Cander J Clin.* 2018;68(2):106-115.

23. Pharr JR, Kachen A, Cross C. Health disparities among sexual gender minority women in the United States: A population-based study. *J Community Health.* 2019;Epub ahead of print.

24. Wood SM, Schott W, Marshal MP, Akers AY. Disparities in body mass index trajectories from adolescence to early adulthood for sexual minority women. *J Adolesc Health.* 2017;61(6):722-728.

25. VanKim NA, Austin SB, Jun HJ, Corliss HL. Dietary patterns during adulthood among lesbians, bisexual, and heterosexual women in the Nurses’ Health Study II. *J Acad Nutr Diet.* 2017;117(3):386-395.

26. VanKim NA, Austin SB, Jun HJ, Corliss HL. Physical activity and sedentary behaviors among lesbian, bisexual, and heterosexual women: findings from the Nurses’ Health Study II. *J Womens Health.* 2017;26(10):1077-1085.

27. Woodford MR, Howell ML, Silverschanz P, Yu L. “That’s so gay!”: Examining the covariates of hearing this expression among gay, lesbian, and bisexual college students. *J Am Coll Health.* 2012;60(6):429-434.

28. Frost DM, Lehavot K, Meyer IH. Minority stress and physical health among sexual minority individuals. *J Behav Med.* 2015;38(1):1-8.

29. Lick DJ, Durso LE, Johnson KL. Minority stress and physical health among sexual minorities. *Perspect Psychol Sci.* 2013;8(5):521-548.

30. Hutchinson MK, Thompson AC, Cederbaum JA. Multisystem factors contributing to disparities in preventive health care among lesbian women. *J Obstet Gynecol Neonatal Nurs.* 2006;35:393-402.

31. Agenor M, Bailey Z, Krieger N, Austin SB, Gottlieb BR. Exploring the cervical cancer screening experiences of black lesbian, bisexual, and queer women: the role of patient-provider communication. *Women Health.* 2015;55(6):717-736.

32. Obedin-Maliver J, Goldsmith ES, Stewart L, et al. Lesbian, gay, bisexual, and transgender-related content in undergraduate medical education. *JAMA.* 2011;306(9):971-977.

33. Coulter RWS, Kenst KS, Bowen DJ, Scout. Research funded by the National Institutes of Health on the health of lesbian, gay, bisexual, and transgender popuations. *Am J Public Health.* 2014;104(2):e105-112.

34. Gates GJ. How many people are lesbian, gay, bisexual and transgender? In: The Williams Insitute; 2011.

35. Smith HA, Matthews A, Markovic N, Youk A, Danielson ME, Talbott EO. A comparative study of complementary and alternative medicine use among heterosexually and lesbian identified women: Data from the ESTHER Project (Pittsburgh, PA, 2003-2006). *J Altern Complement Med.* 2010;16(11):1161-1170.

36. Kinsky S, Stall R, Hawk M, Markovic N. Risk of the metabolic syndrome in sexual minority women: Results from the ESTHER study. *J Womens Health.* 2016;25(8):784-790.

37. Centers for Disease Control and Prevention. About Adult BMI. <http://www.cdc.gov/healthyweight/assessing/bmi/adult_BMI/>. Published 2011. Accessed August 24, 2013.

38. National Heart L, and Blood Institute,. How Are Overweight and Obesity Diagnosed? <http://www.nhlbi.nih.gov/health/health-topics/topics/obe/diagnosis>. Published 2012. Accessed December 9, 2014.

39. Riley BB, Hughes TL, Wilsnack SC, Johnson TP, Benson P, Aranda F. Validating a Hazardous Drinking Index in a Sample of Sexual Minority Women: Reliability, Validity, and Predictive Accuracy. *Subst Use Misuse.* 2017;52(1):43-51.

40. Hughes TL, Johnson TP, Steffen AD, Wilsnack SC, Everett B. Lifetime Victimization, Hazardous Drinking, and Depression Among Heterosexual and Sexual Minority Women. *LGBT Health.* 2014;1(3):192-203.

41. Miller WC, Anton HA, Townson AF. Measurement properties of the CESD scale among individuals with spinal cord injury. *Spinal cord.* 2008;46(4):287-292.

42. Birnholz JL, Young MA. Differential item functioning for lesbians, bisexual, and heterosexual women in the center for epidemiological studies depression scale. *Assessment.* 2012;19(4):502-505.

43. Soules MR, Sherman S, Parrott E, et al. Executive summary: Stages of reproductive aging workshop (STRAW). *Climacteric.* 2001;4(4):267-272.

44. Rifai N. High-sensitivity C-reactive protein: A useful marker for cardiovascular disease risk prediction and the metabolic syndrome. *Clin Chem.* 2005;51(3):504-505.

45. Oda E, Oohara K, Abe A, et al. The optimal cut-off point of C-reactive protein as an optional component of metabolic syndrome in Japan. *Circulation.* 2006;70(4):384-388.

46. Salazar J, Martinez MS, Chavez M, et al. C-reactive protein: Clinical and epidemiological perspectives. *Cardiol Res Pract.* 2014;2014:e1-10.

47. Segman RH, Stein MB. C-Reactive Protein: A Stress Diathesis Marker at the Crossroads of Maladaptive Behavioral and Cardiometabolic Sequelae. *Am J Psyhchiatry.* 2015;172(4):307-309.

48. Michopoulos V, Rothbaum AO, Jovanovic T, et al. Association of CRP genetic variation and CRP level with elevated PTSD symptoms and physiological responses in a civilian population with high levels of trauma. *Am J Psyhchiatry.* 2015;172(4):353-362.

49. Elliot AJ, Mooney CJ, Infurna FJ, Chapman BP. Associations of lifetime trauma and chronic stress with C-reactive protein in adults ages 50 years and older: examining the moderating role of perceived control. *Psychosom Med.* 2017;79(6):622-630.

50. Koh AS, Ross LK. Mental health issues: A comparison of lesbian, bisexual and heterosexual women. *J Homosex.* 2006;51(1):33-57.

51. Heffernan K. Eating disorders and weight concern among lesbians. *Int J Eat DIsord.* 1996;19(2):127-138.

52. Feldman MB, Meyer IH. Eating disorders in diverse lesbian, gay, and bisexual populations. *Int J Eat DIsord.* 2007;40(3):218-226.

53. Boehmer U, Bowen DJ, Bauer GR. Overweight and Obesity in Sexual-Minority Women: Evidence from Population-Based Data. *Am J Public Health.* 2007;97(6):1134-1140.

54. Fish JN, Hughes TL, Russell ST. Sexual identity differences in high-intensity binge drinkings: findings from a US national sample. *Addiction.* 2017;113(4):749-758.

55. Wilsnack SC, Hughes TL, Johnson TP, Bostwick WB, Szalacha LA, Benson P. Drinking and drinking-related problems among heterosexual and sexual minority women. *J Stud Alcohol Drugs.* 2008;69(1):129.

56. Dilley JA, Wynkoop Simmons K, Boysun MJ, Pizacani BA, Stark MJ. Demonstrating the Importance and Feasibility of Including Sexual Orientation in Public Health Surveys: Health Disparities in the Pacific Northwest. *Am J Public Health.* 2010;100(3):460-467.

57. Boehmer U, Bowen DJ. Examining factors linked to overweight and obesity in women of different sexual orientations. *Prev Med.* 2009;48:357-361.

58. Deputy NP, Boehmer U. Weight Status and Sexual Orientation: Differences by Age and Within Racial and Ethnic Subgroups. *Am J Public Health.* 2014;104(1):103-109.

59. Laska MN, VanKim NA, Erickson DJ, Lust K, Eisenberg ME, Rosser SBR. Disparities in Weight and Weight Behaviors by Sexual Orientation in College Students. *Am J Public Health.* 2015;105(1):111-121.

60. Jun HJ, Corliss HL, Nichols LP, Pazaris MJ, Dm S, Austin SB. Adult body mass index trajectories and sexual orientation: the nurses’s health study III. *Am J Prev Med.* 2012;42(4):348-354.

61. Petterson LJ, VanderLaan DP, Persson TJ, Vasey PL. The Relationship Between Indicators of Depression and Anxiety and Sexual Orientation in Canadian Women. *Arch Sex Behav.* 2018;47(4):1173-1182.

62. Kerr DL, Santurri L, Peters P. A Comparison of Lesbian, Bisexual, and Heterosexual College Undergraduate Women on Selected Mental Health Issues. *J Am Coll Health.* 2011;61(4):185-194.

63. Bostwick WB, Boyd CJ, Hughes TL, McCabe SE. Dimensions of Sexual Orientation and the Prevalence of Mood and Anxiety Disorders in the United States. *Am J Public Health.* 2010;100(3):468-475.

64. Gonzales G, Henning-Smith C. Health Disparities by Sexual Orientation: Results and Implications from the Behavioral Risk Factor Surveillance System. *J Community Health.* 2017;42(6):1163-1172.

65. Weinberger AH, Gbedemah M, Martinez AM, Nash D, Galea S, Goodwin RD. Trends in depression prevalence in the USA from 2005 to 2015: widening disparities in vulnerable groups. *Psychol Med.* 2017;48:1308-1315.

66. van Dam MA. Lesbian disclosure, social support, and depression: A geopolitical perspective. *Sex Res Soc Policy.* 2014;11:233-244.

67. Holder EH. The Matthew Shephard and James Byrd, Jr., Hare Crimes Prevention Act of 2009. In: Justice, ed2009.

68. Altmire J. H.R.2965 - Don’t ask, don’t tell repeal act of 2010. In:2009.

69. American Civil Liberties Union. Windsor v. United States. <https://www.aclu.org/cases/lesbian-and-gay-rights/windsor-v-united-states>. Published 2014. Accessed April 17, 2019.

70. Supreme Court of the United States. Obergefell et al. v. Hodges, Director, Ohio Department of Health, et al. In:2015.

71. Johnson SE, Holder-Hayes E, Tessman GK, King BA, Alexander T, Zhao X. Tobacco Product Use Among Sexual Minority Adults: Findings from the 2012-2013 National Adult Tobacco Survey. *Am J Prev Med.* 2016;50(4):e91-e100.

72. Matthews AK, Steffen A, Hughes T, Aranda F, Martin K. Demographic, Healthcare, and Contextual Factors Associated with Smoking Status Among Sexual Minority Women. *LGBT Health.* 2017;4(1):17-23.

73. Matthews AK, Riley BB, Everett B, Hughes TL, Aranda F, Johnson T. A Longitudinal Study of the Correlated of Persistent Smoking Among Sexual Minority Women. *Nicotine Tob Res.* 2014;16(9):1199-1206.

74. Hisock R, Bauld L, Amos A, Fidler JA, M M. Socioeconomic status and smoking: a review. *Ann NY Acad Sci.* 2011;1248(1):107-123.

75. United States Census Bureau. QuickFacts: Pittsburgh city, Pennsylvania; Allegheny County, Pennsylvania. In:2010.

76. Warren-Findlow J. Weathering: Stress and heart disease in African American women living in Chicago. *Qual Health Res.* 2006;16(2):221-237.

77. Office of Minority Health U.S. Department of Health and Human Services. Heart Disease and African Americans. In:2015.

78. National Center for Health Statistics. Health, United States, 2014: With Special Feature on Adults Aged 55-64. In: U.S. Department of Health and Human Services, ed. Hyattsville, MD2015.

79. Williams DR, Mohammed SA, Leavell J, Collins C. Race, socioeconomic status, and health: Complexities, ongoing challenges, and research opportunities. *Ann NY Acad Sci.* 2010;1186(1):69-101.

80. Fredriksen-Goldsen K, Kim HJ, Barkan S, Balsam KF, Mincer SL. Disparities in health-related quality of life: A comparison of lesbians and heterosexual women. *Am J Public Health.* 2010;100(11):2255-2261.

81. Kim HJ, Fredriksen-Goldsen K. Hispanic lesbians and bisexual women at heightened risk or health disparities. *Am J Public Health.* 2012;102(1):e9-15.

82. Lambe J, Cerezo A, O’Shaughnessy T. Minority stress, community involvement, and mental health among bisexual women. *Psychol Sex Orientat Gend Divers.* 2017;4(2):218-226.