

Disparities in Chronic Health Outcomes and Health Behaviors Between Lesbian and Heterosexual Adult Women in Pittsburgh: A Longitudinal Study

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Abstract

Background: Compared to heterosexual women, lesbian women experience higher rates of many chronic diseases, including depression, obesity, hypertension, and diabetes. 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.

Methods: A total of 1,084 women were initially recruited from Pittsburgh, PA to participate in the Epidemiologic Study of HEalth Risk in Women (ESTHER) study and completed a baseline survey between 2003 and 2006. In 2015 or 2016, $N=483$ women, 270 of whom were lesbian, completed a follow-up survey. Participants completed a questionnaire at both baseline and follow-up and completed a clinic visit for the baseline study to provide biometric data.

Results: At baseline, lesbian participants reported higher rates of obesity ($p=0.03$), depression ($p=0.02$), and smoking ($p=0.04$). Lesbian participants had elevated measured C-reactive protein levels ($p=0.05$). By the time of the follow-up survey 10 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. We found no differences in any other outcomes of interest.

Conclusions: 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.

Keywords: women's health, sexual orientation, heterosexual women, lesbian women, health behavior

Background

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 U.S. adults reported having multiple chronic health conditions, but this percentage rises to 50% of adults ages 45–64.² The most commonly reported chronic condi-

tions are hypertension, dyslipidemia, and mood disorders, including depression.² Worldwide, rising rates of overweight and obesity continue to be causes of concern as obesity is strongly associated with increased risk for type 2 diabetes and cardiovascular disease.⁴

The burden of chronic disease disproportionately affects some groups in the United States. For example, non-Hispanic Black adults are more likely to die from heart disease or stroke prematurely than non-Hispanic white adults,⁵ and

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individuals with low levels of education are at higher risk for obesity compared to their more highly educated counterparts.⁵ Women are nearly twice as likely as men to have depression,⁶ and depression has been further linked to an increased risk of all-cause and cardiovascular disease-related mortality in women.⁷

Lesbian women, or women with exclusive romantic/sexual attraction to and/or relationships with other 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, and report more depressive symptoms and suicidality than heterosexual youth.⁸ In addition, 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 becoming more obese than their heterosexual counterparts.^{9,10}

Throughout the life course, sexual minority women develop higher rates of preventable chronic diseases, including hypertension and diabetes.^{11–13} However, Nurses' Health Study II, which included almost 100,000 women, found no difference in physical activity or diet by sexual orientation.^{14,15} Another recently published large-scale study reported that 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.¹⁶ Sexual minority women are also less likely to receive preventive care, including screening for breast and cervical cancer.¹⁶

In adulthood, sexual minority women have higher rates of frequently poor mental health, and as older adults sexual minority women report higher rates of mental distress, depression, and disability than heterosexual adults.^{12,17–19} In addition, several studies have reported higher rates of risky health behaviors or lack of preventive measures in lesbian women compared to heterosexual women. 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.^{11,13,18,20–23}

The bulk of this research on lesbian health disparities is cross-sectional in nature and often characterizes health-related behaviors and substance use. 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 10 years apart and to characterize any health disparities and changes in those disparities over time to address this gap. We hypothesized that lesbian women would report higher rates of harmful health behaviors and higher rates of poor health outcomes. In addition, we hypothesized that disparities present in the baseline survey would be present in the follow-up survey data.

Methods

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 (T1) survey, conducted between 2003 and 2006, participants were recruited through newspaper and radio advertisements, com-

munity health events, LGBT events, and the University of Pittsburgh broadcast phone-message system. A total of 1,084 women were recruited; approximately half were lesbian. 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. To account for the disproportionate number of older heterosexuals compared to lesbians, women over age 65 were excluded for analysis. The final T1 sample consisted of 479 lesbian and 400 heterosexual women.

In 2015–2016, participants were contacted by mail to complete a short follow-up (T2) 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 T2 sample of 270 lesbian and 213 heterosexual women. Approximately similar proportions of lesbian and heterosexual women completed the T2 survey, with 56.3% of lesbian women and 53.3% of heterosexual women completing T2.

At T1, participants' weight, height, and blood pressure were measured using standardized protocols and they provided a blood sample to measure data, including fasting glucose, cholesterol, triglycerides, and C-reactive protein (CRP). They also completed a battery of written questionnaires that assessed a number of psychosocial and demographic variables, current and past medical conditions and treatment history, a physical activity interview, and a 2-week medicine history. Lesbian participants completed a series of questions related to their coming out experiences. Participants were offered a \$50 incentive for their time.

At T2, participants self-reported medical conditions and treatment history, weight and waist circumference, and physical activity limitations. They also provided data on psychosocial and demographic variables. The research was approved by the University of Pittsburgh Institutional Review Board (approval number 0404147).

Measures

Sexual orientation. Women were classified as lesbian at T1 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 5 years or having only or primarily female sexual partners in the past 5 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 as sexual partners in the past 5 years were excluded from the original study. For the purposes of this analysis, sexual orientation was defined as what the participant reported at T1. Sexual orientation was a dichotomous variable. Only cis-gender women were included in this analysis.

Race. Participants reported their race at T1 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 T1 analytic sample due to small numbers ($n=32$), race was recoded into a dichotomous variable (White/Black).

Ethnicity. Participants were asked if they were of Hispanic/Latino ethnicity. Due to the extremely low number of Hispanic/Latino respondents, this group was excluded from analysis.

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

Education. Education was assessed using a 5-point scale and collapsed to be a dichotomous variable indicating educational attainment less than a bachelor's degree or completion of a bachelor's degree or higher level of education.

Relationship status. Because marriage was not legal for lesbian participants at the time, relationship status at T1 was instead self-reported as in a committed relationship, single, or other. There were additional options at T2, which were: married, committed, divorced, widowed, separated, single, and other. To make categories congruent at T1 and T2, married and committed were collapsed into "committed." Other, divorced, widowed, and separated were collapsed into "other."

Body mass index. Height and weight were measured by a standardized research protocol at the T1 clinic visit. Body mass index (BMI) was categorized using the formula $\text{weight (lb)}/[\text{height (in)}]^2 \times 703$.²⁴ 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 =obese²⁵ and created dummy variables. At T2, participants self-reported weight. BMI was calculated using height at T1 and self-reported weight at T2.

Current smoking. Current smoking was assessed at both T1 and T2. Respondents who answered "yes" to "Do you currently smoke cigarettes" were coded as current smokers. Those who smoked previously but not currently were 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). Responses were summed and dichotomized for each of the four types of questions (0=no behaviors, 1=any behavior) to create an index of 0–4. Hazardous drinking was dichotomized using a cutoff of two or more on the index.²⁶

Binge eating. Binge eating behaviors were assessed at both T1 and T2 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?" Endorsing both of the first two questions led to the participant being identified as exhibiting binge eating behavior.

Depression. Depression was assessed at both time points using the Center for Epidemiologic Studies Depression (CES-D) scale (Cronbach's alpha=0.86).²⁷ The scale has the same reliability for lesbians compared to heterosexuals.²⁸ Depression was coded as a dichotomous variable where any participant with a score of 16 or greater was coded as reporting depressive symptoms. Depression was also assessed using the chronic disease diagnosis questions described below.

Chronic condition diagnoses. Chronic disease outcomes were measured in two steps.

At T1 the survey assessed any lifetime diagnosis of certain conditions, and participants were coded as having the condition if they endorsed one of the following: "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]?"

At T2 participants were asked if they had been diagnosed with a condition since their first survey. Participants at T2 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), and 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 T1. Menopause was defined as not having a period within the last 12 months.²⁹ Parity was defined as ever having given birth. Given the mean age of the sample at T1, the majority of women were assumed to be in menopause at T2, and parity was assumed to be the same as at T1.

C-reactive protein. CRP was assessed only at T1 as funding was not available to obtain blood samples at T2. Individuals with CRP levels above 3 mg/L are at higher risk of cardiovascular disease than individuals with CRP levels below 3 mg/L^{30–32}; therefore, we analyzed proportions above and below the cutoff level of 3 mg/L.

Analysis

The final analytic sample was limited to women who completed both the T1 and T2 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, NC). Descriptive statistics was used to assess the entire sample, and chi-square tests were used to assess differences between heterosexual and lesbian women. Two-tailed *t*-tests were used to evaluate differences between heterosexual and lesbian women for continuous outcome measures. A nonresponse analysis, including chi-square tests and two-tailed *t*-tests, was conducted to compare the outcomes of women who responded only to the T1 survey to the outcomes of women who responded to both T1 and T2 surveys.

Results

At T1, 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 T1 income of greater than \$75,000 per year with 40% of all participants in this category. An additional 22.5% of participants at T1 reported income between \$40,000 and \$59,000 annually. 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 ($p=0.04$).

In the T2 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 T1 ($p=0.70$). When the T2 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 ($p=0.0002$).

Lesbian and heterosexual ESTHER participants had similar health outcomes at both T1 and T2 (Table 2). BMI means

TABLE 1. ESTHER SAMPLE CHARACTERISTICS AT BASELINE AND FOLLOW-UP BY SEXUAL ORIENTATION

	Total (N=483), n (%)	Heterosexual (n=213), n (%)	Lesbian (n=270), n (%)	p
Baseline				
Age				
35–39	57 (11.8)	25 (11.7)	32 (11.9)	0.97
40–44	106 (22.0)	47 (22.1)	59 (21.9)	
45–49	122 (25.3)	55 (25.8)	67 (24.8)	
50–54	86 (17.8)	35 (16.4)	51 (18.9)	
55–65	112 (23.2)	51 (23.9)	61 (22.6)	
Race				
White	459 (95.0)	197 (92.5)	262 (97.0)	0.02 ^a
Black	24 (5.3)	16 (7.5)	8 (3.0)	
Education				
<Bachelor's	138 (28.6)	67 (31.5)	71 (26.3)	0.21
≥Bachelor's	345 (71.4)	146 (68.5)	199 (73.7)	
Has given birth	220 (45.6)	153 (71.8)	67 (24.8)	<0.0001 ^a
Reached menopause	285 (59.0)	129 (60.6)	156 (55.9)	0.54
Annual household income				
<\$25,000	46 (9.68)	25 (12.02)	21 (7.87)	0.04 ^a
\$25,000–\$39,999	75 (15.8)	37 (17.79)	38 (14.23)	
\$40,000–\$59,999	107 (22.5)	45 (21.6)	62 (23.2)	
\$60,000–\$74,999	57 (12.0)	15 (7.2)	42 (15.7)	
≥75,000	190 (40.0)	86 (41.2)	104 (39.0)	
Relationship status				
Committed	360 (74.5)	156 (73.2)	204 (75.6)	0.70
Single	103 (21.3)	49 (23.0)	54 (20.0)	
Other	20 (4.1)	8 (3.8)	12 (4.4)	
Follow-up				
Annual household income				
<\$25,000	53 (11.6)	25 (12.4)	28 (10.9)	0.59
\$25,000–\$39,999	42 (9.2)	21 (10.5)	21 (8.2)	
\$40,000–\$59,999	77 (16.8)	31 (15.4)	46 (17.9)	
\$60,000–\$74,999	53 (11.6)	27 (13.4)	26 (10.1)	
≥75,000	233 (50.9)	97 (48.3)	136 (52.9)	
Relationship status				
Committed	330 (68.9)	140 (66.4)	190 (70.9)	0.0002 ^a
Single	86 (18.0)	29 (13.7)	57 (21.3)	
Other	63 (13.2)	42 (19.9)	21 (7.8)	

^a $p<0.05$, proportions differ significantly between categories based on a chi-square test of equal proportions ($p<0.05$). ESTHER, Epidemiologic Study of HEalth Risk in women.

were similar for the lesbian and heterosexual groups at T1 (mean BMI=28.5 vs. 27.8, respectively, $p=0.29$) and T2 (mean BMI=28.2 vs. 28.1, respectively, $p=0.97$); however at T1, a higher proportion of lesbian women were classified as obese compared to heterosexual women (34.1% vs. 25.4%) ($p=0.03$). At the time of the T2 survey there were no differences in obesity rates between heterosexual women (31.0%) and lesbian women (31.1%) ($p=0.24$). At T1, a significantly higher proportion of lesbian women (29.7%) than heterosexual women (21.6%) had measured CRP levels above 3 mg/L ($p=0.049$).

Binge eating did not differ by sexual orientation at either T1 or T2. Likewise, hazardous drinking was not different for lesbian participants compared to heterosexual participants. The overall rate of hazardous drinking did decrease from 56.9% of participants at T1 to 13.4% of participants at T2. Lesbian women reported being current smokers at higher rates than heterosexual women at both T1 (11.5% vs. 6.2%, $p=0.04$) and T2 (8.5% and 3.8%, $p=0.04$).

Similarly, the proportion of lesbian women (42.2%) self-reporting a depression diagnosis at T1 was higher than the proportion of heterosexual women (31.6%) ($p=0.02$). At T2, the rates of depression diagnoses had been reduced by at least half for both groups, and there was no significant difference in rates of depression diagnoses between the heterosexual (14.4%) and lesbian (16.5%) groups ($p=0.53$). However, in both T1 and T2 surveys, the proportions of participants above the CES-D cutoff indicating depressive symptoms were not different between heterosexual and lesbian participants. At T1, 4.2% of heterosexual and 7.0% of lesbian participants had CES-D scores of at least 16 ($p=0.19$), and at T2 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).

Our nonresponse analysis found some notable differences between participants who responded to only the T1 survey, and were thus excluded from the overall analysis, and participants who responded to both T1 and T2 surveys. Compared to respondents, a higher proportion of nonrespondents were younger ($p=0.0015$), lower income ($p<0.0001$), Black ($p=0.0003$), had less than a bachelor's degree ($p<0.0001$), menopausal ($p=0.032$), obese ($p<0.0001$), smokers ($p=0.024$), diagnosed with depression ($p=0.025$), and had a CRP level above 3 mg/L ($p=0.0054$). There were no differences in response rates when we compared participants who demonstrated hazardous drinking behavior ($p=0.81$), binge eating ($p=0.053$), or had ever been diagnosed with cancer ($p=0.74$), hypertension ($p=0.41$), heart attack ($p=0.37$), heart disease ($p=0.17$), emphysema ($p=0.61$), or diabetes ($p=0.34$). Lesbian and heterosexual participants responded to the T2 survey at an equal rate ($p=0.35$).

Discussion

ESTHER sought to examine differences in the health of lesbian and heterosexual adult women in the Pittsburgh, PA

TABLE 2. HEALTH OUTCOMES FOR ESTHER PARTICIPANTS AT BASELINE AND FOLLOW-UP BY SEXUAL ORIENTATION

	Baseline (2003–2006)				Follow-up (2015–2016)			
	Total (N=483)	Heterosexual (n=213)	Lesbian (n=270)	p	Total (N=483)	Heterosexual (n=213)	Lesbian (n=270)	p
BMI, mean (SD) ^a	28.19 (7.1)	27.81 (6.5)	28.49 (7.5)	0.29	28.15 (6.7)	28.14 (6.6)	28.16 (6.7)	0.97
Obesity, n (%)	146 (30.2)	54 (25.4)	92 (34.1)	0.03 ^b	150 (31.1)	66 (31.0)	84 (31.1)	0.24
CRP >3 mg/L, n (%)	118 (26.1)	44 (21.6)	74 (29.7)	0.05 ^b	—	—	—	—
Binge eating, n (%)	54 (11.7)	29 (13.9)	25 (9.8)	0.17	35 (7.3)	15 (7.04)	20 (7.4)	0.88
Hazardous drinking, n (%)	230 (56.9)	100 (54.6)	130 (58.8)	0.40	63 (13.4)	24 (11.5)	39 (14.8)	0.31
Current smoker, n (%)	44 (9.2)	13 (6.2)	31 (11.5)	0.04 ^b	30 (6.4)	8 (3.8)	22 (8.5)	0.04 ^b
Depression CES-D score, mean (SD) ^a	5.86 (4.9)	5.45 (4.5)	6.19 (5.2)	0.09	5.49 (5.0)	5.54 (4.7)	5.45 (5.1)	0.85
Ever diagnosed with... n (%)								
Hypertension	84 (17.4)	36 (16.9)	48 (17.8)	0.80	141 (29.2)	61 (28.6)	80 (29.6)	0.81
Stroke	1 (0.2)	1 (0.5)	0 (0)	0.44	5 (1.0)	3 (1.4)	2 (0.7)	0.66
Heart attack	1 (0.2)	1 (0.5)	0 (0)	0.441	5 (1.0)	4 (1.9)	1 (0.4)	0.18
Cancer	35 (7.3)	20 (9.6)	15 (5.6)	0.10	63 (13.0)	25 (11.7)	38 (14.1)	0.45
Cardiovascular disease	19 (3.9)	8 (3.8)	11 (4.1)	0.86	21 (4.4)	10 (4.7)	11 (4.1)	0.74
COPD	21 (4.4)	9 (4.3)	12 (4.4)	0.92	15 (3.1)	8 (3.8)	7 (2.6)	0.46
Diabetes	16 (3.3)	4 (1.9)	12 (4.4)	0.12	43 (8.9)	18 (8.5)	25 (9.3)	0.76
Depression	181 (37.6)	67 (31.6)	114 (42.2)	0.02 ^b	73 (15.5)	30 (14.4)	43 (16.5)	0.53

^aContinuous variables were compared using a two-tailed *t*-test

^b $p<0.05$, proportions differ significantly between categories based on a chi-square test of equal proportions ($p<0.05$).

BMI, body mass index; CES-D, Center for Epidemiologic Studies Depression; COPD, chronic obstructive pulmonary disease; CRP, C-reactive protein.

area. In many areas, the groups had similar outcomes. The demographic differences of note were in education levels and income level. At T1, the lesbian participants had attained higher levels of education than heterosexual participants, although the difference was not significant, and a larger proportion of lesbian participants belonged to the highest income categories. However, at T2 there were no longer significant differences in income between the groups. The T1 differences and subsequent equalization in income may be due to loss of income as a result of time away from work for childbearing and rearing followed by a return to the workforce and recovery of lost income.

Mean BMI was not different between the lesbian and heterosexual women at T1 or T2, although the proportions of women in each group who were obese did differ at T1. A significantly higher proportion of lesbian women had CRP 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.^{33–35}

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^{36–38}; however, binge eating is the most common form of disordered eating found in lesbian and bisexual women.^{37,39} At both T1 and T2, 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.^{40,41} Hazardous drinking is consistently reported to decline with age; therefore, the dramatic decline in hazardous drinking demonstrated here may be at least partially attributable to our aging sample.¹

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 which had been reported. However, we acknowledge that some of the reason this gap closed is due to an increase in obesity among heterosexual participants from a 25.4% obesity rate at baseline to a 31.0% obesity rate at follow-up. It remains important that the obesity rate among lesbian participants decreased over the time our study was conducted.

Given that researchers consistently report high rates of obesity in sexual minority women,^{12,15,39,42–45} 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 that lesbian women were more likely than heterosexual women to have an obese-to-overweight weight loss trajectory over >15 years.⁴⁶ However, Jun et al. also reported that lesbian women having higher odds of rapid weight gain.⁴⁶ In a study of >120,000 adults in California, Deputy and Boehmer found that 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.⁴⁴

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,⁴⁷ but the majority of studies agree that lesbian women of all ages have greater risk factors for poor mental health and higher rates of depression compared to their heterosexual peers.^{48–50} Additional studies have established an inverse relationship between age and prevalence of depression.⁵¹ Thus, our findings that both groups of women reported fewer diagnoses of depression 10 years after they began the ESTHER study echo previous studies. However, we found no difference in rates of depression at the time of the T2 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.⁵² 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 T1 survey ended and 2015 when the T2 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,⁵³ the repeal of the U.S. military's "Don't Ask, Don't Tell" policy,⁵⁴ the Obama administration's decision to no longer support the Defense of Marriage Act (DOMA), and the eventual overturning of DOMA by the U.S. Supreme Court, which then established federally recognized rights for gay couples to secure Social Security benefits and family leave,⁵⁵ and finally the U.S. Supreme Court striking down state bans on same-sex marriage and legalizing marriage between same-sex couples throughout the United States.⁵⁶

We are also reporting significantly higher smoking rates for lesbian participants than their heterosexual counterparts at both the T1 and T2 survey times. This disparity is consistent with other literature that has demonstrated higher rates of substance use in sexual minority adults.^{57–59} However, the smoking rates reported here are lower than in many other studies.^{57–59} This may be due to the relatively high socioeconomic status (SES) of our sample as smoking prevalence decreases as SES increases.⁶⁰ 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.⁶¹ 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 nondifferential.

Given the higher rates of loss to follow-up among participants with lower SES and higher rates of obesity, elevated CRP, smoking, and depression, it seems likely that our sample may be healthier than the community the sample is meant to represent, particularly given that a number of non-respondents died between T1 and T2. Had those women participated in the T2 survey, our results likely would have shown higher rates of obesity, depression, and smoking-related conditions than we found. Although we did not observe any differences in response bias between lesbians and heterosexuals, we did observe higher loss to follow-up among low SES respondents and participants with lower levels of education. It is plausible that individuals at both ends of the SES spectrum were more transient, making it difficult for us to reach them at T2.

The high SES of the lesbian participants could also indicate high social connectedness among higher SES lesbians, a group captured in our convenience sample. Thus, it is possible that our lesbian participants demonstrated increased resilience and better health outcomes due, in part, to increased income, stable employment, and high education levels. This may be particularly important as this group may be able to risk disclosing their sexual identity more safely than lesbian women of color or than lesbian women with lower levels of education and income who would have been risking housing and employment by disclosing their sexual orientation.

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.^{62–65} The lack of African American women in this sample, and the increased rate of loss to follow-up among these women, may mean that the overall rates of risk factors and health outcomes may be lower than another study conducted in a more racially diverse sample.

In addition, findings may be impacted by the need to use self-reported weight information from participants at the time of the T2 survey rather than having research staff independently weigh participants. However, there is no reason to believe that lesbian and heterosexual women report their weight differently; therefore, the bias would be nondifferential 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 are consistently reported to have worse health outcomes and greater health disparities than lesbian women.^{36,66–68} Finally, this analysis was based on how participants identified their sexual orientation in the T1 survey. However, the T1 questionnaire asked about sexual attraction and behavior over the last 5 years, which aimed to limit the original study sample to respondents with more stable sexual orientations. One research study into sexual orientation identity in adults found that slightly >2% of adults reported a shift in sexual identity over a 10 year span.⁶⁹ Future analyses should examine any health disparities in women whose sexual orientation shifts over time versus remains stable.

Conclusions

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. In

addition, ESTHER reached both lesbian and heterosexual-identifying women and therefore provides a direct comparison against which we can measure lesbian women's health. To our knowledge, this is the first study to report a resolution in obesity or depression disparities between lesbian and heterosexual women. In addition, we found no differences in many chronic health outcomes between lesbian and heterosexual participants. Understanding and noting these nondifferences are important to fully understanding lesbian women's health. 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.

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