



## Trends in mental health and smoking disparities between sexual minority and heterosexual adults in Canada, 2003–2020

Travis Salway<sup>a,b,c,\*</sup>, Jorge Andrés Delgado-Ron<sup>a,b</sup>, Ashleigh J. Rich<sup>b,d</sup>, Christoffer Dharma<sup>e</sup>, Laura Baams<sup>f</sup>, Jessica Fish<sup>g,h</sup>

<sup>a</sup> Faculty of Health Sciences, Simon Fraser University, Blusson Hall, Room 11300-8888 University Drive, Burnaby, BC, V5A 1S6, Canada

<sup>b</sup> Centre for Gender and Sexual Health Equity, 1190 Hornby St. (11th floor), Vancouver, BC, V6Z 2K5, Canada

<sup>c</sup> British Columbia Centre for Disease Control, 655 W 12th Ave, Vancouver, BC, V5Z 4R4, Canada

<sup>d</sup> Department of Social Medicine, University of North Carolina, Chapel Hill, NC, 27599-7240, United States

<sup>e</sup> Dalla Lana School of Public Health, University of Toronto, 155 college street, 6th floor, Toronto, ON, M5T 3M7, Canada

<sup>f</sup> Department of Pedagogy and Educational Sciences, University of Groningen, 9712 CP, Groningen, Netherlands

<sup>g</sup> Department of Family Science, University of Maryland, 1142 School of Public Health, 2242 Valley Dr, College Park, MD, 20742, United States

<sup>h</sup> University of Maryland Prevention Research Center, Building #255, Rm. 2302, 4200 Valley Drive, Room 1242L, College Park, MD, 20742-2611, United States

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### ABSTRACT

Sexual minority populations experience a higher burden of mental health and substance use/misuse conditions than heterosexual comparators—a health inequality that has predominantly been attributed to forms of minority stress experienced by the former group. Sexual minority-affirming legislative and policy advances, as well as improvements in social attitudes toward sexual minorities in recent decades, should presumably reduce experiences of minority stress, thereby attenuating these disparities. We conducted temporal trend analyses of annual prevalence of anxiety, depression, poor self-rated mental health, and cigarette smoking, stratified by sexual orientation and gender/sex subgroups using the Canadian Community Health Survey, 2003–2020. Descriptive analyses were used to display temporal trends; joinpoint regression was used to identify significant changes in prevalence data during 2003–2020; and prevalence ratios were estimated by year to detect any reduction in disparities. The prevalence of self-rated mental health and mood and anxiety disorders increased, whereas the prevalence of smoking decreased, between 2003 and 2020, among both sexual minority and heterosexual people in Canada. We observed a significant inflection point in 2009 in the self-rated mental health trend among bisexual women, where rates of poor mental health initially decreased from 2003 but then increased drastically from 2009 to 2020. Significant inflection points in current smoking trends were observed in 2012 among bisexual and heterosexual women and in 2013 among heterosexual men; in all three groups, both segments demonstrated decreasing trends, however, the slope of the trend became more pronounced in the latter period. Consistent with other North American studies, we found that relative differences between sexual minority and heterosexual groups for all four outcomes remained the same or increased during this 18-year period. Findings highlight the need to better understand mechanisms bolstering sexual orientation health disparities.

### 1. Introduction

Multiple meta-analyses have demonstrated persistent disparities in mental health conditions and substance use between sexual minority (i. e., bisexual, lesbian, gay, or otherwise sexually oriented to the same or multiple genders/sexes) and heterosexual populations (Ross et al., 2018; Salway et al., 2019; Shokoohi et al., 2020). The prevalence of anxiety and mood disorders—the most common mental health conditions—is

1.5–4 times greater among sexual minority people than among heterosexual people, with important variation by sexual orientation subgroups (Ross et al., 2018). Use and misuse of various substances follows similar patterns. For example, cigarette smoking is 1.5–2 times more prevalent among sexual minority people than among heterosexual comparators (Shokoohi et al., 2020). The causal mechanisms of these disparities are matters of ongoing inquiry, though evidence increasingly points to minority stress-related pathways (Brooks, 1981; Meyer, 2003)—which

\* Corresponding author. Faculty of Health Sciences, Simon Fraser University, Blusson Hall, Room 11300, 8888 University Drive, Burnaby, BC, V5A 1S6, Canada.  
E-mail address: [travis\\_salway@sfu.ca](mailto:travis_salway@sfu.ca) (T. Salway).

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affect attendant psychological processes like rumination and hopelessness (Hatzenbuehler, 2009)—as well as structural disadvantages like reduced social opportunities or material resources (e.g., income) to buffer against minority and more general stressors (Bränström et al., 2019). In mediational frameworks, anxiety, depression, and substance use (including regular cigarette smoking) have all been conceived as psychopathological outcomes of minority stress, the latter constituting behavioral adaptations to chronic stress (Hatzenbuehler, 2009).

Most of the empirical disparity research included in these meta-analyses was conducted between 1990 and 2020, a period during which sexual minority-related policies and social attitudes were shifting (National Academies of Sciences, 2020). For example, in Canada, legislative protections for sexual minorities—including protections against discrimination and hate speech, and protections of the rights to marry and adopt—expanded dramatically between 1996 and 2012 (ILGA World, 2024). Assuming that these shifts in markers of structural stigma reflect improvements in overall social climates (i.e., resulting in greater affirmation and resources for sexual minorities), we may anticipate a corresponding temporal reduction in mental health and substance use disparities (Krieger, 2020). Such improvements are predicted by minority stress theory through the mechanisms of reductions in structural stigma (e.g., repealing harmful policies) and provision of social and institutional supports, in turn diminishing the frequency and severity of psychologically distressing experiences of discrimination, rejection, exclusion, and violence (Hatzenbuehler, 2016).

A growing number of temporal trend studies of sexual orientation health disparities have been conducted to-date using population-based serial survey data in the US and Canada. These analyses have been enabled by the addition of sexual orientation measures in recent decades, thereby allowing sufficient observation time to detect population-level changes. Most of these studies have focused on youth, with surveys such as the British Columbia Adolescent Health Survey and the Youth Risk Behavior Survey, which added sexual orientation measures in the late 1990s and mid-2000s, respectively (Fish & Baams, 2018; Fish et al., 2017). Collectively, these studies exhibit few sustained decreases, and in some cases increases, in sexual orientation disparities for alcohol use (1998–2013, BC; 2007–2015, US), smoking (1998–2013, BC; 1999–2013, Massachusetts), and suicide-related outcomes (1998–2018, BC; 2009–2017, US; 1995–2017, Massachusetts) (Fish & Baams, 2018; Fish et al., 2017, 2019; Liu et al., 2020; Peter et al., 2017; Polonijo et al., 2022; Raifman et al., 2020; Stuart-Maver et al., 2021; Watson et al., 2018). A smaller number of US studies have examined trends in sexual minority adults and likewise have found no evidence of sustained reductions in disparities for recreational drug use (2000–2015), binge drinking (2000–2015), and smoking (2000–2015) (Drabble et al., 2021; Max et al., 2016; Paschen-Wolff et al., 2019). Notwithstanding the lack of reduction in sexual orientation disparities, absolute temporal decreases have been observed in prevalence of smoking and some other forms of substance use for all sexual orientation subgroups, suggesting that improvements in the epidemiology of some mental health and substance use outcomes have not been large enough to redress the inequity sexual minorities have experienced (Drabble et al., 2021; Fish et al., 2017). Importantly, some of the observed increasing disparities were specific to sexual orientation (i.e., bisexual, lesbian/gay) and gender/sex subgroups, highlighting the importance of disaggregating trends across these strata. For example, in one study, the disparities in suicide ideation and attempt increased significantly for bisexual girls but not for other sexual orientation and gender/sex-stratified subgroups (Peter et al., 2017).

In the present article, we build upon this literature by presenting the first temporal trend analysis of adult sexual orientation disparities in anxiety, depression, poor self-rated mental health, and cigarette smoking using the Canadian Community Health Survey, 2003–2020. These outcomes are four of the most studied psychological and behavioral disparities affecting sexual minorities, with cigarette smoking constituting an additional indicator of underlying psychological distress; in

other words, smoking is conceptualized as both a parallel effect of minority stress as well as a potential coping strategy for sexual minorities experiencing anxiety or depression (also referred to as a ‘self-medication model’ of smoking) (Fluharty et al., 2017). Considering the potential for plurisexual/monosexual and gender/sex-specific differences, we additionally examine trends across six sexual orientation and gender/sex-stratified subgroups. Finally, we apply joinpoint regression models to inductively identify segmented or changing trends across the 18 years of study. Our overarching goal is to contribute to the growing literature regarding trends in sexual orientation health disparities and to continue to motivate improvements in social and structural conditions for sexual minorities if inequitable gaps in health are not closing in Canada. This study specifically addresses gaps in existing sexual orientation disparity trend research with regard to adult data, data representing Canada (nationally), and data with anxiety and depression outcome measures.

## 2. Methods

### 2.1. Sample

We used data from the Canadian Community Health Survey (CCHS) obtained via the Statistics Canada Research Data Centre at Simon Fraser University. CCHS employs a complex survey design to gather periodic health-related data from nationally representative samples of people in Canada (Béland, 2002). Data were collected by telephone or in person through a trained interviewer supported by computer-assisted interviewing (Béland, 2002). We used the annual files for 2003 (when CCHS first collected data on sexual identity) and 2005 (initially, the survey was administered every other year), and two-year files from 2007–2008 onwards until 2019–2020 (during which time the survey was administered on an annual basis). As all two-year files provided master and replicate weights averaged to the population for both years, we duplicated them to obtain annual estimates. We included participants who were asked about sexual orientation throughout the study period (i.e., adults ages 19 to 59) and who provided valid answers for all outcomes. ‘Refusal,’ ‘Don’t know,’ or ‘Not stated’ responses were not considered valid. Non-response to the sexual orientation question in CCHS is low (approximately 3.7%, with some variation by cycle); therefore, these participants were excluded (Brabete et al., 2020).

### 2.2. Measures

In the CCHS survey *sexual orientation* was captured with the item, “Do you consider yourself to be ... heterosexual, homosexual, or bisexual?” The wording of the survey item was similar for most years; however, in 2019 and 2020, “bisexual” changed to “bisexual or pansexual,” and “sexual orientation, not elsewhere classified” was added. For the current analysis, the former was coded as bisexual and the latter as missing data. For analyses in which sexual minorities were compared to heterosexuals, we grouped bisexuals and homosexuals as ‘sexual minorities.’ The interviewer assigned binary *gender/sex* for most cycles of the CCHS analyzed (Rich et al., 2020); self-reported and transgender-inclusive gender identity ascertainment measures were not added to the CCHS until 2019 and thus were not used for our analyses examining trends over time. *Self-rated mental health* was coded as ‘poor’ if the participant answered “fair” or “poor” to the question: “In general, would you say your mental health is ... ?” Mood and anxiety disorders were self-reported in response to the following questions: “Do you have a *mood disorder* such as depression, bipolar disorder, mania, or dysthymia?”; “Do you have an *anxiety disorder* such as a phobia, obsessive-compulsive disorder, or a panic disorder?”. Finally, *current smoking status* was defined with the item, “At the present time, do you smoke cigarettes daily, occasionally, or not at all?” where ‘daily’ and ‘occasionally’ were considered indicative of current smoking.

### 2.3. Analyses

The “svrepdesign” function in the “survey” package in R v. 4.1 was employed to create our survey design for each year (Lumley, 2022). The survey design incorporated the replicate weights provided by Statistics Canada. Analyses were conducted in three steps. Participants with missing information on sexual identity or gender/sex were excluded, as were those missing outcome status for each of the four outcomes. Heterosexuals were used as the referent group for all analyses.

- (1) Descriptive trends: Once we subset the eligible population, we applied the “svyciprop” function to estimate the weighted prevalence, standard errors, and corresponding Wald-type 95% confidence intervals (CI) for each outcome, stratifying by sexual orientation and gender/sex (i.e., bisexual women, lesbian women, heterosexual women, bisexual men, gay men, and heterosexual men). This process was repeated for each available year from 2003 until 2020.
- (2) Joinpoint regression: Then, we applied the Joinpoint Trend Analysis Software v.4.9.1.0 to identify significant changes in prevalence data from 2003 to 2020 (H. J. Kim et al., 2000). The joinpoint regression model uses the Monte Carlo Permutation method and the Bayesian Information Criterion to estimate the smallest number of joints that is not significantly different

- ( $p$ -value<0.05) from an additional inflection (H. J. Kim et al., 2000). Given our number of observations ( $n = 16$ ), joinpoint modelling results in up to three-period segments (i.e., two time-points of inflection), each described by an annual prevalence change (APCs) and a corresponding 95% CI. We also calculated an overall “average” annual prevalence change (AAPC) for the entire study period (2003–2020) with a 95% CI and tested whether this AAPC was different from zero. Each of these joinpoint analyses was stratified by the six sexual orientation and gender/sex subgroups and repeated across the four outcomes, as in step one. Finally, pairwise comparisons by sexual orientation were calculated to test for parallelism between AAPCs (H.-J. Kim et al., 2004).
- (3) Prevalence ratio (PR) trends: In the third step, we estimated age-adjusted odds ratios (OR) and corresponding 95% CI using a design-based multivariable logistic regression for each outcome and year, where sexual identity (self-identifying as a sexual minority; referent: heterosexual) was the independent variable. Multivariable models were adjusted for age, type of interview (phone or in-person), sampling frame, whether the respondent was alone during the interview, and whether the interviewer considered that the answers of the respondent were affected by presence of another person. The ORs were subsequently transformed to the prevalence ratio (PR) scale (Zhang & Yu, 1998).

**Table 1a**

Characteristics by sexual identity and period, Canadian women aged 18–59, Canadian Community Health Survey (CCHS) 2003–2020.

	2003 and 2005		2007 to 2014*		2015 to 2020*	
	Heterosexual (n = 8,911,356)	Sexual minorities (n = 156,234)	Heterosexual (n = 9,291,921)	Sexual minorities (n = 232,646)	Heterosexual (n = 9,347,910)	Sexual minorities (n = 419,851)
<b>Outcomes</b>						
Poor mental health (%)	5.3	12.3	6.0	14.4	8.6	27.7
Mood disorder (%)	7.7	18.9	9.3	23.1	11.2	33.5
Anxiety disorder (%)	5.8	13.6	8.0	19.4	12.1	32.0
Current smoker (%)	24.4	36.6	20.9	34.9	15.1	26.8
<b>Sexual orientation (%)</b>						
Bisexual	–	0.9	–	1.4	–	3.0
Lesbian	–	0.8	–	1.0	–	1.2
<b>Marital status (%)</b>						
Partnered	65.6	39.8	63.5	38.8	63.3	39.3
Separated/widowed	10.1	9.9	10.5	8.9	9.0	7.8
Never married/partnered	24.3	50.2	26.0	52.4	27.7	52.9
Living alone (%)	9.5	16.8	11.5	18.4	11.0	17.2
<b>Age (%)</b>						
18 to 29	26.5	39.3	26.7	45.5	24.8	49.8
30 to 39	23.8	22.0	22.8	19.3	25.7	26.1
40 to 49	27.6	27.2	25.1	20.5	24.0	12.7
50 to 59	22.1	11.5	25.3	14.6	25.5	11.4
Finished secondary education (%)	97.6	97.1	96.6	95.1	95.0	93.0
<b>Personal Income (%)</b>						
Less than 20,000	42.4	44.7	33.6	39.8	33.0	46.0
20,000 to 49,999	41.6	38.4	41.1	37.6	36.3	33.7
50,000 to 79,999	12.5	13.5	17.3	15.4	18.3	13.0
80,000 or more	3.5	3.4	8.1	7.2	12.5	7.3
Worked last year (%)	72.5	77.2	83.5	84.4	84.4	84.5
White (%)	84.3	88.2	79.8	88.2	73.1	81.8
Indigenous (%)	3.4	5.3	4.2	7.8	5.5	10.4
<b>Geographic location (%)</b>						
Atlantic provinces <sup>a</sup>	7.6	6.1	6.9	7.4	6.3	7.8
British Columbia	13.2	16.7	13.2	15.9	13.0	16.9
Ontario	39.0	34.6	39.3	35.1	39.2	35.4
Prairies <sup>b</sup>	16.4	13.3	17.4	17.1	18.6	19.1
Quebec	23.4	29.1	22.8	24.1	22.7	20.4
Territories <sup>c</sup>	0.3	0.3	0.3	0.4	0.3	0.4

\* Biannual datasets. Sample sizes (n) are weighted yearly averages. Prevalence was weighted using master weights provided by Statistics Canada. CCHS 2003–2020 participants aged 18–59 years were included. Sexual minority included participants who identified as homosexuals, that is, lesbian or gay, or bisexuals. People with missing information on sexual identity, gender/sex, mental health status, mood disorder, anxiety disorder, and smoking consumption were excluded.

<sup>a</sup> New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island.

<sup>b</sup> Alberta, Manitoba, and Saskatchewan.

<sup>c</sup> Northwest Territories, Yukon, and Nunavut.

## 2.4. Ethical review

Data collection, access, privacy standards, and ethical standards are governed by Statistics Canada policies and the federal *Statistics Act*.

## 3. Results

As shown in [Table 1](#), the proportion of CCHS respondents classified as a sexual minority increased over the study period, from 1.7% (weighted estimate: 312467/18135178) in 2003–2005, to 2.4% (1861161/76196534) in 2007–2014, to 4.3% (2519105/58606560) in 2015–2020. Among sexual minorities, a shift in age distribution was observed, with the percentage of sexual minorities 18–29 years of age increasing from 39.3% in 2003–2005, to 45.5% in 2007–2014, and 49.8% in 2015–2020.

### 3.1. Descriptive trends

Between 2003 and 2020, the proportions of respondents who self-rated their mental health as poor, who reported an anxiety disorder, and who reported a mood disorder increased across all six subgroups, while the proportion of respondents who reported current smoking decreased across all six subgroups ([Fig. 1](#)).

**Table 1b**

Characteristics by sexual identity and period, Canadian men aged 18–59, Canadian Community Health Survey (CCHS) 2003–2020.

	2003 and 2005		2007 to 2014*		2015 to 2020*	
	Heterosexual (n = 8,780,537)	Sexual minorities (n = 189,343)	Heterosexual (n = 9,261,166)	Sexual minorities (n = 222,629)	Heterosexual (n = 9,394,386)	Sexual minorities (n = 352,193)
<b>Outcomes</b>						
Poor mental health (%)	4.3	6.8	5.1	10.3	7.0	17.2
Mood disorder (%)	4.0	11.2	5.1	15.4	6.2	19.0
Anxiety disorder (%)	3.0	9.0	4.4	12.3	6.3	17.2
Current smoker (%)	29.4	34.9	27.9	35.7	22.1	26.5
<b>Sexual orientation (%)</b>						
Bisexual	–	0.7	–	0.6	–	1.4
Gay	–	1.4	–	1.7	–	2.2
<b>Marital status (%)</b>						
Partnered	64.4	34.4	62.5	31.5	61.6	37.0
Separated/widowed	6.0	5.0	6.4	7.3	5.4	4.3
Never married/partnered	29.6	60.6	31.1	61.3	33.0	58.6
Living alone (%)	10.9	33.0	14.0	32.9	13.6	26.2
<b>Age (%)</b>						
18 to 29	27.3	24.9	27.8	32.5	26.7	40.0
30 to 39	23.5	25.1	22.5	18.9	24.8	25.6
40 to 49	27.6	30.5	25.2	26.2	23.5	15.9
50 to 59	21.6	19.6	24.6	22.4	24.9	18.5
Finished secondary education (%)	97.6	98.1	96.1	97.1	93.4	95.4
<b>Personal Income (%)</b>						
Less than 20,000	20.0	27.8	17.7	25.4	21.8	34.2
20,000 to 49,999	41.0	43.3	34.6	36.4	30.6	35.8
50,000 to 79,999	25.6	20.4	26.6	22.1	23.2	15.7
80,000 or more	13.4	8.5	21.1	16.2	24.4	14.3
Worked last year (%)	87.8	80.9	91.9	87.0	92.0	86.5
White (%)	83.8	89.6	80.3	86.8	73.8	79.1
Indigenous (%)	3.1	4.3	4.1	4.6	5.4	5.6
<b>Geographic location (%)</b>						
Atlantic provinces <sup>a</sup>	7.4	4.7	6.6	5.3	6.0	5.4
British Columbia	13.2	12.8	13.0	14.8	13.1	12.6
Ontario	38.8	36.7	38.8	38.2	38.3	38.4
Prairies <sup>b</sup>	16.9	11.0	18.4	12.0	19.5	15.4
Quebec	23.4	34.7	22.9	29.5	22.7	27.9
Territories <sup>c</sup>	0.3	0.1	0.3	0.2	0.3	0.2

\* Biannual datasets. Sample sizes (n) are weighted yearly averages. Prevalence was weighted using master weights provided by Statistics Canada. CCHS 2003–2020 participants aged 18–59 years were included. Sexual minority included participants who identified as homosexuals, that is, lesbian or gay, or bisexuals. People with missing information on sexual identity, gender/sex, mental health status, mood disorder, anxiety disorder, and smoking consumption were excluded.

<sup>a</sup> New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island.

<sup>b</sup> Alberta, Manitoba, and Saskatchewan.

<sup>c</sup> Northwest Territories, Yukon, and Nunavut.

### 3.2. Joinpoint regression

The average annual percentage changes (AAPCs) for poor self-rated mental health, anxiety disorders, and mood disorders across all six gender/sex and sexual orientation subgroups ranged from 2.6% to 9.0% and were statistically significant for all six sexual orientation/gender subgroups ([Table 2a, 2b](#)). The AAPCs for smoking ranged from –3.8% to 1.7% and were statistically significant for all three sexual orientation subgroups among men and among heterosexual and bisexual women ([Table 2a, 2b](#)). Annual prevalence changes (APCs) for specific segments are presented in [Supplementary Table 1](#).

The results of the pairwise comparison for all included AAPCs failed to reject the parallelism between trends ([Table 3a, 3b](#)), except for trends in poor mental health prevalence between heterosexual and bisexual men ( $p = 0.048$ ) and between lesbian and heterosexual women ( $p = 0.01$ ) ([Table 3](#)).

Results from the joinpoint regression illustrated a few significant inflection points ([Fig. 2](#)). There is a significant inflection point in 2009 in the self-rated mental health trend among bisexual women, where rates of poor mental health initially decreased from 2003 but then increased drastically from 2009 to 2020. Significant inflection points in current smoking trends were observed in 2012 among bisexual and heterosexual women and in 2013 among heterosexual men; in all three groups, both segments demonstrated decreasing trends, however, the slope of the

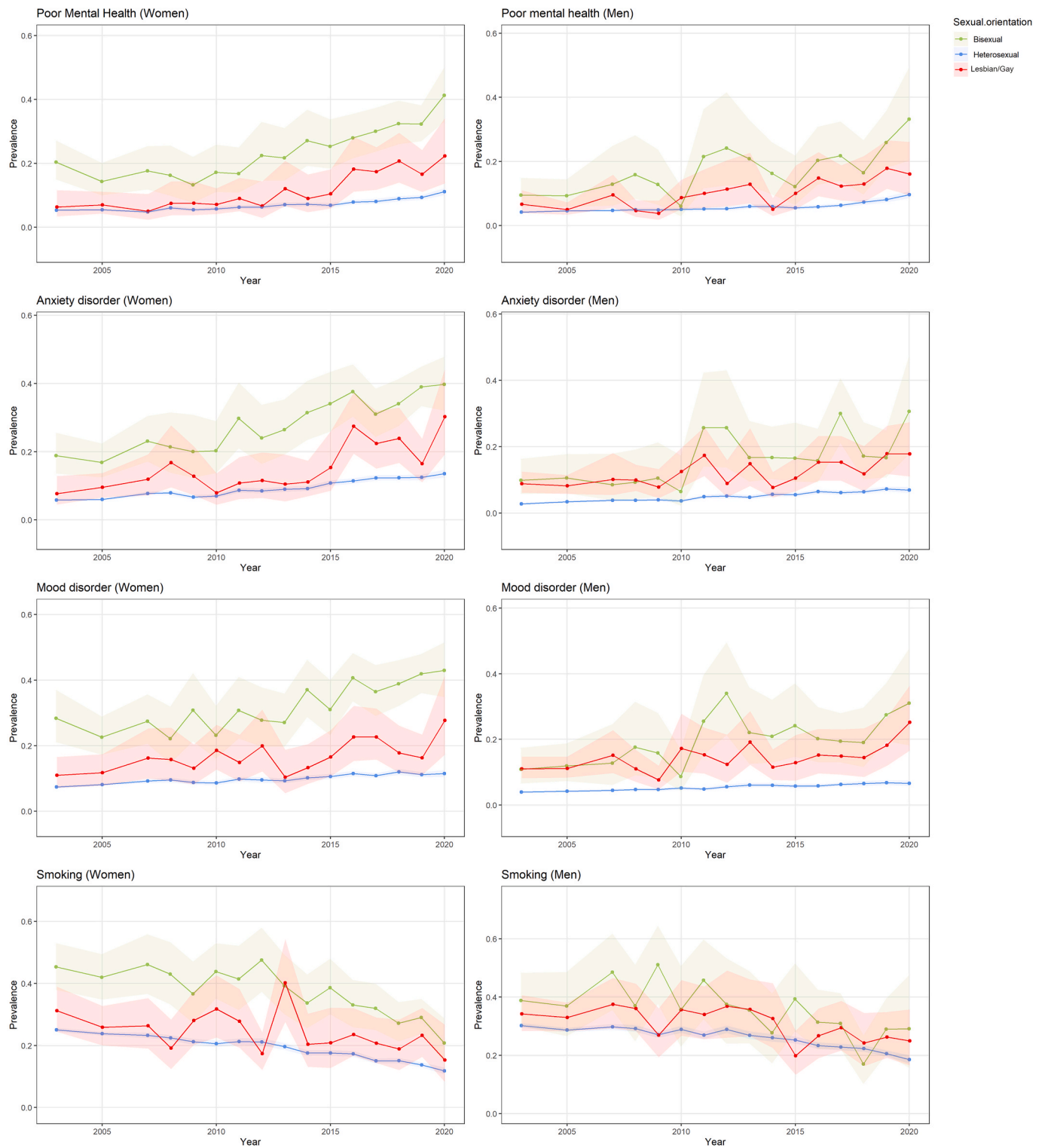


Fig. 1. Trends in the prevalence of poor self-rated mental health, anxiety disorder, mood disorder, and current smoking in Canada from 2003 to 2020, by sexual identity and gender/sex (the shaded area represents 95% confidence intervals).

trend became more pronounced in the latter period.

### 3.3. Prevalence ratio trends

Prevalence ratios (PRs) comparing mental health and smoking outcomes between sexual minority and heterosexual respondents (referent group) remained positive and statistically significant for most years and

outcomes across both gender/sex subgroups between 2003 and 2020; in other words, sexual minority health disparities remained throughout the 18-year period. (Fig. 3; Supplementary Table 2).

## 4. Discussion

The prevalence of self-rated mental health and mood and anxiety

**Table 2a**

Average annual percentage change derived from joinpoint models for trends in poor self-rated mental health, anxiety disorder, mood disorder, and current smoking among women in Canada from 2003 to 2020, by sexual identity.

Outcome	Cohort (# Joinpoints)	AAPC	95% Conf. Interval	Test Statistic~	P-Value~
Poor mental health	Bisexual (1)	4.3*	1.8; 6.9	3.4	0.001
	Heterosexual (1)	3.6*	2.0; 5.2	4.5	<0.001
	Lesbian (0)	9.0*	6.7; 11.4	8.6	<0.001
Anxiety disorder	Bisexual (0)	5.1*	4.0; 6.2	10.2	<0.001
	Heterosexual (0)	5.3*	4.6; 6.0	16	<0.001
	Lesbian (0)	7.1*	4.1; 10.2	5.1	<0.001
Mood disorder	Bisexual (0)	3.8*	2.6; 5.0	6.8	<0.001
	Heterosexual (0)	2.6*	2.1; 3.1	11	<0.001
	Lesbian (0)	3.6*	1.5; 5.8	3.7	0.003
Smoking	Bisexual (1)	-3.2*	-4.8; -1.6	-3.9	<0.001
	Heterosexual (1)	-3.8*	-4.4; -3.1	-10.9	<0.001
	Lesbian (0)	-2.1	-4.2; 0.1	-2.1	0.059

AAPC = average annual percentage change. Confidence intervals obtained through the parametric method. The t-distribution is used for cohorts with 0 Joinpoints. Otherwise, the normal (z) distribution is used.

**Table 2b**

Average annual percentage change derived from joinpoint models for trends in poor self-rated mental health, anxiety disorder, mood disorder, and current smoking among men in Canada from 2003 to 2020, by sexual identity.

Outcome	Cohort (# Joinpoints)	AAPC	95% Conf. Interval	Test Statistic~	P-Value~
Poor mental health	Bisexual (0)	6.4*	3.6; 9.3	5	<0.001
	Heterosexual (1)	4.9*	3.8; 5.9	9.4	<0.001
	Gay (0)	7.2*	3.8; 10.6	4.7	<0.001
Anxiety disorder	Bisexual (0)	6.0*	2.3; 9.8	3.6	0.003
	Heterosexual (0)	5.6*	4.9; 6.3	17.4	<0.001
	Gay (0)	4.1*	1.8; 6.5	3.8	0.002
Mood disorder	Bisexual (0)	6.0*	2.3; 9.8	3.6	0.003
	Heterosexual (0)	5.6*	4.9; 6.3	17.4	<0.001
	Gay (0)	4.1*	1.8; 6.5	3.8	0.002
Smoking	Bisexual (0)	-2.5*	-4.4; -0.6	-2.8	0.015
	Heterosexual (1)	-2.5*	-3.2; -1.7	-6.4	<0.001
	Gay (0)	-1.7*	-3.0; -0.5	-2.9	0.012

AAPC = average annual percentage change. Confidence intervals obtained through the parametric method. The t-distribution is used for cohorts with 0 Joinpoints. Otherwise, the normal (z) distribution is used.

**Table 3a**

Pairwise comparison of the segmented line regression models for women.

Outcome	Cohort 1	Cohort 2	Kmax of Joinpoints	P-Value (parallel)
Poor mental health	Bisexual	Heterosexual	2	0.1909
	Bisexual	Lesbian	1	0.0542
	Heterosexual	Lesbian	1	0.0109
Anxiety disorder	Bisexual	Heterosexual	0	0.8009
	Bisexual	Lesbian	0	0.1167
	Heterosexual	Lesbian	0	0.1822
Mood disorder	Bisexual	Heterosexual	0	0.1778
	Bisexual	Lesbian	0	0.9222
	Heterosexual	Lesbian	0	0.3167
Smoking	Bisexual	Heterosexual	1	0.4522
	Bisexual	Lesbian	1	0.5684
	Heterosexual	Lesbian	1	0.4278

disorders increased, whereas the prevalence of smoking decreased,

**Table 3b**

Pairwise comparison of the segmented line regression models for men.

Outcome	Cohort 1	Cohort 2	Kmax of Joinpoints	P-Value (parallel)
Poor mental health	Bisexual	Heterosexual	1	0.0478
	Bisexual	Gay	0	0.5651
	Heterosexual	Gay	1	0.0902
Anxiety disorder	Bisexual	Heterosexual	0	0.7551
	Bisexual	Gay	0	0.2287
	Heterosexual	Gay	0	0.1813
Mood disorder	Bisexual	Heterosexual	0	0.7551
	Bisexual	Gay	0	0.2287
	Heterosexual	Gay	0	0.1813
Smoking	Bisexual	Heterosexual	1	0.4380
	Bisexual	Gay	1	0.5080
	Heterosexual	Gay	1	0.9076

between 2003 and 2020 among both sexual minority and heterosexual people in Canada. Consistent with other North American studies (Fish & Baams, 2018; Liu et al., 2020; Max et al., 2016), we found that relative differences between sexual minority and heterosexual groups for all four outcomes remained the same or increased during this 18-year period. In other words, we found no evidence that sexual orientation disparities in mental health and substance have improved during a period of concurrent improvements in legislative and policy efforts to protect the well-being of sexual minority populations, as well as improvements in societal attitudes toward sexual minority people (National Academies of Sciences, 2020).

While the serial cross-sectional nature of this study precludes claims of causality, if there were an underlying health effect of changes in structural stigma, this effect should have been evident in the 18-year period we analyzed. There may be several explanations for why net improvements in structural stigma have not been temporally associated with improvements in the epidemiology of sexual minority mental health. Given the long induction period between experiences of minority stress and expressions of psychological distress in adulthood, it may take more time before cumulative progress in the social and political environment has material benefits to the population-level mental health of this minority group (Krieger, 2011). For example, some of the most significant federal legislative advances for sexual minority people in Canada happened when most of the recent CCHS cycle participants were well into their adulthood (e.g., amendment of Canadian Civil Rights Act to protect against discrimination on the basis of sexual orientation in 1996). As such, respondents would have experienced relatively greater structural stigma during more formative developmental periods that may not be alleviated by more recent policy changes. In addition, it may be that the laws, policies, and affirming shifts in public attitudes are simply not enough to redress the large burden of minority stress that many sexual minority people carry. Heteronormativity is a strong and intractable social force and one that may not be fully remedied by structural adjustments through law and policy. In the US context, some social epidemiologists have posited that the increasing politicization and polarization of issues relating to lesbian, gay, bisexual, and transgender rights may contribute to worsening of social minority health disparities by exacerbating already stressful social conditions (Woolf, 2022). While evidence of similar polarization regarding sexual minority issues in Canada is limited, this hypothesis merits further investigation, especially given the frequent exchange of political and social norms between the two countries (Wagner, 2019, pp. 259–278).

There may be other factors beyond our current conceptualization of minority stress that contribute to the sexual orientation disparities in mental health and substance use, and these factors may not be amenable to the current set of social and policy advances. For example, marriage equality aimed to improve same-sex couples' opportunities to access legal rights and benefits previously available only to heterosexual couples; however, this legislative achievement has not resulted in an appreciable improvement in the percentage of sexual minority women

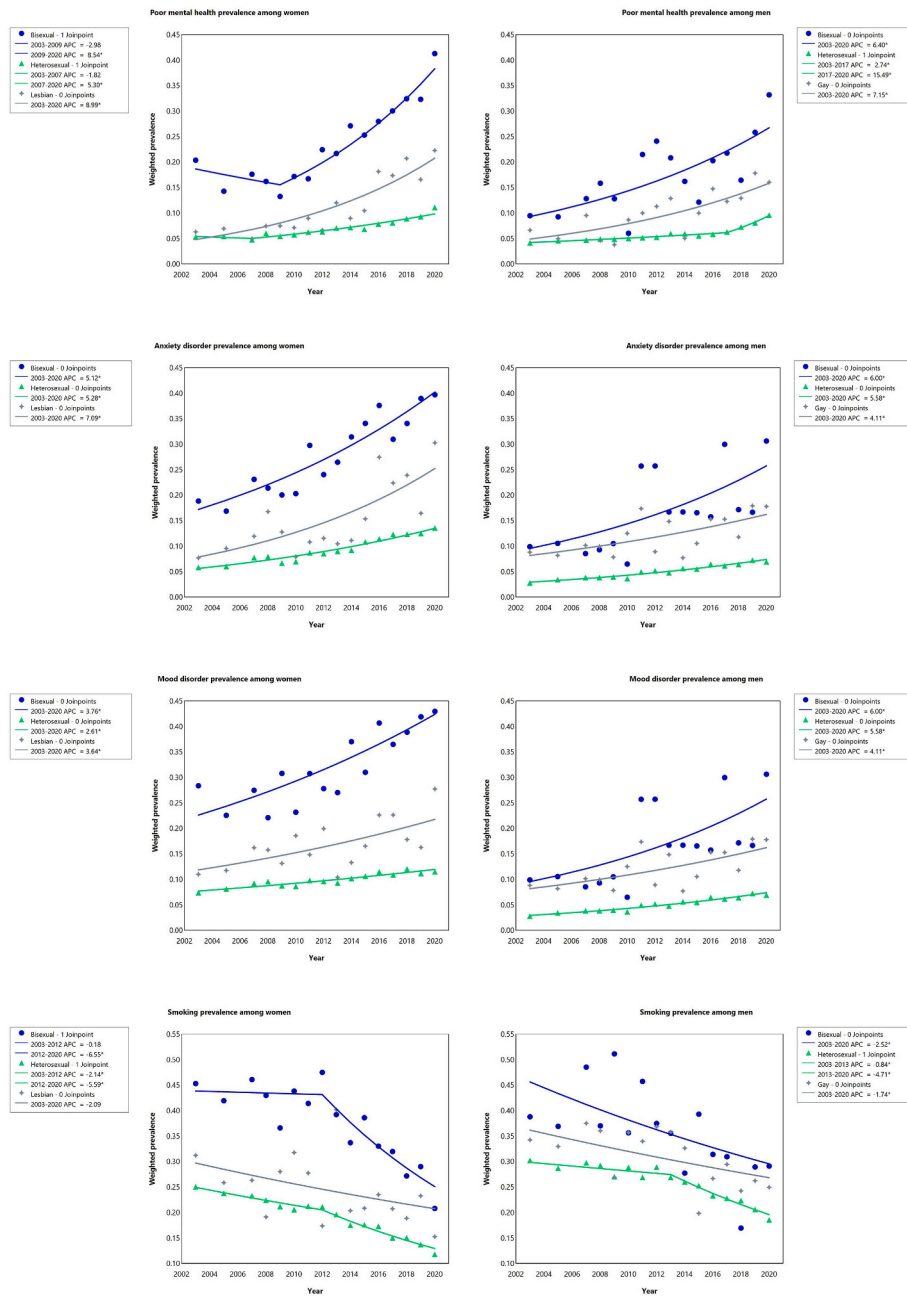


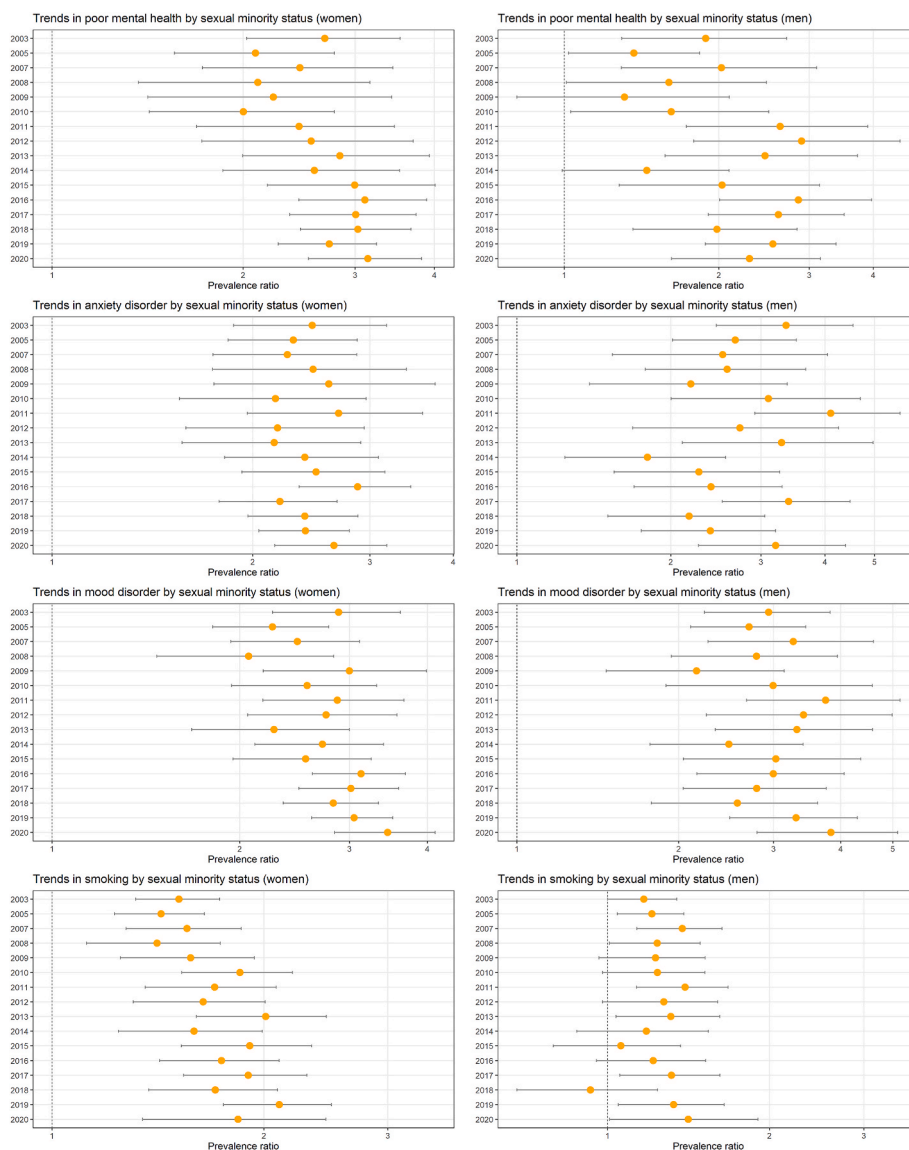
Fig. 2. Joinpoint models for the prevalence of poor self-rated mental health, anxiety disorder, mood disorder, and current smoking in Canada from 2003 to 2020, by sexual identity and gender/sex. \*Annual Percentage Change (AAC) is different from zero ( $\alpha$ : 0.05).

and men who have never been married/partnered, as shown in Tables 1a and 1b

Although our results are consistent with other sexual orientation trend analyses, we offer several novel insights. To our knowledge, this study encompasses the longest period of trend analysis among sexual minority adults, spanning 18 years in total. By combining four different mental health and substance use outcomes, we are able to strengthen the inference of our findings—showing that the obstinate disparities are consistent across outcomes. We additionally included outcomes for which there are general population-level improvements (i.e., smoking) as well as those for which trends have worsened (mental health).

Finally, the use of joinpoint regression enabled the detection of statistical inflections in the temporal trends. In particular, our finding of a significant worsening of self-rated mental health for bisexual women since 2009 warrants further investigation. While statistically significant

inflections were not observed among trends for other outcomes among bisexual women, disparities most consistently increased for this sexual minority/gender subgroup, as shown in Fig. 1. Bisexual women consistently experience the greatest burden of mental health disparities of all sexual minority/gender subgroups (Ross et al., 2018), and responsive interventions should therefore target this group as a priority. Future studies should continue to monitor this disaggregated and intersectional (bisexual + woman) disparity accordingly. The differences in disaggregated sexual orientation/gender subgroups—particularly for bisexual women—point to the promise of bringing intersectional approaches to disparity trend research. Intersectionality frameworks, including their quantitative applications, assert that social categories—and attendant systems of oppression—do not operate independently but rather work in complex and joint ways (Bauer et al., 2021).



**Fig. 3.** Trends in prevalence ratios comparing prevalence of poor mental health, anxiety disorder, mood disorder, and smoking prevalence between sexual minorities and heterosexuals in Canada, 2003–2020.

#### 4.1. Limitations

The CCHS offers geographically representative and randomly selected samples of the Canadian population. It furthermore was one of the first general population probabilistic surveys to incorporate sexual orientation measures globally. Nonetheless, it has several known limitations in its application to sexual minority epidemiologic research. Misclassification (underreporting) of sexual minority status may be as high as 30%, and if these misclassification errors are differential with respect to the outcomes, then our comparative estimates will be biased (Salway et al., 2019). We excluded participants who did not respond to the sexual orientation question; while non-response is low (<5%), it has been found to be associated with other social characteristics, including specific cultural identities, which may have a small effect on our comparative estimates—albeit one that is likely lower in magnitude than misclassification (Brabete et al., 2020).

CCHS data collection methods have changed considerably over time. In 2007, the yearly collection of 130,000 participants was adjusted to 11,000 participants every other month to get a better representation of all health areas and time periods. In addition, the sampling frames have adjusted over time (Government of Canada & Canada, 2019). Up to

2015, three different frames were used, with each frame having different collection methods. Participants sampled through a list frame of telephone numbers and through Random Digit Dialling were interviewed via telephone, whereas those sampled from the geographic area frame were interviewed in-person. The transition to a single frame for all adults started in 2012 and was finished in 2015 (Government of Canada & Canada, 2019). During this transition period, a proportion of area frame participants were also interviewed by phone causing inconsistencies in data collection that had proven to produce varying results to sensitive information like smoking. However, mental health prevalence estimates seemed to remain consistent irrespective of the CCHS data collection method (Béland & St-Pierre, 2007).

Future studies should explore additional subgroup analyses, as noted above. For instance, given the distinct age-related epidemiology of mental health outcomes, future studies should explore age-disaggregated trends, as sample sizes allow. Finally, we were unable to analyze other substance use outcomes because of inconsistencies in measurement across cycles of the CCHS.



## 4.2. Implications

The durability of sexual orientation disparities in mental health and substance use suggests a failure of public policy, and this growing body of research calls for a more in-depth investigation into how and why improvements in structural stigma are not remedying sexual minority health disparities. Implementation science frameworks may be fruitful in investigating specific mechanisms for policies, to identify where policy actors can do more to ensure that sexual minority people achieve intended benefits. In the meantime, our results emphasize the need for ongoing secondary/tertiary prevention efforts, such as tailored and affirming mental health supports for sexual minority service users. Sexual minority people in North America continue to report numerous barriers to accessing responsive and affirming mental healthcare, including perceived heterosexism within the mental healthcare system, lack of affordable services, and challenges in identifying affirming practitioners (Ferlatte et al., 2019; Salway et al., 2018).

Future trend analyses can expand upon our research in several ways, especially as sexual and gender minority-inclusive data platforms continue to grow. Future trend analyses may adopt intersectional approaches to monitor for other subgroups differences, e.g., on the basis of race, socioeconomic position, and geography. With the addition of transgender-inclusive measures, similar trend analyses must be undertaken to monitor if and how gender minority health disparities are improving. Finally, researchers may expand the number and nature of health outcomes we are monitoring, acknowledging that the magnitude of sexual minority health disparities differs by outcome (Salway et al., 2022).

## Ethical review

Data collection, access, privacy standards, and ethical standards are governed by Statistics Canada policies and the federal Statistics Act.

## Declaration of generative AI in scientific writing

Not used. Nothing to declare.

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## CRediT authorship contribution statement

**Travis Salway:** Writing – review & editing, Writing – original draft, Supervision, Project administration, Methodology, Funding acquisition, Conceptualization. **Jorge Andrés Delgado-Ron:** Writing – original draft, Visualization, Software, Methodology, Formal analysis. **Ashleigh J. Rich:** Writing – review & editing, Funding acquisition, Conceptualization. **Christoffer Dharma:** Writing – review & editing, Methodology, Funding acquisition. **Laura Baams:** Writing – review & editing. **Jessica Fish:** Writing – review & editing, Conceptualization.

## Declaration of competing interest

None.

## Data availability

The authors do not have permission to share data.

## Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.ssmph.2024.101697>.

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