

The Impacts of School Climate and Education Policy on Weight and Victimization Disparities
Among Sexual Minority Adolescents

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Abstract

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This dissertation examines the influences of LGBTQ positive school climate and state-level anti-bullying policy with sexual and gender minority (SGM) identity enumeration on weight and victimization disparities among sexual minority adolescents. Compared to their heterosexual peers, sexual minority adolescents (those who identify as gay/lesbian or bisexual, or who are unsure of their sexual identity) have higher odds of having obesity and experiencing school violence victimization. The effects of school climate and anti-bullying policy that seek to specifically provide protections for LGBTQ adolescents on the health outcomes of obesity and school violence have rarely been examined, and especially in tandem. Decreasing disparities in both these outcomes would help improve quality of life and decrease morbidity. Therefore, the overall objective of this dissertation is to help fill several gaps in the literature related to obesity, school violence, school climate, and state-level anti-bullying policy with SGM identity enumeration. An adapted Social Ecological Model guided conceptualization and design of the three studies included. Chapter 1 introduces the current state of adolescent obesity, including trends in obesity over time, contextual influences on obesity, and obesity disparities among sexual minority adolescents. Existing research on school violence victimization, school climate, and SGM enumerated policy are also introduced and described.

Chapter 2, a systematic review, aimed to systematically search and review the literature on the effects of positive school climate on weight-related health behaviors and risk factors for

obesity. Overall, we found that LGBTQ adolescents in more positive school climates reported lower levels of bullying victimization, depressive and suicidal feelings, and sexual orientation-based harassment than those in less positive school climates. Results were more mixed for studies examining the effects of positive school climate on alcohol, tobacco, and other drug use.

Chapter 3, a cross-sectional analysis of the Center for Disease Control and Prevention's (CDC's) Youth Risk Behavior Surveys (YRBS) and School Health Profiles (SHP) from 2010–2019, examined and compared the associations among sexual identity, school violence victimization, and obesity across varying levels of LGBTQ school climate in ten United States school districts. We found that for both female and male adolescents, regardless of sexual identity, those who reported two or more counts of school violence victimization had significantly higher odds of obesity compared to those who reported no violence victimization experienced in the last 12 months (1.33 and 1.24 greater odds, respectively). We also found that in the presence of more positive LGBTQ school climates, adolescents had 0.85 lower odds of obesity compared to those in the presence of less positive LGBTQ school climates.

Chapter 4, a quasi-experimental difference-in-differences analysis of state-level anti-bullying policies and state-level CDC YRBS data from 1999–2019, examined the causal effect of anti-bullying policies with SGM identity enumeration on bullying and obesity trends over time. We found that adolescent girls had a significant 1.0 percentage point decrease in the probability of bullying victimization in the period post SGM enumeration enactment. For boys, this association was slightly stronger with a 3.2 percentage point decrease in the probability of bullying victimization in the post-period. However, when we examined subgroups of sexual minority adolescents specifically, we found the average treatment effects for SGM enumeration were even stronger for sexual minority girls and boys—with a 6.4 percentage point decrease in

the probability of being bullied for sexual minority girls and a 6.0 percentage point decrease for sexual minority boys. Results for the obesity outcome showed that in the post-period, obesity rates increased for sexual minority girls and boys, an unintended effect that should be explored in future research that considers temporality of relationships among these outcome variables.

Finally, Chapter 5 summarizes the studies included in the dissertation, identifies strengths and limitations, reviews key findings, and discusses implications for policy, practice, and future research. Using strong quantitative statistical methods, our primary contribution to the public health literature is that LGBTQ positive school climates and inclusive, SGM enumerated anti-bullying policies work to help decrease odds of obesity and rates of bullying victimization, respectively, for both heterosexual and sexual minority adolescents—highlighting how specific protections for one group of adolescents can extend benefits to all adolescents.

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Dedication

To all the queer kids out there—you are seen, you are heard, you are loved. Keep being you; there are people who will love you no matter what.

Chapter 1: Introduction

1.1 The Prevalence and Burden of Adolescent Obesity

Pediatric obesity is a significant public health concern, with approximately one-third of children and adolescents ages 2–19 in the United States (U.S.) meeting criteria for overweight or obesity (Ogden et al., 2016). Rates of obesity among youth have tripled since the 1970s (Fryar et al., 2018), and across this age group the prevalence of obesity is highest (20.5%) among adolescents aged 12–19 years (Ogden et al., 2016). Adolescent obesity carries significant immediate health concerns (Chu et al., 2017; Kumar & Kelly, 2017; Umer et al., 2017). In adolescence, obesity has been linked to comorbid conditions such as hypertension, diabetes, and dyslipidemia, as well as increased mortality risk related to these conditions (Cheung et al., 2016; Finkelstein et al., 2014; Nadeau et al., 2011). Obesity has also been associated with increased risk of disability and carries both direct and indirect economic burdens for those affected (Kumar & Kelly, 2017; Lehnert et al., 2013). In 2014, the economic impact of obesity was estimated to be \$2.0 trillion U.S. dollars—2.8% of the global gross domestic product (Dobbs et al., 2014).

In addition to its health and economic costs, obesity is also associated with negative psychosocial experiences such as social discrimination and bullying (Puhl & King, 2013). Further, physical health problems experienced during this life stage can have lasting effects into adulthood (Inge et al., 2013; Nadeau et al., 2011; Umer et al., 2017). Adolescence is a particularly vulnerable and important developmental period as many health behaviors learned during this period continue into adulthood (Buscot et al., 2018; Patton et al., 2016), and obese adolescents are five times as likely to be obese adults as their normal-weight peers (Simmonds et al., 2016).

1.2 Obesity Disparities Among Sexual Minority Adolescents

Racial/ethnic and economic disparities in obesity are well-documented (Kirby et al., 2012; National Academies of Sciences, 2019a; Scharoun-Lee et al., 2009; Wang et al., 2011). An emerging body of literature has also explored obesity among sexual minority adults, with findings suggesting that they are more likely than their heterosexual counterparts to be obese. There is particularly robust research for sexual minority women and bisexual men to be more obese than their heterosexual counterparts (Azagba et al., 2019; Caceres et al., 2018; Caceres et al., 2019a; Caceres et al., 2019b; Simoni et al., 2017). Less research has examined obesity among sexual minority adolescents (SMA; i.e., those who identify as gay/lesbian or bisexual, or who are unsure of their sexual identity). However, studies among adolescents consistently find higher body mass indices (BMIs) for sexual minority populations, especially for sexual minority girls compared to heterosexual girls (Ancheta et al., 2020; Austin et al., 2013; Hadland et al., 2014; Keenan et al., 2018; Wood et al., 2017). Accordingly, researchers seek to uncover relationships for why these obesity disparities exist.

1.3 Contextual Influences on Obesity

Individual-Level: Health Behaviors

Obesity is a multifactorial condition influenced by individual-, interpersonal-, community-, and policy-level factors (Utley et al., 2016; Wasserman et al., 2014). Individual-level factors known to influence obesity include race/ethnicity, sex, income level, genetics (National Academies of Sciences, 2019a; Orsi et al., 2011; Semmler et al., 2009; Speliotes et al., 2010), and health behaviors (e.g. diet, physical activity, sleep, sedentary behaviors) (Hruby & Hu, 2015; Liu et al., 2012). Overall, SMA report lower rates of physical activity and higher rates of sedentary behavior than their heterosexual peers (Ancheta et al., 2020; Beach et al., 2018;

Calzo et al., 2014; Mereish & Poteat, 2015). The percentage of SMA who fail to meet the Centers for Disease Control and Prevention (CDC) recommendation for physical activity is a staggering 70%, compared to 48% for heterosexual adolescents (Kann et al., 2016). Further, SMA are 46%–76% less likely to participate in sports teams than their sex-matched heterosexual peers (Calzo et al., 2014), likely due to fears of open discrimination at school and, among transgender and gender diverse (TGD; i.e., those whose current gender identity is different from the sex they were assigned at birth) adolescents, the inability to use locker rooms aligned with their gender identity (Kosciw et al., 2020), which can contribute to obesity disparities among sexual and gender minority (SGM) adolescents (Grammer et al., 2019).

Interpersonal-Level: School Violence Victimization

At the interpersonal level, school violence victimization is a key risk factor for obesity among adolescents (Piontak et al., 2017; Thapa & Kelvin, 2017). School violence includes violent acts such as bullying, fighting, and weapon use that have negative effects on students and that occur on school property or on the way to or from school (National Center for Injury Prevention and Control, 2021; Olsen, 2019). Among the general adolescent population, school violence victimization has been linked to suicidal ideation and attempts, depression, anxiety, decreased academic achievement, and physical health problems such as cardiometabolic syndrome and obesity (Ferrara et al., 2019; Troop-Gordon, 2017; Van Geel et al., 2014b). A number of investigators have found a dose-response relationship between the number of childhood adversities (including school violence victimization) and obesity (Midei & Matthews, 2011; Stein et al., 2010). These stressful, often discriminatory, experiences are posited to trigger the release of cortisol, cytokines, and other substances that can alter and damage physiologic

systems, immune protections, and vital organs (Hatzenbuehler & Mclaughlin, 2014; Wardecker et al., 2021). This in turn leads to increased risk for obesity (Maripuu et al., 2016).

SMA are at heightened risk of school violence victimization because of their minority sexual identity (Earnshaw et al., 2016; Hatzenbuehler & Pachankis, 2016; Russell et al., 2011). Specifically, SMA are at increased risk of school-based bullying from peers, as well as from teachers and coaches (Earnshaw et al., 2018; GLSEN, 2013). Bullying and name-calling in hallways and harassment in school athletic facilities, during physical education classes and during participation on sports teams, cause many students to feel unsafe, uncomfortable, and that they do not belong (GLSEN, 2013). In a nationally-representative sample, 79% of lesbian, gay, bisexual, transgender, queer/questioning (LGBTQ) students reported feeling uncomfortable talking to physical education staff/coaches about LGBTQ issues (GLSEN, 2013)—another factor that contributes to their lack of participation in physical activity opportunities that can reduce obesity risk (Toomey & Russell, 2013). In general, SMA are almost three times as likely to experience school violence as their heterosexual peers (Olsen, 2019). Given higher rates of school violence among SMA, it is plausible that they are also at higher risk of obesity, but to our knowledge this association has yet to be examined.

Community-Level: School Climate

At the community-level, school climate (i.e., the quality and character of school life that reflect norms, social interactions, and organizational policies) (Cohen et al., 2009) is an important social determinant of health (Huang, K.-Y. et al., 2013). Although the National Academy of Medicine asserts that school climate is a key area for intervention research with SMA (Institute of Medicine, 2011; National Academies of Sciences, 2019b), it remains understudied in connection to weight status.

Researchers have found that positive school climates (i.e., climates that promote the healthy growth and development of students) are associated with lower levels of school violence against SMA (Marx & Kettrey, 2016; Russell et al., 2016). More specifically, positive school climates that support and promote the wellbeing of SMA are characterized by the presence of gender-sexuality alliances (GSAs), the prohibition of harassment based on a student's actual or perceived sexual/gender minority status, the facilitation of access to LGBTQ providers not on school property, and curricula that are specific to LGBTQ concerns (Hatzenbuehler et al., 2014; Russell & Mcguire, 2008). Such positive school climates have been associated with reduced bullying and harassment; reduced risk of suicidal ideation and attempts; and greater social, emotional, and academic wellbeing among all adolescents, but especially among SMA (Ancheta et al., 2021a; Gower et al., 2018; Porta et al., 2017). However, associations between positive school climates and physical health outcomes, such as obesity, have rarely been examined. To this end, Study 1 of this dissertation systematically reviews the effects of school climate on weight-related health behaviors and psychological and victimization-based risk factors for obesity among LGBTQ adolescents. Further, because obesity can be linked to individual-level health behaviors and interpersonal-level school violence—and given that positive school climates can decrease risk of school violence for LGBTQ adolescents—an examination of the associations among school climate, school violence, and obesity is also warranted. Study 2 of this dissertation addresses this gap.

Policy-Level: State-Level Anti-Bullying Policy With Sexual and/or Gender Minority Identity Enumeration

Lastly, obesity risk is also influenced at the policy level. Common policy-level factors that influence obesity among adolescents include the Supplemental Nutrition Assistance Program

(SNAP); the Child Tax Credit; access to school-based lunch programs; access to clean, safe, and walkable neighborhoods and parks; access to physical education classes in schools; access to health insurance; and access to trusted healthcare providers (Kristensen et al., 2014; National Academies of Sciences, 2019a; State of Childhood Obesity, 2021; Story et al., 2008). These policies, at federal, state, and local levels, directly or indirectly impact proper nutrition and physical activity among adolescents, two factors important to maintaining a healthy body weight (Kumar & Kelly, 2017). However, interpersonal-level factors and experiences such as bullying victimization and exposure to other types of violence can also contribute to weight gain through subsequent engagement in unhealthy coping behaviors, such as overeating, binge eating, and low levels of engagement in physical activity (Grammer et al., 2019; Hemmingsson, 2018).

Ecological momentary assessment research has shown that among adolescents, exposure to violence one day is linked to engagement in obesogenic behaviors the same day (e.g., unhealthy food consumption, including fast food intake and consumption of caffeinated beverages) as well increased feelings of tiredness (Piontak et al., 2017) that could hinder engagement in physical activity.

To discourage students from bullying other students, and to provide explicit protections for students who are bullied, since 2010 state legislatures in all U.S. states have passed anti-bullying policies as part of their education statutes. In 2011, the U.S. Department of Education published the report *Analysis of State Bullying Laws and Policies* in which they highlighted 11 key components that every state-level anti-bullying policy should contain (Stuart-Cassel et al., 2011). These components include a prohibition and purpose statement; description of prohibited conduct; enumeration of specific characteristics; communications of policies; and training and prevention for both students and staff. The component that is of particular importance for

LGBTQ students is the enumeration of specific characteristics, which can include sexual and/or gender minority identity. Enumeration in general is important in a legal sense to explicitly define bullying acts that may be motivated by certain characteristics, and it is important in a symbolic sense to communicate that discrimination against certain groups is prohibited and will not be tolerated (Stuart-Cassel et al., 2011).

A systematic review conducted in 2017 examining the effectiveness of various policy interventions on school bullying outcomes showed that LGBTQ students who attended schools with comprehensive bullying policies (including enumeration on the basis of LGBTQ identity) reported less bullying and that more school personnel intervened when anti-LGBTQ comments were made (Hall, 2017). Further, the 21 studies included in the review reported inconsistent results in whether the presence or quality of policies was associated with lower rates of bullying in general (among all students). However, the one consistent finding across studies that assessed sexual identity and enumerated policies was that explicit protections for LGBTQ students were associated with lower rates of bullying compared to other, more general interventions such as teacher training on how to implement the anti-bullying policy or having resources available at the school for teacher intervention (Hall, 2017). It is posited that among drivers of bullying targeting LGBTQ adolescents are bias-based stigma and discrimination that increases minority stress and creates power differentials—but such stigma can ultimately be influenced by policy (Hatzenbuehler, 2016; Hatzenbuehler et al., 2013; National Academies of Sciences, 2020b), creating changes in the larger social environment rather than at individual or interpersonal levels. Therefore, given the findings of this 2017 review, an examination of state-level anti-bullying policy with sexual and/or gender minority identity enumeration and how it affects bullying

outcomes among LGBTQ youth is warranted—especially using methods that examine trends over time.

Further, given prior research showing that experiences of bullying victimization are linked to increased risk for obesity (Baldwin et al., 2016; Midei & Matthews, 2011; Takizawa et al., 2014) and that obesity disparities among minority populations are associated with discrimination and minority stress (Bernardo et al., 2017; Hatzenbuehler et al., 2013; Mason & Lewis, 2015; Mereish, 2014), examining the potential impacts of inclusive anti-bullying policy for SGM adolescents on obesity is also warranted. Recent research has shown that school connectedness (i.e., the degree of closeness, happiness, and inclusiveness in a school) is associated with BMI changes in girls. In particular, lower school connectedness was associated with an increase in BMI in girls, as well as larger waist circumference (Quader et al., 2022). To examine the association between state-level anti-bullying policy with sexual and/or gender minority identity enumeration and bullying and obesity trends among adolescents over time, Study 3 uses difference-in-differences, a causal inference method commonly used in Econometrics that controls for state and year fixed effects (Wing et al., 2018), to examine these relationships.

1.4 Gaps in the Literature

The three studies included in this dissertation help fill several gaps in the literature related to obesity, school violence, school climate, and state-level anti-bullying policy with sexual and/or gender minority identity enumeration.

Study 1, Chapter 2

Existing systematic reviews have explored relationships between general school climate and mental health and wellbeing among adolescents (Aldridge & Mcchesney, 2018; Ancheta et

al., 2021a; Kidger et al., 2012). However, no systematic review or meta-analysis has examined relationships between general and LGBTQ-specific school climate and weight-related health behaviors and risk factors for obesity among LGBTQ youth. This is important because adolescents spend a great portion of their days in schools (National Academies of Sciences, 2019b), and weight-related health disparities faced by LGBTQ students may be influenced by disinhibited eating behaviors and violence experienced at schools (Lie et al., 2019). Therefore, the aim of this study was to qualitatively review the literature on the associations between positive school climate and weight-related health behaviors and risk factors for obesity among LGBTQ adolescents.

Study 2, Chapter 3

Findings from the Study 1 systematic review influenced and guided the aims for Study 2, which were to examine and to compare associations among school violence, school climate, and obesity among SMA and their heterosexual peers using Youth Risk Behavior Survey (YRBS) data collected by the CDC in large urban school districts across the U.S.

Study 3, Chapter 4

Study 3 builds upon Study 2 by examining policies that may influence bullying victimization and obesity that are particularly salient for SMA—state-level anti-bullying policies with sexual and/or gender minority identity enumeration.

1.5 Aims of the Dissertation

The overall goal of the work outlined in this dissertation is to improve understanding of interpersonal-, community-, and policy-level factors that influence risk of obesity and bullying victimization among SMA, a health disparities population as designated by the U.S. National Institutes of Health (National Institute of Minority Health and Health Disparities, 2022). Table

1.1 summarizes each chapter of the dissertation and highlights each study's aim(s), design, sample, methods, and target journal for publication. To facilitate understanding, Table 1.2 contains a list of abbreviations used in this dissertation and their definitions. Additionally, of note, throughout this document I alternate between the use of "SMA" and "LGBTQ." The differentiation is intentional and is used because Study 1 includes transgender and gender diverse adolescents, while Studies 2 and 3 do not. Further, the main predictors for all three studies (i.e., LGBTQ school climate and SGM enumerated anti-bullying policies) are relevant for LGBTQ adolescents and not solely sexual minority adolescents.

1.6 Conceptual Framework

The Social Ecological Model (SEM), one of the four models proposed by the National Academy of Medicine to guide research on sexual minority health (Institute of Medicine, 2011), provides the conceptual underpinnings for this dissertation. This model illustrates how the growth and development of an adolescent is influenced by the interactions between adolescents and their environments (Sallis et al., 2015). This multi-environment world constitutes an ecological system. The Social Ecological Model is comprised of internally tangent circles (i.e., levels), with the adolescent and individual-level health behaviors in the center, foremost circle. Domains that are more proximal to the center circle have more of a direct influence on the adolescent, whereas the more distal domains have more indirect influences (Sallis et al., 2015). The model illustrates that health behavior changes can target multiple environmental levels, and that the combination of proximal and distal influences provide a more comprehensive picture of adolescent development than either level itself (Diclemente et al., 2018; Sallis et al., 2015).

I have adapted the Social Ecological Model to include concepts most relevant to the outcome of adolescent obesity in accordance with previous studies (Ohri-Vachaspati et al., 2015;

Pratt et al., 2007). The shaded circles represent the domains (levels) that are the focus of this dissertation. The center, foremost circle represents the adolescent and their individual-level *Health Behaviors* (i.e., diet, physical activity). The proximal circle includes *School Violence* (i.e., bullying victimization, fighting on school property). *School Climate*, a more distal domain, refers to LGBTQ positive school climate. The most distal domain, *State Legislation and Policy*, represents anti-bullying policy with sexual and/or gender minority identity enumeration at the state-level (see Figure 1). By examining multiple levels of influence, I aimed to examine how these levels interact to influence obesity risk primarily, and bullying victimization risk secondarily (through school climate and state policy), among SMA and heterosexual adolescents.

1.7 Study Designs

Study 1 is a systematic review of associations between positive school climate and weight-related health behaviors and risk factors among LGBTQ adolescents. Building on findings from Study 1, Study 2 is a secondary analysis of cross-sectional data from the CDC's Youth Risk Behavior Survey (YRBS) linked with data from the CDC's School Health Profiles (SHP). In this study I examined and compared associations among school violence, school climate, and obesity in SMA and their heterosexual counterparts using multilevel generalized logistic regression models with moderation analyses. Guided by the Social Ecological Model, I explored the most distal factor, state legislation and policy, in Study 3. For this study I used a quasi-experimental difference-in-differences approach to examine the year-by-year trend effect of SGM enumerated policies on bullying victimization and obesity rates in states that implemented an enumerated policy versus states that did not.

1.8 IRB Exemption Status

My dissertation includes one systematic review, one study using CDC publicly available data, and a third study using CDC publicly available data and coded, publicly available, state-level education policy data. Studies 2 and 3 were deemed exempt by the Columbia University Irving Medical Center Institutional Review Board.

1.9 Conclusion

SMA are at increased risk of obesity, in part because they are more likely to engage in negative weight-related health behaviors as a means of coping with stigma and discrimination (Grammer et al., 2019; Hatzenbuehler et al., 2013). Bullying victimization and exposure to other childhood adversities have also been linked to higher cortisol secretion, which is associated with higher likelihood of developing overweight/obesity (Chu et al., 2017). Prior research has explored racial/ethnic differences in adolescent obesity; however, this dissertation extends existing literature on obesity among SMA by accounting for multiple levels in a social ecological system (i.e., interpersonal level, community level, and policy level) that may increase risk beyond the individual level. This dissertation fills gaps in knowledge by synthesizing current evidence of the effects of positive school climate on weight-related health behaviors and risk factors for obesity among SMA, by examining the effects of school violence and school climate on obesity using multilevel modeling, and by examining the effect of state-level anti-bullying policy on bullying and obesity among SMA using a difference-in-differences design. Study findings have the potential to inform targeted interventions that affect the lives of SMA and to call action policymakers, healthcare professionals, nurses, teachers, and counselors to work in concert to support the wellbeing of this vulnerable population and to help decrease weight and bullying victimization disparities.

1.10 Respective Contributions

With the exception of the literature review (in which I worked with another PhD student), the work described in this dissertation was completed by me, under the supervision of Drs. Hughes and Bruzzese. Because each of the three studies described in this dissertation will be submitted for publication, with E.B.M. as co-author on the literature review and Drs. Hughes and Bruzzese as co-authors on each of the manuscripts, I opted to use the plural “we” rather than “I” when describing the studies in the following chapters.

Tables

Table 1.1

Summary of Dissertation Chapters

| Chapter | Title | Aim(s) | Design | Sample | Methods | Target journal |
|---------|---|--|--|---|--|---|
| 1 | Introduction | | | | | |
| 2 | A Systematic Review of Associations Between Positive School Climate and Weight-Related Health Behaviors and Risk Factors for Obesity Among LGBTQ ^a Adolescents | 1. To systematically search and review the literature on the effects of positive school climate on weight-related health behaviors and risk factors for obesity. | Systematic review | $N = 9$ cross-sectional studies | Review/synthesis of literature | <i>Adolescent Research Review</i> |
| 3 | Interpersonal- and Community-Level Risk Factors for Adolescent Obesity: An Examination of Sexual Identity, School Violence, and School Climate in a Large Sample of Urban Adolescents | 1. To examine and compare the association between school violence and obesity in SMA ^b and their heterosexual peers. 2. To examine and compare associations among sexual identity, school violence, and obesity across varying levels of LGBTQ school climate. | Cross-sectional using CDC ^c YRBS ^d and SHP ^e data | $N = 60,625$ adolescents, $N = 10$ school districts | Multilevel generalized logistic regression models with moderation analyses | <i>Journal of Youth and Adolescence</i> |

| Chapter | Title | Aim(s) | Design | Sample | Methods | Target journal |
|---------|--|--|--|--|--|--|
| 4 | A Difference-in-Differences Analysis of the Relationship Between State-Level Anti-Bullying Policy With Sexual and/or Gender Minority Identity Enumeration and Bullying and Obesity Among Sexual Minority Adolescents | <ol style="list-style-type: none"> 1. To examine the causal effect of anti-bullying policies with sexual and/or gender minority identity enumeration on bullying and obesity trends over time using a difference-in-differences approach. 2. To examine whether the causal effect of anti-bullying policies with sexual and/or gender minority identity enumeration on bullying and obesity trends over time differs for SMA and their heterosexual peers. | Quasi-experimental using CDC YRBS data and coded state policy data | $N = 408,510$ adolescents, $N = 44$ states with available data (25 with no anti-bullying enumeration, 19 with anti-bullying enumeration) | Linear regression difference-in-differences models | <i>American Journal of Public Health</i> |
| 5 | Synthesis | | | | | |

^a LGBTQ = lesbian, gay, bisexual, transgender, queer/questioning. ^b SMA = sexual minority adolescents (those who identify as gay/lesbian or bisexual, or who are unsure of their sexual identity). ^c CDC = Centers for Disease Control and Prevention. ^d YRBS = Youth Risk Behavior Survey. ^e SHP = School Health Profiles

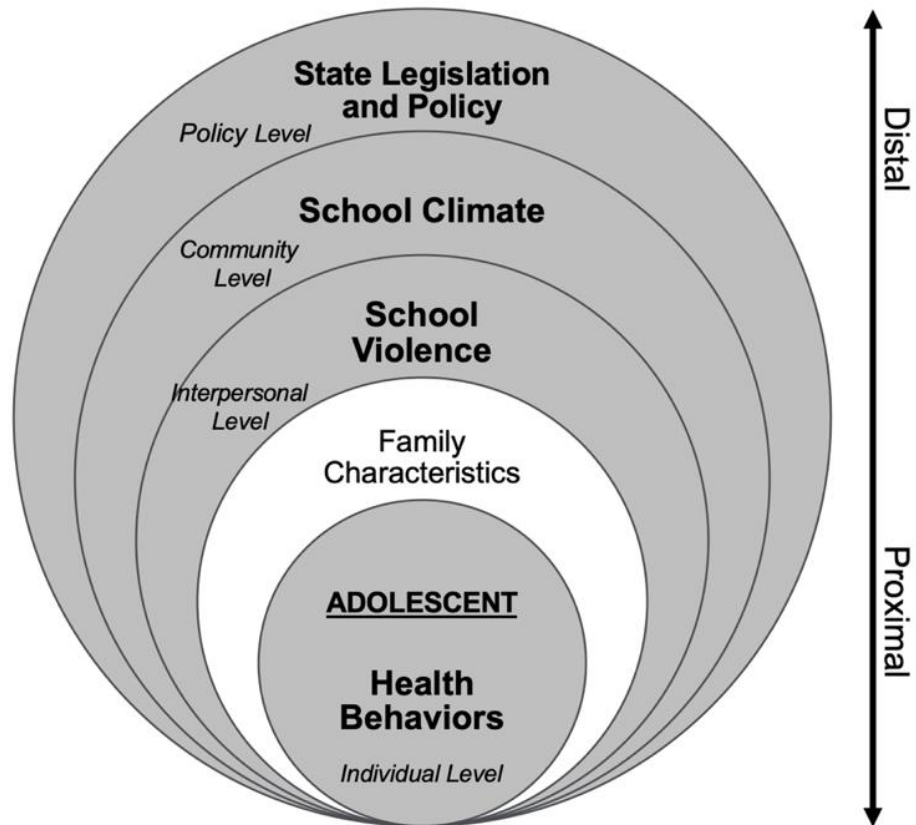
Table 1.2*Abbreviations Used in Dissertation*

| Abbreviation | Definition |
|--------------|--|
| U.S. | United States |
| SMA | Sexual minority adolescents |
| BMI | Body mass index |
| CDC | Centers for Disease Control and Prevention |
| TGD | Transgender and gender diverse |
| SGM | Sexual and gender minority |
| LGBTQ | Lesbian, gay, bisexual, transgender, queer/questioning |
| GSA | Gender-sexuality alliance |
| SNAP | Supplemental Nutrition Assistance Program |
| YRBS | Youth Risk Behavior Survey |
| SEM | Social Ecological Model |
| SHP | School Health Profiles |
| PROSPERO | Prospective Registry of Systematic Reviews |
| PRISMA | Preferred Reporting Items for Systematic Reviews and Meta-Analyses |
| JBI | Joanna Briggs Institute |
| HED | Heavy episodic drinking |
| SPQ | School Principal Questionnaire |
| LHETQ | Lead Health Education Teacher Questionnaire |
| ODPHP | Office of Disease Prevention and Health Promotion |
| GLSEN | Gay, Lesbian, Straight Education Network |
| NASEM | National Academies of Science, Engineering, and Medicine |

Figures

Figure 1

Application of Adapted Social Ecological Model to Dissertation



Chapter 2: A Systematic Review of Associations Between Positive School Climate and Weight-Related Health Behaviors and Risk Factors for Obesity Among LGBTQ Adolescents

2.1 Introduction

Trends in childhood obesity have been steadily rising since the 1970s, when obesity rates were approximately 13% (Von Hippel & Nahhas, 2013). Today, childhood obesity has grown to epidemic proportions; 18.5% of youth ages 2–19 years are obese (Hales et al., 2017), and trends are continuing to rise, especially among disadvantaged groups (National Academies of Sciences, 2020a). Accordingly, in its updated goals, Healthy People 2030 has again named reducing the proportion of children and adolescents with obesity as a national objective (U.S. Department of Health and Human Services, 2020b).

Childhood obesity is associated with greater risk of premature onset of chronic disease morbidity—namely, cardiovascular disease, certain cancers, type 2 diabetes, and depression (Hruby & Hu, 2015). Overweight and obesity at age 11 has been associated with lower math scores at age 16 as well as lower likelihood of graduating from university at age 23 (Segal et al., 2019). A new report released in 2019 by the *New England Journal of Medicine* found that by the year 2030, nearly 1 in 2 adults in the U.S. will have obesity, with nearly 1 in 4 adults projected to have severe obesity (Ward et al., 2019). Because childhood obesity is closely associated with adulthood obesity (Péneau et al., 2017; Ward et al., 2017), it is critically important to understand factors that increase the risk of childhood obesity.

2.2 Importance of School Contexts

Schools are important contexts in the discussion of overweight and obesity risk among adolescents. Not only do schools provide adolescents with nutrition and a space in which they can engage in physical activity and learn about healthy eating habits (Institute of Medicine, 2013), school contexts also are important determinants of other health behaviors and risk factors that influence weight status. Health behaviors such as tobacco use (Brook et al., 2010), alcohol use (Huang, D. Y. et al., 2013), and other drug use have been associated with increased risk for overweight and obesity (Huang, D. Y. et al., 2013), and all are influenced by school contexts (National Academies of Sciences, 2019b). Additionally, schools can influence risk of peer victimization, bullying, and associated trauma (Tillyer et al., 2018). Victimization influences physical inactivity, such that those who report being victimized are more likely to engage in isolative sedentary activities rather than with peers in team-based sports or physical education classes (Hayden-Wade et al., 2005), which in turn can contribute to weight gain. Victimization experiences have also been associated with same-day obesogenic behaviors like fast food consumption in response to negative experiences (Piontak et al., 2017).

2.3 Weight Disparities Among LGBTQ Adolescents

Disparities in weight status by race/ethnicity and income level have been demonstrated in prior research (Kirby et al., 2012; Wang et al., 2011). In addition, lesbian, gay, bisexual, transgender, queer/questioning (LGBTQ) adolescents are more likely than their heterosexual counterparts to be overweight or obese (Miller & Luk, 2019). They are also more likely to engage in alcohol, tobacco, and other substance use; experience multiple forms of victimization, including bullying; and they are more likely to report depressive symptoms (Kann et al., 2016; National Academies of Sciences, 2020b). Minority stress is the leading framework for

understanding health disparities experienced by sexual and gender minorities (Meyer, 2003). It posits that internal and external stressors are enacted via social stigma and can have negative effects on both mental and physical health (Meyer, 2003). Much research has been conducted examining sexual-orientation-related mental health disparities among adolescents, but less has focused on physical health disparities—and even less on overweight and obesity. Previous research has shown that it is important to consider school contexts and peer influences when examining risk of overweight and obesity (Ohri-Vachaspati et al., 2015; Pratt et al., 2007).

2.4 Influence of School Climate on Health Behaviors and Risk Factors for Obesity

Given that adolescents spend a large portion of their days in schools, accounting for these contexts and how they influence obesity risk is important. School climate “refers to the quality and character of school life... based on patterns of people’s experience of school life and reflects norms, goals, values, interpersonal relationships, teaching and learning practices, and organizational structures” (Cohen et al., 2009, p. 182). School climate incorporates both social and physical aspects, referring to the relationships within schools, shared vision, school safety, and safety of the larger physical environment. A positive school climate is one that is beneficial for students and faculty, and one that promotes and affirms positive experiences such as perceived social support and high expectation of students. A negative school climate, on the other hand, promotes negative experiences and is associated with poor outcomes such as higher rates of students missing school due to safety reasons or exposure to discriminatory school policies. School climate is a multi-faceted concept, and proper measurement of school climate goes beyond a singular measure of school connectedness or school belonging (Zullig et al., 2010).

School climate does not directly impact weight status among adolescents; rather, it influences weight-related health behaviors and other factors that contribute to obesity risk, such as violence victimization. A positive school climate has the potential to decrease the high rates of obesity among adolescents by decreasing individual-level weight-related health behaviors and other risk factors for obesity. Weight-related health behaviors include physical inactivity, nutrition, tobacco use, alcohol, and other drug use. Other psychological and victimization-based risk factors risk factors for obesity include depression and feelings of safety at school that increase victimization risk, as well as harassment and discrimination.

2.5 Study Purpose

The aim of this study is to systematically review the literature that examines the influence of positive school climate on weight-related health behaviors and risk factors for obesity among LGBTQ adolescents. This review was informed by existing reviews that have examined overweight and obesity among LGBTQ adolescents (Grammer et al., 2019); sexual orientation disparities in disordered eating and weight-related behaviors among adolescents and young adults (Miller & Luk, 2019); and LGBTQ youth's experiences and engagement in physical activity (Greenspan et al., 2019). No reviews have examined the influence of school climate on physical health, revealing a gap in the literature. Given the important associations of school environments and weight status among adolescents in general (Institute of Medicine, 2013), and evidence that shows that school environments can impact alcohol use, drug use, and other weight-related health behaviors (Brook et al., 2010; Huang, D. Y. et al., 2013; Huang, K.-Y. et al., 2013), this review will help fill gaps in the literature by qualitatively synthesizing information on the impacts of positive school climate on weight-related health behaviors and risk factors for obesity among LGBTQ adolescents.

2.6 Methods

This systematic review was registered with the International Prospective Registry of Systematic Reviews (PROSPERO) (registration number CRD42020184243) prior to conducting the study. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati et al., 2009).

Data Sources and Search Strategy

The following seven electronic databases were searched on May 4, 2020: (a) PubMed; (b) PsycINFO; (c) Cumulative Index to Nursing and Allied Health Literature (CINAHL); (d) LGBT Life; (e) Education Resources Information Center (ERIC); (f) GenderWatch; and (g) Embase. The search strategy, developed by an iterative process, (see Appendix 1), was reviewed for robustness and accuracy with a medical library informationist before execution. The search was limited to English language articles; no date restrictions were applied. Search terms for each weight-related health behavior, as well obesity, were not included in the initial search to increase yield of studies to be reviewed for inclusion. The search was initially conducted in PubMed, and permutations of the key words and medical subject headings were created to replicate the search in the six other databases.

Study Selection and Eligibility for Full-Text Review

Figure 2 details the PRISMA flow diagram. Our search yielded 2124 articles; an additional five were identified through hand searching (i.e., reviewing the reference lists of relevant articles). All 2124 articles were imported into the web-based systematic review management software *Covidence* (<https://www.covidence.org/>). A total of 497 duplicate articles were removed, leaving 1632 for title and abstract screening. To be eligible for full-text review, a study needed to meet the following criteria: include youth ages 10- to 19-years-old who attended

middle schools or high schools; assess sexual and/or gender identity (i.e., identification as LGBTQ); assess school climate using a multi-faceted scale (Cohen et al., 2009); and include weight-related health behaviors and risk factors for obesity (i.e., physical inactivity, nutrition, victimization [e.g., peer victimization, bullying, trauma], depression, tobacco use, alcohol use, other drug use) as outcomes. In addition, only articles that reported findings from a quantitative, empirical study were included. There were no inclusion criteria related to how any of the above were defined or measured, with the exception of school climate needing to be measured using a multi-faceted scale. Exclusion criteria included studies focused on youth not in middle schools or high schools (i.e., homeless or incarcerated youth) and qualitative study designs. There were no exclusion criteria based on geographic location of the school. The first two authors (A.J.A. and E.B.M.) independently screened titles and abstracts for inclusion, with disagreements resolved until consensus was met. After eliminating 1592 articles that did not meet inclusion criteria, 40 articles were eligible for full-text review.

A comprehensive, full-text review of the 40 articles was then performed by the two reviewers independently, with disagreements again resolved and consensus met prior to data extraction. Thirty-one articles were eliminated for one or more of the following reasons: (a) the study used an incomplete measure of the multi-faceted school climate construct (e.g., only measured the presence of a gay-straight alliance or presence of positive teacher-student relationships (Cohen et al., 2009; Zullig et al., 2010)) ($n = 18$); (b) did not report results of an empirical study ($n = 5$); (c) measured negative school climate ($n = 4$); (d) school climate was included as a covariate or the outcome, rather than the main exposure ($n = 2$), and (e) did not measure sexual and/or gender identity ($n = 2$). Nine studies met the inclusion criteria and were included in the review.

Quality Appraisal

Because all included studies utilized cross-sectional designs, the Joanna Briggs Institute (JBI) Checklist for Analytical Cross-Sectional Studies Critical Appraisal Tool was used to assess risk of bias. Two reviewers were involved in the quality assessment (i.e., assessing risk of bias), with one main reviewer performing the quality assessment, and the other reviewer checking for accuracy.

The JBI Checklist includes eight criteria for evaluating potential bias in study design, conduct, and analysis. Criteria include questions related to sampling, description of study subjects, reliability and validity of exposure and outcome variable measurements, measurement of the condition of focus, and statistical analysis strategies (Joanna Briggs Institute, 2017). Response options for each of the eight items are “Yes,” “No,” “Unclear,” or “Not applicable.” The developers of the JBI Checklist for Analytical Cross-Sectional Studies did not assign a numerical scoring system to aid in determination of study quality. However, previously published systematic reviews using the JBI Checklist have assessed risk of bias using percentage scores (Lam et al., 2019; Melo et al., 2018). Accordingly, a score of “1” is assigned if the answer to any of the eight questions is “Yes.” Hence, the maximum possible score for each study is 8, with higher scores an indication of higher risk of bias. For this systematic review, overall quality scores were calculated as percentages based on answers of “Yes” to each of the eight questions. These procedures are detailed elsewhere (Melo et al., 2018). The risk of bias of each study was rated as low ($\geq 70\%$), moderate (50–69%), or high ($\leq 49\%$). None of the studies included in this review had a high risk of bias. Therefore, all nine were included in the review.

Data Extraction

Data extraction was performed by one reviewer (A.J.A.), with another reviewer (E.B.M.) checking extraction of the nine studies for accuracy. The study characteristics extracted, according to the JBI Checklist for Analytical Cross-Sectional Studies, included: author (year, country); population of interest (data collection year and source); sample characteristics; study purpose; measure of school climate; measure of weight-related health behaviors and risk factors; and main finding(s). See Table 2.1 for the data extraction. Inter-rater reliability across all seven domains of was 0.90. The only disagreements that arose were in the domains of sample characteristics and main finding(s). They were discussed and resolved before moving on to data synthesis. Data extraction and quality appraisal were performed using Microsoft Excel.

2.7 Results

Methodological Quality

According to the quality percentage scoring system for the JBI Checklist for Analytical Cross-Sectional Studies Critical Appraisal Tool (Joanna Briggs Institute, 2017; Melo et al., 2018), six of the studies had low risk of bias with quality percentage scores ranging from 75 to 100% (Colvin et al., 2019; Coulter et al., 2016; Denny et al., 2016; Eisenberg et al., 2020; Gower et al., 2018; Sterzing, 2012), whereas the other three studies had moderate risks of bias with quality percentage scores of 50% (Birkett et al., 2009; Espelage et al., 2008; Mcguire et al., 2010). These studies were scored as moderate risk mainly because confounding factors were not identified, and therefore strategies to deal with confounding were not mentioned. Further, two of these studies (Birkett et al., 2009; Espelage et al., 2008) measured LGBTQ status in a non-standard way. They did not assess sexual orientation (i.e., they did not include questions about sexual identity, sexual attraction, and/or sexual behaviors). Rather, they asked students if they

were ever confused about their sexual orientation, an unconventional method of sexual orientation assessment (Schrager et al., 2019). Nevertheless, the Birkett et al. (2009) and Espelage et al. (2008) studies met half of the JBI Checklist quality criteria. The Birkett et al. (2009) and McGuire et al. (2010) studies lost points because the outcomes were not assessed using reliable measures (see Table 2.1).

Study Characteristics

Table 2.2 shows the full data extraction table with characteristics of each of the nine studies. As mentioned above, each of the nine studies used cross-sectional designs with data collected between 2008 and 2019. Eight of the nine studies were conducted in the U.S. (Birkett et al., 2009; Colvin et al., 2019; Coulter et al., 2016; Eisenberg et al., 2020; Espelage et al., 2008; Gower et al., 2018; McGuire et al., 2010; Sterzing, 2012); one was conducted in New Zealand (Denny et al., 2016). Ages of study participants ranged between 12 and 19 years, and sample sizes ranged from 125 to 53,162. Six studies included only high school students (Colvin et al., 2019; Coulter et al., 2016; Denny et al., 2016; Eisenberg et al., 2020; Espelage et al., 2008; Gower et al., 2018). Three studies focused solely on LGBTQ students (Colvin et al., 2019; Eisenberg et al., 2020; Sterzing, 2012); the other six studies collected data from combinations of LGBTQ and heterosexual students (Birkett et al., 2009; Coulter et al., 2016; Denny et al., 2016; Espelage et al., 2008; Gower et al., 2018; McGuire et al., 2010). The studies included data collected at the city, county, state, and national levels.

The studies used a variety of scales to assess school climate. Although their scales were developed using different questions, Coulter et al. (2016) and Eisenberg et al. (2020) used data from the Centers for Disease Control and Prevention (CDC) to create school climate scores. Studies reviewed focused on different school climate concepts. For example, general school

climate (Birkett et al., 2009; Colvin et al., 2019; Denny et al., 2016; Espelage et al., 2008; Sterzing, 2012) and LGBTQ-specific school climate (Coulter et al., 2016; Eisenberg et al., 2020; Gower et al., 2018; McGuire et al., 2010) were measured. School climate was also measured from different perspectives. Three measures asked teachers, principals, and administrators about their perceptions of LGBTQ-related school climate (Coulter et al., 2016; Eisenberg et al., 2020; Gower et al., 2018), whereas the other six surveyed students and asked about positive school climates in general—so both the exposure and outcome data were reported by the students. Studies used measures with varying numbers of questions (range = 3-13). Lastly, reliability of scales varied (see Table 2.2). The Gower et al. (2018) and McGuire et al. (2010) studies did not provide a measure of reliability for their scales. Cronbach's α for the Eisenberg et al. (2019) study was 0.55, indicating low internal consistency (Tavakol & Dennick, 2011).

For weight-related health behaviors, of the nine studies, four examined tobacco use, alcohol use, marijuana use, and prescription drug use (Birkett et al., 2009; Coulter et al., 2016; Eisenberg et al., 2020; Espelage et al., 2008). Coulter et al. (2016) and Eisenberg et al. (2020) used data from the CDC to measure alcohol use and heavy episodic drinking (HED) in the last 30 days. Birkett et al. (2014), and Espelage et al. (2008) measured alcohol/marijuana use in the last 12 months using the same three-item scale. None of the other studies used similar items or scales to measure these weight-related health behaviors.

Seven of the nine studies examined risk factors for obesity including depression/suicidal ideation, bullying victimization and perpetration, sexual orientation-based harassment, and feelings of safety (Birkett et al., 2009; Colvin et al., 2019; Denny et al., 2016; Espelage et al., 2008; Gower et al., 2018; McGuire et al., 2010; Sterzing, 2012). Birkett et al. (2009) and Espelage et al. (2008) used the same two questions to measure suicidality/depression, although

Espelage and colleagues measured this on a scale and provided a measure of internal consistency, whereas Birkett and colleagues did not.

Only three of the nine studies collected demographic data on gender identity (Colvin et al., 2019; Mcguire et al., 2010; Sterzing, 2012); two of these (Colvin et al., 2019; Mcguire et al., 2010) analyzed data from students who identified as gender minorities, although subgroup analyses for gender minorities was not performed (and therefore no specific conclusions can be made for transgender and gender diverse adolescents). The heterogeneity of the studies across multiple domains is clear.

School Climate and Weight-Related Health Behaviors

Four of the nine studies examined the association between school climate and negative weight-related health behaviors (e.g., tobacco use, alcohol use, other drug use) among LGBTQ adolescents (Birkett & Espelage, 2015; Coulter et al., 2016; Eisenberg et al., 2020; Espelage et al., 2008), with one study performing moderation analyses to determine whether positive school climate moderated the association between sexual orientation and weight-related health behaviors (Birkett & Espelage, 2015). Results were mixed. Birkett and colleagues (2009) found that alcohol/marijuana use was lower for both LGBQ and heterosexual students in schools with more positive school climates than in schools with less positive school climates. However, Espelage and colleagues (2008) found that school climate was not a significant moderator in the relationship between homophobic teasing and alcohol/marijuana use among LGBQ youth. For alcohol outcomes alone, Coulter and colleagues (2016) found significant associations between positive school climate and fewer drinking days at school for unsure adolescents, as well as fewer HED days for both heterosexual and gay/lesbian adolescents. However, there was no association between positive school climate and number of overall drinking days (not necessarily

on school property). Eisenberg and colleagues (2019) included the largest number of weight-related health behaviors in their study. They included 30-day tobacco use, alcohol use, HED, marijuana use, and prescription drug use as outcomes and number of in-school resources for LGBQ students as their measurement of school climate. Results showed that none of the outcomes were significantly related to the number of in-school resources.

School Climate and Obesity Risk Factors

Seven of the nine studies examined the association between obesity risk factors and positive school climates among LGBTQ adolescents (Birkett et al., 2009; Colvin et al., 2019; Denny et al., 2016; Espelage et al., 2008; Gower et al., 2018; McGuire et al., 2010; Sterzing, 2012). Across all seven studies, LGBTQ students in more positive school climates reported lower levels of suicidal/depressive feelings (Birkett et al., 2009; Espelage et al., 2008), depressive symptoms (Colvin et al., 2019; Denny et al., 2016), bullying victimization (Gower et al., 2018; Sterzing, 2012), and sexual orientation-based harassment (Gower et al., 2018). Also, compared with less positive school climates, these studies found higher levels of perceived safety (McGuire et al., 2010).

Three of the nine studies performed moderation analyses to determine whether positive school climate moderated the association between sexual identity and risk factors for obesity (Birkett & Espelage, 2015; Denny et al., 2016; Gower et al., 2018). Birkett and colleagues (2009) found no differential impact of sexual identity on the association between positive school climate and depression/suicidal feelings. Gower and colleagues (2018) also found no differential impact of sexual identity on the association between LGBT supportive climate and bullying victimization. On the other hand, Denny and colleagues (2016) found that positive school climates were associated with fewer depressive symptoms only among gay/bisexual male

adolescents; there were no significant associations for lesbian/bisexual female or heterosexual adolescents.

2.8 Discussion

The purpose of this review was to qualitatively synthesize current literature on the relationship between positive school climate and weight-related health behaviors and other risk factors for obesity among LGBTQ adolescents. Existing reviews have documented higher prevalence of overweight and obesity among LGBTQ adolescents, especially among sexual minority females, than their heterosexual peers (Grammer et al., 2019; Miller & Luk, 2019). Reviews have also found lower rates of physical activity participation and sport involvement in this population compared to heterosexual adolescents (Greenspan et al., 2019; Miller & Luk, 2019). Findings have suggested that sexual minority males are more likely to binge eat (Miller & Luk, 2019), which can increase obesity risk over time (National Institute of Mental Health, 2018). This current review adds to the existing literature by synthesizing evidence related to contextual factors that can impact weight-related health behaviors and obesity risk.

Results show that positive school climate is an important contextual influence in risk factors for obesity, and that promoting positive school climates can potentially help reduce sexual- and gender-related health disparities in obesity. Seven of nine studies reviewed found that LGBTQ adolescents in more positive school climates reported lower levels of bullying victimization, depressive and suicidal feelings, and sexual orientation-based harassment than those in less positive school climates. These studies included students who attended middle schools and high schools in both urban and rural school districts. The presence of a supportive adult at school, anti-bullying policies protective of LGBTQ adolescents, and the presence of

gender-sexuality alliances (GSAs)—all components of a positive school climate—were found to be significantly associated with lower risk factors for obesity among LGBTQ adolescents.

However, results were mixed for weight-related health behaviors. Each of the four studies that examined impacts of school climate on these behaviors included alcohol use as a behavioral outcome. Two studies found lower rates of alcohol use among LGBTQ students enrolled in schools with more positive school climates vs. less positive school climates (Birkett et al., 2009; Coulter et al., 2016). However, the other two studies found no significant associations between school climate and alcohol use (Eisenberg et al., 2020; Espelage et al., 2008). Interestingly, although two of the studies (Birkett et al., 2009; Espelage et al., 2008) used the same 3-item scale to measure alcohol/marijuana use, their results differed. This may be explained, in part, by differences in ages and grades included in the study: the Espelage sample included high school students (mean age = 15.8), and the Birkett sample included middle school students (ages 12–14). In a longitudinal study focused on students in grades 6–8 in Illinois, perceptions of positive school climate declined over the three years of middle school (i.e., students’ perceptions of school climate grew more negative over the years, with sharper declines found among girls than among boys) (Way et al., 2007). Although Way and colleagues used a general student population and did not assess sexual or gender identity, this pattern may also hold for LGBTQ students. It is also important to note that alcohol use tends to increase as one transitions from middle school to high school (Jackson & Schulenberg, 2013). Future research using longitudinal designs are needed to assess how school climate perceptions and alcohol use trends change over time among LGBTQ adolescents, especially with changing political attitudes.

Nevertheless, the evidence seems strong that LGBTQ adolescents, in more positive school climates, are at lower risk of bullying victimization and depressive/suicidal feelings than

those in less positive school climates. These findings might indicate that age and school setting do not matter as much in the relationship between school climate and victimization outcomes—compared to the relationship between school climate and weight-related health behaviors—because some of the studies that examined these school climate and victimization outcomes studied adolescents that were also of middle school age (Birkett et al., 2009; McGuire et al., 2010). Future research should examine the possible differential impacts of school climate on weight-related health behaviors and risk factors for obesity over time among LGBTQ adolescents, as they age and move from middle schools to high schools.

Moreover, mixed findings can also be due to the differences in reliability between the school climate measures among the four studies. Notably, Eisenberg and colleagues (2019) used a 4-item in-school resources scale that had a Cronbach's alpha of 0.55. Prior research has deemed a Cronbach's alpha value of 0.70 or higher to be acceptable (Devellis, 2016). Causes of a low alpha value could be due to poor inter-relatedness between scale items, low number of questions, or inclusion of heterogeneous constructs in one scale (Tavakol & Dennick, 2011). School climate is a multi-faceted concept whose measurement should be valid and reliable and contain multiple items that measure concepts from school connectedness to teacher support (Zullig et al., 2010). It is possible that the null findings of Eisenberg et al. (2019) regarding the relationship between perceptions of school climate and substance use outcomes was the result of poor scale reliability. Future research should seek to measure school climate using more valid and reliable scales, including scales that are sensitive to the unique experiences of LGBTQ adolescents. It is also interesting to note that of the four studies to include an LGBTQ-specific measure of positive school climate (i.e., the measure included items that would be salient for LGBTQ students such as safe space stickers and LGBTQ representation in curricula), as opposed

to a more general measure of school climate, the study conducted by Eisenberg and colleagues (2019) is the only one not to have significant associations of the LGBTQ-specific school climate measure and weight-related health outcomes.

Finally, because the construct school climate can be operationalized using a wide range of disparate factors (e.g., peer support, teacher and administration support, policy, physical environment), it may be that more singular measures of school support are more useful when examining risk factors among LGBTQ adolescents. A 2014 meta-analysis of minority stress and substance use in sexual minority adolescents (SMA) found that support from an adult figure in school was significantly associated with lower risk of substance use. Students who perceived less support from adults at school reported higher levels of substance use compared to their peers who reported greater support (Goldbach et al., 2014). Given mixed findings from this systematic review for weight-related health behaviors, and that no two school climate measures used were the same, it may be that for certain health behaviors, specific aspects of school climate may be more relevant than others for LGBTQ adolescents.

2.9 Limitations

Findings from this systematic review have the potential to improve the weight-related health of LGBTQ adolescents through an examination of health behaviors and obesity risk factors that are impacted by school climate. However, the review is not without limitations. One limitation is that we restricted the search to articles written in English. Also, no two studies included the same school climate measures, and reliability of these measures were not all of generally accepted values. This compromises replicability and comparison across studies. Moreover, it is well-documented that diet (Brown et al., 2015; Kumar & Kelly, 2017; Story et al., 2008), physical activity (Brown et al., 2015; Iannotti & Wang, 2013), built environment

(Iannotti & Wang, 2013), and income level (Story et al., 2008) all affect obesity rates among adolescents. However, this literature review was unable to assess the impacts of positive school climate on these outcomes because no studies were found that examined these relationships. Future students should seek to examine these associations. However, major strengths of this review include searching a total of seven databases and also including grey literature in our search domains.

2.10 Conclusion

Although no study directly examined the impact of positive school climate on weight status specifically, this systematic review was still able to draw from prior literature and known relationships between school-related factors and obesity risk to examine associations between weight-related health behaviors (i.e., tobacco use, alcohol and other drug use) and risk factors for obesity (i.e., depressive/suicidal feelings, bullying victimization, and perceived safety at school) and school climate. Results for school climate and risk factors for obesity that were included in this study were clear: in the presence of more positive school climates, LGBTQ adolescents report fewer of these risk factors than in the presence of less positive school climates. However, results for weight-related health behaviors were more mixed. Future research should examine the role that individual aspects of school climate play on weight-related health behaviors among LGBTQ adolescents and also the ways in which perceptions of school climate may change with age and moving from middle school to high school.

Table 2.1*Characteristics of Included Studies (n = 9)*

| Author (year, country) | Population of interest (data collection year and source) | Sample characteristics (<i>N</i> ; age; sex; race/ethnicity; % LGBTQ; urbanicity ^a) | Study purpose | Measure of school climate | Measures(s) of weight-related health behaviors and risk factors | Main finding(s) |
|--------------------------------|--|--|---|---|--|---|
| 1. Birkett et al. (2009, U.S.) | 7 th and 8 th grade middle school students (2005 Dane County Youth Survey) | County sample (<i>N</i> = 6,667; ages 12–14; 51% female; 73% White; 15% LGBTQ; urban) | To examine how school climate and homophobic teasing affect suicidality/depression, drug use, and truancy among LGBTQ and heterosexual adolescents | 8-item positive school climate scale; student-reported ($\alpha = 0.78$) | Alcohol and drug use- 3-item scale measuring alcohol/marijuana use [†] ($\alpha = 0.85$) Suicidality/depression- 2 items measuring depression/suicidality ^{††} ($r = 0.48$) | In the presence of a more positive school climate, alcohol/marijuana use and depression/suicidal feelings were lowest for both LGBTQ and heterosexual students. |
| 2. Colvin et al. (2019, U.S.) | High school students (2019 online survey) | National sample (<i>N</i> = 240; ages 14–18 [mean age 15.8]; 16% cisgender female, 3% transgender female, 20% nonbinary; 62% White; 100% LGBTQ; unclear urbanicity) | To investigate how school climate, supportiveness of school personnel, and presence of a Gay-Straight Alliance are associated with depressive and anxiety | 3-item adapted California School Climate Survey ^b ; student-reported ($\alpha = 0.90$) | Depression- 9-item Patient Health Questionnaire-9 ^b for children ages 11-17 (past-week depressive symptoms) ($\alpha = 0.89$) | More positive school climate is associated with lower depressive symptoms (0.13 points on a 3-point scale; $p < 0.05$) for LGBTQ adolescents. |

| Author (year, country) | Population of interest (data collection year and source) | Sample characteristics (<i>N</i> ; age; sex; race/ethnicity; % LGBTQ; urbanicity ^{a)}) | Study purpose | Measure of school climate | Measures(s) of weight-related health behaviors and risk factors | Main finding(s) |
|--------------------------------|---|--|---|---|--|--|
| 3. Coulter et al. (2016, U.S.) | High school students (2005 and 2007 Youth Risk Behaviors Surveys) | Sample from eight U.S. cities and states (<i>N</i> = 53,162; ages 13–18 or older; sex and race/ethnicity demographics not provided; 6.9% LGBQ; urban) | symptoms among LGBTQ adolescents To examine the effects of LGBTQ school climate on drinking behaviors stratifying by sexual orientation subgroup | 8-item LGBTQ school climate scale; principal and teacher reported ($\alpha = 0.97$) | Drinking days- 1 item measuring number of days drank at least one drink of alcohol ^{††} Drinking days at school- 1 item measuring number of days drank at least one drink of alcohol on school property ^{††} HED days- 1 item measuring number of days drank 5+ drinks of alcohol in a row ^{††} | LGBTQ school climate was not associated with overall drinking days. More positive school climate associated with fewer drinking days specifically at schools for unsure adolescents (IRR = 0.57, 95% CI = 0.35-0.94). More positive school climate associated with fewer HED days for both heterosexual (IRR = 0.80, 95% CI = 0.76-0.83) and gay/lesbian adolescents (IRR = 0.70, 95% CI = 0.56-0.87). |

| Author (year, country) | Population of interest (data collection year and source) | Sample characteristics (<i>N</i> ; age; sex; race/ethnicity; % LGBTQ; urbanicity ^a) | Study purpose | Measure of school climate | Measures(s) of weight-related health behaviors and risk factors | Main finding(s) |
|-------------------------------------|---|---|--|---|--|---|
| 4. Denny et al. (2016, New Zealand) | High school students (2007 high school survey;) | Nationally-representative sample (<i>N</i> = 9,107; ages 13–17; 46% female; 52.6% New Zealand European ^d ; 4.4% LGBQ; 84% urban) | To examine if LGB status moderates the relationship between school environments and mental health outcomes | 7-item supportive school environment scale; student-reported (α = 0.86) | Depression-10-item Reynolds Adolescent Depression Scale-Short Form ^b (no specified time frame) (α = 0.88) | More positive school environment associated with report of fewer depressive symptoms (p = 0.006) for male GB adolescents, but not for female LB adolescents; no association between school environments and depressive symptoms for heterosexual students. |
| 5. Eisenberg et al. (2019, U.S.) | 9 th and 11 th grade high school students (2013 Minnesota Student Survey) | State sample from 81 different schools (<i>N</i> = 2454; 55.4% 9 th graders ^d ; 54% female; 63.9% white; 100% LGBQ; 38.2% urban) | To examine the effects of school and community supports for LGBQ students on substance use behaviors | 4-item in-school resources scale; principal and teacher reported (α = 0.55) | Cigarette smoking- 1 item measuring number of days smoked a cigarette ^{††} Alcohol use- 1 item measuring number of days drank one or more alcoholic beverages ^{††} Heavy episodic drinking- 1 item measuring number of | Odds for all outcomes were not significantly altered by number of in-school resources (e.g., moderate versus none and high versus none). |

| Author (year, country) | Population of interest (data collection year and source) | Sample characteristics (<i>N</i> ; age; sex; race/ethnicity; % LGBTQ; urbanicity ^a) | Study purpose | Measure of school climate | Measures(s) of weight-related health behaviors and risk factors | Main finding(s) |
|----------------------------------|--|--|---|---|--|---|
| | | | | | <p>days drank five or more drinks in a row ††</p> <p>Marijuana use- 1 item measuring number of days used marijuana or hashish ††</p> <p>Prescription drug misuse- 1 item measuring number of days used prescription drugs not prescribed for individual ††</p> | |
| 6. Espe-lage et al. (2008, U.S.) | High school students (2005 Dane County Youth Survey) | County sample (<i>N</i> = 13,921; mean age = 15.8; 50% female; 79% White; 14% LGBTQ; urban) | To understand the degree to which parental communication-support and positive school climate influence psychological outcomes among adolescents questioning their sexuality | 6-item general school climate scale; student-reported ($\alpha = 0.78$) | <p>Alcohol and drug use- 3-item scale measuring frequency of alcohol-marijuana use (no specified time frame) ($\alpha = 0.85$)</p> <p>Suicidality/depression- 2-item scale measuring</p> | <p>School climate was not a significant moderator in the relationship between homophobic teasing and alcohol and drug use among LGBTQ youth.</p> <p>School climate was a significant moderator of the relationship between homophobic</p> |

| Author (year, country) | Population of interest (data collection year and source) | Sample characteristics (<i>N</i> ; age; sex; race/ethnicity; % LGBTQ; urbanicity ^a) | Study purpose | Measure of school climate | Measures(s) of weight-related health behaviors and risk factors | Main finding(s) |
|------------------------------|---|---|---|--|--|---|
| | | | compared to those who identify as homosexual | | depression/suicidal feelings ^{††} ($\alpha = 0.64$) | teasing and depression/suicidal feelings among LGBQ youth; across all levels of homophobic teasing, students who reported moderate to high levels of positive school climate reported significantly less depression/suicidal feelings ($p < 0.001$, $\eta^2 = 0.2$). |
| 7. Gower et al. (2018, U.S.) | 9 th and 11 th grade high school students (2013 Minnesota Student Survey) | State-representative sample from 103 different schools ($N = 31,183$; 53.1% 9 th graders ^d ; 49.8% female; 75.4% white; 6.3% LGBQ; 33% urban) | To examine how the number of LGBT-supportive practices a school implements is related to reports of bullying involvement among students | 6-item LGBT-supportive climate; school administrator reported ^e | Relational bullying victimization- 2 items measuring how often rumors or lies were spread about individual or if was purposefully excluded from friends or events ^{††} Physical bullying perpetration- 2 items measuring how often | Sexual orientation did not moderate the associations between LGBT-supportive climate and bullying involvement; however, students who attended schools with more supportive LGBT climate had lower odds of (a) relational bullying |

| Author (year, country) | Population of interest (data collection year and source) | Sample characteristics (<i>N</i> ; age; sex; race/ethnicity; % LGBTQ; urbanicity ^a) | Study purpose | Measure of school climate | Measures(s) of weight-related health behaviors and risk factors | Main finding(s) |
|---------------------------------|---|---|---|--|---|---|
| | | | | | physically perpetrated or threatened to physically perpetrate another individual ^{††} Sexual orientation-based harassment- 1 item measuring how often harassed or bullied because someone thought individual was LGBTQ ^{††} | victimization (OR = 0.96, 95% CI = 0.92-0.99); (b) physical bullying perpetration (OR = 0.93, 95% CI = 0.89-0.98); and (c) sexual orientation-based harassment (OR = 0.95, 95% CI 0.91-0.998) compared to students who attended schools with less positive school climates. |
| 8. Mc-Guire et al. (2010, U.S.) | 6 th to 12 th grade middle and high school students (2003, 2004, and 2005 Preventing School Harassment Surveys) | State sample (<i>N</i> = 2,260; median grade 10.5 ^d ; unclear sex breakdown; 50% white; 34% LGBTQ; 0.030 transgender-identifying; unclear urbanicity) | To examine the associations between interpersonal risk and protective factors and feelings of safety and well-being among trans youth | 5 items measuring positive school climate; student-reported ^e | Perceived safety- 2 items measuring personal safety and perceived safety of gender non-conforming peers (no specified time frame) (<i>r</i> = 0.52) | Positive school climate was indirectly associated with trans students' feelings of safety via connection to adults (<i>p</i> < 0.01). |
| 9. Sterzing et | Adolescents (2010 survey) | Local sample (<i>N</i> = 125; ages 15–19) | To identify modifiable and | 13-item Thoughts | Adapted Swearer Bullying Survey: | LGB adolescents in more positive school |

| Author (year, country) | Population of interest (data collection year and source) | Sample characteristics (<i>N</i> ; age; sex; race/ethnicity; % LGBTQ; urbanicity ^a) | Study purpose | Measure of school climate | Measures(s) of weight-related health behaviors and risk factors | Main finding(s) |
|------------------------|---|--|--|---|---|--|
| al. (2012, U.S.) | administered to students in St. Louis, MO and Indianapolis, IN) | years [mean age 17.2]; 48.8% female, 40.8% male, 10.4% transgender-identifying; 68.6% white; 100% LGBQ; not urban) | non-modifiable risk and protective factors associated with bullying victimization and mental health problems among sexual minority adolescents (SMA) | About School ^b positive school climate scale; student-reported ($\alpha = 0.88$) | Bullying victimization ^b - 1 item measuring if ever been bullied in lifetime Verbal bullying victimization- 4 items measuring verbal bullying ^{†††} ($\alpha = 0.85$) Relational bullying victimization- 7 items measuring relational bullying ^{†††} ($\alpha = 0.82$) Electronic bullying victimization- 3 items measuring electronic bullying ^{†††} ($\alpha = 0.80$) Physical bullying victimization- 4 items measuring physical bullying ^{†††} ($\alpha = 0.79$) | climates had lower frequencies of all types of bullying victimization except for electronic bullying victimization (all <i>p</i> -values < .05). |

Note. All studies had a cross-sectional design.

α = Cronbach's alpha, a measure of internal consistency. r = Pearson's correlation coefficient, a measure of association between two continuous variables. IRR = incidence rate ratio. η = effect size, a measure of the strength of the effects. OR = odds ratio.

^a Urbanicity = the degree to which a given geographical area is urban. ^b These are the exact names of the scales used. ^c This study used the standard ethnicity question of the New Zealand census to measure ethnicity. ^d These studies did not provide ages of participants in their studies, but rather provided information on grade level. ^e No Cronbach's alpha reported.

[†] Time frame = within last 12 months. ^{††} Time frame = within last 30 days. ^{†††} Time frame = within last school year.

Table 2.2

The Joanna Briggs Institute Checklist for Analytical Cross-Sectional Studies Critical Appraisal Tool

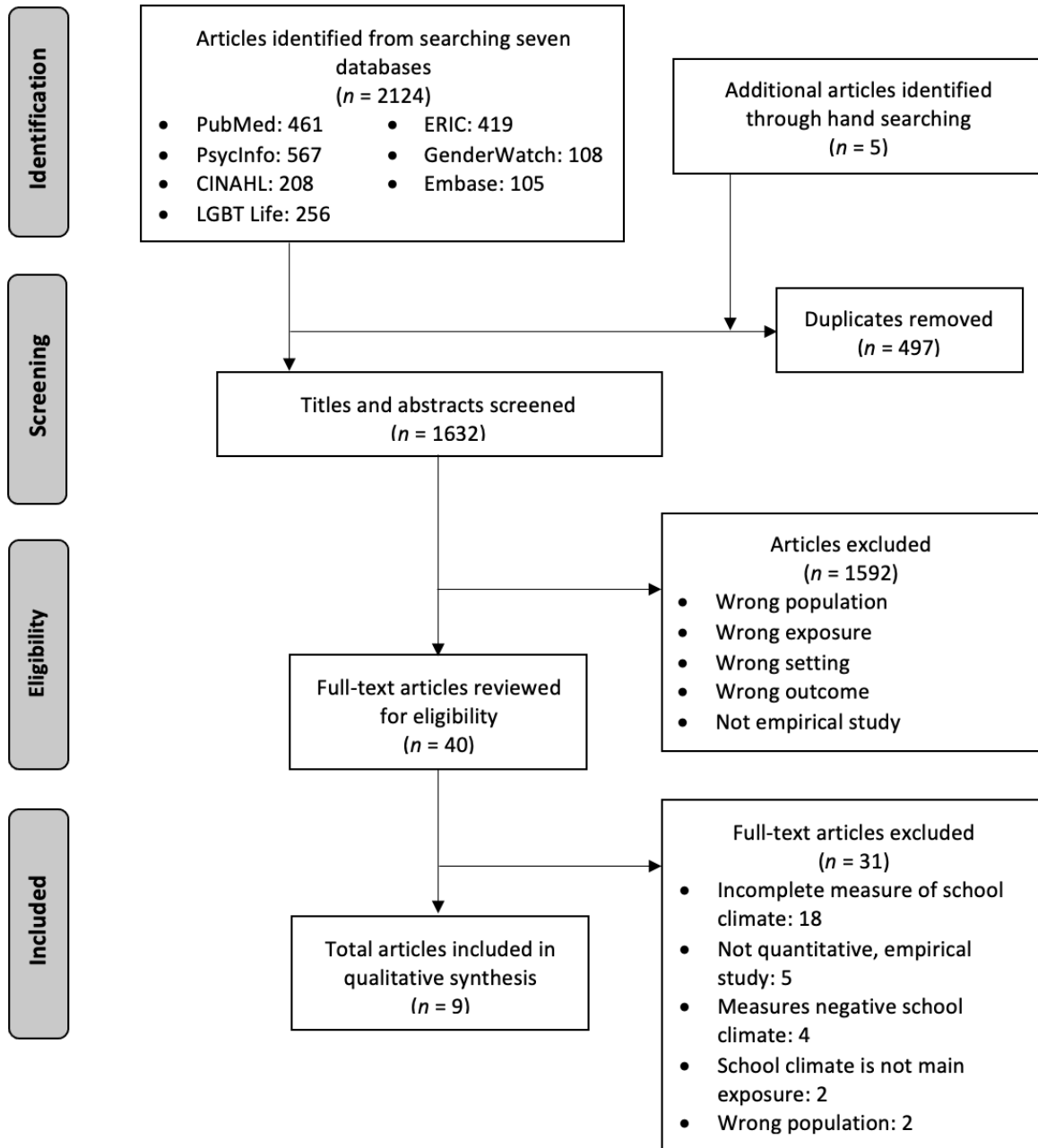
| Author (year) | 1. Were the criteria for inclusion in the sample clearly defined? | 2. Were the study subjects and the setting described in detail? | 3. Was the exposure measured in a valid and reliable way? | 4. Were objective, standard criteria used for measurement of the condition? | 5. Were confounding factors identified? | 6. Were strategies to deal with confounding factors stated? | 7. Were the outcomes measured in a valid and reliable way? | 8. Was appropriate statistical analysis used? | Score percentage (%) | Risk of bias ^a (low/moderate/high) |
|------------------------------|---|---|---|---|---|---|--|---|----------------------|--|
| Birkett et al. (2009) | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | ✗ | ✓ | 50% | Moderate |
| Colvin et al. (2019) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 100% | Low |
| Coulter et al. (2016) | ✗ | ✗ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 75% | Low |
| Denny et al. (2016) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 100% | Low |
| Eisenberg et al. (2019) | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | 75% | Low |
| Espelage et al. (2008) | ✗ | ✓ | ✓ | ✗ | ✗ | ✗ | ✓ | ✓ | 50% | Moderate |
| Gower et al. (2018) | ✓ | ✓ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | 75% | Low |
| McGuire et al. (2010) | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | ✓ | 50% | Moderate |
| Sterzing et al. (2012, U.S.) | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | 100% | Low |

Note. ✓ = Yes, ✗ = No.

^a Risk of bias: low = score of 70% or higher, moderate = 50%–69%, high = 49% or lower.

Figure 2

PRISMA Flow Diagram Illustrating the Literature Search



Note. CINAHL stands for Cumulative Index to Nursing and Allied Health Literature. ERIC stands for Education Resources Information Center.

Appendices

Appendix 1

Search Strategy for Systematic Review

| Database | Search strategy | Results |
|---------------------|---|---------|
| PubMed | (<u>Sexual and Gender Minorities</u> [mh] OR sexual identit*[tiab] OR sexual minorit*[tiab] OR sexual orientation*[tiab] OR <u>Homosexuality, Male</u> [mh] OR gay*[tiab] OR <u>Homosexuality, Female</u> [mh] OR lesbian*[tiab] OR <u>Bisexuality</u> [mh] OR bisexual*[tiab] OR <u>Homosexuality</u> [mh] OR homosexual*[tiab] OR lgb*[tiab] OR <u>Transgender Persons</u> [mh] OR transgender*[tiab]) AND (<u>Adolescent</u> [mh] OR adolescen*[tiab] OR <u>Child</u> [mh] OR child*[tiab] OR teen*[tiab] OR kid*[tiab] OR youth*[tiab] OR <u>Students</u> [mh] OR student*[tiab]) AND ((<u>Schools</u> [mh] OR school*[tiab] OR "school" OR "schools") AND (climate*[tiab] OR "climate" OR "climates" OR environment*[tiab] OR "environment" OR "environments")) | 461 |
| PsycInfo | (TI (sexual identit* OR sexual minorit* OR sexual orientation* OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*) OR AB (sexual identit* OR sexual minorit* OR sexual orientation* OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*) OR (MJ sexual orientation OR MJ sexual minority OR MJ homosexual)) AND (TI (adolescen* OR child* OR teen* OR kid* OR youth*) OR AB (adolescen* OR child* OR teen* OR kid* OR youth*) OR (MJ adolescent OR MJ youth OR MJ child OR MJ students)) AND ((TI (school* OR MJ schools) AND (climate* OR environment*)) OR (AB (school* OR MJ schools) AND (climate* OR environment*)) OR MJ school environment)) | 567 |
| CINAHL ^a | (TI (sexual identit* OR sexual minorit* OR sexual orientation* OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*) OR AB (sexual identit* OR sexual minorit* OR sexual orientation* OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*) OR (MJ sexual orientation OR MJ sexual minority OR MJ homosexual)) AND (TI (adolescen* OR child* OR teen* OR kid* OR youth*) OR AB (adolescen* OR child* OR teen* OR kid* OR youth*) OR (MJ adolescent OR MJ youth OR MJ child OR MJ students)) AND ((TI (school* OR MJ schools) AND (climate* OR environment*)) OR (AB (school* OR MJ schools) AND (climate* OR environment*)) OR MJ school environment)) | 208 |
| LGBT Life | (TI (sexual identit* OR sexual minorit* OR sexual orientation* OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*) OR AB (sexual identit* OR sexual minorit* OR | 256 |

| Database | Search strategy | Results |
|-------------------|---|---------|
| ERIC ^b | sexual orientation* OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*) OR (MJ sexual orientation OR MJ sexual minority OR MJ homosexual)) AND (TI (adolescen* OR child* OR teen* OR kid* OR youth*) OR AB (adolescen* OR child* OR teen* OR kid* OR youth*) OR (MJ adolescent OR MJ youth OR MJ child OR MJ students)) AND ((TI (school* OR MJ schools) AND (climate* OR environment*)) OR (AB (school* OR MJ schools) AND (climate* OR environment*)) OR MJ school environment))) | 419 |
| GenderWatch | (TI("sexual identity" OR "sexual identities" OR "sexual minority" OR "sexual minorities" OR "sexual orientation" OR "sexual orientations" OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*) OR AB("sexual identity" OR "sexual identities" OR "sexual minority" OR "sexual minorities" OR "sexual orientation" OR "sexual orientations" OR gay* OR lesbian* OR bisexual* OR homosexual* OR lgb* OR transgender*)) AND (TI(adolescen* OR child* OR teen* OR kid* OR youth*) OR AB(adolescen* OR child* OR teen* OR kid* OR youth*)) AND ((TI(school* AND (climate* OR environment*)) OR (AB(school* AND (climate* OR environment*)))) | 108 |
| Embase | ('sexual and gender minority'/exp OR 'sexual orientation'/exp OR 'sexual identit*':ab,ti OR 'sexual minorit*':ab,ti OR 'sexual orientation*':ab,ti OR 'gay*':ab,ti OR 'lesbian*':ab,ti OR 'bisexual*':ab,ti OR 'homosexual*':ab,ti OR 'lgb*':ab,ti OR 'transgender*':ab,ti) AND ('juvenile'/exp OR 'student'/exp OR 'adolescen*':ab,ti OR 'child*':ab,ti OR 'teen*':ab,ti OR 'kid*':ab,ti OR 'youth*':ab,ti OR 'student*':ab,ti) AND ('high school'/exp OR 'middle school'/exp OR 'primary school'/exp) AND ('climate'/exp OR 'climate*':ab,ti OR 'environment'/exp OR 'environment*':ab,ti) | 105 |

Note. The search was conducted on May 4, 2020.

Chapter 3: Interpersonal- and Community-Level Risk Factors for Adolescent Obesity: An Examination of Sexual Identity, School Violence, and School Climate in a Large Sample of Urban Adolescents

3.1 Introduction

Adolescent obesity is a major health concern in the United States (U.S.). Despite knowledge of its negative impact on health and wellbeing during this developmental stage and later in adulthood (Institute of Medicine Committee on Accelerating Progress in Obesity Prevention, 2012), obesity rates have steadily increased over the past two decades (Ogden et al., 2020). The prevalence of obesity among youth is highest (20.9%) among those ages 12-19 (Ogden et al., 2020), and prior work has consistently uncovered racial/ethnic and sexual minority adolescent disparities in obesity, with Black and Hispanic and sexual minority adolescents typically showing higher rates of obesity than their White, heterosexual peers (Ancheta et al., 2020; Johnson et al., 2021; National Academies of Sciences, 2019a). Obesity impacts both the physical and mental health of adolescents. Adolescent obesity is associated with high blood pressure and dyslipidemia (Cote et al., 2013), type 2 diabetes (Bacha & Gidding, 2016), obstructive sleep apnea, and nonfatty liver disease, among other physical health conditions (Kumar & Kelly, 2017; Suglia et al., 2018). Adolescents who are obese are also at elevated risk of teasing and bullying by peers (Van Geel et al., 2014a) and are more likely than non-bullied adolescents to report being depressed (Griffiths et al., 2010; Madowitz et al., 2012). Further, adolescent obesity is linked with obesity in adulthood (Gordon-Larsen et al., 2010), which is in

turn associated with chronic conditions such as cardiovascular disease and cancer (Jensen et al., 2014).

3.2 Correlates of Obesity

The correlates of adolescent obesity in the U.S. are multifactorial. Beyond excess caloric intake and low engagement in physical activity, other upstream factors also affect weight control and related behaviors, including individual and family socioeconomic status, education level, housing status, neighborhood and locality, and employment and occupation (National Academies of Sciences, 2019a). The Social Ecological Model (SEM) (Bronfenbrenner, 1979), which can be used to contextualize multi-level determinants of adolescent obesity (Davison & Birch, 2001), postulates that an individual's health is influenced by personal factors (e.g., age, sex, race/ethnicity, genetics) and the environments in which they find themselves (e.g., friends and family, local community, physical environment, policy contexts) (Sallis et al., 2015). These factors are located within levels, which are nested within each other, with more proximal factors having direct influence and more distal factors having indirect influence on health outcomes (see Figure 1). There is consensus that multiple levels of influence must be considered when developing effective interventions to reduce childhood and adolescent obesity in the U.S. (Institute of Medicine Committee on Accelerating Progress in Obesity Prevention, 2012; Institute of Medicine Committee on Prevention of Obesity in Children and Youth, 2005; National Academies of Sciences, 2019a).

3.3 School Contexts

One context of particular importance for adolescents and healthy weight is schools. Adolescents spend a substantial portion of their time in school (Chung et al., 2018; National Academies of Sciences, 2019b), and schools have been identified as a key location for obesity

prevention initiatives (Institute of Medicine Committee on Prevention of Obesity in Children and Youth, 2005). At the interpersonal-level, school violence, or violent acts that occur on school property or during school-sponsored events, disrupts learning and has negative effects on students and their communities (National Center for Injury Prevention and Control, 2021). School violence also includes violent acts that occur on the way to or from school property or during school-sponsored events, as well as cyberbullying that may or may not be enacted during schooltime, but is influenced by school peers and school-related activities (National Center for Injury Prevention and Control, 2021). Although prior research has linked adverse childhood experiences, such as school violence victimization, with higher risk for overweight/obesity during adolescence (Davis et al., 2019; Midei & Matthews, 2011) and later on during adulthood (Davis et al., 2019; Suglia et al., 2018), school violence is frequently overlooked in school-based obesity prevention interventions (Jacob et al., 2021).

At the community-level, school climate, or the experience of school life, based on norms, values, relationships, connectedness, academic outcomes, and physical environment, can also greatly influence obesity risk among adolescents (Zullig et al., 2010). The physical activity environments and food available at schools are part of school climate and play a large role in food choices and exercise participation among adolescents (Jacob et al., 2021; State of Childhood Obesity, 2021). However, other aspects of school climate can also influence obesity risk, such as climates that allow or perpetuate stigma and acts of discrimination against certain minority groups, by students, teachers, or staff. It is well-documented that institutional racism and other forms of discrimination impact obesity (Aaron & Stanford, 2021; National Academies of Sciences, 2019a), but more needs to be known about the relationship between bias-based discrimination and obesity among adolescents in schools.

3.4 Weight Disparities Among Sexual Minority Adolescents

Sexual minority adolescents (SMA; i.e., those who identify as gay/lesbian or bisexual, or who are unsure of their sexual identity) experience disparities in both obesity and school violence victimization. Subgroups of SMA, especially lesbian and bisexual girls, have higher prevalence of obesity than their heterosexual peers (Ancheta et al., 2020; Katz-Wise et al., 2014a; Mereish & Poteat, 2015); this has been demonstrated in population-based cross-sectional studies and in longitudinal research. And according to a recent Centers for Disease Control and Prevention (CDC) report, SMA had greater odds of all forms of victimization examined in the CDC's Youth Risk Behavior Survey (YRBS) (Johns et al., 2020). Other research has shown that SMA are 2.7 times more likely than their heterosexual peers to experience school violence (Olsen, 2019).

Research on mechanisms underlying disparities in obesity among SMA is sparse. The few existing studies that have examined disparities hypothesize that they are driven by lower rates of physical activity and higher engagement in disordered eating behaviors, such as overeating and binge eating (Austin et al., 2009; Grammer et al., 2019; Hadland et al., 2014). These higher rates also persist in adulthood (Ancheta et al., 2021b; Eliason et al., 2015). Additionally, one study found child abuse to be associated with higher BMI in this population (Katz-Wise et al., 2014b).

A positive school climate for lesbian, gay, bisexual, transgender, and queer/questioning (LGBTQ) students, supports and promotes a sense of belonging and support and is an important predictor of better health outcomes for this population (Ancheta et al., 2021a; Gower et al., 2018; Hatzenbuehler et al., 2014; Russell & McGuire, 2008). Such a climate includes positive student-teacher relationships, student empowerment, inclusion of LGBTQ experiences and stories in

curricula, and LGBTQ-specific resources and development opportunities for staff (Gower et al., 2019; Russell et al., 2010; Saewyc et al., 2014). A positive school climate for LGBTQ students has been linked to lower reports of suicidal thoughts, suicide attempts, and alcohol and other drug use among SMA (Ancheta et al., 2021a; Colvin et al., 2019; Coulter et al., 2016; Eisenberg et al., 2020; Hatzenbuehler et al., 2014). However, an association between positive school climate and obesity has yet to be examined among high schoolers. In addition to the mental and physical health benefits documented in prior research, school climate may also affect weight-related outcomes among SMA. For example, although the sample was older in age, a 2020 U.S. study of college students in Minnesota found that higher LGB college climate scores were associated with lower risk of overweight and obesity among both sexual minority and heterosexual college students (VanKim et al., 2020).

3.5 Current Study

Few studies have examined the impact of school violence and school climate on obesity, and even fewer studies have examined the potential differential impact of these factors on SMA. The current study aimed to help fill these gaps, stratifying analyses by sex given known sex differences in obesity among adolescents (Suglia et al., 2014).

Aim 1: To examine and compare the association between school violence and obesity in SMA and their heterosexual peers.

Hypothesis 1: Sexual identity will moderate the association between school violence and obesity such that the association between school violence and obesity will be stronger for SMA than for heterosexual adolescents.

Aim 2: To examine and compare associations among sexual identity, school violence, and obesity across varying levels of LGBTQ school climate.

Hypothesis 2: LGBTQ school climate will moderate the effect of sexual identity on the association between school violence and obesity such that the more positive the school climate, the weaker the moderating effect of sexual identity.

3.6 Methods

Datasets

Individual- and interpersonal-level data (adolescent health behaviors and school violence, respectively) are from the Youth Risk Behavior Survey (YRBS), a biennial, paper and pencil self-report survey conducted by the CDC that is administered to public secondary school students in grades 9 through 12 during designated class time (Brener et al., 2013). The YRBS uses a two-stage, cluster sample design to obtain a representative sample of U.S. students in respective school districts. Collected data are cross-sectional; the same students are not followed over time. Procedures for the YRBS are designed to protect student privacy by allowing voluntary, anonymous participation, with active or passive parental consent obtained either before or after survey administration, depending on the school (Brener et al., 2013). The YRBS contains questions specific to six priority health-related behaviors that are associated with the leading causes of morbidity and mortality among adolescents (Brener et al., 2013). The health-related behaviors relevant to this study are diet, physical activity, sedentary behaviors, and violence victimization.

Community-level data (i.e., LGBTQ school climate) are from the School Health Profiles (SHP) conducted by the CDC. The SHP, a biennial, self-report questionnaire completed by principals and lead health education teachers in public middle and secondary schools in the U.S., was designed to measure progress in the implementation of school practices and policies aimed at improving the overall health of school-aged youth. It uses a random, systematic, equal-

probability sampling design to produce representative samples of principals and teachers who are responsible for students in grades 6–12 in schools in each district (Brener et al., 2017). Principals and health education teachers in these schools are invited to participate; participation is confidential and voluntary (Brener et al., 2017). The SHP includes two questionnaires: 1) the School Principal Questionnaire (SPQ) and 2) the Lead Health Education Teacher Questionnaire (LHETQ). Data provide unique perspectives and insights into the structural and interpersonal school environments and relationships that influence school climate for LGBTQ students (Demissie et al., 2018; Hatzenbuehler et al., 2014). Prior studies have used the YRBS and SHP to examine impacts of LGBTQ school climate on health outcomes (Adams et al., 2021; Coulter et al., 2016), but none have examined the outcome of obesity. Because only de-identified data were used, the Columbia University IRB granted this study exempt status.

Study Sample

The samples of adolescents ages 12–18 (from YRBS) and of principals and teachers (from SHP) were drawn from ten large urban school districts: Broward County, FL; Charlotte-Mecklenburg, NC; Chicago, IL; Duval County, FL; Fort Worth, TX; Miami-Dade County, FL; Oakland, CA; Orange County, FL; Philadelphia, PA; and Shelby County, TN. These districts were the only ones with publicly available data for height and weight (for BMI calculation) and sexual identity. In this study, use of YRBS and SHP data that are collected and aggregated at the school district level (as opposed to the state or national level) allows for the most proximal association of school climate most relevant to the adolescent to individual adolescent data.

Individual-Level Measures

Major variables in the study included weight status, sexual identity, health behaviors, school violence, and school climate. YRBS study variables are described in Table 3.1. SHP study variables are described in Table 3.2.

Sexual Identity. Sexual identity was measured using responses to the question, “Which of the following best describes you?” “Heterosexual,” “Gay or lesbian,” “Bisexual,” or “Not sure.” We combined those who answered “Not sure” with lesbian, gay and bisexual adolescents (SMA) given findings that they are also at higher risk for many negative health outcomes compared to their heterosexual peers (Austin et al., 2013; Wood et al., 2017).

School Violence Victimization. School violence victimization was measured using six questions. Four questions asked about violence victimization occurring directly on school property: (a) being threatened with a weapon; (b) being involved in a physical fight; (c) being bullied; and (d) carrying a weapon. One question asked about safety concerns traveling to and from school and one about being electronically bullied. Responses were dichotomized (yes/no) and summed to create a count measure (0–6), which was further used to create a categorical variable for school violence reported within the past 12 months, with three levels of reported violence: (1) no violence; (2) one count of violence; and (3) two or more counts of violence. This categorization into three levels was based on the frequency distribution of school violence reported by all adolescents in the sample.

Weight Status. The CDC calculates body mass index (BMI) in the YRBS using self-reported height and weight and the formula kg/m^2 (Phillips et al., 2019). Based on CDC growth charts, those with a BMI in the 95th or greater percentile are considered to be obese (Centers for Disease Control and Prevention, 2017). We chose to focus on obesity (and not overweight) in

this study because of its more serious health consequences and because prior research has shown that obese adolescents are more likely to experience peer victimization and to internalize the symptoms of victimization than overweight adolescents (Waasdorp et al., 2018). In addition, adolescents are classified as overweight if their BMI is between the 85th and less than the 95th percentiles. In the YRBS dataset, the CDC classifies adolescents as obese using a dichotomized (yes/no) variable.

Community-Level Measures

School Climate. School climate was measured using seven items from the SHP that ask about policies and practices that promote a positive school climate for LGBTQ students. Examples include whether the school: has a gender-sexuality alliance (GSA; also referred to as gay-straight alliance); has a designated safe space for LGBTQ adolescents and their allies; includes LGBTQ-relevant content in health education curricula; and has an anti-bullying policy containing language that includes protection for LGBTQ adolescents. The SHP school climate questions can be found in Table 3.2. Following a method that has been previously used (Adams et al., 2021; Coulter et al., 2016; Hatzenbuehler et al., 2014), we summed responses, then standardized and averaged the school climate scores across school districts. With standardization, a score of 0 indicates an average school climate, a negative score indicates a less-than-average (poorer) school climate for LGBTQ adolescents, and a positive score indicates a greater-than-average (better) school climate. The Cronbach's alpha for school climate in the present sample was 0.78, indicating good internal consistency (Tavakol & Dennick, 2011).

Covariates

Health Behaviors. Consistent with previous obesity research (Brown et al., 2015; Iannotti & Wang, 2013; Patton et al., 2016; Wang, Y. C. et al., 2012), variables related to diet,

physical activity, and sedentary behavior were included as covariates. Responses were dichotomized indicating engagement/no engagement in the behavior during the specified time frame (e.g., 7 days, 30 days) or whether the frequency met or exceeded that of the U.S. Office of Disease Prevention and Health Promotion's (ODPHP) Dietary Guidelines for Americans (i.e., fruit consumption every day and no soda consumption) (U.S. Department of Health and Human Services, 2015) and the U.S. ODPHP's Youth Physical Activity Recommendations (i.e., 60 minutes a day of moderate-to-vigorous exercise) (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2017). We chose to dichotomize television watching and computer use as either greater than or less than five hours, based on prior obesity research using YRBS data (Kenney & Gortmaker, 2017; Kim et al., 2016).

Statistical Analyses

The percent of missing data for variables relevant to the current study ranged from 0–24.1%, with sexual identity, obesity status, physical education class participation, soda consumption, and sports team participation, having the highest percentages of missing data. To check the pattern of missingness of data (i.e., to determine which type of technique to use for imputation), we performed *t*-tests and Pearson chi-square tests to assess whether a group of respondents with missing data on a particular variable was significantly different from a group of respondents with observed data on the same variable. Given significant differences between the two groups on multiple, as opposed to a few, key variables, we determined that the data were missing at random (MAR)—that the missingness in data can be explained by differences in the observed data (Sterne et al., 2009). Given this, we chose multiple imputation by chained equations to impute for complete data (Azur et al., 2011). Imputation models included survey year, sampling weights, and all variables in the final analytic models. Although once considered

controversial, inclusion of all variables, including outcome variables, in imputation models, provides necessary information about missing values of predictors, outcomes, and covariates in multiple imputation (Van Ginkel et al., 2020). Five imputed datasets were generated.

We conducted cross-sectional analyses of pooled data from the 2011–2019 district-level YRBS surveys linked with the 2010-2018 district-level SHP surveys. The YRBS and SHP are conducted biennially on odd- and even-numbered years, respectively; thus, we had five years of data from five cycles. We chose to pool data across years to increase sample size; the 2011–2019 surveys were used because they included a measure of sexual identity. To address changes in societal attitudes toward sexual minority people over time (Witeck, 2014), we controlled for survey year. Further, the CDC created survey weights for the YRBS to account for student non-response and unequal probability of selection based on sex, race/ethnicity, and grade in school, and in the SHP to account for principal and teacher non-response (Brener et al., 2017; Brener et al., 2013). By applying these weights, the data are more representative of their respective populations (Kann et al., 2018). Survey weights were included in the imputation models. Across pooled years, the total analytic sample size was 60,625 respondents in the YRBS.

We first examined survey-weighted sample characteristics by sex and sexual identity. We then used multilevel mixed effects logistic regression (to account for the clustering effect of adolescents nested within school districts) to examine the association between sexual identity and obesity, controlling for age, sex, race/ethnicity, fruit consumption, soda consumption, physical inactivity, physical education class participation, sports team participation, TV watching, computer use, and survey year. We used a primarily three-step model-building process to address each of the aims. Model 1 contained all student-level variables, including school violence victimization. To address Aim 1 (comparing associations between school violence and

obesity among SMA and their heterosexual peers), in Model 2 we added interaction terms between sexual identity and school violence victimization. Model 3 added the school-level school climate variable. To address Aim 2 (comparing associations among sexual identity, school violence and obesity across varying levels of school climate), in Model 4 we added additional three-way interaction terms for sexual identity, school violence, and school climate. Models 5 and 6 tested the two-way interactions of sexual identity and school climate, and the two-way interactions of school violence victimization and school climate, respectively, minus the three-way interaction terms. All statistical tests were two-sided, and p -values $<.05$ were considered statistically significant. Data cleaning and coding were conducted using Stata version 17.

3.7 Results

Demographics

Table 3.3 presents participant characteristics stratified by sex and sexual identity subgroup and school district. The overall sample included 60,625 adolescents from ten U.S. school districts, with Miami-Dade County, FL contributing the largest proportion of respondents (16.9%). Percentages of heterosexual-identifying adolescents ranged from 80.2–89.6% across the school districts, with 85.2% of the overall sample identifying as heterosexual and 14.8% identifying as sexual minority. Approximately half of the sample identified as female (52.5%). Although gender identity data were collected in some school districts in some years, data were insufficient to conduct meaningful analyses.

Table 3.4 presents proportions of obesity across demographic variables. In the full sample, 13.8% of adolescents were classified as obese. Males had higher rates of obesity than females (16.4 vs. 11.4%), and each sexual minority subgroup had a higher rate of obesity than

their heterosexual counterparts. Compared with White students, rates of obesity were higher in all racial/ethnic minority groups, except Asian students. In terms of individual-level health behaviors, those who drank soda, did not meet U.S. ODPHP physical activity guidelines, and those who did not participate on a sports team had higher rates of obesity. Regarding interpersonal-level risk of school violence victimization, compared to those who reported no school violence victimization in the past 12 months, students who reported at least one form of school violence victimization had higher rates of obesity.

Mean school climate scores for the ten U.S. school districts ranged from 3.15 to 5.41 (Table 3.5), with the highest score being 7. Charlotte-Mecklenburg, NC had the lowest (poorest) score, and Oakland, CA had the highest (most positive) mean school climate scores across pooled years 2010-2018.

Associations to Obesity Stratified by Sex: Females

Across models, lesbian and bisexual adolescent girls had significantly higher odds of obesity than their heterosexual peers (Table 3.6). Nearly every model also showed that girls who were unsure of their sexual identity had significantly higher odds of obesity than heterosexual girls. In every model, Black, Hispanic, and multi-racial/ethnic girls, and girls who identified as another race/ethnicity had higher odds of obesity than their White counterparts. Asian girls, on the other hand, had lower odds of obesity than White adolescents in all models. Further, those who did not meet the U.S. ODPHP's youth physical activity recommendations and those who did not participate in a sports team in the past 12 months had higher odds of obesity in every model. However, counterintuitively, adolescent girls who did not attend PE class five days a week had lower odds of obesity compared to those who attended PE class all five days. Age, fruit and soda

consumption, TV watching, and computer use were not significantly associated with obesity among girls.

Female adolescents who reported two or more counts of school violence victimization had significantly higher odds of obesity than those who reported no violence victimization across all models. There was no significant association for girls who reported only one count of violence victimization. Lastly, Model 3 shows that for adolescent girls who attended schools with more positive LGBTQ school climates, the odds of obesity were lower than those for girls who attended schools with less positive LGBTQ school climates (AOR 0.84, 95% CI = 0.79–0.90).

The three-way interaction terms between sexual identity, school violence victimization, and school climate (Model 4) were not significant. Therefore, we refit two separate models containing two, two-way interactions (sexual identity \times school climate) and (school violence victimization \times school climate), separately, in Model 5 and Model 6. The two-way interaction terms for sexual identity \times school climate were not significant, indicating that the effect of school climate on obesity did not differ by sexual identity among female adolescents. The two-way interaction terms for school violence victimization \times school climate were also not significant, indicating that the effect of school climate on obesity among female adolescents did not differ by school violence victimization.

Associations to Obesity Stratified by Sex: Males

For male adolescents, we found no differences in any of the models comparing obesity in sexual minority and heterosexual boys (Table 3.7). Black, Hispanic, and multi-racial/ethnic boys had higher odds of obesity than their White counterparts in all models. Compared to White male adolescents, we found no differences in odds of obesity among Asian adolescents or those who

identified as another race/ethnicity. Further, consistent with findings among female adolescents, male adolescents who did not meet the U.S. ODPHP's youth physical activity recommendations and those who did not participate in a sports team in the past 12 months had higher odds of obesity in every model. On the other hand, boys who did not attend PE class five days a week and those who reported excessive hours of TV watching and computer use had lower odds of obesity compared to adolescent boys who attended PE class five days a week and those who reported hours of TV watching and computer use that were less than five hours. Age and fruit and soda consumption were not significantly associated with obesity among boys.

Also, similar to findings among female adolescents, across all models, male adolescents who reported two or more counts of violence victimization had higher odds of obesity than those who reported no experiences of school violence victimization. We found no significant association with obesity among adolescents who reported one count of violence victimization. Lastly, Model 3 shows that male adolescents in schools with more positive LGBTQ school climates had lower odds of obesity than male adolescents in schools with less positive LGBTQ school climates (AOR 0.85, 95% CI = 0.81–0.91). The three-way interaction terms among sexual identity, school violence victimization, and school climate with obesity were not significant (Model 4). As with the female sample, in Models 5 and 6 we refit two separate models containing two, two-way interactions (sexual identity \times school climate) and (school violence victimization \times school climate). None of these interactions were significant.

3.8 Discussion

In this study we examined and compared associations between school violence and obesity in SMA and their heterosexual peers using 2011–2019 YRBS adolescent data linked with 2010–2018 SHP school climate data. We also examined and compared previously understudied

associations among sexual identity, school violence, and obesity across varying levels of LGBTQ school climate. Analyses of survey-weighted sample characteristics demonstrated that SMA girls in this sample had higher odds of obesity than heterosexual girls. This is consistent with prior literature (Ancheta et al., 2020; Katz-Wise et al., 2014a; Wood et al., 2017). In contrast, we found no sexual identity differences in odds of obesity among boys, which is inconsistent with a prior study that found higher odds of obesity among bisexual than heterosexual boys (Ancheta et al., 2020). Research findings related to rates of obesity among sexual minority boys is more mixed overall (Grammer et al., 2019; Katz-Wise et al., 2014a) than findings among sexual minority girls. Further, our results are consistent with those of other studies that have found racial/ethnic disparities in obesity among adolescents, especially among Black and Hispanic adolescents compared with White adolescents (Johnson et al., 2021; Wang, Y. C. et al., 2012).

Findings Related to School Violence Victimization and Obesity

We found that both girls and boys who reported two or more counts of school violence victimization in the last 12 months had higher odds of obesity than those who reported no counts of school violence victimization. This association was found in models that did not include school climate (Model 1) and in models controlling for school climate (Model 3). Girls who reported two or more counts of school violence victimization had 1.33 greater odds of obesity than those who reported no school violence victimization. Among male students, those who reported two or more counts of school violence victimization had 1.24 greater odds of obesity than those who reported no school violence victimization. Contrary to our hypothesis, there were no sexual identity differences in these associations. One potential explanation for this finding is that the school violence measure did not include questions specific to sexual identity-based

victimization. Although prior studies using YRBS data have shown that SMA are more likely than heterosexual adolescents to experience bullying, electronic bullying, and to be threatened at school with a weapon (Jackman et al., 2020; Johns et al., 2020), none of the school violence victimization questions included in this study were specific to SMA. For example, the bullying question did not specify a reason for being bullied on school property—it simply asked if the student was ever bullied in the last 12 months. This lack of specificity may have influenced our results. In other words, because reasons for being targeted for victimization are unknown (and students could have been bullied for any number of reasons such as sexual identity, gender identity, race/ethnicity, religion, weight), this may have resulted in null findings for sexual identity differences. Future studies should seek to include measures to assess attributions of reasons for victimization experiences.

Additionally, our school violence measure may have been too broad, as it included questions related to safety (e.g., carrying a weapon on school property and missing school due to feelings of unsafety) that, conceptually, may not be related to violence victimization. However, we chose this approach to measuring school violence victimization because it has been used in prior research (Olsen, 2019), is in line with the National Center for Injury Prevention and Control’s definition for school violence (National Center for Injury Prevention and Control, 2021) and permitted us to capture as many salient interpersonal, peer-related aspects of school violence for SMA as possible.

Findings Related to School Climate and Obesity

In our examination of school climate, after controlling for demographic characteristics, health behaviors, and school violence victimization, we found that all adolescent girls and boys who lived in school districts with more positive school climates had lower odds of obesity

(Model 3; girls, AOR = 0.84; boys, AOR = 0.85) than those who lived in school districts with less positive school climates. The three-way interaction terms among sexual identity, school violence, and school climate were not significant—contrary to our Aim 2 hypothesis. Therefore, we refit the models to test for interactions in the association between school climate and obesity by sexual identity (Model 5), and between school violence and obesity by school climate (Model 6). However, none of these interaction terms were significant. The null finding of the association between school climate and obesity by sexual identity (Model 5) is consistent with literature examining this association among college students (VanKim et al., 2020). VanKim and colleagues found that although more LGB support was associated with lower risk for overweight and obesity, there were no differences between sexual minority and heterosexual college students in Minnesota (VanKim et al., 2020). Our finding of no sexual identity differences may be due to other contextual, protective factors for LGB students, beyond the school level, that can also influence obesity risk, such as state-level anti-discrimination policies and fair, non-discriminatory food and housing policies. LGBTQ adolescents face food and housing insecurity at higher rates than their heterosexual peers (USC Homelessness Policy Research Institute, 2019), and these are chronic concerns that can lead to poor quality diet (Russomanno et al., 2019). Although we found that in the presence of more positive school climates, all students had lower odds of obesity, the obesity disparity for SMA persisted, and possible changes in housing assistance, food policies, and poverty for LGBTQ adolescents and their families may be needed to decrease this disparity.

Our findings of no differences in the association between school violence and obesity by level of school climate (Model 6) may also be due to the non-specific measure of school violence used in the study. However, our finding that higher counts of school violence victimization is

associated with greater odds of obesity is important and adds to evidence that victimization experiences in earlier adolescence can increase risk for obesity in later adolescence (Davis et al., 2019; Midei & Matthews, 2011) and in adulthood (Suglia et al., 2018).

Findings from our study have several implications for policy development or refinement and future research. Our finding that more positive LGBTQ school climates benefit not only SMA but also heterosexual adolescents by decreasing odds of obesity adds to the literature on why more positive school climates are important for all adolescents in creating safer, more inclusive environments that affect both mental and physical health outcomes (Adams et al., 2021; Coulter et al., 2016; Hatzenbuehler et al., 2014). Prior research has shown that environments supportive of sexual minority people also benefit the psychological health of heterosexual people within those same environments (Meyer et al., 2019; Raifman et al., 2017).

School nurses, public health professionals, school administrators, teachers, and health educators should seek to promote more positive LGBTQ school climates in their schools. Moreover, given our finding that one count of violence was not statistically associated with obesity suggests that efforts to reduce, if not eliminate, school violence may have beneficial outcomes for both sexual minority and heterosexual adolescents.

3.9 Limitations

Although findings from this study have the potential to increase understanding of how interpersonal-level school violence victimization and community-level school climate influence obesity risk among SMA, the study is not without limitations. All data in the YRBS and SHP are self-reported. Therefore, the extent of under- or over-reporting cannot be determined. However, studies have shown that self-report of height and weight in the YRBS are reliable (Brenner et al., 2003; Troped et al., 2007). Data for this study are from cross-sectional surveys that permit

examination of associations, but not temporality. The data are also derived from only ten school districts in the U.S., which limits generalizability, although survey weights were applied making these estimates less biased and more representative of public school students in grades 9–12 than if weights were not applied (Kann et al., 2018). Further, although promotion and enforcement of an LGBTQ positive school climate has been linked to many positive health outcomes for SMA, disparities in school climates still exist on the basis of U.S. region, local communities, and acceptance and enforcement of policies and practices by teachers, staff, and other students (Demissie et al., 2018; Kosciw et al., 2020). Future research should expand this work beyond the 10 U.S. school districts included in this study.

In addition, the YRBS does not collect data on familial food choices and income level, which are known to influence obesity risk (Kumar & Kelly, 2017; Patton et al., 2016). The district-level YRBS data included in this study did not collect gender identity information, which prohibits examination of how school climate might impact obesity risk among transgender and gender diverse adolescents. There is also a concern about mischievous responders in these surveys. Mischievous responders are those who intentionally report extreme and untruthful responses, often overreporting undesirable behaviors because they may find it “funny” to do so (Robinson-Cimpian, 2014). One study found that some evidence of non-random mischievousness in the 2015 national YRBS. However, it mainly reduced estimates of the average SMA health disparity for drug- and alcohol-related outcomes; the disparities for bullying between SMA and their heterosexual peers remained unaffected (Cimpian et al., 2018). Lastly, we were unable to directly link the adolescent-level data to the school-level data due to aggregation at the district level, but this introduction of measurement error is non-differential by outcome and biased towards the null, making our estimates conservative.

3.10 Conclusion

Results of this study provide important information about interpersonal- and community-level factors that influence obesity risk among adolescents. We found that regardless of sexual identity, adolescents who lived in school districts with more positive school climates had lower odds of obesity than adolescents who lived in school districts with less positive school climates. To our knowledge, this is the first study to link positive LGBTQ school climate with lower odds of obesity in both heterosexual and sexual minority adolescents. We also found that adolescents who reported two or more counts of school violence victimization in the past 12 months had higher odds of obesity than adolescents who reported no 12-month school violence victimization; there were no sexual identity differences in this association. Findings suggest the need for future research to identify additional influences on risk of obesity among SMA. Overall, the examination of school violence and school climate as social determinants of obesity among adolescents can further inform targeted obesity prevention interventions.

Table 3.1*Summary of Study Variables Found in Youth Risk Behavior Survey*

| Variable | Item | Variable type |
|--------------------------------------|--|---------------|
| Demographics | | |
| Age | How old are you? | Categorical |
| Sex | What is your sex? (<i>Female, Male</i>) | Dichotomous |
| Race/ethnicity | What is your race? / Are you Hispanic or Latino? (<i>White, Black or African American, Hispanic/Latino, All Other Races</i>) | Categorical |
| Height | How tall are you without your shoes on? | Continuous |
| Weight | How much do you weigh without your shoes on? | Continuous |
| Sexual Identity | | |
| Sexual identity | Which of the following best describes you? (<i>Heterosexual, Gay/lesbian, Bisexual, Not sure</i>) | Dichotomous |
| Diet | | |
| Fruit | During the past 7 days, how many times did you eat fruit? † | Dichotomous |
| Green salad | During the past 7 days, how many times did you eat green salad? † | Dichotomous |
| Soda | During the past 7 days, how many times did you drink a can, bottle, or glass of soda or pop, such as Coke, Pepsi, or Sprite? † | |
| Breakfast | During the past 7 days, on how many days did you eat breakfast? † | Dichotomous |
| Physical Activity | | |
| Physically active for 60 minutes/day | During the past 7 days, on how many days were you physically active for a total of at least 60 minutes per day? †† | Dichotomous |
| Attend PE class | In an average week when you are in school, on how many days do you go to physical education (PE) classes? †† | Dichotomous |
| Sports team | During the past 12 months, on how many sports teams did you play? †† | Dichotomous |
| Sedentary Behavior | | |
| TV watching | On an average school day, how many hours do you watch TV? †† | Dichotomous |
| Computer use | On an average school day, how many hours do you play video or computer games or use a computer for something that is not school work? †† | Dichotomous |

| Variable | Item | Variable type |
|-----------------------------------|---|---------------|
| | School Violence | |
| Threatened with weapon | During the past 12 months, how many times has someone threatened or injured you with a weapon such as a gun, knife, or club on school property? ^{†††} | Dichotomous |
| Physical fight on school property | During the past 12 months, how many times were you in a physical fight on school property? ^{†††} | Dichotomous |
| Bullied | During the past 12 months, have you ever been bullied on school property? ^{†††} | Dichotomous |
| Weapon carrying | During the past 30 days, on how many days did you carry a weapon such as a gun, knife, or club? ^{†††} | |
| Safety | During the past 30 days, on how many days did you not go to school because you felt you would be unsafe at school or on your way to or from school? ^{†††} | Dichotomous |
| Electronically bullied | During the past 12 months, have you ever been electronically bullied? (Count being bullied through texting, Instagram, Facebook, or other social media.) ^{†††} | |

Note. [†] Collapsed (Y/N) if behavior frequency meets or exceeds that of the U.S. Office of Disease Prevention and Health Promotion Dietary Guidelines for Americans. ^{††} Collapsed (Y/N) if behavior frequency meets or exceeds that of the U.S. Office of Disease Prevention and Health Promotion Guidelines Youth Physical Activity Recommendations. ^{†††} Collapsed (Y/N) if ever engaged in or experienced behavior during time frame.

Table 3.2*Summary of Study Variables Found in School Health Profiles for LGBTQ Positive School Climate Calculation*

| Variable | Item |
|--|--|
| Gay-straight alliances | Does your school have a student-led club that aims to create a safe, welcoming, and accepting school environment for all youth, regardless of sexual orientation or gender identity? These clubs sometimes are called gay/straight alliances. ^a |
| LGBTQ health education | Does your school provide curricula or supplementary materials that include HIV, STD, or pregnancy prevention information that is relevant to LGBTQ youth? ^b |
| Prohibition of LGBTQ harassment | Does your school prohibit harassment based on a student's perceived or actual sexual orientation or gender identity? ^a |
| Staff development for bullying prevention | During the past year, did all staff at your school receive professional development on preventing, identifying, and responding to student bullying and sexual harassment, including electronic aggression? ^a |
| Identification of LGBTQ safe spaces | Does your school identify "safe spaces" (e.g., a counselor's office, designated classroom, student organization) where LGBTQ youth can receive support from administrators, teachers, or other school staff? ^a |
| LGBTQ health service providers outside of school | Does your school facilitate access to providers not on school property who have experience in providing health services, including HIV/STD testing and counseling, to LGBTQ youth? ^a |
| LGBTQ psychological providers outside of school | Does your school facilitate access to providers not on school property who have experience in providing social and psychological services to LGBTQ youth? ^a |

Note. All variables are dichotomous.

^a Data from SHP-SPQ. ^b Data from SHP-LHETQ.

Table 3.3*YRBS District-Level Frequencies and Percentages of Sex and Sexual Identity Subgroups by School District, 2011–2019*

| School district name | Overall sample | | | | Sex | | | | Sexual identity | | | | | |
|------------------------------|----------------|-------|------------------|------|----------------|------|------------------------|------|-----------------------|-----|--------------------|-----|--------------------|-----|
| | <i>n</i> | (%) | Female, <i>n</i> | (%) | Male, <i>n</i> | (%) | Heterosexual, <i>n</i> | (%) | Gay/lesbian, <i>n</i> | (%) | Bisexual, <i>n</i> | (%) | Not sure, <i>n</i> | (%) |
| 1. Broward County, FL | 6593 | 10.9 | 3208 | 48.7 | 3382 | 51.3 | 5709 | 86.6 | 189 | 2.9 | 411 | 6.2 | 284 | 4.3 |
| 2. Chicago, IL | 2912 | 4.8 | 1549 | 53.2 | 1360 | 46.8 | 2609 | 89.6 | 77 | 2.6 | 146 | 5.0 | 80 | 2.7 |
| 3. Charlotte-Mecklenburg, NC | 5292 | 8.7 | 2681 | 50.7 | 2608 | 49.3 | 4420 | 83.5 | 162 | 3.1 | 462 | 8.7 | 248 | 4.7 |
| 4. Duval County, FL | 7041 | 11.6 | 3398 | 48.3 | 3640 | 51.7 | 5691 | 80.8 | 341 | 4.8 | 654 | 9.3 | 355 | 5.0 |
| 5. Fort Worth, TX | 5924 | 9.8 | 3100 | 52.4 | 2821 | 47.6 | 5167 | 87.2 | 127 | 2.1 | 394 | 6.7 | 236 | 4.0 |
| 6. Miami-Dade County, FL | 10258 | 16.9 | 5387 | 52.5 | 4879 | 47.5 | 9089 | 88.6 | 238 | 2.3 | 534 | 5.2 | 398 | 3.9 |
| 7. Oakland, CA | 4592 | 7.6 | 2395 | 52.1 | 2205 | 47.9 | 3947 | 85.9 | 74 | 1.6 | 378 | 8.2 | 194 | 4.2 |
| 8. Orange County, FL | 7394 | 12.2 | 3959 | 53.5 | 3443 | 46.5 | 6348 | 85.8 | 209 | 2.8 | 504 | 6.8 | 334 | 4.5 |
| 9. Philadelphia, PA | 7277 | 12.0 | 3995 | 54.8 | 3290 | 45.2 | 6081 | 83.6 | 258 | 3.5 | 612 | 8.4 | 327 | 4.5 |
| 10. Shelby County, TN | 3342 | 5.5 | 1944 | 58.5 | 1381 | 41.5 | 2676 | 80.2 | 176 | 5.3 | 325 | 9.7 | 161 | 4.8 |
| Total | 60625 | 100.0 | 31616 | 52.5 | 29009 | 47.5 | 51737 | 85.2 | 1851 | 3.1 | 4420 | 7.4 | 2617 | 4.3 |

Table 3.4*Weighted Proportions of Obesity by Demographic Variables, 2011–2019*

| Variable | <i>n</i> | (<i>%</i>) | <i>SE</i> | 95% CI | |
|------------------------------|----------|--------------|-----------|-----------|-----------|
| | | | | <i>LL</i> | <i>UL</i> |
| Overall sample | 8,438 | 13.78 | 0.0014 | 13.50 | 14.06 |
| Age | | | | | |
| 14 years or younger | 1,070 | 13.80 | 0.0044 | 13.21 | 14.96 |
| 15 years | 2,027 | 13.68 | 0.0029 | 13.10 | 14.24 |
| 16 years | 2,172 | 13.57 | 0.0028 | 13.00 | 14.10 |
| 17 years | 1,984 | 13.92 | 0.0029 | 13.29 | 14.44 |
| 18 years or older | 1,185 | 14.11 | 0.0042 | 13.15 | 14.80 |
| Race/ethnicity | | | | | |
| White | 955 | 9.55 | 0.0032 | 8.76 | 10.03 |
| Black | 3,083 | 15.89 | 0.0029 | 15.45 | 16.60 |
| Hispanic | 3,621 | 14.54 | 0.0024 | 14.03 | 14.96 |
| Asian | 265 | 7.97 | 0.0049 | 7.01 | 8.92 |
| Multiple Races | 337 | 13.47 | 0.0069 | 11.98 | 14.70 |
| Sex | | | | | |
| Female | 3,641 | 11.41 | 0.0018 | 11.06 | 11.77 |
| Male | 4,797 | 16.36 | 0.0023 | 15.90 | 16.82 |
| Sexual identity | | | | | |
| Heterosexual | 6,832 | 13.17 | 0.0015 | 12.87 | 13.47 |
| Gay/lesbian | 361 | 18.04 | 0.0110 | 15.63 | 20.14 |
| Bisexual | 779 | 17.05 | 0.0061 | 15.74 | 18.15 |
| Not sure | 466 | 16.82 | 0.0088 | 15.17 | 18.77 |
| Other | 177 | 16.28 | 0.0129 | 13.73 | 18.88 |
| Fruit consumption | | | | | |
| Yes | 2,074 | 13.83 | 0.0029 | 13.28 | 14.44 |
| No | 6,364 | 13.76 | 0.0016 | 13.43 | 14.07 |
| Soda consumption | | | | | |
| Yes | 6,268 | 14.08 | 0.0018 | 13.70 | 14.43 |
| No | 2,170 | 12.99 | 0.0029 | 12.43 | 13.61 |
| Physical inactivity | | | | | |
| Yes | 5,894 | 14.91 | 0.0019 | 14.44 | 15.21 |
| No | 2,544 | 11.72 | 0.0025 | 11.37 | 12.35 |
| Physical education <5 days | | | | | |
| Yes | 4,324 | 13.15 | 0.0020 | 12.73 | 13.51 |
| No | 4,114 | 14.52 | 0.0022 | 14.13 | 14.97 |
| No sports team participation | | | | | |
| Yes | 4,912 | 15.14 | 0.0021 | 14.80 | 15.62 |
| No | 3,526 | 12.25 | 0.0021 | 11.75 | 12.58 |
| TV watching >5 hours | | | | | |
| Yes | 5,775 | 13.22 | 0.0017 | 12.87 | 13.55 |
| No | 2,663 | 15.17 | 0.0028 | 14.66 | 15.74 |

| Variable | <i>n</i> | (%) | <i>SE</i> | 95% CI | |
|-------------------------------------|----------|-------|-----------|-----------|-----------|
| | | | | <i>LL</i> | <i>UL</i> |
| Computer use >5 hours | | | | | |
| Yes | 4,588 | 12.78 | 0.0020 | 12.49 | 13.28 |
| No | 3,850 | 15.19 | 0.0027 | 14.50 | 15.60 |
| School violence victimization count | | | | | |
| 0 | 5,340 | 13.19 | 0.0017 | 12.84 | 13.51 |
| 1 | 1,639 | 14.08 | 0.0033 | 13.37 | 14.68 |
| 2+ | 1,459 | 16.03 | 0.0046 | 15.24 | 17.09 |

Table 3.5*SHP District-Level School Climate Scores Across Ten School Districts, 2010–2018*

| School district name | Mean school climate score (range 0–7) | <i>SE</i> | 95% CI | |
|---------------------------|---------------------------------------|-----------|-----------|-----------|
| | | | <i>LL</i> | <i>UL</i> |
| Broward County, FL | 5.15 | .0083 | 5.13 | 5.17 |
| Charlotte-Mecklenburg, NC | 3.15 | .0009 | 3.14 | 3.15 |
| Chicago, IL | 3.97 | .0069 | 3.96 | 3.98 |
| Duval County, FL | 4.71 | .0073 | 4.70 | 4.73 |
| Fort Worth, TX | 4.33 | .0091 | 4.31 | 4.35 |
| Miami-Dade County, FL | 5.19 | .0038 | 5.18 | 5.19 |
| Oakland, CA | 5.41 | .0092 | 5.39 | 5.42 |
| Orange County, FL | 4.93 | .0036 | 4.93 | 4.94 |
| Philadelphia, PA | 4.11 | .0043 | 4.10 | 4.12 |
| Shelby County, TN | 4.23 | .0013 | 4.23 | 4.23 |
| Total | 4.64 | .0030 | 4.64 | 4.65 |

Note. Mean school climate scores shown are unstandardized values.

Table 3.6

YRBS Student-Level and SHP School-Level Correlates of Obesity, 2011–2019: Females

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Student-level variables | | | | | | |
| Age | | | | | | |
| 14 years or younger | Reference | Reference | Reference | Reference | Reference | Reference |
| 15 years | 0.95 (0.78, 1.14) | 0.95 (0.78, 1.14) | 0.94 (0.78, 1.14) | 0.94 (0.78, 1.14) | 0.94 (0.78, 1.14) | 0.94 (0.78, 1.14) |
| 16 years | 0.90 (0.75, 1.08) | 0.90 (0.75, 1.08) | 0.89 (0.75, 1.07) | 0.89 (0.75, 1.07) | 0.90 (0.75, 1.07) | 0.89 (0.75, 1.07) |
| 17 years | 1.03 (0.84, 1.25) | 1.02 (0.84, 1.25) | 1.02 (0.83, 1.24) | 1.02 (0.83, 1.24) | 1.02 (0.83, 1.24) | 1.02 (0.83, 1.24) |
| 18 years or older | 1.01 (0.81, 1.26) | 1.01 (0.80, 1.26) | 0.99 (0.80, 1.24) | 0.99 (0.80, 1.24) | 0.99 (0.80, 1.24) | 0.99 (0.80, 1.24) |
| Race/ethnicity | | | | | | |
| White | Reference | Reference | Reference | Reference | Reference | Reference |
| Black | 2.72 (2.18, 3.40) | 2.72 (2.18, 3.40) | 2.64 (2.11, 3.29) | 2.66 (2.14, 3.30) | 2.65 (2.12, 3.30) | 2.64 (2.12, 3.29) |
| Hispanic | 1.74 (1.40, 2.16) | 1.74 (1.41, 2.15) | 1.77 (1.43, 2.19) | 1.78 (1.44, 2.20) | 1.77 (1.43, 2.20) | 1.77 (1.43, 2.19) |
| Asian | 0.56 (0.36, 0.87) | 0.56 (0.36, 0.87) | 0.54 (0.35, 0.84) | 0.54 (0.35, 0.84) | 0.54 (0.35, 0.84) | 0.54 (0.35, 0.84) |
| Multiple Races | 1.84 (1.37, 2.47) | 1.84 (1.38, 2.47) | 1.78 (1.33, 2.39) | 1.79 (1.34, 2.39) | 1.79 (1.33, 2.39) | 1.78 (1.33, 2.39) |
| Other | 2.33 (1.58, 3.44) | 2.31 (1.57, 3.41) | 2.33 (1.58, 3.42) | 2.29 (1.56, 3.36) | 2.33 (1.58, 3.43) | 2.33 (1.58, 3.42) |
| Sexual identity | | | | | | |
| Heterosexual | Reference | Reference | Reference | Reference | Reference | Reference |
| Lesbian | 1.41 (1.07, 1.86) | 1.37 (1.00, 1.86) | 1.38 (1.04, 1.83) | 1.34 (0.99, 1.83) | 1.38 (1.05, 1.82) | 1.38 (1.04, 1.83) |
| Bisexual | 1.44 (1.24, 1.68) | 1.49 (1.23, 1.81) | 1.41 (1.21, 1.64) | 1.44 (1.19, 1.75) | 1.41 (1.21, 1.64) | 1.41 (1.21, 1.64) |
| Not sure | 1.61 (1.29, 2.00) | 1.39 (0.95, 2.04) | 1.59 (1.28, 1.99) | 1.38 (0.95, 2.02) | 1.59 (1.28, 1.98) | 1.59 (1.28, 1.99) |
| Fruit consumption | 0.89 (0.77, 1.01) | 0.88 (0.77, 1.01) | 0.89 (0.78, 1.01) | 0.89 (0.78, 1.01) | 0.89 (0.78, 1.01) | 0.89 (0.78, 1.01) |
| Soda consumption | 1.04 (0.93, 1.17) | 1.04 (0.93, 1.17) | 1.02 (0.91, 1.14) | 1.02 (0.91, 1.15) | 1.02 (0.91, 1.14) | 1.02 (0.91, 1.14) |
| Physical inactivity | 1.16 (1.04, 1.31) | 1.16 (1.03, 1.31) | 1.17 (1.04, 1.32) | 1.17 (1.04, 1.32) | 1.17 (1.04, 1.32) | 1.17 (1.04, 1.32) |
| Physical education <5 days | 0.86 (0.76, 0.97) | 0.86 (0.76, 0.97) | 0.89 (0.79, 1.00) | 0.89 (0.80, 1.01) | 0.89 (0.79, 1.00) | 0.89 (0.79, 1.00) |
| No sports team participation | 1.59 (1.40, 1.80) | 1.59 (1.40, 1.81) | 1.60 (1.41, 1.82) | 1.60 (1.41, 1.82) | 1.60 (1.41, 1.82) | 1.60 (1.41, 1.82) |
| TV watching >5 hours | 0.92 (0.83, 1.03) | 0.92 (0.83, 1.03) | 0.92 (0.83, 1.03) | 0.93 (0.83, 1.03) | 0.92 (0.83, 1.03) | 0.92 (0.83, 1.03) |
| Computer use >5 hours | 0.97 (0.88, 1.07) | 0.97 (0.88, 1.07) | 0.97 (0.88, 1.07) | 0.97 (0.88, 1.08) | 0.97 (0.88, 1.07) | 0.97 (0.88, 1.07) |
| School violence victimization count | | | | | | |
| 0 | Reference | Reference | Reference | Reference | Reference | Reference |
| 1 | 1.09 (0.97, 1.22) | 1.04 (0.89, 1.22) | 1.09 (0.97, 1.23) | 1.04 (0.89, 1.22) | 1.09 (0.97, 1.22) | 1.09 (0.97, 1.23) |
| 2+ | 1.33 (1.14, 1.54) | 1.36 (1.12, 1.64) | 1.33 (1.15, 1.55) | 1.36 (1.13, 1.65) | 1.33 (1.15, 1.55) | 1.33 (1.15, 1.55) |

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|--|-------------|-------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Single-level interactions | | | | | | |
| Lesbian × 1 count victimization | | 1.07 (0.45, 2.55) | | 1.02 (0.46, 2.28) | | |
| Lesbian × 2 counts victimization | | 1.05 (0.60, 1.82) | | 1.04 (0.60, 1.82) | | |
| Bisexual × 1 count victimization | | 1.07 (0.71, 1.61) | | 1.10 (0.73, 1.65) | | |
| Bisexual × 2 counts victimization | | 0.82 (0.58, 1.16) | | 0.84 (0.59, 1.19) | | |
| Not sure × 1 count victimization | | 1.52 (0.82, 2.80) | | 1.47 (0.82, 2.65) | | |
| Not sure × 2 counts victimization | | 1.18 (0.57, 2.46) | | 1.18 (0.57, 2.45) | | |
| School-level variables | | | | | | |
| School climate | | | 0.84 (0.79, 0.90) | 0.83 (0.77, 0.90) | 0.83 (0.78, 0.89) | 0.84 (0.78, 0.91) |
| Cross-level interactions | | | | | | |
| Lesbian × school climate | | | | 1.10 (0.80, 1.51) | 1.17 (0.89, 1.54) | |
| Bisexual × school climate | | | | 1.14 (0.95, 1.37) | 1.04 (0.91, 1.18) | |
| Not sure × school climate | | | | 0.92 (0.70, 1.21) | 1.05 (0.88, 1.25) | |
| 1 count victimization × school climate | | | | 1.01 (0.86, 1.17) | | 1.02 (0.89, 1.16) |
| 2 counts victimization × school climate | | | | 0.99 (0.85, 1.16) | | 1.00 (0.87, 1.14) |
| Lesbian × 1 count victimization × school climate | | | | 1.34 (0.53, 3.40) | | |
| Lesbian × 2 counts victimization × school climate | | | | 1.05 (0.53, 2.08) | | |
| Bisexual × 1 count victimization × school climate | | | | 0.80 (0.58, 1.11) | | |
| Bisexual × 2 counts victimization × school climate | | | | 0.88 (0.66, 1.17) | | |
| Not sure × 1 count victimization × school climate | | | | 1.38 (0.84, 2.28) | | |
| Not sure × 2 counts victimization × school climate | | | | 1.20 (0.72, 2.00) | | |

Note. $n = 31,616$. Model 1 is adjusted multilevel logistic regression model testing the effect of school violence victimization on obesity. Model 2 added an interaction term for sexual identity × school violence victimization. Model 3 added the school-level school

climate variable. Model 4 added the three-way interaction terms for sexual identity × school violence × school climate. Model 5 tested the two-way interaction of sexual identity × school climate. Model 6 tested the two-way interaction of school violence victimization × school climate. All models controlled for year. Boldface indicates statistical significance at $p < .05$

Table 3.7

YRBS Student-Level and SHP School-Level Correlates of Obesity, 2011–2019: Males

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|-------------------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Student-level variables | | | | | | |
| Age | | | | | | |
| 14 years or younger | Reference | Reference | Reference | Reference | Reference | Reference |
| 15 years | 0.91 (0.78, 1.06) | 0.91 (0.78, 1.06) | 0.90 (0.77, 1.05) | 0.90 (0.77, 1.06) | 0.90 (0.77, 1.05) | 0.90 (0.77, 1.05) |
| 16 years | 0.88 (0.76, 1.01) | 0.88 (0.76, 1.01) | 0.88 (0.76, 1.01) | 0.87 (0.76, 1.01) | 0.88 (0.76, 1.01) | 0.88 (0.76, 1.01) |
| 17 years | 0.87 (0.76, 1.00) | 0.87 (0.76, 1.00) | 0.87 (0.76, 1.00) | 0.87 (0.76, 1.00) | 0.87 (0.76, 1.00) | 0.87 (0.76, 1.00) |
| 18 years or older | 0.84 (0.70, 1.01) | 0.84 (0.70, 1.00) | 0.84 (0.70, 1.00) | 0.84 (0.70, 1.01) | 0.84 (0.70, 1.00) | 0.84 (0.70, 1.00) |
| Race/ethnicity | | | | | | |
| White | Reference | Reference | Reference | Reference | Reference | Reference |
| Black | 1.42 (1.23, 1.63) | 1.42 (1.23, 1.64) | 1.37 (1.18, 1.58) | 1.37 (1.18, 1.58) | 1.37 (1.18, 1.58) | 1.37 (1.18, 1.58) |
| Hispanic | 1.48 (1.29, 1.70) | 1.48 (1.29, 1.70) | 1.50 (1.31, 1.72) | 1.50 (1.31, 1.72) | 1.50 (1.31, 1.72) | 1.50 (1.31, 1.72) |
| Asian | 0.98 (0.79, 1.21) | 0.98 (0.79, 1.21) | 0.93 (0.75, 1.15) | 0.93 (0.75, 1.16) | 0.93 (0.75, 1.15) | 0.93 (0.75, 1.15) |
| Multiple Races | 1.33 (1.03, 1.72) | 1.33 (1.03, 1.73) | 1.29 (1.00, 1.66) | 1.28 (1.00, 1.65) | 1.28 (1.00, 1.65) | 1.29 (1.00, 1.65) |
| Other | 1.28 (0.84, 1.95) | 1.28 (0.84, 1.95) | 1.27 (0.84, 1.93) | 1.28 (0.85, 1.94) | 1.28 (0.84, 1.93) | 1.27 (0.84, 1.93) |
| Sexual identity | | | | | | |
| Heterosexual | Reference | Reference | Reference | Reference | Reference | Reference |
| Gay | 1.20 (0.89, 1.61) | 1.25 (0.73, 2.12) | 1.19 (0.88, 1.61) | 1.25 (0.73, 2.15) | 1.19 (0.88, 1.61) | 1.19 (0.88, 1.61) |
| Bisexual | 1.13 (0.89, 1.43) | 1.38 (0.96, 1.97) | 1.12 (0.88, 1.42) | 1.35 (0.95, 1.92) | 0.90 (0.72, 1.12) | 1.12 (0.88, 1.42) |
| Not sure | 1.11 (0.77, 1.59) | 1.14 (0.69, 1.90) | 1.11 (0.77, 1.58) | 1.10 (0.68, 1.78) | 1.08 (0.75, 1.55) | 1.11 (0.77, 1.58) |
| Fruit consumption | 0.97 (0.87, 1.07) | 0.97 (0.87, 1.07) | 0.97 (0.87, 1.07) | 0.96 (0.87, 1.07) | 0.97 (0.87, 1.07) | 0.97 (0.87, 1.07) |
| Soda consumption | 0.97 (0.86, 1.10) | 0.97 (0.87, 1.07) | 0.96 (0.85, 1.09) | 0.96 (0.85, 1.09) | 0.96 (0.85, 1.09) | 0.96 (0.85, 1.09) |
| Physical inactivity | 1.40 (1.26, 1.55) | 1.40 (1.26, 1.55) | 1.39 (1.26, 1.54) | 1.39 (1.26, 1.54) | 1.39 (1.26, 1.54) | 1.39 (1.26, 1.54) |
| Physical education <5 days | 0.88 (0.80, 0.97) | 0.88 (0.80, 0.97) | 0.89 (0.81, 0.98) | 0.89 (0.81, 0.98) | 0.89 (0.81, 0.98) | 0.89 (0.81, 0.98) |
| No sports team participation | 1.20 (1.09, 1.32) | 1.19 (1.08, 1.31) | 1.21 (1.09, 1.33) | 1.21 (1.10, 1.33) | 1.21 (1.09, 1.33) | 1.21 (1.09, 1.33) |
| TV watching >5 hours | 0.85 (0.77, 0.95) | 0.85 (0.77, 0.95) | 0.85 (0.77, 0.95) | 0.85 (0.77, 0.95) | 0.85 (0.77, 0.94) | 0.85 (0.77, 0.95) |
| Computer use >5 hours | 0.80 (0.71, 0.89) | 0.80 (0.71, 0.89) | 0.80 (0.71, 0.89) | 0.80 (0.71, 0.89) | 0.80 (0.71, 0.89) | 0.80 (0.71, 0.89) |
| School violence victimization count | | | | | | |
| 0 | Reference | Reference | Reference | Reference | Reference | Reference |
| 1 | 1.04 (0.92, 1.18) | 1.05 (0.93, 1.18) | 1.04 (0.92, 1.17) | 1.04 (0.93, 1.17) | 1.04 (0.92, 1.17) | 1.04 (0.92, 1.17) |
| 2+ | 1.24 (1.10, 1.40) | 1.29 (1.14, 1.47) | 1.22 (1.08, 1.39) | 1.27 (1.12, 1.45) | 1.23 (1.08, 1.39) | 1.22 (1.08, 1.39) |

| Variable | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 | Model 6 |
|--|-------------|-------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) | OR (95% CI) |
| Single-level interactions | | | | | | |
| Gay × 1 count victimization | | 1.03 (0.50, 2.14) | | 1.03 (0.50, 2.13) | | |
| Gay × 2 counts victimization | | 0.85 (0.44, 1.62) | | 0.79 (0.44, 1.45) | | |
| Bisexual × 1 count victimization | | 0.78 (0.38, 1.60) | | 0.76 (0.37, 1.55) | | |
| Bisexual × 2 counts victimization | | 0.62 (0.36, 1.07) | | 0.64 (0.37, 1.09) | | |
| Not sure × 1 count victimization | | 0.96 (0.45, 2.06) | | 0.99 (0.48, 2.04) | | |
| Not sure × 2 counts victimization | | 0.89 (0.53, 1.51) | | 0.93 (0.55, 1.59) | | |
| School-level variables | | | | | | |
| School climate | | | 0.85 (0.81, 0.91) | 0.85 (0.80, 0.91) | 0.86 (0.80, 0.91) | 0.85 (0.80, 0.90) |
| Cross-level interactions | | | | | | |
| Gay × school climate | | | | 0.86 (0.58, 1.26) | 1.00 (0.73, 1.36) | |
| Bisexual × school climate | | | | 0.90 (0.61, 1.32) | 0.90 (0.72, 1.12) | |
| Not sure × school climate | | | | 1.20 (0.79, 1.82) | 1.08 (0.75, 1.55) | |
| 1 count victimization × school climate | | | | 1.05 (0.93, 1.17) | | 1.04 (0.93, 1.16) |
| 2 counts victimization × school climate | | | | 0.98 (0.85, 1.13) | | 0.99 (0.86, 1.14) |
| Gay × 1 count victimization × school climate | | | | 0.82 (0.46, 1.46) | | |
| Gay × 2 counts victimization × school climate | | | | 1.68 (0.83, 3.40) | | |
| Bisexual × 1 count victimization × school climate | | | | 1.27 (0.71, 2.27) | | |
| Bisexual × 2 counts victimization × school climate | | | | 0.79 (0.43, 1.43) | | |
| Not sure × 1 count victimization × school climate | | | | 0.83 (0.36, 1.94) | | |
| Not sure × 2 counts victimization × school climate | | | | 0.81 (0.38, 1.74) | | |

Note. $n = 29,009$. Model 1 is adjusted multilevel logistic regression model testing the effect of school violence victimization on obesity. Model 2 added an interaction term for sexual identity × school violence victimization. Model 3 added the school-level school

climate variable. Model 4 added the three-way interaction terms for sexual identity × school violence × school climate. Model 5 tested the two-way interaction of sexual identity × school climate. Model 6 tested the two-way interaction of school violence victimization × school climate. All models controlled for year. Boldface indicates statistical significance at $p < .05$

Chapter 4: A Difference-in-Differences Analysis of the Relationship Between State-Level Anti-Bullying Policy With Sexual and/or Gender Minority Identity Enumeration and Bullying and Obesity Among Sexual Minority Adolescents

4.1 Bullying and Obesity Prevalence Among Sexual Minority Adolescents

Sexual minority adolescents (SMA; i.e., those who identify as gay/lesbian or bisexual, or who are unsure of their sexual identity) are more likely to be bullied than their heterosexual peers (Goodenow et al., 2016; Meyer et al., 2019). A 2020 analysis of Youth Risk Behavior Survey (YRBS) data collected by the Centers for Disease Control and Prevention (CDC) from 2015, 2017, and 2019 showed that lesbian, gay, bisexual (LGB) students had greater odds of violence victimization across all seven indicators that the YRBS measures, including being bullied at school and experiencing electronic bullying (Johns et al., 2020). Controlling for sex and race/ethnicity, LGB adolescents were 2.1 more likely to be bullied at school and 1.9 times more likely to experience electronic bullying compared to heterosexual adolescents (Johns et al., 2020). Recognizing the disparities in bullying that lesbian, gay, bisexual, transgender, queer/questioning (LGBTQ) students face, the United States (U.S.) Office of Disease Prevention and Health Promotion has named reducing the bullying of LGBTQ high school students an objective in their Healthy People 2030 initiative (U.S. Department of Health and Human Services, 2020a). One potential reason for SMA being the target for bullying is their greater likelihood of having obesity (Grammer et al., 2019). Prior research has found that when compared to their heterosexual peers, SMA consistently had higher body mass indices (BMIs), especially sexual minority girls compared to heterosexual girls (Ancheta et al., 2020; Austin et

al., 2013; Hadland et al., 2014; Katz-Wise et al., 2014a; Mereish & Poteat, 2015; Schvey et al., 2021; Wood et al., 2017).

4.2 Relationship Between Bullying and Obesity

Overall, the link between bullying and obesity appears to be bidirectional. For example, previous research has shown that bullying victimization increases the odds of obesity one year later in adolescence (Pearce et al., 2002). In addition, numerous longitudinal and prospective cohort studies have shown that adolescents who were bullied at a younger age had higher odds of developing obesity by late adolescence/early adulthood (Baldwin et al., 2016; Mamun et al., 2013; Takizawa et al., 2014). Research findings also suggest that adolescents who are bullied are at heightened risk of obesity due to engagement in weight-related health behaviors such as overeating, binge eating, and physical inactivity, and also due to associated negative affect that has been linked to higher odds of obesity (Grammer et al., 2019; Lie et al., 2019; Midei & Matthews, 2011). A 2017 systematic review and meta-analysis on bullying victimization in childhood and adolescence found that in 10 cross-sectional analyses examined, there were possible associations between bullying victimization and risk of being obese (OR = 1.78, 95% CI: 1.42-2.21) (Moore et al., 2017). However, it has also been shown that adolescents who are obese are more likely to be bullied because of their weight status (Koyanagi et al., 2020; Rupp & McCoy, 2019; Van Geel et al., 2014a).

4.3 Anti-Bullying Policy With Sexual and/or Gender Minority Identity Enumeration

Given that links between bullying victimization and obesity are believed to be reciprocally-related, with the presence of one factor seemingly increasing the risk of the other, it is important to examine potential methods of addressing both bullying and obesity with policies that can be protective for both outcomes. This may be especially true for SMA who experience

disparities in both bullying and obesity. In a 2019 National Academies of Sciences, Engineering, and Medicine report, forms of discrimination and stigma were listed as contextual influences on weight control and related behaviors that influence obesity risk (National Academies of Sciences, 2019a). It is therefore possible that policies targeting discrimination and stigma in high-risk populations, such as SMA, may reduce obesity risk, as well as bullying victimization, due to social identity.

Discrimination faced by SMA can be reinforced by societal-level structures that trickle down and are perpetuated at the school (community) and peer (interpersonal) levels (Hatzenbuehler et al., 2013). Anti-bullying policies with sexual and/or gender minority (SGM) identity enumeration addresses societal-level structures by protecting these identities that can be stigmatized (Centers for Disease Control and Prevention, 2021). In general, enumeration means listing of traits or characteristics in policies. For SGM enumerated anti-bullying policy specifically, this policy contains explicit language listing SGM identity as one of the special classes to be protected when it comes to bullying victimization because it is one of the classes that has been historically targeted for bullying (Centers for Disease Control and Prevention, 2021). An example of SGM enumeration can be found in New York State's *Dignity for All Students Act* that states that students at school should be free of discrimination and harassment that, "includes but is not limited to conduct, verbal threats, intimidation or abuse based on a person's actual or perceived race, color, weight, national origin, ethnic group, religion, religious practice, disability, sexual orientation, gender or sex" (The Dignity for All Students Act, 2010). Instead of implicitly including certain groups, the protection of SGMs is made explicit, and this explicitness signals to communities that this population is at heightened risk of being bullied and needs to be protected (Kull et al., 2015). Given that social norms are influenced by the presence

or absence of laws and policies (Chung & Rimal, 2016), the presence of this type of policy may help shift social norms to further acceptance of SMA, which can lead to decreased bullying victimization and lower risk for negative health behaviors that influence obesity.

A 2019 study examined the impact of sexual orientation enumeration in state anti-bullying policies in the U.S. on bullying and suicidal outcomes among youth (Meyer et al., 2019). The authors used logistic regression models to test these associations, controlling for demographic characteristics. Results showed that across all respondents, regardless of sexual identity, living in a state with an enumerated anti-bullying policy was associated with lower odds of bullying and suicidal ideation and attempts. Enumerated anti-bullying policy was effective in reducing odds of both outcomes for all adolescents. However, this study was limited by its cross-sectional design and analysis of outcomes data from the 2015 YRBS, with data for enumerated anti-bullying policy only taking into account whether the state had a policy enacted by 2015 (Meyer et al., 2019). This design precludes making causal inferences because it does not consider time and inherent differences among U.S. states. Therefore, the lower odds of bullying and suicide outcomes may have been related to the presence of enumerated policy, or it may have been related to something else.

Another study examined the associations between inclusive anti-bullying policies and risk of suicide attempts in lesbian and gay youth (Hatzenbuehler & Keyes, 2013). This study also used a cross-sectional design, analyzing outcomes data from the Oregon Healthy Teens Survey from 2006–2008 with policy data from matching Oregon school districts. The authors found that lesbian and gay youth living in counties with school districts that had less inclusive anti-bullying policies were 2.3 times more likely than those living in counties with more inclusive school policies to have attempted suicide in the past year (Hatzenbuehler & Keyes, 2013). Findings

from each of these studies support the importance of anti-bullying policies on psychological outcomes among SMA. However, understanding the effects of these policies can be improved using methods that allow for causal inference, especially useful in the context of policy analysis, and by examining other outcomes that are also important to the health and wellbeing of SMA.

4.4 Study Aims

This study aims to help fill the gap in information about the effects of SGM enumerated anti-bullying policies on bullying and obesity rates among SMA.

Aim: To examine the causal effect of anti-bullying policies with sexual and/or gender minority identity enumeration on bullying and obesity trends over time among sexual minority adolescents using a difference-in-differences approach.

Hypothesis 1: In the period after enactment of anti-bullying policies with SGM identity enumeration, states with such policies will show a decreased trend in sexual minority adolescent *bullying* rates, above and beyond what the trend would have been if such a policy had not been enacted.

Hypothesis 2: In the period after enactment of anti-bullying policies with SGM identity enumeration, states with such policies will show a decreased trend in sexual minority adolescent *obesity* rates, above and beyond what the trend would have been if such a policy had not been enacted.

Exploratory Aim: To examine whether the causal effect of anti-bullying policies with sexual and/or gender minority identity enumeration on bullying and obesity trends over time differs for SMA and their heterosexual peers.

Exploratory Hypothesis 1: Sexual identity will moderate the causal effect of anti-bullying policies with SGM enumeration on *bullying* rates, such that the causal effect will be stronger for SMA than for heterosexual adolescents.

Exploratory Hypothesis 2: Sexual identity will moderate the causal effect of anti-bullying policies with SGM enumeration on *obesity* rates, such that the causal effect will be stronger for SMA than for heterosexual adolescents.

4.5 Methods

Data and Sample

Data on adolescent demographic characteristics, bullying, obesity, and health behaviors were obtained from state-level Youth Risk Behavior Surveys (YRBS) administered by the CDC. These biennial, paper and pencil, self-report questionnaires are administered in the spring to public secondary school students in grades 9–12 during designated class times (Brener et al., 2013). The YRBS employs a two-stage, cluster sample design to obtain a representative sample of U.S. students in respective states. Students are not followed over time (Brener et al., 2013). We used publicly available, weighted data from 44 states collected between January 1, 1999 and January 1, 2019 (Centers for Disease Control and Prevention, 2018). Given that only de-identified data were used for this study, the Columbia University Institutional Review Board approved the study using exempt status.

Individual-Level Measures

Sexual Identity. In the YRBS, sexual minority status is measured using the question, “Which of the following best describes you?” with response options “Heterosexual,” “Gay or lesbian,” “Bisexual,” and “Not sure.” We chose to include heterosexual adolescents in our analyses given prior research that has shown that effects of SGM protective policies (such as

same-sex marriage, SGM-enumerated hate crime laws) have benefits for everyone regardless of sexual identity (Meyer et al., 2019; Raifman et al., 2017). Of the 44 states with publicly available, weighted data, 36 included this question.

Bullying Victimization. Bullying victimization was measured using the item, “During the past 12 months, have you ever been bullied on school property?” (yes/no).

Obesity. Obesity status is based on CDC growth charts and student self-report data of height and weight. The YRBS classifies adolescents as obese or not obese using a dichotomized (yes/no) variable. Adolescents with a body mass index (BMI) between the 5th to 85th percentiles are considered normal weight, those between the 85th and 95th percentiles are considered overweight, and those with a BMI \geq 95th percentile are considered to be obese (Centers for Disease Control and Prevention, 2017). We examined obesity (not overweight) in the these analyses because prior research has shown that obese adolescents are more likely to be victimized than overweight adolescents (Waasdorp et al., 2018), and obesity has more negative health consequences for the adolescent (Cote et al., 2013; Kumar & Kelly, 2017).

Policy-Level Measure

Anti-Bullying Policy With Sexual and/or Gender Minority Identity Enumeration.

The exposure for this study is state-level educational anti-bullying policy that explicitly enumerates prohibition of bullying on the basis of sexual and/or gender minority identity (Kull et al., 2015). Each of the 44 states with available YRBS data were coded as either having enumerated policy or not (yes/no) if the policy was in place during the full period of YRBS data collection (YRBS data collection is completed in the spring of each odd-numbered year) or not having enumerated policy (Brener et al., 2013). State-level anti-bullying policy enumeration data were derived from data collected by the Movement Advancement Project. The Movement

Advancement Project (MAP) is an independent, nonprofit think tank that provides rigorous research to help speed equality and opportunity for LGBT people. MAP has aggregated state-level anti-bullying policy data from all 50 states and five U.S. territories, and this information is publicly available (Movement Advancement Project, 2020). We used the most recent MAP data (last updated in March 2020) to reflect the most up-to-date state-level anti-bullying policies. Of the 44 states, 19 were included in our treatment group for having enumerated policy, and 25 were included in our control group for not having enumerated policy. See Table 4.1 for year of each state's enumerated policy enactment and Table 4.2 for the corresponding first year coding of enumerated policy enactment. The first state to pass an enumerated anti-bullying policy was New Jersey in 2002, and the most recent state to pass such a policy was Nevada in 2015. Most states that have passed enumerated anti-bullying policies passed them from 2010–2012. Table 4.2 also contains information on data availability for the bullying victimization and obesity outcomes. Table 4.3 contains information on data available for sexual identity.

Covariates

Demographic Characteristics. Demographic covariates included age and race/ethnicity as prior research has shown age and racial/ethnic differences in both bullying and obesity outcomes (Byrne et al., 2016; Ogden et al., 2018; Wang et al., 2011; Xu et al., 2020).

Health Behaviors. Health behavior covariates included questions related to diet, physical activity, and sedentary behavior to control for individual-level factors associated with obesity (Brown et al., 2015; Iannotti & Wang, 2013; Patton et al., 2016; Wang, Y. C. et al., 2012). Responses were dichotomized indicating engagement/no engagement in the behavior during the specified time frame (e.g., 7 days, 30 days) or whether the frequency met or exceeded that of the U.S. Office of Disease Prevention and Health Promotion's (ODPHP) Dietary Guidelines for

Americans (U.S. Department of Health and Human Services, 2015) and the U.S. ODPHP's Youth Physical Activity Recommendations (i.e., 60 minutes a day of moderate-to-vigorous exercise) (U.S. Department of Health and Human Services and U.S. Department of Agriculture, 2017). Responses for television watching and computer use were dichotomized as either greater or less than five hours, based on prior obesity research using YRBS data (Kenney & Gortmaker, 2017; Kim et al., 2016).

Other Factors. We also included asthma status (yes/no) and feelings of sadness or hopelessness in the past 12 months (yes/no) as covariates as both have been associated with bullying victimization and obesity status among adolescents (Akula et al., 2018; Charles et al., 2020; Mohanan et al., 2014; Rupp & McCoy, 2019). We included a school violence victimization count variable as a covariate given that Study 2 findings revealed a significant association between violence victimization count and odds of obesity among adolescents. Lastly, we included a variable indicating state-level percentage of students eligible for free/reduced-price lunch provided by the U.S. National Center for Education Statistics (National Center for Education Statistics, 2019) as a measure of income level.

Statistical Analyses

We first calculated survey-weighted differences in adolescent characteristics between states with enumeration and states without enumeration. We then calculated weighted means of bullying victimization and obesity rates by sex and sexual identity subgroups. We used a difference-in-differences (DID) approach to examine trends in adolescent bullying victimization and obesity rates in states with and without SGM identity enumeration in the post-period. DID is a recommended statistical technique for understanding causes of health disparities, especially when assessing the impact of policies or in situations in which randomized controlled trials are

deemed unethical (Jeffries et al., 2019; Wing et al., 2018). It can be considered a quasi-experimental or natural experiment in which the exposure (e.g., a policy) is not randomized between two groups (Shadish et al., 2002). Instead, under a set of assumptions, the exposure is determined by an external means or force that approximates randomization in that there is no plausible relation to residual confounding factors and therefore causal inference can be made from observational data (Dimick & Ryan, 2014; Jeffries et al., 2019). We were able to utilize this technique as we have a difference in assignment of treatment (states with enumerated policy and states without enumerated policy) and outcomes data in the pre- and post-periods of policy passing. Further, because we have multiple time points for policy passing, and not just one singular timepoint, this is commonly referred to as a “staggered assignment” or “differential timing” of treatment (Goodman-Bacon, 2021).

To test our Aim, we estimated a linear regression difference-in-differences model for each of the two binary outcomes (bullying victimization and obesity) with binary indicators for time period (before and after enactment of anti-bullying policy with SGM enumeration) and treatment and comparison groups (states with and those without enumerated policies). In this model, we also included the interaction of these time and group indicators, and fixed effects for state and year (also known as two-way fixed effects) (Cunningham, 2021), controlling for potential confounding variables. In line with traditional difference-in-differences analyses, we estimated linear, rather than logit, models due to their unbiased estimation properties in fixed effects analyses (Greene, 2004; Wing et al., 2018). To account for the YRBS’ complex sampling design, we estimated standard errors using Taylor series linearization with clustering by state.

We performed analyses of the effect of SGM enumerated policies on the two study outcomes among all adolescents (Model 1) and then among a subgroup of SMA only (Model 2).

For the Exploratory Aim, we tested an interaction term between treatment group \times sexual identity for each study outcome (presented as Model 3). For all analyses, we stratify by sex given known sex differences in both outcomes among adolescents (Byrne et al., 2016; Suglia et al., 2014).

For our analyses, we included state as a fixed effect for two reasons. It allowed the DID analysis to capture relative changes in bullying victimization and obesity rates for each state, preventing baseline state rates from affecting analyses. Also, U.S. states vary greatly in terms of culture, politics, traditions, and history that could confound analyses. Therefore, controlling for each state and their state-invariant characteristics is important. Including year as a fixed effect is also important to control for differences in bullying victimization and obesity rates over time that would not be the cause of the treatment (e.g., greater societal acceptance of sexual minorities) (Wing et al., 2018). DID design is intended to control for these unmeasured confounders in states and years, even though they are not measured explicitly (Wing et al., 2018). The statistical formula for the difference-in-differences model with bullying victimization as the outcome is as follows:

$$Bullied_{ist} = \beta D_{st} + \gamma_s + \lambda_t + \theta_{is} + \mu_{ist},$$

where i = individual, s = group, t = time period, β = causal effect, D = indicator for enumerated states and treated time, γ = state fixed effects, λ = year fixed effects, θ = vector for demographic and other control variables, and μ = error term. Our *a priori* significance threshold was set at p -value $< .05$.

Lastly, use of DID requires that a parallel trends assumption be met (i.e., the trends in the outcomes between the treatment and comparison groups are the same prior to exposure and would have continued to be the same if the exposure did not occur) (Dimick & Ryan, 2014).

Therefore, we tested this assumption using event study analysis, a specific type of DID approach that allows for leads (time before) and lags (time after) of the event of interest to be estimated, while still controlling for the same fixed effects factors in the linear regression DID analyses (Clarke & Tapia-Schythe, 2021). This type of method is especially helpful when performing DID with an exposure that occurred during multiple timepoints, instead of an exposure that occurred at one timepoint (Clarke & Tapia-Schythe, 2021). By plotting leads and lags, visual representation of an event study analysis allows one to confirm that the parallel trends assumption is met, and one is also able to map out the effect of exposure over time (Rees et al., 2020). Specifically, if the estimated coefficients of leads are small and statistically insignificant, the parallel trends assumption has been met (Rees et al., 2020). In order to conduct the event study analyses, we replaced the treatment binary variable in our DID linear regression models with binary variables for leads and lags for each model, in line with prior research (Rees et al., 2020). Lastly, we used complete case analysis to examine participants with only complete data for all predictors, outcomes, and covariates in our regression analyses as this is the most popular approach for DID (Goodman-Bacon, 2021). Our total analytic sample size for regression analyses was 408,510 respondents in the YRBS. Data cleaning and coding were conducted using Stata version 17.

4.6 Results

Demographic Characteristics and Study Outcomes

Table 4.4 presents demographic and outcome characteristics of adolescents by state enumeration status (i.e., group of states with enumeration vs. without enumeration). The mean age for both groups was around 16 years, and males represented a little more than half of the sample in both groups. The majority of represented adolescents were White, and approximately

14% identified as sexual minorities. Slightly less than half of adolescents qualified for free or reduced-price lunch. Bullying victimization rates were a little higher for the group of states without enumeration (20.83% vs. 19.79%). Obesity rates were around the same at 12.50%. Overall, there were significant differences in both groups on all variables except for sex and obesity rates.

Outcome Prevalence by Sex and Sexual Identity

Table 4.5 presents the weighted means for each of the study outcomes for the entire sample. From 1999–2009, the average rate of bullying victimization for females was significantly higher than the average rate for males (22.56% vs. 17.48%), but rates of obesity were significantly higher for males than for females (15.80% vs. 9.32%). Of note, rates of bullying victimization and obesity were significantly higher among sexual minority girls and boys compared to their heterosexual peers across this time period (Table 4.6). Figures 4.1 and 4.2 show bullying victimization rates by sex and sexual identity subgroups from 2009–2019. Figures 4.3 and 4.4 show obesity rates by sex and sexual identity subgroups from 1999–2019.

Descriptive Changes in Bullying Victimization and Obesity Rates by Enactment Period and State Enumeration Status

Tables 4.7 and 4.8 present the descriptive statistics reflecting changes in average rates of bullying victimization and obesity between the pre- and post-period of enumerated policy enactment (first difference) and the difference in average rates between the treatment and control groups (second difference). This difference-in-differences is the average treatment effect (ATE) of policy enactment in states with SGM enumeration. As detailed in these descriptive tables, there were small ATEs for bullying victimization and obesity among females in general (0.19 and 1.11, respectively), but larger ATEs for each outcome among sexual minority girls (-5.29

and 3.78, respectively). The same pattern exists for males, with larger ATEs for each outcome among sexual minority boys compared to all boys in general. Results of the linear difference-in-differences models provide a more robust analysis of these relationships.

Difference-in-Differences Analysis of SGM Enumerated Policies and Bullying Victimization by Sex

Controlling for age, race/ethnicity, obesity and asthma status, feelings of sadness or hopelessness, percentage of free or reduced-price lunch, and state and year fixed effects, our linear regression difference-in-differences analysis presented in Model 1 (Tables 4.9 and 4.10) revealed significant associations: bullying victimization rates for adolescent girls and boys in enumerated states during the post-period were significantly lower than victimization rates for adolescent boys and girls in non-enumerated states during the post-period. Specifically, for girls, living in an SGM enumerated state was associated with a 1.0 percentage point decrease in the probability of bullying victimization (Model 1, Table 4.9). For boys, this association was slightly stronger with a 3.2 percentage point decrease in the probability of bullying victimization compared to living in a state with no SGM enumeration in anti-bullying policy (Model 1, Table 4.10).

We then tested the linear regression DID analysis in a subgroup of SMA only, as this was our main population of interest and the specific target of these SGM enumerated anti-bullying policies. In these models (Models 2) for both sexual minority girls and boys, we found significant treatment terms—meaning that among sexual minority girls and boys, those living in states with enumerated policies had lower likelihoods of bullying victimization in the period after policy enactment compared to those living in states with no enumerated policies. These findings, which support Hypothesis 1, indicate that that the likelihood of bullying victimization

is lower than would be expected if the policies were not enacted. For sexual minority girls, there was a 6.4 percentage point decrease (a 20.65% reduction relative to the mean bullying victimization rate of 30.99% among SM girls) and for sexual minority boys, a 6.0 percentage point decrease in the probability of being bullied, (a 19.95% reduction relative to the mean bullying victimization rate of 30.08%). Tables 4.9 and 4.10 show the DID results for bullying victimization among females and males, respectively.

Lastly, findings were non-significant when we included an interaction term (Exploratory Hypothesis 1, Model 3) to identify potential differences in the effect of SGM enumerated anti-bullying policy between heterosexual and sexual minority adolescents, indicating that the effect of the policy on both groups is not different.

Difference-in-Differences Analysis of SGM Enumerated Policies and Obesity by Sex

For the DID results with obesity as the outcome, controlling for age, race/ethnicity, weight-related health behaviors, school violence, feelings of sadness or hopelessness, percentage of free or reduced-price lunch, and state and year fixed effects, our linear regression DID analyses among all adolescents (i.e., no subgroup analysis, Model 1, Tables 4.11 and 4.12) revealed significant findings only among girls. However, obesity rates increased among girls, instead of decreased. For girls living in states with SGM enumerated policy, they had a 3.0 percentage point increase in the probability of having obesity compared to those living in states with no enumerated policy.

Subgroup analyses among SMA (Model 2, Tables 4.11 and 4.12) revealed significant findings of the ATE in the post-period for obesity for both SM girls and boys. On average, SM girls had a 2.2 percentage point increase in the probability of having obesity, and SM boys had a

6.0 percentage point increase in the probability of obesity—findings incongruent with Hypothesis 2.

The interaction term of treatment \times sexual minority was not significant for either girls or boys (Model 2, Tables 4.11 and 4.12) similar to findings for the bullying victimization outcome. This finding did not support our Exploratory Hypothesis 2. Figures 4.5–4.8 show trends in obesity and bullying victimization rates by time to policy enactment among states with SGM enumeration by sex and sexual identity subgroups. A timepoint of 0 indicates the year an enumerated policy was enacted.

Event Study Analysis of SGM Enumerated Policies and Bullying Victimization by Sex

Event study analyses and graphs show estimated effects of enumerated policies in the lead (time before) and lag (time after) years of policy enactment. Figures 4.9 and 4.10, show the estimated effects of enumeration on the y-axis and the lead years as indicated as dots with 95% confidence interval bars to the left of the red-dashed vertical line. The parallel trends assumption is met because the coefficients of the leads are small and statistically insignificant (as indicated by the 95% confidence intervals crossing 0). Visually, we can also see that for sexual minority girls, in the post-period, the decrease in bullying victimization is lower in the years following SGM enumerated policy enactment, and that this effect seemed to be sustained over time. For sexual minority boys, we can see a slight decrease in bullying victimization rates in the post-period compared to the pre-period; however, this effect does not seem to be sustained over time.

Event Study Analysis of SGM Enumerated Policies and Obesity by Sex

Figures 4.11 and 4.12 display graphical results of the event study analyses for the obesity outcome among sexual minority girls and sexual minority boys, respectively. We found significant associations of our treatment variable for both SM girls and boys, but in the opposite

direction of our hypothesis that with the enactment of SGM enumerated anti-bullying policies, obesity rates would decrease. Event study analyses in this subgroup further confirm a significant increase in obesity rates over time, although this increase occurs much later after the passing of enumerated policies (i.e., around years 8–10, see Figures 4.11 and 4.12).

Sensitivity Analyses

A series of sensitivity analyses were also conducted to check the robustness of our DID models. In addition to performing the event study analyses, we also performed a linear regression DID analysis in which we swapped in seatbelt use (yes/no) as our outcome (instead of bullying victimization or obesity). This method of changing the outcome to a variable not expected to be associated with the predictor of interest (i.e., in our study—changes to SGM enumerated anti-bullying policy) is used as a falsification test to ensure there were no omitted variables possibly driving results (Raifman et al., 2017). When we performed this, we found that among both girls and boys, there were no significant findings for each of the three models we ran for our original outcome variables, indicating robustness of our results.

In another check, we also excluded all observations for New Jersey and Nevada (as those were the two states that had passed their SGM enumerated policies the earliest and the latest, respectively), and we re-ran all models. The purpose of this was to assess whether results were driven by the earliest or latest states to implement their enumerated policies. The significance of the treatment or the treatment \times sexual identity variables for all models, stratified by sex, were the same as the original sample with New Jersey and Nevada included, indicating our results were robust to the exclusion of these states with the most lag and lead data.

4.7 Discussion

In our study, we found significant associations between SGM enumerated anti-bullying policy and decreased bullying victimization rates in the full sample of adolescents (heterosexual and sexual minority), for both girls and boys. This suggests that for both girls and boys overall, anti-bullying policy with SGM enumeration on bullying victimization was associated with a decrease in bullying victimization following the enactment of enumerated policies. When we performed a subgroup analysis focused only on SM girls, we found that in states with enumerated policies, SM girls had on average a 6.4 percentage point decrease in the probability of being bullied. The subgroup analysis among SM boys revealed that in states with enumerated policies, SM boys had on average a 6.0 percentage point decrease in the probability of being bullied. To examine potential differences by sexual identity, we tested the triple difference (i.e., the difference of the effect between heterosexual adolescents and SMA in the difference-in-differences model). In models for both girls and boys, our interaction term between treatment \times sexual minority was not significant, suggesting that the effect of SGM enumerated anti-bullying policy enactment had no differing effect between heterosexual adolescents and SMA.

Our finding that for both girls and boys, those who live in states with SGM enumerated policy had decreased bullying victimization rates is of importance. Our finding adds to prior literature that has shown that including sexual and/or gender minority identity as special classes to be protected in state law reduces bullying victimization among SMA (Meyer et al., 2019; Rees et al., 2020; Seelman & Walker, 2018). We extend this literature by providing estimates using causal inference (controlling for state and year fixed effects) and by performing moderation analyses to determine if there is a differing effect of policies protective of SGM identity between heterosexual and sexual minority adolescents—methods that have not been combined in prior

research, to our knowledge. Our use of causal inference with DID is able to make a stronger claim than regression analyses using cross-sectional data. These state-level anti-bullying policies that are protective of SGM adolescents have their intended effect—to decrease bullying victimization among SMA. But their implementation is also associated with decreased bullying victimization for all adolescents.

Further, event study analyses confirmed the significant difference in the pre-trends of both bullying and obesity among SM girls and boys, as well as the effect of enactment of the policy over time (i.e., is the effect significant in the post-period, and if so, during which period of data collection). For bullying victimization, we found that the decrease in victimization rates among SM girls and boys was fairly immediate, with significant decrease in trends 2–4 years following inclusion of sexual and/or gender minorities as a protected class against bullying. Event study analyses also revealed that this decrease in trends effect persisted for almost the entire period of data availability (i.e., 10 years post policy enactment) for SM girls (Figure 4.9). For sexual minority boys, however, this effect did not seem to last as long with slight decreases post-policy implementation, but significant increases again in bullying victimization rates around 8–10 years post policy enactment (Figure 4.10) Nevertheless, our linear regression DID models, overall, reveal significant decreases in bullying victimization rates for both SM girls and boys in the post-period following policy passing.

There are several potential explanations for why the effect may have persisted for longer for girls than boys. Generally, boys may be more motivated than girls to convey an image of independence and self-reliance, not desiring to seek help in handling problems with peers (Blomqvist et al., 2020; Cortes & Kochenderfer-Ladd, 2014). This can translate into lower likelihood of reporting social problems such as bullying victimization (Cortes & Kochenderfer-

Ladd, 2014). Girls, on the other hand, are more likely than boys to seek help and counseling for their victimization experiences. Not only may girls want to seek help to stop the bullying victimization, but they also may be seeking emotional support and sympathy—a social norm that is more acceptable for girls than boys (Cortes & Kochenderfer-Ladd, 2014; Mishna et al., 2020). Although we found that SGM enumerated anti-bullying policy was associated with a decrease in bullying victimization rates in the post-period for both sexual minority girls and boys, this effect persisted for a longer time among girls. It could be that SM girls feel more protected and seek more help for their bullying victimization, which in turn leads to less victimization in the presence of anti-bullying policy that protects by social identity. The types of victimization that girls experience compared to boys can also help explain why there is more sustained decreases in bullying victimization among SM girls compared to SM boys after the passing of protective policy. Girls experience more relationship aggression (that take the form of gossip and conversational attacks) (Wang, J. et al., 2012; Williams et al., 2017) while boys experience more physical and verbal aggression (Silva et al., 2013). Although boys, compared to girls, experience more homophobic name-calling, a type of verbal aggression associated with sexual identity (Birkett & Espelage, 2015), they appear to be less likely to report this victimization (Mishna et al., 2020). The higher general bullying rates among boys than girls, the different types of bullying experienced by boys and girls, and the lower likelihood of boys seeking help for bullying, could together help explain this finding.

Findings related to obesity are more nuanced. We found that for girls overall (heterosexual and sexual minority girls), that living in a state with SGM enumerated policy was associated with an increase in the probability of having obesity. Subgroup analyses of SM girls and SM boys revealed significant associations between enumerated policy and obesity rates

among both groups. Controlling for covariates and state and year fixed effects, SM girls had a 3.0 percentage point increase in the probability of having obesity on average. SM boys had a 6.0 percentage point increase in the probability of having obesity on average. The triple difference model was not significant, revealing no differing effect of the policies for heterosexual and sexual minority adolescents.

For SM girls and boys, event study analyses revealed significant increases in obesity rates not immediately after policy passing (as in the bullying victimization outcome), but in the 8–10 years following policy enactment. This event study finding and the linear DID finding are counter to our hypothesis. We hypothesized that anti-bullying policy protective of SGM adolescents would be associated with a decrease in obesity rates among SMA because of known associations between bullying victimization and obesity among this population. At the urban school district level, Study 2 revealed that sexual minority girls and boys who reported 2+ counts of violence victimization (including bullying victimization) had higher odds of having obesity compared to their heterosexual peers. Study 2 also revealed that in the presence of more protective school climates, SM girls and boys had lower odds of obesity compared to those who lived in school districts with less positive school climates—and one component of a positive school climate was SGM enumerated anti-bullying policy. Therefore, the finding of an increase in obesity rates, at the state-level, among SM boys after the passing of a protective SGM anti-bullying policy is surprising. Again, we offer several possible explanations for this finding.

One, it is possible that protective SGM policies are associated with increases in obesity rates among adolescent girls and SM boys simply as a result of already increasing obesity trends among these populations and unmeasured covariates in regression models (such as family food choices, healthy food access, housing) that are related to obesity (National Academies of

Sciences, 2019a) but unavailable in the YRBS. Further, with the positive effects of SGM enumerated anti-bullying policies on bullying victimization among adolescents fading over time (as shown through the event study analyses), one possible explanation for the increase in obesity rates 8–10 years after the passing of enumerated policy is that the fading protection of bullying victimization (which may include verbal and physical harassment and assault, experiences that increase the likelihood of developing obesity later on) may result in increases in obesity that did not exist during the same time as the decreases in bullying victimization. This is because the periods during which the treatment effects of enumerated policy are significant—are different for both outcomes. Again, Figures 4.9 and 4.10 for the bullying victimization outcome show more immediate decreases in the period following the passing of such policies; whereas this is different for the obesity outcome. The significant effect of the policy passing does not occur until 8–10 years after. This difference in policy effect timing, and given that one possible relationship between bullying victimization and obesity is that obesity develops after experiences of bullying victimization (Baldwin et al., 2016; Takizawa et al., 2014)—can help explain the significant increases in obesity rates that occurs only many years after policy enactment, when bullying victimization rates are rising again (and the positive effect of enumerated policies for this outcome is already fading).

Moreover, it could very well be that state-level anti-bullying policy with SGM enumeration is not the best predictor of obesity because it is not specific enough to obesity—its overall purpose is to decrease bullying victimization among SGM adolescents. However, we chose *a priori* to include this as an outcome to examine whether one form of anti-discrimination policy relevant to SGM adolescents would help decrease rates of obesity, a health disparity outcome for this population. It did not; in fact, enumerated anti-bullying policy was associated

with an increase of obesity rates for adolescent girls and SM boys, but event study analyses revealed that this increase occurred many years later relative to the passing of the enumerated policy. Typically, we would expect the effects of policy enactment to be more immediate than more distal relative to the time of passing, unless implementation was much after enactment. We did not measure implementation, which can be quite difficult to measure, but the fact that the increase in obesity rates among SM boys occurs 8–10 years post enactment of the protective policy could indicate that this association is weaker and therefore less indicative of meaningful interpretation than if the effects were more immediate.

4.8 Limitations

Generalizability of findings is a concern in quasi-natural experiments (Jeffries et al., 2019). For this study, states in different regions of the U.S. likely vary in social and political views that influence adoption and implementation of SGM enumerated anti-bullying policies (e.g., the 19 states with anti-bullying enumeration may be more socially and politically progressive and inclusive). This could result in a “self-selection” of states with enumerated anti-bullying policy, although we controlled for state fixed effects. Future research could possibly seek to examine variation in anti-bullying and other education policies across states at large. Further, unmeasured covariates that vary with time (e.g., neighborhood factors such as built environment and overall school climate that are more proximal and time variant) may confound findings that cannot be accounted for in a general difference-in-differences analysis, even when including a fixed effect for year (Allison, 2009).

Our findings were further limited by the lack of data points in analyses for both bullying victimization and obesity, particularly in the pre-enactment period of SGM enumerated policy. Despite pooling data from 1999–2019 to map out trends and present demographic characteristics,

our linear regression DID analyses utilized complete case analysis, listwise deleting any observations with missing data on variables included in our models. Among our 19 treated states, the year 2010 was the average for when SGM enumerated policy was passed. This is important to note as bullying victimization data in state-level YRBSs were not collected until 2009 (height and weight have been collected since 1999). However, several other variables for covariates included in the DID models (such as salad consumption and TV watching) were also not collected until 2009. This resulted in all observations prior to 2009 being dropped in analyses, resulting in decreased sample sizes across our DID models by sex. At least one pre-period data point is needed to conduct DID analyses; however, more pre-period time points would be ideal (Goodman-Bacon, 2021). Future research looking to examine the impacts of social and education policies on SGM adolescents should seek to utilize data with more time points before and after policy implementation. It is also important to note that with the shifting societal attitudes toward LGBTQ people in the U.S. (Witeck, 2014), results overall may look different if analyses were limited to say that last five years instead of since 1999. Future research should explore such differences in timing that would also possibly help alleviate the issue of lack of datapoints in the YRBS as aforementioned.

Moreover, although we controlled for school violence experiences (which included a question about bullying victimization) in our models with obesity as the outcome, this measure was very broad, and not specific to one type of discrimination. SMA are at higher risk for stigma-based discrimination (Kosciw et al., 2020), as well as weight-based victimization, a type of victimization related to body weight that can be experienced across diverse body weight categories (Puhl et al., 2019). Weight-based victimization in particular has been found to be associated with maladaptive eating (such as binge eating), as well as exercise avoidance and

poorer sleep (Himmelstein et al., 2019). Future research should seek to include discrimination and/or victimization questions that are more specific and relevant for sexual and gender minority adolescents.

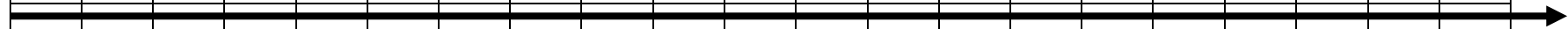
4.9 Conclusion

State-level anti-bullying policy with SGM enumeration is a type of non-discrimination policy that was found to be salient in reducing bullying victimization among all adolescents, but especially among SMA. This type of protective policy can empower adolescents to speak up for themselves and report victimization, and our study had strong findings for decreased bullying victimization rates among SM girls and boys in the post-period after policy enactment. Anti-bullying policy with SGM enumeration may also have an unintended effect of increasing obesity rates among adolescent girls and SM boys, although this effect occurred much later in time after passing of enumerated anti-bullying policy, possibly indicating other relationships between anti-bullying policy, bullying, obesity, and temporality among sexual minority adolescents that should be explored in future research.

Table 4.1

Timeline of State-Level Anti-Bullying Policy With Sexual and/or Gender Minority Identity Enumeration Enactment From 1999–2019

| | | | | | | | | | | | | | | | | | | | | |
|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|
| | | | NJ | | | | NM | IO | CO | NC | IL | AR | DE | | | NV | | | | |
| | | | | | | | | VT | HI | | NH | CA | ME | | | | | | | |
| | | | | | | | | | MD | | NY | CT | WV | | | | | | | |
| | | | | | | | | | | | | RI | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | |
| 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |



Note. YRBS data collection occurred during odd-numbered years (bolded). States were coded as having an SGM enumerated anti-bullying policy if the enumerated policy was implemented for the full period of data collection. Hence, states that enacted an enumerated anti-bullying policy during odd-numbered years were not coded as having an enumerated anti-bullying policy until the following odd-numbered year (e.g., Iowa was not coded as having an enumerated anti-bullying policy until 2009) to capture full effects of having an enumerated policy in place for at least one year prior to data collection.

Table 4.2

Date of State-Level Anti-Bullying Policy With Sexual and/or Gender Minority Identity Enumeration Enactment and Corresponding First Year of Analysis

| State | Date of enumerated anti-bully policy implementation | First year of analysis coded as anti-bullying policy in place | Number of survey cycles of weighted data measuring bullying | Number of survey cycles of weighted data measuring obesity |
|----------------|---|---|---|--|
| 1. Alabama | N/A | N/A | 5 | 9 |
| 2. Alaska | N/A | N/A | 6 | 8 |
| 3. Arizona | N/A | N/A | 2 | 9 |
| 4. Arkansas | 2011 | 2013 | 5 | 10 |
| 5. California | 2011 | 2013 | 3 | 3 |
| 6. Colorado | 2008 | 2009 | 4 | 5 |
| 7. Connecticut | 2011 | 2013 | 5 | 8 |
| 8. Delaware | 2012 | 2013 | 5 | 10 |
| 9. Florida | N/A | N/A | 6 | 10 |
| 10. Georgia | N/A | N/A | 3 | 7 |
| 11. Hawaii | 2008 | 2009 | 5 | 9 |
| 12. Idaho | N/A | N/A | 6 | 10 |
| 13. Illinois | 2010 | 2011 | 6 | 7 |
| 14. Iowa | 2007 | 2009 | 3 | 5 |
| 15. Kansas | N/A | N/A | 5 | 7 |
| 16. Kentucky | N/A | N/A | 6 | 9 |

| State | Date of enumerated anti-bully policy implementation | First year of analysis coded as anti-bullying policy in place | Number of survey cycles of weighted data measuring bullying | Number of survey cycles of weighted data measuring obesity |
|--------------------|---|---|---|--|
| 17. Louisiana | N/A | N/A | 5 | 6 |
| 18. Maine | 2012 | 2013 | 6 | 10 |
| 19. Maryland | 2008 | 2009 | 6 | 8 |
| 20. Michigan | N/A | N/A | 6 | 11 |
| 21. Mississippi | N/A | N/A | 5 | 9 |
| 22. Missouri | N/A | N/A | 5 | 10 |
| 23. Montana | N/A | N/A | 6 | 11 |
| 24. Nebraska | N/A | N/A | 5 | 7 |
| 25. Nevada | 2015 | 2017 | 4 | 7 |
| 26. New Hampshire | 2010 | 2011 | 6 | 9 |
| 27. New Jersey | 2002 | 2003 | 4 | 6 |
| 28. New Mexico | 2006 | 2007 | 6 | 8 |
| 29. New York | 2010 | 2011 | 5 | 10 |
| 30. North Carolina | 2009 | 2011 | 6 | 10 |
| 31. North Dakota | N/A | N/A | 6 | 11 |
| 32. Oklahoma | N/A | N/A | 6 | 9 |
| 33. Pennsylvania | N/A | N/A | 4 | 4 |
| 34. Rhode Island | 2011 | 2013 | 6 | 10 |
| 35. South Carolina | N/A | N/A | 6 | 9 |
| 36. South Dakota | N/A | N/A | 4 | 10 |

| State | Date of enumerated anti-bully policy implementation | First year of analysis coded as anti-bullying policy in place | Number of survey cycles of weighted data measuring bullying | Number of survey cycles of weighted data measuring obesity |
|-------------------|---|---|---|--|
| 37. Tennessee | N/A | N/A | 6 | 9 |
| 38. Texas | N/A | N/A | 5 | 8 |
| 39. Utah | N/A | N/A | 5 | 10 |
| 40. Vermont | 2007 | 2009 | 0 | 11 |
| 41. Virginia | N/A | N/A | 5 | 5 |
| 42. West Virginia | 2012 | 2013 | 6 | 10 |
| 43. Wisconsin | N/A | N/A | 5 | 10 |
| 44. Wyoming | N/A | N/A | 4 | 9 |

Note. The YRBS has collected state-level data since 1991. Height and weight data from which the CDC calculates BMI and obesity status have been collected since 1999. Bullying victimization data have been collected since 2009. The maximum number of survey cycles that could have collected height and weight data is 11. The maximum number of survey cycles that could have collected bullying data is 6.

Table 4.3*YRBS State-Level Sexual Identity Data Collection, 2003–2019*

| State | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 | 2015 | 2017 | 2019 | Never | Number of survey cycles of weighted data measuring sexual identity |
|----------------|------|------|------|------|------|------|------|------|------|-------|--|
| 1. Alabama | | | | | | | | | X | | 1 |
| 2. Alaska | | | | | | | | | | X | 0 |
| 3. Arizona | | | | | | X | X | X | X | | 4 |
| 4. Arkansas | | | | | | | X | X | X | | 3 |
| 5. California | | | | | | | X | X | X | | 3 |
| 6. Colorado | | | | | | | | X | X | | 2 |
| 7. Connecticut | | | | | X | X | X | X | X | | 5 |
| 8. Delaware | X | X | X | X | X | X | X | X | | | 8 |
| 9. Florida | | | | | | X | X | X | X | | 4 |
| 10. Georgia | | | | | | | | | | X | 0 |
| 11. Hawaii | | | | | X | X | X | X | X | | 5 |
| 12. Idaho | | | | | | | | | | X | 0 |
| 13. Illinois | | | | X | X | X | X | X | X | | 6 |
| 14. Iowa | | | | | | | | X | X | | 2 |
| 15. Kansas | | | | | | | | | | X | 0 |
| 16. Kentucky | | | | | | | X | X | X | | 3 |

| State | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 | 2015 | 2017 | 2019 | Never | Number of survey cycles of weighted data measuring sexual identity |
|--------------------|------|------|------|------|------|------|------|------|------|-------|--|
| 17. Louisiana | | | | | | | | | | X | 0 |
| 18. Maine | | | X | X | X | X | X | X | X | | 7 |
| 19. Maryland | | | | | | X | X | X | X | | 4 |
| 20. Michigan | | | | | | X | X | X | X | | 4 |
| 21. Mississippi | | | | | | | | | X | | 1 |
| 22. Missouri | | | | | | | | | X | | 1 |
| 23. Montana | | | | | | | | | | X | 0 |
| 24. Nebraska | | | | | | | | X | X | | 2 |
| 25. Nevada | | | | | | | X | X | X | | 3 |
| 26. New Hampshire | | | | | | X | | X | X | | 3 |
| 27. New Jersey | | | | | | | | | X | | 1 |
| 28. New Mexico | | | | | | X | X | X | X | | 4 |
| 29. New York | | | | | | | X | X | X | | 3 |
| 30. North Carolina | | | | | | X | X | X | X | | 4 |
| 31. North Dakota | | | | X | X | X | X | X | X | | 6 |
| 32. Oklahoma | | | | | | | X | X | X | | 3 |
| 33. Pennsylvania | | | | | | | X | X | X | | 3 |
| 34. Rhode Island | | | X | X | X | X | X | X | X | | 7 |
| 35. South Carolina | | | | | | | | X | X | | 2 |

| State | 2003 | 2005 | 2007 | 2009 | 2011 | 2013 | 2015 | 2017 | 2019 | Never | Number of survey cycles of weighted data measuring sexual identity |
|-------------------|------|------|------|------|------|------|------|------|------|-------|--|
| 36. South Dakota | | | | | | | | | | X | 0 |
| 37. Tennessee | | | | | | | | | | X | 0 |
| 38. Texas | | | | | | | | X | X | | 2 |
| 39. Utah | | | | | | | | | X | | 1 |
| 40. Vermont | | X | X | X | X | X | X | X | X | | 8 |
| 41. Virginia | | | | | | | | | X | | 1 |
| 42. West Virginia | | | | | | | X | X | X | | 3 |
| 43. Wisconsin | | | | | X | X | | X | X | | 4 |
| 44. Wyoming | | | | | | | X | | | | 1 |

Note. Sexual identity data have been collected since 2003. Of states with anti-bullying policy with sexual and/or gender minority identity enumeration ($n = 19$), all states have collected sexual identity data in at least one cycle. Of states with no anti-bullying policy with sexual and/or gender minority identity enumeration ($n = 25$), eight states have never collected sexual identity data.

Table 4.4*Adolescent Characteristics by State Enumeration Status, 1999–2019*

| Variable | Enumeration status | | <i>p</i> -value |
|-------------------------------------|---|--|-----------------|
| | States without enumeration, <i>n</i> (%) (<i>n</i> = 619,048) | States with enumeration, <i>n</i> (%) (<i>n</i> = 858,957) | |
| Age, mean (SD) | 16.0 (1.21) | 15.8 (1.21) | < .001 |
| Sex | | | |
| Female | 318,754 (49.3) | 456,498 (49.2) | 0.14 |
| Male | 309,654 (50.7) | 441,335 (50.8) | 0.14 |
| Race/ethnicity | | | |
| White | 391,369 (63.2) | 479,106 (55.8) | < .001 |
| Black | 92,175 (14.9) | 112,907 (13.1) | < .001 |
| Hispanic | 79,442 (12.8) | 148,735 (17.3) | < .001 |
| Asian | 13,502 (2.2) | 47,004 (5.5) | < .001 |
| Multiple | 21,588 (3.5) | 39,781 (4.6) | < .001 |
| Other | 20,972 (3.4) | 31,424 (3.7) | < .001 |
| Sexual identity ^a | | | |
| Heterosexual | 94,305 (86.5) | 488,092 (85.8) | < .001 |
| Sexual minority | 14,743 (13.5) | 80,973 (14.2) | < .001 |
| Free or reduced-price lunch, % (SD) | 47.10 (9.90) | 44.12 (9.87) | < .001 |
| Bullying rate mean, % (SD) | 20.83 (0.41) | 19.79 (0.40) | < .001 |
| Obesity rate mean, % (SD) | 12.57 (0.33) | 12.50 (0.33) | 0.22 |

^a = Among the states that collected sexual identity across 1999–2019.

Table 4.5*Weighted Means of Bullying Victimization and Obesity Rates by Sex, 1999–2019*

| Outcome | Females, <i>n</i> (%) | Males, <i>n</i> (%) | <i>p</i> -value |
|------------------------|-----------------------|---------------------|-----------------|
| Bullying victimization | 99,168 (22.56) | 73,777 (17.48) | < .001 |
| Obesity | 58,511 (9.32) | 96,447 (15.80) | < .001 |

Table 4.6*Weighted Means of Bullying Victimization and Obesity Rates by Sexual Identity Subgroups, 1999–2019*

| Outcome | Females | | <i>p</i> -value |
|------------------------|----------------------------------|-------------------------------------|-----------------|
| | Heterosexual girls, <i>n</i> (%) | Sexual minority girls, <i>n</i> (%) | |
| Bullying victimization | 46,626 (20.25) | 16,853 (32.16) | < .001 |
| Obesity | 21,838 (9.20) | 9,227 (16.64) | < .001 |
| | Males | | |
| | Heterosexual boys, <i>n</i> (%) | Sexual minority boys, <i>n</i> (%) | |
| Bullying victimization | 38,212 (15.68) | 8,265 (32.57) | < .001 |
| Obesity | 43,902 (15.72) | 5,518 (21.02) | < .001 |

Table 4.7*Changes in Average Bullying Victimization and Obesity Rates by Enactment Period and State**Enumeration Status: Females*

| Enactment period | Enumeration status | | Difference |
|------------------------|-----------------------------------|--------------------------------|------------|
| | States without enumeration (%) | States with enumeration (%) | |
| All girls | | | |
| Bullying victimization | | | |
| Pre-period | 20.32 | 20.44 | 0.12 |
| Post-period | 22.27 | 22.20 | -0.07 |
| Difference | 1.95 | 1.76 | 0.19 |
| Obesity | | | |
| Pre-period | 8.70 | 8.11 | -0.59 |
| Post-period | 11.54 | 9.84 | -1.7 |
| Difference | 2.84 | 1.73 | 1.11 |
| Sexual minority girls | | | |
| Bullying victimization | | | |
| Pre-period | 40.01 | 34.25 | -5.76 |
| Post-period | 31.18 | 30.71 | -0.47 |
| Difference | -8.83 | -3.54 | -5.29 |
| Obesity | | | |
| Pre-period | 14.54 | 15.59 | 1.05 |
| Post-period | 19.31 | 16.66 | -2.65 |
| Difference | 4.77 | 1.07 | 3.78 |

Note. For untreated states (i.e., states with no SGM enumerated anti-bullying policy), we considered the period of 2010 and after as the post-period as this was the average year of implementation among treated states.

Table 4.8*Changes in Average Bullying Victimization and Obesity Rates by Enactment Period and State**Enumeration Status: Males*

| Enactment period | Enumeration status | | Difference |
|------------------------|-----------------------------------|--------------------------------|------------|
| | States without enumeration (%) | States with enumeration (%) | |
| All boys | | | |
| Bullying victimization | | | |
| Pre-period | 17.11 | 17.63 | 0.52 |
| Post-period | 16.22 | 17.34 | 1.12 |
| Difference | -0.89 | -0.29 | -0.6 |
| Obesity | | | |
| Pre-period | 15.66 | 15.24 | -0.42 |
| Post-period | 17.57 | 16.48 | -1.09 |
| Difference | 1.91 | 1.24 | 0.67 |
| Sexual minority boys | | | |
| Bullying victimization | | | |
| Pre-period | 38.82 | 34.01 | -4.81 |
| Post-period | 29.83 | 30.11 | 0.28 |
| Difference | -8.99 | -3.9 | -5.09 |
| Obesity | | | |
| Pre-period | 21.14 | 20.12 | -1.02 |
| Post-period | 22.76 | 21.22 | -1.54 |
| Difference | 1.62 | 1.10 | 0.52 |

Note. For untreated states (i.e., states with no SGM enumerated anti-bullying policy), we considered the period of 2010 and after as the post-period as this was the average year of implementation among treated states.

Table 4.9*Linear Difference-in-Differences Analysis of State-Level Anti-Bullying Policies With Sexual and/or Gender Minority Identity**Enumeration: Changes in Bullying Victimization Rates From 2009–2019 Among Females*

| Variable | Model 1 (All girls) <i>n</i> = 211,580 | | Model 2 (SM girls) <i>n</i> = 37,671 | | Model 3 (Interaction term) <i>n</i> = 211,580 | |
|-----------------------------|---|------------------|---|------------------|--|------------------|
| | Coefficient | 95% CI | Coefficient | 95% CI | Coefficient | 95% CI |
| Age | | | | | | |
| 14 years or younger | Reference | | Reference | | Reference | |
| 15 years | -0.021*** | (-0.027, -0.016) | -0.028*** | (-0.038, -0.018) | -0.021*** | (-0.027, -0.016) |
| 16 years | -0.055*** | (-0.062, -0.049) | -0.064*** | (-0.074, -0.053) | -0.056*** | (-0.062, -0.050) |
| 17 years | -0.086*** | (-0.092, -0.080) | -0.100*** | (-0.114, -0.085) | -0.086*** | (-0.092, -0.080) |
| 18 years or older | -0.093*** | (-0.103, -0.083) | -0.114*** | (-0.137, -0.091) | -0.093*** | (-0.103, -0.083) |
| Race/ethnicity | | | | | | |
| White | Reference | | Reference | | Reference | |
| Black | -0.098*** | (-0.106, -0.089) | -0.147*** | (-0.176, -0.119) | -0.100*** | (-0.109, -0.091) |
| Hispanic | -0.060*** | (-0.076, -0.045) | -0.079*** | (-0.099, -0.060) | -0.062*** | (-0.077, -0.047) |
| Asian | -0.078*** | (-0.085, -0.071) | -0.114*** | (-0.133, -0.094) | -0.078*** | (-0.085, -0.071) |
| Multiple Races | -0.021*** | (-0.033, -0.010) | -0.042** | (-0.072, -0.012) | -0.026*** | (-0.037, -0.014) |
| Other | -0.031 | (-0.067, 0.004) | -0.056** | (-0.097, -0.015) | -0.034 | (-0.068, 0.000) |
| Obesity | 0.055*** | (0.045, 0.066) | 0.062*** | (0.048, 0.075) | 0.049*** | (0.039, 0.059) |
| Asthma | -0.040*** | (-0.044, -0.035) | -0.043*** | (-0.054, -0.033) | -0.039*** | (-0.043, -0.034) |
| Felt sad or hopeless | 0.213*** | (0.200, 0.227) | 0.209*** | (0.195, 0.223) | 0.203*** | (0.191, 0.215) |
| Free lunch, % | -0.000 | (-0.001, 0.000) | -0.002* | (-0.004, -0.000) | -0.001 | (-0.001, 0.000) |
| Treatment | -0.010* | (-0.020, -0.000) | -0.064*** | (-0.090, -0.037) | -0.010 | (-0.021, 0.001) |
| Sexual Identity | | | | | | |
| Heterosexual | | | | | Reference | |
| Sexual Minority | | | | | 0.069*** | (0.048, 0.090) |
| Treatment × sexual minority | | | | | -0.007 | (-0.033, 0.019) |

Note. Model 1 is adjusted linear regression difference-in-differences model testing effect of anti-bullying policy with SGM

enumeration on bullying victimization among all adolescents. Model 2 is a subgroup analysis of only those who identify as sexual

minorities. Model 3 includes an interaction term between treatment \times sexual identity. All models control for state and year fixed effects.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4.10*Linear Difference-in-Differences Analysis of State-Level Anti-Bullying Policies With Sexual and/or Gender Minority Identity**Enumeration: Changes in Bullying Victimization Rates From 2009–2019 Among Males*

| Variable | Model 1 (All boys) <i>n</i> = 196,930 | | Model 2 (SM boys) <i>n</i> = 16,153 | | Model 3 (Interaction term) <i>n</i> = 196,930 | |
|-----------------------------|--|------------------|--|------------------|--|------------------|
| | Coefficient | 95% CI | Coefficient | 95% CI | Coefficient | 95% CI |
| Age | | | | | | |
| 14 years or younger | Reference | | Reference | | Reference | |
| 15 years | -0.018*** | (-0.022, -0.015) | -0.030*** | (-0.041, -0.018) | -0.018*** | (-0.022, -0.014) |
| 16 years | -0.052*** | (-0.056, -0.047) | -0.068*** | (-0.080, -0.056) | -0.052*** | (-0.057, -0.047) |
| 17 years | -0.075*** | (-0.081, -0.069) | -0.088*** | (-0.103, -0.074) | -0.076*** | (-0.082, -0.069) |
| 18 years or older | -0.087*** | (-0.097, -0.077) | -0.107*** | (-0.127, -0.087) | -0.089*** | (-0.099, -0.078) |
| Race/ethnicity | | | | | | |
| White | Reference | | Reference | | Reference | |
| Black | -0.055*** | (-0.064, -0.046) | -0.077*** | (-0.104, -0.050) | -0.056*** | (-0.065, -0.047) |
| Hispanic | -0.040*** | (-0.055, -0.025) | -0.017 | (-0.044, 0.011) | -0.041*** | (-0.056, -0.027) |
| Asian | -0.029*** | (-0.036, -0.022) | -0.043* | (-0.077, -0.008) | -0.030*** | (-0.037, -0.023) |
| Multiple Races | -0.008 | (-0.022, 0.005) | -0.005 | (-0.047, 0.038) | -0.011 | (-0.024, 0.002) |
| Other | -0.019 | (-0.049, 0.010) | 0.000 | (-0.040, 0.041) | -0.022 | (-0.051, 0.006) |
| Obesity | 0.032*** | (0.027, 0.038) | 0.032*** | (0.014, 0.049) | 0.029*** | (0.023, 0.035) |
| Asthma | -0.025*** | (-0.031, -0.019) | -0.032*** | (-0.047, -0.018) | -0.024*** | (-0.030, -0.018) |
| Felt sad or hopeless | 0.214*** | (0.199, 0.229) | 0.234*** | (0.215, 0.253) | 0.202*** | (0.188, 0.216) |
| Free lunch, % | -0.001* | (-0.002, -0.000) | -0.003 | (-0.007, 0.001) | -0.001* | (-0.002, -0.000) |
| Treatment | -0.032*** | (-0.041, -0.023) | -0.060*** | (-0.074, -0.045) | -0.030*** | (-0.039, -0.021) |
| Sexual Identity | | | | | | |
| Heterosexual | | | | | Reference | |
| Sexual Minority | | | | | 0.125*** | (0.107, 0.143) |
| Treatment × sexual minority | | | | | -0.013 | (-0.032, 0.007) |

Note. Model 1 is adjusted linear regression difference-in-differences model testing effect of anti-bullying policy with SGM

enumeration on bullying victimization among all adolescents. Model 2 is a subgroup analysis of only those who identify as sexual

minorities. Model 3 includes an interaction term between treatment \times sexual identity. All models control for state and year fixed effects.

* $p < .05$. ** $p < .01$. *** $p < .001$.

Table 4.11*Linear Difference-in-Differences Analysis of State-Level Anti-Bullying Policies With Sexual and/or Gender Minority Identity**Enumeration: Changes in Obesity Rates From 1999–2019 Among Females*

| Variable | Model 1 (All girls) <i>n</i> = 128,910 | | Model 2 (SM girls) <i>n</i> = 22,626 | | Model 3 (Interaction term) <i>n</i> = 128,910 | |
|--|---|------------------|---|------------------|--|------------------|
| | Coefficient | 95% CI | Coefficient | 95% CI | Coefficient | 95% CI |
| Age | | | | | | |
| 14 years or younger | Reference | | Reference | | Reference | |
| 15 years | 0.001 | (-0.004, 0.006) | -0.002 | (-0.014, 0.010) | 0.000 | (-0.005, 0.005) |
| 16 years | -0.002 | (-0.007, 0.003) | -0.003 | (-0.016, 0.010) | -0.002 | (-0.008, 0.003) |
| 17 years | 0.006* | (0.000, 0.011) | 0.010 | (-0.003, 0.024) | 0.006* | (0.000, 0.011) |
| 18 years or older | 0.008* | (0.002, 0.014) | 0.005 | (-0.017, 0.026) | 0.007* | (0.001, 0.013) |
| Race/ethnicity | | | | | | |
| White | Reference | | Reference | | Reference | |
| Black | 0.073*** | (0.068, 0.079) | 0.073*** | (0.060, 0.086) | 0.071*** | (0.065, 0.077) |
| Hispanic | 0.035*** | (0.024, 0.046) | 0.034** | (0.012, 0.056) | 0.034*** | (0.023, 0.046) |
| Asian | -0.029*** | (-0.044, -0.013) | -0.059*** | (-0.088, -0.029) | -0.028*** | (-0.044, -0.013) |
| Multiple Races | 0.037*** | (0.029, 0.045) | 0.036** | (0.015, 0.058) | 0.033*** | (0.025, 0.041) |
| Other | 0.070*** | (0.046, 0.094) | 0.068* | (0.005, 0.130) | 0.068*** | (0.043, 0.093) |
| Fruit consumption | 0.001 | (-0.003, 0.005) | -0.012 | (-0.028, 0.004) | -0.001 | (-0.005, 0.003) |
| Salad consumption | -0.005* | (-0.008, -0.001) | -0.011** | (-0.019, -0.003) | -0.006* | (-0.010, -0.002) |
| Soda consumption | 0.014*** | (0.011, 0.018) | 0.021** | (0.008, 0.033) | 0.014*** | (0.010, 0.018) |
| Breakfast consumption | 0.013*** | (0.009, 0.017) | 0.002 | (-0.007, 0.011) | 0.011*** | (0.007, 0.015) |
| Physical inactivity | 0.041*** | (0.034, 0.047) | 0.045*** | (0.035, 0.055) | 0.038*** | (0.032, 0.044) |
| TV watching >5 hours | 0.019*** | (0.013, 0.024) | 0.028*** | (0.016, 0.041) | 0.019*** | (0.013, 0.024) |
| Computer use >5 hours | 0.012*** | (0.009, 0.015) | 0.020*** | (0.010, 0.030) | 0.009*** | (0.006, 0.013) |
| School violence victimization count | | | | | | |
| 0 | Reference | | Reference | | Reference | |
| 1 | 0.014*** | (0.012, 0.017) | 0.018** | (0.007, 0.028) | 0.012*** | (0.009, 0.015) |
| 2+ | 0.023*** | (0.018, 0.028) | 0.037*** | (0.028, 0.046) | 0.018*** | (0.013, 0.023) |
| Felt sad or hopeless | 0.021*** | (0.016, 0.027) | 0.008 | (-0.003, 0.019) | 0.013*** | (0.008, 0.017) |
| Free lunch, % | -0.001* | (-0.002, -0.000) | -0.001 | (-0.003, 0.001) | -0.001* | (-0.002, -0.000) |
| Treatment | 0.030*** | (0.020, 0.040) | 0.022* | (0.000, 0.043) | 0.031*** | (0.019, 0.043) |

| Variable | Model 1 (All girls) <i>n</i> = 128,910 | | Model 2 (SM girls) <i>n</i> = 22,626 | | Model 3 (Interaction term) <i>n</i> = 128,910 | |
|-----------------------------|---|--------|---|--------|--|-----------------|
| | Coefficient | 95% CI | Coefficient | 95% CI | Coefficient | 95% CI |
| Sexual identity | | | | | | |
| Heterosexual | | | | | Reference | |
| Sexual Minority | | | | | 0.074*** | (0.061, 0.087) |
| Treatment × sexual minority | | | | | -0.014 | (-0.030, 0.002) |

Note. Model 1 is adjusted linear regression difference-in-differences model testing effect of anti-bullying policy with SGM

enumeration on obesity among all adolescents. Model 2 is a subgroup analysis of only those who identify as sexual minorities. Model 3 includes an interaction term between treatment × sexual identity. All models control for state and year fixed effects.

p* < .05. *p* < .01. ****p* < .001.

Table 4.12*Linear Difference-in-Differences Analysis of State-Level Anti-Bullying Policies With Sexual and/or Gender Minority Identity**Enumeration: Changes in Obesity Rates From 1999–2019 Among Males*

| Variable | Model 1 (All boys) <i>n</i> = 120,706 | | Model 2 (SM boys) <i>n</i> = 9,830 | | Model 3 (Interaction term) <i>n</i> = 120,706 | |
|--|--|------------------|---------------------------------------|-----------------|--|------------------|
| | Coefficient | 95% CI | Coefficient | 95% CI | Coefficient | 95% CI |
| Age | | | | | | |
| 14 years or younger | Reference | | Reference | | Reference | |
| 15 years | -0.009 | (-0.019, 0.001) | -0.024 | (-0.054, 0.006) | -0.009 | (-0.019, 0.001) |
| 16 years | -0.007 | (-0.016, 0.001) | -0.009 | (-0.036, 0.018) | -0.008 | (-0.016, 0.001) |
| 17 years | -0.008 | (-0.018, 0.003) | -0.018 | (-0.051, 0.015) | -0.008 | (-0.019, 0.003) |
| 18 years or older | -0.006 | (-0.016, 0.003) | -0.030 | (-0.071, 0.011) | -0.006 | (-0.016, 0.003) |
| Race/ethnicity | | | | | | |
| White | Reference | | Reference | | Reference | |
| Black | 0.011* | (0.002, 0.020) | 0.036** | (0.012, 0.059) | 0.011* | (0.003, 0.020) |
| Hispanic | 0.038*** | (0.025, 0.051) | 0.057*** | (0.029, 0.085) | 0.038*** | (0.025, 0.051) |
| Asian | -0.038* | (-0.067, -0.009) | -0.008 | (-0.044, 0.028) | -0.038* | (-0.067, -0.009) |
| Multiple Races | 0.004 | (-0.005, 0.012) | 0.030 | (-0.017, 0.078) | 0.003 | (-0.005, 0.012) |
| Other | 0.077*** | (0.041, 0.113) | 0.098*** | (0.051, 0.144) | 0.076*** | (0.040, 0.113) |
| Fruit consumption | 0.003 | (-0.004, 0.009) | -0.003 | (-0.029, 0.023) | 0.002 | (-0.004, 0.009) |
| Salad consumption | -0.022*** | (-0.027, -0.017) | -0.004 | (-0.022, 0.014) | -0.021*** | (-0.027, -0.016) |
| Soda consumption | -0.001 | (-0.005, 0.004) | 0.009 | (-0.005, 0.024) | -0.000 | (-0.005, 0.004) |
| Breakfast consumption | 0.034*** | (0.027, 0.041) | 0.015 | (-0.007, 0.037) | 0.034*** | (0.027, 0.040) |
| Physical inactivity | 0.053*** | (0.049, 0.057) | 0.042*** | (0.030, 0.055) | 0.052*** | (0.048, 0.056) |
| TV watching >5 hours | 0.034*** | (0.030, 0.039) | 0.051*** | (0.034, 0.068) | 0.034*** | (0.029, 0.039) |
| Computer use >5 hours | 0.034*** | (0.030, 0.038) | 0.038*** | (0.019, 0.057) | 0.034*** | (0.030, 0.038) |
| School violence victimization count | | | | | | |
| 0 | Reference | | Reference | | Reference | |
| 1 | 0.013*** | (0.008, 0.017) | 0.003 | (-0.028, 0.034) | 0.012*** | (0.007, 0.016) |
| 2+ | 0.021*** | (0.015, 0.027) | 0.011 | (-0.013, 0.034) | 0.019*** | (0.012, 0.025) |
| Felt sad or hopeless | 0.003 | (-0.001, 0.008) | 0.004 | (-0.020, 0.029) | 0.002 | (-0.003, 0.006) |
| Free lunch, % | -0.000 | (-0.002, 0.001) | 0.001 | (-0.002, 0.003) | -0.000 | (-0.002, 0.001) |
| Treatment | 0.004 | (-0.006, 0.013) | 0.060*** | (0.029, 0.090) | 0.004 | (-0.006, 0.013) |

| Variable | Model 1 (All boys) <i>n</i> = 120,706 | | Model 2 (SM boys) <i>n</i> = 9,830 | | Model 3 (Interaction term) <i>n</i> = 120,706 | |
|-----------------------------|--|--------|---------------------------------------|--------|--|-----------------|
| | Coefficient | 95% CI | Coefficient | 95% CI | Coefficient | 95% CI |
| Sexual identity | | | | | | |
| Heterosexual | | | | | Reference | |
| Sexual Minority | | | | | 0.024** | (0.010, 0.038) |
| Treatment × sexual minority | | | | | 0.007 | (-0.009, 0.022) |

Note. Model 1 is adjusted linear regression difference-in-differences model testing effect of anti-bullying policy with SGM

enumeration on obesity among all adolescents. Model 2 is a subgroup analysis of only those who identify as sexual minorities. Model 3 includes an interaction term between treatment × sexual identity. All models control for state and year fixed effects.

p* < .05. *p* < .01. ****p* < .001.

Figure 4.1

Trends in Adolescent Bullying Victimization Rates by Sex, 2009–2019

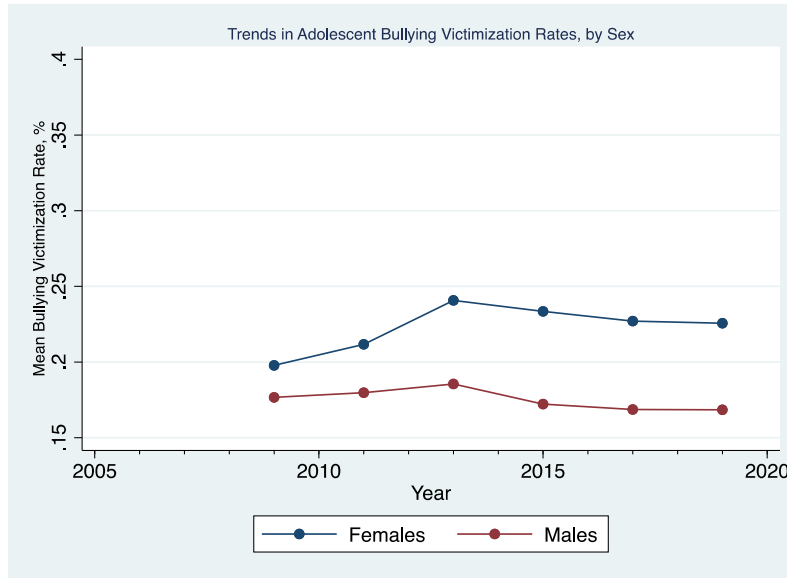


Figure 4.2

Trends in Adolescent Bullying Victimization Rates by Sex Among Sexual Minority Adolescents, 2009–2019

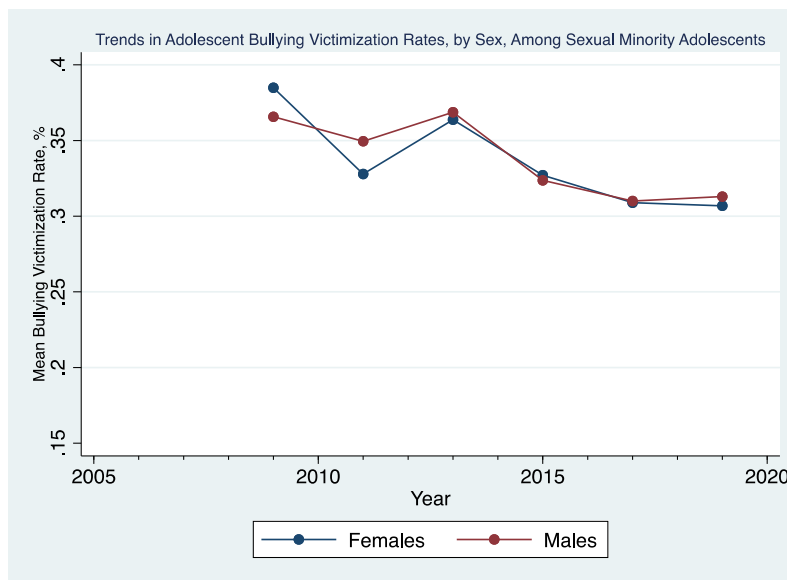


Figure 4.3

Trends in Adolescent Obesity Rates by Sex, 1999–2019

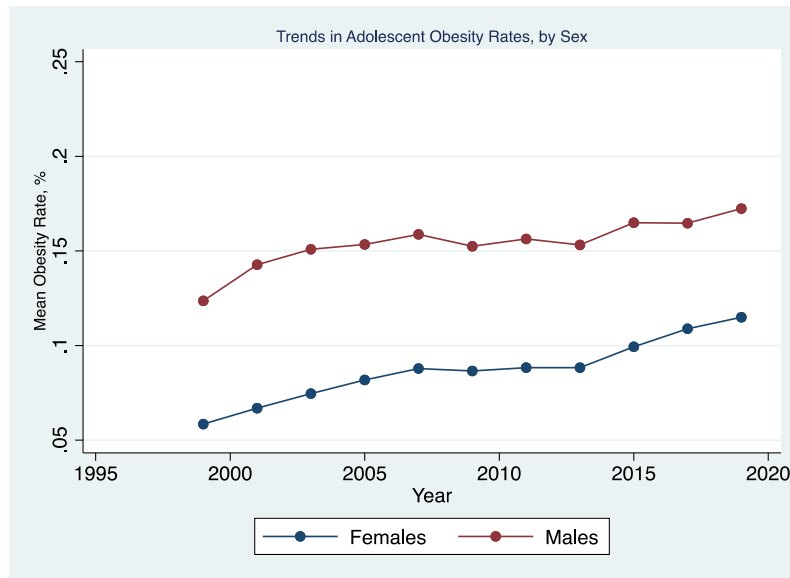


Figure 4.4

Trends in Adolescent Obesity Rates by Sex Among Sexual Minority Adolescents, 2003–2019

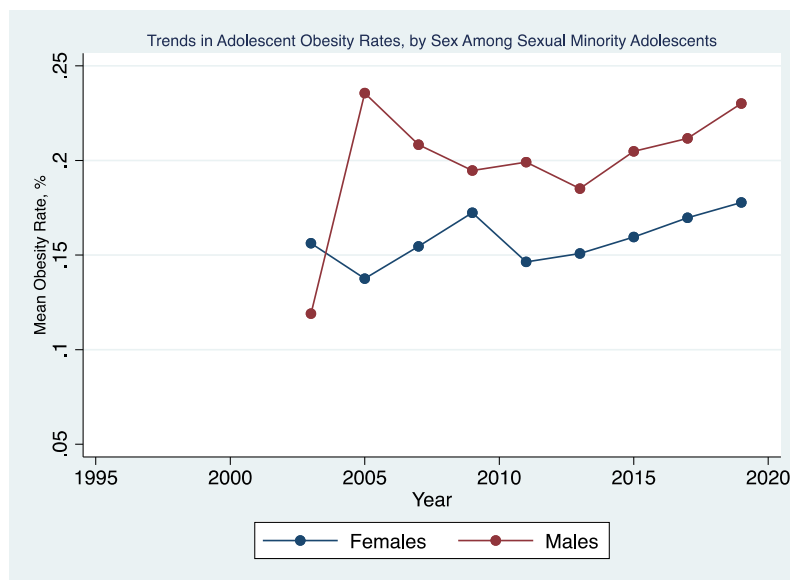


Figure 4.5

Trends in Bullying Victimization Rates by Time to Policy Enactment for States With Enumeration Among Sexual Minority Girls

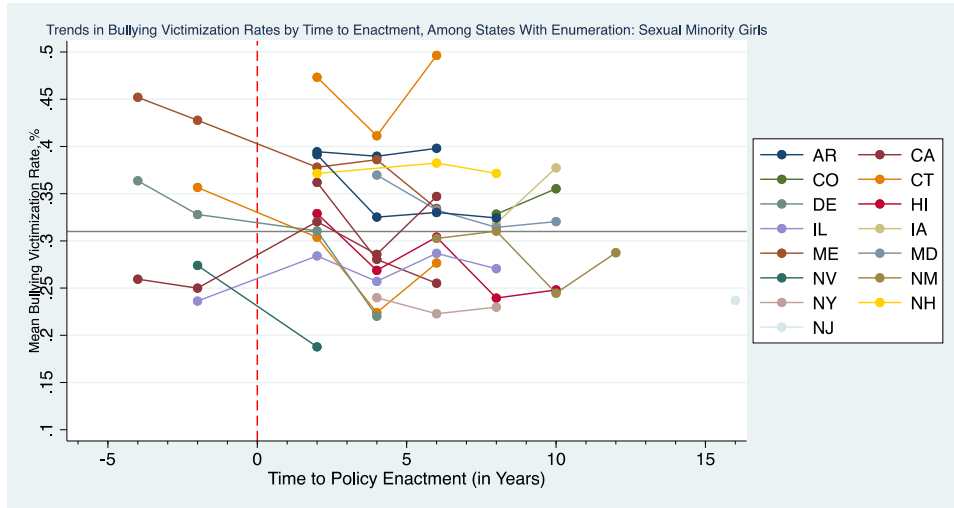


Figure 4.6

Trends in Bullying Victimization Rates by Time to Policy Enactment for States With Enumeration Among Sexual Minority Boys

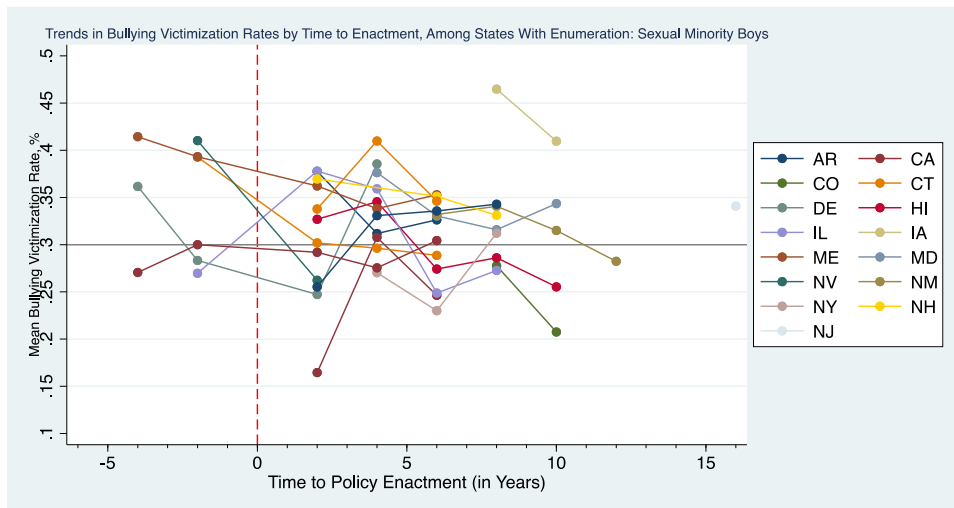


Figure 4.7

Trends in Obesity Rates by Time to Policy Enactment for States With Enumeration Among Sexual Minority Girls

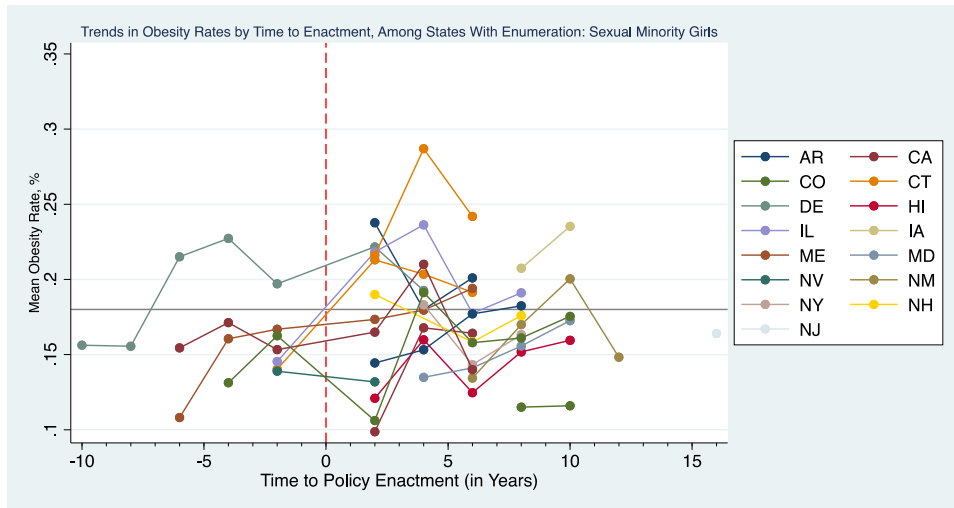


Figure 4.8

Trends in Obesity Rates by Time to Policy Enactment for States With Enumeration Among Sexual Minority Boys

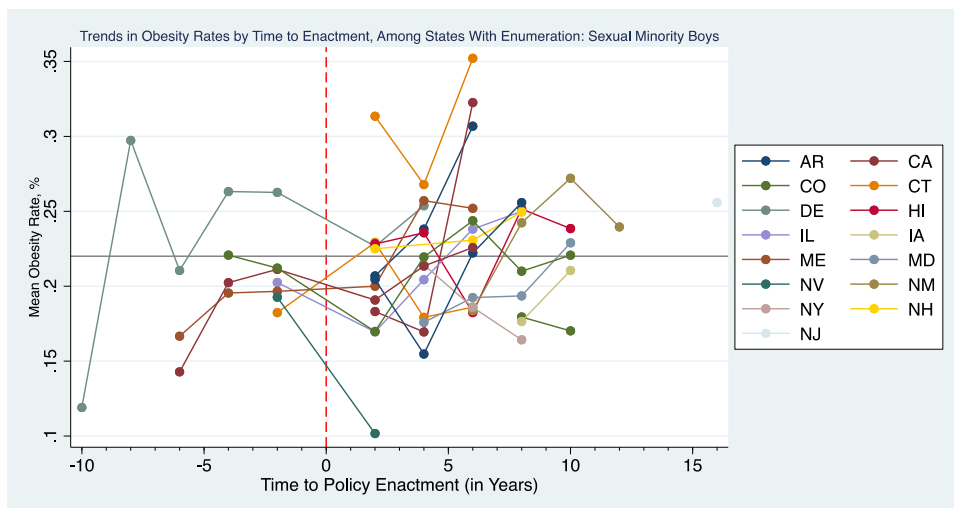


Figure 4.9

Event Study Analysis of Anti-Bullying Policies With Sexual and/or Gender Minority Identity

Enumeration and Bullying Victimization Rates Among Sexual Minority Girls

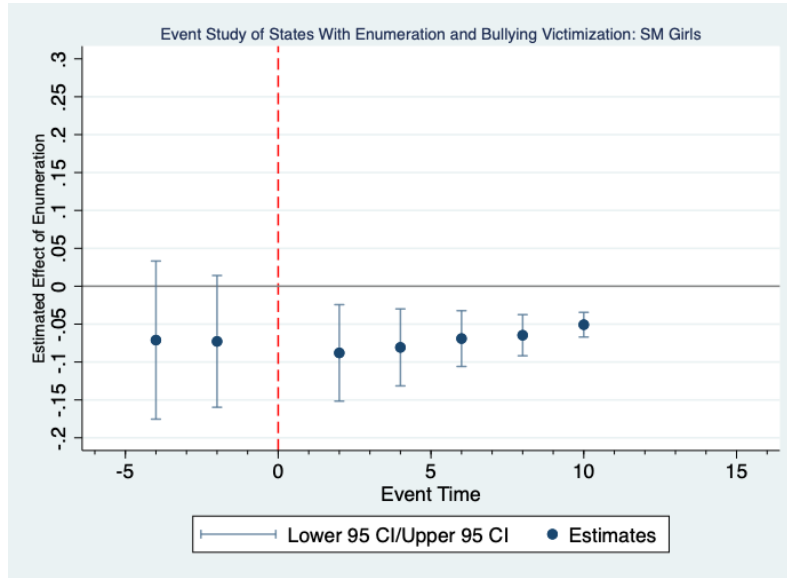


Figure 4.10

Event Study Analysis of Anti-Bullying Policies With Sexual and/or Gender Minority Identity

Enumeration and Bullying Victimization Rates Among Sexual Minority Boys

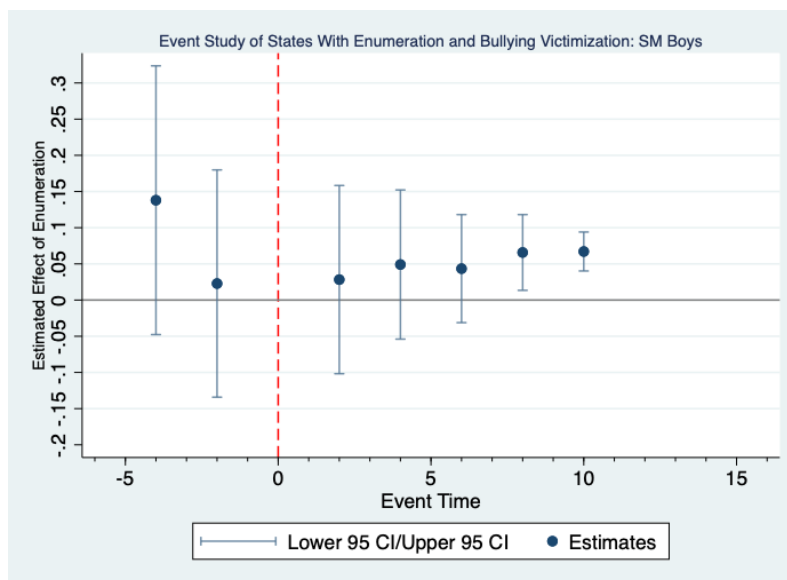


Figure 4.11

Event Study Analysis of Anti-Bullying Policies With Sexual and/or Gender Minority Identity

Enumeration and Obesity Rates Among Sexual Minority Girls

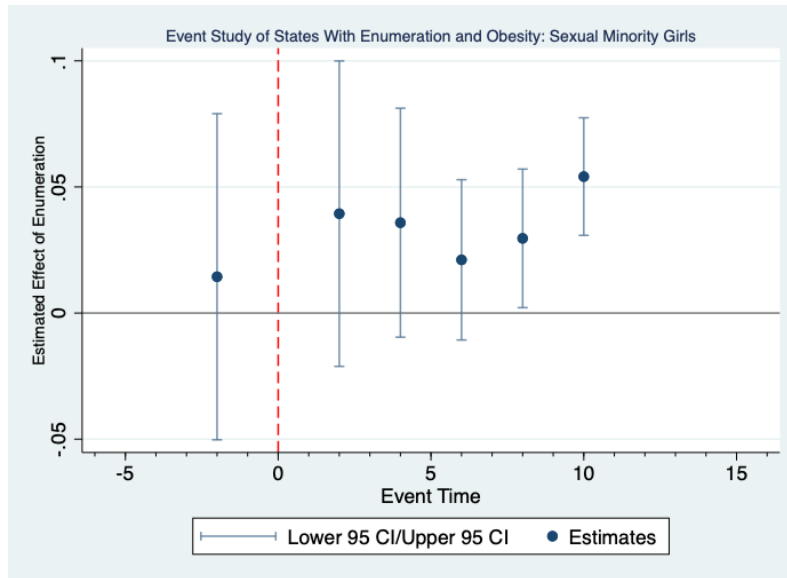
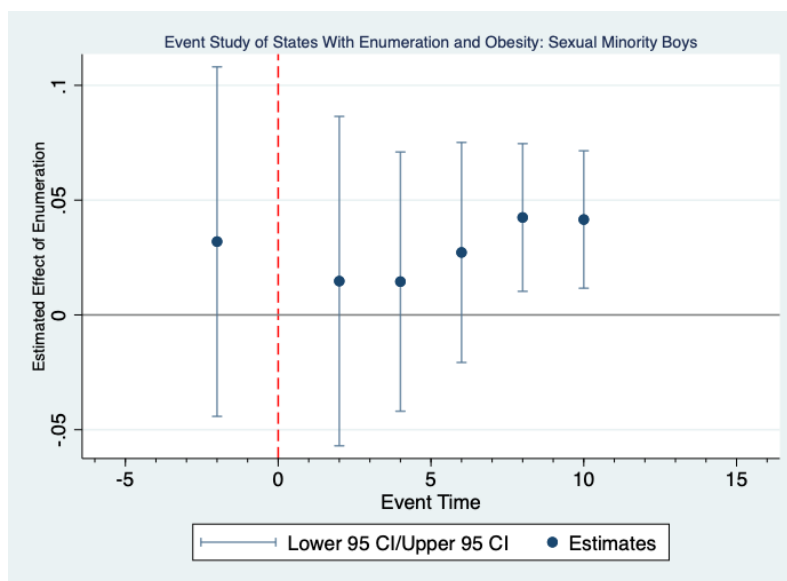


Figure 4.12

Event Study Analysis of Anti-Bullying Policies With Sexual and/or Gender Minority Identity

Enumeration and Obesity Rates Among Sexual Minority Boys



Chapter 5: Synthesis

The goal of this dissertation was to examine the impacts of school climate and education policy on obesity disparities among sexual minority adolescents. As a secondary outcome, we also sought to examine the impacts of education policy on bullying victimization. Guided by the Social Ecological Model framework (Bronfenbrenner, 1979), all three studies included in this dissertation aimed to examine more distal influences on study outcomes—namely, interpersonal-level school violence victimization, community-level school climate, and policy-level anti-bullying policy with sexual and/or gender minority identity enumeration. Individual-level health behaviors, such as diet and physical activity directly impact weight status; however, these behaviors are largely shaped by relationships, environments, and policies that are oftentimes beyond one’s control. Hence, this dissertation framed obesity risk factors as multi-factorial.

The first study was a systematic review of the impacts of positive school climate and risk factors for obesity among LGBTQ adolescents. The second study was a cross-sectional secondary analysis of CDC YRBS and SHP data from 10 large urban school districts in the U.S, and the third study was a quasi-experimental difference-in-differences analysis of cross-sectional CDC YRBS data from 44 U.S. states. This final chapter summarizes the studies included in the dissertation, reviews key findings, and discusses implications for policy, practice, and future research.

5.1 Summary of Results and Key Findings

Study 1, Chapter 2

In Study 1 (Chapter 2), we conducted a systematic review of the literature on the impacts of positive school climate on weight-related health behaviors and risk factors for obesity among LGBTQ adolescents. We systematically searched seven databases, including grey literature. We

considered several outcomes in our inclusion criteria and found nine articles that met inclusion criteria. These studies focused on the impact of positive school climate on a number of adolescent obesity correlates, such as alcohol and tobacco use, depressive symptoms, and bullying victimization.

Among the nine articles included in the review, four examined the impact of positive school climate on weight-related health behaviors (i.e., tobacco use, alcohol use, marijuana use, and prescription drug use). Seven studies examined the impacts of positive school climate on other risk factors for obesity (i.e., depressive symptoms, bullying victimization, sexual orientation-based harassment, and feelings of unsafety). It is noteworthy that no studies focused on diet, physical activity, or weight status as outcomes. We found that positive school climate is an important contextual factor that influences obesity risk suggesting that measures to promote positive school climates can potentially reduce disparities in obesity by SGM identity. In all seven studies that assessed risk factors for obesity, LGBTQ adolescents in schools with more positive climates reported lower levels of bullying victimization, depressive and suicidal feelings, and sexual orientation-based harassment than those in schools that had less positive school climates. This effect was demonstrated in county, state, and national surveys in the U.S., as well as a high school survey conducted in New Zealand. For weight-related health behaviors, findings were more mixed. Two of the four studies that examined health behaviors found that alcohol/marijuana use in the last 12 months, number of drinking days at school, and number of heavy episodic drinking in the last 30 days were lower for LGBTQ and heterosexual adolescents who attended schools with more positive school climates than those who attended schools with less positive school climates. However, the other two studies found no significant associations

between positive school climate and alcohol/marijuana use, tobacco use, or heavy episodic drinking.

In studies that assessed sexual identity differences, results indicated that positive school climates, are associated with lower psychological and victimization-based risk factors for obesity (e.g., bullying victimization and depressive symptoms) for LGBTQ as well as heterosexual students. Mixed findings regarding the effects of positive school climate on weight-related health behaviors (e.g., alcohol and tobacco use) highlight the need for studies using longitudinal designs, more reliable outcome measures, and inclusion of more specific aspects of school climate (e.g., student-teacher relationships, health services support). Moreover, no two studies in this review used the same method to measure school climate, reducing the ability to draw strong conclusions from the review.

Study 2, Chapter 3

In Study 2 (Chapter 3), we built upon findings from the systematic review to examine relationships among sexual identity, school violence, LGBTQ school climate, and obesity. We leveraged publicly available CDC data on adolescent health and school principal and health education teachers to conduct a cross-sectional secondary analysis of the above associations. We used multi-level generalized logistic regression models with moderation analyses, analyzing pooled adolescent health data from 2011–2019 in 10 U.S. school districts, stratifying analyses by sex.

Two major findings emerged from this study. One was that for both female and male adolescents, regardless of sexual identity, those who reported two or more counts of school violence victimization had significantly higher odds of obesity compared to those who reported no violence victimization experiences in the last 12 months. Female adolescents who

experienced two or more counts of school violence victimization had 1.33 greater odds of having obesity than female adolescents who experienced no violence victimization. For males, those who experienced two or more counts of school violence victimization had 1.24 greater odds of having obesity compared to male adolescents who experience no violence victimization, emphasizing the role that school violence victimization experiences such as being bullied on school property, electronic bullying, and engaging in physical fighting on school property have on obesity risk. There were no sexual identity differences in these associations—indicating that the effect of school violence victimization on obesity is similar for heterosexual and sexual minority adolescents.

The second important finding was that in the presence of more positive LGBTQ school climates, adolescents had lower odds of obesity compared to in the presence of less positive LGBTQ school climates. Females who attended schools with more positive school climates had lower odds (0.84) of obesity than those who attended schools with less positive climates. The association was similar for males: those who attended schools with more positive school climates had lower odds (0.85) of obesity than those who attended schools with less positive school climates. Analyses including an interaction term of sexual identity \times school climate resulted in the same null findings for sexual identity differences as analyses with sexual identity \times school violence victimization. Sexual identity did not moderate the relationship between school climate and obesity. The effect of more positive school climates on obesity was the same for heterosexual and sexual minority adolescents. This finding supports previous research indicating that school and social environments that promote LGBTQ specific rights and or protections benefit not only sexual minority but also heterosexual populations as well (Meyer et al., 2019;

Poteat et al., 2013; Raifman et al., 2017). Further LGBTQ school climate did not moderate the effect of sexual identity on the association between school violence and obesity.

Study 3, Chapter 4

In Study 3 (Chapter 4), we again leveraged publicly available CDC data on adolescent health, utilizing state-level data, instead of school district-level data, to examine the causal effect of inclusion of sexual and gender minority identity enumeration in state-level anti-bullying policies on bullying victimization and obesity rates in the post-enactment period. For this difference-in-differences (DID) analysis, we used data from 44 states (19 with enumerated policies and 25 without such policies) and examined bullying victimization and obesity trends in pre- and post-periods of policy enactment, including state and year fixed effects in linear regression models. As with Study 2, we stratified analyses by sex.

Our findings from Study 3 revealed results similar to those in Study 2. Namely, that environments and policies that have the goal of providing protections and resources for LGBTQ adolescents are good for not only sexual minority adolescents, but for all adolescents. Specifically, in Study 3 we found that for the outcome of bullying victimization, in the period following SGM enumeration in state-level anti-bullying policies, bullying rates fell for all adolescents, regardless of sexual identity. On average, adolescent girls had a significant 1.0 percentage point decrease in the probability of bullying victimization. For boys, this association was slightly stronger with a 3.2 percentage point decrease in the probability of bullying victimization in the post-period for those living in states with SGM enumerated policy.

To obtain precise estimates of the effect for sexual minority adolescents specifically, we then performed subgroup analyses with sexual minority girls and sexual minority boys. In these analyses, controlling for related covariates, we found that SM girls in states with SGM

enumeration had a statistically significant 6.4 percentage point decrease in the probability of being bullied. This is above and beyond what the probability would have been if the policy had not been enacted. Similarly, SM boys in states with enumerated policies had a 6.0 percentage point decrease in the probability of being bullied in the post-period. Last, we performed moderation analyses to determine if there were sexual identity differences in the relationship between SGM enumerated policies and bullying victimization. Our analyses revealed that bullying victimization did not differ for heterosexual and sexual minority adolescents, suggesting that even though not the target of the SGM enumerated policies, such policies benefit heterosexual adolescents as well.

We then applied the same linear regression DID models to the outcome of obesity among adolescents. In analyses that included all adolescents, we found that in the post-period, girls living in states with SGM enumerated policies had a 3.0 percentage point increase in the probability of obesity compared to those living in states with no enumerated policy. There were no significant findings for boys overall. In subgroup analyses with only SMA, we found that SM girls had a significant 2.2 percentage point increase in the probability of having obesity and that SM boys had a 6.0 percentage point increase in the probability of having obesity if they lived in states with enumerated policies compared to SMA living in states without enumerated policies. Similar to analyses for bullying victimization, when we examined an interaction term between treatment \times sexual identity, this term was non-significant, indicating there were no sexual identity differences in these associations. Findings related to obesity were a little more nuanced, especially in light of the additional event study analyses showing that effects were not significant until 8–10 years following policy enactment. In addition, the lack of data availability for this

outcome, in contrast to those related to the bullying victimization outcome, could have affected results.

Nonetheless, anti-bullying policies with SGM enumeration appear to have their intended effect—to decrease bullying victimization rates among SMA; they also have the spillover effect of also decreasing bullying victimization rates among heterosexual adolescents. Findings that state-level SGM enumerated anti-bullying policies were associated with increasing obesity rates were unexpected and somewhat surprising. Future research should seek to explore the relationships between bullying victimization, obesity, and temporality to better understand these associations.

5.2 Major Contributions

Findings from this dissertation have several important implications for policy, practice, and future research for a broad range of professionals including middle and high school teachers and administrators, guidance counselors, as well as mental health providers, nursing and allied health professionals, policymakers, and researchers.

5.3 Implications for Policy

As this dissertation was focused primarily on community-level school climate and policy-level anti-bullying policy with SGM enumeration, our findings have numerous policy implications. Foremost, policymakers should be made aware that LGBTQ positive school climates benefit not only LGBTQ students, but all students by decreasing their risk of obesity. Policymakers should also be made aware that SGM enumeration is an important component of comprehensive, inclusive policy and should not be overlooked. Adolescents living in states with SGM enumerated policies have a lower probability of bullying victimization compared to adolescents living in states without SGM enumerated policies. Each of these findings adds

support to previous findings that protections specific to LGBTQ adolescents do not only benefit this population, but they also benefit heterosexual adolescents as well. They also do not disadvantage one group (heterosexual students) in favor of another group (LGBTQ students) when providing LGBTQ-specific supports and resources (Meyer et al., 2019; Poteat et al., 2013). Therefore, states that have yet to pass an SGM inclusive anti-bullying policy should be encouraged to do so, especially given the myriad benefits to LGBTQ youth including reducing suicidal thoughts and behaviors and depressive feelings (Meyer et al., 2019), as well as bullying victimization (Rees et al., 2020).

In light of the recent policy attacks on LGBTQ youth at the state-level, including at least 40 states considering legislation damaging school climate and undermining school safety for LGBTQ students (with nine states enacting such bills into law) from 2020–2021, and at least 20 states considering curriculum censorship bills that would censor topics such as education about LGBTQ people, it is important now more than ever for the federal government to pass inclusive protections (Movement Advancement Project, 2022). Two main bills that would directly affect LGBTQ students have been introduced in Congress—the Safe Schools Improvement Act of 2021 and the Real Education and Access for Healthy Youth Act of 2021. The Safe Schools Improvement Act of 2021 would provide specific, enumerated protections that prohibit bullying in elementary and secondary schools based on several student characteristics including sexual orientation and gender identity (*Safe Schools Improvement Act of 2021, H.R. 4402, 117th Congress, 2021*). As detailed in this dissertation, several states have already passed these inclusive policies, but enacting the Safe Schools Improvement Act of 2021 into federal law would codify protections against bullying and harassment of LGBTQ students throughout the country. The Real Education and Access for Healthy Youth Act of 2021 would award grants to

school districts to train education professionals to effectively teach comprehensive sex education, including topics concerning sex and sexuality—a key component of an LGBTQ positive school climate (*Real Education and Access for Healthy Youth Act of 2021, H.R. 3312, 117th Congress, 2021*). Passage of these pieces of legislation should be a priority for LGBTQ legislative advocates.

Further, in relation to health outcomes, future research should examine the impacts of other policies that affect overweight and obesity among LGBTQ adolescents. Policies that address food insecurity and homelessness, which constrain the ability for adolescents to make positive dietary and physical activity changes, include the Supplemental Nutrition Assistance Program (SNAP); the Child Tax Credit; school meal policies; and housing and homelessness policies (State of Childhood Obesity, 2021). In an effort to better identify who uses these services, agencies and organizations should engage in concerted efforts to collect demographic information on sexual orientation and gender identity and to standardize these collection efforts across multiple state and federal government agencies.

5.4 Implications for Practice

Findings from this dissertation also have important implications for practice. For health professionals who care for adolescents in schools, professional development and continuing education on LGBTQ health issues and topics is imperative. Such education should include social determinants of health and the impacts of policies and practices such as the positive effects of LGBTQ school climates and inclusive policies for all adolescents. Health professions students' formal education should also cover this information. Health professionals must understand the associations between school violence and obesity, and the need to prevent school violence and its consequences (e.g., obesity and mental distress). School nurses and health

teachers could also teach students about healthy eating patterns, physical activity, and positive body image.

As a practice implication, not only is it important to highlight the enactment of SGM inclusive policies for teachers, guidance counselors, mental health providers, administrators, and school staff, it is equally important to measure the impact of enforcement of such policies. SGM enumeration in state-level anti-bullying policies can exist, but if such policies are not enforced and there are no repercussions for not following policies, then the policies do not have their intended effect. In a 2015 report titled *From Statehouse to Schoolhouse: Anti-Bullying Policy Efforts in U.S. States and School Districts* authored by the Gay, Lesbian, & Straight Education Network (GLSEN), the authors state that inclusion of professional development and accountability requirements are critical aspects to include in anti-bullying policy to help improve their enforcement (Kull et al., 2015). School staff should be educated about how to recognize bullying and how to intervene—and there should be district accountability requirements for documenting incidents of bullying and harassment to ensure the incidents are addressed. Further, oftentimes the policies set at the state-level affect how policies are written at the school district and local levels (Kull et al., 2015); therefore, it is important to include these aspects of professional development and accountability at state-levels, something already recommended by the U.S. Department of Education (Stuart-Cassel et al., 2011).

Study findings support the recommendations of the American Academy of Pediatrics (Rafferty et al., 2018) and the American Psychological Association (American Psychological Association, 2020) that physical education teachers and coaches should seek to make their locker rooms and playing fields inclusive of all adolescents and allow teens to play on sports teams that

align with their gender identity. Policies addressing anti-LGBTQ discrimination and harassment in sports and physical education by peers and adults should be implemented and enforced.

5.5 Implications for Future Research

Findings from this dissertation also have implications for future research. Our primary contribution to the literature is that LGBTQ positive school climates and inclusive, SGM enumerated anti-bullying policies work to help decrease odds of obesity and rates of bullying victimization, respectively, for both heterosexual and sexual minority adolescents. Thus, this implies that while this is a positive outcome for LGBTQ adolescents, the disparities in obesity and bullying victimization were not reduced. Additional research is needed to identify modifiable factors that may lead to health equity in obesity and bullying victimization for LGBTQ students. Descriptive findings from Studies 2 and 3 highlighted disparities in both outcomes for SMA, which are in line with prior research (Kann et al., 2018; Kann et al., 2016). Despite the predictors of both studies being LGBTQ-specific, additional supports are needed to decrease these disparities. Differences also exist within the sexual minority population (e.g., gay vs. bisexual) in both obesity and bullying victimization, which needs to be explored in future research.

Given that most research has focused on LGBTQ adolescents in urban settings, more research is needed to understand experiences of rural LGBTQ adolescents and their schools' and states' interpretations of SGM inclusive policies (if they exist). For example, Study 2 examined school district level YRBS data from urban school districts specifically because the school district level YRBS does not collect data from rural school districts. This limited our ability to draw conclusions about the presence of LGBTQ school climates for adolescents in rural areas and subsequently the impacts of those school climates on obesity and bullying victimization

rates. For Study 3, we did not perform separate DID analyses based on U.S. regions (which can be a loose proxy for urbanicity) because we controlled for state fixed effects to be able to examine changes in obesity and bullying victimization rates in pre- and post-policy enactment periods regardless of any state trend effects that may have been present (e.g. Arkansas having a higher baseline adolescent obesity rate than Colorado). However, given that much of our U.S. political climate nowadays is influenced by decisions made by state legislatures, with many anti-LGBTQ state bills being introduced or passed in more rural states, future research should seek to examine differences in rural and urban experiences of LGBTQ adolescents, especially in the context of other anti-LGBTQ rhetoric.

Lastly, findings from this dissertation also have implications for measurement of sexual orientation and gender identity on future research. Studies 2 and 3 used the same question to assess sexual identity as both studies examined data from the CDC's Youth Risk Behavior Survey. The CDC's YRBS has long been one of the few national, population-based surveys to assess sexual identity (a component of sexual orientation) among adolescents (Federal Interagency Working Group on Improving Measurement of Sexual Orientation and Gender Identity in Federal Surveys, 2016). However, not all states and school districts collect gender identity information, precluding researchers from including in our analyses transgender and gender diverse (TGD; i.e., those whose current gender identity is different from the sex they were assigned at birth) adolescents. Further, the Study 1 systematic review reviewed studies that included TGD adolescents but there were differences in the way sexual orientation and gender identity were assessed. For example, two studies assessed sexual orientation by asking students if they were ever confused about their sexual orientation (Birkett et al., 2009; Espelage et al., 2008), an unconventional method of assessing sexual orientation (Schrager et al., 2019).

A new 2022 report by the National Academies of Sciences, Engineering, and Medicine (NASEM) titled *Measuring Sex, Gender Identity, and Sexual Orientation* provides guidelines for sexual orientation and gender identity assessment. This report states that without national standards for the collection, analysis, and report of these data, there will be continue to be differences in measures of this information (National Academies of Sciences, 2022). This lack of consistency in measures can increase concerns about data comparability and hinder the development of effective programs and policies for LGBTQ people (National Academies of Sciences, 2022). The 2022 NASEM report provided recommendations for the measurement of sex, gender identity, and sexual orientation for adult populations; however, the report states that future research should examine evidence for children and adolescents and in specific settings (e.g., schools, health care). Findings from this dissertation support these calls for additional research on SGM measures. Assessment of sexual orientation and gender identity should be routine in government, administrative, and healthcare settings.

5.6 Strengths and Limitations

Strengths

This dissertation has several key strengths. A major strength is the use of rigorous methods in each study. For the Study 1 systematic review, we strictly followed standardized PRISMA guidelines, created and used a reproducible search strategy that was vetted by a medical library informationist, appraised each study using a validated quality appraisal tool, and we verified all findings with the team until consensus was reached. We also searched seven databases and included grey literature in our search domains. For Study 2, we pooled cross-sectional data across years to increase sample size, a method deemed acceptable by the CDC (Centers for Disease Control and Prevention, 2020), and to account for the clustering effect of

adolescents nested within school districts, we tested multilevel regression models. We also applied appropriate survey weights in all analyses, and we performed multiple imputation to account for missing data. For Study 3, we also pooled data across years to increase sample size and applied appropriate survey weights.

Our use of CDC data was also a strength, as the CDC used a two-stage cluster sample design to obtain representative samples of U.S. students in respective school districts and states. Survey questions have also undergone test-retest analyses, and results have demonstrated good reliability (Brener et al., 2002; Brener et al., 2003). By utilizing CDC data in Studies 2 and 3, we were also more easily able to draw conclusions about sexual minority adolescents as a group, given that both studies measured sexual identity using the same question.

A significant strength of Study 3 is that we leveraged the availability of CDC data from years 1999–2019 and the differing enactment years of SGM enumerated anti-bullying policies to perform a difference-in-difference analysis. DID analysis is used to analyze the effects of naturally occurring experiments (in that the exposure is not randomized between two groups), which allows one to draw causal inference. This enabled us to draw stronger conclusions from this study than is possible in cross-sectional studies.

Limitations

Despite these strengths, the dissertation research is also limited in several ways. In all three studies generalizability of findings is limited. For Study 1, no two studies assessed LGBTQ positive school climate using the same measure, which limited ability to make comparison across studies. For Study 2, only 10 large urban U.S. school districts were included despite the CDC collecting data on school districts across the entire country. Only these 10 school districts were included because they collected LGBTQ school climate and sexual identity data. For Study 3,

generalizability of findings is a concern in quasi-natural experiments, especially with the “self-selection” aspect of states (i.e., states were more likely to have an SGM enumerated policy if they are more socially and politically progressive). This could mean that states with enumerated policies were more like each other than they were like states without enumerated policy.

All YRBS data were self-reported, including data on height and weight, which was used to calculate BMI. Research is needed that assesses weight using more objective measures, although height and weight data from the YRBS have been found to be reliable (Brener et al., 2003). Also, Studies 2 and 3 could have been strengthened if the school violence victimization count measure was SGM-specific. None of the survey questions included in this count measure assessed perceived reasons for victimization (e.g., because of race, religion, or sexual orientation/gender identity). Data analyses for Study 2 were also cross-sectional, which permitted the examination of associations, but not temporality.

Additional Topics That Require Attention. There were several topics that we were unable to address, as they were beyond the scope of this dissertation. However, they are important for future research in obesity and bullying victimization disparities among LGBTQ adolescents.

Obesity Among Transgender and Gender Diverse Adolescents. A large disparity in overweight/obesity also exists among transgender and gender diverse adolescents. Multiple studies in recent years have shown that TDG adolescents have higher rates of overweight/obesity than non-trans adolescents (Bishop et al., 2020; Streed Jr et al., 2021; Valentine et al., 2021). Compared to cisgender adolescents, TGD adolescents report lower levels of physical activity, more frequent intake of fast food and soft drinks, and are more likely to be bullied because of their weight or size (Aparicio-García et al., 2018; Bishop et al., 2020). A limitation of this

dissertation was the inability to examine the impacts of LGBTQ positive school climate and SGM enumerated anti-bullying policies on obesity and bullying victimization disparities on TGD adolescents. Future research that includes these adolescents is greatly needed.

Body Image Among Sexual Minority Adolescents. Researchers posit that a major driver of obesity disparities among SMA, and especially SM girls, is that they are more likely than their heterosexual peers to engage in negative coping behaviors such as overeating and binge eating to deal with discrimination experiences and to engage in physical activity at lower levels (Grammer et al., 2019; Miller & Luk, 2019). However, other potential drivers of these disparities (unmeasured in this dissertation) are gender and sexual minority-specific norms concerning ideal body image and appearance. Prior research has shown that lesbian communities are more accepting of larger body sizes and that they tend to focus less on traditional models of physical attractiveness, rejecting cultural female physical standards so slim bodies (Alvy, 2013; Mason et al., 2018). On the other hand, sexual minority boys have been found to prioritize expressions of leanness as well as obtaining a muscular ideal (Calzo et al., 2015). These differing opinions of ideal body image could play a role in ideal, perceived, and actual weight status among SMA, and future research should incorporate assessments of these concepts.

Intersectionality. The studies in this dissertation did not examine racial/ethnic differences, or other social identity differences—a limitation that should be addressed in future studies of LGBTQ positive school climate and SGM enumerated anti-bullying policies. An exploration of the intersections of multiple marginalized social identities would help further contextualize adolescent experiences and associated health behaviors.

Qualitative research is also needed to expand understanding of students' perceptions of school climate and state-level anti-bullying policy with SGM enumeration. Notably, the measure

of LGBTQ positive school climate in Study 2 used principal and teacher-reported data to calculate the school climate score. However, the presence of an LGBTQ safe space in schools or the inclusion of SGM-specific topics in health education curricula, as reported by adults, may not directly translate into the awareness and utilization of these resources by students. A 2015 GLSEN report noted that many LGBTQ students are unaware of the protections they have under anti-bullying policies. However, when aware of such enumerated protections, students were more likely to report bullying incidents (Kull et al., 2015). Therefore, future research should not only seek to design measures of LGBTQ positive school climate from the student-perspective, but should also qualitatively explore these practices and policies, how they are interpreted by LGBTQ students, and how they ultimately impact experiences of stigma and discrimination that contribute to obesity and bullying victimization. The same argument can be made for state-level anti-bullying policies with SGM enumeration. Future research should qualitatively explore the effects of protective policies on the experiences of LGBTQ adolescents and their sense of safety, inclusion, and representation in such policies at the more distal level of the state, as opposed to the school district level.

5.7 Conclusion

In this dissertation we examined two main resilience-promoting factors posited to decrease obesity and bullying victimization rates: LGBTQ positive school climate and anti-bullying policy with sexual and gender minority identity enumeration. We found that both are effective in reducing odds of obesity and bullying victimization, respectively, not only for sexual minority students, but for heterosexual students as well, highlighting how specific protections for one group can benefit all groups. However, school district specific school climate and state-level anti-bullying policy are only the foundations in this ongoing advocacy for protections and

inclusion of LGBTQ young people in American society. With the ongoing attacks on LGBTQ rights for youth and adolescents across the U.S., especially within the past two years, it is more imperative than ever to signal to students that our institutions, schools, and healthcare environments accept them, understand them, and will fight for their basic human rights to belong through federal-level protections that can change attitudes and perceptions.

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