

Structural Factors and Sexual Orientation Disparities in Adolescent Substance Use: A Multi-
Level Model

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Abstract

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Studies consistently find sexual orientation disparities in tobacco, alcohol and marijuana use among adolescents in the United States (Goldbach, Tanner-Smith, Bagwell, & Dunlap, 2014; Hatzenbuehler, Jun, Corliss, & Austin, 2015; Kann et al., 2018; Marshal et al., 2008; Mustanski, Van Wagenen, Birkett, Eyster, & Corliss, 2014). Having documented this elevated risk, the field has turned to identifying mediators that may explain the sexual orientation disparity in substance use behaviors. There is growing evidence that one of the mediators of sexual orientation-based health disparities is structural stigma—defined as “societal-level conditions, cultural norms, and institutional policies that constrain the opportunities, resources, and well-being of the stigmatized” (Hatzenbuehler & Link, 2014, p.2). Structural stigma can in turn lead to greater stress and subsequent negative coping behaviors among sexual minorities (Hatzenbuehler et al., 2015; Hatzenbuehler & Link, 2014; Hatzenbuehler & McLaughlin, 2014; Pachankis, Hatzenbuehler, & Starks, 2014). However, most of this work has been conducted among adults and has focused on mental health outcomes (e.g., suicide attempts, psychiatric morbidity, mental distress) as opposed to specific substance use behaviors; further, if structural factors are found to affect sexual orientation health disparities and these can be altered, the gap between sexual minority and heterosexual substance use can be narrowed through policy change. State-level substance use policy (e.g., levels of taxation of cigarettes and alcohol, policies that remove adolescent access to driving upon substance use infractions) may also explain the gap in substance use prevalence between sexual minority and heterosexual youth because tobacco, alcohol and marijuana are also stigmatized substances and restrictive substance use environments may enhance the stigma attached to sexual minority youth.

However, only one study has explored this research question, and it was conducted with an adult sample (Hatzenbuehler, Keyes, Hamilton, & Hasin, 2014).

This project aims to address these gaps in the literature. It uses multi-level modeling to test the association between (1) state-level sexual minority structural stigma (SMSS) and (2) state-level substance use policy environments (SUPEs) and sexual orientation disparities in recent substance use as measured in the Youth Risk Behavior Surveillance Survey (YRBSS). Analyses were also conducted to assess the size and direction of the association between SMSS and SUPE and state-level prevalence of substance use within heterosexual and sexual minority youth subpopulations. Analyses were conducted in subpopulations of female and male youth.

Support was found for the structural stigma hypothesis among girls but not boys. Higher overall measures of sexual minority structural stigma were associated with larger disparities in tobacco use, alcohol use, and marijuana use among girls. Higher scores on the SMSS scale were associated with tobacco use among sexual minority girls but not heterosexual girls. Individual indicators of structural stigma (e.g., specific state-level policies) were also associated with disparities in these outcomes, as well as with the other outcomes tested (binge drinking and drunk driving). No such associations were found among male youth.

Very little support was found for the hypotheses that restrictive substance use policy environments would be associated with larger sexual orientation disparities in substance use and that heterosexual but not sexual minority youth would demonstrate lower prevalence of substance use in restrictive states. Among girls, no associations were found between scales measuring the restrictiveness of substance use and sexual orientation disparities in substance use. A smaller sexual orientation disparity in recent cigarette smoking was associated with one indicator of restrictiveness: state enforcement of underage tobacco sale laws. Among boys, no associations were found between scales measuring the restrictiveness of substance use and sexual orientation disparities in substance use; two indicators of

restrictiveness were associated with *smaller* sexual orientation disparities in binge drinking and three indicators were associated with smaller sexual orientation disparities in drunk driving. Among heterosexual but not sexual minority boys, higher tobacco taxes were associated with lower prevalence of smoking.

This study raises several questions for future research on structural factors that may explain sexual orientation disparities in substance use behaviors among youth. For instance, future work is needed to understand the gender differences in response to structural stigma among sexual minorities. Sexual minority girls may have greater rejection sensitivity than sexual minority boys and thus may be more likely to use substances in response to structural stigma; however, further research is needed to test this hypothesis. In addition, the current study lacked data on the implementation of substance use policy environments, which may have masked important effects. A study of SUPE that includes measures of implementation of restrictive substance use policies is therefore needed to expand the work reported herein. Finally, a better understanding of gender identity and expression is needed; while the YRBSS measures “sex” and not gender or gender expression in these datasets, more information about these topics will help to understand how these factors may play into experiences of structural stigma and substance use policy environments.

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Chapter 1: Introduction

Substance use among adolescents is a widespread concern for public health in the United States. In the 2017 Youth Risk Behavior Survey, 8.8% of students reported smoking one or more cigarettes in the past 30 days, 29.8% had drunk at least one alcoholic beverage on at least one of the past 30 days, 13.5% had four or more drinks (female) or five or more drinks (male)¹, 5.5% had driven while drinking alcohol, and 19.8% had used marijuana one or more times in the 30 days before the survey (Kann et al., 2018).

Recent research suggests that sexual minorities are much more likely to use tobacco, alcohol, and marijuana than their heterosexual counterparts, and these disparities are observed in adolescents as well as adults (Balsam, Beadnell, & Riggs, 2012; Blosnich, Lee, & Horn, 2013; Corliss et al., 2014; Hatzenbuehler, Wieringa, & Keyes, 2011; Institute of Medicine, 2011; Jun et al., 2010; Lowry, Johns, Robin, & Kann, 2017; Mustanski et al., 2014; Phillips et al., 2017; Rosario, Corliss, Everett, Reisner, et al., 2014). For example, recent YRBSS data show that sexual minority youth, compared to heterosexual youth, are more likely to have smoked cigarettes on at least one day in the past 30 (15.4% of LGB youth vs. 6.6% of heterosexual youth) (Kann et al., 2018), to have had at least one drink of alcohol in the past 30 days (39.9% vs. 32.2%), to have recently engaged in binge drinking (18.3% vs. 13.9%), to have driven when drinking alcohol (7.1% vs. 3.5%) and to have recently smoked marijuana (74.0% vs. 63.8%). A meta-analysis found that sexual minority youth were 2.76 times as likely to use cigarettes as heterosexual youth, 2.55 times as likely to use any alcohol, 1.34 times as likely to use heavy alcohol, and 1.56 times as likely to use marijuana (Marshall et al., 2008).

Understanding the causes of these sexual orientation substance use disparities is important, not only because one cannot improve population health without improvements in the most affected communities, but also because there is a lack of understanding of how current policies that affect the lives

¹ Consuming of 4 or more drinks for females and five or more drinks for males (in one sitting) will be referred to as “binge drinking”, following the definition offered in the Youth Risk Behavior Survey (Kann et al., 2018).

of adolescents may be affecting these disparities, including policies that may increase stigma against sexual minorities (referred to below as “structural stigma”) and those that restrict substance use among adolescents (referred to below as “substance use policy environments”).

This project is intended to contribute to the growing literature examining the policies associated with sexual orientation substance use disparities. The remainder of this chapter will provide a review of the literature and theory suggesting the importance of understanding the size and direction of the associations between structural stigma and substance use policy environments and sexual orientation-based substance use disparities among youth. Specifically, it will begin by describing substance use as a public health problem among adolescents, what is known about disparities in substance use prevalence between heterosexual and sexual minority youth (including the role that stigma plays in these disparities), how policies can reinforce or combat stigma, and how substance use policy environments affect adolescent substance use. The chapter will conclude by offering hypotheses about each specific aim.

1.1 Substance Use as a Public Health Problem Among Adolescents

Research suggests that tobacco and alcohol are harmful to developing adolescent bodies and brains (Ammerman, Ryan, Adelman, & The committee on substance use, the committee on adolescence, 2015; Tenenbaum & Merrick, 2014; US Department of Health and Human Services, 2014; U.S. Department of Health and Human Services (HHS), Office of the Surgeon General, 2016; Zeigler et al., 2005). According to a recent Surgeon General’s report (2016), substance misuse and substance use disorders cost \$442 billion per year in the United States alone in costs to the health care system (although the specific costs of alcohol, tobacco and marijuana were not disaggregated in this study).

Young people who use tobacco are more likely to develop respiratory problems, oral and lung cancers, heart disease and other health problems, than those who do not use tobacco (Tenenbaum & Merrick, 2014). Young people who use alcohol are more likely to engage in other risky behaviors while

they are under the influence of alcohol, and heavy use of alcohol by adolescents is associated with neurocognitive problems, which may persist into adulthood (Zeigler et al., 2005).

The research on marijuana use among adolescents and its effects on adolescent brains, bodies and future health outcomes is less conclusive than that conducted on tobacco and alcohol. Some studies have found that young people who use marijuana can be affected by cognitive and memory problems that often do not remit upon diminished use in adulthood (Ammerman et al., 2015; Gonzalez & Swanson, 2012). A recent review of studies examining the effects of marijuana on adolescent brain structure found that there was an association between anxiety and marijuana use, but that the quality of the evidence linking marijuana use and negative outcomes is poor and that there is further research necessary to establish harmful effects of marijuana on adolescent brains (Cancelliere, Yusuf, & Weyandt, 2018). While research is being conducted on possible positive effects of cannabis use (for example, in treating pain or psychiatric disorders) among adults, some recent studies show that there are adverse effects and little positive benefit of cannabis for treatment of mental disorders (Black et al., 2019) and that better research is needed to evaluate the effects of cannabis on pain (Hill, Palastro, Johnson, & Ditre, 2017).

While many adolescents experiment with substances and experience few psychosocial or health issues associated with this experimentation, a smaller number use substances through later life and experience profound, lasting effects of use (Brook, Lee, Rubenstone, Brook, & Finch, 2014; Flory, Lynam, Milich, Leukefeld, & Clayton, 2004; Lee, Humphreys, Flory, Liu, & Glass, 2011; Rose, Winter, Viken, & Kaprio, 2014; Zeigler et al., 2005). For example, nine out of ten current cigarette smokers began smoking before age 18 and 98% started smoking before age 26 (US Department of Health and Human Services, 2014).

1.2 Sexual Orientation Substance Use Disparities Among Adolescents

Sexual orientation is an enduring pattern of sexual and/or romantic attraction to others, often defined by the relationship between one's own gender and the gender(s) to which one is attracted (Institute of Medicine, 2011). Sexual minority youth are those who identify as gay, lesbian and bisexual;

some researchers also include those who may not identify as gay, lesbian or bisexual but who have had same-sex sexual contact (Kann et al., 2018). Sexual minority youth and adults experience a range of disparities in physical, mental and behavioral health as well as in access to health care (e.g. Balsam et al., 2012; Blosnich et al., 2013; Bränström, Hatzenbuehler, & Pachankis, 2016; Charlton et al., 2018; Corliss et al., 2014; Institute of Medicine, 2011; Li, Turner, Mustanski, & Phillips, 2018; Lowry et al., 2017; Mustanski et al., 2014; Phillips et al., 2017; Rosario, Corliss, Everett, Reisner, et al., 2014).

Dozens of studies have demonstrated the association between sexual minority status and elevated substance use. In addition to the data described above regarding the elevated prevalence of substance use among sexual minority youth (SMY) compared with heterosexual adolescents, studies have found that SMY are more likely to start drinking earlier (Garofalo, Wolf, Kessel, Palfrey, & DuRant, 1998) and to use alcohol more frequently (Faulkner & Cranston, 1998) and heavily (Corliss, Rosario, Wypij, Fisher, & Austin, 2008) than heterosexual youth. In addition to being more likely to smoke, SMY also initiate smoking at younger ages than heterosexuals (Marshal, Friedman, Stall, & Thompson, 2009). Research consistently shows that sexual minority youth are more likely to use marijuana than heterosexual youth (Hatzenbuehler et al., 2015; Marshal et al., 2008, 2009; Parnes, Prince, & Conner, 2018).

1.3 Stigma as A Fundamental Cause of Health Inequalities

Having documented this elevated risk in substance use among SMY relative to their heterosexual peers, the field has turned its attention to identifying risk factors and mechanisms that can explain this disparity. Scholars posit that one reason SMY are more likely to use illicit substances than heterosexual youth is because they experience harassment and victimization from non-SMY who hold prejudicial attitudes towards SMY (Blosnich & Horn, 2011; Haas et al., 2011; Marshal et al., 2008; Rosario, Corliss, Everett, Russell, et al., 2014). Minority populations that experience prejudice have poorer health even when controlling for differences in economic status because they experience stigma.

Stigma was defined by sociologist Erving Goffman as the condition of being “disqualified from full social acceptance” due to having a “discrediting” attribute of the body, of character or of membership in a group

(1974, p. 9). Stigma is socially constructed, and the subpopulations that experience stigma vary across time and space. Experiences of stigma are disempowering, as members of the dominant group can exert their power to deny stigmatized groups access to resources (Herek, 2009). A more recent definition of stigma applied in public health is the “co-occurrence of labeling, stereotyping, separation, status loss, and discrimination in a context in which power is exercised” (Hatzenbuehler, Phelan, & Link, 2013, p. 813).

Recent public health scholarship has pointed out that stigma is a fundamental cause of health disparities (Hatzenbuehler, Phelan, & Link, 2013). *Fundamental causes* of health conditions and outcomes are those that inhere in social structures (including laws and policies) and affect multiple health conditions through multiple pathways (Link & Phelan, 1995). Stigma denies minority groups access to multiple forms of capital—financial, social, human, educational and others—making it difficult for them to access the prerequisites of good health.

There are a variety of theories about why sexual minorities are stigmatized by non-SMY. One emphasizes an origin of anti-gay attitudes in misogyny, suggesting that those who hold attitudes that denigrate women and femininity may associate same-sex desire among men to be feminizing of those men, and thus subject to stigma (R. Connell, 1987; R. W. Connell, 2005). Other theories emphasize the centrality of disgust; sexual minorities, in identifying as such, bring behavior considered “private” (sexual behavior) into public spaces, violating important social norms about the division between public and private space (Warner, 2000).

Drug users are also a stigmatized group (Becker, 1973). Recent work suggests that nearly half of smokers in New York City, for example, experience stigma and feel devalued as people because of their smoking (Evans-Polce, Castaldelli-Maia, Schomerus, & Evans-Lacko, 2015; Kulesza, Larimer, & Rao, 2013). One ethnographic study has suggested that for black women who smoke, the additional stigma associated with their use of cigarettes to cope with stress related to being dually marginalized—as black and as female—worsens their experiences of inequality (Antin, Annechino, Hunt, Lipperman-Kreda, & Young, 2017). This suggests that groups that already experience inequality due to prejudice may be particularly harmed by the addition of another form of stigma such as smoking or drug use. As will be

described below, public health has sometimes ignored the potential negative consequences of stigmatizing policies designed to decrease behaviors detrimental to health.

Stigma can manifest within an individual, during interpersonal interactions, or at the structural level (as in the case here, where policies are stigmatizing structures). *Internalized* stigma occurs when individuals believe the negative attitudes projected onto them by others and take them in, incorporating them into their own self-concept and their own judgment of their membership in the group that is targeted for stigma. For example, when gay people direct negative social attitudes towards themselves, they are experiencing internalized homophobia (Meyer & Dean, 1998; Plummer, 2002). For some sexual minority youth, the coming out process may resolve feelings of internalized homophobia and replace them with a sense of pride and belonging; for others, internalized homophobia may remain present (Frost & Meyer, 2009). Internalized homophobia (alternatively called “internalized homonegativity”) is associated with several adverse outcomes, including concealment of sexual identity; mental health symptoms (including depression (Heiden-Rootes, Wiegand, Thomas, Moore, & Ross, 2018); poor body image, low self-esteem, bulimia (Reilly & Rudd, 2006)); HIV/AIDS and associated risk behaviors (Amola & Grimmer, 2015; Williamson, 2000); substance use disorders (Weber, 2008); and drug use (Moody, Starks, Grov, & Parsons, 2018).

Interpersonal experiences of stigma occur when one person enacts prejudicial attitudes towards another who is a member of a stigmatized group through direct contact with that person (Allport, 1979; Dovidio, Glick, & Rudman, 2008; B. Link & Hatzenbuehler, 2016). Interpersonal experiences of stigma range from subtle microaggressions to serious physical violence. Among youth, peer victimization and bullying related to sexual orientation have been found to be associated with depression (Williams, Connolly, Pepler, & Craig, 2005), alcohol use (Phillips et al., 2017), prescription drug use (Li et al., 2018) and a range of negative mental health outcomes (Poteat, Scheer, DiGiovanni, & Mereish, 2014; Poteat, Scheer, & Mereish, 2014; Williams et al., 2005). In addition to interpersonal experiences of stigma perpetuated by peers, much attention has been paid to the negative effects of family rejection of sexual

minority youth on adolescent and adult mental health (Ryan, Huebner, Diaz, & Sanchez, 2009; Ryan, Russell, Huebner, Diaz, & Sanchez, 2010; Ryan et al., 2010).

Attention to structural stigma and its effects on public health, including sexual minority structural stigma, has emerged more recently as a focus of public health scholarship. *Structure* has long been a focus of public health—as early as Engels’ writing about the effects of class structure on the health and life chances of the English working class (Engels, 1892). One structure of particular interest to public health researchers is policy, because there is evidence that certain policies can influence health outcomes, but unlike immutable factors such as genetic predisposition, they can be changed. Stigma is a structure when it inheres in policies and repeated practices that normalize or reinforce the idea that the stigmatized are inferior to others; it is also a structure in that it determines life chances through multiple pathways of influence (Hatzenbuehler, 2017; B. Link & Hatzenbuehler, 2016).

Stigmatizing policies can be overtly prejudiced, as when bans on same-sex marriage make clear that there are structures in place that denigrate gay and lesbian relationships, and they can be indirectly stigmatizing, as when people of color are disproportionately incarcerated under sentencing guidelines for crimes involving crack and cocaine compared to white people who are not jailed (Alexander, 2010). So are school policies that prohibit comprehensive, medically accurate sex education and exclude sexual minority youth, as well as curricula that fail to recognize the important contributions that sexual minority people have made to historical events (Kosciw, Greytalk, Giga, Villenas, & Danischewski, 2016; Schwartz et al., 2017; Snapp, Burdge, Licona, Moody, & Russell, 2015). Structural changes, such as altering policies, can facilitate a move towards a climate of lower structural stigma. Examples of such affirmative policies include mandating coverage of issues related to sexual minorities in curricula or state recognition of same-sex relationships (Hatzenbuehler & Pachankis, 2016).

1.4 Stigma, Stress, and Substance Use

There is a growing body of literature to suggest that one mechanism that connects experiences of stigma to experiences of ill health is stress. *Minority stress theory*, most associated with the work of Ilan

Meyer (2003), suggests that experiences of stigma and prejudice lead to greater stress and lack of social support. He further suggests three sub-parts to this mechanism: “a) external, objective stressful events and conditions (chronic and acute), (b) expectations of such events and the vigilance this expectation requires, and (c) the internalization of negative societal attitudes” (p. 676). This hypothesis is well supported both in that there is a biomedical relationship between stress and harm to health and in that the existence of the stress disparity and the pathway to internalization has been well-specified and supported by data (Hatzenbuehler, 2009).

When stigma disempowers individuals through attributing discreditable attributes to them, it also causes physiological changes in the body. For example, it causes over-production of cortisol which has negative effects on memory, mental health and physical health. This connection has been shown specifically in sexual minorities by at least one study, in which sexual minorities who were exposed to high levels of structural stigma as adolescents had blunted cortisol reactions to stressors measured in later life (Hatzenbuehler & McLaughlin, 2014).

Adolescents (and adults) also sometimes try to manage feelings of stress by using substances such as tobacco, alcohol and marijuana, which then have subsequent negative health effects of their own (Charles, Mathias, Acheson, & Dougherty, 2017; Chassin, Pillow, Curran, Molina, & Barrera Jr., 1993; Copeland-Linder, Lambert, Chen, & Jalongo, 2011; Hoffmann & Su, 1998; Wills, Sandy, & Yaeger, 2002).

1.5 Substance Use Policy Environments

In this previous section, I considered policy environments that either promulgate or alleviate stigma and how these in turn may influence substance use behaviors among SMY and sexual orientation disparities in these outcomes. This section describes a different set of policy environments that may also affect substance use among SMY as well as sexual orientation disparities in substance use. Specifically, I review three groups of policies that states use to discourage substance use by adolescents. While the first two types, taxation and general regulation, are not exclusively for adolescents, they have been shown to

affect adolescent behavior. The third, prohibitions of substance use that are age-specific, are intended specifically to regulate adolescent behavior. This is an important distinction, as adolescent brains are more vulnerable to the effects of substance use, and thus attention to adolescent use is important to improving both current and future population health.

1.5.1 Taxation

Economic theory suggests that taxes influence the purchase and use of items because by raising the price of the item, taxes lower demand for it. In the case of potentially unhealthy items such as tobacco and alcohol, taxation should decrease use of those items, especially among people with fewer assets and others who tend to be price sensitive; in addition, research has shown that youth specifically are more affected by taxes than adults (Hingson & White, 2014). For example, in states with higher tobacco taxes, there are lower odds of smoking initiation and lower smoking among youth compared with states with lower taxes (van Hasselt et al., 2015). In states with higher alcohol taxes, there is similarly lower alcohol-related morbidity and mortality (Wagenaar, Tobler, & Komro, 2010) and lower binge drinking overall (Xuan, Blanchette, et al., 2015) compared with states with lower taxes.

Some scholars suggest that “sin taxes”—those imposed on activities such as smoking, alcohol use, gambling or pollution emissions—are stigmatizing and thus morally problematic: “. . . as symbolic expressions of disapproval, excise taxes can be highly precise, differentiating sharply between good and bad commodities and even between the components of a commodity (e.g., glass, corn, wheat, rye, malted barley), and the commodity itself (e.g., bottled bourbon whiskey) (Carruthers, 2016, p. 2570).” Associating taxation with assignment of moral judgment (e.g. corn is good, corn-derived alcohol is bad) assigns blame to those who use those substances in addition to dissuading their use through raising of prices. Whether or not that stigma is more salient or more harmful for groups that are already stigmatized, like sexual minorities, remains under-theorized.

Taxes also have effects on population health disparities. One study found, for example, that “. . . real cigarette prices are strong determinants of youth smoking. Blacks, females, Hispanics, and low-SES

subpopulations are found to have a larger price response with respect to smoking prevalence . . .” (Tauras, Huang, & Chaloupka, 2013, p. 2). However, studies of this kind have not been done that determine the extent to which taxation influences sexual orientation disparities in substance use among youth.

1.5.2 General Restrictions

General restrictions are those not specifically targeted at adolescents. These range from complete prohibition (as of alcohol in “dry counties” or marijuana in many states) to restrictions on where and when substances can be consumed (e.g., clean air laws for tobacco-free workplaces and public accommodations or limits on the hours bars can operate and serve alcohol).

Restrictions on the location and time where adults can access tobacco and alcohol have been shown to be associated with lower prevalence of youth smoking (Farkas, 2000, Seigel et. al., 2005). Requiring registration of beer kegs, which makes provision of large quantities of alcohol at parties more difficult, has been shown to decrease youth drunk driving fatalities (Fell, Fisher, Voas, Blackman, & Tippetts, 2009). These types of restrictions have some impact on youth substance use behavior; however, as with studies of taxes, these effects of restrictions on youth have not been differentiated by sexual orientation.

Among adults, one study found that sexual orientation disparities (LGB vs. heterosexual) were smaller in states with more restrictive (compared to less restrictive) tobacco environments (Hatzebuehler, Keyes, Hamilton, & Hasin, 2014). One mechanism suggested for these findings is that LGB adults may move to states with more favorable policies regarding sexual orientation, and that because these favorable policies are associated with restrictive tobacco policies, LGB adults may be more exposed to restrictive tobacco environments than they are to nonrestrictive environments. However, unlike LGB adults, LGB youth live where their parents live and thus do not choose to live in states with positive environments; consequently, it is unclear whether these same findings would pertain to LGB youth.

Underage Restrictions. There are a number of regulations of tobacco and alcohol that apply only to minors (typically those under age 18 for smoking and under 21 for alcohol use in the United States).

For example, prohibitions on possession and purchase of alcohol, so-called “use/lose” policies (those that require revoking the driver’s license of any young person caught breaking alcohol-related laws or policies), and zero tolerance for blood alcohol level (as opposed to allowing BAC levels up to .02) have all been shown to lower alcohol-related fatalities among youth drivers (Fell et al., 2009; Fell, Scherer, Thomas, & Voas, 2016; Hingson & White, 2014).

1.6 Specific Aims

This project proposes to use Youth Risk Behavior Survey (YRBS) data to test the associations between two state-level predictors--*sexual minority structural stigma* and *substance use policy environment*--and sexual orientation disparities in recent substance use among adolescents. In doing so, it not only contributes to a growing body of literature on SMY substance use but also provides preliminary data on the potential for structural interventions to reduce sexual orientation disparities in substance use. Specifically, the project proposes to:

Aim 1: Use multi-level modeling to assess the size and direction of the association between state-level indices of sexual orientation structural stigma and sexual orientation disparities in recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use in a population-based sample of adolescent girls and boys (i.e., between-group analyses).

Hypothesis #1: The growing literature on sexual minority structural stigma suggests that *the relationship between stigmatizing environments and sexual orientation disparities will be positive* (that is, there will be larger disparities in states with higher levels of sexual minority structural stigma, or if a causal argument is made, higher levels of structural stigma will cause sexual minority use to go up while non-SMY use will remain the same). This hypothesis is consistent with prior literature suggesting that sexual minority structural stigma is associated with sexual orientation disparities in marijuana and other illegal drug use (Hatzenbuehler et al., 2015) and in tobacco use among adolescents (Hatzenbuehler, Keyes, et al., 2014) and tobacco and alcohol use among sexual minority men (Pachankis et al., 2014).

Aim 2: Use multi-level modeling to assess the size and direction of the association between state-level indices of sexual orientation structural stigma and prevalence of recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use among sexual minority and heterosexual boys and girls (i.e., within-group analyses).

Hypothesis #2: Following the literature suggesting that higher levels of structural stigma is associated with larger sexual orientation substance use disparities, the hypothesis corresponding to Aim 2 is that among sexual minority youth but not heterosexual youth, structural stigma will be associated with higher prevalence of substance use.

Aim 3: Use multi-level modeling to assess the size and direction of the association between state-level indices of restrictive substance use policies and sexual orientation disparities in recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use and in a population-based sample of adolescent girls and boys (i.e., between-group analyses).

Hypothesis #3: There is less evidence to guide hypotheses about the relationship between restrictive substance use policy environments and sexual orientation disparities in substance use among youth. While research on sexual orientation disparities in tobacco use has suggested that restrictive tobacco policy environments may narrow sexual orientation health disparities (Hatzenbuehler, Keyes, et al., 2014), the mechanisms suggested for this association are not applicable to adolescents and to some other substances. The article suggests that sexual minority adults may be attracted to living in liberal environments, which have restrictive smoking policies as well as pro-sexual minority policies. However, sexual minority youth do not often select the states in which they live. Further, some substance use policies (such as those regarding access to marijuana), are associated positively with liberal attitudes. This project hypothesizes that restrictive substance use policy environments *will widen, rather than narrow, sexual orientation disparities in substance use across all substances* because adolescents are quite sensitive to stigma, including stigma that inheres in drug use, and sexual minority youth, who are already subject to stigma, may find that it compounds, adds to stress and increases their use of negative coping mechanisms (such as drug use itself). In other words, more restrictive policies compound stigma

associated with substance use, which inheres in sexual minority youth because they are already stigmatized, and increase stress further, thus creating a perverse effect of increased substance use.

Aim 4: Use multi-level modeling to assess the size and direction of the association between state-level indices of restrictive substance use policies and prevalence of recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use among sexual minority and heterosexual boys and girls (i.e., within-group analyses).

Hypothesis #4: Among heterosexual youth, but not sexual minority youth, more restrictive substance use policies will be associated with lower prevalence of substance use. This is because the benefits of restrictive substance use for sexual minority youth are expected to be canceled out by the potential stigmatizing effect of these restrictive substance use policies.

Examining Gender Differences. One important methodological decision in this study was to approach each research question by examining sexual orientation-based substance use disparities among youth who indicate they are female separately from those who indicate they are male. While the gender gap in substance use and related disorders may be narrowing, there is persistent evidence to show that young women and young men differ in their biological and psychosocial responses to substance use (Keyes, Grant, & Hasin, 2008; McHugh, Votaw, Sugarman, & Greenfield, 2018). Further, substance use patterns differ between sexual minority men/boys and women/girls, and the size of the sexual orientation disparity in substance use is often larger for girls/women than boys/men (Hughes, Wilsnack, & Kantor, 2016; Rosario, Corliss, Everett, Reisner, et al., 2014; Talley, Hughes, Aranda, Birkett, & Marshal, 2014). For example, in one study of YRBS data from 2005 and 2007, separate analyses of female and male sexual minorities (compared with heterosexuals) found that the adjusted odds ratios (AORs) for smoking were 4.0 for females compared with 2.4 for males, 2.2 compared to 1.6 for recent alcohol use, and 2.2 vs. 1.5 for binge drinking; while statistical tests were not performed, in no cases did these confidence intervals overlap (Rosario et. al, 2014). Finally, there is some suggestive evidence that boys and girls may respond differently to restrictive substance use environments. For example, one examination of state-level taxes found that women are more responsive to these taxes than men are (i.e., smoke less in states

with higher tobacco policies), although the direction of these differences varies across studies, with some studies finding that women are more responsive to tax increases on cigarettes (Stehr, 2007), while others finding that men are more responsive)(see review in Azagba & Sharaf, 2011). While there are no specific hypotheses posited about the differences between sexual minority boys and girls in this study, the analyses are stratified by sex because the research suggests that this is important to understanding data on sexual minority youth.

Chapter 2: Methods

This chapter describes the sources of data at the individual level (students in school sampled by the YRBSS in 2011 and 2013 in states where sexual orientation identity was measured) and the group level (policy indicators of structural stigma and substance use policy environments). It describes how the indices of sexual minority structural stigma were created, and how the subscales and scales for substance use policy environments were created. It shows the general and specific forms of the multi-level modeling equations used to estimate the parameters shown to test the hypotheses discussed in the introduction as well as the tests conducted for confounder variables and covariates.

As discussed in the introduction, there are four hypotheses tested in this manuscript.

2.1 Data Sources

2.1.1 Individual-level Data Source

The Youth Risk Behavior Survey (YRBSS) collects data biannually from high school students grades 9-12 across the nation about their health and well-being, including their use of tobacco, alcohol and marijuana. It uses a multi-stage cluster design in which schools are first selected in proportion to enrollment size and then intact classes of a specific subject or period are randomly selected (Brener et al., 2013; Mustanski et al., 2014). State response rates vary from 60% to 90%, and sample sizes for states vary (see “confounder analysis” below for tests of response rate confounding). As of 2013, 17 states also collected sexual orientation information, allowing for an analysis of the sexual orientation health disparities in these states (Mustanski et al., 2014). The YRBSS has been used to assess individual-level risk factors for sexual orientation health disparities, but not for structural- and policy-related correlates of those disparities (Corliss et al., 2014; Mustanski et al., 2014; Newcomb, Birkett, Corliss, & Mustanski, 2014).

The 17-state YRBSS surveys that measure sexual identity most often do so using the question: “Which of the following best describes you?” and the response options 1) “heterosexual (straight),” 2) “gay or lesbian,” 3) “bisexual,” and 4) “not sure. For this analysis, students who were “not sure” were

excluded, those who selected “gay or lesbian” or “bisexual” were coded as 1 and those who selected heterosexual were coded 0. Gay/lesbian and bisexual youth were combined to increase the sample size and thus statistical power. The survey asks: “What is your sex?” with the response options “male” and “female” (the core, required survey module does not ask about gender, gender identity, or transgender identity).

The YRBSS asks about a variety of behaviors related to substance use; states may ask additional questions, but all YRBSS surveys share some measures of tobacco use, four measures of alcohol use and three measures of marijuana use. This analysis will confine itself to recent use. The strength of this approach is that it increases the likelihood that YRBSS respondents began to identify with their sexual orientation category prior to the substance use behavior taking place; however, it is a weakness in that recent substance use is not an indicator of substance abuse or a long-term habit of using substances.

Recent substance use is measured by the following indicators:

1. “During the past 30 days, on how many days did you smoke cigarettes?”
2. “During the past 30 days, on how many days did you have at least one drink of alcohol?”
3. “During the past 30 days, on how many days did you have 5 or more drinks of alcohol in a row, that is, within a couple of hours?”
4. “During the past 30 days, how many times did you drive a car or other vehicle when you had been drinking alcohol?”
5. “During the past 30 days, how many times did you use marijuana?”

All youth who answered one or more days were coded as 1 for that substance, while those who reported using zero times were coded as 0.

The YRBSS also asks about demographic covariates of substance use, including age and race/ethnicity of the respondent. To measure race and ethnicity, the survey asks two separate questions. First, it asks, “Are you Hispanic or Latino?” with answer choices “yes” and “no” and then “What is your race? (select one or more responses)” with answer choices including “American Indian or Alaska Native”, “Asian”, “Black” “White” and “Other”. The multiracial category excludes Hispanic and Latino(a) respondents. Hispanic/Latino(a) includes all who selected this ethnicity, regardless of whether they

selected other races (this category is referred to as “Hispanic” in tables and text for the remainder of the manuscript). Some YRBSS sites use slightly different race and ethnicity categories, so all were recoded into a multicategorical race/ethnicity variable, with the following categories: American Indian/Alaska Native (only), Asian and Pacific Islander (only), Black or African American (only), White (only), Hispanic/Latino(a) (including those who also selected one or more other races) and all multiracial who did not select Hispanic/Latino(a). Tables refer to this category as “Hispanic” for brevity. Age was recoded into a multicategorical variable: 12 and under, 13 and 14, 15, 16, 17, and 18 years or older (12 and under and 13 year- and 14 year-olds were combined into one category because 13 years and 12 and under were very small categories).

Race and age were selected as covariates because they are associated with substance use among youth in many studies (Balbach, Hartman, & Barbeau, n.d.; Chaloupka & Pacula, 1999; Corliss et al., 2014), including those using YRBSS data (e.g. Ravello, Jones, Tulloch, Taylor, & Doshi, 2014). Further, previous studies examining the association between tobacco policies and sexual orientation disparities in tobacco use controlled for these factors (in addition to other data that are not available, such as income: see “limitations” section below) (Hatzenbuehler, Keyes, et al., 2014).

2.2.1 Group-Level Data Sources

Sexual minority structural stigma and related concepts have been operationalized in a variety of ways. “Institutionalized discrimination” has been measured using constitutional amendments banning same-sex marriage (Hatzenbuehler, McLaughlin, Keyes, & Hasin, 2010) in one study, while another used lack of state policies protecting lesbian, gay and bisexual people from employment discrimination and lack of inclusion of sexual orientation as a protected category in hate crime legislation (Hatzenbuehler, Keyes, & Hasin, 2009). Another study used state-aggregated mean attitude scores from surveys measuring public opinion on several topics (e.g., gay adoption, hate crimes, health benefits, discrimination, marriage, sodomy and civil unions) and the presence or absence of such policies (bans on

same-sex marriage, hate crime protections, adoption restrictions for same-sex couples, non-discrimination or anti-bullying laws enumerating sexual orientation) (Pachankis et al., 2014). Density of same-sex couples is used as an indicator of social context for LGB people by several other articles (Hatzenbuehler, Birkett, Van Wagenen, & Meyer, 2013; Hatzenbuehler, Keyes, & McLaughlin, 2011).

In order to capture the complex construct of sexual minority structural stigma (SMSS), this project used two domains that have been used in prior work (e.g., Hatzenbuehler et al., 2009; 2010; 2011): policies that disproportionately affect sexual minorities (including same-sex marriage bans, presence or absence of hate crime, employment, housing and public accommodation protects, etc.) and the density of same-sex couples at the state level (Table 1). In 2011, many states had bans on recognizing domestic partnership or marriage for same sex couples. In this index, those states were scored with a 1 for relationship recognition, while those that had no ban but also had no domestic partnership or marriage option for same-sex couples were scored with a 2. Finally, those with domestic partnership, marriage or both options for same-sex couples were scored with a 3. Similarly, for each type of protection (school non-discrimination, school anti-bullying, ability to adopt jointly as a same-sex couple, presence of hate crimes legislation, employment public accommodation and housing protection), the state was assigned a one; if the state lacked the protections for sexual orientation it was assigned a zero. Density of same-sex couples was divided into three categories, with the lowest density assigned a score of 1 (0.29-0.66), medium density a 2 (0.67-0.95), and high density a 3 (0.96-1.75).

The maximum scale score was 13. For the purposes of description (see, e.g., Table 3 in the Findings chapter), the population experiencing each policy is shown; however, for the purposes of analysis in the multilevel model, the SMSS index was reverse coded and standardized so that rather than showing the amount of protection for sexual minorities, the scale indicates the amount of stigma, as per the construct of interest in this study.

Table 1: Sexual Minority Structural Stigma Indicators

		Coding (1 = present, 0 = absent)	Data Source
Policy	Same-Sex Relationship Recognition Ban	1	Movement Advancement Project historical data and Human Rights Campaign
	No Recognition, No Ban	2	
	Same-Sex Relationship Recognition	3	
	School Non-Discrimination	1	
	School Anti-Bullying	1	
	Joint Adoption	1	
	Hate Crimes Legislation	1	
	Employment Protection	1	
	Public Accommodation Protection	1	
	Housing Discrimination Protection	1	
Density of Same-sex Couples (Numbers per 1000 Households)	0.29-0.66	1	
	0.67-0.95	2	
	0.96-1.75	3	

Tobacco, alcohol and marijuana, the three substances of interest to this project, are regulated differently from one another. While there is currently a great deal of variation in the level of access to marijuana, in 2011 the states included in this study did not have wide variation, and thus the marijuana policy index was coded simply as having any legal status=1 (e.g., for research or medical use) or no legal status=0 (National Conference of State Legislators, 2016).

Tobacco and alcohol are regulated through restrictions and punishments specific to those who are under the legal age to purchase and use those substances, restrictions on use that apply to adult users, and restrictions on businesses. Both tobacco and alcohol are also taxed, with a per-pack tax that varies across states and beer, wine, and liquor taxes on alcohol that differ from one another due to the differing amount of alcohol in each type of beverage.

For the tobacco policy index, which is shown in Table 2, underage restrictions included were smoke-free campus laws, smoke-free school bus regulations, prohibitions on underage purchase, possession and use penalizing buyers who purchase cigarettes on behalf of someone underage (while tobacco is regulated in all states, the mechanism of underage regulation varies; thus, there is variation in the prohibitions on purchase, possession and use, even though it might appear that all three should be equally illegal in all states) (State Tobacco Activities Tracking and Evaluation, 2016). Restrictions on public use included those prohibiting smoking in vehicles, public and private workplaces and restaurants. Finally, the domain of business restrictions included the states' ability to enforce tobacco sale laws against businesses (as opposed to only enforcing this on the minors themselves), requiring signs stating that selling to youth under the state limit is illegal, and the ability to revoke a business' license to operate if they sell to underage users. Each of these indicators is coded with a 1 for present or a 0 for absent. All indicators were taken from the State Tobacco Activities Tracking and Evaluation database.

Table 2 also shows the domains for the alcohol policy index. Because so-called "use/lose" laws have been shown to be some of the most effective at decreasing alcohol-related mortality, these are the first domain tested. "Use/Lose" laws are those which suspend or revoke a driver's license if he or she is under age and attempts to use or purchase alcohol (Alcohol Policy Information System (APIS), 2016). States can apply these laws using one or more of the following restrictions: suspending the license for purchasing alcohol, for possessing alcohol, or for consuming alcohol. Other underage policies, specifically prohibitions on consumption, using blood alcohol level as evidence of consumption (called by policy makers "internal consumption"), prohibitions on alcohol purchases and a zero-tolerance level for underage blood alcohol content, were also included. Each of these indicators is coded with a 1 for

present or a 0 for absent. Finally, prohibitions on unregistered kegs, which has been shown to be an effective deterrent for teenagers, was also included. Three forms of taxation, on beer, wine and liquor, were also included.

Table 2: Tobacco and Alcohol Policy Environment Indicators

Tobacco Policy Domain	Policy		Alcohol Policy Domain	Policy
Underage Restrictions Range (0-6)	Smoke-Free Campus		Use/Lose Policies Range (0-3)	Suspend or Revoke Drivers License for Underage Alcohol Purchase
	Smoke-Free Bus			Suspend or Revoke Drivers License for Underage Alcohol Possession
	Prohibit Underage Buying Tobacco			Suspend or Revoke Drivers License for Underage Alcohol Consumption
	Prohibit Underage Tobacco Possession		Underage Policies Range (0-4)	Underage Alcohol Consumption Prohibited
	Prohibit Underage Use of Tobacco			Underage Alcohol Consumption Blood Alcohol Level Prohibited
	Penalize Underage Buyer for Cigarette Purchase			Underage Alcohol Purchase Prohibited
Public Restrictions Range (0-4)	Smoking Banned in Vehicles			Zero Underage Blood Alcohol Content
	Smoking Banned in Private Workplaces		Unregistered Keg Policy (present=1, absent=0)	Unregistered Keg Prohibited
	Smoking Banned in Government Workplaces		Taxes	Beer
	Smoking Banned in Restaurants			Wine
Business Restrictions Range (0-3)	Can Enforce Underage Tobacco Sale Laws Against Businesses			Liquor
	Require Sign About Underage Tobacco Sale Ban			
	Revoke Business License for Underage Tobacco Sale			

Tobacco Policy Domain	Policy		Alcohol Policy Domain	Policy
Taxes	Tax Per Pack of Cigarettes			
Total Scale Range (0-11)			Total Scale Range (0-8)	

Additional indicators that were considered for inclusion but were homogenous or had only one or two states that differed from other states in this dataset included adult blood alcohol level and restrictions on the age of servers in bars and restaurants. Exceptions to policies (such as those that exempt parents from rules prohibiting furnishing alcohol to minors) were also excluded from the index for two reasons: first, they are nonstandard across sites and thus difficult to include in a scale, and second, they are very detailed and difficult to code as to their impact on the overall strictness of the policy environment.

In addition to the individual-level covariates described above, public opinion polling on sexual orientation and average income data were collected at the state level and tested for confounding, consistent with prior studies (e.g., Pachankis et al., 2014). Neither was shown to be a confounder and thus were not included in the analyses.

2.2 Statistical Analysis

Analyses were conducted in Stata. In order to obtain estimates of the associations between state-level variables (i.e., structural stigma and state policy environments) and the sexual orientation substance use disparity, the multilevel model was specified in two steps. The procedure was followed in much the same manner for hypotheses relating to sexual minority structural stigma and those relating to substance use policy environments and so will be described only once below. The procedure was also repeated for each substance use behavior and within each sex category (female and male).

The procedure was as follows: Estimates of the sexual orientation substance use disparity were obtained within each of the 17 states in the dataset by predicting prevalence of substance use from sexual orientation (and two covariates, race and age). For summary purposes, estimates were also obtained for the entire sample; full-sample estimates are derived from equations predicting prevalence, not from

averages of state-level estimates. Because of the YRBSS’s sampling structure, these equations were specified using the “svy” family of commands in Stata, which allow for adjustment for nesting, clustering and stratified sampling. Weights provided in the datasets were used in all analyses. Weights were halved for states that were included in both years, as per instructions to analysts of the YRBSS dataset (Centers for Disease Control and Prevention, 2014). The estimated covariate representing the sexual orientation disparity was then predicted from the state-level policy variable. The covariate measuring the effect of the state policy was the focal statistic testing the hypotheses of interest to this project.

The full model for testing the association between sexual orientation substance use disparities is composed of the following equations, where the subscripts *i* and *j* refer to individuals and states (respectively);

$$\text{Equation 1: } \text{Subst}_{ij} = \beta_{0j} + \beta_{1j}\text{LGB} + \beta_2\text{Race} + \beta_3\text{Age}$$

$$\text{Equation 2: } \beta_{0j} = \beta_{00} + \sigma_{j1}$$

$$\text{Equation 3: } \beta_{1j} = \beta_{01} + \sigma_{j2}$$

Equation 1 describes the individual level (*i*) equation for a state (*j*), in which an individual’s substance use is predicted from LGB status (1=LGB, 0=heterosexual), with the state level average substance use (β_{0j}) and the state coefficient on LGB (β_{1j}). The state level average substance use (β_{0j}) is predicted from the constant average (β_{00}) and the state variation (σ_{j1}) in substance use, while the state coefficient on LGB (β_{1j}) predicted from the average coefficient (β_{01}) and the state-level variation in the coefficient (σ_{j2})

Substituting the equations gives the full equation 4:

$$\text{Subst}_{ij} = (\beta_{00} + \sigma_{j1}) + (\beta_{01} + \sigma_{j2})\text{LGB} + \beta_2\text{Race} + \beta_3\text{Age}$$

The final equation also includes the variation in policy restrictions. Because policies vary only at the state level, not at the individual level, the equation is given by:

$$\text{Subst}_{ij} = (\beta_{00} + \sigma_{j1}) + (\beta_{01} + \sigma_{j2})\text{LGB} + \beta_2\text{Race} + \beta_3\text{Age} + \beta_4\text{Policy} + \beta_5\text{Policy}*\text{LGB}$$

The coefficient of interest for testing the hypothesis is β_5 .

Here substance use is predicted from the state-level constant average and the state-level variation.

The procedure to estimate the association between state-level variables and substance use prevalence among sexual minority and heterosexual youth was as follows: state-specific estimates were calculated within sexual minority youth and then a second level regression was created estimating the association between these state-specific betas and the policy score for the state. The procedure was repeated for heterosexual youth.

The equations estimating the association between state-level policy variables and prevalence of substance use *within* sexual minority and heterosexual youth were specified by estimating the prevalence and predicting it from the state-level policy variable.

In addition to the main analytic method described above, supplementary analyses were conducted to evaluate the robustness of the approach using a logistic regression without multi-level modeling and a multi-level model without adjustment for complex sample design. These results are shown in Appendix I.

Chapter 3: Findings

This chapter describes the distribution of students in the 17 states that contributed to the dataset, including the percent of the dataset from each state (Table 3), demographic information among SMY and heterosexual girls and boys (Table 4) and the distribution of the sample who lived in states with each of the sexual minority structural stigma (SMSS) and substance use policy environment indicators (Tables 5 through 8). The subsequent two sections in this chapter describe first the female subsample and then the male subsample, with each section including the following: the distribution of sexual minority youth, the estimates of adjusted odds ratios that describe the substance use disparities between sexual minority and heterosexual youth, and the tests of hypotheses that address Aims 1-4.

3.1 Descriptive Findings

When examining the 17 states that contributed data to the analytic dataset as shown in Table 3, the weighted data show the largest percentage of respondents from Illinois (19.94%) and Florida (14.32%) and the smallest from Vermont (1.00%), North Dakota and New Hampshire (1.04% each). The remainder of the states vary in the number of respondents they contribute, from 1.37% (Delaware) to 10.26% (Massachusetts).

Table 3: Sample Distribution by State

State	N	Weighted N	Weighted %	95% Confidence Interval
AZ	1,490	16,735	10.10	(7.14, 14.08)
CT	4,178	9,373	5.65	(4.19, 7.60)
DE	5,055	2,269	1.37	(1.12, 1.67)
FL	6,089	23,743	14.32	(11.41, 17.83)
HI	8,708	2,485	1.50	(1.18, 1.90)
IL	6,463	33,055	19.94	(15.46, 25.33)
MA	5,447	17,013	10.26	(7.89, 13.24)
MD	51,374	7,038	4.25	(3.84, 4.70)
ME	18,659	3,440	2.08	(1.50, 2.87)
MI	4,211	13,042	7.87	(5.73, 10.71)
NC	1,496	11,603	7.00	(4.81, 10.09)
ND	3,757	1,725	1.04	(0.84, 1.28)

NH	1,616	1,730	1.04	(0.84, 1.29)
NM	5,280	2,792	1.68	(1.10, 2.56)
RI	6,303	2,531	1.53	(0.99, 2.35)
VT	30,306	1,653	1.00	(0.33, 3.01)
WI	5,329	15,534	9.37	(7.21, 12.10)
Total	165,761	165,761	100.00	---

The 2011-2013 YRBSS weighted sample is 49.16% female. Of the girls in the sample, 9.59% are lesbian, gay or bisexual (sexual minority) and the remainder (90.41%) are heterosexual. Of the boys in the sample, 4.38% are gay or bisexual and 95.62% are heterosexual. As Table 4 illustrates, the range of age categories was from 14 years or younger to 18 years or older, with the majority of the sample concentrated in the 15-17 range (as would be expected for a sample of high school students).

Among boys, sexual minorities were statistically significantly more likely to be 18 years old or older (27.70% vs. 15.33%, $p < .001$) compared to heterosexual boys. The largest racial/ethnic group among both sexual minorities and heterosexual boys and girls was white; however, the racial and ethnic composition varied across gender and sexual orientation. Among both girls and boys, sexual minorities were underrepresented among white respondents when compared to heterosexuals, 49.36% vs 60.67% among girls and 48.10 % vs 59.12% for boys (p -value for both $< .001$). In contrast, sexual minorities were over-represented among Hispanic respondents (21.96 vs 17.46 girls, $p < .001$ and 24.99 vs 18.58, $p < .01$ for boys) and among multiracial respondents (4.96 vs. 2.80 $p < .05$ for girls, 3.65 vs. 2.76 $p < .001$ for boys) when compared to their heterosexual counterparts.

Table 4: Age and Race among Girls and Boys by Sexual Orientation

Demographics	SMY Girls Weighted Percent	Heterosexual Girls Weighted Percent	SMY Boys Weighted Percent	Heterosexual Boys Weighted Percent
Age				
14 years or younger	10.92	11.83	8.69	10.05
15 years old	24.79	25.07	21.40	25.06
16 years old	27.20	25.22	23.68	25.59
17 years old	23.23	24.63	24.53	23.97

Demographics	SMY Girls Weighted Percent	Heterosexual Girls Weighted Percent	SMY Boys Weighted Percent	Heterosexual Boys Weighted Percent
18 years old or older	13.85	13.26	21.70	15.33
Race/Ethnicity				
American Indian/Alaska Native	1.13	0.92	3.56	1.23
Asian and Pacific Islander	2.54	3.95	4.31	3.93
Black or African American	20.05	14.20	15.39	14.37
White	49.36	60.67	48.10	59.12
Hispanic/Latinx (inc. multi)	21.96	17.46	24.99	18.58
Multiracial, non Hisp/Lat	4.96	2.80	3.65	2.76

This section describes the distribution of independent variables, including the structural stigma (SMSS) indicators (Table 5), tobacco policy indicators (Table 6), alcohol policy indicators (Table 7) and percent living in states with no legal status for marijuana (Table 8). The tables present the number (or percent) of young people in the dataset who live in states with the regulation presented (not the number of states with this regulation).

As shown in Table 5, indicators of sexual minority structural stigma varied in prevalence in this dataset, with the most common type of protection being hate crimes legislation (82.41%) and the least common being public accommodation protection (16.02%). On a scale ranging from 1 to 12, with 1 being the least restrictive (or most friendly) to sexual minorities and 12 being the most restrictive (or unfriendly) to sexual minorities, the weighted scale mean for the population was 5.25.

Table 5: Sexual Minority Structural Stigma (SMSS) Indicators

		N	Weighted N	Weighted %	Weighted 95% Confidence Interval
SMSS Indicator	Same-Sex Relationship Recognition Ban	100,030	61,129	36.88	(32.56, 41.42)
	No Recognition, No Ban	17,721	41,808	25.22	(21.53, 29.31)
	Same-Sex Relationship Recognition	48,010	62,824	37.9	(33.08, 42.97)
	School Non-Discrimination	135,744	92,383	55.73	(50.93, 60.43)
	School Anti-Bullying	133,527	90,182	54.4	(49.59, 59.14)
	Joint Adoption	60,206	33,209	20.03	(16.91, 23.57)
	Hate Crimes Legislation	151,017	136,599	82.41	(78.65, 85.62)
	Employment Protection	144,934	107,725	64.99	(60.25, 69.44)
	Public Accommodation Protection	39,813	26,559	16.02	(13.18, 19.34)
	Housing Discrimination Protection	111,805	86,151	51.97	(47.19, 56.72)
Density of Same-sex Couples	0.29-0.66	3,757	1,725	1.04	(0.84, 1.28)
	0.67-0.95	70,489	82,002	49.47	(44.64, 54.31)
	0.96-1.75	91,515	82,034	49.49	(44.68, 54.31)
SMSS Scale Mean				5.25	(4.99, 5.51)

As Table 6 illustrates, among tobacco regulations specific to underage smokers, the highest weighted prevalence among the sample was buying tobacco while underage (85.49 %). The most common public restrictions applying to both adults and youth were bans on smoking in government workplaces and in restaurants (both 93.30%). Business restrictions were overall somewhat less common, with about two-thirds (64.68%) of the weighted sample living in states that require signs about the ban on underage tobacco sales. The population weighted mean of the business restrictions scale, which ranged

from 0 to 3, was 1.58. The weighted mean tax on a pack of cigarettes was 1.76; the scale mean was 8.1, meaning that on a scale of 0 to 13, with 13 being the most restrictive, the average person in this population lived in a state with about half of the available restrictions.

Table 6: Tobacco Policy Environment Indicators

Policy Domain	Tobacco Indicator	N	Weighted N	Weighted %	Weighted 95% Confidence Interval
Underage Restrictions	Smoke-Free Campus	67,242	59,098	35.65	(30.69, 40.95)
	Smoke-Free Bus	21,199	80,938	48.83	(43.95, 53.73)
	Prohibit Underage Buying Tobacco	108,940	141,710	85.49	(82.55, 88.01)
	Prohibit Underage Tobacco Possession	139,775	129,599	78.18	(74.33, 81.60)
	Prohibit Underage Use of Tobacco	97,830	79,575	48.01	(43.20, 52.85)
	Penalize Underage Buyer for Cigarette Purchase	154,985	133,214	80.36	(76.66, 83.61)
	Underage Restrictions Scale Mean				3.77
Public Restrictions	Smoking Banned in Vehicles	18,659	3,440	2.08	(1.50, 2.87)
	Smoking Banned in Private Workplaces	158,471	143,055	86.30	(82.99, 89.06)
	Smoking Banned in Government Workplaces	159,967	154,658	93.30	(91.37, 94.83)
	Smoking Banned in Restaurants	157,826	154,663	93.30	(91.37, 94.83)
Public Restrictions Scale Mean				2.75	(2.69, 2.81)
Business Restrictions	Can Enforce Underage Tobacco Sale	89,278	96,120	57.99	(53.27, 62.57)

Policy Domain	Tobacco Indicator	N	Weighted N	Weighted %	Weighted 95% Confidence Interval
	Laws Against Businesses				
	Require Sign About Underage Tobacco Sale Ban	102,677	107,208	64.68	(59.43, 69.59)
	Revoke Business License for Underage Tobacco Sale	47,229	58,620	35.36	(31.22, 39.74)
Business Restrictions Scale Mean				1.58	(1.48, 1.68)
Tobacco Tax				1.76	(1.69, 1.83)
Tobacco Regulation Scale				8.1	(7.95, 8.25)

As shown in Table 7, the most common alcohol policy was prohibition of underage alcohol purchase (97.63%); there are a small number of states that regulate underage alcohol use through statutes related to consumption rather than purchase. Loss of driver's licenses for purchasing (76.75%) or possessing alcohol (70.76%) while underage were also common policies. BAC limits for adults were homogenous and thus were not included in the analysis. Table 7 also illustrates that taxes on alcohol varied, with beer averaging \$0.26, wine \$1.03 and liquor \$5.19 (per gallon).

Table 7: Alcohol Policy Environment Indicators

Policy Domain	Alcohol Indicator	N	Weighted N	Weighted %	Weighted 95% Confidence Interval
Use/Lose Policies	Suspend or Revoke Drivers License for Underage Alcohol Purchase	48,221	127,221	76.75	(73.27, 79.90)
	Suspend or Revoke Drivers License for	101,885	117,285	70.76	(66.41, 74.75)

Policy Domain	Alcohol Indicator	N	Weighted N	Weighted %	Weighted 95% Confidence Interval
	Underage Alcohol Possession				
	Suspend or Revoke Drivers License for Underage Alcohol Consumption	78,419	77,116	46.52	(41.67, 51.45)
Use/Lose Policies Scale Mean					1.94
Underage Policies	Underage Alcohol Consumption Prohibited	136,848	108,579	65.50	(61.09, 69.67)
	Underage Alcohol Consumption Blood Alcohol Level Prohibited	7,323	26,375	15.91	(12.77, 19.65)
	Underage Alcohol Purchase Prohibited	130,400	161,839	97.63	(96.19, 98.54)
	Zero Underage Blood Alcohol Content	89,022	100,447	60.60	(56.06, 64.96)
Underage Policies Scale Mean					2.4
Unregistered Keg Policy	Unregistered Keg Prohibited	77,323	33,184	20.02	(17.03, 23.39)
Beer Tax					0.26
Wine Tax					1.03
Liquor Tax					5.19
Total Alcohol Scale					4.54

Table 8 shows that about three-quarters (76.76%) of the weighted population estimate for this sample lived in a state with no legal status for marijuana (medical, recreational or otherwise).

Table 8: Sample Living in States with No Legal Status of Marijuana

N	Weighted N	Weighted %	Weighted 95% Confidence Interval
85,749	127,236	76.76	(73.24 - 79.94)

3.2 Findings Among Girls

This section describes the findings among the female sample in the YRBSS 2011-2013 dataset. I begin by presenting the population weighted estimates of the number of sexual minority girls (Table 9), recent substance use among those girls (Table 10), and sexual orientation disparities in substance use (Table 11).

The average population estimated weighted percent sexual minority was 9.59% among girls, ranging from a low of 6.18% in North Dakota to a high of 13.16% in New Mexico.

Table 9: Prevalence of Sexual Minority Girls by State

State	N Sexual Minority	Weighted N Sexual Minority	Weighted Percent Sexual Minority	Weighted 95% Confidence Interval
AZ	80	77	10.37	(8.03, 13.29)
CT	202	200	9.96	(8.32, 11.87)
DE	233	245	10.43	(8.90, 12.19)
FL	320	322	11.33	(9.94, 12.89)
HI	351	397	8.76	(7.35, 10.40)
IL	367	308	9.58	(8.23, 11.12)
MA	212	221	8.45	(7.07, 10.08)
MD	2,843	3,082	12.28	(11.64, 12.94)
ME	749	728	8.11	(7.33, 8.98)
MI	166	164	8.01	(6.60, 9.70)
NC	76	73	10.01	(6.97, 14.19)
ND	113	113	6.18	(4.97, 7.67)
NH	75	75	9.21	(7.15, 11.78)
NM	326	328	13.16	(11.06, 15.58)
RI	356	343	10.84	(9.51, 12.34)
VT	1,247	1,154	8.11	(7.65, 8.60)
WI	218	197	7.54	(6.12, 9.26)
Total	7,934	7,728	9.63	(9.06, 10.23)

Table 10 (below) shows substance use among all girls (sexual minority and heterosexual) by state. It illustrates that recent cigarette smoking among girls varied by state, from 8.65% in Rhode Island

to 19.60% in North Dakota, and averaged 11.76%. Recent alcohol drinking among girls ranged from 27.51% in Maine to 39.52% in Delaware, averaging 34.35%. Recent binge drinking among girls ranged from 11.75% in North Carolina to 22.36% in North Dakota, averaging 17.36%. Recent drunk driving among girls had a much lower prevalence than the other substance use behaviors measured and ranged from 3.27% in North Carolina to 8.68% in North Dakota, with an average of 6.39%. Recent marijuana smoking among girls ranged from 12.64% in Massachusetts to 25.49% in New Mexico, averaging 16.66% across the female sample.

Table 10: Recent Substance Use Among All Girls by State

	Smoking	Drinking	Binge Drinking	Drunk Driving	Marijuana Use
AZ	11.96	38.36	20.79	6.89	19.55
CT	12.60	39.28	17.91	28.17	n/a
DE	15.71	39.52	20.56	7.10	24.70
FL	9.22	34.04	14.34	7.19	20.11
HI	9.77	29.41	14.68	19.48	n/a
IL	14.42	39.04	20.87	26.98	n/a
MA	9.28	28.16	17.74	4.88	12.64
MD	9.72	32.92	16.36	6.02	17.56
ME	11.92	27.51	13.92	4.91	18.56
MI	10.71	28.70	15.46	5.67	16.85
NC	11.86	32.35	11.75	19.89	n/a
ND	19.60	37.36	22.36	8.68	14.59
NH	12.98	35.73	17.21	8.21	22.64
NM	12.38	30.00	16.51	6.61	25.49
RI	8.65	33.73	16.08	4.63	22.47
VT	11.44	32.89	17.72	5.67	20.42
WI	11.64	35.75	18.61	5.64	16.66
Sample Average	11.76	34.55	17.54	6.43	18.77

Notes: This table uses the abbreviation n/a to indicate that this variable was not measured in this state.

Table 11, below, shows the adjusted odds ratios (AORs) on sexual minority status for recent substance use, controlling for age and race/ethnicity. The largest AORs were for recent cigarette smoking. The adjusted odds of recent cigarette smoking among sexual minority vs. heterosexual girls ranged from 3.519 in Wisconsin to 9.130 in Arizona and averaged 5.171.

The adjusted odds of recent alcohol drinking among sexual minority vs. heterosexual girls ranged from 1.453 in Connecticut to 3.907 in Arizona and averaged 2.218, while the adjusted odds of sexual minority binge drinking ranged from 1.130 in New Hampshire to 2.398 in North Carolina, and averaged 1.462. The adjusted odds of recent drunk driving among sexual minority vs. heterosexual girls ranged from 1.102 in Massachusetts to 5.668 in Rhode Island, and averaged 2.197, and for marijuana use ranged from 2.103 in New Hampshire to 4.201 in New Mexico, averaging 2.354.

These findings are consistent with previous research finding that SMY girls have higher prevalence of substance use than non-SMY girls (Hatzenbuehler et al., 2015; Kann et al., 2018; Marshal et al., 2008; Newcomb et al., 2014).

Table 11: Sexual Orientation Disparities in Recent Substance Use Among Girls by State (AOR)

Outcome	Recent Cigarette Smoking (AOR)	Recent Alcohol Drinking (AOR)	Recent Binge Drinking (AOR)	Recent Drunk Driving (AOR)	Recent Marijuana Use (AOR)
AZ	9.130	3.907	1.724	2.418	3.459
CT	4.134	1.453	1.143	1.510	n/a
DE	5.210	2.625	1.886	2.296	3.924
FL	5.740	2.220	1.871	3.192	4.061
HI	4.932	2.800	2.344	2.763	n/a
IL	3.972	1.874	1.531	2.353	n/a
MA	6.461	1.862	2.314	1.102	2.866
MD	4.563	1.855	1.864	2.764	2.960
ME	3.861	2.065	1.899	1.762	2.806
MI	7.863	3.122	2.292	3.927	3.662
NC	8.569	3.393	2.398	2.661	n/a
ND	4.504	1.685	1.337	1.740	4.087
NH	3.683	1.622	1.130	1.257	2.103
NM	5.887	2.269	2.395	2.742	4.201
RI	4.797	2.120	2.078	5.668	2.848
VT	3.875	1.648	1.624	1.921	2.557
WI	3.519	1.650	1.462	2.197	2.354
Total	5.171	2.218	1.749	2.088	2.900
Variance	1.175	1.136	1.165	1.332	1.133

3.2.1 Sexual Minority Structural Stigma and Substance Use Disparities

Tables 12 through 16 show the associations between sexual minority structural stigma and disparities in recent substance use among girls (while the unstandardized sexual minority structural stigma scales were shown in the prior tables, all variables in the analyses are standardized). These tables represent Aim #1 and are testing hypothesis 1, which states that higher levels of sexual minority structural stigma will be associated with larger disparities in substance use.

For cigarette smoking among girls (Table 12), larger disparities were associated with greater sexual minority structural stigma ($b=0.164$). When specific items in the sexual minority structural stigma scale were examined, larger disparities were only associated with lack of employment protections ($b=-0.325$).

Table 12: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Cigarette Smoking Among Girls

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.270	(-0.012 , 0.552)	0.059
	No Recognition, No Ban	-0.128	(-0.540 , 0.283)	0.517
	Same-Sex Relationship Recognition	-0.235	(-0.559 , 0.090)	0.144
	School Non-Discrimination	-0.273	(-0.554 , 0.008)	0.056
	School Anti-Bullying	-0.144	(-0.458 , 0.170)	0.344
	Joint Adoption	-0.243	(-0.565 , 0.080)	0.130
	Hate Crimes Legislation	-0.316	(-0.649 , 0.016)	0.061
	Employment Protection	-0.325	(-0.625 , -0.025)	0.035
	Public Accommodation Protection	-0.347	(-0.719 , 0.024)	0.065
	Housing Discrimination Protection	-0.248	(-0.541 , 0.046)	0.092
Density of Same-sex Couples	0.29-0.66	-0.133	(-0.805 , 0.540)	0.680
	0.67-0.95	-0.029	(-0.361 , 0.304)	0.857

	Predictor	SMSS * SO Beta	95% CI	P-Value
	0.96-1.75	0.057	(-0.265 , 0.379)	0.710
SMSS Scale Mean	Standardized SMSS Scale	0.164	(0.020 , 0.308)	0.028
Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent cigarette smoking among girls. Covariates for individual level models are race and age; no covariates are included at the group level.				

Table 13, shown below illustrates that for girls, a larger sexual orientation disparity in recent alcohol drinking was associated with greater sexual minority structural stigma (b=0.166). When specific items in the sexual minority structural stigma scale were examined, larger disparities were associated with a lack of joint adoption (b=-0.322), a ban on relationship recognition (b=0.352), and lack of public accommodation protection (b=-0.377).

Table 13: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Alcohol Drinking Among Girls

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.352	(0.114 , 0.589)	0.007
	No Recognition, No Ban	-0.103	(-0.500 , 0.294)	0.589
	Same-Sex Relationship Recognition	-0.350	(-0.625 , -0.075)	0.016
	School Non-Discrimination	-0.259	(-0.530 , 0.012)	0.060
	School Anti-Bullying	-0.161	(-0.459 , 0.137)	0.269
	Joint Adoption	-0.322	(-0.607 , -0.037)	0.029
	Hate Crimes Legislation	-0.206	(-0.548 , 0.137)	0.220
	Employment Protection	-0.227	(-0.538 , 0.085)	0.142
	Public Accommodation Protection	-0.377	(-0.720 , -0.033)	0.034
	Housing Discrimination Protection	-0.269	(-0.542 , 0.005)	0.054
Density of Same-sex Couples	0.29-0.66	-0.262	(-0.896 , 0.372)	0.393

	Predictor	SMSS * SO Beta	95% CI	P-Value
	0.67-0.95	-0.005	(-0.325 , 0.316)	0.976
	0.96-1.75	0.064	(-0.245 , 0.373)	0.665
SMSS Scale Mean	Standardized SMSS Scale	0.166	(0.031 , 0.301)	0.019

Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent alcohol drinking among girls. Covariates for individual level models are race and age; no covariates are included at the group level.

The sexual orientation disparity in recent binge drinking among girls (Table 14) was not associated with the overall structural stigma index. However, a smaller disparity in binge drinking was associated with two positive items: the presence of same-sex relationship recognition (b=-0.257) and the existence of public accommodation protections (b=-0.303).

Table 14: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Binge Drinking Among Girls

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.217	(-0.350 , 0.342)	0.979
	No Recognition, No Ban	-0.004	(-0.510 , -0.005)	0.046
	Same-Sex Relationship Recognition	-0.257	(-0.262 , 0.266)	0.987
	School Non-Discrimination	0.002	(-0.258 , 0.278)	0.935
	School Anti-Bullying	0.010	(-0.465 , 0.073)	0.141
	Hate Crimes Legislation	-0.175	(-0.471 , 0.120)	0.225
	Employment Protection	-0.071	(-0.358 , 0.216)	0.606
	Public Accommodation Protection	-0.303	(-0.606 , -0.000)	0.050
	Housing Discrimination Protection	-0.083	(-0.347 , 0.181)	0.514
Density of Same-sex Couples	0.29-0.66	-0.311	(-0.845 , 0.223)	0.233
	0.67-0.95	-0.062	(-0.336 , 0.212)	0.636
	0.96-1.75	0.130	(-0.129 , 0.388)	0.302

SMSS Scale Mean	Standardized SMSS Scale	0.063	(-0.073 , 0.199)	0.340
Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent binge drinking among girls. Covariates for individual level models are race and age; no covariates are included at the group level.				

As illustrated in Table 15, among girls, the overall SMSS scale was not significant. However, a smaller sexual orientation disparity in recent drunk driving was associated with the presence of joint adoption ($b=-0.637$) and the existence of school anti-bullying policies ($b=-0.559$).

Table 15: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Drunk Driving Among Girls

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.173	(-0.248 , 0.593)	0.395
	No Recognition, No Ban	0.480	(-0.019 , 0.978)	0.058
	Same-Sex Relationship Recognition	-0.543	(-0.908 , -0.177)	0.006
	School Non-Discrimination	-0.255	(-0.662 , 0.153)	0.202
	School Anti-Bullying	-0.362	(-0.751 , 0.027)	0.066
	Joint Adoption	-0.625	(-0.948 , -0.301)	0.001
	Hate Crimes Legislation	-0.190	(-0.686 , 0.307)	0.428
	Employment Protection	-0.230	(-0.685 , 0.225)	0.298
	Public Accommodation Protection	-0.261	(-0.807 , 0.284)	0.324
	Housing Discrimination Protection	-0.240	(-0.657 , 0.176)	0.238
Density of Same-sex Couples	0.29-0.66	-0.296	(-1.195 , 0.604)	0.494
	0.67-0.95	0.062	(-0.387 , 0.511)	0.773
	0.96-1.75	0.009	(-0.428 , 0.446)	0.964
SMSS Scale	Standardized SMSS Scale	0.177	(-0.031 , 0.384)	0.089
Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent drunk driving among girls. Covariates for individual level models are race and age; no covariates are included at the group level.				

Among girls, larger disparities in recent marijuana use (Table 16) were associated with higher levels of sexual minority structural stigma ($b=.170$). Smaller disparities in recent marijuana smoking were associated with the presence of laws that are positive for sexual minorities, such as employment protection ($b=-0.341$), same sex relationship recognition (-0.305), hate crimes legislation (-0.304) and joint adoption protection ($b=-0.296$). Larger disparities in recent marijuana smoking were associated with laws against same-sex marriage ($b=0.206$).

Table 16: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Marijuana Use Among Girls

	Predictor	SMSS * SO Beta	95% CI	P-Value	
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.260	(0.025 , 0.495)	0.033	
	No Recognition, No Ban	-0.059	(-0.401 , 0.284)	0.713	
	Same-Sex Relationship Recognition	-0.305	(-0.584 , -0.026)	0.035	
	School Non-Discrimination	-0.148	(-0.423 , 0.126)	0.259	
	School Anti-Bullying	-0.183	(-0.448 , 0.082)	0.156	
	Joint Adoption	-0.296	(-0.542 , -0.050)	0.023	
	Hate Crimes Legislation	-0.304	(-0.583 , -0.024)	0.036	
	Employment Protection	-0.341	(-0.536 , -0.147)	0.003	
	Public Accommodation Protection	-0.294	(-0.646 , 0.058)	0.093	
	Housing Discrimination Protection	-0.236	(-0.509 , 0.037)	0.084	
	Density of Same-sex Couples	0.29-0.66	0.283	(-0.229 , 0.795)	0.249
		0.67-0.95	-0.218	(-0.497 , 0.062)	0.114
		0.96-1.75	0.111	(-0.178 , 0.401)	0.415
	SMSS Scale	Standardized SMSS Scale	0.170	(0.056 , 0.283)	0.007

	Predictor	SMSS * SO Beta	95% CI	P-Value
Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent marijuana use among girls. Covariates for individual level models are race and age; no covariates are included at the group level.				

3.2.2 Sexual Minority Structural Stigma Within-Group Analyses

The second aim of the study was to assess the size and direction of the association between state-level indices of sexual orientation structural stigma and prevalence of recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use among sexual minorities and heterosexuals (i.e., within-group analyses). This aim tested hypothesis 2, that structural stigma would be associated with higher prevalence of substance use among sexual minority (but not heterosexual) youth.

As Table 17 shows, greater sexual minority structural stigma is associated with recent cigarette smoking ($b=0.039$) among sexual minority but not heterosexual girls, consistent with the study hypothesis. No association was found between sexual minority structural stigma and recent alcohol drinking, binge drinking, drunk driving or marijuana use in heterosexual or sexual minority girls.

Table 17: Sexual Minority Structural Stigma and Recent Substance Use Among Girls by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Recent Cigarette Smoking	0.039	(0.010, 0.068)	0.012	0.008	(-0.008, 0.023)	0.304
Recent Alcohol Drinking	0.032	(-0.002, 0.066)	0.063	-0.003	(-0.027, 0.021)	0.777
Recent Binge Drinking	0.005	(-0.017, 0.027)	0.622	-0.001	(-0.019, 0.017)	0.912
Recent Drunk Driving	-0.023	(-0.094, 0.049)	0.508	-0.028	(-0.069, 0.014)	0.176
Recent Marijuana Use	0.036	(-0.008, 0.079)	0.102	-0.003	(-0.025, 0.020)	0.808

3.2.3 Substance Use Policy Environment and Substance Use Disparities

Tables 18 through 22 show the associations between the substance use policy environment (for tobacco, alcohol and marijuana separately) and sexual orientation disparities in recent substance use among girls (while the unstandardized policy scales were shown in the prior tables, all scales shown in these analytic tables are standardized). These tables represent Aim #3 and are testing the hypothesis that more restrictive substance use policies will widen the disparity in the prevalence of substance use between sexual minority and heterosexual girls.

Table 18, below, shows that among girls, the overall tobacco regulation scale was not associated with sexual orientation disparities in recent cigarette smoking. However, a smaller sexual orientation disparity in recent cigarette smoking ($b=-0.363$) was associated with the state's ability to enforce underage tobacco sale laws against businesses who violate them.

Table 18: Smoking Policy and Sexual Orientation Disparities in Recent Cigarette Use Among Girls

Predictor	Policy * SO beta	95% CI	P-Value
Underage Restrictions			
Smoke-Free Campus	-0.151	(-0.473, 0.172)	0.336
Smoke-Free Bus	0.290	(-0.021, 0.601)	0.066
Prohibit Underage Buying Tobacco	-0.070	(-0.563, 0.423)	0.766
Prohibit Underage Tobacco Possession	-0.250	(-0.571, 0.071)	0.118
Prohibit Underage Use of Tobacco	-0.115	(-0.428, 0.198)	0.445
Penalize Underage Buyer for Cigarette Purchase	0.077	(-0.415, 0.569)	0.743
Underage Tobacco Regulation Scale	-0.045	(-0.207, 0.117)	0.563
Public Restrictions			
Smoking Banned in Vehicles	-0.297	(-0.953, 0.360)	0.351
Smoking Banned in Private Workplaces	0.008	(-0.410, 0.425)	0.969
Smoking Banned in Government Workplaces	0.304	(-0.160, 0.769)	0.183

Predictor	Policy * SO beta	95% CI	P-Value
Smoking Banned in Restaurants	0.190	(-0.293, 0.673)	0.414
Other Public Area Tobacco Regulations Scale	0.046	(-0.137, 0.230)	0.597
Business Restrictions			
Can Enforce Underage Tobacco Sale Laws Against Businesses	-0.363	(-0.618, -0.109)	0.008
Require Sign About Underage Tobacco Sale Ban	-0.031	(-0.406, 0.344)	0.864
Revoke Business License for Underage Tobacco Sale	-0.270	(-0.557, 0.017)	0.063
Regulations of Business Tobacco Scale	-0.135	(-0.274, 0.004)	0.056
Tobacco Tax	-0.079	(-0.269, 0.112)	0.392
Standardized Tobacco Regulation Scale	-0.102	(-0.256, 0.052)	0.177
Notes: This table shows the beta for the interaction between can enforce underage tobacco sale laws against businesses policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent cigarette smoking among girls. Covariates for individual level models are race and age; no covariates are included at the group level.			

Table 19 shows that no associations were found between sexual orientation disparities in recent alcohol drinking and any of the alcohol policy indicators or scales among girls.

Table 19: Alcohol Policy and Sexual Orientation Disparities in Recent Alcohol Use Among Girls

Predictor	Policy * SO beta	95% CI	P-Value
Use/Lose Policies			
Suspend or Revoke Driver's License for Underage Alcohol Purchase	0.130	(-0.172, 0.433)	0.374
Suspend or Revoke Driver's License for Underage Alcohol Possession	-0.031	(-0.350, 0.289)	0.840
Suspend or Revoke Driver's License for	0.128	(-0.185, 0.440)	0.397

Predictor	Policy * SO beta	95% CI	P-Value
Underage Alcohol Consumption			
Lose Driving License Scale	0.052	(-0.106, 0.210)	0.496
Underage Policies			
Underage Alcohol Consumption Prohibited	0.196	(-0.105, 0.498)	0.186
Underage Alcohol Consumption Blood Alcohol Level Prohibited	0.218	(-0.164, 0.601)	0.243
Underage Alcohol Purchase Prohibited	0.041	(-0.434, 0.515)	0.857
Zero Underage Blood Alcohol Content	0.199	(-0.092, 0.490)	0.166
Underage Alcohol Regulations Scale	0.116	(-0.018, 0.251)	0.085
Unregistered Keg Policy			
Unregistered Keg Prohibited	-0.119	(-0.448, 0.211)	0.455
Beer Tax	0.484	(-0.167, 1.135)	0.134
Wine Tax	0.149	(-0.141, 0.440)	0.291
Liquor Tax	0.005	(-0.091, 0.101)	0.916
Total Alcohol Scale	0.061	(-0.028, 0.150)	0.164
Notes: This table shows the beta for the interaction between alcohol policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent alcohol drinking among girls. Covariates for individual level models are race and age; no covariates are included at the group level.			

Table 20 shows that no associations were found between sexual orientation disparities in recent binge drinking and any of the alcohol policy indicators or scales among girls.

Table 20: Alcohol Policy and Sexual Orientation Disparities in Recent Binge Drinking Among Girls

Predictor	Policy * SO beta	95% CI	P-Value
Use/Lose Policies			
Suspend or Revoke Driver's License for Underage Alcohol Purchase	0.107	(-0.154, 0.369)	0.395
Suspend or Revoke Driver's License for Underage Alcohol Possession	-0.119	(-0.388, 0.149)	0.357

Predictor	Policy * SO beta	95% CI	P-Value
Suspend or Revoke Driver's License for Underage Alcohol Consumption	-0.009	(-0.285, 0.267)	0.943
Lose Driving License Scale	-0.003	(-0.142, 0.135)	0.960
Underage Policies			
Underage Alcohol Consumption Prohibited	0.044	(-0.231, 0.319)	0.738
Underage Alcohol Consumption Blood Alcohol Level Prohibited	0.032	(-0.314, 0.377)	0.848
Underage Alcohol Purchase Prohibited	0.026	(-0.383, 0.435)	0.894
Zero Underage Blood Alcohol Content	0.058	(-0.208, 0.324)	0.647
Underage Alcohol Regulations Scale	0.028	(-0.099, 0.156)	0.641
Unregistered Keg Policy			
Unregistered Keg Prohibited	-0.147	(-0.425, 0.131)	0.277
Beer Tax	0.424	(-0.136, 0.983)	0.128
Wine Tax	0.130	(-0.120, 0.380)	0.285
Liquor Tax	0.024	(-0.058, 0.106)	0.541
Total Alcohol Scale	-0.001	(-0.083, 0.081)	0.981
Notes: This table shows the beta for the interaction between alcohol policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent binge drinking among girls. Covariates for individual level models are race and age; no covariates are included at the group level.			

Table 21 shows that no associations were found between sexual orientation disparities in recent drunk driving and any of the alcohol policy indicators or scales among girls.

Table 21: Alcohol Policy and Sexual Orientation Disparities in Recent Drunk Driving Among Girls

Predictor	Policy * SO beta	95% CI	P-Value
Use/Lose Policies			
Suspend or Revoke Driver's License for Underage Alcohol Purchase	0.103	(-0.330, 0.537)	0.618
Suspend or Revoke Driver's License for	0.200	(-0.236, 0.637)	0.344

Predictor	Policy * SO beta	95% CI	P-Value
Underage Alcohol Possession			
Suspend or Revoke Driver's License for Underage Alcohol Consumption	0.102	(-0.345, 0.548)	0.634
Lose Driving License Scale	0.091	(-0.130, 0.311)	0.394
Underage Policies			
Underage Alcohol Consumption Prohibited	0.091	(-0.356, 0.538)	0.671
Underage Alcohol Consumption Blood Alcohol Level Prohibited	0.032	(-0.532, 0.595)	0.907
Underage Alcohol Purchase Prohibited	0.102	(-0.563, 0.768)	0.747
Zero Underage Blood Alcohol Content	0.153	(-0.276, 0.581)	0.460
Underage Alcohol Regulations Scale	0.066	(-0.140, 0.272)	0.507
Unregistered Keg Policy			
Unregistered Keg Prohibited	-0.272	(-0.720, 0.176)	0.215
Beer Tax	0.228	(-0.753, 1.209)	0.627
Wine Tax	0.174	(-0.240, 0.587)	0.384
Liquor Tax	0.056	(-0.075, 0.188)	0.375
Total Alcohol Scale	0.043	(-0.089, 0.174)	0.500
Notes: This table shows the beta for the interaction between alcohol policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent drunk driving among girls. Covariates for individual level models are race and age; no covariates are included at the group level.			

Table 22 shows that legal status for marijuana was not associated with the sexual orientation disparity in marijuana use among girls.

Table 22: Legal Status of Marijuana and Sexual Orientation Disparities in Recent Marijuana Use Among Girls

Predictor	Policy * SO beta	95% CI	P-Value
No legal status for marijuana	-0.103	(-0.386, 0.180)	0.441
Notes: This table shows the beta for the interaction between marijuana policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent marijuana smoking among girls. Covariates for individual level models are race and age; no covariates are included at the group level.			

3.2.4 Substance Use Policy Environments Within-Group Analyses

Aim 4 of the study was to assess the size and direction of the association between state-level indices of restrictive substance use policies and prevalence of recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use among sexual minorities and heterosexuals (i.e., within-group analyses). Tables 23 through 26 show the association between the substance use policy environment (for tobacco, alcohol and marijuana separately) and the prevalence of recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use among sexual minorities and heterosexuals (i.e., within-group analyses) among girls. This aim tested hypothesis 4, that more restrictive substance use policy environments would be associated with lower prevalence of substance use among heterosexual but not sexual minority girls, because the benefits of restrictive substance use for sexual minority youth were expected to be canceled out by the potential stigmatizing effect of these restrictive substance use policies for that group.

Table 23 shows that no associations were found between restrictions in the tobacco policy environment and smoking among sexual minority or heterosexual girls, while higher tobacco taxes were associated with lower prevalence of cigarette smoking among both sexual minority ($b=-0.040$) and heterosexual girls ($b=-0.018$).

Table 23: Smoking Policy and Recent Cigarette Use Among Girls by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Underage Restrictions						
Smoke-Free Campus	0.009	(-0.062, 0.079)	0.792	0.001	(-0.030, 0.033)	0.926
Smoke-Free Bus	0.006	(-0.068, 0.080)	0.872	-0.013	(-0.045, 0.019)	0.394
Prohibit Underage Buying Tobacco	0.055	(-0.046, 0.155)	0.262	0.025	(-0.019, 0.070)	0.246
Prohibit Underage	-0.019	(-0.093, 0.054)	0.580	0.008	(-0.024, 0.041)	0.599

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Tobacco Possession						
Prohibit Underage Use of Tobacco	0.001	(-0.066, 0.069)	0.968	0.009	(-0.021, 0.039)	0.528
Penalize Underage Buyer for Cigarette Purchase	0.049	(-0.052, 0.151)	0.314	0.009	(-0.037, 0.055)	0.682
Underage Tobacco Regulation Scale	0.009	(-0.026, 0.043)	0.604	0.004	(-0.011, 0.019)	0.566
Public Restrictions						
Smoking Banned in Vehicles	-0.025	(-0.168, 0.118)	0.716	0.004	(-0.060, 0.067)	0.900
Smoking Banned in Private Workplaces	0.010	(-0.079, 0.098)	0.816	-0.008	(-0.047, 0.032)	0.688
Smoking Banned in Government Workplaces	0.018	(-0.086, 0.122)	0.720	-0.013	(-0.059, 0.033)	0.567
Smoking Banned in Restaurants	-0.072	(-0.169, 0.025)	0.134	-0.051	(-0.088, -0.014)	0.011
Other Public Area Tobacco Regulations Scale	-0.007	(-0.046, 0.032)	0.701	-0.010	(-0.026, 0.007)	0.237
Business Restrictions						
Can Enforce Underage Tobacco Sale Laws Against Businesses	-0.048	(-0.111, 0.016)	0.131	0.004	(-0.027, 0.034)	0.801
Require Sign About Underage	-0.055	(-0.128, 0.019)	0.133	-0.023	(-0.056, 0.010)	0.157

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Tobacco Sale Ban						
Revoke Business License for Underage Tobacco Sale	-0.051	(-0.113, 0.012)	0.105	0.001	(-0.030, 0.031)	0.960
Regulations of Business Tobacco Scale	-0.029	(-0.058, 0.001)	0.056	-0.003	(-0.017, 0.012)	0.711
Tobacco Tax	-0.040	(-0.075, -0.005)	0.028	-0.018	(-0.034, -0.003)	0.022
Standardized Tobacco Regulation Scale	-0.017	(-0.050, 0.017)	0.304	-0.003	(-0.018, 0.012)	0.666

Notes: This table shows the betas for the association between smoking policy indicators and cigarette use among sexual minority and heterosexual girls. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 24 shows that no associations were found between alcohol policies and recent alcohol use among sexual minority or heterosexual girls.

Table 24: Alcohol Policy and Recent Alcohol Use Among Girls by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Use/Lose Policies						
Suspend or Revoke Driver's License for Underage Alcohol Purchase	0.023	(-0.049, 0.094)	0.505	-0.009	(-0.054, 0.037)	0.691
Suspend or Revoke Driver's License for Underage	0.037	(-0.035, 0.109)	0.293	0.037	(-0.005, 0.080)	0.081

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Alcohol Possession						
Suspend or Revoke Driver's License for Underage Alcohol Consumption	0.059	(-0.008, 0.126)	0.080	0.026	(-0.019, 0.071)	0.233
Lose Driving License Scale	0.027	(-0.008, 0.061)	0.122	0.012	(-0.011, 0.035)	0.280
Underage Policies						
Underage Alcohol Consumption Prohibited	0.049	(-0.021, 0.118)	0.158	0.002	(-0.046, 0.049)	0.939
Underage Alcohol Consumption Blood Alcohol Level Prohibited	0.020	(-0.073, 0.113)	0.650	-0.020	(-0.079, 0.038)	0.466
Underage Alcohol Purchase Prohibited	-0.028	(-0.137, 0.082)	0.598	-0.027	(-0.096, 0.041)	0.407
Zero Underage Blood Alcohol Content	0.026	(-0.045, 0.097)	0.449	-0.009	(-0.054, 0.037)	0.694
Underage Alcohol Regulations Scale	0.016	(-0.018, 0.049)	0.334	-0.007	(-0.028, 0.015)	0.516
Unregistered Keg Policy						
Unregistered Keg Prohibited	-0.035	(-0.111, 0.041)	0.339	-0.000	(-0.050, 0.049)	0.988
Beer Tax	0.059	(-0.102, 0.220)	0.448	-0.083	(-0.177, 0.010)	0.077
Wine Tax	0.033	(-0.035, 0.101)	0.321	-0.012	(-0.056, 0.033)	0.582

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Liquor Tax	0.004	(-0.018, 0.026)	0.710	-0.003	(-0.017, 0.012)	0.711
Total Alcohol Scale	0.015	(-0.006, 0.035)	0.155	0.002	(-0.012, 0.016)	0.779

Notes: This table shows the betas for the associations between alcohol policy indicators and recent drinking among sexual minority and heterosexual girls. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 25 shows that while no associations were found between the overall restrictiveness of alcohol policies and recent binge drinking among sexual minority or heterosexual girls, keg registration policies were associated with lower prevalence of binge drinking among sexual minority girls ($b=-0.64$) but not heterosexual girls and taxes on beer were associated with lower prevalence of binge drinking among heterosexual (-0.085) but not sexual minority girls.

Table 25: Alcohol Policy and Recent Binge Drinking Among Girls by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Use/Lose Policies						
Suspend or Revoke Driver's License for Underage Alcohol Purchase	0.008	(-0.034, 0.050)	0.695	-0.011	(-0.044, 0.022)	0.492
Suspend or Revoke Driver's License for Underage Alcohol Possession	-0.002	(-0.045, 0.041)	0.924	0.010	(-0.024, 0.044)	0.537
Suspend or Revoke Driver's License for Underage	0.023	(-0.018, 0.065)	0.255	0.021	(-0.012, 0.053)	0.198

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Alcohol Consumption						
Lose Driving License Scale	0.006	(-0.015, 0.028)	0.530	0.004	(-0.013, 0.021)	0.608
Underage Policies						
Underage Alcohol Consumption Prohibited	0.012	(-0.031, 0.055)	0.571	0.008	(-0.026, 0.043)	0.611
Underage Alcohol Consumption Blood Alcohol Level Prohibited	-0.044	(-0.093, 0.004)	0.071	-0.028	(-0.068, 0.013)	0.163
Underage Alcohol Purchase Prohibited	-0.020	(-0.083, 0.044)	0.519	-0.022	(-0.072, 0.028)	0.364
Zero Underage Blood Alcohol Content	-0.014	(-0.055, 0.028)	0.497	-0.008	(-0.041, 0.025)	0.624
Underage Alcohol Regulations Scale	-0.008	(-0.028, 0.011)	0.388	-0.006	(-0.021, 0.010)	0.453
Unregistered Keg Policy						
Unregistered Keg Prohibited	-0.064	(-0.093, -0.035)	0.000	-0.022	(-0.057, 0.012)	0.182
Beer Tax	-0.011	(-0.106, 0.084)	0.802	-0.085	(-0.145, -0.025)	0.009
Wine Tax	0.006	(-0.035, 0.047)	0.769	-0.019	(-0.050, 0.011)	0.199
Liquor Tax	0.003	(-0.010, 0.016)	0.603	-0.004	(-0.014, 0.006)	0.370
Total Alcohol Scale	-0.006	(-0.018, 0.006)	0.317	-0.003	(-0.013, 0.008)	0.602

Notes: This table shows the betas for the associations between alcohol policy indicators and recent binge drinking among sexual minority and heterosexual girls. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 26 shows that while the overall alcohol policy environment was not associated with the state-level prevalence of drunk driving, among sexual minority but not heterosexual girls associations were found between higher prevalence of drunk driving and higher taxes on beer (0.290) and liquor (b=0.043).

Table 26: Alcohol Policy and Recent Drunk Driving Among Girls by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Use/Lose Policies						
Suspend or Revoke Driver's License for Underage Alcohol Purchase	0.051	(-0.085, 0.186)	0.437	0.012	(-0.072, 0.096)	0.768
Suspend or Revoke Driver's License for Underage Alcohol Possession	0.051	(-0.088, 0.191)	0.445	0.030	(-0.055, 0.115)	0.458
Suspend or Revoke Driver's License for Underage Alcohol Consumption	0.054	(-0.085, 0.193)	0.419	0.023	(-0.063, 0.108)	0.580
Lose Driving License Scale	0.035	(-0.034, 0.104)	0.293	0.014	(-0.028, 0.057)	0.481
Underage Policies						
Underage Alcohol Consumption Prohibited	0.038	(-0.103, 0.179)	0.574	0.005	(-0.082, 0.091)	0.912
Underage Alcohol Consumption Blood	0.031	(-0.147, 0.208)	0.719	0.009	(-0.100, 0.117)	0.862

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Alcohol Level Prohibited						
Underage Alcohol Purchase Prohibited	0.079	(-0.127, 0.286)	0.427	0.042	(-0.085, 0.168)	0.491
Zero Underage Blood Alcohol Content	0.031	(-0.106, 0.168)	0.636	0.006	(-0.078, 0.090)	0.881
Underage Alcohol Regulations Scale	0.026	(-0.039, 0.091)	0.404	0.007	(-0.033, 0.047)	0.701
Unregistered Keg Policy						
Unregistered Keg Prohibited	0.035	(-0.113, 0.183)	0.624	0.045	(-0.043, 0.132)	0.295
Beer Tax	0.290	(0.021, 0.559)	0.036	0.114	(-0.066, 0.294)	0.196
Wine Tax	0.076	(-0.052, 0.203)	0.224	0.027	(-0.053, 0.107)	0.486
Liquor Tax	0.043	(0.008, 0.079)	0.021	0.021	(-0.002, 0.044)	0.075
Total Alcohol Scale	0.028	(-0.011, 0.067)	0.150	0.013	(-0.012, 0.037)	0.299
Notes: This table shows the betas for the associations between alcohol policy indicators and recent drunk driving among sexual minority and heterosexual girls. Covariates for individual level models are race and age; no covariates are included at the group level.						

Table 27, below, shows no association between the legal status of marijuana and recent use by sexual minority or heterosexual girls.

Table 27: Legal Status of Marijuana and Recent Marijuana Use Among Girls by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
No legal status for marijuana	-0.075	(-0.151, 0.000)	0.051	-0.030	(-.067, .006)	0.090

Notes: This table shows the beta for the association between legal status of marijuana and recent marijuana use among sexual minority and heterosexual girls. Covariates for individual level models are race and age; no covariates are included at the group level.

3.3 Findings Among Boys

This section describes the findings among the male sample in the YRBSS 2011-2013 dataset. I begin by presenting the population weighted estimates of the number of sexual minority boys (Table 28), recent substance use among those boys (Table 29), and sexual orientation disparities in substance use (Table 30).

The average population estimated weighted percent sexual minority was 4.53% among boys, ranging from a low of 2.95% in North Carolina to a high of 7.35% within Arizona (Table 28).

Table 28: Prevalence of Sexual Minority Boys by State

State	N Sexual Minority	Weighted N Sexual Minority	Weighted Percent Sexual Minority	Weighted 95% Confidence Interval
AZ	55	52	7.35	(4.45, 11.88)
CT	115	113	5.59	(4.52, 6.89)
DE	73	71	3.12	(2.43, 3.99)
FL	98	95	3.51	(2.92, 4.22)
HI	216	207	5.35	(4.36, 6.55)
IL	143	137	4.61	(3.81, 5.56)
MA	101	99	3.71	(3.02, 4.56)
MD	1,500	1,467	6.11	(5.70, 6.54)
ME	369	337	3.82	(3.38, 4.32)
MI	92	90	4.38	(3.53, 5.43)
NC	22	21	2.95	(1.92, 4.53)
ND	88	80	4.37	(3.52, 5.42)
NH	27	27	3.66	(2.50, 5.33)
NM	155	151	5.84	(4.90, 6.93)
RI	147	138	4.73	(3.86, 5.80)
VT	525	462	3.18	(2.92, 3.45)
WI	109	102	3.94	(3.12, 4.97)

State	N Sexual Minority	Weighted N Sexual Minority	Weighted Percent Sexual Minority	Weighted 95% Confidence Interval
Population Average	3,835	3,538	4.53	(4.08, 5.04)

As shown in Table 29, below, recent cigarette smoking among boys ranged from 10.14% in Hawaii to 18.32% in North Dakota with a population average of 14.92%. Recent alcohol drinking among boys ranged from 25.06% in Hawaii to 39.39% in Connecticut and averaged 33.34% across the population, while recent binge drinking ranged from 13.49% in Hawaii to 24.96% in North Dakota and averaged 20.23%. Recent drunk driving among boys ranged from 7.01% in Michigan to 27.32% in North Carolina and averaged 9.88%. Recent marijuana use among boys ranged from 16.30% in North Dakota to 30.01% in New Mexico and averaged 24.24%.

Table 29: Recent Substance Use Among All Boys by State

	Recent Cigarette Smoking	Recent Alcohol Drinking	Recent Binge Drinking	Recent Drunk Driving	Recent Marijuana Use
AZ	15.98	34.45	19.91	10.37	27.06
CT	16.43	39.39	24.89	10.15	21.91
DE	16.46	37.13	21.69	9.85	28.13
FL	12.20	35.38	18.53	12.33	23.93
HI	10.14	25.06	13.49	21.01	n/a
IL	17.27	35.25	22.47	10.11	19.95
MA	12.08	29.46	19.80	8.37	18.20
MD	12.56	29.03	17.18	10.21	21.30
ME	15.82	27.60	16.62	7.84	23.56
MI	12.99	27.82	17.92	7.01	19.63
NC	18.25	31.98	16.91	27.32	n/a
ND	18.32	36.37	24.96	12.83	16.30
NH	14.17	30.14	17.23	8.44	26.16
NM	16.28	27.55	17.55	10.62	30.01
RI	10.39	30.97	17.12	10.86	27.44
VT	14.88	35.28	22.32	10.95	27.45
WI	14.43	36.62	23.81	11.74	22.01
Population Average	14.92	33.34	20.23	9.88	24.24

Notes: This table uses the abbreviation n/a to indicate that this variable was not measured in this state.

Table 30, below, shows the adjusted odds ratios (AORs) on sexual minority status for recent substance use, controlling for age and race/ethnicity. The largest AORs were for recent drunk driving (AOR=2.692). The adjusted odds of recent cigarette smoking sexual minority vs. heterosexual boys ranged from 1.223 in North Carolina to 2.114 in Wisconsin and averaged 2.554.

The adjusted odds of recent alcohol drinking among sexual minority vs. heterosexual boys ranged from 0.737 in New Hampshire to 2.489 in Michigan and averaged 1.548. The adjusted odds of recent binge drinking among sexual minority vs. heterosexual boys ranged from 0.473 in North Carolina to 2.479 in Rhode Island, averaging 1.587, while the adjusted odds of recent drunk driving among sexual minority vs. heterosexual boys ranged from 0.448 in North Carolina to 5.637 in Wisconsin and averaged 2.692. Finally, the adjusted odds ratios of recent marijuana use among sexual minority vs. heterosexual boys ranged from 0.636 in New Hampshire to 2.243 in Illinois, averaging 1.490. As in the case of girls (Table 11), this pattern is consistent with previous literature finding SMY boys have higher prevalence of substance use than non-SMY boys (Hatzenbuehler et al., 2015; Kann et al., 2018; Marshal et al., 2008; Newcomb et al., 2014)

Table 30: Sexual Orientation Disparities in Recent Substance Use Among Boys by State (AOR)

Outcome	Recent Cigarette Smoking (AOR)	Recent Alcohol Drinking (AOR)	Recent Binge Drinking (AOR)	Recent Drunk Driving (AOR)	Recent Marijuana Use (AOR)
AZ	1.617	0.965	1.214	2.355	0.891
CT	2.783	1.834	1.492	1.823	1.785
DE	2.086	1.957	1.791	3.067	1.236
FL	2.108	1.388	1.581	2.112	1.445
HI	2.112	1.554	1.980	1.659	n/a
IL	3.343	2.368	1.843	3.858	2.243
MA	1.678	1.054	0.880	3.209	0.951
MD	3.866	1.802	1.980	3.044	1.731
ME	1.840	1.408	1.166	0.981	1.457
MI	2.644	2.489	2.354	2.957	1.769
NC	1.223	1.037	0.473	0.448	n/a
ND	3.283	1.945	1.965	1.758	2.898
NH	1.708	0.737	0.701	1.310	0.636

Outcome	Recent Cigarette Smoking (AOR)	Recent Alcohol Drinking (AOR)	Recent Binge Drinking (AOR)	Recent Drunk Driving (AOR)	Recent Marijuana Use (AOR)
NM	2.512	2.019	2.284	4.686	1.778
RI	4.172	1.880	2.479	3.238	1.798
VT	1.896	1.474	1.361	2.347	1.537
WI	4.114	1.689	1.809	5.637	2.160
Total	2.554	1.548	1.587	2.692	1.490
Variance	1.273	1.217	1.274	1.361	1.245

3.3.1 Sexual Minority Structural Stigma and Substance Use Disparities

Tables 31 through 35 show tests of associations between sexual minority structural stigma and disparities in recent substance use among boys (while the unstandardized sexual minority structural stigma scales were shown in the prior tables, all variables in the analyses are standardized). These tables represent Aim 1 and are testing Hypothesis 1, which states that higher levels of sexual minority structural stigma will be associated with larger sexual orientation disparities in substance use.

As the tables below show, no such associations were found for any of the substances, neither between the sexual minority structural sigma scale and substance use nor between any of its individual components and any substance use.

Table 31: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Cigarette Smoking Among Boys

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	-0.138	(-0.518 , 0.242)	0.451
	No Recognition, No Ban	0.401	(-0.055 , 0.857)	0.081
	Same-Sex Relationship Recognition	-0.115	(-0.535 , 0.304)	0.567
	School Non-Discrimination	0.151	(-0.227 , 0.529)	0.408
	School Anti-Bullying	-0.220	(-0.593 , 0.154)	0.229
	Joint Adoption	-0.284	(-0.679 , 0.110)	0.145

	Predictor	SMSS * SO Beta	95% CI	P-Value
	Hate Crimes Legislation	0.059	(-0.395 , 0.513)	0.786
	Employment Protection	0.006	(-0.418 , 0.430)	0.976
	Public Accommodation Protection	0.194	(-0.301 , 0.690)	0.417
	Housing Discrimination Protection	0.204	(-0.172 , 0.580)	0.266
Density of Same-sex Couples	0.29-0.66	0.343	(-0.456 , 1.142)	0.375
	0.67-0.95	0.125	(-0.273 , 0.524)	0.513
	0.96-1.75	-0.197	(-0.574 , 0.181)	0.284
SMSS Scale	Standardized SMSS Scale	-0.007	(-0.213 , 0.199)	0.945

Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent cigarette smoking among boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 32: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Alcohol Drinking Among Boys

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.094	(-0.259 , 0.448)	0.577
	No Recognition, No Ban	0.071	(-0.395 , 0.537)	0.750
	Same-Sex Relationship Recognition	-0.163	(-0.544 , 0.218)	0.376
	School Non-Discrimination	0.138	(-0.211 , 0.487)	0.413
	School Anti-Bullying	-0.157	(-0.509 , 0.196)	0.358
	Joint Adoption	-0.311	(-0.663 , 0.042)	0.080
	Hate Crimes Legislation	-0.187	(-0.595 , 0.220)	0.343
	Employment Protection	-0.111	(-0.498 , 0.275)	0.549
	Public Accommodation Protection	0.085	(-0.380 , 0.551)	0.702
	Housing Discrimination Protection	0.100	(-0.258 , 0.458)	0.561

	Predictor	SMSS * SO Beta	95% CI	P-Value
Density of Same-sex Couples	0.29-0.66	0.244	(-0.502 , 0.990)	0.497
	0.67-0.95	0.001	(-0.372 , 0.374)	0.996
	0.96-1.75	-0.057	(-0.418 , 0.305)	0.743
SMSS Scale	Standardized SMSS Scale	0.041	(-0.148 , 0.230)	0.649

Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent alcohol drinking among boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 33: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Binge Drinking Among Boys

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.084	(-0.398 , 0.567)	0.714
	No Recognition, No Ban	0.314	(-0.296 , 0.925)	0.290
	Same-Sex Relationship Recognition	-0.321	(-0.822 , 0.179)	0.191
	School Non-Discrimination	0.138	(-0.341 , 0.616)	0.549
	School Anti-Bullying	-0.366	(-0.814 , 0.082)	0.102
	Joint Adoption	-0.451	(-0.920 , 0.018)	0.058
	Hate Crimes Legislation	-0.010	(-0.581 , 0.560)	0.969
	Employment Protection	-0.294	(-0.800 , 0.211)	0.234
	Public Accommodation Protection	0.048	(-0.586 , 0.682)	0.873
	Housing Discrimination Protection	0.095	(-0.393 , 0.584)	0.683
Density of Same-sex Couples	0.29-0.66	0.299	(-0.715 , 1.314)	0.539
	0.67-0.95	-0.187	(-0.682 , 0.309)	0.434
	0.96-1.75	0.108	(-0.380 , 0.596)	0.644
SMSS Scale	Standardized SMSS Scale	0.063	(-0.193 , 0.318)	0.608

Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent binge drinking among boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 34: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Drunk Driving Among Boys

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	-0.323	(-0.953 , 0.306)	0.291
	No Recognition, No Ban	0.488	(-0.325 , 1.301)	0.220
	Same-Sex Relationship Recognition	0.046	(-0.670 , 0.762)	0.893
	School Non-Discrimination	0.356	(-0.269 , 0.980)	0.243
	School Anti-Bullying	-0.382	(-1.011 , 0.248)	0.216
	Joint Adoption	-0.342	(-1.033 , 0.350)	0.309
	Hate Crimes Legislation	0.284	(-0.469 , 1.038)	0.434
	Employment Protection	-0.204	(-0.912 , 0.503)	0.547
	Public Accommodation Protection	0.298	(-0.542 , 1.139)	0.461
	Housing Discrimination Protection	0.391	(-0.236 , 1.019)	0.204
Density of Same-sex Couples	0.29-0.66	-0.267	(-1.646 , 1.113)	0.686
	0.67-0.95	-0.038	(-0.721 , 0.645)	0.907
	0.96-1.75	0.097	(-0.564 , 0.758)	0.759
SMSS Scale	Standardized SMSS Scale	-0.103	(-0.446 , 0.240)	0.532

Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent drunk driving among boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 35: Sexual Minority Structural Stigma and Sexual Orientation Disparities in Recent Marijuana Use Among Boys

	Predictor	SMSS * SO Beta	95% CI	P-Value
SMSS Indicator	Same-Sex Relationship Recognition Ban	0.082	(-0.368 , 0.531)	0.701
	No Recognition, No Ban	0.196	(-0.355 , 0.747)	0.455

	Predictor	SMSS * SO Beta	95% CI	P-Value
	Same-Sex Relationship Recognition	-0.233	(-0.690 , 0.225)	0.292
	School Non-Discrimination	0.186	(-0.252 , 0.623)	0.376
	School Anti-Bullying	-0.142	(-0.585 , 0.302)	0.502
	Joint Adoption	-0.362	(-0.788 , 0.064)	0.089
	Hate Crimes Legislation	-0.398	(-0.909 , 0.112)	0.116
	Employment Protection	-0.112	(-0.585 , 0.362)	0.619
	Public Accommodation Protection	0.219	(-0.329 , 0.767)	0.403
	Housing Discrimination Protection	0.160	(-0.289 , 0.610)	0.455
Density of Same-sex Couples	0.29-0.66	0.692	(-0.110 , 1.495)	0.085
	0.67-0.95	0.046	(-0.431 , 0.524)	0.837
	0.96-1.75	-0.222	(-0.663 , 0.218)	0.295
SMSS Scale	Standardized SMSS Scale	0.062	(-0.168 , 0.292)	0.573
Notes: This table shows the beta for the interaction between SMSS indicators and sexual orientation (SO, 1=sexual minority) in predicting recent marijuana use among boys. Covariates for individual level models are race and age; no covariates are included at the group level.				

3.3.2 Sexual Minority Structural Stigma Within-Group Analyses

The second aim of the study was to assess the size and direction of the association between state-level indices of sexual orientation structural stigma and prevalence of recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use among sexual minorities and heterosexuals (i.e., within-group analyses). This aim tested hypothesis 2, that structural stigma would be associated with higher prevalence of substance use among sexual minority (but not heterosexual) youth.

As Table 36 shows, no associations were found between sexual minority structural stigma and any of the recent substance use behaviors among either sexual minority or heterosexual boys.

Table 36: Sexual Minority Structural Stigma and Recent Substance Use Among Boys by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Recent Cigarette Smoking	0.007	(-0.031, 0.045)	0.702	0.006	(-0.008, 0.020)	0.405
Recent Alcohol Drinking	0.004	(-0.046, 0.055)	0.855	-0.006	(-0.030, 0.018)	0.612
Recent Binge Drinking	0.003	(-0.041, 0.047)	0.884	-0.006	(-0.025, 0.012)	0.479
Recent Drunk Driving	-0.016	(-0.059, 0.027)	0.449	0.008	(-0.021, 0.038)	0.557
Recent Marijuana Use	0.003	(-0.039, 0.045)	0.868	-0.002	(-0.028, 0.024)	0.876

3.3.3 Substance Use Policy Environment and Substance Use Disparities

Tables 37 through 41 show the associations between the substance use policy environment (for tobacco, alcohol and marijuana separately) and sexual orientation disparities in recent substance use among boys (while the unstandardized policy scales were shown in the prior tables, all scales shown in these analytic tables are standardized). These tables represent Aim #3 and are testing the hypothesis that more restrictive substance use policies are associated with larger disparities in substance use among sexual minority vs. heterosexual boys.

Table 37, below, shows that among boys, no associations were found between the overall tobacco regulation scale and sexual orientation disparities in recent cigarette smoking; neither were any associations found between individual indicators within the tobacco regulation scale and sexual orientation disparities in recent cigarette smoking.

Table 37: Smoking Policy and Sexual Orientation Disparities in Recent Cigarette Use Among Boys

Predictor	Policy * SO beta	95% CI	P-Value
Underage Restrictions			
Smoke-Free Campus	-0.251	(-0.631, 0.129)	0.179
Smoke-Free Bus	-0.140	(-0.557, 0.277)	0.485
Prohibit Underage Buying Tobacco	-0.078	(-0.677, 0.520)	0.784
Prohibit Underage Tobacco Possession	0.342	(-0.038, 0.722)	0.075
Prohibit Underage Use of Tobacco	0.209	(-0.161, 0.578)	0.248
Penalize Underage Buyer for Cigarette Purchase	-0.114	(-0.710, 0.483)	0.690
Underage Tobacco Regulation Scale	0.014	(-0.185, 0.213)	0.885
Public Restrictions			
Smoking Banned in Vehicles	-0.272	(-1.080, 0.535)	0.484
Smoking Banned in Private Workplaces	0.339	(-0.132, 0.810)	0.146
Smoking Banned in Government Workplaces	0.098	(-0.499, 0.695)	0.731
Smoking Banned in Restaurants	-0.272	(-0.853, 0.309)	0.334
Other Public Area Tobacco Regulations Scale	0.021	(-0.204, 0.245)	0.847
Business Restrictions			
Can Enforce Underage Tobacco Sale Laws Against Businesses	0.146	(-0.238, 0.530)	0.431
Require Sign About Underage Tobacco Sale Ban	-0.250	(-0.684, 0.184)	0.239
Revoke Business License for Underage Tobacco Sale	0.105	(-0.284, 0.493)	0.574
Regulations of Business Tobacco Scale	0.013	(-0.178, 0.204)	0.883
Tobacco Tax	0.113	(-0.116, 0.342)	0.308
Standardized Tobacco Regulation Scale	0.028	(-0.170, 0.226)	0.768

Notes: This table shows the beta for the interaction between tobacco policy indicators and sexual orientation (SO, 1=sexual minority) disparities in recent cigarette smoking among boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 38, below, shows that among boys, no associations were found between the overall alcohol regulation scale and sexual orientation disparities in recent alcohol use; neither were any associations found between individual indicators and sexual orientation disparities in recent alcohol use.

Table 38: Alcohol Policy and Sexual Orientation Disparities in Recent Alcohol Use Among Boys

Predictor	Policy * SO beta	95% CI	P-Value
Use/Lose Policies			
Suspend or Revoke Driver's License for Underage Alcohol Purchase	-0.272	(-0.602, 0.058)	0.099
Suspend or Revoke Driver's License for Underage Alcohol Possession	0.057	(-0.315, 0.429)	0.750
Suspend or Revoke Driver's License for Underage Alcohol Consumption	0.112	(-0.256, 0.480)	0.525
Lose Driving License Scale	-0.026	(-0.213, 0.160)	0.767
Underage Policies			
Underage Alcohol Consumption Prohibited	0.155	(-0.209, 0.518)	0.379
Underage Alcohol Consumption Blood Alcohol Level Prohibited	-0.269	(-0.713, 0.175)	0.216
Underage Alcohol Purchase Prohibited	-0.106	(-0.657, 0.444)	0.687
Zero Underage Blood Alcohol Content	0.043	(-0.318, 0.405)	0.802
Underage Alcohol Regulations Scale	-0.004	(-0.178, 0.170)	0.963
Unregistered Keg Policy			
Unregistered Keg Prohibited	-0.258	(-0.623, 0.107)	0.152
Beer Tax	-0.287	(-1.092, 0.518)	0.459
Wine Tax	-0.009	(-0.361, 0.343)	0.957
Liquor Tax	0.042	(-0.067, 0.152)	0.425
Total Alcohol Scale	-0.033	(-0.142, 0.076)	0.531

Predictor	Policy * SO beta	95% CI	P-Value
Notes: This table shows the beta for the interaction between can enforce underage tobacco sale laws against businesses policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent cigarette smoking among boys. Covariates for individual level models are race and age; no covariates are included at the group level.			

As shown in Table 39, among boys, no associations were found between recent binge drinking and the overall alcohol regulation scale or subscales. However, prohibitions on underage alcohol consumption enforced by blood alcohol level (called “internal possession,” a restrictive measure) were associated with *smaller* sexual orientation disparities in recent binge drinking ($b=-0.579$), as were prohibitions on unregistered kegs ($b=-0.521$).

Table 39: Alcohol Policy and Sexual Orientation Disparities in Recent Binge Drinking Among Boys

Predictor	Policy * SO beta	95% CI	P-Value
Use/Lose Policies			
Suspend or Revoke Driver’s License for Underage Alcohol Purchase	-0.219	(-0.695, 0.258)	0.343
Suspend or Revoke Driver’s License for Underage Alcohol Possession	0.321	(-0.153, 0.796)	0.169
Suspend or Revoke Driver’s License for Underage Alcohol Consumption	0.253	(-0.233, 0.740)	0.285
Lose Driving License Scale	0.076	(-0.175, 0.326)	0.530
Underage Policies			
Underage Alcohol Consumption Prohibited	0.066	(-0.439, 0.571)	0.784
Underage Alcohol Consumption Blood Alcohol Level Prohibited	-0.579	(-1.128, -0.031)	0.040
Underage Alcohol Purchase Prohibited	-0.058	(-0.808, 0.692)	0.870
Zero Underage Blood Alcohol Content	-0.101	(-0.589, 0.387)	0.665

Predictor	Policy * SO beta	95% CI	P-Value
Underage Alcohol Regulations Scale	-0.090	(-0.320, 0.140)	0.418
Unregistered Keg Policy			
Unregistered Keg Prohibited	-0.521	(-0.968, -0.074)	0.025
Beer Tax	-0.430	(-1.517, 0.656)	0.412
Wine Tax	0.030	(-0.446, 0.507)	0.894
Liquor Tax	0.032	(-0.119, 0.182)	0.662
Total Alcohol Scale	-0.050	(-0.198, 0.098)	0.481
Notes: This table shows the beta for the interaction between unregistered keg prohibited policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent binge drinking among boys. Covariates for individual level models are race and age; no covariates are included at the group level.			

As shown in Table 40, among boys, no associations were found between sexual orientation disparities (sexual minority vs. heterosexual) in recent drunk driving and the overall alcohol regulation scale or subscales; however, as with binge drinking, prohibitions on underage alcohol consumption enforced by blood alcohol level (“internal possession”) were associated with smaller sexual orientation disparities in recent drunk driving ($b=-0.767$), as were prohibitions on unregistered kegs ($b=-0.826$). Table 40 also shows that *smaller* sexual orientation disparities in recent drunk driving ($b=-1.447$) were associated with higher beer taxes.

Table 40: Alcohol Policy and Sexual Orientation Disparities in Recent Drunk Driving Among Boys

Predictor	Policy * SO beta	95% CI	P-Value
Use/Lose Policies			
Suspend or Revoke Driver’s License for Underage Alcohol Purchase	0.095	(-0.567, 0.756)	0.764
Suspend or Revoke Driver’s License for Underage Alcohol Possession	0.527	(-0.092, 1.145)	0.090
Suspend or Revoke Driver’s License for Underage Alcohol Consumption	0.460	(-0.175, 1.094)	0.144

Predictor	Policy * SO beta	95% CI	P-Value
Lose Driving License Scale	0.240	(-0.077, 0.556)	0.127
Underage Policies			
Underage Alcohol Consumption Prohibited	-0.158	(-0.835, 0.520)	0.627
Underage Alcohol Consumption Blood Alcohol Level Prohibited	-0.767	(-1.512, -0.021)	0.045
Underage Alcohol Purchase Prohibited	-0.194	(-1.202, 0.813)	0.687
Zero Underage Blood Alcohol Content	-0.096	(-0.757, 0.565)	0.761
Underage Alcohol Regulations Scale	-0.172	(-0.476, 0.131)	0.245
Unregistered Keg Policy			
Unregistered Keg Prohibited	-0.826	(-1.380, -0.272)	0.006
Beer Tax	-1.447	(-2.719, -0.174)	0.028
Wine Tax	-0.088	(-0.731, 0.554)	0.773
Liquor Tax	0.029	(-0.176, 0.233)	0.769
Total Alcohol Scale	-0.044	(-0.246, 0.157)	0.648
Notes: This table shows the beta for the interaction between beer tax policy indicators and sexual orientation (SO, 1=sexual minority) in predicting recent drunk driving among boys. Covariates for individual level models are race and age; no covariates are included at the group level.			

Table 41 shows that there was no association found between the legal status of marijuana and sexual orientation disparities in marijuana use among boys.

Table 41: Marijuana and Sexual Orientation Disparities in Recent Marijuana Use Among Boys

Predictor	Policy * SO beta	95% CI	P-Value
No legal status for marijuana	0.0780	(-0.371, 0.527)	0.714
Notes: This table shows the betas for the associations between marijuana policy indicators and marijuana use disparities between sexual minority and heterosexual boys. Covariates for individual level models are race and age; no covariates are included at the group level.			

Within-Group Analyses

3.3.4 Substance Use Policy Environments Within-Group Analyses

Aim 4 of the study was to assess the size and direction of the association between state-level indices of restrictive substance use policies and prevalence of recent tobacco use, alcohol use, binge drinking, drunk driving and marijuana use among sexual minorities and heterosexuals (i.e., within-group analyses). Tables 42 through 46 show these results. These analysis are tests of Hypothesis 4, i.e., that more restrictive substance use policy environments would be associated with lower prevalence of substance use among heterosexual but not sexual minority boys, because the benefits of restrictive substance use for sexual minority youth were expected to be canceled out by the potential stigmatizing effect of these restrictive substance use policies for that group.

As shown in Table 42, no associations were found between the overall tobacco environment and recent smoking among either sexual minority or heterosexual boys. However, among heterosexual but not sexual minority boys, higher tobacco taxes were associated with lower prevalence of smoking ($b=-0.021$).

Table 42: Smoking Policy and Recent Cigarette Use Among Boys by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Underage Restrictions						
Smoke Free Campus	-0.043	(-0.114, 0.029)	0.223	0.004	(-0.025, 0.032)	0.785
Smoke Free Bus	-0.027	(-0.105, 0.050)	0.460	0.004	(-0.026, 0.034)	0.787
Prohibit Underage Buying Tobacco	0.013	(-0.098, 0.124)	0.806	0.030	(-0.009, 0.069)	0.123
Prohibit Underage Tobacco Possession	0.052	(-0.021, 0.125)	0.149	-0.005	(-0.034, 0.025)	0.748
Prohibit Underage Use of Tobacco	0.020	(-0.051, 0.091)	0.554	-0.010	(-0.037, 0.017)	0.432
Penalize Underage	-0.022	(-0.133, 0.088)	0.672	0.015	(-0.026, 0.057)	0.445

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Buyer for Cigarette Purchase						
Underage Tobacco Regulation Scale	-0.000	(-0.037, 0.036)	0.981	0.002	(-0.012, 0.016)	0.722
Public Restrictions						
Smoking Banned in Vehicles	-0.014	(-0.166, 0.138)	0.844	0.012	(-0.045, 0.070)	0.651
Smoking Banned in Private Workplaces	0.043	(-0.048, 0.134)	0.335	-0.022	(-0.056, 0.012)	0.189
Smoking Banned in Government Workplaces	0.029	(-0.081, 0.139)	0.579	-0.007	(-0.049, 0.035)	0.720
Smoking Banned in Restaurants	-0.072	(-0.176, 0.032)	0.161	-0.026	(-0.066, 0.014)	0.190
Other Public Area Tobacco Regulations Scale	0.001	(-0.040, 0.043)	0.950	-0.008	(-0.023, 0.008)	0.307
Business Restrictions						
Can Enforce Underage Tobacco Sale Laws Against Businesses	0.031	(-0.039, 0.102)	0.360	0.005	(-0.022, 0.033)	0.681
Require Sign About Underage Tobacco Sale Ban	-0.067	(-0.143, 0.009)	0.078	-0.013	(-0.045, 0.018)	0.373
Revoke Business License for Underage Tobacco Sale	0.002	(-0.071, 0.075)	0.959	-0.006	(-0.033, 0.022)	0.664

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Regulations of Business Tobacco Scale	-0.003	(-0.039, 0.032)	0.837	-0.002	(-0.016, 0.011)	0.741
Tobacco Tax	-0.021	(-0.064, 0.021)	0.298	-0.021	(-0.033, -0.009)	0.002
Standardized Tobacco Regulation Scale	-0.002	(-0.039, 0.035)	0.905	-0.003	(-0.017, 0.011)	0.632

Notes: This table shows the beta for the interaction between smoking policy indicators and sexual orientation (SO, 1=sexual minority) in predicting cigarette use among boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 43 illustrates that no associations were found between either the overall alcohol policy environment or individual indicators and alcohol use among sexual minority or heterosexual boys.

Table 43: Alcohol Policy and Recent Alcohol Use Among Boys by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Use/Lose Policies						
Suspend or Revoke Driver's License for Underage Alcohol Purchase	-0.080	(-0.166, 0.006)	0.065	-0.014	(-0.059, 0.032)	0.530
Suspend or Revoke Driver's License for Underage Alcohol Possession	0.017	(-0.083, 0.116)	0.727	0.012	(-0.035, 0.059)	0.588
Suspend or Revoke Driver's License for Underage Alcohol Consumption	0.037	(-0.061, 0.134)	0.433	0.008	(-0.039, 0.055)	0.726

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Lose Driving License Scale	-0.007	(-0.057, 0.043)	0.768	0.001	(-0.022, 0.025)	0.914
Underage Policies						
Underage Alcohol Consumption Prohibited	0.047	(-0.049, 0.143)	0.317	0.002	(-0.045, 0.049)	0.923
Underage Alcohol Consumption Blood Alcohol Level Prohibited	-0.079	(-0.196, 0.038)	0.171	-0.024	(-0.082, 0.033)	0.380
Underage Alcohol Purchase Prohibited	-0.078	(-0.219, 0.063)	0.258	-0.047	(-0.112, 0.018)	0.144
Zero Underage Blood Alcohol Content	0.008	(-0.088, 0.105)	0.860	-0.010	(-0.055, 0.036)	0.657
Underage Alcohol Regulations Scale	-0.006	(-0.052, 0.040)	0.777	-0.009	(-0.031, 0.012)	0.369
Unregistered Keg Policy						
Unregistered Keg Prohibited	-0.064	(-0.162, 0.034)	0.184	-0.007	(-0.057, 0.042)	0.760
Beer Tax	-0.157	(-0.357, 0.044)	0.118	-0.078	(-0.172, 0.017)	0.100
Wine Tax	-0.015	(-0.109, 0.078)	0.733	-0.010	(-0.054, 0.034)	0.627
Liquor Tax	0.005	(-0.025, 0.034)	0.744	-0.003	(-0.017, 0.011)	0.698
Total Alcohol Scale	-0.011	(-0.040, 0.018)	0.446	-0.004	(-0.018, 0.010)	0.541

Notes: This table shows the betas for the associations between alcohol policy indicators and recent drinking among sexual minority and heterosexual boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Table 44 shows that no associations were found between the overall alcohol policy environment and binge drinking among sexual minority or heterosexual boys. When examining individual indicators, however, recent binge drinking and prohibitions against alcohol consumption as measured by blood alcohol level (“internal possession”) were negatively associated among sexual minority (b=-0.102) and heterosexual (-0.022) boys. Among sexual minority but not heterosexual boys, prohibitions against unregistered kegs were negatively associated with recent binge drinking (b=-0.095). Among both sexual minority (-0.182) and heterosexual (b=-0.085) boys, higher beer taxes were negatively associated with recent binge drinking.

Table 44: Alcohol Policy and Recent Binge Drinking Among Boys by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Use/Lose Policies						
Suspend or Revoke Driver’s License for Underage Alcohol Purchase	-0.052	(-0.132, 0.027)	0.180	-0.020	(-0.054, 0.013)	0.217
Suspend or Revoke Driver’s License for Underage Alcohol Possession	0.026	(-0.059, 0.112)	0.523	-0.005	(-0.042, 0.031)	0.758
Suspend or Revoke Driver’s License for Underage Alcohol Consumption	0.033	(-0.052, 0.118)	0.416	0.002	(-0.035, 0.039)	0.909
Lose Driving License Scale	0.001	(-0.043, 0.044)	0.966	-0.006	(-0.024, 0.013)	0.526
Underage Policies						
Underage Alcohol	0.017	(-0.069, 0.104)	0.672	0.006	(-0.031, 0.043)	0.736

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Consumption Prohibited						
Underage Alcohol Consumption Blood Alcohol Level Prohibited	-0.102	(-0.195, -0.009)	0.034	-0.022	(-0.066, 0.023)	0.310
Underage Alcohol Purchase Prohibited	-0.046	(-0.173, 0.080)	0.445	-0.030	(-0.082, 0.022)	0.235
Zero Underage Blood Alcohol Content	-0.014	(-0.098, 0.069)	0.719	-0.005	(-0.041, 0.030)	0.760
Underage Alcohol Regulations Scale	-0.017	(-0.057, 0.022)	0.362	-0.006	(-0.022, 0.011)	0.487
Unregistered Keg Policy						
Unregistered Keg Prohibited	-0.095	(-0.169, -0.020)	0.016	-0.011	(-0.049, 0.027)	0.542
Beer Tax	-0.182	(-0.344, -0.020)	0.030	-0.085	(-0.151, -0.019)	0.015
Wine Tax	-0.026	(-0.107, 0.054)	0.498	-0.023	(-0.055, 0.009)	0.149
Liquor Tax	-0.001	(-0.027, 0.025)	0.953	-0.004	(-0.014, 0.007)	0.484
Total Alcohol Scale	-0.015	(-0.039, 0.010)	0.222	-0.006	(-0.016, 0.005)	0.280
Notes: This table shows the betas for the associations between alcohol policy indicators and recent binge drinking among sexual minority and heterosexual boys. Covariates for individual level models are race and age; no covariates are included at the group level.						

While no associations were found between the overall alcohol policy environment scale and recent drunk driving among sexual minority or heterosexual boys, one subscale, which measures restrictions resulting in suspension of driver’s licenses for underage drinking (“use/lose” policies) was

associated with greater drunk driving among sexual minority but not heterosexual boys, as shown in Table 45 (b=0.045). When examining individual indicators of the restrictiveness of the policy environment, suspension of driver’s license for underage alcohol consumption (one of the components of the “use/lose” scale) was associated positively with drunk driving (b=0.080) among sexual minority but not heterosexual boys. Prohibitions on unregistered kegs were negatively associated with recent drunk driving among sexual minority but not heterosexual boys (b=-0.097), while higher beer taxes were positively associated with recent drunk driving among heterosexual but not sexual minority boys (b=0.167).

Table 45: Alcohol Policy and Recent Drunk Driving Among Boys by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Use/Lose Policies						
Suspend or Revoke Driver’s License for Underage Alcohol Purchase	0.052	(-0.028, 0.131)	0.185	0.033	(-0.021, 0.087)	0.211
Suspend or Revoke Driver’s License for Underage Alcohol Possession	0.067	(-0.011, 0.146)	0.087	-0.014	(-0.073, 0.044)	0.607
Suspend or Revoke Driver’s License for Underage Alcohol Consumption	0.080	(0.006, 0.155)	0.036	0.003	(-0.055, 0.062)	0.906
Lose Driving License Scale	0.045	(0.009, 0.081)	0.018	0.005	(-0.024, 0.035)	0.705
Underage Policies						
Underage Alcohol	0.017	(-0.069, 0.103)	0.680	0.027	(-0.030, 0.084)	0.333

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
Consumption Prohibited						
Underage Alcohol Consumption Blood Alcohol Level Prohibited	-0.085	(-0.183, 0.013)	0.086	0.037	(-0.034, 0.108)	0.281
Underage Alcohol Purchase Prohibited	-0.011	(-0.139, 0.118)	0.863	0.017	(-0.070, 0.103)	0.685
Zero Underage Blood Alcohol Content	-0.012	(-0.096, 0.071)	0.756	0.006	(-0.051, 0.063)	0.825
Underage Alcohol Regulations Scale	-0.011	(-0.051, 0.029)	0.554	0.013	(-0.013, 0.040)	0.300
Unregistered Keg Policy						
Unregistered Keg Prohibited	-0.097	(-0.170, -0.023)	0.013	0.016	(-0.045, 0.077)	0.575
Beer Tax	0.046	(-0.142, 0.235)	0.608	0.167	(0.077, 0.258)	0.001
Wine Tax	0.027	(-0.053, 0.107)	0.487	0.021	(-0.033, 0.076)	0.411
Liquor Tax	0.011	(-0.015, 0.036)	0.379	0.003	(-0.014, 0.021)	0.708
Total Alcohol Scale	0.005	(-0.020, 0.031)	0.668	0.009	(-0.008, 0.026)	0.263
Notes: This table shows the betas for the associations between alcohol policy indicators and recent drunk driving among sexual minority and heterosexual boys. Covariates for individual level models are race and age; no covariates are included at the group level.						

Table 46 shows that having no legal status for marijuana is negatively associated with recent marijuana use among heterosexual ($b=-0.053$) but not sexual minority boys.

Table 46: Marijuana Policy and Recent Marijuana Use Among Boys by Sexual Orientation

Predictor	Sexual Minority Beta	Sexual Minority 95% CI	Sexual Minority P-Value	Heterosexual Beta	Heterosexual 95% CI	Heterosexual P-Value
No legal status for marijuana	-0.035	(-0.114, 0.044)	0.356	-0.053	(-0.092, -0.014)	0.011

Notes: This table shows the betas for the associations between legal status of marijuana and recent marijuana use among sexual minority and heterosexual boys. Covariates for individual level models are race and age; no covariates are included at the group level.

Chapter 4: Conclusions

This study used multi-level modeling to examine the relationship between state-level (1) sexual minority structural stigma (SMSS) and (2) substance use policy environment (SUPE) and sexual orientation disparities in five substance use outcomes: cigarette smoking, drinking, binge drinking, drunk driving and marijuana use (all within the past 30 days). It further examined the associations between SMSS and SUPE and prevalence of these outcomes within sexual minority youth and heterosexual youth populations. All analyses were stratified by gender.

4.1 Summary of Findings and Relation to Extant Literature

Table 47 summarizes the results from the analyses related to the first predictor: structural stigma. Among girls, the analyses suggest some support for the hypothesis that higher levels of sexual minority structural stigma are associated with larger disparities in substance use prevalence between sexual minority and heterosexual youth. Specifically, sexual orientation disparities in tobacco use, drinking and marijuana use are associated with higher levels of structural stigma among girls as measured by a composite scale. Appendix I shows the results of the supplementary analysis, which confirmed the results seen here using the alternative modeling strategies. Among girls, some individual indicators of structural stigma showed an association with all five substance use behaviors; all results were in the expected direction. Among boys, however, no such associations were found.

Table 47: Summary of Findings Regarding Associations Between Sexual Minority Structural Stigma and Sexual Orientation Disparities in Substance Use and Prevalence within Sexual Orientation Groups

Substance	Girls			Boys		
	Disparity Analysis	Within SMY	Within Heterosexual	Disparity Analysis	Within SMY	Within Heterosexual
Tobacco	SMSS scale Employment protection (1 of 11);	SMSS scale	Null	Null	Null	Null

Drinking	SMSS scale Same-sex relationship recognition, public accommodation protections, joint adoption (3 of 11)	Null	Null	Null	Null	Null
Binge Drinking	Relationship recognition, public accommodation protection (2 of 11)	Null	Null	Null	Null	Null
Drunk Driving	Joint adoption, anti-bullying (2 of 11)	Null	Null	Null	Null	Null
Marijuana Use	SMSS scale Same-sex relationship recognition, public accommodation protections, hate crimes legislation, joint adoption (4 of 11)	Null	Null	Null	Null	Null

Notes. The results relating to the overall measure of sexual minority structural stigma are in bold type, while the significant indicators comprising the scale are shown within parentheses.

Table 48 summarizes the results from the analyses related to the second predictor: substance use policy environments. Among girls, no scales or subscales measuring substance use policy environments were associated with disparities. Just one indicator (enforcement of tobacco policy) was associated with sexual orientation substance use disparities among girls, and it was not in the hypothesized direction; thus, this analysis entirely lacked support for Hypothesis 3 among girls.

There was mixed support for Hypothesis 4 among girls. Taxes on beer were associated with lower prevalence of binge drinking among heterosexual but not sexual minority girls, supporting Hypothesis 4; however, keg registration policies were associated with lower prevalence of binge drinking among sexual minority girls but not heterosexual girls, providing support for a hypothesis in the *opposite* direction from that described in Aim 4. Higher tobacco taxes were associated with lower prevalence of smoking among both heterosexual and sexual minority girls, providing no support for hypothesis 4. Finally, among sexual minority but not heterosexual girls, associations were found between higher prevalence of drunk driving

and higher taxes on beer and liquor. While this does suggest different effects that disadvantage sexual minority girls, it does not support Hypothesis 4's position that heterosexual girls but not sexual minority girls would display lower rates of drinking in the presence of more restrictive substance use environments.

Among boys, no scales or subscales measuring substance use policy environment were associated with sexual orientation disparities in substance use, providing no support for Hypothesis 3 from any analyses involving scales. A small number of individual items were associated with disparities in binge drinking (internal possession, unregistered keg regulations) and drunk driving (internal possession and unregistered keg regulations); however, these were not in the expected direction but rather supported a hypothesis that restrictive substance use environments are associated with *smaller* rather than larger sexual orientation disparities in substance use.

Support for hypothesis 4 (that restrictive substance use policies would be associated with lower levels of substance use among heterosexual but not sexual minority boys) was only weakly supported, in that having no legal status for marijuana was negatively associated with recent marijuana use among heterosexual (but not sexual minority) boys. One subscale, which measures restrictions resulting in suspension of driver's licenses for underage drinking ("use/lose" policies), was associated with greater drunk driving among sexual minority but not heterosexual boys (this does indirectly suggest that the use/lose policies might be associated with larger disparities in drunk driving in the expected direction, but via a different mechanism from the one hypothesized in Aim 4).

Findings that did not support Hypothesis 4 include the following: Among heterosexual boys, higher taxes were associated with larger amounts of substance use (in the case of tobacco and recent smoking and of beer taxes and recent binge drinking and drunk driving), and the negative associations found between drunk driving and prohibitions on unregistered kegs among heterosexual boys suggest support for the *reverse* hypothesis from that posited by Aim 4.

Table 48 therefore illustrates that in addition to associations that run counter to the hypotheses of this study, there were relationships found that run counter to the theory behind substance use policies; in other words, while restrictive substance use policies are intended to decrease substance use, some relationships were found in which more restrictive substance use policies were associated with *higher* levels of substance use. While this association may not be causal, it does not support the theory behind substance use policies.

Table 48: Summary of Findings Regarding Associations Between Substance Use Policies and Sexual Orientation Disparities in Substance Use and Prevalence within Sexual Orientation Groups

Substance	Girls			Boys		
	Disparity Analysis	Within SMY	Within Heterosexual	Disparity Analysis	Within SMY	Within Heterosexual
Tobacco	Enforcement (1 of 14) (H-)	Taxes (H0)	Taxes (H0)	Null	Null	Taxes (H+)
Drinking	Null	Null	Null	Null	Null	Null
Binge Drinking	Null	Keg registration (1 of 8) (H-)	Beer Taxes (1 of 3)	Internal possession (H-), unregistered keg regulations (H-) (2 of 8)	Internal possession (H-), unregistered kegs (H-) (2 of 8), beer taxes (1 of 3) (H0)	Beer taxes (1 of 3) (H0)
Drunk Driving	Null	Beer and Liquor Taxes* (2 of 3) (H+)	Null	Internal possession, unregi	“Use/Lose” subscale (1 of 2)* (H+), Loss of license for alcohol consumption (H-), unregistered keg (H-)(2 of 8)	Beer taxes* (H+)

Substance	Girls			Boys		
	Disparity Analysis	Within SMY	Within Heterosexual	Disparity Analysis	Within SMY	Within Heterosexual
				stered keg regulations (H-) (2 of 8), beer taxes (H+) (1 of 3)		
Marijuana Use	Null	Null	Null	Null	Null	Legal Status (H+)

Notes: H+ indicates a pattern of association that supports the hypotheses, while H- indicates a pattern of association that indicates support for the reverse. H0 indicates associations that do neither. An asterisk indicates that the association is in the opposite direction from the intention of the policy.

It is important to note that there are a variety of ways that substance use policies can affect disparities. Restrictive policies can increase substance use among sexual minorities but not heterosexual youth (running counter to both the intent of the policy, to depress substance use, and counter to efforts to create health equities between groups such as sexual minorities and heterosexual youth). Restrictive policies can decrease substance use among heterosexual but not sexual minority youth (working as intended for heterosexual youth but running counter to health equity goals).

There is an emerging body of literature suggesting that high levels of sexual minority structural stigma are associated with larger sexual orientation disparities in the prevalence of mental health symptoms and diagnoses, including depression and anxiety (Hatzenbuehler, 2010, 2011; Hatzenbuehler, Keyes, et al., 2011; Hatzenbuehler et al., 2010). With rare exceptions (Hatzenbuehler et

al., 2015; Hatzenbuehler, Jun, Corliss, & Austin, 2014; Pachankis et al., 2014), few studies have examined relationships between structural stigma and substance use among LGB populations, particularly among youth. The current study found that the sexual orientation disparity in marijuana use was associated with elevated levels of sexual minority structural stigma for girls, a finding that is consistent with Hatzenbuehler et. al. (2015). It extended these findings in that these associations were also found for drunk driving (an outcome that was not included in prior studies). However, unlike prior studies, which have observed associations between structural stigma and sexual orientation substance use among males (Hatzenbuehler et al., 2014; 2015; Pachankis et al., 2014), the current study did not find a similar set of associations among boys. This may be due to several factors, including different methods used in this study compared to previous studies (cross-sectional in the current study vs. longitudinal panel data in the prior studies); measurement of structural stigma (a focus on policies in the current study vs. composite indices of structural stigma in the prior studies); and different periods of development (e.g., adolescence in the current study vs. young adulthood in the prior studies). While this study found significant results in girls and not boys, drawing conclusions about gender differences in the areas investigated by this study would require specific tests of statistical interaction between gender, sexual orientation, and the state-level exposures, which were not conducted in this study for reasons of statistical power.

While there is an emerging consensus that sexual minority structural stigma is associated health disparities that disadvantage sexual minority youth and adults (Hatzenbuehler, 2016), no such consensus about the effects of substance use policy environments on youth substance use has emerged, and even less is understood about the different effects of restrictive substance use environments across subpopulations that experience health disparities. This study finds that higher tobacco taxes were associated with lower prevalence of smoking among both heterosexual and sexual minority girls. This finding is consistent with the literature that finds that higher taxes on substances are associated with less use of that substance among adolescents and that girls respond more to taxation of substances than boys by decreasing use (van Hasselt et al., 2015; Xuan et al., 2013). However, this finding is not consistent with literature that finds

that boys are more responsive to price increases than girls are (Azagba & Sharaf, 2011). Similarly, this study found that higher beer taxes were associated with higher rates of recent drunk driving among heterosexual (but not sexual minority) boys, contrary to existing literature suggesting that populations experiencing higher taxes drive drunk less than those experiencing lower or no taxes (Naimi et al., 2014; Xuan, Chaloupka, et al., 2015; Xuan et al., 2013).

“Use/lose” policies and zero tolerance for blood alcohol level have all been shown to lower alcohol-related fatalities among youth drivers (Fell et al., 2009, 2016; Hingson & White, 2014), suggesting that these policies ought to be associated with less drunk driving among heterosexual and sexual minority youth; however, this was not the case in this study. In this study, driving drunk among girls was not associated with those policies; among boys, “use/lose” policies were associated with *greater* drunk driving among sexual minority (but not heterosexual) youth.

Overall, this study is somewhat consistent with previous studies of sexual minority structural stigma that find associations between sexual orientation substance use disparities and structural stigma. It does not provide support for the hypothesis that restrictive substance use policies stigmatize sexual minorities and therefore exacerbate sexual orientation disparities in substance use; however, further research is needed in order to both overcome the limitations of the study at hand and to further explore the possible mechanisms present in the study, topics which are explored in the next section.

4.2 Limitations

One methodological concern in research on adolescent sexual orientation is whether the constructs and their operationalizations are adequate. These decisions interact with questions of statistical power, as more inclusive definitions of “sexual minority” (such as those that include “not sure,” or that encompass those who do not identify as gay, lesbian or bisexual but who have had same-sex sexual contact) allow for larger samples of sexual minority youth to be included in analyses.

While widely used for research on sexual orientation and on sexual minority health in youth, the Youth Risk Behavior Surveillance Survey (YRBSS) has some limitations for testing hypotheses related to sexual orientation and substance use. First, the measure of sexual orientation used does not include all common terms for minority sexual orientations (for example “queer” or “pansexual”). Because this study’s hypotheses focused on stigma, and stigma primarily (although not exclusively) inheres in identities (e.g. Major & O’Brien, 2005), the more strictly identity-based definition was appropriate, especially given that prior studies on structural stigma have all used identity measures of sexual orientation (Hatzenbuehler, 2009, 2010; Hatzenbuehler et al., 2015; Hatzenbuehler, Keyes, et al., 2014; Pachankis et al., 2014). However, if there is future support for a hypothesized mechanism connecting the predictor variables and the outcome variables that inheres in behavior, it would be appropriate to repeat a test with a more liberal definition that includes respondents who report same-sex behaviors (irrespective of how they identify).

Secondly, the YRBSS does not include measures of some important and potentially confounding predictors of substance use relevant to this analysis, such as a measure of socioeconomic status and exposure to anti-substance use messages. Little is known about whether sexual minority youth experience greater economic precarity when compared with heterosexual youth; however, some studies that suggest that family rejection is a common experience propose that sexual minority youth may lose access to financial resources during family rejection processes (Ryan et al., 2009, 2010). Given that youth with low socioeconomic status are more sensitive to price controls (meaning they are more likely to react to additional taxation by purchasing less or abstaining from use of a restricted substance), knowing whether sexual minority youth have different socioeconomic status than comparable heterosexual peers is important to understanding their behavior with regards to substance use policies (Tauras et al., 2013).

Further, the YRBSS includes only a measure of sex, while recent literature suggests the importance of examining sex and gender separately (Krieger, 2003). The dataset does not include information about gender expression or transgender status, limitations that will be discussed further in the section below on future research.

In addition to limitations that inhere in the YRBSS as a data source, the measure of policy used in this project does not refer to implementation of policy, only policy as written. Recent research suggests that when examining the relationship between restrictive substance use policy environments and prevalence of substance use, implementation, rather than policy as written, may be a better predictor of substance use behaviors (Naimi et al., 2014).

Finally, having 17 of 50 possible states meant that the variation in state-level variables was limited. For example, while the possible range of the tobacco scale was 0 to 13, the actual ranges were from 5-11, meaning there was no data at the lowest levels of the range in the dataset. The opposite was true for the alcohol scale which could range from 0-8 but ranged in this dataset from 1-6 and the sexual minority structural stigma (which could range from 1-13 but ranged in practice from 1-11) meaning there were no data points at the highest level (or most restrictive) end of the range. The effect of this lack of variation is not possible to estimate directly, but it is likely that it restricted our ability to detect an effect, given the restricted range. Increasing the sample size of states may allow for additional power to test the hypotheses specified in this project, which will be possible as more states in the YRBSS begin to assess sexual orientation. Further, the states electing to measure sexual orientation on the YRBSS in 2011 and 2013 may have some unmeasured endogenous characteristics, limiting the ability of this work to generalize to all 50 states.

4.3 Future Research

This section will describe three avenues of further research: 1) exploring the role of gender identity and expression in sexual orientation substance use disparities; 2) the role of implementation of substance use policies on experiences of stigma and substance use; and 3) the role of peer effects in substance use among adolescents.

4.3.1 Gender Differences in Experiences of Sexual Minority Structural Stigma

The differing pattern of findings between girls and boys in this sample suggests that further research regarding sexual minority structural stigma should not only stratify by sex and gender but also that the mechanisms that may explain these gender differences be explored. While this analysis lacked the statistical power to explore interaction effects between gender, sexual orientation, and the state-level exposures, future analyses with larger sample sizes can explore this. Additionally, if constructs of sex and gender could be measured in more nuanced ways, the role of gender expression may be found to moderate the relationship between sexual minority structural stigma and associated negative outcomes because the effects of sexual minority structural stigma may be more pronounced among gender non-conforming youth. Specifically, analyses of four municipal sites that included a question about gender expression in their Youth Risk Behavior Surveillance Survey optional questions found that among both boys and girls, identifying as a sexual minority is associated with expressions of gender that are non-conforming and that gender non-conforming youth are more likely to use substances than are gender-conforming youth (Gill & Frazer, 2016). Another study has suggested that masculine gender role performance is associated with greater substance use (although this study did not examine sexual orientation) (Peralta, 2007).

Some research suggests that among gay and bisexual men, rejection sensitivity moderates the influence of stigma on health; specifically, gay and bisexual men who are more sensitive to rejection are more likely to use tobacco and alcohol than those with lower rejection sensitivity (Institute of Medicine, 2011; Kann et al., 2018; Marshal et al., 2008; Newcomb et al., 2014). A small number of studies find female adolescents have higher rejection sensitivity than male adolescents (Erozkan, 2009) One study examining the role of rejection sensitivity in sexual minority adults found an association (but no gender differences) between experiences of discrimination and depression and anxiety symptoms mediated by rejection sensitivity (Feinstein, Goldfried, & Davila, 2012). Further research may explore whether rejection sensitivity and gender interact in tests of association between sexual minority structural stigma and substance use prevalence.

Another testable hypothesis may have to do with reactions to stress; if sexual minority structural stigma is a predictor of higher levels of stress in sexual minority youth, does it cause more stress in girls

than boys and if so, why? Girls and boys certainly react to different stressors and cope with stress differently; do they also experience sexual minority structural stigma differently (Armstrong, Ronzitti, Hoff, & Potenza, 2018; Lupien & Juster, 2016; Schmaus, Laubmeier, Boquiren, Herzer, & Zakowski, 2008)? If using substances is coded as a “masculine” form of coping, perhaps gender nonconforming sexual minority girls who experience sexual minority structural stigma are more likely to manifest their stress by using substances to cope. Further studies might explore whether this is driving the relationship between substance use disparities and sexual minority structural stigma among girls found in this study.

4.3.2 Substance Users and Sexual Minority Youth as Outsider and Other

Queer theorists such as Gayle Rubin and Michael Warner have suggested that one reason sexual minority people (including youth) experience prejudice is that they are outside of the “charmed circle” of behavior acceptable to most Americans. Rubin cites several examples, including historian Judith Walkowitz’s work on the criminalization of sex between consenting adults, which describes how police powers over sexual “deviants” increased during a time of moral panic about threats to the “post-war American dream” or the heterosexual family (Rubin, 1984; Walkowitz, 1980, 1992). Rubin describes how heterosexual, married, monogamous, reproductive sex taking place in the privacy of a home is normative, while those who are unmarried, practicing same-sex sexual behavior or promiscuity, and those who are transvestites, fetishists or sadomasochists are outside of these norms.

Warner moves Rubin’s thinking into his analysis of debates within the LGBTQ community about the centrality of marriage to attaining rights for sexual minorities. He argues that while some in the LGBTQ community want to appear “normal”, he suggests that there is a “trouble with normal” (in his book of the same title). The “trouble” is that many LGBTQ people identify with their own outsider-ness and do not wish to be included in what others consider to be the “normal” or “respectable” practices of heterosexual life (such as marriage). If one accepts his premise that part of what manifestations of queerness bring to American life is an interest in and even celebration of deviance, then “pleasures once imaginable only with disgust, if at all, become the material out of which individuals and groups elaborate

themselves” (Warner, 2000, p. 12). Rather than argue that LGBTQ+ people are similar to heterosexual, cisgender people, he argues that they should take shame out of their feeling of being different and celebrate it. Warner describes numerous examples of LGBTQ+ people feeling shame as outsiders and feeling proud of their outsiders, with celebrations of LGBTQ+ pride a paradigmatic example of the latter.

Drug users are also seen as outsiders, although there is no parallel movement to celebrate their unique contributions to culture in the way of LGBTQ+ pride celebrations and no robust theoretical literature comparable to queer theory in which the movement can elaborate its scholarly thinking in this area (although the work of harm reduction organizations such as VOCAL and the Harm Reduction Coalition borrow from queer theory in their messaging, with t-shirts that say “I love drug users” that parallel similar LGBTQ+ pride messages). Sociological theory has described how drug users are constructed as “outsiders.” For example, sociologist Howard Becker describes that “Considerations of morality and expediency, occasioned by the reactions of society, may interfere and inhibit use, but use continues to be a possibility in terms of his conception of the drug” (Becker, 1973, p. 59). Being an “outsider” does not necessarily provide a barrier to use, but may be internalized as an identity.

If both sexual minority youth and drug users are outsiders and both identities come attached to a sense of shame and stigma, policies that stigmatize might be compounded and increase minority stress—particularly in the absence of any protective effect of pride in that identity and in the presence of pre-existing shame. The YRBSS does not measure feelings of outsidership or of shame or pride. However, future research (particularly qualitative investigations, as those done by Becker) can observe and report on the ways in which these identities interact and compound feelings of stigma. The YRBSS is limited in that it discusses only substance use behavior, and not the extent to which substance use becomes an identity or mode of resisting normative forces.

There are at least two factors at play in public health in this discussion: the use of shame and restriction as a way to discourage a behavior that is undesirable for health (drug use), and a concern for the mental well-being of those who are already stigmatized (see Bayer, 2008). Making substances illicit may encourage their rejection by those who identify with “normal”; these practices may actually

encourage those who identify as outsiders to use them. Further study is needed to understand whether restricting substance use could have a perverse consequence of increasing use by those sexual minority youth who identify with the type of deviance described by Warner. One might, for example, follow Becker's example and observe sexual minority youth in their own environments, as they do or do not interact with substances forbidden to them, or conduct qualitative interviews with them about how they see themselves: as followers of laws and policies forbidding substance use or as those rebelling against those laws and policies.

4.3.3 Implementation and Substance Use Policy Environments

Substance use policies only have a chance to work as intended if they are implemented, and implementation varies greatly across states (Botello-Harbaum et al., 2009; Naimi et al., 2014). It is possible that a study using measures of implementation of substance use policies might find an association between sexual orientation substance use disparities and the strictness of such policies (and the strictness of their implementation). Future research should access this information where available. Further, while activists have suggested that police target sexual minority youth (and to a greater extent, transgender and gender non-conforming youth) for enforcement of drug and alcohol policy, no studies were found that examined this association directly using population-based data (Spade, 2015). Were such disproportionality to be found, it would be a next step to understand whether the greater stigma attached to involvement in the criminal justice system (through arrests for underage or otherwise prohibited substance use) results in increased use of substances among sexual minority youth via the minority stress pathway, or whether the more restrictive policing decreases substance use among sexual minority youth because it diss

4.3.4 Peer Effects and Sexual Orientation Substance Use Disparities

Studies examining correlates of substance use among young people consistently find that peer behavior is a very strong predictor of one's own behavior. There are several mechanisms that explain these findings. The first is homophily, in which individuals who are similar tend to seek one another out

and remain interpersonally close to one another (Andrews, Tildesley, Hops, & Li, 2002; Brechwald & Prinstein, 2011). Another is that adolescents tend to adhere to subjective norms, or individuals' beliefs about what is "normal" or "usual" in their group (Stone, Becker, Huber, & Catalano, 2012; Wechsler et al., 2003). Finally, peers who use substances provide an avenue of access to these substances (Su, Kuo, Meyers, Guy, & Dick, 2018).

If sexual minority youth are more likely to be close to peers who are also sexual minorities than they are to be close to heterosexual peers, if these peers conceive of their identities as stigmatized and thus feel they have less to lose by adhering to laws and policies prohibiting use of substances, this would provide another mediating factor between restrictive substance use policies and the behavior of sexual minority youth. This further research would require study, first, of sexual minority youths' beliefs about their own status as stigmatized individuals; second, whether they are affected more by other sexual minority youth's norms than by heterosexual youth's norms in terms of their substance use behavior; and third, whether their experiences of stigma and subjective norms are actually mediators in a pathway between substance use policies and health disparities.

4.4 Conclusions

While this study has provided some support for the hypothesis that sexual orientation disparities in tobacco use, drunk driving and marijuana use among girls are associated with sexual minority structural stigma, consistent with the emerging literature on sexual minority structural stigma, it is inconsistent with previous literature in that it does not find a similar pattern of association among boys. It also did not find an association between the restrictiveness of state-level substance use policies and sexual orientation disparities in prevalence of substance use. To advance this literature, I have suggested several important directions for future research that can address some of the limitations in the current study by expanding the range of factors that are considered in the study of policy environments and their effect on the health of sexual minority youth.

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Appendix

Table 49: Model Comparison for Sexual Orientation Disparities and Recent Cigarette Smoking Among Girls

	Model A			Model B			Model C			Model D			Model E		
	Coef	SE	p	Coef	SE	p	Coef	SE	p	Coef	SE	p	Coef	SE	p
LGB	1.419	0.065	0.000	1.376	0.066	0.000	1.203	0.168	0.000	1.381	0.066	0.000	1.381	0.066	0.000
SMSS	0.022	0.005	0.000	-0.049	0.035	0.164	-0.031	0.015	0.041	0.020	0.019	0.276	0.020	0.019	0.276
LGB*S MSS	0.021	0.013	0.102	0.033	0.013	0.011	0.081	0.028	0.004	0.031	0.013	0.015	0.031	0.013	0.015

The appendix shows a comparison of various modeling techniques using one sample outcome among girls (recent smoking), which is statistically significant in the final model in the main text (see Table 16, page 45). Model A is a simple logistic regression predicting recent smoking from LGB status, sexual minority structural stigma (SMSS) and an interaction between the two and ignoring state-specific variation and the complex survey sampling design. Model B is identical to model A, with the addition of a categorical variable representing the state of residence. Model C is identical to model A, with the addition of adjustment for the complex survey sampling design. Model D is a multi-level model with a random intercept by state, while model E is a multi-level model with a random intercept by state and a random slope for the relationship between LGB and recent smoking.

Comparing these models, it is evident that the coefficients differ very little in size, sign or statistical significance. For example, the interaction effect of LGB and SMSS is in the same order of magnitude throughout the variations in modeling techniques and ranges from .021 to .081, with model B, D and E being identical. The model shown in Table 12 in the body of the text shows a larger effect (0.164); however, the effect in the supplementary models is in the same direction and in each case is statistically significant.

This procedure is repeated below for two other outcomes among girls, recent drinking and recent marijuana use. Similar to the results for smoking, here we see very similar estimates across models for recent binge drinking (0.024 to .050) and for marijuana use (.043 to 0.75). In each case, the main models shown in tables 12 (smoking), 13 (drinking) and 16 (marijuana use) show larger effects than these supplementary models; however, all are in the same direction and statistically significant.

Table 50: Model Comparison for Sexual Orientation Disparities and Recent Drinking Among Girls

	Model A			Model B			Model C			Model D			Model E		
	Coef	SE	p	Coef	SE	p	Coef	SE	p	Coef	SE	p	Coef	SE	p
LGB	0.523	0.058	0.000	0.511	0.058	0.000	0.300	0.130	0.021	0.511	0.058	0.000	0.503	0.081	0.000
SMSS	-0.000	0.004	0.900	-0.001	0.023	0.980	-0.025	0.009	0.007	0.011	0.016	0.499	-0.012	0.016	0.479
LGB*SMSS	0.042	0.012	0.000	0.045	0.012	0.000	0.095	0.024	0.000	0.045	0.012	0.000	0.050	0.015	0.001

Table 51: Model Comparison for Sexual Orientation Disparities and Recent Marijuana Use Among Girls

	Model A			Model B			Model C			Model D			Model E		
	Coef	SE	p	Coef	SE	p	Coef	SE	p	Coef	SE	p	Coef	SE	p
LGB	0.889	0.059	0.000	0.909	0.059	0.000	0.662	0.129	0.000	0.908	0.059	0.000	0.908	0.059	0.000
SMSS	-0.029	0.004	0.000	-0.032	0.028	0.268	-0.008	0.010	0.416	-0.023	0.019	0.233	-0.023	0.019	0.233
LGB*SMSS	0.046	0.012	0.000	0.043	0.012	0.000	0.075	0.023	0.001	0.043	0.012	0.000	0.043	0.012	0.000