

A Mixed Methods Approach to Understanding Weight-Related Behavioral
Disparities Among College Students by Sexual Orientation

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Abstract

Very little research to date has explored disparities in weight-related behaviors by sexual orientation. Emerging adulthood is a period during one's life-course where weight-related behaviors, including eating habits and physical activity, tend to deteriorate. Emerging adulthood is also a period where sexual orientation may be explored. Thus, emerging adulthood maybe a critical time period for addressing potential disparities related to sexual orientation in order to ensure more favorable weight-related trajectories for all emerging adults. Previous work on sexual orientation disparities among emerging adults found that LGB women were more likely to be overweight or obese while bisexual men were more likely to be obese than their heterosexual counterparts. Bisexual women and gay men were at particularly high risk compared to their heterosexual counterparts for poor weight-related behaviors including frequent eating away from home, insufficient physical activity, unhealthy weight control behaviors, and binge eating.

Using a mixed-methods approach, this dissertation synthesized secondary data from an existing surveillance system of 2- and 4-year college students with primary data collected on institutional supports for LGB college students and qualitative data collected from LGB college students, to explore disparities in weight-related behaviors by sexual orientation. More specifically, this dissertation addressed three aims: (1) to identify major weight-related behavioral profiles and the extent to which these differ by sexual orientation and gender; (2) to examine the relationship between institutional supports for LGB college students, including campus-based policies and resources, and weight-related

behaviors by sexual orientation; and (3) to explore the context surrounding weight-related health among LGB college students.

For the first aim, data from the 2009-2013 College Student Health Survey (a Minnesota-based survey of 2- and 4-year college students) were used to fit gender-stratified latent class models based on self-reported weight-related behaviors. Differences were examined across five sexual orientation groups: heterosexual, discordant heterosexual (heterosexual-identified, but engaged in any same-sex sexual behavior), gay/lesbian, bisexual, and unsure. Overall, four distinct profiles were identified: “healthier diet” (i.e., low soda consumption and fast food/restaurant use), “moderate diet” (i.e., moderate soda consumption and fast food/restaurant use), “unhealthy weight control” (i.e., high unhealthy weight control behaviors), and “healthier diet, physically active” (i.e., low soda consumption and fast food/restaurant use and high physical activity). Heterosexual and bisexual females exhibited all four profiles, discordant heterosexual females did not exhibit a “moderate diet” profile, and neither gay/lesbian nor unsure females exhibited a “healthier diet, physically active” profile. Among males, heterosexual males exhibited all four profiles, discordant heterosexual males exhibited two profiles (“healthier diet” and “unhealthy weight control”), and gay, bisexual, and unsure males exhibited three profiles (“healthier diet,” “moderate diet,” and “unhealthy weight control”).

For the second aim, the relationship between weight-related behavioral profiles and institutional supports for LGB students was examined. Supports included two categories: institutional-focused LGB supports (including school policies, institution-

administered LGB and diversity organizations, and housing) and student-engaged LGB supports (including courses offered and student-run LGB groups). Institutional-focused LGB supports were associated with more favorable weight-related behavioral profiles for heterosexual and some bisexual women. In contrast, these supports were associated with less favorable weight-related behavioral profiles for some gay and unsure men. Student-engaged LGB supports were not associated with students' weight-related behavioral profiles across sexual orientation and gender.

Finally, for the third aim, individual interviews with LGB, queer, and pansexual college students were conducted. Many participants felt that their sexual orientation helped them be physically active, engage in healthful eating habits, and have a positive body image. However, sexual orientation was also a source of stress that adversely impacted physical activity and eating habits. Participants identified the need for institutional-level interventions to promote physical activity, healthy eating, and positive body image among LGB students.

Overall, findings from this dissertation underscore the importance of sexual orientation as a salient characteristic with regard to weight-related health disparities. Further, in order to address these disparities, there is a need for multi-behavioral interventions that are specifically targeted toward LGB, discordant heterosexual, and unsure students. Tailoring of on-campus interventions and resources should also consider gender differences and the unique experiences and needs of LGB college students, particularly around sexual orientation-related barriers to physical activity, healthy eating, and body image.

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Chapter 1. Introduction and Background

A 2011 report from the Institute of Medicine (IOM) highlighted the dearth of health research on lesbian, gay, bisexual, and transgender (LGBT) communities.¹ In this report, the committee outlined a national research agenda in order to build a stronger foundational knowledge on the health of LGBT people across the life-course. One of the identified priority areas for research was in weight-related health. Since the report, the availability of population-based evidence has grown and indicates that lesbian, gay, and bisexual (LGB) adult women are more likely to be obese,¹⁻⁸ while LGB adult men may be less likely to be obese⁷⁻⁹ compared to their heterosexual counterparts. Findings related to nutrition and physical activity continue to be largely mixed,^{4,6,8,10-16} although some studies have suggested that LGB men may be less physically active than heterosexual men.^{6,10,11} Further, among adult men, cross-sectional studies using convenience samples have suggested that LGB men may be at higher risk of body dissatisfaction¹⁷⁻²¹ and disordered eating compared to heterosexual men,²¹⁻³⁰ while LGB women may be less likely to be dissatisfied with their bodies compared to heterosexual women.^{2,17,21,28,31-35}

The impetus for more LGB weight-related research also comes in light of the increasing prevalence of obesity during the last three decades. Among adults, one-third are considered obese and another third overweight.³⁶⁻³⁸ Excess weight increases risk for a number of other conditions including cardiovascular disease, type 2 diabetes, some cancers, high blood pressure, high cholesterol, liver disease, gallbladder disease, sleep apnea, osteoarthritis, and some gynecological problems.³⁹ While obesity disparities have

been well documented across race/ethnicity and socioeconomic position,^{36,40} disparities across sexual orientation has not received similar attention, in part due to lack of data.¹

This dissertation describes four studies that help address a gap in LGB health and obesity research. These studies focus on LGB college students using a mixed methods approach to understand the relationship between sexual orientation and weight-related health. There are three overarching theoretical frameworks that guide the conceptualization of this dissertation: minority stress, life-course perspective, and social ecological model.

1.1. Sexual orientation and health

Prevalence of sexual orientation. While the IOM report outlines the dearth of health research on LGBT communities (i.e., sexual orientation and gender identity), this dissertation focuses specifically on LGB or sexual orientation. Sexual orientation “refers to an enduring pattern of or disposition to experience sexual or romantic desires for, and relationships with, people of one’s same sex, the other sex, or both sexes.”¹ Within this broader definition, measurement of sexual orientation typically assesses any of three dimensions: identity, behavior, and attraction.^{1,41–44} Although other dimensions of sexual orientation have been characterized (such as sexual fantasy, emotional preference, social preference, or physical preference) they have not been as widely used in public health research.^{42–45}

Sexual identity appears to be the most popular dimension of sexual orientation assessed on population-based surveys in the United States (Table 1). Based on these surveys, it is estimated that the prevalence of LGB identity and same-sex attraction

Table 1. Sexual orientation prevalence estimates from select population-based health surveys

Data source	Year(s)	Age range	Sex	Sexual orientation dimension		
				Attraction	Behavior	Identity
Youth Risk Behavior Survey - Selected Sites	2001-2009	9th-12th grade students	Male and Female		Same-sex: 0.7%-3.9% Both-sex: 1.9%-4.9%	LGB: 3.9%-7.8% Unsure: 1.3%-4.7%
California Women's Health Survey	2001-2005	18+	Female		Same-sex: 1.4% Both-sex: 0.4%	
California Health Interview Survey	2001-2007	18+	Male			Gay: 3.0% Bisexual: 1.2%
			Female			Lesbian: 1.3% Bisexual: 1.5%
	2005	18+	Male			Gay: 2.9% Bisexual: 0.9%
Massachusetts Behavioral Risk Factor Surveillance System	2001-2008	18-64	Male and Female			Gay: 2.0% Bisexual: 1.0%
New Mexico Behavioral Risk Factor Surveillance System	2005-2008	18-64	Male and Female			Gay or lesbian: 1.1%-1.5% Bisexual: 1.0%-1.7%
Washington Behavioral Risk Factor Surveillance System	2003-2006	18-64	Male			Gay: 1.9% Bisexual: 0.9%
			Female			Gay or lesbian: 1.4% Bisexual: 1.6%
National Survey of	2002	15-44	Male	Both-sex: 1.0%	Same-sex: 6.0%	Gay: 2.3%

Family Growth					
	(behavior) 18-44		Mostly same-sex: 0.7%		Bisexual: 1.8%
	(attraction, identity)	Female	Only same-sex: 1.5%		Something else: 3.9%
			Both-sex: 1.9%	Same-sex: 11.2%	Gay or lesbian: 1.3%
			Mostly same-sex: 0.8%		Bisexual: 2.8%
			Only same-sex 0.7%		Something else: 3.8%
2006- 2008	15-44 (behavior) 18-44	Male	Both-sex: 0.5%	Same-sex: 5.2%	Gay: 1.7%
	(attraction, identity)	Female	Mostly same-sex 0.7%		Bisexual: 1.1%
			Only same-sex 1.2%		Something else: 0.2%
			Both-sex: 2.8%	Same-sex: 12.5%	Gay or lesbian: 1.1%
			Mostly same-sex 0.6%		Bisexual: 3.5%
			Only same-sex: 0.8%		Something else: 0.6%

ranges between 2%-5% among adults.^{5,6,9,12,46-48} This finding is consistent with previous estimates from various national surveys during the 1970s and 1980s in the United States and in Europe and Asia, as well as a more recent national survey of adolescents in the United States.^{49,50} In contrast, recent estimates of the percentage of adults reporting same-sex sexual behavior ranged between 5%-13%,⁴⁶ which is higher than earlier estimates of 2%-4% from the 1970s and 1980s.⁵⁰ This discrepancy could be due in part to differences in age ranges (e.g., all adults versus age-limited to 15-44 years old), differences in question wording and comprehension, as well as cultural changes related to sexual orientation and sexual behavior between the 1970s and 2000s. Among youth, the range for LGB identity is wider than that of adults (3%-8%) while students unsure of their sexual identity ranged from 1%-5%.⁵¹

The saliency of any dimension of sexual orientation measured varies depending on the purpose of the research question.^{43-45,52} For example, a researcher interested in HIV/AIDS will be most interested in sexual behavior rather than other dimensions. To date, there is no standardized approach to measure sexual orientation, however, based on existing research, important recommendations in the approach to measuring sexual orientation include: (1) assess as many dimensions of sexual orientation as possible given the study design, (2) consider the population (e.g., youth who are not yet sexually active may not provide useful information on sexual behavior and may not yet have fully developed a sexual identity), and (3) consider the purpose of the research in the determination of sexual orientation measurement.^{42,44,45} These considerations are

important in the measurement of sexual orientation because there have been documented discrepancies in sexual orientation depending on the measures assessed.⁴¹

Sexual orientation and health disparities. Due to the inherently small samples of sexual minority (i.e., individuals whose sexual identity, behavior, or attraction departs from heterosexual norms) youth and adults, as well as the general lack of inclusion of sexual orientation measures in the majority of datasets, existing research on LGB health has relied mostly on convenience samples.¹ There have been very few population-based or large cohort studies. Among existing population-based studies and large cohort studies, evidence suggests that sexual minority youth and adults are at higher risk of suicidal ideation and attempts,^{5,51,53-57} depression,^{53,55-57} poor mental health,^{5,6,51} violence and victimization,^{5,51,53,58,59} alcohol use,^{6,12,51,60,61} tobacco use,^{5,6,12,51,61,62} illicit drug use,^{5,51,63} sexually transmitted infections,⁶⁴ and HIV/AIDS⁶⁴ as well as higher body mass index and disordered eating behaviors.^{1-8,11,13,17-30,65-75} These documented disparities underlie the importance of sexual orientation as a relevant and meaningful factor in a variety of public health issues.

Although there is evidence that sexual minority youth and adults experience worse health than their heterosexual counterparts on a broad variety of indicators, there is a substantial lack of existing theory to explain why these disparities exist. Within existing literature, social stress theory, specifically *minority stress*, has been applied to understanding LGB health. Social stress theory suggests that “conditions in the social environment, not only personal events, are sources of stress that may lead to mental and physical ill effects.”⁷⁶ Social stress theory has been extended to sexual minority people

through the concept of *minority stress*.⁷⁶ Minority stress suggests that for ‘minority’ populations, these stressful social conditions may include experiencing explicit or covert discrimination, stigmatization, or prejudices. As implied by the name, ‘minority’ refers to groups that experience discrimination who are not in the ‘majority,’ such as people of color, youth, people in low socioeconomic positions, people living with disabilities, and of course, individuals whose sexual orientation departs from heterosexuality.

To date, social stress theory, and more specifically, minority stress, is perhaps the most commonly utilized theory to explain the impact of social experiences of sexual minority individuals on their health, particularly mental health. As related to weight-related health, mental health and substance use are associated with weight-related behaviors, such as physical activity, unhealthy weight control behaviors (including using diet pills, taking laxatives, or vomiting), and binge eating,⁷⁷⁻⁸² suggesting that negative experiences related to sexual orientation could also have an adverse impact on these aspects of physical health. However, one limitation of the ‘minority’ framework is that a ‘majority’ group can experience discrimination and oppression. For example, females represent the majority in the U.S. population (estimated at nearly 51% in 2011),⁸³ however, it is well-established that females experience discrimination and oppression.⁸⁴ Thus, females represent a group impacted by ‘minority stress’, although they may not actually be a minority group by definition. Related, power and privilege can lie and be gained by a ‘minority’ group, which may be an important factor in addressing issues of discrimination and oppression. Therefore, when ‘minority stress’ is used throughout this dissertation, it is refers to the social stress that certain groups experience as a result of

oppression and that these groups may or may not actually be a smaller group from the majority population.

Overall, social stress theory, specifically this construct of ‘minority stress,’ provides a general backdrop for the unique discriminatory and oppressive circumstances experienced by many sexual minority people that may make them more prone to adverse health, including the current public health crisis of obesity. Other important frameworks to consider in addressing LGB health include life-course perspective and the social ecological model.¹ These frameworks were also used to guide this dissertation and will be discussed in further detail.

1.2. Obesity and weight-related behaviors among adults by sexual orientation

Overweight and obesity among adults by sexual orientation. Although obesity has been a major public health problem over the last three decades in the United States, little research has explored disparities by sexual orientation. One of the first published studies of excess weight and sexual orientation was conducted by Herzog and colleagues in 1991 and used a convenience sample of homosexual and heterosexual men.¹⁹ This was followed in 1992 by a similar study of a clinic sample of homosexual and heterosexual women.³¹ Herzog and colleagues found in these studies that homosexual men were more likely to weigh less than heterosexual men while homosexual women were more likely to weigh more than heterosexual women.^{19,31} While the body of research on body weight disparities is growing, the majority have focused on women. In a 2008 article, Bowen and colleagues reviewed 15 studies and found that nine studies indicated lesbian women had higher weight and/or obesity rates than heterosexual women, although none of the studies

reviewed used population-based samples.² Recently, studies have used various national and state-specific population-based health datasets. These datasets include the Behavioral Risk Factor Surveillance System (BRFSS), the National Survey of Family Growth (NSFG), the California Women's Health Survey (CWHS), and the California Health Interview Survey (CHIS). The BRFSS is a telephone-based survey of non-institutionalized adults that is administered within each state (additional information is publicly available online: <http://www.cdc.gov/brfss/>). Health topics assessed on the BRFSS vary from year to year but generally cover a wide range of public health issues such as alcohol and tobacco use, health screening, health care access, nutrition and physical activity, weight status, diabetes, cardiovascular disease, and many more. Sexual orientation is considered a state-added question,⁸⁵ meaning that states must specifically include the question on their survey; thus, data is only available for select states (i.e., Washington and Massachusetts). Similar to BRFSS are CWHS and CHIS, which are California-specific public health surveys that assess the health of primarily Californian adults. The CWHS (<http://www.cdph.ca.gov/data/surveys/Pages/CWHS.aspx>) includes only women while CHIS (<http://www.chis.ucla.edu/>) includes both men and women. Content area covered on these surveys is relatively similar to the content covered in BRFSS. The sample of CHIS participants far exceeds that of BRFSS and thus, allows California to provide more detailed estimates for specific geographic regions within the state. Finally, is the NSFG, which is the only national dataset used in the published literature on sexual orientation and weight. In contrast to the telephone-based BRFSS and CHIS, NSFG collects data using in-person interviews and collects a variety of health

information focused more on family life (<http://www.cdc.gov/nchs/nsfg.htm>). While other population-based datasets do collect sexual orientation and health information, these four have been used in exploring the relationship between sexual orientation and weight-related health in peer-reviewed published literature.

Table 2 summarizes the main findings from the studies using population-based samples. Five datasets (i.e., Washington BRFSS, Massachusetts BRFSS, NSFG, CWHs, and CHIS) have been used to assess sexual orientation and overweight. Of the five population-based studies that included women, three found that gay or lesbian and women who partner with women were significantly more likely than heterosexual women to be overweight, with odds ratio (OR) estimates ranging from 1.6-2.7,³⁻⁶ while one study found that only White gay or lesbian women were more likely to be overweight.⁷ In Massachusetts, there did not appear to be a significant difference in overweight status among women by sexual orientation.⁵ Only the Washington BRFSS found a difference between bisexual and heterosexual women [OR (95% confidence interval): 1.6 (1.2-2.0)].⁶ Among men, it appears that gay men are significantly less likely to be overweight than heterosexual men (OR range: 0.4-0.7).^{5-7,9} This finding was also consistent for White, Latino, and Asian gay men in California; there were no significant differences in overweight between heterosexual and gay Black men.⁷ Only in California, among White bisexual men, was there a disparity in overweight, with bisexual men being less likely to be overweight than heterosexual men.⁷ The relationship between sexual orientation and obesity paints a similar picture to overweight, with gay or lesbian women and women who partner with women significantly more likely to be obese (OR range: 1.4-4.1) and

Table 2. Summary of sexual orientation and weight status findings from population-based data

Indicator	Data source (year) ^a	Age Range	Race/Ethnicity	Sexual orientation measure	Estimates ^b	
					Males	Females
Overweight	WA BRFSS (2003-2006)	18+		Gay or lesbian	0.6 (0.4-0.8)*	1.6 (1.3-2.0)*
				Bisexual	0.9 (0.6-1.4)	1.6 (1.2-2.0)*
	MA BRFSS (2001-2008)	18-64		Gay or lesbian	0.5 (0.4-0.7)*	1.1 (0.8-1.4)
				Bisexual	0.7 (0.4-1.2)	1.1 (0.8-1.6)
	NSFG (2002)	20-44		Lesbian		2.7 (1.4-5.2)*
				Bisexual		1.4 (0.9-2.2)
				Other		1.1 (0.7-1.7)
	CWHS (2001-2005)	18+		Same-sex partner		2.4 (1.4-4.0)*
				Both-sex partners		0.6 (0.3-1.5)
	CHIS (2005)	18+		Homosexual/bisexual	0.7 (0.5-0.9)*	
	CHIS (2001-2007)	18+	White	Gay or lesbian	0.6 (0.5-0.7)*	1.4 (1.1-1.7)*
				Bisexual	0.7 (0.5-0.9)*	1.0 (0.8-1.3)
Latino			Gay or lesbian	0.4 (0.2-0.6)*	1.0 (0.4-2.1)	
			Bisexual	1.1 (0.6-2.1)	0.8 (0.5-1.4)	
Asian			Gay or lesbian	0.4 (0.2-0.8)*	1.2 (0.3-4.7)	
			Bisexual	0.6 (0.2-1.6)	1.8 (0.9-3.3)	
Black			Gay or lesbian	0.9 (0.5-1.9)	1.3 (0.5-3.0)	
			Bisexual	0.3 (0.1-1.0)	1.1 (0.6-2.3)	
Obesity	WA BRFSS (2003-2010)	50+		LGB	0.7 (0.6-0.9)*	1.4 (1.2-1.7)*
	MA BRFSS (2001-2008)	18-64		Gay or lesbian	0.5 (0.3-0.6)*	2.1 (1.6-2.7)*
				Bisexual	0.9 (0.5-1.7)	1.3 (0.8-2.0)
	NSFG (2002)	20-44		Lesbian		2.5 (1.2-5.1)*
				Bisexual		0.9 (0.6-1.5)

			Other		0.8 (0.5-1.2)
CWHS (2001-2005)	18+		Same-sex partner		4.1 (2.5-6.7)*
			Both-sex partners		0.5 (0.2-1.3)
CHIS (2005)	18+		Homosexual/bisexual	0.5 (0.4-0.8)*	

* Indicates statistically significant difference compared to heterosexual adults

^a WA BRFSS: Washington Behavioral Risk Factor Surveillance System; MA BRFSS: Massachusetts Behavioral Risk Factor Surveillance System; NSFG: National Survey of Family Growth; CWHS: California Women's Health Survey; CHIS: California Health Interview Survey

^b OR (95% CI) presented with heterosexual as the referent group, unless otherwise specified

gay men significantly less likely to be obese (OR: 0.5-0.7) than their heterosexual counterparts.^{3-5,7-9} These population-based findings further confirm the initial findings from the convenience sample studies conducted by Herzog and colleagues in the early 1990s as well as other non-population-based studies reviewed by Bowen and colleagues.^{2,19,31}

While population-based data provide valuable and reliable information on these weight disparities, they are limited in that data are cross-sectional and longitudinal trends across the life-course to identify changes in behaviors cannot be determined. Longitudinal data on obesity trends by sexual orientation is very limited. We were able to identify only one study using data from the Growing Up Today Study (GUTS), which is a cohort study of the children of the nurses from the Nurses' Health Study II. The Growing Up Today Study includes an assessment of sexual orientation that has been cognitively tested among adolescents and young adults.⁸⁶ Based on these cognitive tests, young people prefer to have intermediary sexual orientation labels such as "mostly heterosexual" and "mostly homosexual." Thus, the response options included, "completely heterosexual (attracted to persons of the opposite sex)," "mostly heterosexual," "bisexual (equally attracted to men and women)," "mostly homosexual," "completely homosexual (gay/lesbian, attracted to persons of the same sex)," and "not sure."⁷³ Using GUTS data, researchers examined longitudinal trends in obesity from adolescence into young adulthood (ages 12-23 years), "mostly heterosexual" and LGB girls had consistently higher BMI compared to heterosexual girls. Among boys, heterosexual boys gained more weight over time compared to non-heterosexual boys.⁷³

These findings highlight the importance of the development of sexual orientation and weight across the lifespan. Despite the longitudinal strength of GUTS, it is limited in that the study participants are not representative of the general population (i.e., this is not a population-based study). More specifically, participants are all children of nurses, representing a sociodemographic group that is different from the make-up of the overall U.S. population.

Physical activity, sedentary behaviors, and nutrition among adults by sexual orientation. Poor physical activity and nutrition, as well as excessive sedentary behaviors are the most proximal behavioral causes of excess weight.⁸⁷ Given evidence of disparities in overweight and obesity across sexual orientation, it is likely that there are also disparities in these proximal behavioral causes of excess weight. Further, these behaviors are often the target of interventions in order to address weight loss and/or maintenance. However, only three population-based surveys have been used to assess the relationship between sexual orientation and physical activity or fruit and vegetable consumption: Washington BRFSS, CHIS and CWHS (Table 3).^{4,6} No population-based surveys have explored the relationship between sexual orientation and sedentary behaviors, such as television viewing. Both the Washington BRFSS and CWHS studies do assess the relationship between sexual orientation and limited activity due to poor physical or mental health,^{4,6} however, this is not a generally accepted measurement of sedentary behavior.⁸⁷

For women, physical activity findings were relatively mixed (Table 3). Studies using the Washington BRFSS and CWHS did not find significant differences in physical

activity across sexual orientation.^{4,6} However, CHIS data indicated that 18-50 year old gay or lesbian women were more likely to engage in moderate physical activity compared to heterosexual women [OR (95% CI): 1.4 (1.1-1.9)] and bisexual women 50 years or older were more likely to engage in strengthening physical activity [OR (95% CI): 1.3 (1.0-1.6)].¹² Previous studies using large cohort data and convenience samples also suggested that LGB women may be more physically active than heterosexual women.^{13-15,88}

Among men, there were no significant differences in physical activity between gay men and heterosexual men in Washington; however, bisexual men were more likely to meet physical activity recommendations than heterosexual men [OR (95% CI): 1.9 (1.1-3.4)].⁶ In California, bisexual men 50 years or older were more likely to engage in vigorous physical activity [OR (95% CI): 1.7 (1.1-2.5)] and 18-50 year old gay men were more likely to engage in strengthening physical activity [OR (95% CI): 1.5 (1.2-1.8)] than their heterosexual counterparts.¹²

Fruit and vegetable consumption has been the only measure used in the assessment of sexual orientation differences in nutrition (Table 3). There were generally no significant differences in fruit and vegetable consumption across sexual orientation among men or women in Washington and California.^{4,6,12} The exception is that gay or lesbian women 50 years or older were less likely to meet fruit and vegetable consumption recommendations [OR (95% CI): 0.6 (0.4-0.9)].¹² One study using cohort data found that women who had sex with women were less likely to consume fruits and vegetables compared to heterosexual women.¹⁶ The limited number of studies and lack of other

Table 3. Summary of sexual orientation, physical activity, and nutrition findings from population-based data

Indicator	Data source (year) ^b	Age Range	Sexual orientation measure	Estimates ^a	
				Males	Females
Physical Activity	WA BRFSS (2003-2006) ^c	18+	Gay or lesbian	1.0 (0.7-1.5)	1.1 (0.8-1.5)
			Bisexual	1.9 (1.1-3.4)*	1.0 (0.7-1.4)
	CHIS (2001-2007) ^d	18-50	Gay or lesbian	1.0 (0.8-1.2)	1.3 (1.0-1.7)
			Bisexual	1.2 (0.8-1.7)	1.1 (0.9-1.4)
		50+	Gay or lesbian	1.0 (0.8-1.4)	1.2 (0.8-1.6)
			Bisexual	1.7 (1.1-2.5)*	1.2 (0.9-1.6)
	CHIS (2001-2007) ^e	18-50	Gay or lesbian	0.9 (0.7-1.1)	1.4 (1.1-1.9)*
			Bisexual	0.9 (0.7-1.3)	1.2 (0.9-1.5)
		50+	Gay or lesbian	1.0 (0.7-1.2)	1.1 (0.8-1.6)
			Bisexual	1.2 (0.8-2.0)	1.0 (0.7-1.4)
	CHIS (2001-2007) ^f	18-50	Gay or lesbian	1.5 (1.2-1.8)*	1.1 (0.8-1.3)
			Bisexual	1.4 (1.0-1.9)	1.3 (1.0-1.6)*
50+		Gay or lesbian	1.2 (0.9-1.5)	1.0 (0.8-1.4)	
		Bisexual	1.5 (1.0-2.2)	0.8 (0.6-1.1)	
CWHS (2001-2005) [% (CL)] ^g	18+	Opposite-sex partner		59.3% (58.4%-60.2%)	
		Same-sex partner		57.3% (47.7%-66.9%)	
		Both-sex partners		60.1% (44.9%-75.2%)	
Fruit and vegetable consumption	WA BRFSS (2003-2006) ^h	18+	Gay or lesbian	0.7 (0.5-1.0)	1.1 (0.7-1.5)
			Bisexual	0.7 (0.4-1.2)	1.2 (0.8-1.7)
	CHIS (2001-2007) ⁱ	18-50	Gay or lesbian	1.0 (0.8-1.2)	1.1 (0.8-1.4)
			Bisexual	1.2 (0.8-1.8)	0.8 (0.6-1.1)

	50+	Gay or lesbian	1.0 (0.8-1.4)	0.6 (0.4-0.9)*
		Bisexual	1.1 (0.7-1.8)	1.0 (0.7-1.5)
CWHS (2001-2005)	18+	Opposite-sex partner		3.2 (3.2-3.3)
[mean (CL)] ^j		Same-sex partner		3.2 (2.9-3.6)
		Both-sex partners		3.2 (2.5-3.9)

* Indicates statistically significant difference at p<0.05 compared to heterosexual adults

^a OR (95% CI) presented with heterosexual as the referent group, unless otherwise specified

^b WA BRFSS: Washington Behavioral Risk Factor Surveillance System; MA BRFSS: Massachusetts Behavioral Risk Factor Surveillance System; NSFG: National Survey of Family Growth; CWHS: California Women's Health Survey; CHIS: California Health Interview Survey

^c Did not meet recommendations: less than 30 minutes of moderate activity per day on 5 days or more days per week OR less than 20 minutes of vigorous activity per day on 3 or more days per week OR not spending most of the time at work walking or doing heavy labor or physically demanding work

^d Vigorous activity in the past week

^e Moderate activity in the past week

^f Strengthening activity in the past week

^g Did not meet recommendations: less than 30 minutes per day on 5 or more days per week

^h less than 5 times per day

ⁱ five or more fruits and vegetables per day

^j number of servings

nutrition indicators make it difficult to draw meaningful conclusions from the data, although there do not appear to be substantial differences in fruit and vegetable consumption across sexual orientation.

One longitudinal study examining physical activity across sexual orientation using GUTS data found that LGB males and females as well as “mostly heterosexual” females consistently reported less moderate-to-vigorous physical activity over time than their heterosexual counterparts.¹⁰ No longitudinal studies have explored sexual orientation trends in sedentary behavior or nutrition.

Body dissatisfaction and disordered eating by sexual orientation. Based on existing longitudinal research, primarily among females, body dissatisfaction is a potential consequence of increased weight and a potential risk factor for disordered eating.⁸⁹⁻⁹¹ Disordered eating behaviors may include bingeing, vomiting, laxative or diuretic use, frequent dieting, and/or fasting. None of the adult population-based studies on sexual orientation disparities have examined disordered eating behaviors or body dissatisfaction.

Cross-sectional studies using convenience samples of adults, including a meta-analysis of studies, have typically found that gay men are more likely to be dissatisfied with their bodies compared to heterosexual men.¹⁷⁻²¹ For women, cross-sectional studies of convenient samples suggest that lesbian women may be less likely to be dissatisfied with their bodies compared to heterosexual women.^{2,17,21,28,31-35} In a meta-analysis of cross-sectional studies, there was a very small difference in body dissatisfaction between

lesbian and heterosexual women, with lesbian women being slightly more satisfied with their bodies.¹⁸

One population-based study of Minnesota adolescents found that homosexual boys were more likely to have a negative body image compared to heterosexual boys (27.8% vs. 12.0%, respectively) while among girls, homosexual and bisexual girls were less likely to have a negative body image compared to heterosexual girls (21.1%, 28.4% vs. 43.7%, respectively).⁹² However, no other population-based study has since explored this potential disparity in body dissatisfaction among youth.

Similar to research on body dissatisfaction disparities by sexual orientation, there have not been population-based studies among adults exploring disparities in disordered eating by sexual orientation. Cross-sectional studies using convenience samples, often clinic samples, have indicated that gay men may be more likely to exhibit disordered eating behaviors compared to heterosexual men.²²⁻³⁰ Among women, cross-sectional findings have been mixed potentially due to differences in sampling.^{2,23}

Several population-based studies of youth have explored disordered eating disparities by sexual orientation.^{51,92,93} Austin and colleagues utilized data from cities and states that collected sexual orientation data on the 2005 and 2007 Youth Risk Behavior Survey, a population-based survey (at the state-level or city-level) of high school students, to assess disordered eating disparities by sexual orientation. Findings indicated that LGB girls and girls unsure about their sexual orientation were more likely to engage in purging behaviors (OR range: 2.6-4.0) and use diet pills (OR range: 1.9-4.0) compared to heterosexual girls. Similarly, LGB boys and boys unsure about their sexual orientation

were more likely to engage in purging behaviors (OR range: 3.8-6.2) and use diet pills (OR range: 3.0-6.8) compared to heterosexual boys.⁹³ A recent study using the same data from Rosario and colleagues found that sexual minority (reported same-sex or both-sex sexual attraction or behavior, or reported a non-heterosexual sexual identity) youth, across four racial/ethnic groups (white, Latino, black, and Asian), consistently reported more purging behaviors (OR range: 5.3-7.6 among males; OR range: 2.4-3.0 among females).¹¹

As far as cohort studies, Austin and colleagues conducted a longitudinal study using GUTS data to explore binge eating and purging behaviors by sexual orientation among young people between the ages of 12 and 23 years.⁷² Findings from this study indicate that there were differences in disordered eating by sexual orientation throughout adolescence and that LGB and “mostly heterosexual” boys and girls were more likely to binge eat than their heterosexual counterparts. In addition, “mostly heterosexual” and bisexual girls and LGB and “mostly heterosexual” boys were more likely to purge than heterosexual youth. These studies among youth can help inform expected findings among emerging adults and adults.

There is a substantial lack of population-based studies exploring body dissatisfaction and disordered eating disparities by sexual orientation among adults. Existing research using convenient samples of adults and population-based and longitudinal study of adolescents suggests that there may be important and meaningful differences in body dissatisfaction and disordered eating behaviors across sexual orientation groups that need to be addressed.

Weight-related behavior patterning by sexual orientation. Existing studies on weight and weight-related behaviors by sexual orientation have explored independent associations of sexual orientation with specific behaviors (e.g., moderate physical activity, binge eating). No study has explored the patterning of these behaviors among LGB persons. Behavioral patterning has been used in other research to identify subgroups of people who exhibit similar behaviors in areas such as substance use,^{94,95} mental health,⁹⁶ and pain.⁹⁷ The advantages of behavioral patterning can be used in the exploration of weight-related behaviors because it allows researchers to understand the relationships of a broad variety of behaviors. For example, based on the studies examining specific behaviors, one might expect many gay men to simultaneously experience adequate physical activity and engaging unhealthy weight control behaviors. This patterning of weight-related behaviors is useful information in developing interventions because it highlights co-occurring behaviors that would need to be addressed in order to be more effective. Unfortunately, this behavioral patterning area of weight-related research has not been explored with regard to sexual orientation.

1.3. Emerging adult weight-related health and sexual orientation

As illustrated in the study by Boehmer and colleagues using CHIS data, age is an important factor in understanding the relationship between sexual orientation and health.¹² This aligns with the *life-course perspective*. The core construct to life-course perspective is that developmental trajectories change as a result of social experiences and interactions throughout one's lifespan.⁹⁸ With respect to health, life-course perspective also emphasizes the variation in health needs and experiences by life stage and birth

cohort.⁹⁸ Based on the life-course perspective, this dissertation will focus on the specific life stage of emerging adulthood, in order to more clearly understand weight-related disparities by sexual orientation (explained in detail below).

Emerging adult weight-related health. Emerging adulthood, typically defined as 18-25 years, is a developmental stage in one's life-course between adolescence and adulthood where, generally, independence is established and new responsibilities, life skills, and identities are negotiated and formed.⁹⁹ Unique aspects of emerging adulthood include the increase in autonomy compared to adolescence, yet less commitments to responsibilities such as workplace standards, home maintenance, or parenting young children compared to most working adults. Certainly, these experiences may not be true for all emerging adults, some of whom may be limited in their ability to use these years for development and exploration for a variety of reasons. Volatility during emerging adulthood makes it an important period during one's life-course. Further, one unique aspect of emerging adulthood that many in this age experience is attending college. Recent estimates indicate that nearly half of emerging adults attend a post-secondary institution.¹⁰⁰

Existing evidence suggests that weight-related health generally declines during emerging adulthood, with noted weight gain and deterioration of diet quality and physical activity.¹⁰¹⁻¹⁰³ Longitudinal data indicates that the prevalence of obesity doubles between adolescence and emerging adulthood and then doubles again from emerging adulthood to adulthood (defined as about 30 years of age or older).¹⁰⁴ Additionally, fruit and vegetable intake decreases from adolescence into emerging adulthood,¹⁰⁵ sugar-sweetened soft

drinks or fruit drink consumption is higher among 19-39 year olds than other adult age groups,¹⁰⁶ fast food consumption increases, breakfast consumption decreases,¹⁰⁷ moderate-to-vigorous physical activity decreases from adolescence to emerging adulthood, continuing into adulthood,¹⁰⁸⁻¹¹⁰ and sedentary behaviors increase.^{108,109,111}

Some studies have suggested that emerging adulthood is a time of widening health disparities.^{101,112-118} For example, one longitudinal study following adolescents into young adulthood found that while weight-related health decreased overall during this transition, differences by race/ethnicity generally increased.¹⁰¹ In another longitudinal study, Scharoun-Lee and colleagues found that the relationship between socioeconomic position and obesity did not differ significantly by race/ethnicity, despite disparities across race/ethnicity; thus indicating that emerging adulthood may be a critical time for addressing the widening race/ethnicity disparity.¹¹⁷ Overall, these studies suggest that emerging adulthood is an important developmental period in the life-course where individual trajectories can have an adverse impact on weight-related health disparities.

Emerging adult sexual orientation weight disparities. Although existing evidence suggests that emerging adulthood is a period of deteriorating weight-related health, there is a lack of research that has explored potential disparities across sexual orientation during emerging adulthood. Adolescence and emerging adulthood is a period for sexual orientation exploration and development,^{41,49,119} thus may be an important time for ensuring that health trajectories between non-heterosexual and heterosexual emerging adults do not yield health disparities later during the life-course.

Of the existing population-based studies discussed earlier, none have focused specifically on emerging adulthood.^{3-6,9,12} Our previous research on sexual orientation disparities among college students found that LGB women were more likely to be overweight or obese, while only bisexual men were more likely to be obese than their heterosexual counterparts.⁷⁵ With regard to weight-related behaviors, bisexual women in particular were at high-risk in terms of poor weight-related behaviors, specifically around breakfast consumption, eating out at restaurants, engaging in strengthening physical activities, unhealthy weight control behaviors, and binge eating. Among men, gay men were at high-risk for high diet soda and restaurant food consumption, insufficient moderate, strenuous, and strengthening physical activities, unhealthy weight control behaviors, and binge eating.

Similarly, there is a lack of longitudinal studies that explore sexual orientation disparities during emerging adulthood. Two longitudinal studies using GUTS data have highlighted disparities in BMI and disordered eating behaviors across sexual orientation from adolescence into young adulthood (ages 12-23 years).^{72,73} Both of these longitudinal studies highlight important differences in BMI and disordered eating by sexual orientation among young people and further support the need for more weight-related research in this age group.

1.4. Emerging adulthood, sexual orientation, and weight-related health in context

Thus far, the literature reviewed has focused on disparities across sexual orientation at an individual level. Although identifying these differences is important in order to inform research priorities, these differences need to be interpreted using a larger

lens that includes the context in which these sexual orientation health disparities exist. Both minority stress and life-course perspective emphasize the importance of social experiences as a contributing factor to one's health and trajectory. Social experiences represent one aspect of the context that is salient to understanding individual health behaviors. This contextual relationship is characterized in the *social ecological model*.

The social ecological model provides a framework for conceptualizing the multiple levels of influence on an individual's health.¹²⁰ These levels of influence on the individual include the interpersonal (mesosystem), organizational (exosystem), community (exosystem), society (macrosystem), and time (chronosystem).¹²¹ Examples of discriminatory social experiences for non-heterosexual emerging adults across the multiple levels of the social ecological model can include experiencing victimization (interpersonal level), not being hired for a job because of one's sexual orientation (organizational level), not having a safe public space (community level), or being denied legal rights granted to other citizens (society level). Moreover, the historical context (time level) in which all of the other levels exist is very important and for non-heterosexual emerging adults, has created particularly unique circumstances for understanding weight-related health.

With regard to weight issues, today's emerging adults were among the first generation to be born following the dramatic increase in obesity during the 1980s and 1990s. Related, emerging adults have experienced their entire life in an obesogenic (or obesity promoting) environment at all levels of the social ecological model.^{38,122}

As far as sexual orientation, several important milestones or events have shifted the social climate for LGB communities. First, today's emerging adults are among the first generation to be born following the removal of 'homosexuality' from the *Diagnostic and Statistical Manual of Mental Disorders*. Furthermore, the 1980's AIDS epidemic brought into light for the first time the public health importance of the LGB community, raising awareness of their unique health needs and demanding public health visibility at a national level. Within the academy was the introduction of queer theory,¹²³ which examines different aspects of gender and sexuality, as well as further development of queer studies and LGBT studies curricula throughout the 1990's. Additionally, there have been several significant federal policies, namely the passage and subsequent repeal of 'Don't Ask, Don't Tell' and the legalization of same-sex marriages over the past decade. Simultaneously occurring has been the increased visibility of prominent LGBTQ public figures, as well as LGBTQ allies, an increase in LGBTQ characters and story arcs on television shows and on film. Overall, these events have shifted the context of the lives of sexual minority emerging adults over time to create a unique set of circumstances that impact the developmental trajectories of this generation of compared to previous generations.

Understanding the social context, in general, is critical in order to effectively address public health problems. For example, within obesity research, there have been tremendous efforts to understand the relationship between social factors and individual health.^{87,124-128} Many of these efforts have also focused on the school context, particularly primary and secondary schools as a way to shift the health of students.¹²⁹⁻¹³¹

Furthermore, the social context has been a point for intervention with efforts such as social marketing campaigns to shift social norms in order to create more sustainable behavior change at the individual level.^{132,133} Despite the great body of work on the social context and weight health, there has been a substantial lack on LGB individuals. Both inherent in the social ecological model as well as demonstrated in current public health work to address obesity, in order to more effectively address the health of LGB emerging adults, it is important to gain an understanding of the social context.

Social context and LGB health. Several studies have focused on individual perceptions of the social context and not on the social context itself. There has been a growing body of work by Hatzenbuehler and colleagues, on different aspects of the social context and the relationship with LGB health at an individual level.¹³⁴⁻¹⁴⁷ Table 4 summarizes the measures of the LGB social context and findings from these studies (focusing particularly on young people) as well as two studies by Eisenberg and colleagues on the college context and LGB health. These studies assess different aspects of the social context including social networks, religious climate, and school-based characteristics. Social networks included assessments of social isolation, degree of connectedness, and social status.^{138,141} Religious climate was measured based on the degree of support different religions have for the LGB community and the degree of religious adherence.¹⁴⁰ Finally school-based characteristics included the presence of Gay-Straight Alliances (GSA), school anti-bullying and anti-discrimination policies that include sexual orientation as a protected group, and resources available to LGB students at the school.^{137,138,142,144} Furthermore, the proportion of same-sex couples was used as a

measure of the social context.¹³⁶⁻¹³⁸ Overall, these studies found that unsupportive LGB social contexts were associated with worse health outcomes, particularly greater mental health issues and substance use, for LGB youth. Unsupportive LGB social contexts included low concentrations of same-sex couples, schools that did not provide LGB resources (through a GSA or anti-bullying or anti-discrimination policies), living surrounded by religious climates that did not support LGB, and being socially isolated.

To highlight the findings of one study as an example of the association between the social context and LGB health, LGB-supportive social environments were associated with decreased tobacco use in youth [OR (95% CI): 0.92 (0.90-0.94)].¹³⁷ This study used population-based data and created an index of the LGB social environment which included the proportion of same-sex couples, whether there was a GSA in the school, and whether sexual orientation was included in school policies on anti-bullying and anti-discrimination. Other studies tended to use a specific aspect of the social context (e.g., a specific state policy) rather than a more comprehensive assessment, such as this index.

The majority of these studies utilized cross-sectional analyses, thus limiting the ability to determine the temporality between the social context and the health outcome. One study examining mental health among adults was prospective and found that the passage of a state constitutional ban on same-sex marriage led to an increase in psychiatric disorders, namely mood disorders (increased by 36.6%), generalized anxiety disorder (increased by 248.2%), and psychiatric comorbidities (increased by 36.3%), among LGB adults in those states compared to before the passage of the ban.¹³⁵ Furthermore, the passage of a constitutional ban also adversely impacted the mental

Table 4. Summary of sexual orientation social context and the relationship with health

Article	LGB Social Context Measure	Health Outcome	Major Findings
Hatzenbuehler et al, 2011	County-level concentration of same-sex couples Proportion of schools with gay-straight alliances Proportion of schools with anti-bullying policies that protect LGB students Proportion of schools with anti-discrimination policies including sexual orientation	Tobacco use	LGB supportive social contexts (based on a score of the four environmental measures) was associated with lower tobacco use among LGB youth [OR (95% CI): 0.92 (0.90-0.94)]
Hatzenbuehler et al, 2011	County-level concentration of same-sex couples County-level concentration of Democrats Proportion of schools with gay-straight alliances Proportion of schools with anti-bullying policies that protect LGB students Proportion of schools with anti-discrimination policies including sexual orientation	Suicide attempts	LGB supportive contexts was associated with fewer suicide attempts [OR (95% CI: 0.97 (0.96-0.99)]

Hatzenbuehler et al, 2012	LGB-supportive religious climate	Alcohol abuse Tobacco use Number of sexual partners	Religious climate modified the relationship between sexual orientation and alcohol abuse and sexual orientation and number of sexual partners [OR (95% CI): alcohol abuse, 0.58 (0.40-0.85); sexual partners 0.77 (0.60-0.99)]
Hatzenbuehler et al, 2012	Social isolation (measured as <i>in-degree</i> , the number of students in the school who nominated the participant, and <i>out-degree</i> , the number of students in the school nominated by the participant) Degree of connectedness Social Status	Depressive symptoms	Social networks was most strongly associated with depression for same-sex and both-sex attracted male youth [Same-sex attracted males (beta (SE)): out-degree (-0.15 (0.03)), social status (-0.69 (0.15)), degree of connectedness (-0.01 (0.00)); Both-sex attracted males (beta (SE)): out-degree (-0.07 (0.02)), social status (-0.39 (0.12)), degree of connectedness (-0.01 (0.00))]
Hatzenbuehler et al, 2013	Anti-bullying policies in school districts at county-level	Suicide attempts	Policies including sexual orientation were associated with reduced risk for suicide attempts [0.18 (0.03-0.92)] for lesbian and gay students. Not including sexual orientation was not associated with suicide attempts.
Hatzenbuehler et al, 2014	Proportion of schools with: Gay-straight alliances Anti-bullying policies that protect LGB students LGB-inclusive curricula Safe spaces for LGB students Professional development for staff on safe and supportive school environments Programs that facilitated access to off-campus health services to	Suicidal thoughts, plans, attempts	More LGB protective school climates was associated with fewer suicidal thoughts among LGB students [OR (95% CI): lesbian or gay: 0.68 (0.47-0.99); bisexual: 0.81 (0.66-0.99)]. There were not significant differences between school climate and suicidal plans and attempts across sexual orientation.

LGB students
 Programs that facilitated access
 to off-campus social and
 psychological services to LGB
 students

Eisenberg, 2002	<i>LGB Resource Index:</i> Presence of LGB student organization Age of LGB student organization Frequency of LGB student organization activities Dedicated staff for LGB students Anti-discrimination policy that protects LGB students LGB studies department LGB courses LGB-friendly housing Programs that offer protection and services to LGB students	Condom use	More LGB supportive college contexts was associated with increased condom use among sexually active students, primarily students with only opposite-sex partners [beta=0.84, p<0.001] There was no significant difference in LGB college context and consistent condom use among students who had same-sex sexual experiences
Eisenberg et al, 2003	<i>LGB Resource Index</i>	Cigarettes smoking Binge drinking	More LGB supportive college contexts was associated with lower cigarette smoking among women [OR (95% CI): 0.92 (0.87-0.97)] and higher binge drinking among LGB men [OR (95% CI): 1.10 (1.02-1.20)]

health of heterosexual adults living in those states, although to a lesser degree than for LGB adults.¹³⁵

College context and LGB emerging adult health. When addressing emerging adult health, the college context is a uniquely important context to consider. In 2012, an estimated 41% of 18-24 year olds, nationally, attended a postsecondary institution, thus representing a critical mass of emerging adults.¹⁰⁰ Similar to how high school contexts are associated with the health of LGB adolescents who attend high school,¹³⁷ the college social context may be associated with the health of LGB emerging adults who attend college.

The importance of the college context on LGB students has been highlighted in a number of studies that assess discrimination, psychological issues, and heterosexual student attitudes toward LGB students.¹⁴⁸ To a lesser degree, LGB student experiences within the college context have been explored.¹⁴⁸ Recently, one study using data from the 2004 National Study of Living-Learning Programs, a study to explore the experiences of students in a learning program, assessed LGB student satisfaction and found that on average LGB students were more satisfied, although the difference was very small, with faculty and staff interactions than heterosexual students. More specifically, compared to lesbian, gay, and heterosexual students, bisexual students were the most satisfied with these interactions (beta=0.02, p<0.05).¹⁴⁹ These studies illustrate how LGB students may have different relationships and experiences of the college environment compared to heterosexual students. These varying experiences may yield differential relationships

with student health, particularly for LGB students who may be experiencing more discrimination than heterosexual students on college campuses.

There are a very limited number of studies that examine the association between the college environment and LGB health. Only two studies (Table 4), both by Eisenberg and colleagues, were identified that explored the LGB college environment and LGB student health. These studies assessed the LGB college environment through the use of an index that included (1) the presence of a student LGB organization, (2) the length of time the organization had been in existence, (3) the frequency of the organization's meetings and activities, (4) the presence of dedicated staff for LGB students, (5) the inclusion of sexual orientation in anti-discrimination policies, (6) the presence of a LGB studies department, (7) the number of LGB courses offered, (8) the presence of LGB housing, and (9) the presence of programs that protect LGB students. Given the dearth of literature on the LGB college context, this index is the most comprehensive assessment to date. In one study assessing the relationship between the LGB college context and condom use among sexually active students, there was a significant positive association between the LGB college context and consistent condom use among all students (beta=0.84, $p<0.001$); that is the more LGB resources (as measured in the index) there were on the college campus, the more students were using condoms. However, among students who had same-sex sexual experiences, the relationship between the LGB college context and consistent condom use was not significant.¹⁵⁰ In the other study using the LGB college context index, Eisenberg and colleagues examined the association with cigarette use and binge drinking. The LGB college context was significantly associated with lower

cigarette smoking among LGB women [OR (95% CI): 0.92 (0.87-0.97)] and an increase in binge drinking among LGB men [OR (95% CI): 1.10 (1.02-1.20)]. Furthermore, the percentage of students with same-sex sexual experience was positively associated with cigarette smoking among women [OR (95% CI): 1.06 (1.00-1.16) and binge drinking among men [OR (95% CI): 1.16 (1.01-1.32)].¹⁵¹

Overall, there is a great dearth of literature on the relationship between the social environment and LGB health, particularly the college environment. No study to date has explored the relationship of the social environment or specifically, the college social environment, on weight health among LGB individuals. Given the importance of the social environment as a point to intervene to create sustainable individual behavior change, the lack of research is a major gap that needs to be addressed.

1.5. Conclusions

Based on the review of literature, there is a general lack of research that examines the relationship between sexual orientation and weight-related health, particularly during emerging adulthood, which is a critical developmental stage during the life-course with regard to both sexual orientation and weight-related health. Population-based studies have documented disparities across sexual orientation among adults in overweight and obesity, with gay or lesbian women more likely to have excess weight while gay men are less likely to have excess weight than their heterosexual peers. Findings for physical activity and nutrition are more mixed. However, differences in assessment of physical activity as well as lack of robust measures of nutrition (that is measures beyond fruit and vegetable consumption) may account for inconsistent and null findings. Only one

population-based study has explored disordered eating among emerging adults, and few studies have examined this issue among youth.

Furthermore, existing research suggests that unsupportive LGB social contexts tend to be associated with worse health (particularly mental health and cigarette use) among LGB youth and adults. However, there is a substantial lack of research on the social context of weight-related health among LGB emerging adults. Understanding the social context is critical in order to develop effective and sustainable interventions to address these disparities.

Due to the lack of research that exists on sexual orientation and weight-related health, the overall goal of this dissertation was to understand the relationships between sexual orientation and weight-related behaviors among college students. To address this, mixed methods were used to synthesize data from an existing surveillance system of 2-year and 4-year college students, newly collected data on characteristics of institutions participating in the surveillance system, and individual interviews with LGB college students. Thus, the aims of this study are:

Aim 1: To identify major weight-related behavioral profiles and the extent to which these differ by sexual orientation and gender.

Aim 2: To examine the relationship between institutional supports for LGB college students and weight-related behaviors by sexual orientation.

Aim 3: To explore the context surrounding weight-related health among lesbian, gay, and bisexual college students.

Chapter 2. College Student Health Survey

2.1. Overview, recruitment, and data merging

Overview. The College Student Health Survey (CSHS) is a statewide surveillance system in Minnesota. Initiated in 1995 to monitor health behaviors at the University of Minnesota, this system is overseen by the Boynton Health Service at the University of Minnesota. Beginning in 2007, CSHS was administered online (with the exception of two schools that completed a paper-and-pencil survey in 2007) throughout the state, surveying both 2-year community and technical colleges and 4-year colleges/universities annually. Students anonymously complete the survey which covers multiple areas of health including: health insurance and health care utilization, mental health, alcohol and other drug use, tobacco use, personal safety, financial health, nutrition and physical activity, and sexual health.

Institutional selection and participation. Educational institutions participating in CSHS do so voluntarily. Between 2009 and 2013, a total of 46 institutions participated in CSHS, of which 26 are two-year institutions. This sample of institutions represents over three-quarters of all institutions in the Minnesota State Colleges and Universities system, University of Minnesota system, and Minnesota Private College Council. Additional details on the schools that participated in CSHS, including all surveys, are publicly available online.¹⁵²

Student selection and participation. For most schools, students are randomly selected (between 12.5% and 66% of students, depending on the size of the school) through a registrar's enrollment list furnished by participating educational institutions.

For smaller schools, all students were invited to participate in order to have sufficient sample sizes for reports generated for each school. Students selected to participate in the survey received multiple invitations, including postcards and emails. Participants received gift cards upon completion of the survey and the opportunity to win larger lottery prizes. Surveys were anonymously completed and administered online. The overall response rate was 33.2%. These response rates are consistent with similar studies, such as the National College Health Assessment, which report response rates ranging from 25-50%.¹⁵³⁻¹⁶¹

Merging 2009-2013 CSHS data. In assembling the 2009-2013 CSHS merged dataset, the most recent survey year for each of the 46 institutions was included in the merged dataset. For institutions that participated in multiple years between 2009 and 2013, sampling overlap was a major concern. Because students completed the survey anonymously, we could not identify students from institutions who may have completed the survey multiple times. In order to reduce the probability that the same student was participating in the survey multiple times in the merged dataset, which would bias the results by estimating standard errors that are artificially tight because information from the same student over multiple years would be treated as independent participants rather than dependent, we only considered including multiple years of data from institutions that participated at least three years apart (i.e., 2009 and 2012, 2009 and 2013, 2010 and 2013). We then calculated the probability that a student would have completed the CSHS more than once while at an institution. We used this probability as a guide to assess the inclusion of multiple time-points for schools. By calculating the probability of overlap we

can ensure that the additional years included in the merged dataset can provide the benefit of increasing the sample size while minimizing the potential bias introduced.

Several assumptions were made in calculating this percentage of overlap. First, we assumed that the student population within each institution was static between 2009 and 2013; that is, students did not transfer between institutions during that time period. Second, we assumed that only first-year and second-year undergraduate students from 2009 or 2010 were likely to participate again in the survey three or four years later. This assumption is consistent with sample overlap calculations made during the merging of multiple years of data from the statewide high school student survey, Massachusetts Youth Risk Behavior Survey.¹⁶² Third, we assumed that the retention rate beyond the second-year and third-year retention rates were 0.95 at all institutions. Finally, we assumed that the first-year (i.e., freshman) retention and 4-year graduation rates are constant over time. That is, we applied 2011 rates to 2009 and 2013 data.

For each institution, we used the distribution of year in school (i.e., first-year undergraduate, second-year undergraduate, third-year undergraduate, fourth-year undergraduate, 5th year undergraduate or beyond, and graduate student) from the first year of survey participation (i.e., 2009 or 2010) and applied the following calculation:

$$\Pr(\text{overlap}) = \frac{\left[\begin{array}{l} \# \text{ first year undergraduate} \times \\ \text{freshman retention rate} \times \\ \text{second year retention rate} \times \\ \text{third year retention rate} \times \\ \text{sampling percentage} \times \\ \text{response rate} \end{array} \right] + \left[\begin{array}{l} \# \text{ second year undergraduate} \times \\ \text{second year retention rate} \times \\ \text{third year retention rate} \times \\ (1 - \text{graduation rate}) \times \\ \text{sampling percentage} \times \\ \text{response rate} \end{array} \right]}{\text{total number of students participating in the two years}}$$

Freshman retention and 4-year graduation rates were taken from publicly available data from the National Center for Education Statistics. This calculation was done for first-year undergraduates in 2009 and 2010 as well as second-year undergraduates. For second-year undergraduates, the freshman retention rate was not included in the calculation. For schools where participation was four years apart (i.e., 2009 and 2013), the probability of overlap was calculated as follows:

$$\Pr(\text{overlap}) = \frac{\left[\begin{array}{l} \# \text{ first year undergraduate } \times \\ \text{freshman retention rate } \times \\ \text{second year retention rate } \times \\ \text{third year retention rate } \times \\ (1 - \text{graduation rate}) \times \\ \text{sampling percentage } \times \\ \text{response rate} \end{array} \right]}{\text{total number of students participating in 2007 and 2011}}$$

Based on the calculation of sample overlap, we determined that only schools with a sampling percentage of less than 50% (i.e., less than 50% of the student body were invited to participate in the survey) had a negligible percentage of sample overlap (i.e., less than 2%; percentage sample overlap range: 0.45%-1.57%). Thus, an additional year of data was included for these schools ($n_{\text{schools}} = 6$, $n_{\text{students}} = 6,912$). This yielded a final merged dataset of 2009-2013 CSHS data with 46 institutions and 29,118 students.

2.2. Measures

As mentioned earlier, CSHS covers multiple areas of health including: health insurance and health care utilization, mental health, alcohol and other drug use, tobacco use, personal safety, financial health, nutrition and physical activity, and sexual health. Measures used within each area reflect standard questions used in numerous national

surveillance and epidemiologic surveys. In addition, many of these measures have been used in previous research.^{82,113,163–167} Variables that were utilized from the CSHS in this dissertation included sexual orientation, weight-related behaviors (primarily from the section on nutrition and physical activity), and sociodemographic characteristics.

Sexual orientation. Sexual orientation is difficult to assess. To date, no assessment has been developed and/or tested specifically for emerging adults. However, assessments of sexual identity have been developed and tested in other populations, such as adolescents and adults 18 years and older.

The CSHS includes assessments of two dimensions of sexual orientation—identity and behavior. For sexual identity, the question asks participants “Which of the following terms best describes you?” Response options include “Heterosexual,” “Gay/Lesbian,” “Bisexual,” and “Unsure.” Although this specific question has not been tested for validity and reliability in this age group, the question is similar to others used in other national surveys.^{168,169} Sexual behavior was assessed as follows: “Within the past 12 months, were your sexual partner(s), if any.” Response options included, “Not applicable – I was not sexually active,” “Male,” “Female,” and “Both male and female.” Sexual activity was specifically defined as “having engaged in vaginal or anal intercourse or oral sex.” Sexual behavior was recoded to “Not sexually active,” “Opposite-sex behavior,” “Same-sex behavior,” and “Both-sex behavior” based on respondent gender and the reported gender of partner(s) in the past 12 months. This question is consistent with a similar item used on the Youth Risk Behavior Survey (YRBS), a national state-based survey of high school students.⁵¹

Given the importance of both identity and behavior in understanding sexual orientation differences, as well as evidence that discordant behavior among heterosexual-identified adults is salient in addressing health disparities,^{170,171} we created the following categories to characterize sexual orientation: “heterosexual” (participants who are heterosexual-identified and have not engaged in any same-sex sexual behavior in the past year), “discordant heterosexual” (participants who are heterosexual-identified who report engaging in any same-sex sexual behavior in the past year), “gay/lesbian” (participants who identify as gay or lesbian, regardless of sexual behavior), “bisexual” (participants who identify as bisexual, regardless of sexual behavior), and “unsure” (participants who identify as unsure, regardless of sexual behavior) (Table 5). This categorization of sexual orientation is consistent with previous research using YRBS data.¹⁶²

Table 5. Prevalence of sexual orientation^a by gender^b, CSHS 2009-2013 (n=29,118)

	Male (n=10,406)	Female (n=18,550)
Heterosexual	92.8%	92.3%
Discordant heterosexual	0.7%	0.8%
Gay/Lesbian	3.2%	1.2%
Bisexual	1.6%	3.7%
Unsure	1.7%	2.0%

^a Heterosexual are respondents who identify as heterosexual and report either no sexual activity in the past year or only opposite-sex sexual behavior in the past year; Discordant heterosexual are respondents who identify as heterosexual and report any same-sex sexual behavior in the past year; Gay/lesbian, bisexual, and unsure are respondents who identify as such, regardless of sexual behavior.

^b Transgender-identified students are excluded due to small sample sizes (n=58).

In addition, this categorization yields an overall prevalence of over 7% of students who report a non-heterosexual identity and/or behavior. This estimate is slightly higher

than those reported in the recent Gallup poll for 18-29 year olds (6.4%) in the general population who identify as LGBT.⁴⁷ The discrepancy is likely due to differences in the question asked.

Gender identity. Similar to sexual orientation, gender identity is also difficult to assess, particularly when response options beyond male and female are made available. No existing question(s) have been tested to most properly assess gender identity in the general population.

The CSHS includes a reasonable question to assess gender. Specifically, the question asks “What is your gender?” Response options include, “Male,” “Female,” “Transgender,” and “Other.” It should be noted that up until 2010 transgender and other were offered as a single gender option, “Transgender/Other.” Beginning in 2011, the gender options were separated into two distinct response categories. Due to small sample sizes, participants identifying as “transgender/other” were excluded from these analyses (n=58).

Weight-related behaviors. A variety of weight-related behaviors were assessed on the CSHS including, dietary intake, eating habits, physical activity, sedentary behavior, and unhealthy weight control behaviors (Table 6 for prevalence of behaviors based on a dichotomization of variables using public health recommendations where applicable and risk-based cut-points otherwise).

Aspects of *dietary intake* assessed on CSHS included fruit and vegetable consumption, soda consumption, and diet soda consumption. These consumption items were collected using a question adapted from the Youth Risk Behavior Survey,¹⁷²

“During the past 7 days, how many times did you eat/drink the following? (Think about all the meals and snack you had from the time you got up until you went to bed. Be sure to include food you ate at home, school, restaurants, or anywhere else).” Specific food/drink items included: 100% fruit juice (no including punch, Kool-Aid, sports drinks, or other fruit-flavored drinks), fruit (no including juice), green salad, potatoes (no including French fries, fried potatoes, or potato chips), carrots, other vegetables (not including green salad, potatoes, or carrots); Can bottle, or glass of soda or pop (Coke, Pepsi, or Sprite, etc) (not including diet soda or diet pop); and Can, bottle, or glass of diet soda or diet pop (Diet Coke, Diet Pepsi, or Diet Sprite, etc). Frequency response options included, “I did not eat or drink this,” “1-3 times during the past 7 days,” “4-6 times during the past 7 days,” “1 time per day,” “2 times per day,” “3 times per day,” and “4 or more times per day.” To create a measure of fruit and vegetable consumption, the midpoint of each response item was taken for the following items: fruit juice, fruit, green salad, potatoes, carrots, and other vegetables. Responses were then summed to create a measure of fruit and vegetable consumption.

In addition to dietary intake, there were three measures of *eating habits*, which does not describe specific food intake, but rather describes general patterns of eating. One measure assessed the frequency of eating breakfast in the past week. Respondents reported the number of days that they ate breakfast. This question has been used in previously published research of CSHS.¹⁶⁷ The other two measures of eating habits assessed away from home eating, specifically the frequency of eating (1) fast food meals

and (2) at other restaurants (not including fast food establishments). Response options ranged from “never” to “several times per day.”

Three types of *physical activity* were assessed: strenuous, moderate, and strengthening. Examples were provided for each type of activity. For strenuous exercise, examples included biking fast, aerobics, dancing, running, basketball, swimming laps, rollerblading, tennis, and soccer. Moderate exercises included walking quickly, baseball, easy biking, volleyball, skateboarding, and snowboarding. Strengthening examples were push-ups, sit-ups, weightlifting/training. The question asked “In the past 7 days, how many hours did you spend doing the following activities?” Response options included, “None,” “Less than ½ hour,” “½-2 hours,” “2½-4 hours,” “4½-6 hours,” and “6½ + hours.”

In addition to physical activity, *sedentary behaviors* are also assessed. One question assessed the amount of time, on an average day, spent watching television, while a second question assessed the amount of time, on an average day, spent using the computer for things besides school or work. Response options include, “None,” “Less than 1 hour,” “1 hour,” “2 hours,” “3 hours,” “4 hours,” “5+ hours.” For survey-based research, this is a consistent assessment of sedentary behaviors.^{166,173}

Using a relatively standard survey assessment of *disordered eating behaviors*, participants indicated the frequency of the following four items in the past 12 months: using laxatives to control weight, taking diet pills, binge eating, and inducing vomiting to control weight. This assessment of disordered behaviors has been used in published works using CSHS data^{113,163,166,167,174} and is similar to items that have been used

extensively in other research, most notably the YRBS.^{51,72,74} This is similar to items that have been used extensively in other research, most notably the YRBS.^{51,72,74} Due, in part, to low prevalence of each, using laxatives, taking diet pills, and inducing vomiting were combined into a single unhealthy weight control behaviors variable (any vs. none) while binge eating was examined separately.⁷⁵

Table 6. Overall prevalence of weight-related behaviors (n=29,118), CSHS 2009-2013

Met nutrition recommendations	
Fruit and vegetable (≥ 5 /day)	17.2%
Soda (<1/day)	84.8%
Diet soda (<1/day)	88.4
Breakfast (≥ 5 days/week)	45.4%
Fast food (<several times/week)	85.7%
Restaurant (<several times/week)	90.0%
Met physical activity recommendations	
Moderate activity (≥ 2.5 hours/week)	38.8%
Strenuous activity (≥ 2.5 hours/week)	29.2%
Strengthening activity (≥ 2.5 hours/week)	18.5%
Met screen time recommendations (<2 hours/day)	52.7%
Unhealthy weight control (Any)	9.5%
Binge eating (Any)	15.4%

Other relevant variables. A range of sociodemographic and individual characteristics were also included on CSHS (Table 7). For sociodemographic characteristics, standard questions were used to assess race/ethnicity and age. Socioeconomic position is particularly difficult to measure in this age group. A variety of questions assessing socioeconomic position were included on CSHS including employment (measured as hours worked for pay) and credit card debt.¹⁶⁷ Measures related to relationship status and living situation were also included. Student type (i.e.,

undergraduate or graduate) was determined based on survey responses to questions about enrollment. Students also indicated whether or not they were international students.

Table 7. Overall sample characteristics (n=29,118), CSHS 2009-2013

Race/ethnicity	
White	81.5%
Black or African American	3.9%
Native American/American Indian	2.4%
Asian or Pacific Islander	7.1%
Latino or Hispanic	2.5%
Other	1.8%
Multiple races	0.9%
Age	
18-20 years	33.8%
21-24 years	31.3%
25+ years	35.0%
Hours worked for pay	
0-10 hours	46.4%
11-30 hours	34.5%
31+ hours	19.1%
Credit card debt	
None	67.6%
\$1-\$999	13.1%
\$1,000+	19.3%
Relationship status	
Single	43.6%
Married or domestic partnership	18.8%
Engaged or committed relationship	35.1%
Divorced, widowed, or other	2.5%
Living situation	
Parent's home	18.0%
Rent or share rent	42.0%
Residence hall or sorority/fraternity	18.9%
Own a house	17.3%
Other	3.9%
Student status	
First-time undergraduate	21.0%
Other undergraduate	68.4%
Graduate or professional	10.5%
International student (yes)	4.2%

The University of Minnesota Institutional Review Board (IRB) approved all recruitment, consent, and measurement protocols for the College Student Health Survey. All analyses performed using CSHS data were considered secondary analysis of anonymous data that was collected for the purpose of surveillance and therefore deemed exempt from IRB review.

Chapter 3. Manuscript 1: Does weight-related behavioral patterning differ by sexual orientation among college women?: A latent class analysis

3.1. Introduction

Existing research suggests that lesbian, gay, and bisexual (LGB) adult women are more likely to be obese than heterosexual women.²⁻⁸ Findings for disparities in diet and physical activity across sexual orientation among women have been mostly mixed, and measurement of these behaviors has been inconsistent.^{4,6,8,10-16}

In studying weight-related health, particularly across sexual orientation, it is important to consider age.^{7,12} Emerging adulthood, typically defined as 18-25 years, is a developmental stage where independence is generally established and new responsibilities, life skills, and identities are negotiated and formed.⁹⁹ Research has suggested that weight-related health generally declines during emerging adulthood, with noted weight gain, deterioration of diet quality and physical activity, and increasing sedentary behaviors.^{102-109,111} Some studies have indicated that during emerging adulthood, health disparities widen.^{101,117,118} Given that adolescence and emerging adulthood is also a period for sexual orientation development and exploration,^{41,49,119} this period in the life-course may be a critical time where individual trajectories can have an adverse impact on weight-related health disparities. Nearly half of emerging adults attend college, representing a large proportion of this age group and an accessible population in which to study emerging adult disparities.¹⁰⁰

In our previous work on weight-related disparities among emerging adults, findings suggested that among females, differences existed across sexual orientation for

breakfast, fast food, and restaurant food consumption, physical activity, unhealthy weight control behaviors (such as vomiting, taking diet pills or laxatives), and binge eating.⁷⁵

Other studies using longitudinal cohort data also found disparities across sexual orientation in unhealthy weight control behaviors and physical activity from adolescence into emerging adulthood.^{10,72} However, none of these studies have explored the patterning of weight-related behaviors.

Patterning of weight-related behaviors is complex, and traditional methods of analysis, such as regression, may not be sufficient in modeling of relationships among multiple behaviors. This is particularly relevant for weight-related factors, where eating habits, sedentary behaviors, and physical activity, might not consistently track together. It is likely that in these instances, a more holistic analytic approach might better capture the heterogeneity in a population (as has been shown in other populations).¹⁶³ It is this heterogeneity that might better explain the differences observed in weight-related health disparities across sexual orientation that can then be used to target and tailor interventions. For example, in a study by Laska and colleagues, four behavioral classes of female college students were identified. “Poor lifestyle, low risk” had the highest membership (40% of students),¹⁶³ highlighting a large proportion of the female student population for which to address health-related programming targeting wellness behaviors (e.g., physical activity and nutrition) with a concurrent focus on other risky behaviors (e.g., alcohol and tobacco use). The study described in this chapter expands this existing work on female college students by examining weight-related behaviors across sexual orientation groups, specifically. Further, the findings from the study by Laska and

colleagues as well as other studies on sexual orientation disparities highlight important differences in weight-related behaviors across gender exist, likely due to factors such as varying social norms.^{5,6,72,163} Therefore, we are examining males and females in separate chapters.

The purpose of this study was to identify and describe homogenous classes of female college students based on patterning of healthful weight-related behaviors (e.g., food and drink consumption, eating habits, physical activity, weight control behaviors), and to examine differences across five sexual orientation groups. We hypothesized that there are distinct classes that share common patterns of weight-related behaviors, and for whom interventions can be developed and tailored. In addition, we hypothesized that differences in proportions of classes and patterning of weight-related behaviors exist across sexual orientation groups, with greater proportions of LGB women in unhealthy classes and exhibiting unhealthier patterns than heterosexual women.

3.2. Methods

Study population and data source. Data were from the 2009-2013 College Student Health Survey (CSHS), an on-going statewide surveillance system of 2- and 4-year colleges and universities across Minnesota. For most schools participating in the CSHS, students were randomly selected through a registrar's enrollment list furnished by participating educational institutions. For smaller schools, all students were invited to participate in order to have sufficient sample sizes for reports generated for each school, while at larger schools only a proportion of students were invited. Eligible participants were sent multiple invitations, including postcards and emails, to complete an anonymous

online survey. Participants who completed the survey were entered into a raffle to win prizes such as iPods and iPads. The overall response rate was 33.2%. Additional details on the CSHS are available online (<http://www.bhs.umn.edu/surveys/index.htm>).

Between 2009 and 2013, 46 institutions participated in CSHS (26 two-year and 20 four-year). Thirty colleges participated in the CSHS in more than one year between 2009 and 2013. To ensure that participants were not included in the dataset more than once and to maximize sample size, a college's second year of data was included when the possibility of overlap in participants was expected to be negligible (i.e., less than 2%), as we and others have done previously.^{75,162,175} Six schools with a sampling percentage of less than 50% (i.e., less than 50% of the student body were invited to participate in the survey) had a negligible percentage of overlap (estimated sample overlap range: 0.45%-1.57%). Thus, an additional year of data was included for these schools ($n_{\text{students}} = 6,912$). This yielded a final merged 2009-2013 CSHS dataset consisting of 29,118 students.

Measures. Sexual orientation was assessed on the CSHS as both identity and behavior. Given the importance of both identity and behavior, as well as evidence that discordant behavior among heterosexual-identified adults is salient in addressing health disparities^{170,171}, we created the following categories for sexual orientation: “heterosexual” (identified as heterosexual and did not report engaging in any same-sex sexual behavior in the past year), “discordant heterosexual” (identified as heterosexual and reported engaging in any same-sex sexual behavior in the past year), “gay/lesbian” (identified as gay or lesbian, regardless of sexual behavior), “bisexual” (identified as bisexual, regardless of sexual behavior), and “unsure” (identified as unsure about their

sexual orientation, regardless of sexual behavior). This categorization is consistent with previous research using the Youth Risk Behavior Survey (YRBS)¹⁶² and CSHS data.⁷⁵

A variety of weight-related behaviors were included in these analyses: dietary intake and eating habits, physical activity, sedentary behavior, and unhealthy weight control behaviors. All variables were dichotomized based on existing public health recommendations or on risk-based cut-points for behaviors where recommendations did not exist. This dichotomization represents practical significance in that it serves as a meaningful threshold for health. Further, dichotomization facilitates interpretation of results and was the most appropriate approach given the non-normality of the majority of the data.

Three aspects of *dietary intake* were assessed: fruit and vegetable, soda, and diet soda consumption. These items used standard questions adapted from the YRBS,¹⁷² “During the past 7 days, how many times did you eat/drink the following?” Six items assessed specific foods/drinks. Frequency response options ranged from, “I did not eat or drink this,” to “4 or more times per day.” Participants met recommendations if they reported consuming fruits and vegetables ≥ 5 times/day. For soda and diet soda, participants met recommendations for each item if they reported consuming < 1 /day.^{113,176}

To assess *eating habits*, participants reported the number of days that they ate breakfast.¹⁶⁷ Breakfast consumption was dichotomized as ≥ 5 days/week or < 5 days/week. The frequency of eating (1) fast food meals and (2) at other restaurants (not including fast food establishments) was also assessed. Response options ranged from “never” to “several times per day.” Frequent consumption of fast food or restaurant food is

associated with increased portion sizes and excess weight.^{177,178} Therefore, both fast food and restaurant food consumption were dichotomized as \geq several times/week vs. $<$ several times/week.¹⁷⁵

Three types of *physical activity* were assessed: strenuous, moderate, and strengthening. The question asked “In the past 7 days, how many hours did you spend doing the following activities?” Examples were provided for each type of activity. Response options ranged from “None,” to “6½ + hours.” Given conceptual similarities between moderate and strenuous physical activity, they were combined into a single ‘moderate-to-vigorous physical activity’ indicator. Meeting recommendations was ≥ 5 hours/week of moderate and vigorous physical activity combined or ≥ 4.5 hours/week of either moderate or vigorous physical activity (guided by recommendations for weight maintenance, which include ≥ 1 hour on most days of the week).¹⁷⁹ Consistent with previous research using CSHS data, strengthening physical activity was categorized as ≥ 2.5 hours/week or ≤ 2 hours/week.⁸²

Time spent watching television and using a computer (for things besides school or work) on an average day were used to assess *sedentary behaviors*. Response options ranged from “None” to “5+ hours.” Categories of ≥ 14 hours/week vs. < 14 hours/week were created for screen time in line with recommendations for young people of < 2 hours/day.¹⁷³

To assess *disordered eating behaviors*, participants indicated the frequency of four behaviors in the past 12 months: using laxatives to control weight, taking diet pills, binge eating, and inducing vomiting to control weight.^{113,163,167} This is similar to items

that have been used extensively in other research, most notably the YRBS.^{51,72,74} Due, in part, to low prevalence of each, using laxatives, taking diet pills, and inducing vomiting were combined into a single unhealthy weight control behaviors variable (any vs. none) while binge eating was examined separately.⁷⁵

Analysis. Latent class analysis (LCA) is a technique designed to identify a small number of homogenous subgroups within a larger heterogeneous group,^{180,181} based on responses to select indicators. Using a standard approach to fitting LCA models, multiple successive models were fit with classes ranging from one to eight were fit and the final model was selected using several available tools that aid in model selection including multiple fit criteria, such as information criteria (Akaiake Information Criteria, AIC; Bayesian Information Criteria BIC; Adjusted BIC), and likelihood ratio tests (Bootstrap Likelihood Ratio Test (BLRT)). Solution interpretability, distribution of classes, and classification quality (e.g., entropy and class separation) are also used in model selection.^{180,182}

After assessing initial LCA models, fruit and vegetable consumption and sedentary behavior were dropped as indicators due to no separation between classes; that is, across classes, the probabilities for these two indicators were similar and did not help in characterizing different classes. Thus, nine indicators were included in final LCA models to identify healthy weight-related behavioral patterning: soda, diet soda, fast food, restaurant food, and breakfast consumption, moderate-to-vigorous and strengthening physical activity, unhealthy weight control behaviors, and binge eating.

Using the whole sample of females, we fit LCA models and identified a best-fitting solution based on fit-statistics (results not presented). To test for measurement invariance, the LCA solution was regressed on sexual orientation. Results were significant ($p < 0.001$), indicating statistical differences across sexual orientation in the latent classes and that models should be stratified by sexual orientation. Upon examination of the final latent classes in each separate sexual orientation group, we determined that a multi-group LCA (which would allow quantitative examination of differences between sexual orientation groups) would not be appropriate given the differing number of final classes across sexual orientation groups. The final selected LCA models (based on fit and interpretability), based on independent LCA models for each sexual orientation group, are presented. Comparisons across sexual orientation groups are qualitative, given the fitting of separate models rather than within a single multi-group model.

For these analyses, we included only female participants (64.0% of original sample). Furthermore, we excluded participants with missing data for sexual orientation ($n=44$), participants who reported being currently pregnant, due to different recommendations for weight and related behaviors while pregnant ($n=255$), and participants who provided questionable response patterns ($n=3$). Questionable response patterns were flagged where participants provided implausible responses on three or more of seven key variables. This yielded a final analytic sample of 18,297 female college students. All data management and analyses were performed using SAS (SAS version 9.1, Cary, NC: SAS Institute Inc.). These analyses were considered secondary analysis of

anonymous data and therefore deemed exempt from IRB review. The University of Minnesota IRB approved all CSHS data collection.

3.3. Results

Overall, the majority of female students was heterosexual (92.3%), 0.8% were discordant heterosexual, 1.2% were gay/lesbian, 3.7% were bisexual, and 2.0% were unsure of their sexuality. Two-thirds (62.3%) attended a 4-year school, the majority was white (82.5%), and the median age was 22 years.

The prevalence of the healthy weight-related behavioral indicators used in the final LCA models, by sexual orientation, are presented in Table 8. Overall, large majorities of females, across sexual orientation, met recommendations for soda, diet soda, fast food, and restaurant food consumption. However, across all sexual orientation groups, less than half of females met recommendations for breakfast consumption, only about a fifth to a quarter met recommendations for moderate-to-vigorous physical activity, and few met recommendations for strengthening physical activity. Most female students did not engage in unhealthy weight control or binge eating (81.0-89.8% for unhealthy weight control, 70.4%-83.4% for binge eating).

Fit statistics for the LCA models for each of the five sexual orientation groups are presented in Table 9. In addition to examining fit statistics, we considered the interpretability of suggested solutions to select final models. For heterosexual females, fit statistics continued to improve with increasing number of classes. However, the gains in AIC, BIC, and adjusted BIC were diminished beyond the four-class solution. Furthermore, the four-class solution had the greatest entropy or separation between

classes (0.60). Moreover, the five-class solution did not yield a new substantive class over the four-class solution. Therefore, the four-class solution appeared to be the optimal solution for heterosexual females. For discordant heterosexual females, AIC, adjusted BIC, and BLRT suggested a four-class solution while BIC suggested a two-class solution. We examined the two-, three-, and four-class solutions and the three-class solution was retained based on interpretability as well as the greater entropy of the three-class solution (0.89). Among gay/lesbian females, information criteria and BLRT results suggested a three-class solution and were also supported by the interpretability of the results. For bisexual females, there were inconsistencies across all fit criteria. We compared the three-, four-, and five-class solutions and retained the four-class solution based on class interpretability. Finally, for unsure participants, although AIC and BLRT suggested a five-class solution and adjusted BIC suggested a four-class solution, both of these solutions yielded classes with few members ($n < 20$); therefore, the three-class solution was selected.

Item-response probabilities and healthy weight-related behavioral patterning of classes are presented in Figure 1. Item-response probabilities represent the probability that members of a certain class endorse that specific indicator. In Figure 1, probabilities closer to one represent a high probability of engaging in healthy weight-related behaviors, while probabilities closer to zero indicate less favorable engagement in weight-related behaviors. In final models, across all sexual orientation groups, four distinct classes were identified, although not all four classes were prevalent for some sexual orientation groups (i.e., groups with three classes). Labels were attributed based on the

patterns exhibited for each profile. Class 1 (“Healthier diet”) was characterized by high probabilities of meeting recommendations for regular soda, diet soda, fast food, and restaurant consumption (heterosexual: 0.90-0.98; discordant heterosexual: 0.78-0.89; gay/lesbian: 0.94-1.00; bisexual: 0.91-0.99; unsure: 0.97-0.99), a moderate probability of eating breakfast ≥ 5 days/week (range across sexual orientation groups: 0.40-0.58), low probability of meeting physical activity recommendations (moderate-to-vigorous physical activity: 0.15-0.31; strengthening physical activity: 0.00-0.19), and low probability of engaging in unhealthy weight control or binge eating (no unhealthy weight control: 0.94-1.00; no binge eating: 0.81-0.97).

Class 2 (“Moderate diet”) had similar patterning to Class 1 on physical activity, unhealthy weight control, and binge eating. However, this class was characterized by lower probabilities of meeting recommendations for regular soda (0.57-0.70), diet soda (0.70-0.86), fast food (0.53-0.68), restaurant food (0.66-0.88), and eating breakfast (0.16-0.25). Among discordant heterosexual females, a Class 2 pattern was not identified in the final solution.

Class 3 (“Unhealthy weight control”) also had similar patterning to Class 1; however similarities were for dietary intake, food consumption, and physical activity only. Class 3 was characterized by a lower probability of reporting no unhealthy weight control (0.13-0.38) and no binge eating (0.03-0.17). A Class 3 pattern was identified for all sexual orientation groups.

Finally, Class 4 (“Healthier diet, physically active”) had high probabilities for meeting recommendations for regular soda, diet soda, fast food, and restaurant food

consumption, similar to Class 1. Furthermore, although probabilities were slightly lower for no unhealthy weight control and binge eating compared to Classes 1 and 2, probabilities were still high (no unhealthy weight control: 0.75-0.92; no binge eating: 0.82-0.88). Class 4 is distinguishable by having the highest probabilities on breakfast consumption and physical activity compared to other classes (breakfast consumption: 0.61-0.67; moderate-to-vigorous physical activity: 0.72-0.77; strengthening physical activity: 0.57-0.91). Gay/lesbian and unsure females did not exhibit a “healthier diet, physically active” pattern in their respective LCA solutions.

In addition to examining patterning, the prevalence of each class was also assessed (Table 10). Across all sexual orientation groups, Class 1 (“Healthier diet”) had the highest prevalence. For all sexual orientation groups except discordant heterosexual and bisexual females, Class 3 (“Unhealthy weight control”) had the lowest prevalence, and the prevalence for heterosexual females was nearly half of the prevalence for all other sexual orientation groups. The prevalence for Class 2 (“Moderate diet”) ranged from 18.5% for heterosexual females to 35.6% for gay/lesbian females. Class 4 (“Healthier diet, physically active”) ranged from 9.1% for bisexual females to 17.0% for heterosexual females.

3.4. Discussion

Overall, our results indicated that regarding patterning of healthy weight-related behaviors, four distinct classes exist: Class 1 (“Healthier diet”), Class 2 (“Moderate diet”), Class 3 (“Unhealthy weight control”), and Class 4 (“Healthier diet, physically active”). Despite conceptual similarities between the classes, differences in the

prevalence of classes across sexual orientation highlight an area of concern. Among gay/lesbian and unsure females no “healthier diet, physically active” class was identified and nearly double the proportion of discordant heterosexual, LGB, and unsure females were in the “unhealthy weight control” group compared to heterosexual women. Consistent with previous work, these findings suggest that discordant heterosexual, LGB, and unsure females experience worse health with regard to weight-related behaviors, particularly in the areas of physical activity and unhealthy weight control.^{6,10-12}

Unique aspects of these findings are related to the patterning of these behaviors, which add a layer of understanding to the disparities in weight-related behaviors across sexual orientation. More specifically, the patterns allow us to examine how healthy weight-related behaviors correlate in differing ways within diverse heterogeneous populations and subsequently enable us to intervene on multiple related behaviors simultaneously. For example, while our previous work using traditional regression methods found that discordant heterosexual, LGB, and unsure female students were more likely to engage in unhealthy weight control behaviors and binge eating,⁷⁵ a finding consistent in the present study, the LCA indicated that unhealthy weight control was coupled with lower probability of meeting recommendations for of physical activity. Existing longitudinal research has found that dieting behaviors (including unhealthy weight control behaviors assessed here) are associated with weight gain over time, as well as physiological and metabolic resistance, possibly because dieting yields less sustained proper nutrition and physical activity.¹⁸³ Our LCA results partially support this hypothesis, with unhealthy weight control co-occurring with less physical activity, but

not with poor nutrition. Overall, this finding suggests that in order to support healthier patterns of weight-related behaviors, it may be important to develop interventions that address both unhealthy weight control and physical activity behaviors. These interventions are particularly needed for discordant heterosexual, LGB, and unsure females as they shoulder a greater burden of this behavioral pattern with nearly double the proportion of people in this class compared to heterosexual females (heterosexual: 7.0%, discordant heterosexual: 14.5%, gay/lesbian: 14.3%, bisexual: 18.2%, unsure: 13.2%).

The majority of females, regardless of sexual orientation, were in classes with low physical activity, a finding consistent with previous work demonstrating low physical activity among college students.^{77,82,115} Although classes with low physical activity also included varying levels of diet and unhealthy weight control, high physical activity co-occurred with a healthier diet and low unhealthy weight control. This healthier diet, physically active class is a critical pattern in this sample of emerging adult females because it was the healthiest pattern identified. An area of concern however, is that neither gay/lesbian nor unsure females exhibited a physically active pattern, highlighting the need for targeted physical activity interventions. It was interesting to identify the absence of a “healthy” behavior pattern rather than the presence of a more uniquely “unhealthy” pattern (such as one that exhibited poor diet and low physical activity) among any of the sexual orientation groups. This finding suggests that there is not a subgroup of emerging adult females, regardless of sexual orientation, which need interventions for all aspects of weight-related behaviors. Furthermore, although there

were statistical differences across sexual orientation based on tests of measurement invariance, there were conceptual similarities in the classes exhibited. This suggests a need for interventions that focus on patterns of behaviors (e.g., physical activity and unhealthy weight control) that can be tailored to incorporate sexual orientation. In addition, there is a need for broad interventions (such as improving physical activity among all females) and these findings indicate that more targeted recruitment of gay/lesbian and unsure females may help address physical activity disparities.

Although nutrition indicators in these analyses were in the moderate-to-high ranges, with the exception of breakfast consumption, it should be noted that fruit and vegetable consumption, which was dropped from analyses due to poor separation across classes, had low probabilities across all sexual orientation groups. Therefore, regarding nutrition-related interventions, it may be important to address both fruit/vegetable and breakfast consumption across all groups; although more comprehensive intervention would be needed for the “moderate diet” group. Furthermore, when addressing nutrition, it is also critical to include components related to physical activity (for all classes except the “healthier diet, physically active”) and unhealthy weight control (for the “unhealthy weight control” class only).

To our knowledge, this is the first study to use LCA to characterize a broad array of healthy weight-related behavioral patterns among emerging adults and also the first to use this strategy to examine disparities across sexual orientation. A strength of this study includes the large sample of lesbian, gay, bisexual, and unsure participants (which allowed separate sexual orientation groups rather than treating non-heterosexual as a

homogenous group) as well as the inclusion of the discordant heterosexual group, thus allowing for a more robust and fine grain examination of sexual orientation disparities. However, despite the relatively large sample size for discordant heterosexual, gay/lesbian, and unsure females, it is possible that the sample size may not have been sufficient to identify additional salient classes, such as the physically active pattern identified for heterosexual and bisexual students. Future studies with larger samples for these groups are needed to confirm our findings. Related, because of the differing number of classes identified across sexual orientation groups, we were not able to quantitatively assess differences between groups (i.e., statistically testing if prevalence of classes or specific item-response probabilities differed across sexual orientation). Although, findings from this study still highlight important differences across sexual orientation that are useful for intervention development, future work should consider incorporating analytic strategies for quantitative comparisons. Finally, because this was a population-based sample of college students in Minnesota only, the results may not be generalizable to college students in other geographic areas or to emerging adults not attending a post-secondary institution.

Overall, these findings highlight unique patterning of healthy weight-related behaviors across sexual orientation among college females. Future research should examine how these behavioral patterns are related to relevant health outcomes, such as overweight and obesity, high cholesterol, high blood pressure, or diabetes. Regarding interventions, future work should tailor intervention components and target recruitment to specific patterns of weight-related behaviors and to specific sexual orientation groups.

Areas of greatest importance include addressing unhealthy weight control behaviors and low physical activity among discordant heterosexual, gay/lesbian, bisexual, and unsure college females.

3.5. Tables

Table 8. Prevalence of meeting weight-related behavioral recommendations^a by sexual orientation among females (n=18,297), College Student Health Survey 2009-2013

	Heterosexual (n=16,891)	Discordant Heterosexual (n=147)	Gay/ Lesbian (n=225)	Bisexual (n=677)	Unsure (n=357)
Fruit and vegetable consumption (≥ 5 /day)	18.0%	15.1%	16.6%	17.5%	16.0%
Regular soda consumption (< 1 /day)	87.9%	85.0%	87.6%	85.4%	87.1%
Diet soda consumption (< 1 /day)	87.3%	83.7%	87.1%	87.2%	89.1%
Fast food consumption ($< \text{several times/week}$)	88.5%	83.7%	87.1%	85.4%	88.5%
Restaurant food consumption ($< \text{several times/week}$)	91.3%	85.7%	84.9%	88.4%	93.8%
Breakfast consumption (≥ 5 days/week)	48.4%	42.9%	42.2%	40.5%	42.3%
Moderate-to-vigorous physical activity (≥ 5 hours/week of moderate and vigorous physical activity combined or ≥ 4.5 hours/week of either moderate or vigorous physical activity)	26.3%	27.2%	21.3%	25.6%	20.5%
Strengthening physical activity (≥ 2.5 hours/week)	14.1%	12.9%	13.3%	11.1%	7.3%
Sedentary behavior (< 14 hours/week)	54.7%	48.3%	62.2%	58.2%	56.6%
Unhealthy weight control behaviors ^b (none)	88.1%	81.0%	89.8%	83.9%	83.8%
Binge eating (none)	83.4%	76.2%	78.6%	70.4%	71.7%

^a risk-based cut-points were used for behaviors where recommendations do not exist
^b includes taking diet pills, laxatives, or vomiting

Table 9. Fit statistics for unconditional independent LCA models among female college students across sexual orientation

		Likelihood	AIC	BIC	Adjusted BIC	Entropy R ²	BLRT*
Heterosexual (n=16,891)	1 class	-65687.29	6047.24	6116.85	6088.25	1.00	
	2 classes	-64489.69	3672.04	3819.00	3758.62	0.39	0.01
	3 classes	-63792.60	2297.86	2522.16	2430.00	0.48	0.01
	4 classes	-63221.79	1176.24	1477.89	1353.95	0.60	0.01
	5 classes	-63083.54	919.74	1298.73	1143.02	0.58	0.01
	6 classes	-63014.59	801.84	1258.18	1070.68	0.58	0.01
Discordant Heterosexual (n=147)	1 class	-648.47	249.76	276.68	248.19	1.00	
	2 classes	-615.26	203.36	260.18	200.05	0.68	0.01
	3 classes	-600.43	193.70	280.42	188.65	0.89	0.03
	4 classes	-588.39	189.60	306.23	182.81	0.77	0.03
	5 classes	-583.02	198.88	345.41	190.35	0.77	0.94
	6 classes	-577.71	208.25	384.69	197.98	0.79	0.76
Gay/Lesbian (n=225)	1 class	-900.41	260.98	291.72	263.20	1.00	
	2 classes	-869.03	218.22	283.13	222.91	0.89	0.01
	3 classes	-841.75	183.67	282.73	190.83	0.67	0.01
	4 classes	-834.70	189.56	322.79	199.19	0.78	0.61
	5 classes	-829.88	199.92	367.31	212.02	0.75	0.83
	6 classes	-824.22	208.61	410.16	223.18	0.75	0.44
Bisexual (n=677)	1 class	-2850.41	508.03	548.69	520.11	1.00	
	2 classes	-2796.52	420.24	506.07	445.75	0.62	0.01
	3 classes	-2755.46	358.13	489.14	397.06	0.51	0.01
	4 classes	-2734.78	336.78	512.97	389.14	0.61	0.01
	5 classes	-2721.30	329.81	551.18	395.60	0.63	0.02
	6 classes	-2711.05	329.30	595.85	408.52	0.66	0.29
Unsure (n=357)	1 class	-1358.38	377.46	412.36	383.81	1.00	
	2 classes	-1316.63	313.95	387.63	327.35	0.66	0.01
	3 classes	-1288.88	278.46	390.92	298.92	0.66	0.01
	4 classes	-1272.52	265.75	416.98	293.25	0.73	0.01
	5 classes	-1259.53	259.77	449.78	294.33	0.76	0.02
	6 classes	-1251.33	263.36	492.15	304.97	0.80	0.37

Bolded classes indicate final selected models.

* p-value represents test for a (k+1)-class solution vs. k-class solution (e.g., 3-class compared to 2-class, 4-class compared to 3-class)

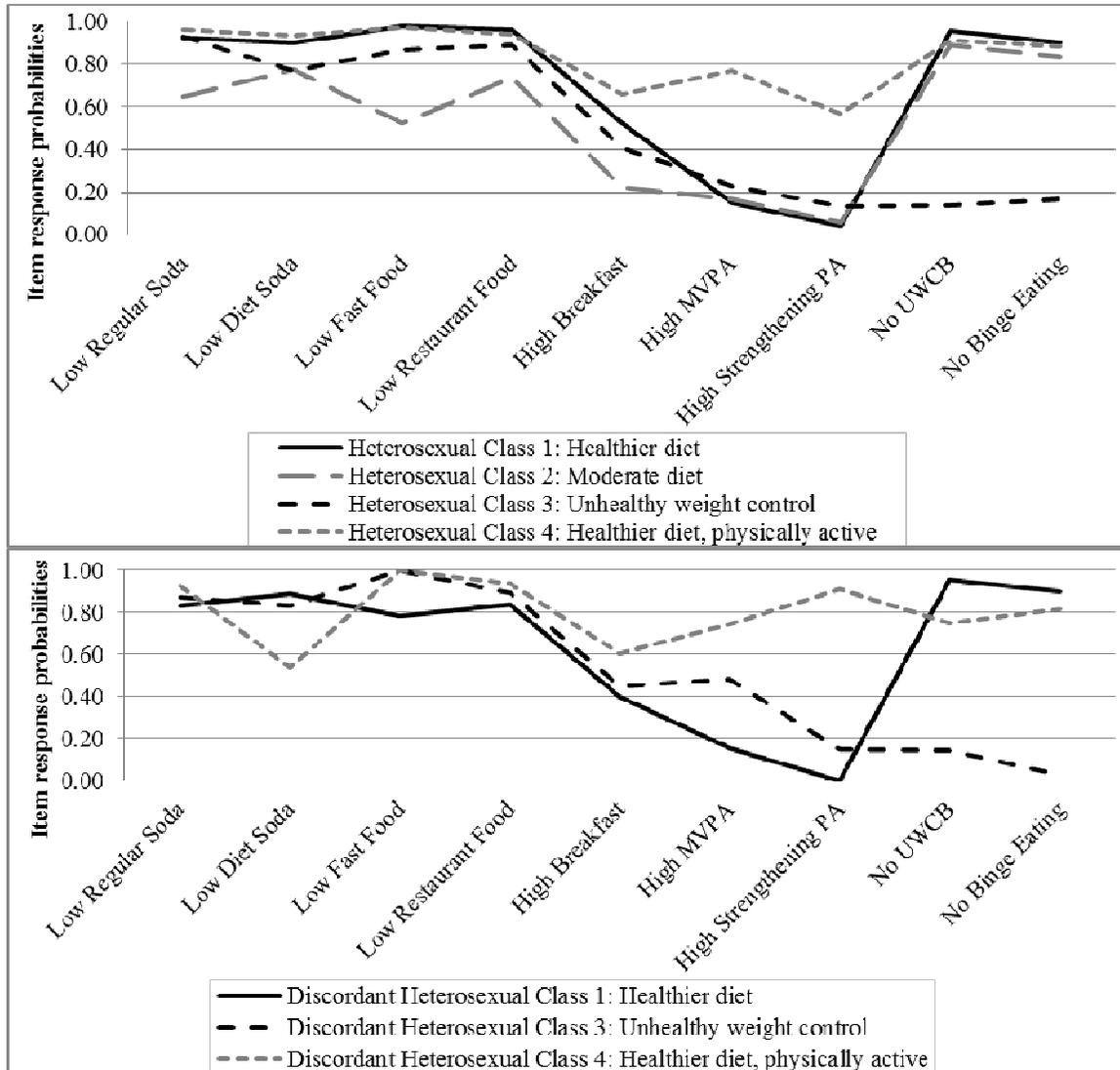
Table 10. Probability of latent class membership among female college students by sexual orientation (n=18,297)

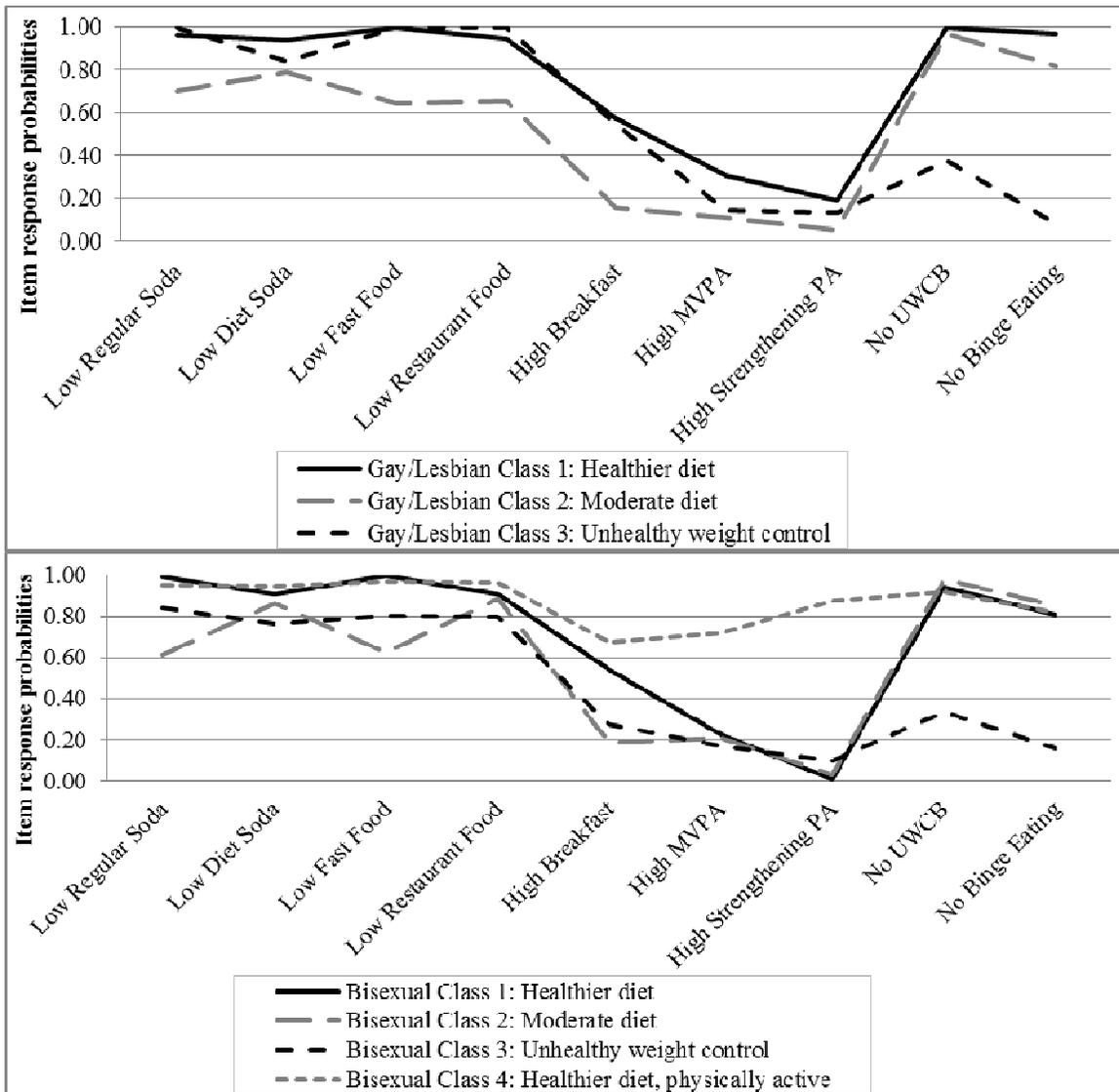
	n	Class 1: Healthier diet	Class 2: Moderate diet	Class 3: Unhealthy weight control	Class 4: Healthier diet, physically active
Heterosexual	16,891	57.6%	18.5%	7.0%	17.0%
Discordant Heterosexual	147	74.0%	n/a	14.5%	11.5%
Gay/Lesbian	225	50.0%	35.6%	14.3%	n/a
Bisexual	677	44.9%	27.9%	18.2%	9.1%
Unsure	357	59.8%	27.0%	13.2%	n/a

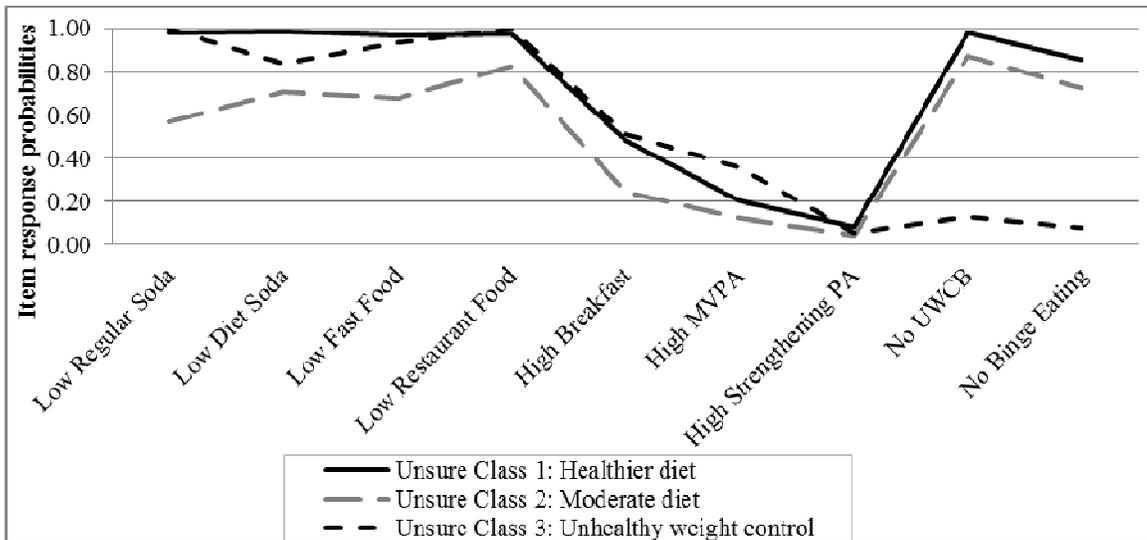
n/a: classes were not identified

3.6. Figures

Figure 1. Item-response probabilities* across sexual orientation among females







* Item-response probabilities represent the probability that members of a certain class endorse that specific indicator. Item-response probabilities of 0.0 reflect *unhealthy* weight-related behaviors in a class and probabilities of 1.0 reflect *healthy* weight-related behaviors in a class.

MVPA: Moderate-to-vigorous physical activity, PA: physical activity, UWCB: Unhealthy weight control behaviors

Chapter 4. Manuscript 2: Differences in weight-related behavioral profiles by sexual orientation among college men

4.1. Introduction

Recent national estimates indicate that over one-third of US adults are obese and over two-thirds are overweight.³⁶ This distribution of weight is concerning given that excess weight is associated with numerous adverse health outcomes, including cardiovascular disease, type 2 diabetes, and some cancers. Weight-related behaviors, such as eating habits, sedentary behaviors, and physical activity, are the most proximal contributing factor in one's energy balance and subsequent weight outcomes. Therefore, for obesity prevention and weight loss research, focus has been on these behaviors as a means to address weight-related health.

A recent Institute of Medicine report on lesbian, gay, and bisexual (LGB) health highlighted several limitations of existing weight-related research for these specific groups, particularly among men.¹ Existing evidence suggests that gay and bisexual adult men may be at lower risk of obesity and higher risk of disordered eating than heterosexual men; however many of these studies rely on convenience samples, with only a handful using population-based data.^{5-7,9,21-30,72,75} Other research suggests that there may not be differences in the frequency of fruit and vegetable consumption between gay, bisexual men and heterosexual men,^{6,12} but research on disparities in other aspects of nutrition by sexual orientation is lacking. There is slightly more research on physical activity, and findings are generally mixed due, in part, to differences in measurement of physical activity. Some evidence suggests lower levels of physical activity among gay or

bisexual men compared to straight men,^{6,10,11} while one other study found more physical activity, particularly strengthening physical activity, among gay or bisexual men.¹²

In exploring sexual orientation disparities for weight-related health, there are some important considerations. First, it is important to examine males and females separately since existing evidence suggests differences in weight-related health across both sexual orientation and gender. For example, while gay men are less likely to be obese than heterosexual men, gay or lesbian women are more likely to obese than heterosexual women.^{3,5-9} An area of weight-related health that is of particular concern among gay and bisexual men is related to disordered eating. While findings for women have been mixed with regard to disordered eating (due in part to differences in sampling),^{2,23} among gay men, evidence suggests more disordered eating than heterosexual men.^{22-30,51,72,92,93} Second, it is also important to examine sexual orientation groups separately, rather than treating these groups as homogenous. For example, while gay men are less likely to be obese compared to heterosexual men, the evidence is not as consistent for bisexual men. Combining gay and bisexual men into a single group could attenuate effects for obesity as well as mask specific interventions needs that each group may have. Finally, existing evidence has explored disparities across sexual orientation for specific behaviors (e.g., fruit and vegetable consumption and strengthening physical activity). Across gender and sexual orientation, how these behaviors co-occur with each other may differ given known differences between men and women in weight-related health across sexual orientation. Further, since multiple weight-related behaviors

contribute to one's overall weight, being able to identify relevant subgroups allows for intervention tailoring.

The purpose of this study was to identify and describe homogenous classes of male college students based on their weight-related behaviors (e.g., dietary intake and eating habits, physical activity, unhealthy weight control behaviors), and to examine differences across five sexual orientation groups. We focused on college students since this represents an age when engagement in healthful weight-related behaviors tends to decline¹⁰¹⁻¹¹¹ and it is a time when many people explore aspects related to sexuality^{41,49,99,119}. Further, college students have been understudied with regard to weight-related health, and the college setting provides an unique platform for intervention development and delivery. We hypothesized that there are distinct classes of weight-related behaviors that share common patterns across sexual orientation groups, and for whom interventions can be developed and tailored. In addition, we hypothesized that differences in the proportion of individuals attributed to specific classes and patterning of weight-related behaviors exist across sexual orientation groups, with greater proportions of gay or bisexual men in unhealthy classes and exhibiting unhealthy patterns compared to heterosexual men.

4.2. Methods

Design and sample. Data were from the 2009-2013 College Student Health Survey (CSHS), an on-going statewide surveillance system of 2- and 4-year colleges and universities across Minnesota. Between 2009 and 2013, 46 institutions participated in CSHS (26 two-year and 20 four-year). For most schools participating in the CSHS,

students were randomly selected through a registrar's enrollment list furnished by participating educational institutions. For smaller schools, all students were invited to participate in order to have sufficient sample sizes for reports generated for each school, while at larger schools only a proportion of students were invited (total sampling range: 12.5-100%, dependent of school size). Eligible participants were sent multiple invitations, including postcards and emails, to anonymously complete an online survey. Participants who completed the survey were entered into a raffle to win prizes such as iPods®, iPads®, and gift cards. The overall response rate was 33.2%. Additional details on the CSHS are available online (<http://www.bhs.umn.edu/surveys/index.htm>).

Between 2009 and 2013, 30 of the 46 colleges participated in the CSHS in more than one year between 2009 and 2013. In order to minimize the possibility that participants were included in the dataset more than once and to maximize sample size, a college's second year of data was included only when the possibility of overlap in participants was expected to be negligible (i.e., less than 2%, calculated from percent of student body sampled, graduation and retention rates), as has been done previously.^{75,162,175} Six schools had a negligible estimated percentage of overlap in the first and second samples (range: 0.45%-1.57%). Thus, an additional year of data was included for these schools ($n_{\text{students}} = 6,912$). This yielded a final merged 2009-2013 CSHS dataset consisting of 29,118 students ($n_{\text{males}}=10,423$).

Measures. Sexual orientation was assessed by self-report for both identity and behavior on the CSHS. Consistent with previous research using the Youth Risk Behavior Survey (YRBS)¹⁶² and CSHS data,⁷⁵ we created the following categories for sexual

orientation: “heterosexual” (identified as heterosexual and did not report engaging in any same-sex sexual behavior in the past year), “discordant heterosexual” (identified as heterosexual and reported engaging in same-sex sexual behavior in the past year), “gay/lesbian” (identified as gay or lesbian, regardless of sexual behavior), “bisexual” (identified as bisexual, regardless of sexual behavior), and “unsure” (identified as unsure about their sexual orientation, regardless of sexual behavior).

Behavioral measures covered four areas of weight-related behaviors: dietary intake and eating habits, physical activity, screen time, and unhealthy weight control behaviors. All variables were dichotomized based on existing public health recommendations or using risk-based cut-points, which have practical significance in that they serve as a meaningful threshold for health. Further, dichotomization facilitated interpretation of results and accounted for the non-normality of data.

Three aspects of *dietary intake* were assessed: fruit and vegetable, soda, and diet soda consumption. These items used standard questions adapted from the YRBS.¹⁷² Frequency response options ranged from, “I did not eat or drink this,” to “4 or more times per day.” Participants met recommendations if they reported consuming fruits and vegetables ≥ 5 times/day. For soda and diet soda, responses were dichotomized for each item as consuming < 1 /day or ≥ 1 day.^{113,176}

To assess *eating habits*, participants reported the number of days that they ate breakfast.¹⁶⁷ Breakfast consumption was dichotomized as ≥ 5 days/week or < 5 days/week. The frequency of eating (1) fast food meals and (2) at non-fast food restaurants was also assessed. Response options ranged from “never” to “several times per day.” Consistent

with previous literature, both fast food and restaurant food consumption were dichotomized as \geq several times/week vs. $<$ several times/week.^{175,177,178}

Three types of *physical activity* were assessed: strenuous, moderate, and strengthening. Examples were provided for each type of activity. Response options ranged from “None,” to “6½+ hours.” Moderate and strenuous physical activities were combined into a single ‘moderate-to-vigorous physical activity’ indicator. Meeting recommendations was ≥ 5 hours/week of moderate and vigorous physical activity combined or ≥ 4.5 hours/week of either moderate or vigorous physical activity (guided by recommendations for weight maintenance, which include ≥ 1 hour on most days of the week).¹⁷⁹ Consistent with previous research using CSHS data, strengthening physical activity was categorized as ≥ 2.5 hours/week or ≤ 2 hours/week.⁸²

Time spent watching television or using a computer (for things besides school or work) on an average day were used to assess *screen time*. Response options ranged from, “None,” to “5+ hours.” Categories of ≥ 14 hours/week vs. < 14 hours/week were created for screen time in line with recommendations for young people of < 2 hours/day.¹⁷³

Using a standard assessment of *disordered eating behaviors*, participants indicated the frequency of four behaviors in the past 12 months: using laxatives to control weight, taking diet pills, binge eating, and inducing vomiting to control weight.^{113,163,167,174} This is similar to items that have been used extensively in other research, most notably the YRBS.^{51,72,74} Using laxatives, taking diet pills, and inducing vomiting were combined into a single unhealthy weight control behaviors variable (any

vs. none) while binge eating, which is conceptually different from the other behaviors, was examined separately.⁷⁵

Analysis. Latent class analysis (LCA) is a technique designed to identify a small number of homogenous subgroups within a larger heterogeneous group, based on responses to select indicators.^{180,181} LCA models with classes ranging from one to eight were fit and the final model was selected using several available tools that aid in model selection including multiple fit criteria, such as information criteria (Akaike Information Criteria, AIC; Bayesian Information Criteria BIC; Adjusted BIC), and likelihood ratio tests (Bootstrap Likelihood Ratio Test (BLRT)). Solution interpretability, distribution of classes, and classification quality (e.g., entropy and class separation) are also used in model selection.^{180,182}

After assessing initial LCA models, fruit and vegetable consumption and sedentary behavior were dropped as indicators due to similarities in responses across classes, thus not helping to differentiate classes. Nine indicators were included in final LCA models: soda, diet soda, fast food, restaurant food, and breakfast consumption, moderate-to-vigorous and strengthening physical activity, unhealthy weight control behaviors, and binge eating.

We fit LCA models to the whole sample of males and identified a best-fitting solution. To test for measurement invariance with regard to sexual orientation, the LCA solution was regressed on sexual orientation. Results were significant ($p < 0.001$), indicating differences across sexual orientation in the latent classes and that models should be stratified by sexual orientation. Upon examination of the final latent classes for

each sexual orientation group, we determined that a multi-group LCA (allowing us to quantitatively examine differences between sexual orientation groups) would not be an appropriate strategy given the differing number of final classes. The final LCA models were selected based on fit and interpretability, with independent models for each sexual orientation group. Comparisons across sexual orientation groups are qualitative in nature, given the fitting of separate models rather than within a single multi-group model.

For these analyses, we excluded participants with missing data for sexual orientation (n=17) and participants who provided questionable response patterns (n=3). Questionable response patterns were flagged where participants provided implausible responses on three or more of seven key variables. This yielded a final analytic sample of 10,405 male college students. All data management and analyses were performed using SAS (SAS version 9.1, Cary, NC: SAS Institute Inc.). These analyses were considered secondary analysis of anonymous data and therefore deemed exempt from IRB review. The University of Minnesota Institutional Review Board approved all CSHS data collection.

4.3. Results

Overall, the majority of our analytic sample was heterosexual (92.8%), 0.7% were discordant heterosexual, 3.2% were gay, 1.5% were bisexual, and 1.7% were unsure of their sexuality. The majority of the sample attended a 4-year school (65.0%), were white (79.8%), and the median age was 22 years.

Prevalence of LCA indicators by sexual orientation is presented in Table 11. Overall, most males, regardless of sexual orientation, reported healthy levels of soda, diet

soda, fast food, and restaurant food consumption, while few met recommendations for fruit and vegetable consumption. Across all sexual orientation groups, less than half ate breakfast at least five days/week and 18%-31% met recommendations for moderate-to-vigorous physical activity. Heterosexual males had the highest proportion of participants engaging in ≥ 2.5 hours/week of strengthening physical activity (27.7%), while less than 20% of males in other sexual orientation groups met recommendations. About half of males met recommendations for screen time. The majority of male students did not engage in unhealthy weight control behaviors or binge eating (85.5-95.6% reported no unhealthy weight control, 74.8-88.6% reported no binge eating).

Fit statistics for LCA models for each individual sexual orientation group are presented in Table 12. In addition to examining fit statistics, we considered the interpretability of solutions in selecting final models. For heterosexual males, fit statistics continued to improve with increasing number of classes. However, the additional gains in information criteria (i.e., AIC, BIC, and adjusted BIC) were much lower after the four-class solution. The five-class solution did not yield a new substantive class over the four-class solution while the four-class solution identified a unique subgroup over the three-class solution. Therefore, the four-class solution appeared to be an optimal solution for heterosexual males. For discordant heterosexual males, AIC and adjusted BIC suggested a three-class solution while BIC and BLRT results suggested a one-class solution. The three-class solution identified classes with few members ($n < 10$). Compared to the one-class solution, there was a unique class identified in the two-class solution and the prevalence was adequate; therefore a two-class solution was retained. Among gay males,

BLRT results suggested a three-class solution while information criteria suggested varying solutions. Based on the higher entropy and interpretability, the three-class solution was retained. For bisexual males, the AIC, adjusted BIC, and BLRT results suggest a three-class solution. This was also supported by the interpretability of the solution. Finally, for unsure participants, the three-class solution was retained based on support from BLRT results and interpretability.

Item-response probabilities and patterning of classes are presented in Figure 2. Item-response probabilities represent the probability that members of a certain class endorse that specific indicator. In Figure 2, probabilities closer to one represent a high probability of engaging in healthy weight-related behaviors, while probabilities closer to zero indicate less favorable engagement in weight-related behaviors. A total of four general classes were identified across the five LCA models, and they can be broadly characterized as “Healthier diet,” “Moderate diet,” “Unhealthy weight control,” and “Healthier diet, physically active.” As noted below, however, some deviations exist in these classes across sexual orientation groups, and not all classes were identified in all sexual orientation groups.

Class 1 (“Healthier diet”) was characterized by a high probability of healthful levels of regular soda, diet soda, fast food, and restaurant consumption among all sexual orientation groups (heterosexual: 0.83-0.94; discordant heterosexual: 0.78-0.98; gay: 0.75-0.87; bisexual: 0.84-0.98; unsure: 0.90-0.97), low probability of meeting physical activity recommendations (range across all sexual orientation groups, moderate-to-vigorous physical activity: 0.11-0.26; strengthening physical activity: 0.00-0.23), and

high probabilities of engaging in no unhealthy weight control behaviors or binge eating (no unhealthy weight control: 0.94-1.00; no binge eating: 0.78-0.99). A deviation existed for breakfast consumption among gay males. For the “healthier diet” class identified among heterosexual, discordant heterosexual, bisexual, and unsure males, probabilities for meeting breakfast consumption ranged from 0.35-0.56. For gay men, two patterns were identified that were consistent with the “healthier diet” pattern for all indicators except for breakfast consumption. Class 1a (“Healthier diet with breakfast consumption”) had a very high probability of meeting breakfast recommendations (0.94), while Class 1b (“Healthier diet without breakfast consumption”) had a very low probability of meeting breakfast recommendations (0.04).

Class 2 (“Moderate diet”) had similar patterning to Class 1 on physical activity measures, unhealthy weight control behaviors, and binge eating. However, this class was characterized by lower probabilities of meeting recommendations fast food (0.36-0.55), restaurant food (0.67-0.83), and eating breakfast (0.15-0.30). Among heterosexual and bisexual males in the “moderate diet” class, probabilities ranged from 0.45-0.54 for regular soda consumption and 0.79-0.82 for diet soda consumption. Among unsure males, a Class 2a (“Moderate diet with regular soda consumption”) was identified as a slight variation on the general “moderate diet” pattern. The probability of regular soda consumption among unsure males in this class was 0.07, suggesting very frequent consumption of regular soda these males. A “moderate diet” pattern was not identified for discordant heterosexual and gay males.

Class 3 (“Unhealthy weight control”) also had similar patterning to Class 1, however similarities were only for dietary intake, food consumption, and physical activity. Class 3 was characterized by a lower probability of meeting recommendations for unhealthy weight control behaviors (range for heterosexual, gay, bisexual, and unsure: 0.06-0.40) and binge eating (0.05-0.33). A Class 3 pattern was identified for all sexual orientation groups. However, among discordant heterosexual males the probabilities were slightly higher (unhealthy weight control behaviors: 0.53; binge eating: 0.45).

Class 4 (“Healthier diet, physically active”), only observed among heterosexual men, had similarly high probabilities for all indicators, except for physical activity, to Class 1. Class 4 was distinguishable by have the highest probabilities on physical activity compared to other classes (moderate-to-vigorous physical activity: 0.58; strengthening physical activity: 0.62).

In addition to examining patterning, it is also important to assess the prevalence of each class (Table 13). Across all sexual orientation groups Class 3 (“Unhealthy weight control”) had the lowest prevalence. The prevalence of Class 1 (“Healthier diet”), including Class 1a and Class 1b, ranged from 39.4% to 77.3% and Class 2 (“Moderate diet”), including Class 2a, ranged from 12.0% to 30.2%. Class 4 (“Healthier diet, physically active”) accounted for over a third of heterosexual men.

4.4. Discussion

Our results suggest that among male college students three general classes exist across all sexual orientation groups: Class 1 (“Healthier diet”), Class 2 (“Moderate diet”), and Class 3 (“Unhealthy weight control”). An additional Class 4 (“Healthier diet,

physically active”) was also identified among heterosexual male college students only. Variations on these classes include Class 1a (“Healthier diet with breakfast consumption”) and Class 1b (“Healthier diet without breakfast consumption”) among gay males as well as Class 2a (“Moderate diet with regular soda consumption”) among unsure males. All sexual orientation groups exhibited an “unhealthy weight control” pattern and some variation of a “healthier diet” pattern.

One major area of concern highlighted by our findings was that between four to fifteen times the proportion of discordant heterosexual, gay, bisexual, and unsure males exhibited the “unhealthy weight control” pattern compared to heterosexual males. These findings were consistent with previous research.^{21–30} Further, unhealthy weight control co-occurred with low physical activity, a finding that is similar to our previous LCA findings among female college students, which found nearly half the proportion of heterosexual women in the “unhealthy weight control” class compared to other sexual orientation groups, as identified in the previous chapter. This finding suggests the need for interventions addressing issues around physical activity and unhealthy weight control that are tailored specifically for non-heterosexual and discordant heterosexual college students, including males. Although there has been a limited amount of work that has explored unhealthy weight control among males,^{184–188} the focus of this work has been predominantly on females.^{89–91,189–193} Our study highlights the need for interventions related to unhealthy weight control among a subset of males who are disproportionately impacted by these behaviors. These interventions could include greater resources on

college campuses, such as increased screening and treating of unhealthy weight control behaviors among males at campus clinics.

A second major area of concern highlighted by these findings was that only heterosexual males exhibited a “healthy diet, physically active” pattern. This finding was consistent with previous research suggesting lower physical activity among gay and bisexual men^{6,10,11} and highlights the need for a physical activity promotion intervention that is targeted specifically to college males who are not exclusively heterosexual. For example, facilities such as college recreation centers need to be safe, supportive spaces for discordant heterosexual, gay, bisexual, and unsure males. Creating these safer spaces could include factors such as availability and promotion of single stall changing rooms and/or restrooms for students, better signage to promote the need for safe spaces and respectful behavior in the gym, hours at the gym designated as LGB hours to promote safety and inclusivity for LGB students, or LGB-specific fitness groups for students to engage in a variety of activities such as hiking, biking, yoga, or organized sports. Some of these resources will be explored in the next chapter.

Further, there were unique patterns that emerged in the form of two minor deviations in patterning of Class 1, specifically around breakfast consumption. For the majority of the college male population, breakfast consumption was an area that needs to be addressed in order to improve overall eating habits in this population. Only one pattern, exhibited by nearly 42% of gay males (Class 1a: “Healthier diet with breakfast consumption”) had high probabilities of breakfast consumption compared to other patterns and other sexual orientation groups, thus representing an area which a subset of

gay males are doing very well with regard to food consumption. Overall, breakfast interventions are needed at the college level (i.e., across sexual orientation groups). Breakfast intervention efforts have focused on primary and secondary school children through initiatives such as the School Breakfast Program,¹⁹⁴ and have included measures such as offering breakfast before school, breakfast in the classroom, and Grab n' Go breakfast options.¹⁹⁴⁻¹⁹⁶ Future work should explore breakfast intervention options for different college settings (such as 2-year vs. 4-year schools) in order to improve dietary habits among all students.

Overall, our findings related to the patterning of nutrition-related variables were similar to findings from females in our previous study; specifically, the probability of engaging in healthful levels of regular soda, diet soda, fast food, and restaurant food consumption was in the moderate-to-high range ([blinded for review purposes], under review). However, consistent with females, fruit and vegetable consumption (which was dropped from inclusion in LCA) had low probabilities across all sexual orientation groups of males. Therefore, it may be particularly important for nutrition-related interventions to address both fruit and vegetable consumption.

To our knowledge, this is the first study to use LCA to examine disparities in weight-related behaviors across sexual orientation among males. A strength of this study includes the large sample of gay, bisexual, and unsure participants (which allowed separate sexual orientation groups rather than treating all non-heterosexual participants as a homogenous group), which have been shown in previous research to be at increased risk in comparison to their consistently heterosexual peers.^{75,162,170,171} The sample size

allowed for a more robust and fine grain examination of sexual orientation disparities. However, for discordant heterosexual males in particular, it may not have been sufficient to identify additional salient classes. Future studies with large samples for these groups are needed to confirm our findings. Related, because of the differing number of classes identified (indicating differences in latent class structure) by sexual orientation group as well as the discrepancies in the breakfast, regular soda, and diet soda indicators among gay and unsure males, we were not able to quantitatively assess differences using significance testing. However, the findings of this study still highlight important differences across sexual orientation that are useful for future intervention development. Finally, because this was a population-based sample of college students in Minnesota, the results may have limited generalizability to college students in other geographic areas or to young adults not attending a post-secondary institution.

Overall, these findings highlight unique patterning of weight-related behaviors across sexual orientation groups among college males. Among all college males, interventions are needed to address physical activity and unhealthy weight control behaviors, although a focus is needed for discordant heterosexual, gay, bisexual, and unsure males for whom these behaviors are more prevalent. Future research should examine patterning using other large datasets across diverse sexual orientation groups. Future intervention work can benefit from these findings by tailoring intervention components and targeting recruitment to specific patterns of weight-related behaviors as well as to specific sexual orientation groups.

4.5. Tables

Table 11. Prevalence of meeting weight-related behavioral recommendations^a by sexual orientation among males (n=10,405), College Student Health Survey 2009-2013

	Heterosexual (N=9,659)	Discordant Heterosexual (N=70)	Gay (N=337)	Bisexual (N=161)	Unsure (N=178)
Fruit and vegetable consumption (≥ 5 /day)	15.6%	10.1%	18.2%	18.2%	20.3%
Regular soda consumption (< 1 /day)	79.5%	82.9%	85.2%	78.9%	79.2%
Diet soda consumption (< 1 /day)	90.6%	82.9%	85.5%	86.3%	88.2%
Fast food consumption ($< \text{several times/week}$)	80.7%	88.4%	82.5%	83.2%	89.3%
Restaurant food consumption ($< \text{several times/week}$)	88.5%	92.8%	77.5%	83.2%	89.3%
Breakfast consumption (≥ 5 days/week)	40.3%	39.1%	44.2%	37.4%	38.8%
Moderate-to-vigorous physical activity (≥ 5 hours/week of moderate and vigorous physical activity combined or ≥ 4.5 hours/week of either moderate or vigorous physical activity)	30.9%	27.1%	19.3%	18.0%	21.9%
Strengthening physical activity (≥ 2.5 hours/week)	27.7%	18.6%	17.8%	14.3%	19.9%
Screen time (< 14 hours/week)	48.1%	51.4%	53.7%	49.7%	54.5%
Unhealthy weight control behaviors ^a (none)	95.6%	85.5%	89.0%	93.2%	88.2%
Binge eating (none)	88.6%	82.6%	78.3%	74.8%	87.5%

^a risk-based cut-points were used for behaviors where recommendations do not exist
^b includes taking diet pills, laxatives, or vomiting

Table 12. Fit statistics for unconditional independent LCA models among male college students across sexual orientation

		Likelihood	AIC	BIC	Adjusted BIC	Entropy R ²	BLRT*
Heterosexual (n=9,659)	1 class	-39420.17	3357.97	3422.55	3393.95	1.00	
	2 classes	-38683.37	1904.36	2040.70	1980.32	0.38	0.01
	3 classes	-38332.73	1223.08	1431.17	1339.02	0.50	0.01
	4 classes	-38189.54	956.71	1236.56	1112.63	0.59	0.01
	5 classes	-38116.40	830.43	1182.03	1026.32	0.60	0.01
	6 classes	-38076.07	769.76	1193.13	1005.63	0.57	0.01
Discordant Heterosexual (n=70)	1 class	-287.97	144.42	164.65	136.30	1.00	
	2 classes	-277.30	143.07	185.79	125.94	0.66	0.09
	3 classes	-265.55	139.57	204.78	113.43	0.84	0.03
	4 classes	-257.27	143.01	230.71	107.86	0.89	0.12
	5 classes	-252.40	153.28	263.45	109.11	0.88	0.69
	6 classes	-247.98	164.43	297.09	111.25	0.86	0.35
Gay (n=337)	1 class	-1464.62	337.80	372.18	343.63	1.00	
	2 classes	-1440.02	308.60	381.18	320.91	0.68	0.01
	3 classes	-1423.51	295.58	406.36	314.37	0.76	0.01
	4 classes	-1410.51	289.57	438.55	314.84	0.65	0.05
	5 classes	-1397.04	282.63	469.81	314.38	0.72	0.02
	6 classes	-1384.01	276.57	501.96	314.80	0.73	0.01
Bisexual (n=161)	1 class	-670.45	229.82	257.55	229.06	1.00	
	2 classes	-647.49	203.91	262.46	202.31	0.92	0.01
	3 classes	-627.40	183.73	273.09	181.28	0.73	0.01
	4 classes	-619.41	187.74	307.91	184.45	0.78	0.38
	5 classes	-613.06	195.03	346.02	190.90	0.81	0.48
	6 classes	-607.85	204.63	386.44	199.66	0.83	0.65
Unsure (n=178)	1 class	-707.62	257.75	286.39	257.88	1.00	
	2 classes	-684.52	231.55	292.00	231.83	0.68	0.01
	3 classes	-671.28	225.09	317.36	225.52	0.80	0.04
	4 classes	-660.11	222.73	346.82	223.31	0.80	0.06
	5 classes	-650.31	223.14	379.05	223.87	0.81	0.08
	6 classes	-642.55	227.62	415.34	228.49	0.85	0.30

Bolded classes indicate final selected models.

* p-value represents test for a (k+1)-class solution vs. k-class solution (e.g., 3-class compared to 2-class, 4-class compared to 3-class)

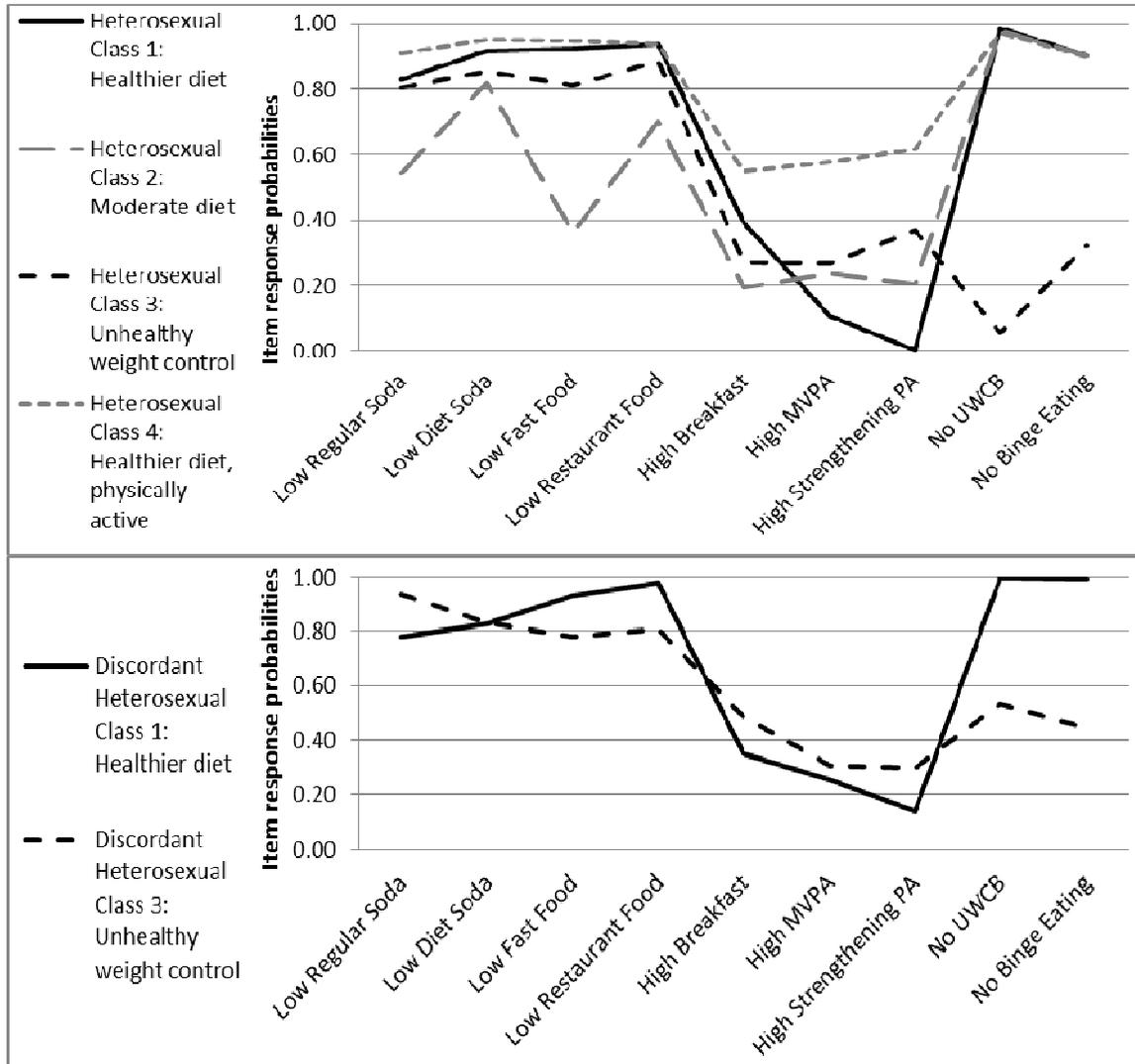
Table 13. Probability of latent class membership among male college students by sexual orientation (n=10,405)

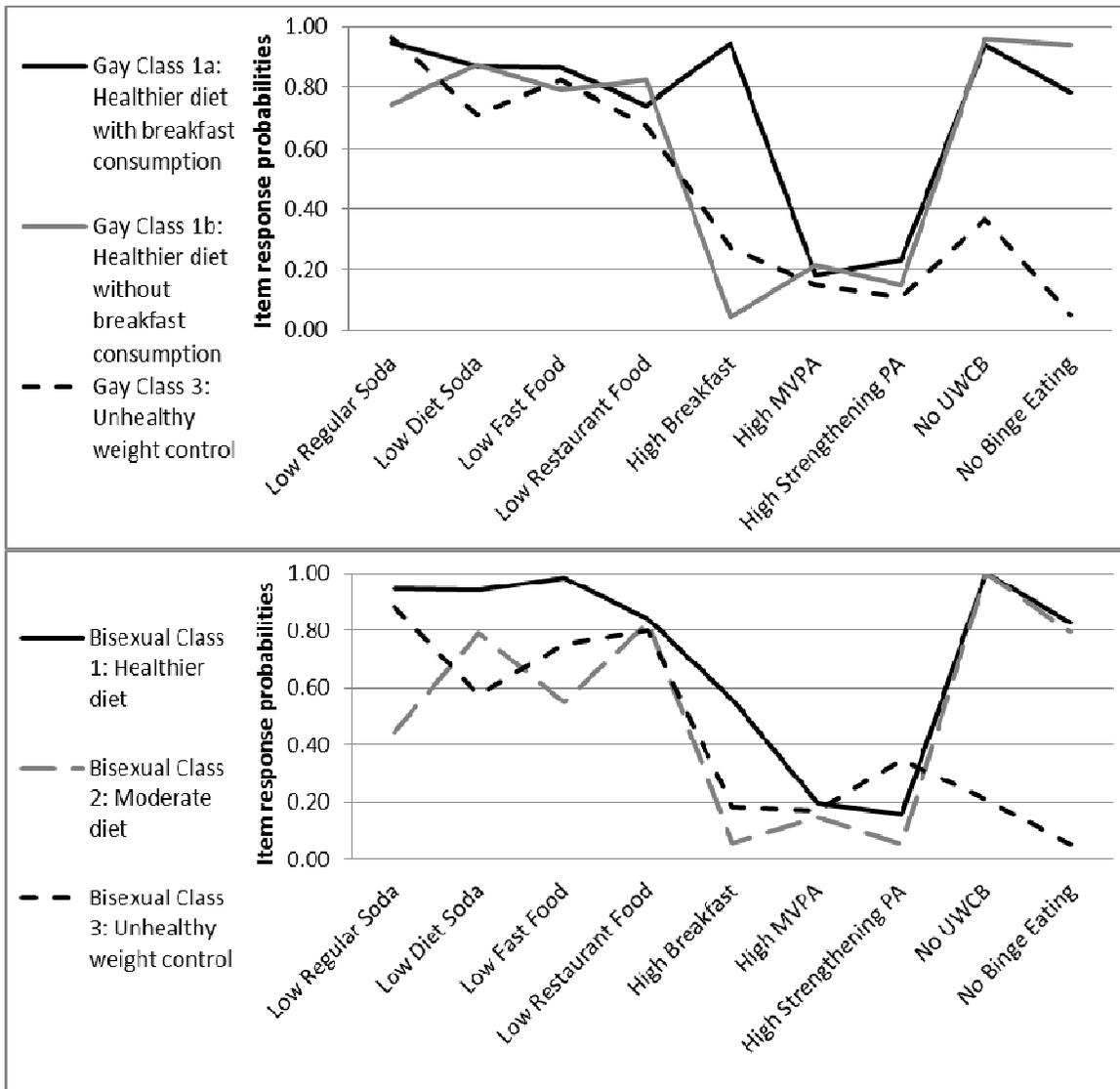
	n	Class 1: Healthier diet	Class 1a: Healthier diet with breakfast consumption	Class 1b: Healthier diet without breakfast consumption	Class 2: Moderate diet	Class 2a: Moderate diet with regular soda consumption	Class 3: Unhealthy weight control	Class 4: Healthier diet, physically active
Heterosexual	9,659	39.4%	n/a	n/a	22.2%	n/a	2.6%	35.8%
Discordant Heterosexual	70	69.7%	n/a	n/a	n/a	n/a	30.4%	n/a
Gay	337	n/a	41.8%	48.0%	n/a	n/a	10.2%	n/a
Bisexual	161	61.4%	n/a	n/a	30.2%	n/a	8.4%	n/a
Unsure	178	77.3%	n/a	n/a	n/a	12.0%	10.7%	n/a

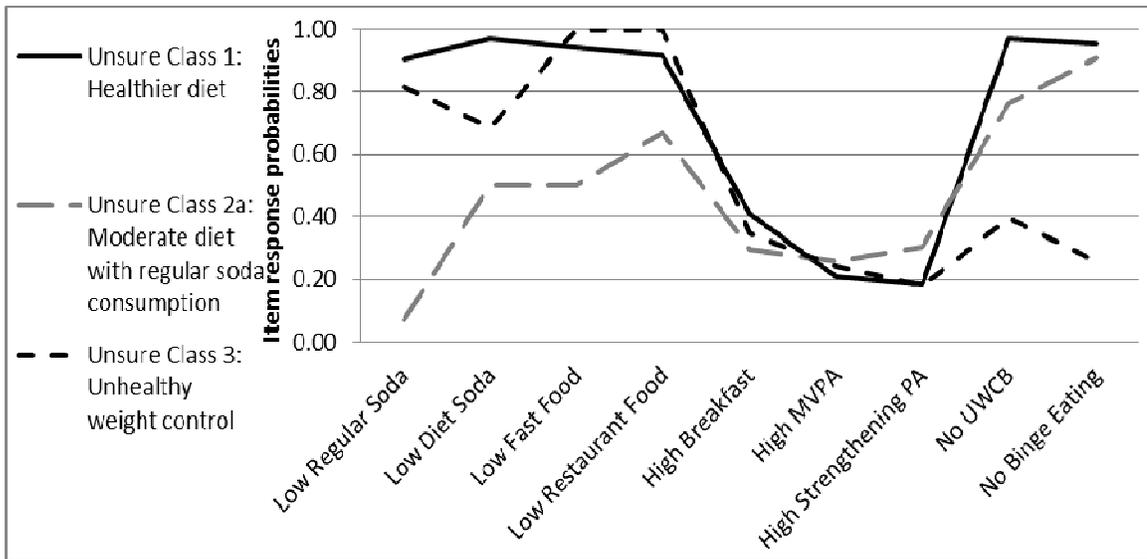
n/a: classes were not identified

4.6. Figures

Figure 2. Item-response probabilities* across sexual orientation among males







* Item-response probabilities represent the probability that members of a certain class endorse that specific indicator. Item-response probabilities of 0.0 reflect *unhealthy* weight-related behaviors in a class and probabilities of 1.0 reflect *healthy* weight-related behaviors in a class.

MVPA: Moderate-to-vigorous physical activity, PA: physical activity, UWCB:

Unhealthy weight control behaviors

Chapter 5. Manuscript 3: College context, weight-related behaviors, and sexual orientation

5.1. Introduction

Existing research suggests that LGB adult women may be at higher risk of being overweight or obese,^{1-6,75} while LGB adult men may be at lower risk, compared to their heterosexual counterparts.^{5-9,75} Further, research suggests that disordered eating may be higher among LGB women and men than heterosexuals,^{11,21-30,75} and findings for nutrition and physical activity have been mixed.^{4,6,8,10-12,75} A 2011 report from the Institute of Medicine (IOM) highlighted the need for more research on the contextual influences contributing to LGB health. Although there has been great emphasis on context within the field of obesity research overall, for example demonstrating the effect of nutrition policies, friends and family, and healthy food availability on obesity and weight-related behaviors,^{87,124-133} little in this area has examined how contextual factors might specifically contribute to weight-related disparities in LGB health.

Stressful social conditions, including explicit or covert discrimination, stigmatization, or prejudice, has explained disparities in mental health and substance use among LGB individuals.^{76,197} Mental health and substance use are associated with weight-related behaviors, such as physical activity, unhealthy weight control behaviors (including using diet pills, taking laxatives, or vomiting), and binge eating,⁷⁷⁻⁸² suggesting that negative experiences related to sexual orientation could also have an adverse impact on these aspects of physical health. There have been more recent efforts to create institutional and societal conditions that are less discriminatory based on sexual

orientation through movements such as legalization of same-sex marriage and inclusion of sexual orientation in anti-discrimination policies.

Previous research has demonstrated the association of LGB-supportive contexts (including state-level and school-level contexts) and positive LGB health outcomes among adolescents and adults, particularly for mental health and substance use.¹³⁴⁻¹⁴⁴ Hatzenbuehler and colleagues found that unsupportive LGB contexts (including lack of gay-straight alliances or inclusion of sexual orientation in anti-bullying or anti-discrimination policies at schools, lack of inclusion of sexual orientation in state-level anti-discrimination policies, living in LGB-unsupportive religious climates) as well as social factors (such as having low concentrations of same-sex couples and/or increased social isolation) were associated with greater mental health issues and substance use for LGB individuals.¹³⁴⁻¹⁴¹ Similarly, Eisenberg and colleagues explored the relationship between LGB college environments and LGB student health (related to substance use and sexual health) on 4-year campuses throughout the United States. Using an index that included measures such as the presence of gay-straight alliances, inclusion of sexual orientation in anti-discrimination policies, dedicated staff for LGB students, presence of an LGB studies department and courses offered, and the presence of LGB housing, more LGB-supportive contexts were associated with less cigarette smoking among LGB women¹⁵¹ and more consistent condom use among all students.¹⁵⁰ Conversely, these more supportive contexts were also associated with greater binge drinking among LGB men,¹⁵¹ suggesting a complex interaction between LGB college contexts and health among students that needs to be explored.

The college context may be a particularly important setting for developing and delivering weight-related health interventions to address sexual orientation related disparities for a number of reasons. First, during emerging adulthood (typically defined as 18-25 years),⁹⁹ weight-related health generally declines, with noted weight gain and deterioration of diet quality and physical activity during emerging adulthood.¹⁰⁴⁻¹¹¹ Second, emerging adulthood is also a period when independence is established and new responsibilities, life skills, and identities are negotiated and formed. In particular, sexual orientation exploration and identity formation around sexuality is common in this age group.^{41,49,119} Third, over 40% of emerging adults attend college at either 2-year or 4-year institutions, representing a critical mass of this age group that is accessible for intervention targeting and delivery.¹⁰⁰ Within existing research on college students and the college setting, 2-year community and technical colleges have generally not been included, representing a major limitation in the current literature. Enrollment in 2-year institutions has been increasing among emerging adults¹⁰⁰ and it is important to capture this under-represented group in order to more effectively understand the relationship of the college context on student health. Fourth, although there have been many existing school-based weight-related intervention efforts (especially in primary and secondary schools),¹²⁹⁻¹³¹ little research has explored strategies for weight-related interventions in the college setting.¹⁰² Finally, existing research has found that LGB emerging adults experience a significant burden of excess weight, poor diet, physical inactivity, and unhealthy weight control behaviors compared to their heterosexual counterparts,^{72,73,75}

highlighting a need to examine some of the contextual factors that may contribute to these disparities.

The purpose of this study was to examine the relationship between the institutional supports for LGB college students including campus-based policies and resources and weight-related behaviors across sexual orientation groups. We hypothesized that LGB-supportive contexts would be associated with more favorable weight-related behaviors.

5.2. Methods

Two levels of data were used in these analyses: individual-level and institutional-level. Individual-level data are from the 2009-2013 College Student Health Survey (CSHS), an on-going statewide surveillance system of 2- and 4-year colleges and universities across Minnesota.^{75,175} Between 2009 and 2013, 46 institutions participated in the CSHS (26 2-year and 20 4-year). For most schools participating in the CSHS, students were randomly selected through a registrar's enrollment list furnished by participating educational institutions. For smaller schools, all students were invited to participate in order to have sufficient sample sizes for reports generated for each school, while at larger schools only a proportion of students were invited (total sampling range: 12.5-100%, dependent of school size). Eligible participants were sent multiple invitations, including postcards and emails, to anonymously complete an online survey. Participants who completed the survey were entered into a raffle to win prizes such as iPods®, iPads®, and gift cards. The overall response rate was 33.2%. Additional details on the CSHS are available online (<http://www.bhs.umn.edu/surveys/index.htm>).

Thirty of the 46 colleges participated in the CSHS in more than one year between 2009 and 2013. In order to minimize the possibility that participants were included in the dataset more than once and to maximize sample size, a college's second year of data was included only when the possibility of overlap in participants was expected to be negligible (i.e., less than 2%, calculated from percent of student body sampled, graduation and retention rates), as has been done previously.^{75,162,175} Six schools had a negligible estimated percentage of overlap in the first and second samples (range: 0.45%-1.57%). Thus, an additional year of data was included for these schools ($n_{\text{students}} = 6,912$). The final merged 2009-2013 CSHS dataset consisted of 46 institutions and 29,118 students.

Sexual orientation was assessed by self-report for both identity and behavior on the CSHS. Consistent with previous research using the Youth Risk Behavior Survey (YRBS)¹⁶² and CSHS data,⁷⁵ we created the following categories for sexual orientation: "heterosexual" (identified as heterosexual and did not report engaging in any same-sex sexual behavior in the past year), "discordant heterosexual" (identified as heterosexual and reported engaging in same-sex sexual behavior in the past year), "gay/lesbian" (identified as gay or lesbian, regardless of sexual behavior), "bisexual" (identified as bisexual, regardless of sexual behavior), and "unsure" (identified as unsure about their sexual orientation, regardless of sexual behavior).

Individual-level outcome variables. Nine individual-level weight-related behaviors were used in a latent class analysis (LCA) to identify homogenous patterns of behaviors within the heterogeneous college population: consumption of regular soda, diet

soda, fast food, restaurant food, and breakfast, and participation in moderate-to-vigorous and strengthening physical activities, no unhealthy weight control behaviors, and no binge eating.

Both soda and diet soda consumption were assessed using standard questions adapted from the YRBS.¹⁷² Frequency response options ranged from, “I did not eat or drink this,” to “4 or more times per day.” Responses were dichotomized for each item as consuming $<1/\text{day}$ or ≥ 1 day.^{113,176}

Participants reported the number of days that they ate breakfast.¹⁶⁷ Breakfast consumption was dichotomized as ≥ 5 days/week or <5 days/week. The frequency of eating (1) fast food meals and (2) at non-fast food restaurants response options ranged from “never” to “several times per day.” Consistent with previous literature, both fast food and restaurant food consumption were dichotomized as \geq several times/week vs. $<$ several times/week.^{175,177,178}

Three types of physical activity were assessed: strenuous, moderate, and strengthening. Examples were provided for each type of activity. Response options ranged from “None,” to “6½+ hours.” Moderate and strenuous physical activities were combined into a single ‘moderate-to-vigorous physical activity’ indicator. Meeting recommendations was ≥ 5 hours/week of moderate and vigorous physical activity combined or ≥ 4.5 hours/week of either moderate or vigorous physical activity (guided by recommendations for weight maintenance, which include ≥ 1 hour on most days of the week).¹⁷⁹ Consistent with previous research using the CSHS data, strengthening physical activity was categorized as ≥ 2.5 hours/week or ≤ 2 hours/week.⁸²

Using a standard assessment of unhealthy weight control behaviors, participants indicated the frequency of four behaviors in the past 12 months: using laxatives to control weight, taking diet pills, binge eating, and inducing vomiting to control weight.^{113,163,167,174} This is similar to items that have been used extensively in other research, most notably the YRBS.^{51,72,74} Using laxatives, taking diet pills, and inducing vomiting were combined into a single unhealthy weight control behaviors variable (any vs. none) while binge eating, which is conceptually different from the other behaviors, was examined separately.⁷⁵

Analyses were stratified by both gender and sexual orientation. Details on these latent class analyses have been described in detail, in Chapters 3 and 4. Briefly, among both males and females, four distinct classes were identified, “healthier diet,” “moderate diet,” “unhealthy weight control,” and “healthier diet, physically active.” Membership in each class varied based on gender and sexual orientation. For example, among females, heterosexual and bisexual females exhibited all four classes while gay/lesbian and unsure females exhibited all but a “healthy diet, physically active” class. Among males, there were slight deviations within each class on a specific indicator were found for some groups (e.g., a “healthier diet with breakfast consumption” and a “healthier diet without breakfast consumption” class were identified among gay men), however, the general pattern was still consistent with those identified among females. Latent classes for each sexual orientation and gender group were used as outcome variables.

Institutional-level exposure variables. The primary exposure of interest was institutional supports for LGB students. Institutional supports were assessed using a

summary index to characterize the availability of LGB resources on-campus and consisted of 10 indicators (described below). Institutional-level data were collected through publicly available sources: the National Center for Education Statistics¹⁹⁸ and individual college/university websites. The use of websites likely reflects the ways prospective and current students gather information about available school resources.^{199–201}

Institutional supports for LGB students are outlined in Table 14 and included school policies, student groups or organizations related to LGB issues or diversity (such as gay-straight alliances or GSAs), courses offered, housing, and prevalence of LGB students. These measures were selected based on previous work by Eisenberg and colleagues, who used similar measures of LGB college environments.^{150,151,201} A number of these measures have also been shown to be associated with LGB health. For example, previous research has shown improved mental health and decreased victimization in the presence of GSAs in schools.^{202,203}

Information on school *anti-discrimination policies* was collected through student handbooks or posted policies on individual college/university websites. We looked for the inclusion of “sexual orientation” and “gender identity and gender expression” in these policies.

Institutional groups whose activities were related to LGB or diversity issues were grouped into four categories: 1) student-run LGB groups, 2) institution-run LGB programs or groups, 3) institution-run diversity programs or groups (which may or may not explicitly include LGB students), and 4) frequency of LGB-specific events. All

schools listed approved student groups on their website, which were used to identify schools where students had a group related to LGB issues specifically (for example, offering social activities, support groups, or activism opportunities for LGB students and their allies). Further, schools also advertised programming that included specific staff or dedicated faculty and these were used to identify institution-run LGB and diversity programs or groups (for example, an institutional office dedicated to LGB student issues or a committee of faculty and staff working to support LGB students, faculty, and staff). These institution-run groups may have included students, but were listed separately from the dedicated student-run groups. The distinction between student-run and institution-run LGB programs or groups is important as it may indicate the degree to which institutions dedicate financial resources to supporting LGB students and creating an LGB-supportive school climate. For the third institutional group, some schools had an overarching institution-administered diversity program that did not always outline specific target populations. If an institution-administered diversity program was also present, schools were coded as having one, regardless of the presence of LGB-specific groups or programs on campus. Finally, for the fourth institutional group, we searched school event calendars and LGB student-run and institution-run program webpages for advertised LGB-specific events for students, faculty, and allies (for example, Day of Silence, LGB student meetings).

For *courses offered*, we searched online course guidebooks for key terms including, “sexual,” “gay,” “lesbian,” and “queer.” We reviewed course descriptions, and schools were identified as having LGB-specific courses if the course title or description

was focused specifically on LGB or sexuality issues (examples included “Lesbian, Gay, Bisexual, Transgender, Queer Literature,” “Introduction to Lesbian Culture,” “Sociology of Sexualities,” and “Issues in Queer Studies”). Many courses included issues related to sexuality or sexual orientation, however, this was not the core focus of the course (for example, “Sociology of the Family,” “Foundations of Women and Gender Studies,” “Diverse and At-Risk Population”) and were coded as LGB-inclusive courses rather than LGB-specific courses.

We searched school housing webpages for information on specialized housing programs available to students interested in *LGB-specific housing*.

Finally, the *prevalence of LGB and unsure students* at each institution was estimated at each school using aggregated college-level data from CSHS responders, to give a sense of the size of the LGB community at each college.

Covariates. Institutional-level covariates included general institutional descriptors (Table 14), which were collected through the National Center for Education Statistics¹⁹⁸ website and included school setting (urban or rural, where urban are schools in city or suburbs and rural are schools in town or rural settings, as defined based on rural-urban commuting area codes), school type (2-year or 4-year, private or public), religious affiliation (yes or no), number of undergraduates enrolled, racial/ethnic make-up, gender distribution, and proportion of full-time students and students receiving financial aid. Previous research has suggested that these measures are associated with LGB institutional factors, such as those of interest in this study.^{150,151,201}

Individual-level sociodemographic covariates in these analyses came from the CSHS and included age, race/ethnicity (white vs. non-white), relationship status (single vs. not single), living arrangements (rent or share rent vs. not renting), student status (undergraduate vs. graduate), hours worked for pay (0-10 hours vs. 11+ hours), and credit card debt (none vs. any).^{75,167,175}

Analysis. We first conducted a classification model using latent class analysis in order to operationalize our outcome, weight-related behavioral profiles.^{204,205} We used a modification of the inclusive maximum-probability approach to assign individuals to their most likely class.²⁰⁶ The inclusive maximum-probability assignment approach includes covariates and the outcome to reduce bias when assigning individuals to classes. Without inclusion of these variables in determining class assignment, the true strength of the relationship between the latent classes and other variables (as identified in a subsequent analytic model) could be attenuated.²⁰⁶

For the two institutional-level constructs (institutional supports for LGB students and general institutional descriptors), we used principal components analysis (PCA) to conserve degrees of freedom and reduce the number of variables used in analysis (Table 15). PCA is a technique that examines a set of correlated variables, removes redundancy due to correlation between the variables, and creates a small number of indexes that account for most of the variance in the observed variables. To create the final components, standardized factor scores were used to weight the components based on the mean and standard deviation of each indicator and summed. Solutions were identified

using scree plots, eigenvalues, the amount of variance explained, and interpretability (using rotated factor patterns to facilitate interpretation of factor loadings).

For institutional supports for LGB students, all indicators were coded so that higher scores reflected greater institutional support for LGB students. We dropped the inclusion of sexual orientation in anti-discrimination policies from the PCA due to lack of variability across colleges and having LGB-specific events due to high correlation ($R^2=0.76$) with the presence of institution-run LGB programs. Two LGB context components were identified (cumulative variance explained=0.60): institution-focused LGB supports (eigenvalue=3.1) and student-engaged LGB supports (eigenvalue=1.1). The institution-focused component included high loadings for anti-discrimination policies, institution-administered LGB and diversity programs, and LGB-specific housing program. The student-engaged component included high loadings for LGB-specific and LGB-inclusive courses and student-run LGB group.

For general institutional descriptors, school setting, school type, race/ethnicity make-up and gender distribution were included in the PCA. Religious affiliation, proportion of full-time students, student receiving financial aid, and number of students enrolled were all dropped due to high correlation ($R^2>0.70$) with other indicators. We retained a two-component solution (cumulative variance explained=0.61), one describing the school structure (i.e. setting and type; eigenvalue=1.81) and a second describing the school's student body make-up (eigenvalue=1.25).

For analytic models, we fit 10 separate models regressing individual-level weight-related behavioral latent classes on institutional-level measures of institutional supports

for LGB students for each sexual orientation and gender group. Adjusted models also included the proportion of LGB and unsure students, institutional-level covariates (general institutional characteristics) and individual-level sociodemographics. Because our outcome variable, individual-level weight-related behavioral latent classes, is nominal and unordered in nature, we used multinomial logistic regression models in order to make multiple comparisons to a single reference group. For all models, the reference category was the healthiest weight-related behavioral latent class available within each sexual orientation group. Using weight-related behavioral profiles as the outcome has the advantage of providing a more comprehensive picture of one's health, because, while each weight-related behavior (e.g., physical activity, drinking soda, eating fast food, etc.) may be important, it is often the combination of these behaviors that have a cumulative impact on individual health. Further, in order to accommodate the two-level structure of our data, we incorporated a multilevel aspect into our analysis. This allows students to be nested within each institution and for us to estimate the relationship between the two levels (i.e., institution and student), which is particularly important in order to answer our research question of the association between institutional context and student health.

Our overall analytic sample was 46 institutions and 29,118 students; however, the sample of schools varied based on the availability of students in each sexual orientation and gender category (range=27-46). All data management, descriptive statistics, principal components analyses, and latent class analyses were conducted using SAS version 9.2

(SAS Institute Inc. 2011. Research Triangle, NC). All regression models were fit using MPlus version 7 (Muthen & Muthen 1998-2011. Los Angeles, CA).

5.3. Results

Characteristics of the colleges and student sample. Descriptive characteristics of schools are presented in Table 14. About half of the schools were located in urban settings and were 4-year institutions. The majority of schools were public institutions (80.4%). On average, schools had about 6,000 enrolled students, 76.1% white students, 43.0% male students, and 49.3% of students receiving financial aid.

As far as institutional supports for LGB students, nearly all schools included sexual orientation in anti-discrimination policies (97.8%); however, less than one-third included gender identity and expression. Over half of schools had student-run LGB programs such as a GSA (58.7%), less than a quarter had an institution-run LGB program or office (23.9%). Over a third had a diversity program (39.1%) and less than a fifth had advertised LGB-specific events (15.2%). With regard to courses offered, 21.7% offered at least one course that was specific to LGB topics and 67.4% offered at least one course that included LGB topics or populations. Finally few schools offered LGB-specific housing (6.5%).

Descriptive characteristics of students are presented in Table 16. Overall, few participants were in the “unhealthy weight control” profile and the majority were in the “healthier diet” class. The majority of students were white, enrolled as an undergraduate student, and had no credit card debt. Relationship status, living situation, and employment varied by gender and sexual orientation.

Associations between institutional supports for LGB students and students' weight-related behaviors. Results for adjusted logistic models are presented in Tables 17 and 18 for women and men, respectively. Covariates included the proportion of LGB and unsure students, school structure (i.e., setting and type of school), student body make-up (i.e., race and gender), and individual-level sociodemographics. For heterosexual women, more institution-focused LGB supports were associated with a lower odds of being in the less healthy profiles than the “healthier diet, physically active” profile [OR (95% CI): “unhealthy weight control”: 0.8 (0.7-1.0); “moderate diet”: 0.7 (0.5-0.8); “healthier diet”: 0.8 (0.7-0.8)]. Additionally, for bisexual women, more institution-focused LGB supports were associated with a lower odds of being in the “moderate diet” class than the “healthier diet, physically active” class [0.4 (0.2-0.8)]. Among men, more institution-focused LGB supports were significantly associated with greater odds of being in the “moderate diet” [3.0 (1.2-7.4)] and of being in the “unhealthy weight control” [5.3 (1.9-14.5)] classes than the “healthier diet, physically active” class for gay and unsure men, respectively. There were no significant associations between student-engaged LGB supports and weight-related behavioral profiles for any of the sexual orientation groups or genders. Crude results were largely similar to adjusted results and are not presented.

5.4. Discussion

The findings from this study suggest that institution-focused LGB policies and practices of college campuses may have a greater association with student's weight-related behaviors than student-engaged LGB supports. Interestingly, institution-focused LGB supports were associated with healthier weight-related behaviors primarily among

heterosexual women, although there was also some positive association among bisexual women. In contrast, significant findings among men indicated that institution-focused LGB supports were associated with less healthy weight-related behaviors (for gay and unsure men), although overall there did not seem to be any consistent relationship.

The lack of consistent positive associations between institutional supports for LGB students and weight-related behaviors among LGB students in particular could be due to a number of reasons. A possible explanation could be that while more institutional support for LGB students can provide a degree of protection or resiliency, it may not address the underlying causes of disparities related to less physical activity, poorer nutrition, or more unhealthy weight control behaviors among LGB, discordant heterosexual, or unsure students. For example, the presence of a student-run LGB group may provide a safe social space for LGB students; however, this acceptance and inclusivity may not translate to other more heteronormative spaces such as a campus recreation center, thus potentially not addressing a structural access barrier for LGB students. Another possible explanation is that more institutional support for LGB students might create more opportunities for LGB students to socialize or engage in a larger LGB student community on campus. Socializing among college students in general can be a context for less healthy dietary habits such as eating away from home. Thus, having more institutional support for LGB students may not result in healthier weight-related behaviors. Our previous research on college students indicated a greater burden of insufficient physical activity, poorer nutrition, and more unhealthy weight control behaviors among LGB, discordant heterosexual, and unsure college students (compared

to their heterosexual counterparts)⁷⁵ suggesting that it is important to continue to examine potential structural and contextual factors that may contribute to these disparities among college students.

While it is possible that our findings reflect a true lack of relationship between institutional supports for LGB students and LGB students' weight-related behaviors, there are other factors to consider. First, while the college campus is an important part of the student experience, it is not the only influence on health behaviors. For example, Minnesota, where all the schools in this study were situated, has historically been relatively progressive from a political and social perspective. Since 1993, Minnesota law has included sexual orientation in state-level anti-discrimination policies with regard to business, credit, education, employment, housing, public accommodations, and public services as well as part of hate crime legislation.²⁰⁷ This state-level context could attenuate the effects of the specific college context on student health. Future research should consider examining colleges in other states, particularly states with fewer LGB protections, in which more LGB-supportive contexts on college campuses may have a greater impact on LGB student health. Regardless of other contexts that may influence LGB student health, it is vital for college campuses to invest in providing support to LGB students and promoting an LGB-supportive climate as other research has demonstrated the importance of school-based LGB support for other aspects of student health and well-being.^{149,202,203}

Second, while we used a variety of measures to grasp the breadth of LGB support on a college campus, there may be other important on-campus factors or influential

contexts or combination of contexts that were not captured. For example, college students in general report common barriers to healthier eating and physical activity to be issues such as lack of time or motivation, high availability of unhealthy foods on campus, and eating because of stress or boredom.²⁰⁸ It is likely that these barriers are true also for LGB college students and an LGB-specific institutional policy or practice may not address this underlying context of what it means to be a college student. However, it is still important to determine any additional barriers experienced by LGB students and how best to reduce or eliminate them.

Related, it is important to explore what types of college-level resources would be helpful to LGB students to facilitate engaging in healthful weight-related behaviors and then assess the impact of these resources on student health. Moreover, while the on-campus context may be important for LGB students, it may not be their only source of support and thus, there may be resources off-campus that are impacting student health. For example, students who are involved and connected with the LGB community outside of campus may not be accessing resources on campus. This scenario may be particularly relevant to 2-year community and technical college campuses where there are fewer resources offered to students (in part, due to differences in student expectations of campus support), although it may not necessarily reflect lack of school support for students such as LGB students. Larger community-based and community-engaged studies would be needed to explore the relationship between factors such as social norms and engagement in the LGB community and weight-related health.

Our finding that more institutional-focused LGB support was consistently associated with being in the “healthier diet, physically active” class among heterosexual females was particularly interesting. It is possible that more institutional-focused LGB support actually also measures an institutional climate that is more supportive of female students in general and thus, heterosexual female students seemingly benefit from the more LGB accepting environment. Further, our finding that more institutional support for LGB students was associated with less healthy weight behaviors among men is consistent with previous research showing that more supportive LGB social contexts can have a negative association on health behaviors college males.¹⁵¹ A potential explanation for this finding could be that male-specific social norms associated with more LGB supportive contexts may also support more negative health behaviors. For example, existing research has found striking disparities in gay male body image perceptions and expectations,²⁰⁹⁻²¹¹ which may influence engagement in weight-related behaviors, such as unhealthy weight control behaviors. Future studies should explore interventions and strategies to offset this unintended consequence of more supportive LGB social contexts and also to explore and address social norms associated with these contexts.

To our knowledge, this study is the first to examine college context and weight-related behaviors across sexual orientation. This study included a comparatively large number of schools (n=46) and an additional strength is in the diversity of school type (i.e., large 4-year universities, and 2-year community colleges and technical colleges). Existing studies examining the association of LGB college context on other health outcomes have focused on 4-year institutions.^{150,151} However, the sample size is still

limited and may not be sufficient to draw conclusive results. This limitation is particularly important as some schools did not have any LGB, discordant heterosexual, or unsure students in their sample, thus reducing the number of schools in the analysis to as low as 27 in some models. Second, this study was cross-sectional; therefore, it is difficult to determine temporality of relationships. For example, we were not able to examine the health of students before a school offered LGB resources and programming with student health after initiatives were in place to determine if there were improvements in student health. Future research could utilize longitudinal data to examine changes in LGB health over time, particularly related to LGB-related policy and programming. Finally, the use of latent class analysis to operationalize weight-related behavioral patterns was a unique aspect of this study. Future research should continue to examine weight-related behaviors more broadly through methods such as latent class analysis; however, larger sample sizes may allow for better identification of less prevalent classes, potentially allowing for quantitative exploration of the impact of different LGB contexts.

Overall, our findings suggest that institutional-focused LGB supports may have a greater association with student health, although this was primarily among heterosexual female students. Other macro-level contexts such as state-level policies, city- or county-level policies, social networks (including families, friends, and communities) as well as the interaction of these contexts with individual resiliency may have an impact on LGB student health that attenuates the effect of the college context. Additional research is needed to examine multi-level LGB contexts and LGB weight-related health and health disparities.

5.5. Tables

Table 14. Institutional measures collected or derived and means across all institutions (n_{schools}=46); College Student Health Survey, 2009-2013 (Minnesota, USA)

Domain	Measure	Scale	Proportion of schools/Mean among schools (range)
Institutional supports for LGB students	Anti-discrimination policy		
	Sexual orientation	Yes = 1, No = 0	97.8%
	Gender identity and expression	Yes = 1, No = 0	30.4%
	Institutional groups		
	Student-run LGB group	Yes = 1, No = 0	58.7%
	Institution-run LGB program	Yes = 1, No = 0	23.9%
	Institution-run diversity program	Yes = 1, No = 0	39.1%
	LGB-specific events	Yes = 1, No = 0	15.2%
	Courses offered		
	LGB-specific	Yes = 1, No = 0	21.7%
	LGB-inclusive	Yes = 1, No = 0	67.4%
LGB-specific housing	Yes = 1, No = 0	6.5%	
% LGB and unsure students ^a	Actual Percentage	6.6% (0.7%-19.0%)	
General Institutional Descriptors ^b	Urban	Yes = 1, No = 0	47.8%
	4-year	Yes = 1, No = 0	45.7%
	Public	Yes = 1, No = 0	80.4%
	Religious Affiliation	Yes = 1, No = 0	4.3%
	School Size	Actual Number	6,063
	% Full-time students	Actual Percentage	58.9%
	% White	Actual Percentage	76.1%
	% Male	Actual Percentage	43.0%
% Receiving federal grants	Actual Percentage	49.3%	

^a These measures were calculated from individual-level self-reported data and an average taken to create institutional-level data

^b These measures were collected from the National Center for Education Statistics website

Table 15. Principal components analysis results

Eigenvalues				Varimax rotated factor patterns for final 2-component solutions					
Components	Eigenvalue	Cumulative Variance Explained	Indicators	Component 1:	Component 2:				
				Institution-focused LGB supports	Student-engaged LGB supports				
Institutional supports for LGB students	1	3.12	0.45	Gender identity and expression policy	0.87	0.15			
	2	1.11	0.60		0.39	0.65			
	3	0.96	0.74		Institution-run LGB program	0.88	0.14		
	4	0.74	0.85		Institution-run diversity program	0.65	0.03		
	5	0.53	0.92		LGB-specific course	0.50	0.52		
	6	0.31	0.97		LGB-inclusive course	-0.08	0.88		
	7	0.22	1.00		LGB-specific housing	0.53	0.24		
General institutional descriptors	1	1.81	0.36	Urban	Component 1: School structure	Component 2: Student body make-up			
	2	1.25	0.61				4-year	-0.39	-0.51
	3	0.93	0.80				Public	-0.79	-0.08
	4	0.59	0.92				White students	0.84	0.08
	5	0.42	1.00				Male students	0.19	0.83
						0.42	-0.63		

Table 16. Latent class membership and individual-level demographics by sexual orientation and gender (n=29,118), College Student Health Survey 2009-2013

	Female				
	Heterosexual (n=16,891)	Discordant heterosexual (n=147)	Gay/Lesbian (n=225)	Bisexual (n=677)	Unsure (n=357)
"Unhealthy weight control"	996 (6.0%)	26 (17.7%)	38 (17.0%)	114 (17.0%)	43 (12.2%)
"Moderate diet"	2,715 (16.3%)	24 (16.3%)	65 (29.0%)	127 (19.0%)	110 (31.2%)
"Healthier diet"	10,409 (62.5%)	97 (66.0%)	121 (54.0%)	374 (55.8%)	200 (56.7%)
"Healthier diet, physically active"	2,527 (15.2%)	n/a	n/a	55 (8.2%)	n/a
White	14,034 (83.2%)	116 (78.9%)	187 (83.1%)	526 (77.8%)	224 (62.8%)
Graduate student	1,703 (10.1%)	15 (10.2%)	41 (18.2%)	43 (7.8%)	16 (4.5%)
Single	6,590 (39.0%)	58 (39.5%)	68 (30.2%)	305 (45.1%)	219 (61.3%)
Rent	6,795 (40.3%)	80 (54.4%)	113 (50.2%)	309 (45.7%)	119 (33.3%)
0-10 hours worked for pay	7,356 (43.9%)	54 (36.7%)	90 (40.2%)	315 (46.8%)	207 (58.2%)
No credit card debt	11,119 (66.0%)	85 (57.8%)	131 (58.2%)	447 (66.0%)	256 (71.9%)
	Male				
	Heterosexual (n=9,660)	Discordant heterosexual (n=70)	Gay (n=337)	Bisexual (n=160)	Unsure (n=178)
"Unhealthy weight control"	356 (3.7%)	n/a	71 (21.2%)	9 (5.7%)	21 (12.0%)
"Moderate diet"	1,786 (18.8%)	n/a	59 (17.6%)	18 (11.4%)	42 (24.0%)
"Healthier diet"	4,747 (49.9%)	56 (81.2%)	205 (61.2%)	131 (82.9%)	112 (64.0%)
"Healthier diet, physically active"	2,631 (27.6%)	13 (18.8%)	n/a	n/a	n/a
White	7,736 (80.1%)	56 (80.0%)	282 (83.7%)	120 (75.0%)	104 (58.8%)
Graduate student	1,104 (11.4%)	5 (7.1%)	57 (16.9%)	15 (9.3%)	10 (5.6%)

Single	4,888 (50.6%)	25 (35.7%)	219 (65.0%)	102 (63.8%)	130 (73.0%)
Rent	4,281 (44.3%)	31 (44.3%)	162 (48.1%)	74 (46.0%)	67 (37.6%)
0-10 hours worked for pay	4,818 (50.3%)	32 (46.4%)	137 (40.8%)	80 (50.0%)	114 (64.4%)
No credit card debt	6,888 (71.5%)	35 (50.0%)	194 (57.6%)	114 (70.8%)	140 (78.7%)

n/a: class was not specified for this sexual orientation group

Table 17. Adjusted^a association between institutional supports of LGB students^b and weight-related behavior profiles^c for women by sexual orientation (n=18,297); College Student Health Survey, 2009-2013 (Minnesota, USA)

		OR (95% CI)			"Healthier diet, physically active"
		"Unhealthy weight control"	"Moderate diet"	"Healthier diet"	
Heterosexual (n _{schools} =46; n _{students} =16,647)	Institution-focused	0.8 (0.7-1.0)*	0.7 (0.5-0.8)*	0.8 (0.7-0.8)*	Ref
	Student-engaged	1.0 (0.8-1.2)	0.9 (0.8-1.1)	0.9 (1.0-1.1)	Ref
Discordant Heterosexual (n _{schools} =38; n _{students} =147)	Institution-focused	1.6 (0.5-4.6)	2.0 (0.5-9.2)	Ref	n/a
	Student-engaged	0.9 (0.3-2.8)	3.5 (1.0-12.8)	Ref	n/a
Gay/Lesbian (n _{schools} =35; n _{students} =224)	Institution-focused	1.0 (0.4-2.5)	0.6 (0.3-1.2)	Ref	n/a
	Student-engaged	0.3 (0.1-1.1)	0.4 (0.1-1.0)	Ref	n/a
Bisexual (n _{schools} =45; n _{students} =670)	Institution-focused	0.8 (0.4-1.5)	0.4 (0.2-0.8)*	1.0 (0.5-2.0)	Ref
	Student-engaged	1.5 (0.7-3.1)	0.9 (0.4-1.7)	1.2 (0.5-2.8)	Ref
Unsure (n _{schools} =42; n _{students} =353)	Institution-focused	1.3 (0.7-2.3)	0.6 (0.4-1.2)	Ref	n/a
	Student-engaged	1.3 (0.6-2.9)	1.2 (0.6-2.2)	Ref	n/a

^a adjusted for school structure, student body make-up, and individual demographics (varies slightly in each model due to zero cells for some sexual orientation groups)
^b calculated using principal components analysis; higher scores are indicative of more institutional supports for LGB students
^c weight-related behavior profiles were generated through latent class analyses. Models were fit for each sexual orientation group, separately
* p<0.05
n/a: class was not specified for this sexual orientation group

Table 18. Adjusted^a association between institutional supports for LGB students^b and weight-related behavior profiles^c for men by sexual orientation (n=10,405); College Student Health Survey, 2009-2013 (Minnesota, USA)

		OR (95% CI)			
		"Unhealthy weight control"	"Moderate diet"	"Healthier diet"	"Healthier diet, physically active"
Heterosexual (n _{schools} =45; n _{students} =9,520)	Institution-focused	0.9 (0.6-1.3)	1.2 (0.9-1.5)	1.0 (0.9-1.2)	Ref
	Student-engaged	0.9 (0.7-1.2)	1.0 (0.8-1.3)	0.9 (0.7-1.0)	Ref
Discordant Heterosexual (n _{schools} =27; n _{students} =69)	Institution-focused	n/a	n/a	1.0 (0.3-3.3)	Ref
	Student-engaged	n/a	n/a	0.3 (0.1-1.3)	Ref
Gay (n _{schools} =37; n _{students} =335)	Institution-focused	1.1 (0.6-2.1)	3.0 (1.2-7.4)*	Ref	n/a
	Student-engaged	1.2 (0.5-2.6)	1.8 (0.6-5.5)	Ref	n/a
Bisexual (n _{schools} =34; n _{students} =158)	Institution-focused	0.9 (0.2-4.2)	0.4 (0.1-1.5)	Ref	n/a
	Student-engaged	0.2 (0.0-2.0) ^d	0.4 (0.1-1.3)	Ref	n/a
Unsure (n _{schools} =38; n _{students} =175)	Institution-focused	5.3 (1.9-14.5)*	0.9 (0.4-2.0)	Ref	n/a
	Student-engaged	1.7 (0.5-6.1)	0.7 (0.4-1.2)	Ref	n/a

^a adjusted for school structure, student body make-up, and individual demographics (varies slightly in each model due to zero cells for some sexual orientation groups)

^b calculated using principal components analysis; higher scores are indicative of more institutional supports for LGB students

^c weight-related behavior profiles were generated through latent class analyses.

Models were fit for each sexual orientation group, separately

^d confidence interval includes zero due to rounding

* p<0.05

n/a: class was not specified for this sexual orientation group

Chapter 6. Manuscript 4: Lesbian, gay, and bisexual college student perspectives on weight-related behaviors: A qualitative analysis

6.1. Introduction

A growing body of research reveals a disproportionate burden of obesity,^{3-9,11,51,73,75} physical inactivity,^{6,8,10,11,51,75} poor eating habits,^{11,51,75} disordered eating,^{51,72,74,75} and poor body image⁷⁵ among lesbian, gay, and bisexual (LGB) individuals, with some differences across gender.^{5-8,10,11,51,72-74} Despite accumulating evidence, very few studies have explored the contributing factors to these high levels of concern in LGB individuals. Given the lack of research on reasons underlying these disparities in weight-related concerns across sexual orientation, qualitative research methods are particularly useful for gaining in-depth, contextualized understanding of LGB individuals' experiences with weight-related behaviors.

In one study, researchers conducted focus groups with LGB women to explore attitudes and beliefs regarding barriers to healthy eating and physical activity.²¹² Findings suggested that, despite a desire to eat healthfully and be physically active, participants experienced general barriers to engaging in these behaviors, such as confusion, lack of knowledge, and time constraints that were not specific to their sexual orientation. Although several qualitative studies have examined body image among LGB men, particularly gay men,²⁰⁹⁻²¹¹ to our knowledge there are no qualitative studies that have explored gay men's experiences with nutrition and physical activity, and only one study that explored weight control behaviors.²¹⁰

Barriers to physical activity and healthy eating among LGB individuals may vary by life stage and situational context. Young adulthood, typically defined as ages 18-30 years,²¹³ is a developmental period that is associated with both deterioration in weight-related behaviors,^{102-106,108,109,111} as well as exploration of sexual orientation.^{41,49,119} A large proportion of young adults are also enrolled in college,¹⁰⁰ which may provide a unique situational context for intervention delivery. In our previous work with college students on weight-related disparities, we found differences between LGB students and heterosexual students for eating behaviors, physical inactivity, purging behaviors, binge eating, and body satisfaction.⁷⁵ Other studies using longitudinal cohort data have also found disparities across sexual orientation in unhealthy weight control behaviors and physical activity from adolescence into emerging adulthood.^{10,72}

To our knowledge, no studies have explored the specific sexual orientation-related barriers to physical activity, healthy eating and positive body image that LGB college students experience and could be contributing to these weight-related disparities. Certain barriers to physical activity and healthy eating are common across sexual orientation and age groups (such as lack of time or bad weather). However, LGB college students possibly experience a unique set of barriers because of their sexual orientation; these barriers could be rooted in conditions related to discrimination, stigmatization, or prejudice.^{76,197} Understanding the specific challenges experienced by this sub-population of college students is important to inform policy and programmatic changes on college campuses that address and reduce these individuals' disproportionately high level of weight-related problems.

To build on our previous quantitative work⁷⁵ and gain a fuller understanding of LGB weight-related health among college students, the purpose of this qualitative study was to explore the context surrounding weight-related health among LGB college students. To achieve this overall aim, this study elicited information on (1) college students' perceived sexual orientation-related barriers to engaging in physical activity, eating healthfully, and maintaining a healthy body image (2) types of resources on physical activity, healthy eating, and body image LGB college students needed.

6.2. Methods

Study population, design, and measures. The study sample included a diverse group of non-heterosexual-identified college students (Table 19). Non-heterosexual identities provided by participants during recruitment included lesbian, gay, bisexual, queer, and pansexual. The terms queer and pansexual are often used by people who do not identify with more mainstream LGB sexual identities and, for some, may reflect sexual attraction to a broader range of gender expressions than a simple male/female binary. The choice behind identifying as queer or pansexual varies from person to person; however, both identities recognize a degree of fluidity and instability in both sexuality and gender expression that LGB identities may not sufficiently capture for these people.¹²³

Eligibility criteria included being 18-30 years old and being currently enrolled as a college student. Participants were recruited from a single, large, urban university. Flyers were posted in public spaces and electronically distributed through student-run LGB organizations on campus. Further, there was a round of recruitment at the Twin Cities

Pride festival (a local annual celebration of the LGBTQ community), and participants recruited there also attended the same university. Interested individuals contacted study staff to confirm eligibility. All interviews were conducted by the first author, were audio-recorded, and transcribed verbatim. A total of 30 interviews (15 male, 15 female) were conducted between July 2013 and February 2014, lasting 15-68 minutes (average length: 34:18). Participants received a \$20 gift card incentive upon completion of the interview.

A semi-structured interview guide was used (Table 20), with probes, follow-up questions, and prompts provided as necessary to delve deeply into participants' views and experiences. The development of questions was, in part, informed by the findings from our previous epidemiologic research among college students attending 2- and 4-year institutions throughout Minnesota, specifically examining sexual orientation disparities among this population.⁷⁵ Generally, the interview started with a set of questions regarding barriers to physical activity and healthy eating, followed by questions on body image. Finally, questions assessed the need for campus resources for physical activity, healthy eating, and body image at their college that addressed participant barriers related to sexual orientation. Included in this set of questions regarding resources was a hypothetical question about an LGB-specific physical activity group or program at the campus recreation center and whether participants would be interested in such a resource. The semi-structured format allowed participants to freely discuss the topics and the script was adjusted during interviews based on participant responses (e.g., a participant may have started talking about body image during the physical activity barriers question and therefore, questions on body image were asked then). Participants also completed a brief

demographic survey, assessing gender, sexual orientation, race, highest level of educational attainment, current degree program, employment, and self-reported height and weight.

The focus of this analysis was on aspects of body image, physical activity, healthy eating, and resources that were related to participants' sexual orientation. Participants also noted common barriers to physical activity and healthy eating that were not specific to their sexual orientation, such as lack of time and motivation as well as high cost and lack of access to healthy foods, which are not presented here.

The University of Minnesota IRB approved all aspects of this study.

Data coding and analysis. All transcripts were cross-checked with audio recordings for accuracy prior to coding. Coding and analyses were conducted using ATLAS.ti 7 (ATLAS.ti Scientific Software Development GmbH, 2002-2012), a qualitative data organizational software.

A quasi-inductive coding technique was used to analyze interview transcripts.²¹⁴ More specifically, there were two cycles of coding conducted by the first author and reviewed by the research team throughout the analysis process. In the first cycle, participant descriptors, including information from the demographic survey were added to the dataset as a first step. The second step was structural coding, or grouping similar responses under a common code before more detailed coding.²¹⁴ Further, during this step, we developed appropriate categories that can be used to summarize and explain the data. The questions posed within the interview script formed the basis for which responses were generally grouped (e.g., physical activity barriers, body image) and additional

groupings were added later when responses fell outside the topics of the interview script. The third step was descriptive coding, which involved coding or summarizing individual responses with key words or short phrases (e.g., gym discomfort, added layer of stress around sexuality) that represent closely what was shared by each participant.

After the first cycle of coding, a second cycle of coding was completed to identify overarching themes as well as distinctions within and across participant sub-groups (i.e., gender and sexual orientation). This process involved going through the interview data again and conducting pattern coding, where common codes (generated from the first cycle) were conceptually grouped into similar categories based on the study aims. This approach helped identify common themes across the participants' data. Overall, this iterative coding process involved examining and re-examining coding decisions for each interview to ensure that data were coded consistently. Memos, notes summarizing research team analysis decisions, were maintained in order to explain coding decisions and to further explain code definitions.

Data were carefully examined by gender to determine any differences and similarities within and across gender sub-groups. In addition, code frequency counts were assessed for additional insight and demonstrated patterns.

6.3. Results

Findings were divided into four main themes discussed below: 1) body image, 2) physical activity, 3) healthy eating, and 4) resources. Resulting themes are summarized in Tables 21-23, with supporting quotes for each theme.

Body image

There were three body image sub-themes related to sexual orientation: one reflecting a more positive body image due to factors related to sexual orientation and two which were negative (Table 21). About one third of the women interviewed talked about experiencing more positive body images with the diversity of body types and acceptance of that diversity within the LGB community. Some shared examples of having LGB friends who had healthier body images than their non-LGB peers. As a corollary, only two women discussed having negative experiences or perceptions of body image that were specific to the LGB community. More often, women talked about having negative experiences regarding female bodies within society at-large.

In contrast, two body image sub-themes emerged among male participants that only related to negative body image. Nearly all men talked about the emphasis and pressure among gay males to have a particular physique and appearance. Many of these comments were associated with needing to be seen as sexually desirable to other gay men within the community. Further, nearly half of the men talked about masculinity in the gay male community as an influence on their body image and weight-related behaviors. Many men felt that although masculinity, in general, was defined by being muscular and appearing more athletic, being gay or bisexual intensified this particular emphasis on appearance in the community. Several talked about how the masculine body image in the gay male community consisted of being muscular yet thin, noting that the emphasis on thinness was unique to the gay male community.

Physical activity. Nearly half of participants (n=14) noted that they did not attribute any existing physical activity barriers to their sexual orientation. Similarly,

nearly half of participants noted that their sexual orientation supported them in being more physical activity through perceived social norms rather than acting as a barrier (Table 22). However, over half of women and one-third of men reported some level of discomfort at the gym and/or campus recreation facilities. Many of these participants attributed their discomfort to factors such as feeling that they need to look a certain way at the gym (which some participants shared was rooted in their perceived body image expectations within the LGB community) or other aspects of the gym environment that create social barriers. Not all participants who shared experiences of gym discomfort felt it was a major barrier to their physical activity. Those who did not feel it was a major barrier shared that they were able to overcome that barrier or seek out other avenues for physical activity. Many participants indicated that the majority of their physical activity was achieved from walking or biking on campus.

Healthy eating. Many participants (n=16) did not attribute any of their barriers to healthy eating to their sexual orientation (Table 22). Similar to physical activity, many participants felt that their sexual orientation facilitated healthy eating, often through social networks such as having LGB friends who ate healthier or through perceived social norms, such as those around vegetarianism or veganism, within the LGB community. Experiences varied among those who felt that their sexual orientation was a source for less healthy eating. A few men talked about less healthy eating that was associated with the “bar culture” being the main platform for socializing within the LGB community, while a few women noted that they experienced negative stereotypes or expectations around the eating habits of lesbian or gay women.

Binge eating was a form of unhealthy eating among participants. Some participants discussed experiences with binge eating in response to stressful experiences, particularly noting that their sexual orientation was either an added stressor or potential trigger for binge eating. Few participants had experiences with purging behaviors that were specifically related to their sexual orientation, although some commented that purging behaviors may be linked to body image expectations.

Resources. Participants identified strategies that their college could implement to encourage more physical activity, healthy eating, and healthier body image among LGB college students (Table 23). Half of participants felt that there was no need to tailor resources specifically to their sexual orientation. Some participants indicated that they were comfortable accessing current resources and that sexual orientation was not a barrier; thus they did not feel that they needed resources to accommodate their sexuality. However, many also expressed interest in having either student groups or other organized opportunities (such as seminars or courses) available on campus to discuss with other students (including the general student body) some of these weight-related issues that adversely impact the LGB college student community. Among males, body image was an area of particular concern, with nearly half of participants indicating that was what they considered the most important point.

In contrast, several participants felt that existing resources needed to be more inclusive. Inclusivity varied based on participant experiences; however, the general sentiment was that existing resources did not always create spaces that were safe, comfortable, or accepting of individual differences or experiences. For example, some

participants felt that resources should not promote a gender binary or gender stereotypes, with a few noting a need for gender-neutral resources (such as locker rooms and bathrooms). Other participants wanted to feel safe accessing resources and not feel that their sexual orientation would be an area for experiencing discrimination.

Several participants indicated that reaching out to LGB students more specifically and strategically with outreach materials could be helpful in having LGB students access general resources (i.e., resources that are not specifically tailored to sexual orientation, but address healthy eating, physical activity and body image, in general). In other words, resources could be designed for the general college student population; however, outreach and recruitment of students should be more targeted toward LGB students.

We asked participants about their interest in participating in an LGB-specific physical activity program that could be offered through the campus recreation center. Nearly half said that they would be interested in attending, with the most common reason being that they felt it would be an opportunity to meet other LGB students. Among those who were not interested in attending, reasons varied from not being out to not needing that resource to be physically active.

6.4. Discussion

The purpose of our study was to identify sexual orientation-related barriers to physical activity, healthy eating and a positive body image, as well as related resources for LGB college students. Our findings highlight unique perspectives and experiences of LGB, queer, and pansexual college students. For example, participants identified less healthy eating due to the social opportunities available within the LGB community or

feeling uncomfortable with being at the gym because of their sexual orientation. In addition to sexual orientation-specific barriers, we also found that sexual orientation facilitated more physical activity and healthy eating for some LGB, queer, and pansexual college students. Although many women experienced positive body image within the LGB community, this finding was not true for men. Our findings suggested a need for college interventions that address both structural barriers (such as gender neutral locker rooms) as well as a perceived lack of awareness of LGB student experiences. Resources also need to be offered to LGB college students through more outreach and LGB-specific interventions.

Although we did not specifically examine barriers unrelated to sexual orientation in these analyses, the college setting provides an exclusive experience to students and inherent structures within the institution, such as scheduling of classes or food offerings in cafeterias and dining halls, that may present barriers across the student body, including LGB, queer, and pansexual students. This study identified additional barriers related to sexual orientation that heterosexual students do not experience, as well as resources that may specifically benefit LGB college students. These findings emphasize the importance of shifting structural aspects within the college setting to more effectively improve the health of all students as well as ensuring that structures and resources available to students (such as campus recreation centers) are consistently inclusive of all students, including non-heterosexual students.

Across physical activity and eating, many participants discussed the importance of socializing and social norms (e.g., going out to bars, vegetarianism among LGB

friends). The opportunity to socialize was a common reason for participants to want to participate in an LGB-specific physical activity program and also a common reason behind the desire to have a student-group. This socializing piece is critical when considering intervention development, particularly when it is targeted at individual behavior change. Previous studies have also noted the importance of socializing or social networks in weight-related behaviors, among young people in general.^{77,187,215} Similarly, in this study, the most common intervention idea suggested by participants was a student group or course that would provide a platform for students to discuss issues related to physical activity, healthy eating, and body image. Related, we had the positive findings that sexual orientation facilitated healthy eating, more physical activity, and healthier body image for some students. Many of these participants talked about having LGB friends or perceptions of social norms within the LGB community that helped facilitate healthier habits, not necessarily something that they experienced in isolation with their sexual orientation. This finding further highlights how social components may be critical in developing interventions for this population. More exploration into the social components of physical activity, healthy eating, and body image among LGB, queer, and pansexual college students may be needed to more effectively develop interventions as well as encourage and motivate participation.

To our knowledge, this is the first qualitative study to examine weight-related behaviors broadly among LGB, queer, and pansexual college students. Our findings build on our existing quantitative work,⁷⁵ providing additional context to some of the disparities we previously identified. We included both men and women, which is a

strength of this study. Although the majority of our participants were white, this was approximately reflective of the racial/ethnic make-up of Minnesota college students. However, none of the participants were currently enrolled in a 2-year community college or technical college, thus limiting our findings. Future research should examine the experiences of 2-year college students, as well as young adults who are not in school, as these populations are highly understudied. Further, it is possible that individuals who chose to participate in this qualitative study might be healthier than the average student. For example, students who care about these issues may be more likely to respond to a recruitment flyer on a study about physical activity and healthy eating. Other recruitment strategies should be considered in future studies. The use of individual interviews as a qualitative method allowed participants more safety in sharing personal experiences around their sexuality without the influence of other opinions (especially for those who were not out or completely comfortable with their sexuality), representing another strength of this study. However, because this format did not allow for participants to engage with each other in experiences, as a focus group format would, we may have missed shared experiences of LGB, queer, or pansexual college students that were not apparent in the individual format. Future research should employ a group interview format to explore additional themes related to body image, physical activity, and healthy eating among LGB, queer, and pansexual college students.

Our study highlights some of the unique sexual orientation-related barriers that LGB, queer, and pansexual college students may experience related to physical activity, healthy eating, and body image. In addition, positive findings related to healthier habits

based on sexual orientation highlight an area that may be important to harness in future intervention development. Based on our findings, college interventions are needed to address some of the disparities experienced by this subpopulation of college students. Interventions in general need to promote more inclusivity by ensuring that a broad range of students would feel safe accessing those resources. Potential strategies included raising awareness around the experiences of LGB students in general and having more gender-neutral resources available, such as locker rooms. Further, outreach for programs and resources available to all students may want to consider specifically targeting LGB students in order to encourage more participation. Interventions that are tailored specifically to LGB students may also be beneficial. Our findings suggest that an LGB-specific student group or class on campus was of interest and could be a platform for students to discuss sexual orientation specific barriers and to be able to socialize and network with other students who may face similar barriers.

6.5. Tables

Table 19. Demographic characteristics of interview participants (n=30)

	Total	Males	Females				
Mean age (range)	22.1 (18-30)	22.2 (18-30)	22.1 (18-29)				
Sexual identity							
Gay/Lesbian	16	53%	11	73%	5	33%	
Bisexual	8	27%	2	13%	6	40%	
Queer	3	10%	1	7%	2	13%	
Pansexual	3	10%	1	7%	2	13%	
Race/ethnicity ^a							
White	25	83%	11	73%	14	93%	
Asian/Pacific Islander	3	10%	2	13%	1	7%	
Latino/Hispanic	2	7%	1	7%	1	7%	
Black	2	7%	2	13%	0	0.0%	
Highest level of education achieved							
High school/GED	2	7%	1	7%	1	7%	
Some college	19	63%	11	73%	8	53%	
Associate's degree	3	10%	0	0%	3	20%	
College graduate	4	13%	2	13%	2	13%	
Graduate school	2	7%	1	7%	1	7%	
Currently enrolled in school							
Yes, 4-year college	25	83%	13	87%	12	80%	
Yes, graduate program	5	17%	2	13%	3	20%	
Employment status ^a							
Not currently working for pay	9	30%	6	40%	3	20%	
Part-time on campus	13	43%	5	33%	8	53%	
Part-time off campus	9	30%	5	33%	4	27%	
Full-time on campus	1	3%	0	0%	1	7%	
Weight status							
Underweight (BMI<18.5)	2	7%	1	7%	1	7%	
Normal (18.5≤BMI<25)	16	53%	8	53%	8	53%	
Overweight (25≤BMI<30)	9	30%	5	33%	4	27%	
Obese (BMI≥30)	3	10%	1	7%	2	13%	

^a Total may not add up due to participants selecting more than one response

Table 20. Overview of interview questions

1. Describe what you think is an ideal healthy meal for lunch.

Common barriers to eating healthy and being active among young people in general include things such as lack of time, not knowing how to eat healthy or prepare a healthy meal, healthy foods are expensive or hard to find, or bad weather. When you think about your sexual orientation...

2. What are aspects of being gay/bi/queer that create barriers that keep you from being more physically active than you currently are?
 3. What are aspects of being gay/bi/queer that create barriers that keep you from eating healthier than you currently do?
 4. How do you think your ideal body, for you, goes against or conforms to mainstream expectations of what your body should look like?
 5. Thinking about the nutrition and physical activity barriers you experience related to your sexual orientation and your experiences within the LGBTQ community, what resources would help you lead a healthier lifestyle?
 6. Hypothetically, if there were an LGBTQ-specific physical activity course offered through the campus recreation center, would that resource help you be more physically active?
 7. What, to you, was the most important point or experience that you shared today?
-

Table 21. Summary of body image findings related to sexual orientation

Theme	Sub-themes	Representative quotes
Body image	<i>More body type diversity in LGBTQ community (n=9)</i>	"I'm surrounded by a lot of pre-med people and everybody seems to look the same and everybody seems to have the same body style, which is way different from like if you go to [the student-run LGBTQ campus group]... everybody kind of embraces their own individuality there..." (female, 24, bisexual)
	Gay males emphasize particular aesthetic (n=12)	"I feel in the gay [male] community it's really competitive as far as really superficial things or concern [with] appearance... there's this pressure I feel I need to just look the best that I can. I mean ..., so... I fit in with the cool gay people." (male, 19, gay)
	Narrow definition of masculinity (n=7)	"Being a male, in general, you are expected to be a bigger and more athletic looking person to maintain that standard of masculinity. So like you are already expected to be masculine but then you have to be like this kind of like processed masculine for the queer community... we all want to be simultaneously slim and muscular at the same time." (male, 22, gay)
Number in parentheses represents the number of respondents who commented on this theme		
<i>Italics represent sub-themes where sexual orientation facilitated healthier body image</i>		

Table 22. Summary of findings on sexual orientation-related physical activity and healthy eating barriers

Theme	Sub-themes	Representative quotes
Physical activity	<i>More physically active because of sexual orientation (n=13)</i>	"Because at least the lesbian community I hang around, it's really physically active so like... let's go on a 40-mile bike ride for some reason. Like let's go out and run 15 miles." (female, 19, lesbian)
	Gym discomfort (n=14)	<p>"If I am going try to workout, sometimes it's a little uncomfortable being surrounded by a bunch of straight guys... I'm just really scrawny and kind of flamboyant... it seems gay males are supposed to be super fit or skinny and I feel I should work out and do more physical activities but... I think it's more of a discomfort in general." (male, 18, gay)</p> <p>"One thing could be the fact that I am heavier set. It is hard to go out and work out in a gym, knowing that you don't look like a lot of the other people there... I don't like working out with the bunch of jocks... I guess more [related] to my sexual orientation... I don't feel, not necessarily not safe, but I just don't like such close quarters while working out. I've been hit on by a guy at the gym before... I'm like I just, no." (female, pansexual)</p>
Healthy eating	<i>Healthy eating because of sexual orientation (n=12)</i>	"One of the labs that I used to work in, we had a lab party and there were many queer individuals in the lab and everybody was just sort of naturally very healthy, very eco-conscious and so everybody was to bring something for the party and I felt influenced or pressured a little bit to bring something more healthy than like a dessert... and so I ended up making a very healthy quinoa dish and I've never done that before because I felt I needed to step it up because everybody is really healthy..." (female, bisexual)
	Less healthy eating because of sexual orientation n=(9)	"I would go out to gay bars and a lot of gay bars have ridiculous drink specials, and so I would... drink heavy amounts of alcohol, as would many other people, and the bars offer really fatty food and so [I would have] really greasy food afterwards, too." (male, 28, gay)
	Sexuality may be linked with more binge eating (n=8)	"I put myself under a lot of pressure to be this bigger, more masculine guy because I have not come to terms with or accepted my bisexuality and... it bothers me and so I overcompensate on this other side by being hyper-athletic and when I don't fit that standard or if I don't fulfill

that, if that doesn't work or whatever then it can trigger an event where I will binge eat.”
(male, bisexual)

Number in parentheses represents the number of respondents who commented on this theme

Italics represent sub-themes where sexual orientation facilitated more physical activity and healthy eating

Table 23. Summary of college strategies related to resources addressing body image, physical activity, and healthy eating

Sub-theme	Representative Quote(s)
No need to tailor resources specifically to sexual orientation (n=15)	“I personally don’t think [the LGBTQ community] needs any encouraging. If we want to do it, we’ll do it. You don’t have to force that on us... I don’t think [resources] necessarily has be tailored for [the LGBTQ community].” (female, bisexual)
Groups to talk about body image, physical activity, and healthy eating (n=10)	<p>“Groups... like a student group or something where you can just meet and just kind of talk about [body image, physical activity, and healthy eating] issues because again realizing I am not like the only one facing this, is helpful and there are other people out there who have similar experiences... and I should not feel so bad about it.” (female, 21, bisexual)</p> <p>“I would like a gay man’s body image class or something. I think that would be helpful and I think that would be a good place to meet people, too and network a little and stuff. Or... maybe a workout, [or class on] eating healthy.” (male, 20, gay)</p>
More inclusivity in available resources and future programming (n=9)	<p>“I would definitely consider having a gender neutral locker room... I would feel more comfortable in the men’s locker room, but I would feel more comfortable in an atmosphere that had option for a gender neutral locker room.” (male, gay)</p> <p>“I feel [the campus rec center]... just like what people who work there... I feel they are the type of people who are very, just normal... They would be the people who would a little bit homophobic but don’t want to show it, but they really are on the inside... but maybe having more... [LGBT] inclusive group fitness classes, [by] having more awareness about the LGBT community in general would be helpful.” (female, 21, bisexual)</p>
Targeting LGB students with outreach materials would be helpful (n=8)	“A lot of times, [LGBTQ students are] in their little world, they don't pay attention to the campus-wide emails or something like that. So if there was something focused into [LGBTQ] groups or in their newsletters or even an information pamphlet available at those locations, it might actually spark

interest.” (male, 30, gay)

Number in parentheses represents the number of respondents who commented on this theme

Chapter 7. Discussion and Implications for Future Research

7.1. Summary of major findings

Emerging adulthood is characterized by a decline in physical activity, proper nutrition, and healthy eating habits.¹⁰¹⁻¹¹¹ Furthermore, during this life stage, many individuals are exploring their sexuality and forming their sexual identities,^{41,49,119} thus representing a critical age for examining sexual orientation-related disparities for weight-related behaviors.²¹³ Previous research on sexual orientation disparities among emerging adults found that LGB women were more likely to be overweight or obese than heterosexual women.⁷⁵ Bisexual women were at high-risk for numerous weight-related behaviors, specifically around breakfast consumption, eating out at restaurants, engaging in strengthening physical activities, unhealthy weight control behaviors, and binge eating. Among men, bisexual men were more likely to be obese than their heterosexual counterparts. Gay men were particularly at high risk for poor weight-related behaviors including, frequent eating away from home, insufficient physical activity, unhealthy weight control behaviors, binge eating, and body dissatisfaction.⁷⁵ Building on this existing line of work, the three primary aims of this dissertation were to (1) identify major weight-related behavioral profiles and the extent to which these differ by sexual orientation and gender, (2) examine the relationship between institutional supports for LGB students and weight-related behaviors by sexual orientation, and (3) explore the context surrounding weight-related health among lesbian, gay, and bisexual college students.

Overall, findings from this dissertation underscored disparities in weight-related behavioral profiles across sexual orientation and gender, with generally more LGB, discordant heterosexual, and unsure students exhibiting patterns of low physical activity and high unhealthy weight control behaviors compared to their heterosexual counterparts. In addition fewer LGB, discordant heterosexual, and unsure students exhibited healthy patterns of high physical activity and healthy eating habits. These findings highlight the need for multi-behavioral interventions that are specifically targeted toward LGB, discordant heterosexual, and unsure students. In addition, there were gender differences that may need to be considered when designing interventions. Further, we found that institutional supports for LGB students were generally not significantly associated with LGB students' weight-related behavioral profiles. This finding suggests that there may be other factors contributing to LGB college students' weight-related behavioral disparities. Finally, this dissertation highlighted the unique experiences and needs of LGB, queer, and pansexual college students with weight-related behaviors, particularly around sexual orientation-related barriers to physical activity, healthy eating, and body image. These specific challenges experienced by LGB college students are important to considering when designing on-campus interventions and resources in order to reduce the disproportionately high burden of adverse weight-related behaviors among this subset of college students.

Further, findings between the quantitative and qualitative analyses demonstrate the complexity of the relationship between sexual orientation and weight-related behaviors. Qualitative findings highlighted not only sexual orientation-related barriers,

but also ways in which LGB, queer, and pansexual college students felt that their sexual orientation was a positive influence on their weight-related behaviors although our quantitative findings highlighted numerous weight-related disparities for these students. It is possible that the discrepancy in findings is due to differences in the sample (i.e., students more aware or interested in physical activity and healthy eating might be more likely to participate in the qualitative study). There are also methodological considerations, for example, we did not assess qualitative study participants' current dietary habits and physical activity patterns using the identical questions from the quantitative study. Questions in the qualitative study specifically assessed sexual orientation-related barriers to physical activity and healthy eating, which were not included in the CSHS. Although some participants felt that their sexual orientation encouraged more physical activity and healthy eating, this may not be an appropriate approximation of their actual behaviors. A strength of the mixed-methods approach here is being able to identify such a discrepancy in findings and to utilize this information to inform future research design and questions, particularly considering that qualitative and quantitative methods are highlighting and exploring different aspects of the relationship between weight-related health and sexual orientation among LGB college students

7.2. Strengths and limitations of study design, population, and measures

This dissertation contributes to the small, but growing body of literature highlighting disparities in weight-related behaviors across sexual orientation. In particular, this dissertation fills substantial gaps in the existing literature by (1) specifically examining college students, which is generally a period for exploring and

negotiating one's sexuality and also when weight-related behaviors tend to deteriorate; (2) taking a more nuanced approach to examining sexual orientation by utilizing both sexual identity and sexual behavior to examine the discordant heterosexual group as well as including those unsure about their sexual identity (both are especially salient sexual identities for this age group, who may still be exploring their sexuality); (3) examining male and female college students separately, given documented gender differences between LGB men and women for weight-related behaviors; (4) utilizing multiple measures of weight-related behaviors including eating habits (such as eating away from home and breakfast consumption), three types of physical activity, and unhealthy weight control behaviors, as well as creating a systematic and meaningful measure of weight-related behavioral profiles using these multiple measures, thus providing a more comprehensive understanding of weight-related behaviors among LGB, discordant heterosexual, and unsure college students; (5) including 2-year college students, who represent a growing population of emerging adults and are highly understudied; and (6) utilizing both quantitative and qualitative data to understand how weight-related behaviors are exhibited and experienced among LGB college students.

Despite the strengths of this dissertation, there are also limitations that should be considered and addressed in interpreting the findings and in future research. First, although the CSHS has robust measurements of weight-related behaviors (especially in comparison to other population-based surveys), the data collected were cross-sectional, thus determination of temporality and causal inference is limited. Although there are few existing longitudinal data for LGB health research, data from GUTS have demonstrated

the persistence, shifts, and worsening of LGB health disparities, particularly for weight-related behaviors and obesity, from adolescence into young adulthood.^{10,72,73}

Longitudinal college data may allow for development of more appropriate interventions based on the shifting needs and experiences of students throughout the college experience (e.g., living in university housing and then moving to off-campus housing). Further, interventions may need to be tailored to LGB students' unique needs; for example, coming out during college would be a unique experience for LGB students, and health behaviors may change during and after that process.

A second limitation is that the measures collected in the CSHS are limited in the depth of information collected. This is due to the primary purpose of the CSHS being surveillance of student health. Future research should develop questions that may more accurately assess the barriers and facilitators to physical activity and healthy eating as well as other experiences of LGB students with regard to weight-related behaviors. For example, our qualitative study identified barriers unique to sexual orientation (e.g., gym discomfort, sexuality may be linked with more binge eating) that prevented LGB students from engaging in healthier eating and physical activity as well as facilitators unique to sexual orientation (e.g., more physically active because of sexual orientation through perceived social norms) that encouraged healthier eating and physical activity among LGB students. Better understanding of how these unique contexts relate to one's sexual orientation may help inform the development of weight-related interventions that address sexual orientation specific barriers while cultivating the aspects of sexual orientation that promote healthier habits.

Relatedly, measures on CSHS are all self-report and in-depth measurements of nutrition and physical activity are limited. For example, the current gold standard for assessing diet is the Food Frequency Questionnaire and for physical activity is the use of accelerometers. Future research should use more robust and objective measures of weight-related behaviors to examine the health of LGB college students.

While the CSHS sample is a much more diverse sample than other college-based samples, with the inclusion of 2-year colleges, all schools were located in Minnesota, thus findings may not extend to other geographic regions. More research is needed to explore how other contexts, including other geographic regions as well as community, city, county, and state contexts, may impact LGB weight-related disparities and how best to shift contexts to address these disparities. Related, the CSHS sample reflects the racial/ethnic make-up of Minnesota. More racially and ethnically diverse samples of LGB individuals may yield much needed insight into the impact of multiple minority identities on weight-related health. Related, because the college setting and experience is particularly unique to emerging adults who attend these institutions, the results may further not be generalizable to emerging adults who do not attend college. Additional research on non-college attending emerging adults is needed to gain a broader understanding of weight-related health and sexual orientation during this life stage.

7.3. Implications for future research

The findings from this dissertation help establish a base of knowledge that can inform future research questions and goals centered around weight-related health among LGB college students. Further, this dissertation also demonstrates the feasibility of

utilizing mixed methods approaches to study this particular topic in this population.

Moving forward, it is important to continue to incorporate and utilize novel methods to assess research questions to build on these findings.

For example, while the sample size in this study was large, it was accumulated over five years. Future research examining more in-depth questions related to weight-related disparities in this population may want to utilize recruitment strategies, such as respondent-driven sampling, in order to gather appropriate sample sizes within a shorter time-frame. Respondent-driven sampling is a technique that relies on social networks to recruit study participants and tracks the chain of referrals in order to account for bias that could result from the nonrandom sampling strategy.²¹⁶ This technique is particularly useful when recruiting participants who may not be located in geographical proximity (e.g., a neighborhood), but may be connected to each other due to other common characteristics, such as the LGBTQ community. This sampling technique and subsequent mathematical adjustment has been shown to generate representative samples.²¹⁶ Further, respondent-driven sampling has been used extensively to recruit hard-to-reach and hidden populations for HIV/AIDS and substance use research²¹⁷⁻²²⁰ and may be a viable method for effectively and efficiently recruiting non-heterosexual college students.

Further, the emerging adult and college populations are some of the most technology-connected groups.^{221,222} More recently, mobile technology has been utilized to collect more objective weight-related behavioral data as well as to deliver interventions to young people. Utilization of mobile technology to collect more in-depth longitudinal data, more objective data, and as a platform for intervention delivery should be explored

for LGB college students. For example, capitalizing on mobile technology to collect data on incoming LGB students and following them throughout their college experience in order to examine how their experiences and health behaviors may shift over time. A potential advantage of this approach could be collecting more focused data through multiple short surveys rather than the one-time long survey approach that is commonly used. For behaviors such as eating and physical activity (where recall bias is often a concern) this may yield more reliable data for this population as well as potentially improve response rates as multiple short surveys may be less taxing on the respondent than a single long survey. Moreover, as described earlier, longitudinal college data could inform intervention development by assessing how LGB student needs shift over time.

Mobile technology may also be viable as a technique to incorporate and explore aspects related to socializing and social contexts, which were important aspects noted by LGB college students with regard to weight-related health. While socializing is certainly not unique to LGB college students, it highlights an area that may look very different from heterosexual students (for whom socializing is also an important aspect of weight-related behaviors). For example, social norms within the LGB community are different (e.g., more body type diversity within the LGB community) and creating a tailored intervention that cultivates this positive social norm, such as through specific imagery and messages that highlight and reaffirm the diversity of body types within the LGB community rather than perpetuating more mainstream images of specific body types, may help shift weight-related behaviors more effectively for LGB college students. Further, quantitative data used in this dissertation did not assess social contexts for the individual,

which may be an important context to capture in order to understand how sexual orientation and weight-related behaviors interact.

With regard to qualitative or mixed methods approaches, although the qualitative findings from this dissertation highlight seemingly different experiences with regard to weight-related health than the story illustrated by the quantitative data, this further highlights the need for multi-method and mixed method approaches in order to better understand the complexities of sexual orientation and health by yielding information on statistical averages or trends as well as personal perspectives. In this dissertation, qualitative study participants were recruited separately from the CSHS. Future research should consider have participants complete both qualitative and quantitative components to examine how individual experiences and narratives relate to quantitative assessment of individual behaviors. Additionally, it would also be informative to examine how this relationship between individual narratives and behaviors may change over time, and how experiences throughout college may be informing these narratives and behaviors.

An additional area for future research would be the exploration of sexual identities other than those included in the CSHS. In our qualitative study, participants also identified as pansexual and queer (which were not options on the CSHS). As evidenced by disparities across sexual orientation (e.g., bisexual women tended to have worse weight-related health than gay/lesbian women), other less mainstream sexual identities, such as queer and pansexual, may be important to explore to gain a deeper understanding as to how sexual identity influences weight-related behaviors and also to examine if these sexual identities that are not captured more broadly exhibit different

weight-related health behaviors. This is a particularly understudied area of LGB health in general, as most data collection is limited to more mainstream identities or collapses less mainstream identities in with LGB identities.

With regard to interventions, the findings from this dissertation indicate that there is a need to multi-level interventions including interventions focused on individual behavior change, social connections within the intervention, and also structural changes on-campus (e.g., increase availability of gender-neutral bathrooms and/or changing rooms within campus recreation centers). Further, interventions also need to be multi-behavioral, such as addressing both physical activity and unhealthy weight control behaviors simultaneously, as these behaviors co-occur. All interventions need to acknowledge the unique social norms, barriers, and resiliency associated with LGB college student experiences in order to appropriately address weight-related health disparities. Additional research is needed to develop and explore strategies for effective interventions for this population as this area is highly understudied and little is known about weight-related behavioral interventions that work for LGB college students.

Overall, sexual orientation is an important characteristic to consider in examining weight-related health disparities. Despite the growing amount of research on sexual orientation-related disparities in recent years, little is still understood about weight-related health and sexual orientation. This dissertation builds a foundation of understanding around weight-related disparities during emerging adulthood and highlights future research modalities and questions that can be utilized to inform intervention development to address these existing disparities.

Table 24. Summary of major findings

Aim 1: To identify major weight-related behavioral profiles and the extent to which these differ by sexual orientation and gender

- Four over-arching weight-related behavioral profiles were identified that highlight important patterns in specific behaviors and the co-occurrence of behaviors exist
- Unhealthy weight control behaviors co-occur with low physical activity
- There is a need for physical activity interventions
- There are proportionally more LGB students exhibiting unhealthy weight control profiles and fewer LGB students exhibiting physically active profiles than heterosexual students, highlighting important weight-related behavioral disparities
- Future interventions should consider the diversity of behavioral patterns across sexual orientation groups to effectively address weight-related behavioral disparities

Aim 2: To examine the relationship between institutional supports for LGB college students and weight-related behaviors by sexual orientation

- Institutional supports for LGB students were generally not significantly associated with LGB students' weight-related behavioral profiles
- There may be other contexts that influence LGB students' weight-related behaviors, such as state, county, or city policies and community or social norms

Aim 3: To understand the context surrounding weight-related health among LGB college students

- Some LGB, queer, and pansexual college students have to negotiate their sexuality in ways that may adversely influence their physical activity, eating habits, and body image
 - Some LGB, queer, and pansexual college students experience resiliency related to their sexual orientation which helps facilitate healthier eating habits, more physical activity, and positive body images
 - Institutional interventions should be inclusive and address some of the unique barriers experienced by LGB college students and also harness the resiliency framework in order to develop an effective and positive intervention
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Table 25. Recommendations for further research and interventions

Methodological and sample considerations

- Collection of longitudinal data to examine LGB health over the life-course, specifically, longitudinal data regarding the college student experience in order to determine shifts in weight-related behaviors and critical points for interventions
- Collection of more in-depth and objective measures of weight-related behaviors among LGB college students
- Collection of data related to socializing and LGB social norms that may be related to LGB weight-related behaviors in order to understand the influence of these forces on weight-related behaviors and how best to intervene
- Development and administration of questions examining barriers and resiliency related to sexual orientation and weight-related health
- Improve geographic diversity in college samples, to allow for comparison to Minnesota findings and to examine contextual influences in other geographic settings
- Increase racial/ethnic diversity of student samples to understand the complex interplay of multiple minority identities and weight-related behavioral disparities
- Exploration into multi-level contextual (including community, city, county, and state contexts) and how they related to LGB college student experiences
- Need to conduct research on emerging adults who do not attend college and examine disparities across sexual orientation
- Exploration of sexual identities beyond “lesbian,” “gay,” and “bisexual” and how weight-related behaviors may be exhibited among college students with less mainstream sexual identities
- Use of respondent-driven sampling to recruit sufficient samples of LGB college students, including students who experience sexual orientation barriers to engaging in healthy weight-related behaviors as well as those who are more resilient to these barriers
- Use of mobile technology to collect data over time and to deliver interventions to LGB college students
- Use of mixed-methods to gather both quantitative and qualitative perspectives in order to understand the complex relationship between sexual orientation and health, particularly over-time

Strategies for interventions to address weight-related behavioral disparities

- Multi-level interventions are needed including those targeted specifically to LGB college students as well as structural changes on-campus (e.g., gender-neutral changing rooms)
 - Multi-behavioral interventions are needed for LGB college students, particularly those addressing both physical activity and unhealthy weight control behaviors
 - Interventions need to acknowledge unique LGB social norms and structural barriers
 - Resiliency related to sexual orientation can be harnessed to provide a positive framework for intervention development to address weight-related disparities
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Appendix

Appendix A: Full Individual Interview Script

Opening question: What you enjoyed most about Pride (for participants recruited at Pride); who is your favorite gay, bi, or queer idol (for participants recruited not at Pride).

1. Describe what you think is an ideal healthy meal for lunch.

Common barriers to eating healthy and being active among young people in general include things such as lack of time, not knowing how to eat healthy or prepare a healthy meal, healthy foods are expensive or hard to find, or bad weather. When you think about your sexual orientation...

2. What are aspects of being gay/bi/queer that create barriers that keep you from being more active than you currently are?

- a. (probe) Can you describe an experience you had that illustrates this barrier?
- b. (probe) Are there barriers that you experience, in general, related to being active, that might be made worse by your sexual orientation?
- c. (probe) Are there certain attitudes or beliefs within the LGBTQ community, in your experience, that influence your level of activity?

3. What are aspects of being gay/bi/queer that create barriers that keep you from eating healthier than you currently do?

- a. (probe) Can you describe an experience you had that illustrates this barrier?
- b. (probe) Are there barriers that you experience, in general, related to eating healthy, that might be made worse by your sexual orientation?
- c. (probe) Are there certain attitudes or beliefs within the LGBTQ community, in your experience, that influence your healthy eating habits?

4. How do you think your ideal body, for you, goes against or conforms to mainstream expectations of what your body should look like?

5 (women). A recent study found that compared to straight women, bisexual women, but not gay or lesbian women, are more likely to take diet pills, laxatives, or vomit in order to lose weight. How do these findings reflect your own experiences within the LGBTQ community?

5 (men). A recent study found that compared to straight men, gay men, but not bisexual men, are more likely to take diet pills, laxatives, or vomit in order to lose weight. How do these findings reflect your own experiences within the LGBTQ community?

6 (women). The same study also found that gay or lesbian and bisexual women are more likely to be binge eat than straight women. How do these findings reflect your perceptions within the LGBTQ community?

6 (men). The same study also found that gay men, but not bisexual men, are more likely to be binge eat than straight men. How do these findings reflect your perceptions within the LGBTQ community?

7 (women) A recent study found that compared to straight women, gay, lesbian, and bisexual women were more likely to eat out at restaurants. How do these findings reflect your experience within the LGBTQ community?

7 (men) A recent study found that compared to straight men, gay and bisexual men were more likely to eat out at restaurants. How do these findings reflect your experience within the LGBTQ community?

8. Thinking about the nutrition and physical activity barriers you experience related to your sexual orientation and your experiences within the LGBTQ community, what resources would help you lead a healthier lifestyle?

a. (probe) How could existing resources be tailored to be more helpful to you in being healthier?

9. What, to you, was the most important point or experience that you shared today?