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Beyond the Freshman 15: Exploring the Contextual, Psychosocial and Behavioral
Risk/Protective Factors Associated with Obesity among U.S. College Students

A dissertation submitted in partial satisfaction of the
requirements for the degree Doctor of Philosophy
in Public Health

by

Chia-Hsin Emily Cheng

2018

ABSTRACT OF THE DISSERTATION

Beyond the Freshman 15: Exploring the Contextual, Psychosocial and Behavioral
Risk/Protective Factors Associated with Obesity among U.S. College Students

by

Chia-Hsin Emily Cheng

Doctor of Philosophy in Public Health

University of California, Los Angeles, 2018

Professor Donald E. Morisky, Co-Chair

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The growing prevalence of obesity among college-attending young adults is a major public health issue. Over one-third of U.S. college students are either overweight (23.3%) or obese (16.3%) (ACHA, 2017). This is problematic because overweight status during young adulthood is predictive of obesity in later life (Zheng et al., 2017). Thus, overweight and obese young adults face greater risk of developing chronic diseases, including more than half of the 15 leading causes of death in the U.S. The college milieu may be key to understanding obesity because it creates a distinct psychosocial context and shapes exposure to unique risks for young adults. Moreover, college students experience greater psychological distress compared to the general population, perhaps due to the stress associated with increased social and academic pressures. Given that distress has been linked with obesity and maladaptive health behaviors in prior research, enhancing psychological well-being may be an effective strategy to address the rising rates of

obesity among college students. However, we still know relatively little about the distinct psychosocial and contextual risk and protective factors among this population. *The purpose of this dissertation is to evaluate the contextual, psychosocial, and behavioral factors associated with obesity among college students at an ethnically diverse public university in Southern California.* This will be investigated in three studies: Study 1 examines the extent to which social context and psychological distress are associated with increased odds of obesity among college students. Study 2 evaluates the role of lifestyle health behaviors in the relationship between distress and obesity. Study 3 assesses the ways that social relationships and eating habits shape comorbidity patterns in psychological distress and obesity among college students; a latent variable structural model is also used to explore these relationships. Findings from this dissertation may contribute to the limited, but growing body of literature on the nuanced relationship between psychological distress and obesity among college students. In addition, understanding how the college context distinguishes the health of this population may help campuses to create more tailored prevention and intervention programs that account for these psychosocial and contextual risk factors.

The dissertation of Chia-Hsin Emily Cheng is approved.

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CHAPTER 1

INTRODUCTION

The growing prevalence of obesity among young adults, particularly those attending college, is a major public health issue in the United States. Recent national data indicate that over one-third of 20-39-year-olds are either overweight or obese (Hales, Carroll, Fryar, & Ogden, 2017), and nearly 40% of college students are overweight or obese (American College Health Association, 2017). Weight gain during late adolescence and young adulthood can have a profound impact on mental and physical health (Geoffroy, Li & Power, 2011). For instance, excess adiposity that accumulates in early adulthood often continues into middle adulthood, significantly increasing risk for obesity and chronic conditions over time (Zheng et al., 2017). Despite these long-term consequences, there is limited knowledge about obesity and its associated risk factors among college-attending young adults. The lack of research on this population may be attributed to the general perception that college students are not often perceived as an “at-risk” population for obesity. Nevertheless, the steady rise in obesity rates among this population suggests otherwise, raising the possibility that the experience of attending college along with the distinct context of college campuses may contribute to this unexpected pattern.

For many young adults, attending college represents a critical period for weight gain. Specifically, adjusting to a new social context and the demands of college life may increase exposure to social stressors and bring about lifestyle changes that increase risk of weight gain. This phenomenon, which may be most pronounced in the first year of college, is commonly known as the “Freshman 15,” referring to a weight gain of 15 pounds among new college students (Vadeboncoeur, Townsend, & Foster, 2015). Nevertheless, scientific evidence supporting the Freshman 15 has been mixed, with most studies reporting an average weight gain of only 7.5 pounds among first-year students (Vella-Zarb & Elgar, 2009; Vadeboncoeur, Townsend, & Foster, 2015). Moreover, critics of the Freshman 15 assert it is more myth than theory. Many argue that

it also perpetuates the harmful belief that weight gain during college is normative and exacerbates negative attitudes toward weight and body image (Graham & Jones, 2002; Mihaloatpoulos, Auinger, & Klein, 2008). However, evidence does suggest a real problem of significant weight gain among college students.

Continued questions about the Freshman 15 phenomenon has motivated new research to address the rising prevalence of obesity among college students, and campuses across the nation have adopted new approaches, such as the Healthier Campus Initiative (HCI), to address this issue. The HCI began in 2014 and is part of a nationwide effort to improve campus health and wellbeing by creating environments that encourage and support greater physical activity and healthier eating habits. The HCI's guidelines are recommended by The Partnership for a Healthier America and are in line with the larger-scale public health frameworks of Healthy People and Healthy Campus 2020. To-date, over 50 colleges and universities across 29 U.S. states have adopted the HCI, and implementing initiatives such as healthier food options and wellness programs for students. Collectively, the healthier choices provided by the HCI have been an integral part of efforts to promote positive behavior change and reduce obesity risk on college campuses. In addition, the HCI's socioecological approach has underscored the importance of built-environments as barriers or facilitators to healthy decision-making among college students. Nevertheless, within extant research, there has been limited consideration of the ways that contextual and psychosocial processes may also play a key role in shaping health behaviors among the student population. As a result, the specific risk factors associated with weight gain among this population remain poorly understood.

Our knowledge of these issues is limited due to several important gaps in prior research. *First, existing studies on obesity have been narrow in their scope, focusing only on certain populations.* This specificity has resulted in a threefold limitation of current knowledge, wherein research on young adults, racial/ethnic minorities, and within-gender patterns are severely lacking. Most notable among these weaknesses is that obesity research and prevention efforts

have focused primarily on children and adolescents, often neglecting young adults aged 18 to 24 (Dietz, 2017). This is problematic because young adulthood is a critical transitional period when individuals often develop new lifestyle habits and face new health risks (Arnett, 2014; Zheng et al., 2017). There is also increasing evidence that exposures during this period can have lifelong health implications and increase risk for premature mortality (Arnett, 2014; Darnton-Hill, Nishida, & James, 2004; Sargent-Cox, Cherbuin, Morris, Butterworth, & Anstey, 2014; Umberson, Crosnoe, & Reczek, 2010). Consequently, it is imperative that we assess obesity and its distinct risks among this population and gain a better understanding of the predictors or determinants in the college context to better target obesity prevention/interventions among this vulnerable population.

Many studies also fail to evaluate patterns across different race and ethnic groups. Although people of color make up nearly 30% of the nation's general and college student populations and are disproportionately affected by obesity, these populations have been included in obesity studies less often than non-Hispanic Whites (ACHA, 2017). This is troublesome given that obesity rates are highest among Hispanics and non-Hispanic Blacks (Hales, Carroll, Fryar, & Ogden, 2017; McTigue, Garrett, & Popkin, 2002; Truong & Sturm, 2005). The changing landscape of college campuses, including shifts in their demographic makeup and obesogenic environments, may be key contributors to the increasing obesity trend. However, the lack of diversity in obesity studies among the college population makes it difficult to draw any conclusions about what exactly those factors may be. This points to a need for more research inclusive of underrepresented minorities (Castillo & Schwartz, 2013) for early identification of at-risk groups.

In addition to limited understanding of obesity risk among this age group and across diverse populations, there is also a lack of knowledge regarding the specific gendered processes that may influence obesity risk. There are well-documented variations between women and men in body mass index (BMI) (Clarke, O'Malley, Johnston, & Schulenberg 2009), and prior research suggests that gendered patterns in the social determinants of health (e.g. socioeconomic status)

as well as socialization and cultural norms are also important (e.g., acculturation and health behaviors, expected participation in sports). For example, evidence suggests that compared to their male counterparts, female immigrants are more likely to adopt American culture (e.g. fast food consumption) and behavioral norms (e.g. driving instead of walking) that are associated with increases in overweight and obesity over time (Gordon-Larsen, Harris, Ward, & Popkin, 2003; Oza-Frank, & Cunningham, 2010). Others point to social expectations as being important, as these expectations may create different risk factors. Women are more likely to express psychological distress and eat in response to distress (Leske et al., 2015), whereas social support may mitigate weight gain from stress eating more strongly in men (Darling et al., 2017). Social expectations can also create different protective factors, such as men are more likely to participate in sports (Fleming & Agnew-Brune, 2015), while women may be expected to eat healthier diets (Spencer, Rehman, & Kirk, 2015). Given colleges and universities also create distinct experiences and social expectations, it is possible that the distinct social context of college in shaping risk factors also varies for female and male students.

Although some scholars have examined gender differences in obesity in general, far fewer researchers have investigated within gender variations, particularly considering the unique college context. This is important because examining genders as a unified population may miss key factors that differentiate obesity outcomes. The need to assess gender-stratified patterns in risk factors provides a better assessment of their impact that can better inform prevention and intervention efforts. Women who belong to a sorority, for example, may have considerably different obesity risk factors from those who do not, and gendered norms often differ across cultural or even subcultural lines (Snook et al., 2017). Thus, there is a need to distinguish the patterns of risk factors separately for women and men, particularly among college-attending young adults, given the continued rise in obesity prevalence in this population. In light of the limited scope of previous research, this dissertation aims to enhance our understanding of obesity

and related within-gender risk patterns by using data from a racially and economically diverse sample of college students.

Another key gap in current knowledge *is the lack of consideration of mental health status as a risk factor of obesity among college students*. Psychological distress is one of the key correlates of weight gain in the general population, yet its role in shaping obesity risk among college students remains unclear. Prior research has examined the links between psychological distress and obesity, finding that psychological distress is positively associated with weight gain (Block, He, Zaslavsky, Ding, & Ayanian, 2009; Halfon, Larson, & Slusser, 2013). At the same time, studies show that college students experience elevated rates of psychological distress and disorders such as anxiety or depression (ACHA-NCHA, 2017; Blanco et al., 2008). Hence, psychological distress may be a particularly important pathway through which weight gain occurs among the college population. Given the high prevalence of distress that students experience, it may contribute to the growing rates of obesity. However, much still remains unclear about the specific role of distress in increasing obesity among college students.

One reason for the limited knowledge in the role of psychological distress in shaping obesity is that they often co-occur, which obscures risk patterns. For example, risk factors for obesity may differ or become exacerbated in the presence of psychological distress. Moreover, the co-occurrence of multiple psychosocial and behavioral mechanisms such as stress exposure and eating habits make interpreting the direction of the association and disentangling the individual effects difficult. Another issue that limits our understanding of the distress-obesity relationship is that research among college students has typically focused on the impact of single health behaviors (e.g., diet or exercise) on weight status or weight perception (e.g. Coco et al., 2014). This overlooks a wide range of other psychosocial or behavioral risk/protective factors during college that may be crucial for *both* distress and obesity, including gender variations. Since gender differences are present for both psychological distress and obesity, it is possible that there are unique patterns of comorbidity for these two conditions that are shaped along gendered lines.

Thus, there is a need to examine the complex pathways that give rise to the frequent comorbid status of distress and obesity and consider the potential distinct variations among female and male students. Examining the comorbidity patterns allows a different approach to understanding college obesity, and may clarify some of the complex pathways such as bidirectional causation and interaction effects. This dissertation will address these gaps within a more diverse population across gender in order to disentangle the unique processes by which psychological distress may explain the disparities in obesity.

A third issue within existing literature is its *limited attention the distinct social and contextual factors that may importantly shape obesity risk among college students*. This contrasts with the increased recognition that social context influences health behaviors and obesity prevalence (Burk et al., 2009; Slack, Myers, Martin, & Heymsfield, 2014). In the general population, social contextual factors such as socioeconomic status, living circumstances, and personal and community resource have been shown to influence health behavior adoption and maintenance (Emmons, 2000). Among the college population, social context has been associated with health risk behaviors of drinking and smoking (Beck et al., 2008; Moran, Wechsler, & Rigotti, 2004). Similarly, living arrangement may directly or indirectly impact dietary habits and weight gain in college (Vadeboncoeur et al., 2015), and sports participation can be associated with lower distress and obesity risk (Bullard, 2016; Marques, Ekelund, & Sardinha, 2016). Given that college-related social contexts create circumstances that critically shape and covary with other psychosocial and behavioral factors including distress and eating habits, it is important to understand how social context impacts obesity prevalence and associated risk factors among this population. However, not enough is known about the distinct contextual risk and protective factors, and therefore a more holistic approach that gives due consideration to the intrinsic complexity of both proximal and contextual conditions is needed. Hence, this dissertation uses a large set of individual, social contextual, behavioral and psychosocial risk and protective factors

to enhance our understanding of the link between distress and obesity among the college population.

In light of these limitations, *the overall purpose of this dissertation is to evaluate the contextual, psychosocial, and behavioral factors associated with obesity among students at an ethnically diverse public university in Southern California.* Theoretically guided by the life course perspective (Elder Jr., Johnson, & Crosnoe, 2003), the stress process model (Pearlin et al., 1981, 2005), and the environmental affordances model (Mezuk et al., 2013), a more integrative model is developed to assess the complex relationships of multiple domains of risk and protective factors. Also central to this dissertation is the examination of distress-obesity comorbidity patterns and identification of associated risk factors among women and men. This integrative approach enables a more comprehensive understanding of obesity among college-attending young adults that is critically lacking in prior research. This will be investigated in three separate, but related studies. The first study examines the extent to which social context and psychological distress are associated with increased odds of obesity among college students. The second study evaluates the role of multiple domains of lifestyle health behaviors in the relationship between distress and obesity. The final study builds on the findings from Study 1 and 2 to assess the ways that social relationships and eating habits shape comorbidity patterns in psychological distress and obesity among college students.

Given the increase in overweight/obesity rates among college students, and the importance of the college experience in forming lifelong health habits and shaping future leaders, interventions targeting college students can play a significant role in the health status of young people and overall population. Findings from the three studies of this dissertation may contribute to the limited but growing body of literature on the nuanced relationship between psychological distress and obesity. In addition, it may disentangle the role of college social context in shaping exposure to psychosocial and behavioral risk factors that influence the comorbid distress-obesity link among college students. Hence, understanding how the college context distinguishes the

health of college students may help inform campuses in developing early identification of psychosocial or contextual risk factors in creating more tailored prevention and intervention programs.

CHAPTER 2

BACKGROUND AND CONCEPTUAL FRAMEWORK

As outlined in the preceding section, this dissertation aims to evaluate the contextual, psychosocial, and behavioral factors associated with obesity among U.S. college students. In the section that follows, I will critically assess evidence from prior research, identify key limitations in existing literature, and describe the theoretical frameworks and perspectives guiding this research. I also present a new conceptual model that integrates the life course framework, stress process model, and environmental affordances model to more fully characterize the range of risk and protective factors expected to affect the relationship between psychological distress and obesity. Given the limited understanding of the psychosocial risk factors of obesity among the college population, this model allows for a more comprehensive approach that considers not only the link between psychological distress and obesity in college students, but also the broader, deeply interrelated psychosocial factors and health behaviors shaped by the college context that are integral parts of this relationship.

The Significance of Obesity in the U.S.

The increasing prevalence of obesity despite efforts to raise awareness and stymie its growth is worrisome because obesity is a major risk factor for more than half of the 15 leading causes of death in the U.S.; these include cardiovascular disease, stroke, diabetes, and cancer (Hruby et al., 2016). This increasing trend also has non-medical related consequences, such as economic impact due to increased health care expenditures and loss of productivity (Cawley & Meyerhoefer, 2012) and psychosocial impact including discrimination and diminished quality of life. For example, being bullied in school, discriminated for a job, or not forming intimate relationships can all lead to feelings of shame, rejection, and depression (Wellman & Freidberg, 2002). In addition, societal standards of acceptability in regards to physical appearance can affect one's own perception of an ideal body image and type. One study found that formally obese

patients preferred to have another condition (e.g., diabetic, heart disease, bad acne), than to be obese (Rand & MacGregor, 1991). In another study examining data from the National Health and Nutrition Examination Survey (NHANES), obesity rates among adults between ages 20-59 are rising but fewer individuals are actively trying to lose weight, from 55.65% in 1988-1994 to 49.17% in 2009-2014 (Snook et al., 2017). These patterns suggest that there is greater social acceptance of obesity and fewer attempts to reduce the health risk. This may somewhat ameliorate the psychosocial costs of obesity, but may also exacerbate the physiological risks because those who may not be trying to lose weight are at greater risk of the serious health consequences of obesity.

Obesity among Young Adults

Obesity, especially among young adults, is an increasingly important public health issue in the United States. According to the CDC, nearly 36% of 20-39-year-olds are overweight or obese (Hales, Carroll, Fryar, & Ogden, 2017). Although the growing prevalence of obesity among young adults is lower than rates for middle-age and older adults, it is still troubling because it represent significant weight gain during an important, formative period that poses significant risk. Obesity in young people is linked to negative physical and mental health functioning, such as general health status and depressive symptoms (Halfon, Larson, & Slusser, 2013; Odlaug et al., 2015). Excess adiposity accumulate during early adulthood often continues into middle adulthood, increasing the risk of obesity and other chronic conditions over time (Zheng et al., 2017). Therefore, understanding and curbing obesity at this stage could have a significant long-term effect in terms of also reducing the incidence of obesity in the overall population.

One context in which obesity is especially troubling—and yet also increasingly prevalent—is that of emerging adulthood. The early phase of young adulthood from late teens to mid- or late 20s is increasingly recognized by scholars as a distinct period of development known as emerging adulthood. It is a vulnerable and transitional life stage characterized by exploration, change, and instability of life directions, as well as identity formation and role experimentation (Arnett, 2014). The incidence of obesity during this formative stage is of particular concern because lifestyle

health behaviors formed in this period tend to endure, increasing the risk of continuing weight gain in later adulthood (Zheng et al., 2017). Specifically, research suggests that weight gain during emerging adulthood can have profound impact on both physical and mental health (Halfon, Larson, & Slusser, 2013; Hruby et al., 2016). This is because, overweight status during young adulthood is predictive of overweight and obesity in later adulthood, and thus increases risk for other chronic conditions (Zheng et al., 2017).

In addition to direct health consequences, weight gain is also associated with adverse psychological outcomes among this age group. Research shows that among those who are obese, there is approximately 25% of increase in the odds of mood and anxiety disorders (Simon et al., 2006). Adolescent weight gain is also associated with the development of maladaptive behaviors such as alcohol abuse, drug use, or self-harm (Micali et al., 2015). In addition, eating disorders such as binge eating, may significantly contribute to weight gain and can be predictive of subsequent, more severe psychological disorders. Combined, these risks are likely because the habits and perceptions developed during this formative stage give rise to future patterns that are often followed for the rest of a person's life (Arnett, 2014).

Why College Students are “At-Risk” for Obesity?

College students are at particular risk for obesity among young adults. This is because for a significant portion of the population, attending college or university is perhaps the defining experience of emerging adulthood. In 2016, there were over 20 million Americans enrolled in U.S. postsecondary institutions and 12 million of these were young adults under the age of 25 years (National Center for Education Statistics, 2016). According to the American College Health Association (2017), over one-third of college students were either overweight (23.3%) or obese (14.6%). This translates to about 4.5 million college students, a trend that has persisted despite greater awareness and prevention efforts of obesity at both the national and global levels.

The growing obesity rate among the college population may be attributed to college being a critical, developmental period during which students are vulnerable to outside factors that create

poor habits or otherwise drive weight gain. The source of weight gain in college is likely due to stress and changing lifestyle that increases students' risk, particularly in their first year of college, known as "Freshman 15" (Vadeboncoeur, Townsend, & Foster, 2015)—referring to a weight gain of 15 pounds. Scientific evidence supporting the Freshman 15 has been mixed, and some scholars remain more critical of the notion that weight gain in college is the norm. These scholars have, for example, argued that actual weight gain is significantly lower than the expression would suggest and that, on average, a college education is more predictive of a lower weight later in life (Baum, 2017). However, in general, there is strong support in the literature for the idea of significant weight gain in the first year of college. For example, a meta-analysis by Vadeboncoeur et al. (2015) that included 22 studies found that over 60% of students do in fact gain weight during their first year of college, averaging 7.5 pounds for those who gained weight. This is supported by another study that suggests the proportion of students who are overweight and obese increases from roughly 25% at the start of freshman year to around 32% at graduation (Nicoteri & Miskovsky, 2014).

Others have asserted that Freshman 15 is more myth than theory. For example, a systematic review by Fedewa, Das, Evans, and Dishman (2014) found that freshman weight gain was insignificant relative to the total weight gain experienced over the course of the average college career and thus the idea that the initial shock of lifestyle change and self-governance of first coming to college is not actually responsible as the Freshman 15 idea implies. Many also argues that it perpetuates the harmful belief that weight gain during college is normative and exacerbates negative attitudes toward weight and body image (e.g. Graham & Jones, 2002; Mihaloatpoulos, Auinger, & Klein, 2008). Thus, while the Freshman 15 may be something of a misnomer, more for alliterative appeal than for its accuracy, evidence does suggest a real problem of significant weight gain among college students. Moreover, while most studies suggest that the beginning of college is a critical period in understanding weight gain, the topic is far from exhausted, with competing views evidenced in the past several years and a resulting need for

additional research. The unique context of college means that college students face distinct risks compared to the general population. Hence, more efforts are needed to understand the risks factors during this pivotal life stage. Specifically, there has been limited consideration of the ways that contextual and psychosocial processes may shape obesity risk among the college population.

Risk Factors of Obesity among U.S. College Students

Prior research has identified numerous determinants of excess body weight, including genetic, physiological, behavioral, psychosocial, sociocultural and environmental factors (Block, He, Zaslavsky, Ding, & Ayanian, 2009; Swinburn, Egger, & Raza, 1999). While behavioral risk factors for obesity such as unhealthy diet and lack of exercise have been extensively studied by public health scholars, a growing body of research also examines psychosocial, contextual and environmental (obesogenic) influences, but with less emphasis on the college population. This is problematic because not considering the full spectrum of the distinct risk factors associated with college obesity is perhaps one key reason that obesity rates remain high among this population. As such, this dissertation will examine the risk factors that are important in enhancing our understanding of obesity among the college population: social context, sociodemographic characteristics, psychological distress, lifestyle health behaviors, and social relationships.

Social Context of College

College students are a unique at-risk population for obesity because of the distinct context of college. Social context represents the medial or interpersonal level factors—the sociocultural milieu important in shaping health behaviors and health outcomes. Social contexts differ from environmental contexts such that they consider the multiple circumstances, experiences, and perceptions that shape individual and interpersonal behavior (Nugent, 2013). This dissertation considers three social context factors highly relevant for the health of the college population: *living arrangements, extracurricular athletics, and Greek membership*.

Living Arrangement. Living arrangement is a social context factor that is expected to influence various factors considered in this dissertation. It is also important from the perspective

of the environmental affordances theory, which is discussed in the following conceptual framework section. For example, where students live may have a direct impact on their dietary habits. Some scholars report students who live off-campus are more likely to be overweight or obese compared to students who live on campus or with their families (Brunt & Rhee, 2008). Living with parents could potentially protect against obesity by preventing the shift in contextual experience that the Freshman 15 phenomenon is commonly attributed to (Vadeboncoeur et al., 2015). However, others suggest that living at home may contribute to worsening obesity rates because of parents' desire to cook for their children or regulate their eating behavior (Clark, Goyder, Bissell, Blank, & Peters, 2007). In addition to a lack of consensus on the exact effects of living arrangement on obesity, social dynamics among housemates may differ between genders, as living situations may have different psychological effects on men and women (Addabbo & Kjeldstad, 2017). Thus, additional research is needed to clarify how living arrangement may impact obesity as well as shape the association between psychological distress and obesity.

Extracurricular Athletics. Students involved in either intercollegiate or recreational sports typically lead more active lives and thus may reduce obesity risk (Marques, Ekelund, & Sardinha, 2016). At the same time, sports participation may have both positive and negative effects on psychological wellbeing. For example, engaging in sports activities may lower stress levels as an enjoyable activity or become an additional obligation that induces distress (Bullard, 2016). Despite an implicit assumption that extracurricular athletics would help with obesity because of the physical activity they entail, the impact of athletic participation has rarely been studied explicitly among college students, and especially not in the context of other psychosocial factors. This study will examine both intercollegiate and recreational sports participation because of the expected protective effects of engaging in extracurricular activities on distress and obesity.

Greek Membership. Being a member of a college fraternity or sorority is another relevant social factor. Like living arrangements, Greek membership may have a significant influence on what environmental affordances are present for a student. For example, Greek membership may

shape one's social environment and social relationships. Moreover, fraternity or sorority involvement has two other potential implications in terms of obesity and its predictors. First, Greek membership is linked to increased "partying", social use of alcohol, and consumption of "junk" (e.g., unhealthy) food (Scott-Sheldon et al., 2016). Thus, membership in a fraternity or sorority may be associated with increased obesity risk. This raises the possibility that students who are not members of Greek organizations may be less exposed to, and engage in fewer risky health behaviors. Alternatively, Greek membership may serve as an enjoyable activity that helps students cope with social stressors (Luk, Fairlie, & Lee, 2017), serving as a buffer that protects against stress and obesity risk. This suggests that non-members would not reap the social benefits of Greek membership. Furthermore, patterns of involvement may considerably differ between men (fraternities) and women (sororities) (Zacherman & Foubert, 2014), with membership having different meanings and implications for health. Therefore, to clarify the impact of Greek life, this study will examine the ways that membership in Greek organization is related to both distress and obesity.

Individual/Sociodemographic Characteristics

Individual-level characteristics, either modifiable or unmodifiable, also influence students' exposure to social stressors and impact their ability to navigate the various social context factors that shape obesity risk. The role of individual and sociodemographic characteristics contributing to one's exposure to stress that affect mental and physical health has been widely researched in the general health literature. However, less is known about their implications for the college population. Among college students, some key factors that may be particularly important to consider are *age, race/ethnicity, nativity status, employment, enrollment, year in college/class standing, academic performance, and financial strain*.

Age & Class Standing. Age and class standing are particularly important individual factors because weight gain during young adulthood is predictive of obesity in older age. However, not all college students are in their late teens or early twenties, as there are non-traditional students

to consider as well. Although college students as a group are generally considered homogeneous (e.g., age range, shared social context), older, returning students are likely to experience college differently than younger students. Some young people start college a year or two later as opposed to immediately after high school, which means their pre-college experience may contribute to different health behavior and obesity risk patterns. Although the traditional notion of the “Freshman 15” suggests that as many as 60% of first year college students experience some degree of weight gain (Vadeboncoeur et al., 2015), other results suggest that first year students gain less weight than students in later years (Nicoteri & Miskovsky, 2014). Therefore, existing literature suggests that class standing or year in college may be an important predictor, but results are conflicting as to the nature and strength of the effect that may be expected. Thus, it would be important to examine variations across class standings and consider any potential confounding among younger or older students.

Race/Ethnicity. The link between race/ethnicity (henceforth referred to as race) and obesity is well-documented, with studies generally report higher rates among Hispanics and non-Hispanic blacks (Hales, Carroll, Fryar, & Ogden, 2017; McTigue, Garrett, & Popkin, 2002; Truong & Sturm, 2005). However, despite racial and ethnic minorities make up nearly 30% of the U.S. population and that minorities are disproportionately affected by obesity, there is a lack of diversity in the study of distress and obesity (National Center for Education Statistics, 2016). Moreover, higher education may be protective against overweight/obesity, but college is also associated with an increased risk of obesity for minority groups (Baum, 2017). This may be due to differential stress exposure among minorities and increased risk of experiencing distress. Race may also differentially impact women and men because many gender roles and norms are culturally defined (Lindsey, 2015). For example, prior research suggests obesity may be more socially acceptable for some groups (e.g., black women). As a result, some groups may feel less pressure to lose weight to reduce obesity risk (Snook et al., 2017). In addition, race is a germane factor because diversity in the college environment has been increasing over recent decades (National Center

for Education Statistics, 2016). This means that understanding the effects of racial demographics is, by extension, increasingly important because minorities make up a larger portion of the college population. However, most studies of collegiate obesity have not given sufficient consideration to minorities, creating an important gap in our understanding of how the association between psychological distress and collegiate obesity may vary across racial/ethnic groups. This dissertation addresses this gap with the inclusion of Hispanics and Asians in addition to blacks and multi-racial groups in the current analysis.

Nativity Status. Similar to race, nativity status may importantly shape health risks. Interestingly, while racial minority groups are more likely to be obese than Whites, being born outside of the U.S. may have a protective effect. This paradox has been extensively documented wherein immigrants often have healthier status than the native-born populations of the countries that they immigrate to (Kennedy, Kidd, McDonald, & Biddle, 2015). This is attributed, in part, to the highly processed diet eaten in many developed countries, along with the greater abundance of food (Argys, 2015). Therefore, as immigrant families integrate into the United States over generations, their health decreases and incidence of obesity increases. Nonetheless, first generation immigrants are less likely to be obese than native-born Americans, though the obesity rates converge over time as immigrants stay longer in developed countries (Argys, 2015). Therefore, nativity status is an important predictor variable because it could potentially mask the effects of race, making minority populations seem healthier than they actually are.

Other College-Related Factors. Other modifiable factors that are important among the college population but have not been fully considered in prior studies are financial strain, employment status, enrollment status, and academic performance. These individual factors are closely intertwined with stress exposure and distress among college students because of their efforts to balance education and employment (Wood, Harrison, & Jones, 2016). *Financial strain* is a common concern in college for several reasons. First, college represents the transition from a parent-dominated lifestyle to an independent one for most students (Larson et al., 2008).

Therefore, many students must, for the first time, manage their own financial affairs, which can be challenging in itself, especially if it involves balancing education and employment (Wood, Harrison, & Jones, 2016). Paying for college may produce its own source of financial strain. While some students' expenses are supported by their parents or by scholarships/financial aid, over 50% of U.S. college students contribute to paying for their own education by working. In many cases, scholarship packages also include a work-study or loan component (Carruthers & Özek, 2016). Therefore, college attendance is often a significant source of financial strain on students. Those who are most likely to be affected by this are those attending part-time, as this type of *enrollment status* limits eligibility for many types of state and federal financial aid (Carruthers & Özek, 2016). Moreover, *employment status* or hours of work per week is expected to be related to full or part-time enrollment, both predictors of academic stress and performance (Wood et al., 2016), and lowered *academic performance* has been linked to obesity (Branigan, 2017; Suraya, Meo, Almubarak, & Alqaseem, 2017). The dual burden of working and studying can leave students tired and stressed, causing them to suffer from a lack of sufficient time to do both activities and also limiting their ability to engage in anti-stress leisure activities, thus increasing their level of distress.

Collectively, these contextual and individual characteristics are important antecedents to consider. Not only might they predispose students to distress, but they may also act as possible confounders in the focal distress-obesity relationship. College attendance is an especially important formative experience in the lives of many young adults and may impact them in several ways. On the one hand, it may represent a period of elevated risk because weight gain during early adulthood makes future health problems more likely to persist or worsen over time (Zheng et al., 2017). On the other hand, it is possible that attending college may be a stage where anti-obesity efforts are more likely to have long-term benefits. As obesity rates continue to increase among the college population, reducing psychological well-being may be an important point of intervention given the documented linkages between psychological distress and obesity.

Therefore, for college students, it is particularly important to understand the role of psychological distress on obesity.

Psychological Distress

There is growing evidence supporting the psychological distress-obesity link in both animal models and the general population (Morris, Beilharz, Maniam, Reichelt, & Westbrook, 2015). This is mostly examined in neuroscience and nutrition literature that psychological distress affects eating habits. Those experiencing psychological distress not only tend to change their eating habits by often eating more, but they also tend to eat less healthily. For example, in Australia, a study of 6881 adults found that psychological distress was inversely linked with consumption of healthy, low calorie fruits, but significantly and positively linked with unhealthy, high-calorie takeout or fast food (Leske, Strodl, Harper, Clemens, & Hou, 2015). The physiological underpinning for this relationship has been widely documented—that individuals under distress may experience neurobiological adaptations such as elevation of the hypothalamic pituitary adrenal axis (HPA) activity and appetite stimulation which leads a person into consuming more unhealthy foods such as fast food, snacks, and calorie dense and highly palatable foods leading to excess weight gain (Adam & Epel, 2007; Morris, Beilharz, Maniam, Reichelt, & Westbrook, 2015). In another example, a study by Hemmingsson (2014) argued that psychological distress may be the key factor linking poor socioeconomic status and obesity. In this view, those from low socioeconomic status backgrounds are more likely to face every day causes of psychological distress, including financial need, unstable home life, or a lack of opportunities. As a result of these constant stressors, they may turn to eating as a way to find comfort (the idea of “comfort food”) or simply as a way of suppressing negative emotions (Tomiya, Finch, & Cummings, 2015). A pattern of maladaptive habits tend to form to cope with significant, continual stressors that build up over time, leading to higher rates of obesity.

This mechanism may explain weight gain among the college student population, since the social context of college is often associated with a significant increase in stressors. For instance,

students may experience a range of academic, social, and financial burdens in addition to the distress that may arise from being away from home. College students therefore have an elevated risk of experiencing psychological distress compared to the general population. Recent data indicated that 55.9% of college students report experiencing moderate to high level of stress and 21.7% report depressive mood the past year (ACHA-NCHA, 2017). Given psychological distress is especially pronounced in this population, understanding the connections between psychological distress and obesity in the college context is especially important.

Psychological Distress and Obesity. The association between psychological distress and obesity is a complex issue. Psychological distress manifests itself as a variety of different symptoms, including anxiety, depression, and overall negative affect. The linkages between obesity and depression, as well as other symptoms of distress, have long-been reported in the general population. Studies have observed an approximately 25% increase in the odds of mood and anxiety disorders among those who are obese (Olvera, Williamson, Fisher-Hoch, Vatcheva, & McCormick, 2015; Simon et al., 2006). A meta-analysis of existing literature by Mannan, Mamun, Doi, and Clavarino. (2016) that used a compiled sample of 226,063 adult participants found that depression is associated with a 36% higher risk of obesity, with smaller or insignificant correlations in the opposite direction. Interestingly, based on an in-depth, structured interview study by Marmorstein et al. (2014), the relative onset of the two conditions seems to affect the nature of their relationship; that is, depression and obesity remain concurrently associated if both are early-onset. However, when depression sets in during late adolescence, it was not predictive of later obesity in early adulthood. Hence, evidence on the distress-obesity linkage remains mixed and thus warrant additional research to clarify the relationship.

The pathway linking psychological distress to obesity could be indicative of an underlying causal mechanism that may stem from one of more of several possible sources. First, physiologically, depression is associated with appetite modulation (Schweinfurth et al., 2016). This means that the presence of depression shifts certain aspects of a person's bodily function

with respect to appetite, which can thereby increase the desire to eat and contribute to obesity. Another explanation for this potential causal mechanism is that depression in the modern world is often treated medically (Wurtman & Wurtman, 2017). Increased appetite or the need to eat along with medication is one side effect of this biomedical approach to treating depression, meaning that the link may be partially a result of depression and partially a result of the common treatments for depression. Although testing for the presence of these medicines is outside the scope of this study, if results suggest the expected link between psychological distress and obesity, then this factor is one that should be explored in further research.

Despite our current knowledge about distress and obesity, the high prevalence of comorbidity of the two conditions along with multiple psychosocial and behavioral mediators of the relationship such as other stressors and lifestyle factors (e.g., diet and physical activity, make interpreting the direction of the association and disentangling the individual effects difficult. Moreover, gender plays an important role in this potential causal link. A literature review by Marshall (2014) suggested that the link between depression and obesity is especially strong in women. The exact nature of this connection is not entirely clear at present; however, depression is associated with certain subconscious traits that control appetite (Schweinfurth, Walter, Borgwardt, & Lang, 2016), and eating is a common self-regulatory behavior that often changes when individuals are under distress, suggests a causal link from depressive mood to obesity.

Stress and Obesity. Since psychological distress is the specific psychological manifestation of stress, the effects of stress exposure on obesity are also relevant. The most pronounced pathway from stress to obesity, is through behavioral changes (Razzoli et al., 2017). Specifically, excess food consumption—especially eating disorders like binge eating disorder—may develop in response to stress as a coping mechanism. When individuals experience external stressors and changes dietary behavior, the hypothalamic-pituitary-adrenal axis (HPA) alters the body's regulation of energy homeostasis (Sinha & Jastreboff, 2013), and impacts the nervous system leading to activation and inhibition of metabolic and hormonal pathways. As stress

becomes chronic, the body tends to store nutrients and increases craving for fatty and sugary foods due to increase in cortisol (Dallman, 2010). The suppression of stress is due to the release of various endogenous opioids with the activation of the HPA axis. These opioids give a negative feedback to the activity of HPA axis thus mimicking the decrease in stress (Cota, Tschöp, Horvath, & Levine, 2006), creating a cycle of negative reinforcement. This is one mechanism through which individuals may learn to relate unhealthy foods to be comforting that reduces stress or anxiety, and thus more likely to consume comfort foods when stressed. However, variations in stress-induced eating have also been reported, that obese individuals tend to eat more under stress but this pattern may be the opposite for lean individuals (Sinha & Jastreboff, 2013). There are also gender differences, with women more prone to unhealthy eating during stress than men (Oliver, Wardle, & Gibson, 2000).

Interestingly, this effect tends to manifest differently in humans compared to other animals, as most animal models show stress-related eating disorders are linked to an overall energy-negative equilibrium and thus weight loss, which has made it quite difficult to create a medical approach to the prevention of stress-related obesity due to a lack of applicable animal testing circumstances (Razzoli et al., 2017). In humans, stress-driven eating disorders are generally not associated with similar weight loss (Razzoli et al., 2017, p. 154).

This result tends to hold true in both laboratory and naturalistic settings, suggesting a strong link between stress and obesity. While it is difficult to say what causes this difference in humans and other animals, the experimental results offer stronger causal links between stress and obesity than the (possibly bi-directional) correlational results for other aspects of psychological distress. However, this also suggests that no medical solution to stress-induced weight gain will be readily forthcoming, which emphasizes the importance of an improved understanding of psychosocial risk factors and tailored public health interventions that can best be leveraged to decrease obesity.

Stress is especially relevant to college students because the college environment creates unique forms of stress, such as academic and financial stress. These are not the only possible

causes of stress, but they are two of the major drivers of psychological distress within the college context. Furthermore, one important area of research on obesity is on underrepresented minority populations who are increasingly important in both the general population and in colleges. Research suggests that minority populations are disproportionately represented in terms of elevated symptoms of psychological distress, such as depression (Adams et al., 2016), and in terms of the incidence of obesity (Baum, 2017). Thus, the lack of sufficient research on the experiences of these populations within the college context is problematic, as students from minority populations are more likely to experience both academic stress and financial strain (Adams, Meyers, & Beidas, 2016).

Thus, stress is highly relevant to the context of college, acting both as a predictor and indicator of distress, with a significant portion of the college population suffering from moderate or high levels of stress during college (ACHA-NCHA II, 2017). And, like the other symptoms of psychological distress, stress has been linked to obesity in prior research. In terms of mechanisms for affecting obesity, the general expectation is that these specific collegiate stressors will drive obesity through the same paths as general stress, discussed above. However, financial strain deserves a special mention, as it is not a direct form of psychological distress, but instead a possible driver of psychological distress. Therefore, for the purposes of this study, financial strain will be considered as an individual-level predictor which may directly drive the distress-obesity link. Other behavioral and psychosocial factors relevant to young adults attending college, such as lifestyle habits and social relationships—which can create or alleviate stress, may serve as direct and/or indirect predictors of obesity—will also be considered in the present research.

Health Behaviors

The emerging adulthood life stage is pivotal in shaping lifestyle behaviors such as *eating habits* and physical activity that correspondingly, influence health status (Arnett, 2014; Green et al., 2011; Larson et al., 2008; Laska, Larson, Neumark-Sztainer, & Story, 2010). The importance of dietary intake is well-attested. Weight gain is ultimately determined as a function of calories

consumed and calories burned. Therefore, the quantity and quality of food consumed directly determines calorie intake, which is the primary driver of weight gain. Most risk factors discussed in prior sections influence weight and obesity by altering food intake patterns, such as stress and depressed mood creating the desire for “comfort food” (Hemmingsson, 2014; Tomiyama, Finch, & Cummings, 2015). Although eating habit is a key factor, it represents only half of the equation for obesity, alongside physical activity which burns calories (Manore, Larson-Meyer, Lindsay, Hongu, & Houtkooper, 2017).

The positive impact of *physical activity* on obesity risk and other chronic health conditions is well-documented. Whereas eating and a poor diet drives obesity through increasing caloric intake, physical activity can alleviate obesity through burning off calories (Bullard, 2016). However, physical activity alone is not enough to prevent obesity; instead, to fully understand the net effect of physical activity, it must be considered in concert with other health behaviors, and especially dietary habits (Manore et al., 2017). Physical activity is relevant in the context of college for several reasons. First, a majority (56%) of college students do not meet the recommended standards for daily physical activity (ACHA-NCHA II, 2017). Research generally shows that levels of physical activity decline significantly after high school. As young adults enter college, time for structured physical activity often decreases, while more demands from work and school means less time for recreational activities. Nevertheless, college may also create new opportunities for physical activity, with the availability of student recreation centers, gyms or pools, and organized recreational/intercollegiate sports. Sports participation may have both positive and negative effects on psychological wellbeing. Additionally, the high incidence of stress and depression in the college context can serve to hamper physical activity, as psychological distress makes a person less likely to be physically active (Roshanaei-Moghaddam, Katon, & Russo, 2009). Thus, it is critical to assess physical activity in the contexts of psychological distress and obesity.

In addition to dietary habits and physical activity, there are other health behaviors that play an important role that few studies have considered in the context of psychological distress and

obesity. One such other important factor is *sleep*. A meta-analysis of 11 longitudinal studies of sleeping habits and obesity among children and adolescents suggested a strong, inverse relationship between sleep duration and obesity (Fatima & Mamun, 2015). Similar results have been reported in cross-sectional research among adolescents, which suggests that decreased sleep duration is linked to increased incidence of obesity (Chaput & Dutil, 2016). Among older adults, a lack of consistency in sleeping habits is also a significant predictor of obesity (Patel et al., 2014). In one study of college students, poor sleep quality is correlated with an increased incidence of body fat (Kahlhöfer, Karschin, Breusing, & Bosy-Westphal, 2016). Thus, lack of sleep or poor sleep quality is as serious a risk for obesity as is a poor diet or a lack of adequate physical activity. Although sleep has been demonstrated to have an impact on weight gain, this relationship has rarely been considered in parallel with psychological distress in the college context.

Many health behaviors are associated with psychological distress. Much of the behavioral pathway between psychological distress and obesity (described in the previous sections) focuses on links between psychological distress and unhealthy eating habits (Leske et al., 2015). Similarly, distress may lead a person to engage in less physical activity (Stults-Kolehmainen, & Sinha, 2014), and psychological distress is negatively associated with sleep duration and quality (Chaput et al., 2016). Therefore, the model used in this study considers not only the net effect of various health behaviors, but also how these behaviors might interact in complex ways with psychological distress and its own effects in driving obesity. The largest gap regarding health behaviors and obesity in the literature is that little to no research has yet examined a more comprehensive model of these behaviors' effects on obesity, as opposed to isolating one or two. Additionally, this study will expand the literature further by considering the possibility that health behaviors *moderate* rather than mediate the link between psychological distress and obesity.

Social Relationships

During young adulthood, individuals often develop social relationships that can influence lifestyle behaviors and have lifelong health implications (e.g. Arnett, 2014; Sargent-Cox,

Cherbuin, Morris, Butterworth, & Anstey, 2014). The myriad aspects of social relationships are linked in varying ways to the incidence of obesity (Liberman, Woodward, Sullivan, & Kinzler, 2016). Social relationships play a vital role both as risk and protective factors in shaping health behaviors across the life span (Broman, 1993; Umberson, Crosnoe, & Reczek, 2010), that in turn, influences health status. For example, low social support has been shown to associate with less physical activity and irregular sleep pattern (Allgower, Wardle, & Steptoe, 2001), and relationships with spouses and friends are associated with preventive health behaviors such as wearing seat belts (Broman, 1993). Eating is also a social behavior for humans—though people sometimes eat alone, shared meals are a significant part of many, if not all, cultures. As previously discussed in the Greek membership section, certain types of social relationships—mainly those that promote partying, alcohol consumption, and junk food—can act to worsen the risk of poor eating habits, increasing caloric intake and thereby contributing to obesity (Luk et al., 2017). Thus, the different types of relationships can have differing effects on obesity and some relationships may be expected to exert a protective influence.

For example, romantic relationships in many cases exert a protective effect against obesity because of standards of attractiveness. Excess weight is generally considered to be unattractive, and hence those who are in a romantic relationship or interested in one may have more motivation to lose weight (Reed, Barnard, & Butler, 2015). Parental relationships can also play a role, as obtaining parental approval remains important to many emerging adults and therefore parents who disapprove of overweight and obesity or help their children to maintain healthy behaviors can thus serve as a protective factor (Lydecker, O'Brien, & Grilo, 2017). However, the nature of the parent-child relationship shifts when children enter college, with parents taking on the role of either a stressor or a supporter, usually from afar as opposed to the more direct role they would have taken in their children's lives up to that point (de Vos et al., 2015). As a result of this changing role, the role of parental influence on emerging adult's propensity toward obesity is an interesting consideration and one which has not been fully

considered in prior studies. Thus, additional research on spousal/partner and parental relationship is needed to clarify the distress-obesity linkage.

The effect of peer relationships can be both beneficial and harmful as well. For example, a study by Leahey, Doyle, Xu, Bihuniak, and Wing (2015) examined the relationship between social networks and effective weight-loss efforts. While their results suggested that those who are trying to lose weight tend to cluster together into social networks, they also found that the only social network factors that are significantly predictive of successful weight loss were weight status of casual friends and normative influence for unhealthy eating. On the other hand, though, Cho, Jae, Choo, and Choo (2014) found that when other factors except stress were controlled for, women who perceived social support for their weight loss efforts were significantly more likely to engage in healthy behaviors that would promote weight loss. However, this association decreased significantly in the presence of stress. In general, the nature of the relationship between peer social relationships and obesity is mixed. Given that such results are already conflicting without looking at the college setting, there is a clear reason to better understand the role of peer relationships in predicting and influencing the incidence of obesity in college students.

Gaps in Research

Overall, although various sociodemographic, behavioral and psychosocial predictors of obesity have been studied, the specific mechanisms linking psychological distress to obesity in the college context has not been fully examined in prior research. The previous section highlighted the importance of the college social context, which may uniquely shape risk factors of obesity among college students; it also illuminated some of the ways in which the existing research is deficient or incomplete. These limitations include: (1) substantially more obesity research in recent decades was focused on children and adolescents or utilized racially or ethnically homogeneous samples; (2) young adulthood has largely been a neglected period of study in the development of obesity; (3) although research has shown that psychological distress is one of the key correlates of weight gain in the general population, its role in shaping obesity risk among college students,

and in particular, how there might be unique underlying processes with men and women remains unclear; and (4) despite more investigators turning to environmental and psychological predictors of weight gain during college, studies have largely focused on the health behaviors of diet and exercise, overlooking a wide range of other psychosocial, behavioral, and contextual risk and protective factors that may be crucial for *both* distress and obesity. Accordingly, this study is motivated by the desire to help bridge some of these gaps in the existing literature.

In light of these limitations, *the purpose of this dissertation is to evaluate the contextual, psychosocial, and behavioral factors associated with obesity among college-attending young adults at an ethnically diverse large public university in Southern California.* This research is theoretically guided by the *life course perspective* (Elder Jr., Johnson, & Crosnoe, 2003), the *stress process model* (Pearlin, 1981, 2005) and the *environmental affordances model* (Mezuk et al., 2013), and it will integrate these perspectives to disentangle the complex relationships of multiple domains of risk and protective factors for a more comprehensive understanding of obesity among college students.

Theoretical Framework and Conceptual Model

The increasing rates of obesity among college students underscores our current knowledge and efforts of focusing primarily on behavioral interventions are likely insufficient at tackling the epidemic. Although research has shown that psychological distress is one of the key correlates of weight gain in the general population, it remains unclear how the context of college influence psychological distress that may uniquely shape the distress-obesity relationship, and in particular how the relationship varies within gender groups. The high prevalence of comorbidity of the two conditions and multiple psychosocial and behavioral mediators of the relationship such as stress, eating behavior, and physical activity, make interpreting the direction of the association and disentangling the individual effects difficult (Stunkard, Faith, & Allison, 2003). Thus, to understand the risk factors of obesity among college students, a framework that incorporates the

dynamic elements of the life stage is needed to evaluate the myriad of psychosocial and contextual forces relevant during a critical period of development of obesity.

Life Course Perspective

The life course perspective provides a guiding theoretical framework for this dissertation. In his influential chapter, *The Emergence and Development of Life Course Theory*, Elder (2003) posits that the life course perspective is *the* theoretical orientation to study people, dissecting age-related patterns embedded in social institutions and history (Elder Jr., Johnson, & Crosnoe, 2003). He emphasizes the contextual influences and social pathways in historical time and place for human development and aging. Young adulthood is a time full of *transitions*, which are changes in responsibilities or social roles (e.g., starting college, marriage, parenthood). For many young adults, starting and attending college is a major life transition characterized by independent living, increased autonomy in decision-making, and new social and academic stressors impacting their health and health behaviors (Arnett, 2014; Larson et al., 2008). New responsibilities and time commitment for classes, study, and work that college students take on affect multiple aspects of their lifestyle, often associated with unhealthy adjustments to choices on exercise, sleep, and food intake. In addition, multiple behaviors often interact, potentially slowing attempts to change a lifestyle behavior. For example, tobacco users may find quitting difficult, sometimes turning to food as a substitute for smoking. Other transitions experienced by college students, such as the beginning or end of a romantic relationship or job, can also have dramatic effects on health behaviors. The transition and social context of college is a central concept of this dissertation, especially given that traditional conceptions of college weight gain, such as the “freshman fifteen,” have their roots in the changes that result from the transition into college.

Whereas transitions are typically normative events, *turning points* are major changes in the directions of one’s life (e.g., returning to school in midlife). Therefore, transitions and turning points, while distinct, are not necessarily mutually exclusive. In the example of returning to school as a nontraditional student, this turning point is also a transition back into student life. Not every

transition is also a turning point, though: for example, the transition from high school to college might be a turning point for someone of low socioeconomic status who had never intended to go to college, but this would not represent a turning point for someone who had always intended to go to college. Most turning points do create transitions, but this is not always true. Weight gain or loss in college can be a turning point in the life of a student. Because of the formative nature of the emerging adult period, choices that lead to a significantly unhealthier—or healthier, lifestyle can be a turning point because they affect the overall pattern of the student's life, possibly even shifting them onto a trajectory that leads to chronic health problems or even premature death in later adulthood.

The concepts of transitions and turning points presented here as normative and life events may imply that daily routines and events are not as important or of lesser weight in contributing to a person's life course. Perhaps daily events in isolation would not be of significance—but multiple singular or related daily events could have cumulative effects on an individual's life course. Indeed, similar findings in the stress literature showed that daily hassles as sources of stress can cause more harm than major life events (DeLongis, Coyne, Dakof, Folkman, & Lazarus, 1982). Recent work on the psychobiology of stress and allostatic load lends support on the cumulative effects of stress on health (e.g. Upchurch et al., 2015). When stress becomes chronic it affects neurobiological adaptations such as elevation of HPA axis activity and appetite stimulation which may lead a person into consuming more unhealthy foods such as fast food, snacks, and calorie dense and highly palatable foods.

Indeed, many recent studies note that a “Western” or “obesogenic” diet comprised mainly of processed foods high in fat and sugars is one of the driving force behind the increase in obesity (e.g. Thorburn, 2014). This effect may be doubled because other recent findings (e.g. García-Toro et al., 2016) in the emerging field of nutritional psychology have linked dietary factors to psychological distress and conditions such as anxiety and depression. Generally, the foods with these negative psychological associations are the same foods that directly contribute to obesity—

that is, the highly processed Western diet (Kasdagly, Radhakrishnan, Reddivari, Veeramachaneni, & Vanamala, 2014). This is in contrast to the generally healthier “Mediterranean diet.” Therefore, the potential long-term impact of day-to-day stressors as they build up over time should not be underestimated, as this type of long-term stress may be the most dangerous type of stress and its effects are problematic on multiple levels. While these individual events do not qualify as transitions or turning points, they can still create a cumulative and often strongly negative impact on the overall trajectory of a person’s life.

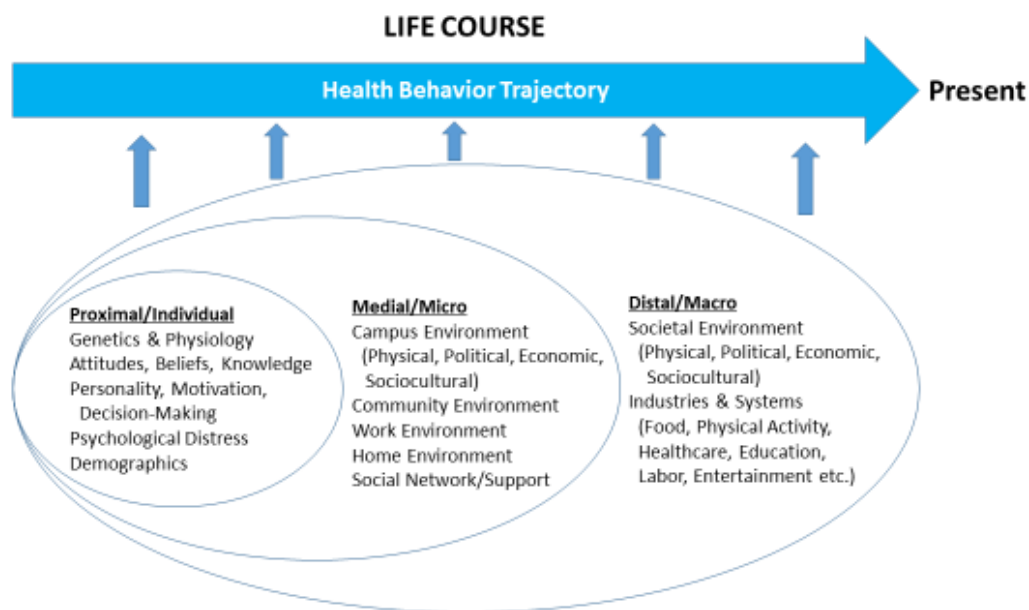
Day-to-day normative events may arise spontaneously, and often they arrive along *social pathways*, because people are social beings with socially organized lives. For example Lee, Harris, and Gordon-Larsen (2009) found in their study a significant relationship between socioeconomic disadvantage (e.g., childhood poverty, low parental education) and obesity during transition to adulthood. Sociocultural influences include contextual factors, historical events or social conditions that shape the process of change. Similar to the ecological perspective (Sallis, Owen, & Fisher, 2015), the social pathway concept highlights the importance of environmental influences that interact with an individual’s health trajectory throughout life. Sociocultural influences, such as neighborhood characteristics and socioeconomic factors, can accumulate over a life course. For example, food consumption may vary significantly by socioeconomic status, age, gender, and place of residence (de Oliveira et al., 2015). For children, it is primarily the home setting and the foods prepared by their caregiver. And if food was in short supply in childhood due to low income, food will likely be viewed as a precious resource throughout the life course, and impact food choice during adulthood.

For college students, social context factors such as living arrangements, commuting time, extracurricular activities may contribute to changes in the patterns of eating, exercising, and sleeping. Often, college students’ diet is determined by what is served in campus dining halls, vending machines, and nearby restaurants—some of the specifics of this were discussed above in the college social context section. Thus, their daily decisions on dietary choices are constrained

by what is available. Many cross-sectional studies on college students provide only a snapshot of their health behavior at a given time. They often ignore the contextual and developmental factors that are important for explaining health behaviors and health outcomes. Emerging literature on obesity now emphasizes the role of social contextual and environmental (obesogenic) influences that interact with individual factors. These social pathways can also take the form of individual social relationships as pathways; partners in a relationship and peer groups often influence each other's health habits and coping behavior, either positively or negatively. Food intake, in particular, is not only about removing hunger, but a social behavior deeply rooted in many cultures as a way to socialize and connect within our social network. Moreover, research has shown how social support buffers the stress-health relationship. The interdependent lives and social relationships of college students with their family, friends, and colleagues all play an important role in shaping health behaviors and health outcomes (Lieberman, Woodward, Sullivan, & Kinzler, 2016). This is particularly true because the act of eating is often a social behavior—such as sharing a meal and going out to for a drink. These interdependent behaviors with respect to eating mean that the choice of what, where, and how often a person eats is often closely linked to his or her interrelationships with peers. Some of the specific effects of this were discussed above in the social context factors section.

In sum, the life course perspective provides an organizing framework for evaluating the development of obesity risk through lifestyle health behavior choices within temporal, social, and historical contexts (Cheng & Solomon, 2014). The key concepts described above provide a guiding framework for this dissertation into the pathways linking individual/sociodemographic characteristics, social context, social relationships, and health behaviors in obesity risk. It highlights the internal and external factors and potential stressors (e.g., school, work, finance) affecting behaviors that are changing constantly and interacting with environmental forces. Figure 2.1 depicts the dynamic nature of the individual/proximal and distal/socioenvironmental factors to characterize college students' health behaviors that shape obesity risk:

Figure 2.1. Life course framework of health and health behavior



Adapted from Booth et al., 2001

Although the life course perspective requires the consideration of individual characteristics while incorporating the temporal effects in the wider sociocultural and contextual factors across the lifespan, the relative influence of each of the multidimensional factors showing in the three ovals, as well as the interactions among them, remains unclear in explaining the increasing obesity rate among college students. Moreover, uncertainty remains on the specific mechanisms by which stress exposure leads to adverse health outcomes. Extant research among the college population focuses primarily on health behaviors and overlooks the range of other psychosocial factors that also contribute to obesity. Hence, the stress process model provides the necessary framework in guiding this area of research and the current study.

Stress Process Model

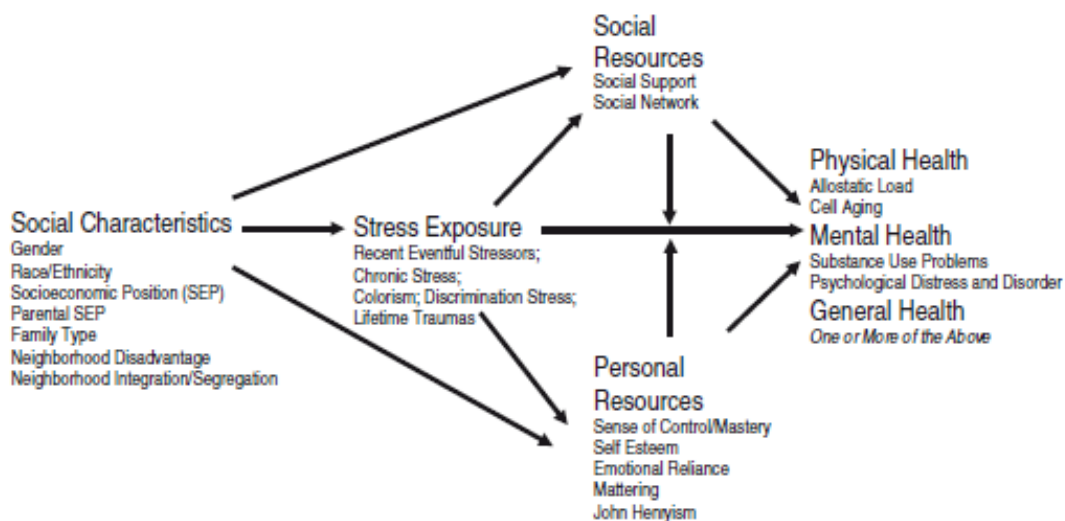
The stress process model was developed to explain the ways that social characteristics shape patterns of stress exposure, which influences individual health risks; this link is significantly moderated by social and personal resources (Pearlin et al, 1981). The stress process aims to

explain differences in morbidity and mortality that exists across groups that have unequal social and economic resources (Turner, 2009; Turner, Taylor, & Van Gundy, 2004). Individuals may face various stressors including economic strain, chronic stressors, and discrimination stress. For example, young adults who experience financial strain and early adversities are susceptible to more adversity over time. Thus, status and circumstances shape both the stressors that a person experiences and access to psychological resources for coping with stress.

The stressors relating from status and life circumstances then give rise to poorer health outcomes and health disparities, as evidenced in disparities in overweight and obesity across racial/ethnic and socioeconomic position strata. For instance, young adults living in areas where they have risks in the places of their work such as exposure to toxins or infectious diseases contributes to chronic stress, and unhealthy behaviors such as smoking having greater negative impact, and their health deteriorate (Avison, Aneshensel, Schieman, & Wheaton, 2009; Khamisa, Oldenburg, Peltzer,, & Ilic, 2015). Financial strain is a common source of chronic stress among college students that may impact physical and mental health (Adams, Meyers, & Beidas, 2016; Nelson, Lust, Story, & Ehlinger, 2008).

The third process that the stress process model focuses is how the circumstances of stress proliferation exacerbate risk for later exposure to additional adversities (Nurius et al., 2015; Pearlin et al, 2005). As stress builds up over time, individuals often develop adaptive or maladaptive coping mechanisms that can serve to buffer or counteract the effect of specific stressors. Coping mechanisms, or reactions to stress, therefore, may diminish the negative impacts of stress in the case of effective coping mechanisms, or worsen the effects of stress in the case of poor coping mechanisms. Yet, even in the presence of effective coping, these coping mechanisms start to become overwhelmed. This is especially true if the initial stressors are not removed and continue to fully occupy the coping processes. This built up stress could lead to more vulnerability in negative health behaviors and health disparities.

Figure 2.2. Stress Process Model



Source: Turner, 2010

In the stress process model, economic strains and discriminatory experiences are examples of pathways that explains disparities in physical (e.g., allostatic load) and mental health (e.g., psychological distress) outcomes due to variation in social hierarchies and statuses. More importantly, the stress process model describes a system of social and personal resources (e.g., social support, coping, self-esteem) that operate in direct and indirect ways in the stress-obesity relationship. Thus, the status stratification and health inequalities influenced by various health-related stressors may be attenuated by the mediating/moderating effects of the social and personal resources (Turner, 2009). This provides the guiding framework for disentangling any negative effects of financial strain and buffering effects of social relationships in shaping the distress-obesity relationship among college students. However, in order to fully understand how psychological distress increases the risk for obesity, we need to return our focus to the role of health behaviors as the key underlying mechanism. The Environmental Affordance Model is the guiding perspective that explicitly emphasizes the “intersection of stress, health behaviors, mental health, and physical health” (Mezuk et al., 2013, p.2). The integration of stress process and

environmental affordance model within the life course perspective offers a comprehensive understanding of the ways in which individual and contextual experiences can shape the course of a person's health status. Specifically, these perspectives explain how status and circumstances can create stress, and how this stress can build up over time to create effects that alter the person's life course along with resources that can buffer or worsen the negative impact of stressors on health.

Environmental Affordances Model

Environmental Affordances (EA) model focuses on the origins of both physical and mental health disparities and how they relate to one another (Mezuk et al., 2013). The model is useful in elaborating the group-based disparities that exist due to subgroup (e.g., racial and ethnic) inequalities. The EA model is based on three critical pillars: “fundamental cause theory, the stress process framework, and the socio-biological perspective” (Mezuk et al., 2013). In essence, the idea of environmental affordances is that not all outcomes are a result of intrinsic conditions, but based on what one's environment affords them. While there may be certain genetic factors predisposing certain groups to obesity and distress, much of what has been discussed highlights instead upon external or contextual factors. For example, the Western diet is so prevalent among U.S. college students because they have ready availability of sweets, potato chips, and other fast foods—they are easily afforded these foods by their environment, predisposing them to eat them. By contrast, healthy foods are often more difficult to find and more expensive (Kasdagly et al., 2014). Hence, a person's choices and actions are significantly influenced by the possibilities offered to them by the environment around him or her (Reyes, 2018). Environmental affordances come in many dimensions: they can be material, social, cultural, or geographic (Reyes, 2018). Understanding the opportunities and resources afforded by a given environment can go a long way to understanding the actions taken by those within that environment.

For young adults, the social disparities existing around their surrounding affects their health since they experience different levels of psychological stress. An example from Mezuk et

al., (2013) was that physical health was poorer among Blacks as compared to non-Hispanic Whites. In this case, physical health includes diseases such as cancer or diabetes (mostly type 2) (Mezuk et al., 2013). On the other hand, when it comes to mental health, Blacks have lower rates of common forms of psychopathology, such that their mental health is worse because they lack the affordances of common forms of mental healthcare.

Recent work provides further evidence that social relations can affect psychological resources that eventually affects the health of the person (Cohen, 2004; Holt-Lunstad, Smith, & Layton, 2010). The EA model explains various pathways and processes linking social structures and context to stress and health behaviors. Physical and mental health must be considered, as both are affected by the social structures and contexts that exist and influence a person to adapt. For instance, college students may adapt to a new eating culture, often the influence of their peer group (e.g., fraternity or sorority members), and this in turn changes their eating habit. The environmental affordances of a specific collegiate social context can limit or expand options in ways that have a direct or indirect effect on weight status and psychological wellbeing. For example, for a college student living on campus without a car, the food options afforded by the dining halls on campus will have a strong effect on eating habits. Even when other options are available, the relative ease or difficulty with which they are afforded may remain a significant source of influence. In other words, even if a student had a car and could travel off-campus easily to buy and prepare food, this option would require more time and effort, making it less likely than what is more accessible.

The impact of environmental affordances can be positive, negative, neutral, or mixed. For example, if the dining hall in the above hypothetical situation were to offer mostly healthy food choices, then even students who might otherwise not be compelled to make healthy food choices would likely be more inclined to eat healthily by the easy affordance of healthy food. On the other hand, if a dining hall mainly offered unhealthy options, even those who preferred to eat more healthily would likely be swayed by a poor diet. If it offered easy access to both healthy and

unhealthy food, then the net sum of its influence would be more difficult to determine. As noted, though, environmental affordances can take on a myriad of dimensions, including physical, social, or cultural. This underscores the importance of an approach that casts the widest possible net, such as the approach adopted in this study, which considers a constellation of psychosocial, behavioral, college social context, and individual factors.

While it is not easy to determine the exact way in which each of these factors may influence overall health behaviors and obesity risk, and future research will almost surely need to refine any results in this regard, the breadth of the factors included in this dissertation should begin to paint a picture of the environmental affordances that each social context or individual characteristics has on the distress and obesity linkage. Hence, the EA model offers an understanding of the potential mechanisms through which these effects might work in understanding both mental and physical health.

It is this ability to suggest mechanisms that allows the theory of environmental affordances to help explain why psychological distress may be considered to be a driver of obesity. The introduction of psychological distress changes the environment in which an individual exists in much the same way as other psychological environmental factors, such as the existence of an eating culture. When a person experience distress, the mechanisms described in the stress process model can be applied and begin to consume coping resources (Turner, 2009). This, in turn, lowers the coping resources afforded to the individual by his or her psychological environment. Eating comfort food is a common coping mechanism, and one that can be employed with relative ease and repetition (Hemmingsson, 2014). Therefore, as coping resources are consumed, the affordances available to the person to deal with stress may diminish, making eating more appealing because of a lack of alternatives. In addition, the experience of psychological distress may create a situation wherein the affordances available lead to higher risk for obesity. Depression has been shown to lead to a physiological response that may affect appetite modulation and make the person hungry (Schweinfurth et al., 2016). In this position,

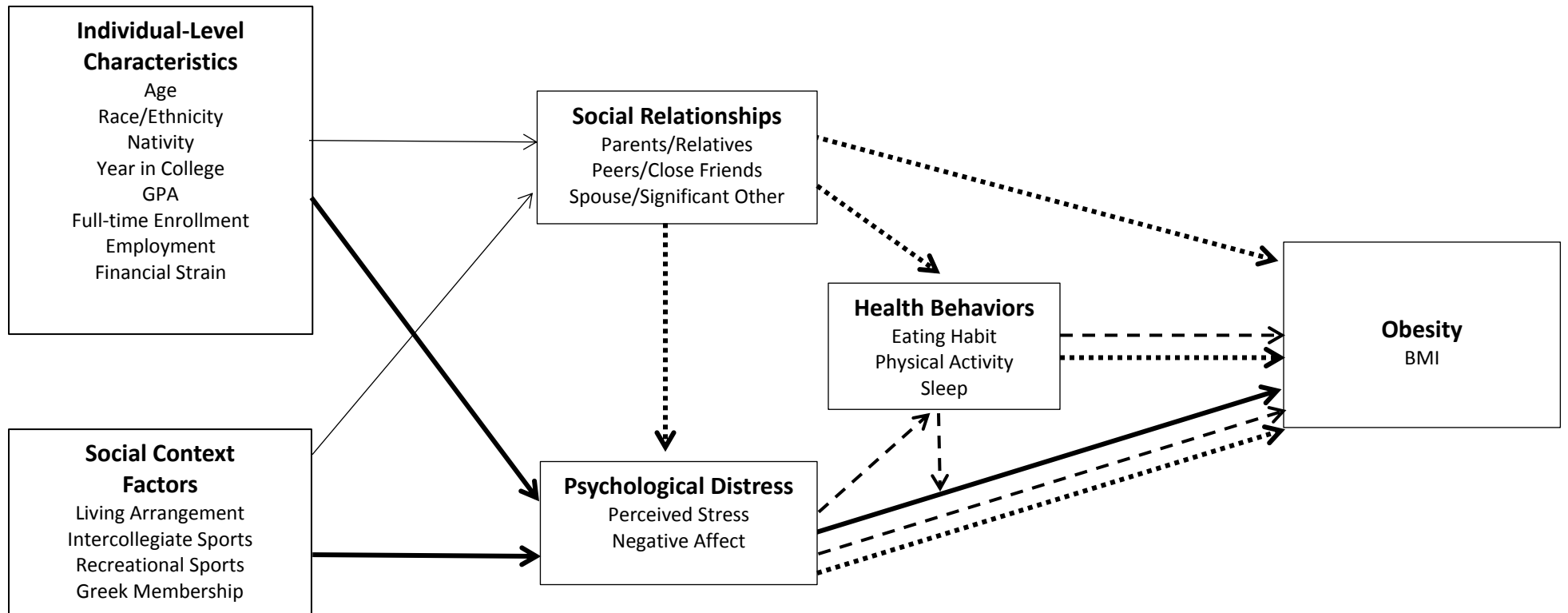
biomedical antidepressants are often one of the most readily available and feasible affordances available to treat depression, but these often carry appetite increases as a side effect (Grundy et al., 2014). Thus, one consequence of such affordance is increased appetite and a corresponding increased risk of obesity.

In sum, evaluating both mental and physical health within the context of environmental affordances offers a path toward a causal understanding of the association between psychological distress and obesity and subgroup variations, such as race and gender. It offers a potential explanation of the ways in which factors that are known to drive obesity may do so in parallel to psychological distress. Understanding environment affordances and how they shape both choices and outcomes is an essential step in understanding and curbing the obesity epidemic.

Conceptual Model

Based on this critical review of existing literature and informed by the theoretical perspectives of the life course, stress process, and environmental affordances, the following integrated conceptual model illustrates the key factors and pathways associated with obesity (Figure 2.3). This model proposes paths of direct and indirect effects based on various variables that have been previously discussed that are associated with psychological distress and obesity:

Figure 2.3. Conceptual model of the psychosocial and behavioral risk/protective factors associated with obesity



- Aim 1
- Aim 2
- Aim 3

The focal association highlighted within this model is psychological distress and obesity, as noted in prior studies suggesting a direct linkage between them (e.g. Olvera et al., 2015). However, as evinced previously, multiple psychosocial factors may shape and modify this relationship. Thus, in concert with the life course and environmental affordances perspective, the proposed conceptual model considers a combination of individual, social context, and behavioral factors in predicting psychological distress and obesity. In addition, stress process theory suggests that stress is most potent when it accumulates from multiple sources over time (Nurius et al., 2015), and that personal or social resources may serve as protective mechanisms. Accordingly, social relationship is considered in this dissertation to influencing college students' level of psychological distress and health behaviors and therefore overall risk of obesity. Another place where interaction is expected, is between psychological distress and health behaviors. While prior research suggest that psychological distress likely inhibit healthy behaviors (e.g., physical activity) which in turn increase obesity risk, a high propensity toward healthy behaviors may also be able to curtail the direct effects of psychological distress in terms of worsening obesity.

Thus, figure 2.3 represents the overall conceptual model that will be tested in this dissertation, through three individual studies. The specifics of each study will be addressed in the following section, but in general, the first of the three studies focus on the connections between individual-level characteristics and college social context on psychological distress and obesity. Then, the second study expands on this by examining health behaviors that are expected to explain the distress-obesity relationship. Finally, the third study examines the role of social relationships, which is expected to be protective against psychological distress—and therefore against obesity—and determines how social relationships influence eating habits in the distress-obesity link. Thus, each of the three individual studies will serve to test a specific part of the proposed conceptual model of the relationship between psychological distress and obesity.

Project Overview

The growing prevalence of obesity among young adults in the United States is a major public health issue. Nevertheless, research and prevention efforts have primarily focused on children and adolescents. Although college students are generally not perceived as an “at-risk population” for obesity, recent estimates indicate that over one-third of U.S. college students are overweight or obese. This is problematic given the documented linkages between obesity and chronic health conditions in later life. Thus, with nearly 20 million young adults enrolled in U.S. postsecondary institutions, understanding how the unique context of college contributes to the growing rates of obesity among this population is a public health priority.

Young adulthood is recognized as a pivotal stage of the life course, in which individuals develop lifestyle habits and social relationships that can have lifelong health implications. This period may be particularly influential for the health of college students, many of whom are young adults facing the psychosocial and contextual risks associated with transitioning to independent living, such as managing financial pressures and achieving school-work balance. Combined, these stress-related factors may predispose college-attending young adults to higher risk of psychological distress—one of the many key correlates of unhealthy behaviors and weight gain. Thus, psychological distress may be an important risk factor associated with higher obesity rates during this critical period of life stage and point of intervention; however, the conditions under which this link is shaped by the college experience remains poorly understood. In addition, obesity research has largely focused on health behaviors, overlooking the range of psychosocial factors that contribute to obesity among college population.

The goal of this dissertation is to evaluate the contextual, psychosocial, and behavioral factors associated with obesity among college students at an ethnically diverse public university in Southern California. This will be investigated in three separate, but related studies: The first study examines the extent to which social context and psychological distress are associated with increased odds of obesity among college students. The second study evaluates the role of

lifestyle health behaviors in the relationship between distress and obesity. The third study assesses the ways that social relationships and eating habits shape comorbidity patterns in psychological distress and obesity among college students; a latent variable structural model is also used to explore these relationships. Findings from this dissertation may contribute to the limited, but growing body of literature on the nuanced relationship between psychological distress and obesity among college students. In addition, understanding how the college context distinguishes the health of this population may help campuses to create more tailored prevention and intervention programs that account for these psychosocial and contextual risk factors.

Study Aim 1: To determine the extent to which psychological distress is associated with increased odds of obesity among US college students

Study Aim 2: To examine health behaviors as risk and protective factors in the association between psychological distress and obesity

Study Aim 3: To evaluate the role of social relationships in shaping eating habits and the distress-obesity link

CHAPTER 3

METHODS

Data Source & Sample Description

Data Source. The data used in this dissertation come from the *College Lifestyle and Wellbeing Study*, a survey of undergraduate and graduate students in a large public university in Southern California. The survey was a CDC-funded project through the Center for the Promotion of Healthy Lifestyles and Obesity Prevention at California State University, Fullerton (CSUF).

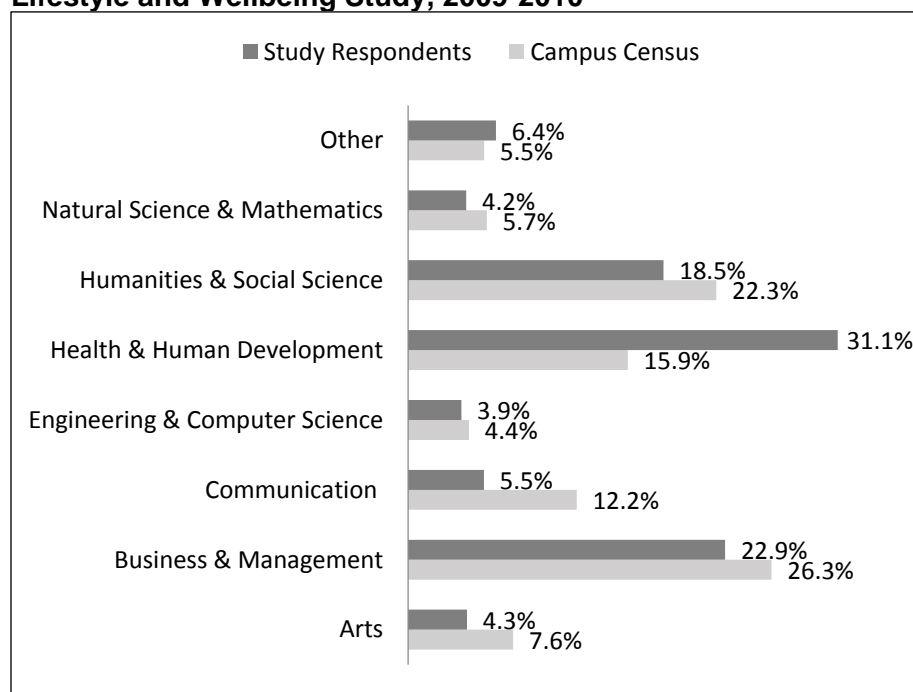
The study was a cross-sectional survey collected between spring of 2009 and spring of 2010. Of the total sample of 2423 study participants, 428 participated in spring of 2009, 135 in summer of 2009, 1439 in fall of 2009, and 421 in spring of 2010. A convenience sampling strategy was employed with recruitment efforts centered on the professors via campus bulletin board, emails, and flyers targeting classes across various departments and general education courses to maximize diversity of the sample characteristics in terms of gender, major, and class standing. Faculty who responded to the recruitment notices were visited by the research team, and potential participants were recruited during the class visitation.

There were two data collection phases in this study. Phase I was an in-class paper and pencil survey called the *Student Health Survey (SHS)*. The SHS consisted of items adopted or adapted from a variety of published and validated sources including student demographics, psychosocial variables, and self-rated behavioral and health indicators (Cheng, Weiss, & Siegel, 2015; see chapters 4-6 for full description of study measures). All student research assistants were trained in the procedures required to distribute and administer the survey to students during a designated class time. Average time to complete the in-class survey was about 30 minutes. Professors and students who participated were given a token of appreciation in the form of a gift card and nutritious snack, respectively.

Phase II was an optional 7-day online food intake questionnaire that students completed at home. Recruitment occurred at the end of the in-class data collection sessions at Phase I. A total of 701 students volunteered and gave consent to participate. Students attended a workshop that provided detailed information and requirements of the additional one-week study commitment and were trained on how to complete the online food questionnaire and back-up paper questionnaire in the event there is no Internet access. At the end of the one-week at home data collection period, students returned to the research lab to turn in any paper questionnaires and received a gift card. The study protocol was approved by the university's Institutional Review Board and informed consent was obtained from all participants prior to data collection.

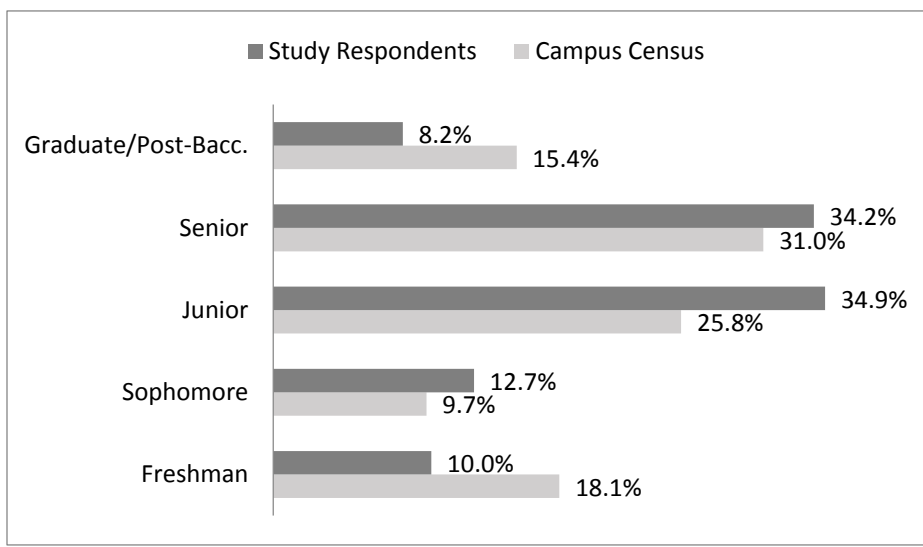
Sample Description. As shown in Figure 3.1, the study sample was a representative group of undergraduate and graduate students from various colleges and departments comparable to campus-wide student characteristics. Two exceptions were from Health and Human Services (campus census 15.9% vs. study sample 31.1%) and from Communication (campus census 12.2% vs. study sample 5.5%).

Figure 3.1. Distribution of Study Respondents across University Colleges/Majors, College Lifestyle and Wellbeing Study, 2009-2010



The study sample also closely mirrored university enrollment by class levels. Figure 3.2 shows the distribution of respondents across class standings relative to the university data within each class. The study sample comprised primarily of juniors (34.9%) and seniors (34.2%), similar to campus-wide student characteristics. However, there was an under-representation of freshmen in the study sample (campus census 18.1% vs. study sample 10%) and graduate/post-baccalaureate students (campus census 15.4% vs. study sample 8.2%).

Figure 3.2. Distribution of Study Respondents across Class Levels, College Lifestyle and Wellbeing Study, 2009-2010



The analytic sample for Study 1 of this dissertation was 2392 respondents. Participants with more than four days of missing data from the food intake questionnaire were excluded, resulting in a sub-sample size of 690 for Study 2 and 3. Table 3.3 shows the descriptive statistics of the study variables, split by full and sub-samples and gender groups. There were no significant differences between the full and sub-samples, including BMI status, psychological distress, social context factors, lifestyle health behaviors, and social relationships. However, differences were found with individual characteristics of age, gender, class level, and enrollment status.

Table 3.1*Descriptive Statistics of Study Variables, College Lifestyle and Wellbeing Study, 2009-2010 (N=2392)*

Variables (range)	Full Sample (Study 1)			Sub-Sample ^a (Study 2 & 3)		
		Male ^b	Female		Male ^c	Female
	% or M (SD)	% or M (SD)	% or M (SD)	% or M (SD)	% or M (SD)	% or M (SD)
BMI						
Underweight <18.5	5.5	1.8	7.7	5.4	3.0	6.5
Normal 18.5-24.9	63.3	54.7	68.0	65.9	57.0	69.5
Overweight 25-29.9	22.7	32.7	17.1	20.2	29.5	16.5
Obese >30	8.5	10.9	7.1	8.5	10.5	7.5
Psychological Distress						
Negative Affect (0-40)	15.25 (5.12)	15.34 (5.06)	15.21 (5.15)	15.36 (5.19)	15.34 (5.12)	15.34 (5.21)
Perceived Stress (0-40)	17.25 (6.21)	16.02 (6.12)	17.93 (6.15)	17.30 (6.62)	15.52 (6.46)	18.02 (6.56)
Distress Composite (0-80)	32.49 (10.01)	31.30 (9.92)	33.14 (9.99)	32.66 (10.38)	30.81 (10.38)	33.39 (10.29)
Individual Characteristics						
Age (17-66)	22.58 (4.78)	22.81 (4.42)	22.46 (4.98)	22.15 (4.74)	22.32 (3.75)	22.09 (5.11)
Gender (referent male)		36.1	63.9		29.6	70.4
Race						
White non-Hispanic (ref.)	33.8	33.6	33.9	33.3	35.5	32.2
Hispanic/Latino	26.5	23.2	28.3	24.6	22.7	25.6
Asian/Pacific Islander	24.7	30.5	21.5	26.3	33.0	23.6
Black/African American	3	1.9	3.7	4.1	2.5	4.5
Multi-race/Other	11.9	10.8	12.6	11.7	6.4	14.0
Nativity (ref. US born)	82.7	80.4	84	83.6	84.8	82.9
Class Level						
Freshman (ref.)	10	11.1	9.4	12.3	13.2	11.8
Sophomore	12.7	8.6	14.9	15.6	10.8	17.6
Junior	34.9	36	34.3	34.7	33.3	35.2
Senior	34.2	37.9	32.1	35.7	40.7	34.0
Post Bac/Graduate	8.2	6.5	9.3	1.6	2.0	1.4
GPA						
Mostly As	24.3	19.5	27	23.4	20.7	24.5
Mostly Bs	37.2	34.9	38.3	38.5	35.0	39.8
Mostly Cs	31.1	35.3	28.7	31.3	33.5	30.5
Cs and below	7.5	10.2	6	6.8	10.8	5.2
Full-time Enrollment	83.9	82	84.9	88.5	89.7	88.1
Employment						
Not employed	36.5	41.2	33.8	37.5	41.7	35.4
1-19 hrs	21	17	23.2	22	24.0	21.2
20-29 hrs	24.9	21.5	26.9	25.6	19.6	28.4
>30 hrs	17.6	20.3	16.2	14.8	14.7	15.0
Financial Strain (1-7)	2.84 (1.28)	2.87 (1.26)	2.83 (1.28)	2.86 (1.29)	2.77 (1.28)	2.90 (1.29)
Social Context Factors						
Living Arrangement						
Parents/relatives (ref.)	61.6	62.1	61.2	60.4	63.8	59.3
Non-university	21.5	25.3	19.4	22.2	25.5	20.7
Significant other	9.6	6.7	11.4	8.4	3.4	10.5
University housing	4.4	3.7	4.8	6.5	5.4	6.8
Fraternity/Sorority	2.8	2.2	3.1	2.5	2.0	2.7
Intercollegiate Sports	2.2	3.6	1.4	1.7	3.9	0.8
Recreational Sports	10.6	19.1	5.8	8.9	17.6	5.4
Fraternity/Sorority	6.4	5.7	6.9	7.3	4.9	8.5
Health Behaviors						
Vegetables	-	-	-	7.73 (4.08)	7.67 (4.54)	7.77 (3.85)
Fruits	-	-	-	5.32 (4.27)	5.32 (4.75)	5.34 (4.08)
Snacks/sweets	-	-	-	6.63 (4.11)	6.06 (4.27)	6.81 (4.03)
Fast food	-	-	-	3.09 (2.56)	3.52 (2.83)	2.95 (2.43)
Vig/moderate PA (1-5)	2.76 (1.16)	2.94 (1.15)	2.66 (1.15)	2.85 (1.14)	3.00 (1.14)	2.79 (1.14)
Strengthen/tone PA (1-5)	2.34 (1.19)	2.71 (1.22)	2.13 (1.12)	2.42 (1.20)	2.76 (1.22)	2.28 (1.17)
Sleep hours per night	6.75 (1.27)	6.78 (1.28)	6.73 (1.27)	6.80 (1.22)	6.84 (1.28)	6.79 (1.20)

Social Relationships

Family & Relatives (1-7)	5.38 (1.28)	5.40 (1.24)	5.37 (1.31)	5.33 (1.30)	5.38 (1.25)	5.32 (1.32)
Close Friends (1-7)	5.62 (1.19)	5.59 (1.18)	5.63 (1.20)	5.59 (1.19)	5.58 (1.16)	5.59 (1.21)
Spouse/Sig Other (1-7)	5.03 (1.63)	4.85 (1.62)	5.12 (1.63)	5.03 (1.73)	4.77 (1.71)	5.13 (1.74)

Note. Sub-sample comprise of respondents who completed the 7-day food intake questionnaire during Phase II of the study (N=690). PA = Physical activity. All significance test reported at $*p < .05$.

^a. Significant sample differences comparing respondents with and without food intake data: age, gender, class level, and enrollment.

^b. Significant gender differences within *full sample*: BMI, perceived stress, distress composite, race, nativity, class standing, GPA, employment, living arrangement, intercollegiate sports, recreational sports, vigorous/moderate PA, strengthen/tone PA, relationship with spouse/sig other.

^c. Significant gender differences within *sub-sample*: BMI, perceived stress, distress composite, race, GPA, living arrangement, intercollegiate sports, recreational sports, snacks/sweets, fast food, vigorous/moderate PA, strengthen/tone PA, relationship with spouse/sig other.

As the present dissertation focuses on understanding psychosocial and behavioral risk factors of obesity among college students, using data collected from a university with diverse student body was most appropriate. California State University Fullerton (CSUF) is one of the ten CSU campuses in Southern California with the second largest enrollment among all 23 campuses (over 38,000 students). It is located in Orange County (OC), the third most populous county in California where obesity rate has reached epidemic proportions: over two-thirds of Latino and one third of Asian adults are overweight or obese (OC Public Health Services, 2013). Orange County's racial/ethnic composition is 31% White, 29% Hispanic, 21% Asian, 3% Black, 0.4% American Indian, and 14.4% Multi/Other. The study population mirrored both campus and Orange County demographics, which was comprised primarily of non-Hispanic whites, Hispanics, and Asians. Although Non-Hispanics blacks make up only 3% of the study population, this rate is congruent with Orange County's racial/ethnic composition. In addition, CSUF students are racially and economically diverse that closely mimics the demographics of Orange County with about half are OC residents and many enrollees are first generation college students. Overall, the College Lifestyle and Wellbeing data will contribute to our understanding of college obesity that has

traditionally been conducted with ethnically homogeneous samples, or general population studies that focus primarily on black-white differences.

This dataset provides a unique opportunity in filling the gaps of knowledge in obesity risk among college-attending young adults with a racially diverse sample. Therefore, findings obtained from this dissertation will provide insights into those risk factors related to college student distress and obesity.

CHAPTER 4

STUDY 1: PSYCHOLOGICAL DISTRESS AND OBESITY: DIFFERENTIAL RISK PATTERNS AMONG FEMALE AND MALE COLLEGE STUDENTS

Introduction

The growing prevalence of obesity among college-attending young adults is a major public health issue. According to the American College Health Association (2017), over one-third of U.S. college students are either overweight (23.3%) or obese (14.6%). Weight gain during late adolescence and young adulthood can have a profound impact on mental and physical health (Geoffroy, Li & Power, 2011), and overweight status during young adulthood is predictive of obesity in later life (Zheng et al., 2017). The college setting may be key to understanding obesity because it creates a distinct context with exposures to unique risks that bring about changes in lifestyles and health status for young adults (Vadeboncoeur, Townsend, & Foster, 2015). Recognizing this, many colleges and universities across the U.S. have adopted the Healthier Campus Initiative (HCI). The HCI is part of a nationwide effort to improve campus health and wellbeing by creating environments that encourage and support greater physical activity and healthier eating habits (Partnership for a Healthier America). Such efforts underscore the importance of the college context for facilitating positive behavior change and improving health status. Nevertheless, our understanding of the specific risk factors that shape obesity in the college student population remains limited.

While studies have examined the health behaviors associated with rising college obesity rates, one risk factor that has not been fully considered among this population is psychological distress. Many college students experience elevated levels of psychological distress due to academic demands, managing finances, achieving work-school balance, and changing lifestyles (ACHA-NCHA, 2017; Blanco et al., 2008). Since there are documented linkages between distress and obesity in the general population, it is likely that this heightened distress may also contribute

to the growing rates of obesity among college students. In addition, the prevalence of psychological distress and obesity differs for women and men, so it is possible that there are gender differences in these risks. However, since few studies have examined within-gender variations in these outcomes, the gender-specific mechanisms linking psychological distress and obesity remain poorly understood.

This paper seeks to address these gaps by identifying the social contextual and psychosocial risk factors of obesity for female and male college students, examining psychological distress as a key determinant. Gender is also a central focus of this study because of the well-documented differences in obesity and psychological distress among women and men. For example, studies show that women are more likely to have significant stress-related weight gain (Finch & Tomiyama, 2015) and are more likely to eat in response to psychological distress than men (Leske et al., 2015). Due to societal norms, gender may also play a role in individual's acceptance of obesity and motivation to lose weight (Snook et al., 2017). Research suggests that these variations exist because of the distinct ways in which women and men react to psychological distress, consume healthy and unhealthy foods, and face different social roles and expectations. Nevertheless, knowledge about these gendered patterns and how they may shape the relationship between psychological distress and obesity among the college population is limited. As such, the present study will distinguish the risk patterns and the distress-obesity linkage of female and male college students.

The Social Context of U.S. Colleges

Colleges and universities play a key role in shaping health and wellbeing for many young people. In the U.S., over 12 million students enrolled in postsecondary institutions are young adults under the age of 25 years (National Center for Education Statistics, 2016). The social context of college is unique because it encompasses the circumstances, experiences, and perceptions of shared environments that are critical for understanding individual and interpersonal behavior (Nugent, 2013). Studies also find that social context importantly shapes health behaviors

and health status (Burke, Joseph, Pasick, & Barker, 2009). Adjusting to a new social context and demands of college life means exposure to new social stressors and lifestyle changes that increase risk of psychological distress and weight gain (Hicks & Heastie, 2008; Vadeboncoeur, Townsend, & Foster, 2015). To better understand the rising obesity rates among the college population, this study examines three key contextual factors of college important in shaping both psychological distress and obesity: living arrangements, intercollegiate and recreational sports participation, and Greek membership.

Living Arrangements. Numerous contextual factors play an important role in shaping obesity risk among college students. For many young people, adjusting to independent living for the first time and having to learn to regulate their own diets is what makes social context of college distinct. Research suggests that this experience often leads to weight gain. For instance, the “Freshman 15” phenomenon—the notion that students gain significant weight during first year of college—is generally linked to the transition of college as a critical period in understanding weight gain. In particular, research has highlighted the importance of living arrangements and food access, as some studies show that students who live off-campus tend to eat less healthy foods and face higher risk for overweight or obesity compared to students who live on campus or at home with their families (Brunt & Rhee, 2008; Small, Bailey-Davis, Morgan, & Maggs, 2013). However, others suggest that living at home may contribute to worsening obesity rates because of parents’ desire to cook for their children or regulate their eating behavior (Clark, Goyder, Bissell, Blank, & Peters, 2007). Thus, while prior research demonstrates the relevance of living arrangements for shaping obesity risk, the evidence of its impact remains mixed.

One plausible reason why there are no conclusive findings in the living arrangement and obesity relationship is that past studies have focused on the physical or structural aspects of living situations. This work posits that it is the social conditions created in these various living arrangements that are the key in shaping behaviors and health outcomes. For example, students living at home may report higher levels of distress due to conflicts parents, spouses, or children

(Mirowsky & Ross, 2003), but far fewer research has examined this in relation to obesity risk. In addition, the effects of social dynamics on the relationship between psychological distress and obesity may differ between genders, as living situations may have different psychological effects on men and women (Addabbo & Kjeldstad, 2017).

Recreational Sports Participation. In addition to one's living situation, participation in sports is a major part of college life on many campuses important in shaping obesity. Research has generally shown that physical activity level significantly decreases after high school. However, young adults who remain active during college in either intercollegiate or recreational sports typically lead more active lives as they age, which may reduce obesity risk (Marques, Ekelund, & Sardinha, 2016). At the same time, sports participation may have both positive and negative effects on psychological wellbeing. For example, engaging in sports activities may lower stress levels as an enjoyable activity or become an additional obligation that induces distress (Bullard, 2016). Moreover, men and women often play different sports and interact with recreational and intercollegiate sports differently, with women having consistently lower rates of sports participation in high school and college (Shifrer, Pearson, Muller, & Wilkinson, 2015). Thus, women and men may experience different effects from participating in sports during college. Although there is an implicit assumption that extracurricular athletics would decrease obesity risk because of the physical activity they entail, few have explicitly studied this linkage, especially not in the context of gender differences in psychological distress and obesity. This study will examine both intercollegiate and recreational sports participation because of the expected protective effects of engaging in extracurricular activities on distress and obesity.

Membership in Greek Organizations. Another unique dimension of the social context and experience of college is membership in a fraternity or sorority. The number of students participating in Greek organizations is far fewer than sports on most college campuses. However, a significant segment of the college population are Greek members, which can play a major role in the social context with potentially large social impact. Like living arrangements, Greek life is

key in shaping one's social environment and health behavior, but its impact on obesity is not wholly clear. On the one hand, membership in fraternities or sororities has been linked to increased consumption of alcohol and unhealthy foods, both of which increase calorie intake and directly contribute to obesity (Scott-Sheldon, Carey, Kaiser, Knight, & Carey, 2016). On the other hand, Greek membership may serve as an enjoyable activity that helps students cope with stress (Luk, Fairlie, & Lee, 2017). Thus, membership in these organizations may decrease obesity risk through lowering psychological distress. This raises the possibility that students who are not members of Greek organizations may be less exposed to, and engage in fewer risky health behaviors. At the same time, however, they would not reap the social benefits of Greek membership. Furthermore, patterns of involvement may considerably differ between men (fraternities) and women (sororities) (Zacherman & Foubert, 2014), and membership may have different meaning or significance in terms of health outcomes for men and women. Thus, the overall effect of Greek life is not clear. Hence this study will examine the ways that membership in Greek organization is related to both distress and obesity among female and male college students.

Individual Characteristics and Sociodemographic Determinants

Along with contextual dynamics, individual-level characteristics are important antecedents to consider because of their potential roles in predisposing students to stress and influencing how students navigate the various social context factors that shape obesity risk. The role of individual and sociodemographic characteristics contributing to one's exposure to stress that affect mental and physical health has been widely researched the general health literature, but less is known about their effects among the college population. Among college students, some key factors that may be particularly important to consider are age, race/ethnicity, nativity status, employment, enrollment, year in college/class standing, academic performance, and financial strain.

Age and *class standing* are important individual factors because weight gain during young adulthood is predictive of obesity in older age. While young adults are the primary focus of this

study, not all college students are in their late teens or early twenties, as there are many non-traditional students who attend college at later ages. Although college students as a group are generally considered homogeneous (e.g., age range, shared social context), older, returning students are likely to experience college differently than younger students. There are also young people starting college a year or two later as opposed to immediately after high school, and thus their pre-college experience may contribute to different health behavior and obesity risk patterns. Although the traditional notion of the “Freshman 15” suggests that as many as 60% of first year college students experience some degree of weight gain (Vadeboncoeur et al., 2015), other results suggest that first year students gain less weight than students in later years (Nicoteri & Miskovsky, 2014). Therefore, existing literature suggests that class standing or year in college may be an important predictor, but results are conflicting as to the nature and strength of the effect that may be expected. Thus, it would be important to examine variations across class standings and consider any potential confounding among younger or older students.

Like gender and age, the link between *race/ethnicity* (henceforth referred to as race) and obesity is well-documented, with the general finding that rates are higher among Hispanics and non-Hispanic blacks (Hales, Carroll, Fryar, & Ogden, 2017; McTigue, Garrett, & Popkin, 2002; Truong & Sturm, 2005). However, there is a lack of diversity in the study of distress and obesity despite racial and ethnic minorities make up nearly 30% of the U.S. population, and that minorities are disproportionately affected by obesity (National Center for Education Statistics, 2016). Although higher education may be protective against overweight/obesity, college is also associated with an increased risk of obesity for minority groups (Baum, 2017). This may be attributed to differential stress exposure among minorities and increased risk of experiencing distress. Race and gender may importantly interact to create different patterns since many gender roles and norms are culturally defined (Lindsey, 2015). For example, studies suggest that obesity acceptance is higher among some race-gender groups (e.g., black women), which may lead to lower levels of motivation to lose weight among those populations (Snook et al., 2017). In addition, race is a

germane factor because diversity in the college environment has been increasing over recent decades (National Center for Education Statistics, 2016). This means that understanding the effects of racial demographics becomes increasingly important because students of color make up a growing portion of the college population. However, most studies of collegiate obesity have not given sufficient consideration to students of color, creating an important gap in our understanding of how the association between psychological distress and collegiate obesity may vary across racial/ethnic groups.

Similarly, *nativity status* may importantly shape health risks. Interestingly, while native-born individuals in racial minority groups are more likely to be obese than non-Hispanic Whites, being born outside of the U.S. may have a protective effect. This paradox has been extensively documented wherein immigrants often have healthier status than the native-born populations of the countries that they immigrate to (Kennedy, Kidd, McDonald, & Biddle, 2015). This is attributed, in part, to the highly processed diet eaten in developed countries, along with the greater abundance of food (Argys, 2015). Therefore, as immigrant families integrate into the host country over generations, their health decreases and incidence of obesity increases. Nonetheless, first generation immigrants are less likely to be obese than native-born Americans, though the obesity rates converge over time as immigrants stay longer in developed countries (Argys, 2015). Therefore, nativity status is an important predictor variable because it could potentially mask the effects of race, making minority populations seem healthier than they actually are.

Other modifiable factors that are important among the college population but have not been fully considered in prior studies are *financial strain*, *employment status*, *enrollment status*, and *academic performance*. These individual factors are closely intertwined with stress exposure and distress levels among college students because of their efforts to balance education and employment (Wood, Harrison, & Jones, 2016). In the U.S., over 50% students work while attending college to pay for all or part of their educational costs (Carruthers & Özek, 2016), and this can be a major source of financial strain. Moreover, hours of work per week is expected to be

related to full or part-time enrollment, both predictors of academic stress and performance (Wood et al., 2016), and lowered academic performance has been linked to obesity (Branigan, 2017; Suraya, Meo, Almubarak, & Alqaseem, 2017). The dual burden of working and studying can leave students tired and stressed, causing them to suffer from a lack of sufficient time to do both activities and also limiting their ability to engage in anti-stress leisure activities, thus increasing their level of distress.

Collectively, these contextual and individual characteristics are important antecedents to consider. Not only might they predispose students to distress, but they may also act as possible confounders in the focal distress-obesity relationship. College attendance is an especially important formative experience in the lives of many young adults and may impact them in several ways. On the one hand, it may represent a period of elevated risk because weight gain during early adulthood makes future health problems more likely to persist or worsen over time (Zheng et al., 2017). On the other hand, it is possible that attending college may be a stage where anti-obesity efforts are more likely to have long-term benefits. As obesity rates continue to increase among the college population, reducing psychological well-being may be an important point of intervention given the documented linkages between psychological distress and obesity. Therefore, for college students, it is particularly important to understand the role of psychological distress on obesity.

Psychological Distress as a Key Pathway

The linkages between obesity and depression as well as other symptoms of distress (e.g., anxiety, depression, negative affect) have long been reported in the general population (Geoffroy, Li, & Power, 2011), and psychological distress is positively associated with weight gain (Block, He, Zaslavsky, Ding, & Ayanian, 2009; Halfon, Larson, & Slusser, 2013). Although college is a period of intellectual and social development for many young adults, college students are also at greater risk for psychological distress or psychiatric disorders such as anxiety or depression. This is because students experience a range of academic, social, and financial burdens in addition to

the distress that may arise from being away from home. Indeed, recent data indicated that over half (55.9%) of college students report experiencing moderate to high level of stress and 21.7% report depressive mood the past year (ACHA-NCHA, 2017). Given psychological distress is especially pronounced in this population, understanding the connections between distress and obesity in the college context is important because it may be a key pathway through which weight gain occurs among the college population. However, much still remains unclear about the specific role of distress in increasing obesity risk, particularly among college students.

One reason for the limited knowledge in the role of psychological distress in shaping obesity risk in this population is that they often co-occur, which obscures risk patterns. Risk factors for obesity may also differ across racial/ethnic and gender groups, or become exacerbated in the presence of psychological distress. For example, in a study of 3,570 participants from the National Survey of American Life, depression was positively associated with BMI among Caribbean black women, and anxiety was positively associated with BMI among Caribbean black men and African American women (Assari, 2014). Another issue that limits our understanding of the distress-obesity relationship is that research among college students has typically focused on the impact of health behaviors (e.g., diet or exercise) on weight status or weight perception (e.g. Coco et al., 2014), overlooking a wide range of other college social context factors that may interact with distress, such as Greek life and extracurricular sports. In addition, despite the high prevalence of distress that students experience, few studies within the Freshmen 15 literature examined its potential role in contributing to the growing rates of obesity.

Purpose of the Study

In light of these limitations, the overarching goal of this study is to evaluate the extent to which psychological distress is associated with increased odds of obesity among U.S. college students and how this relationship varies for women and men. This study will also identify the individual characteristics and college social context factors associated with distress and obesity. Correspondingly, the three specific aims for this study are:

AIM #1: Identify the (a) *individual characteristics* (i.e., age, race, nativity, class standing, GPA, enrollment status, employment, financial strain) and (b) *social context factors* (i.e., living arrangement, intercollegiate sports, recreational sports, Greek membership) associated with *psychological distress* among male and female college students.

Hypothesis 1.1: Financial strain is positively associated with psychological distress among college students.

Hypothesis 1.2: Social context factors of recreational sports and Greek membership are negatively associated with psychological distress among college students.

AIM #2: Identify the (a) *individual characteristics* (i.e., age, race, nativity, class standing, GPA, enrollment status, employment, financial strain) and (b) *social context factors* (i.e., living arrangement, intercollegiate sports, recreational sports, Greek membership) associated with *obesity* among male and female college students.

Hypothesis 2.1: Individual characteristics of age, Hispanic race, U.S. born, and financial strain are positively associated with obesity among college students.

Hypothesis 2.2: Social context of off-campus living arrangement and Greek membership are positively associated with obesity among college students.

AIM #3: Examine the relationship between *psychological distress* and *obesity* among college students.

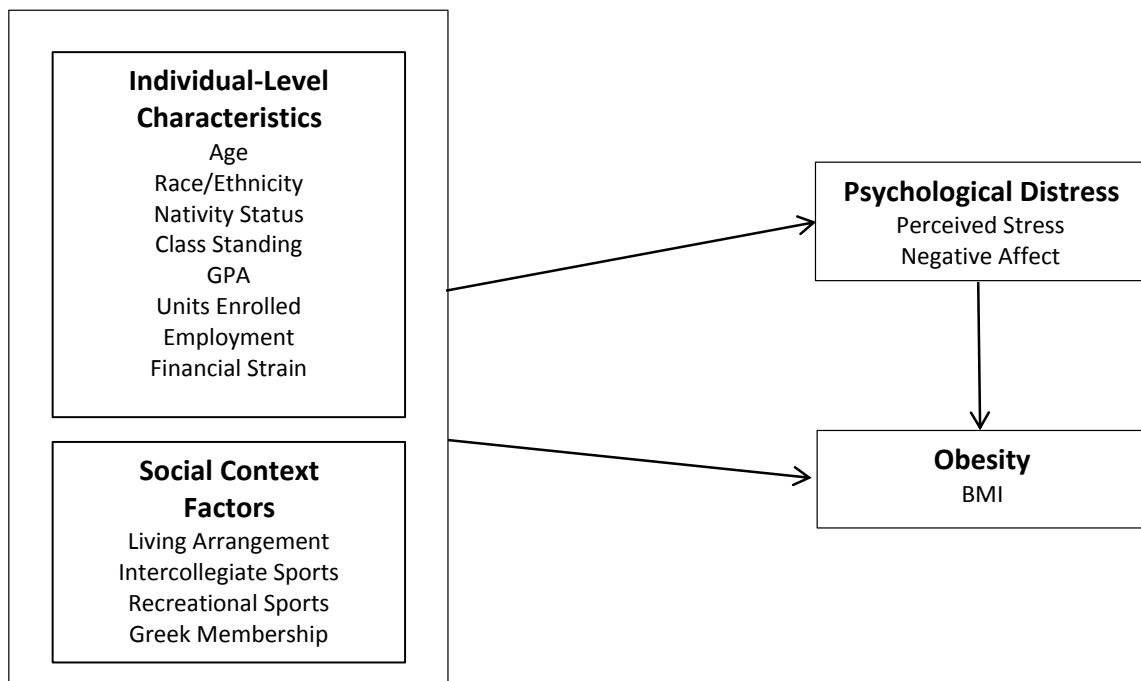
Hypothesis 3.1: Higher level of psychological distress is associated increased odds of obesity among male and female college students, net of the effects of individual characteristics and social context factors.

Hypothesis 3.2: Psychological distress is a stronger predictor of obesity among female college students, net of the effects of individual characteristics and social context factors.

Findings from this study may disentangle the role of college social context in shaping the psychological distress and obesity link among college students. Understanding how the college context distinguishes the health of college students may help inform campuses in developing

early identification of psychosocial or contextual risk factors in creating more tailored prevention and intervention programs.

Figure 4.1. Conceptual model of the relationship between psychological distress and obesity, and associated individual and social context risk/protective factors among college students



Methods

Data & Sample Description

Data for this paper come from the *College Lifestyle and Wellbeing Study*, a survey of undergraduate and graduate students in a large public university in Southern California. The study was a cross-sectional survey collected between spring of 2009 and spring of 2010 (See Chapter 3 for a complete description of the methods). For the present study, 31 participants with missing

data on height and weight were excluded, resulting in 2392 respondents (36% male, 64% female) included as the analytic sample.

Measures

Dependent Variable

Obesity. Obesity status is a binary variable defined as (0) = *under/normal weight* and (1) = *overweight/obese*. The two categories were based on respondents' height and weight in computing their body mass index (BMI) typically categorized as: underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), obese (and > 30 kg/m²). BMI is a widely used index as a screening tool and indicator of body fat, obesity, and clinical outcomes (CDC, 2015). There may be a loss of power for dichotomizing BMI; however it reduces potential bias, as self-reported data are prone to underestimation of obesity, with heavy individuals more likely under-report their weight, and short individuals more likely to over-report their height. The response rates were 99% for height and 98.9% for weight.

Independent Variables

Psychological Distress. Psychological distress is a continuous variable derived from two measures: the *Perceived Stress Scale* (PSS) and *Affect Balance Scale* (98.6% and 99.5% response rates, respectively). A composite score of the two scales was computed, with a range of 0-80 and higher score indicating more distress. The PSS is a widely used measure developed by Cohen, Kamarck and Mermelstein (1983) for assessing the degree to which people feel their lives are uncontrollable, unpredictable, and overloaded, and it includes questions that ask directly about the levels of stress they are currently experiencing. Four positive items were reversed scored, and all 10 items summed to derive a total score, with higher values indicating more perceived stress (Cronbach's alpha = .85). The *Affect Balance Scale* (ABS: Bradburn, 1969) is a measure of psychological well-being used extensively in a wide variety of settings and populations (Bolin & Dodder, 1990). It is a 10-item rating scale containing five statements reflecting positive feelings and five statements reflecting negative feelings. Five positive affect items were reversed

scored, and all 10 items summed to derive a total score, with higher values indicating more negative affect (Cronbach's alpha = .74).

Individual Characteristics. Health disparities across various sociodemographic groups such as age, gender and race, as well as psychosocial factors such as financial strain are well-established. The following variables are included in the present study: age, race/ethnicity, nativity status, class standing/year in college, grade points average (GPA), units enrolled, and hours employed and financial strain. *Age* is a continuous variable with a range of 17-66 years. There are five *race/ethnicity* groups: Asian/Pacific Islander, Hispanic/Latino, Black/African American, White, non-Hispanic (reference group), and Multi-race/other (which include Native and Alaskan American). *Nativity status* was assessed by a yes/no question, "Were you born in the U.S.?" with U.S. born coded as the reference group. *Class standing/year in college* was comprised of the following categories: freshman (reference group), sophomore, junior, senior, and graduate/post-bac. *GPA* is an ordinal variable categorized into four categories: mostly As (3.5-4.0), mostly Bs (3.0-3.4), mostly Cs (2.5-2.9), and Cs and below (less than 2.4). Number of *units enrolled* is a continuous variable assessed by an open-ended question, "How many units are you taking this semester?" *Hours employed* was determined by students who answered "yes" to the question, "Are you employed?" and reported their average hours of work per week. *Financial strain* is an ordinal variable assessed by students' rating of their satisfaction with their material comforts, including home, food, conveniences, and financial security on a scale of (1) = *terrible* to (7) = *delighted*. Response scale was reverse scored such that higher value indicate more financial strain.

Social Context Factors. Young adults on college campuses are exposed to, and experience, unique social and contextual factors that influence health and health behaviors (Beck et al., 2008; Emmons, 2000; Stockdale, et al. 2007). Within the limits of available data collected in the College Lifestyle and Wellbeing Study, the following variables were included as indicators of social context factors: Living arrangement is a discrete variable with five categories: parents

(reference group), dormitory/university housing, non-university housing/apartments, significant other/spouse/ partner, other relatives, and fraternity or sorority house. Participation in extracurricular or social organizations/activities included the following binary yes/no items: “Are you currently a member of an intercollegiate athletic team?”, “Are you a member of a recreational sports team?”, and “Are you a member of a fraternity or sorority?”

Analytic Strategy

All analyses were conducted using SPSS 25 using gender split design with significance determined at $p < .05$ and 95% confidence interval.

Univariate and Bivariate Analyses

Univariate distributions of all predictor and outcome variables were examined with histograms, frequencies or percentages, measures of central tendency (e.g., means, median) and dispersion (e.g., range, standard deviation). Due to expected differences between males and females on the outcome variables, analyses were split by gender. Bivariate associations among individual characteristics, college social context factors, psychological distress and obesity were tested using Chi-square for categorical IV and DV, t-test or ANOVA for categorical IV and continuous DV, and Pearson correlation for continuous IVs and DVs.

Multivariate Analysis

Prior to conducting the multivariate analysis, the assumptions for multiple linear regression were, including linearity, normality, homoscedasticity, independence, and multicollinearity. For the results of the regression analysis, the F -statistic was used to determine if the regression model created is a valid or robust model in predicting the dependent variable. Typically, the model is a good fit when the F -statistic of the regression model is statistically significant with a p -value less than the alpha level. The R^2 statistic was used to show if the regression model has a strong or weak explanatory power. Then, the beta coefficients of the regression were examined to determine the magnitude of the contributions of the independent variables on the dependent variable. This statistic was used to show how much change in the dependent variable could be

explained by variations in the independent variables. A positive regression coefficient means a positive relationship indicating that the dependent variable increased when the independent variable increased. A negative regression coefficient means a negative relationship indicating that the dependent variable decreased when the independent variable increased.

For logistic regression, the dependent variable must be a discrete variable. The model produced by logistic regression is based on a nonlinear function of the best linear combination of predictors, and the linear regression equation creates the logit or log of the odds. For the test results, goodness-of-fit test was used to evaluate the models, Wald test was used to evaluate the contribution of individual predictors, Nagelkerke R square was used to determine strength of association, and the coefficients were interpreted as odds. The B coefficients are the natural logs of the odds ratio, or odds ratio = e^B . Odds ratios greater than 1 indicate an increase in odds of an outcome of 1 with a one-unit increase in the predictor. Conversely, odds ratio less than 1 indicate a decrease in odds.

Aim 1 was tested by regressing psychological distress on individual characteristics and college social context factors using multiple OLS linear regression because the distress composite score is a continuous variable. There were three regression models to address research aim one. In model one, all individual characteristics were entered as independent variables and distress composite score as the dependent variable. In model two, all college social context factors were entered as independent variables and distress composite score as the dependent variable. In model three, individual characteristics were inputted as block one, followed by college social context factors in block two using the enter method with psychological distress composite score inputted as the dependent variable. The regression equation for research aim one is:

$$Y_{\text{psychological distress}} = A_{\text{Constant}} + B_1X_{\text{Age}} + B_2X_{\text{Race/Ethnicity}} + B_3X_{\text{Nativity}} + B_4X_{\text{Year in college}} + B_5X_{\text{GPA}} + B_6X_{\text{Full-time enrollment}} + B_7X_{\text{Employment}} + B_8X_{\text{Financial Strain}} + B_9X_{\text{Living arrangements}} + B_{10}X_{\text{Intercollegiate Sports}} + B_{11}X_{\text{Recreational sports}} + B_{12}X_{\text{Greek Membership}}$$

Aim 2 was tested by regressing obesity on individual characteristics and college social context factors using binary logistic regression because obesity (BMI group) is a dichotomous variable. There were three models to address research aim two. In model one, all individual characteristics were entered as independent variables and obesity status as the dependent variable. In model two, all college social context factors were entered as independent variables and obesity status as the dependent variable. In model three, both individual characteristics and college social context factors were entered as independent variables with obesity status as the dependent variable.

Aim 3 was tested using sequential logistic regression. In block one, psychological distress was entered as the independent variable and obesity status as the dependent variable. In block two, individual characteristics were entered into the model. In block three, college social context factors were entered into the model. With each set of predictors, the sequential approach will show whether individual characteristics and college social context add to the prediction of obesity status beyond psychological distress. As previously noted, gender stratified analysis will be conducted to examine variations within female and male students in the distress-obesity relationship.

Results

Sample Characteristics

Table 4.1 shows the descriptive statistics of the key study variables stratified by gender. The mean age of the full sample was 22.6 ($SD = 4.78$) and born in the U.S. (82.7%). The racial composition was 33.8% White/non-Hispanic, 26.5% Hispanic/Latino, 24.7% Asian/Pacific Islander, 11.9% Multi-race/other, and 3% Black/African American. The majority of the students were upperclassmen comprising of juniors and seniors (69.1%), enrolled full-time (83.9%), and living with parents/relatives (61.6%). Consistent with national data, over 30% of the students were either overweight (22.7%) or obese (8.5%). The mean score for psychological distress was 32.5

($SD = 10$, range 0-80). As expected, significant gender differences were found across BMI categories and psychological distress. More males than females were overweight or obese ($p < .001$), and females reported higher levels of distress than did males ($p < .001$). Gender differences also were found with individual characteristics of race, nativity status, class level, GPA and employment. Among social context factors, significant gender variations were found across all variables with the exception of Greek membership.

Table 4.1*Study 1 - Descriptive Statistics of Study Variables by Gender, College Lifestyle and Wellbeing Study (N=2392)*

Variables (range)	Full	Male	Female
	% or M (SD)	% or M (SD)	% or M (SD)
BMI***			
Under/Normal Weight	68.8	56.5	75.7
Overweight/Obese	31.2	43.6	24.2
Psychological Distress			
Distress Composite (0-80)***	32.49 (10.01)	31.30 (9.92)	33.14 (9.99)
Individual Characteristics			
Age (17-66)	22.58 (4.78)	22.81 (4.42)	22.46 (4.98)
Gender		36.1	63.9
Race***			
White non-Hispanic	33.8	33.6	33.9
Hispanic/Latino	26.5	23.2	28.3
Asian/Pacific Islander	24.7	30.5	21.5
Black/African American	3	1.9	3.7
Multi-race/Other	11.9	10.8	12.6
U.S. Born*	82.7	80.4	84
Class Level***			
Freshman	10	11.1	9.4
Sophomore	12.7	8.6	14.9
Junior	34.9	36	34.3
Senior	34.2	37.9	32.1
Post Bac/Graduate	8.2	6.5	9.3
GPA***			
Mostly As	24.3	19.5	27
Mostly Bs	37.2	34.9	38.3
Mostly Cs	31.1	35.3	28.7
Cs and below	7.5	10.2	6
Full-Time Enrollment (12+ units)	83.9	82	84.9
Employment per week***			
Not employed	36.5	41.2	33.8
1-19 hrs	21	17	23.2
20-29 hrs	24.9	21.5	26.9
>30 hrs	17.6	20.3	16.2
Financial Strain (1-7)	2.84 (1.28)	2.87 (1.26)	2.83 (1.28)
Social Context Factors			
Living Arrangement***			
Parents or relatives	61.6	62.1	61.2
Spouse/Significant other	9.6	6.7	11.4
Apartments	21.5	25.3	19.4
University housing/Dorms	4.4	3.7	4.8
Fraternity/Sorority	2.8	2.2	3.1
Intercollegiate Sports***	2.2	3.6	1.4
Recreational Sports***	10.6	19.1	5.8
Greek Membership	6.4	5.7	6.9

Note. Gender differences tested with t-test for continuous and Chi-square for categorical variables.

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

Risk Factors for Psychological Distress

Table 4.2 depicts the multivariate OLS regression analysis for Aim 1 examining the association between psychological distress, individual characteristics, and social context factors stratified by gender. Among males, individual characteristics of Asian ($B = 1.77$; $\beta = 0.08$, $p < .05$) and financial strain ($B = 2.44$; $\beta = 0.31$, $p < .001$) were *positively* associated with distress. Social context factors were not associated with distress. The baseline model without social context factors and the full model both explained 11% of the variance in psychological distress for males. Among females, individual characteristics of foreign born ($B = 2.73$; $\beta = 0.10$, $p < .001$), sophomore standing ($B = 2.10$; $\beta = 0.07$, $p < .05$), and financial strain ($B = 2.67$; $\beta = 0.34$, $p < .001$) were *positively* associated with distress. On the other hand, GPA ($B = -0.70$; $\beta = -0.06$, $p < .05$) and hours employed ($B = -0.08$; $\beta = -0.10$, $p < .001$) were *negatively* associated with distress. Social context factors of living with spouse/significant other ($B = -1.94$; $\beta = -0.06$, $p < .05$) and Greek membership ($B = -2.87$; $\beta = -0.07$, $p < .05$) were *negatively* associated with distress. Baseline model with only individual characteristics accounted for 14% of the variance, and both individual characteristics and social context factors accounted for 15% of the variance in psychological distress for females. Taken together, findings from Aim 1 indicated that individual characteristics of race, nativity status, class standing, GPA, employment, and financial strain, as well as social context of living arrangement and Greek membership were significantly associated with psychological distress. However, social context was only associated with distress among women, suggesting gendered patterns in risk and protective factors. Financial strain was the strongest predictor for both men and women.

Table 4.2

Association between Psychological Distress, Individual Characteristics, and Social Context Factors Stratified by Gender, College Lifestyle and Wellbeing Study, 2009-2010

	Male		Female	
	B (SE)	β	B (SE)	B
Individual Characteristics				
Age	0.01 (0.10)	0.01	-0.08 (0.06)	-0.04
Nativity (referent U.S. Born)	1.15 (0.94)	0.05	2.73 (0.73)	0.10***
Race (referent White)				
Hispanic/Latino	0.02 (0.92)	0.00	-0.41 (0.63)	-0.02
Asian	1.77 (0.89)	0.08*	0.55 (0.74)	0.02
Black/African American	0.42 (2.56)	0.01	-0.22 (1.38)	-0.00
Multi-Race/Other	-0.14 (1.19)	-0.00	0.89 (0.81)	0.03
Class Standing (referent Freshmen)				
Sophomore	-0.90 (1.56)	-0.03	2.10 (1.03)	0.07*
Junior	-1.64 (1.28)	-0.08	0.12 (0.96)	0.01
Senior	-1.31 (1.34)	-0.06	0.91 (0.99)	0.04
Post-bac/Graduate	-2.60 (2.02)	-0.06	-0.41 (1.24)	-0.01
GPA	-0.62 (0.38)	-0.06	-0.70 (0.29)	-0.06*
Units Enrolled	-0.18 (0.11)	-0.06	-0.13 (0.08)	-0.04
Hours Employed	-0.02 (0.02)	-0.03	-0.08 (0.02)	-0.10***
Financial Strain	2.44 (0.27)	0.31***	2.67 (0.19)	0.34***
Social Context Factors				
Living Arrangement (referent Parents)				
Spouse or Sig Other	-1.43 (1.54)	-0.04	-1.94 (0.87)	-0.06*
Relatives	-2.64 (1.82)	-0.05	0.50 (1.28)	0.01
Apartments	-0.89 (0.82)	-0.04	-0.73 (0.65)	-0.03
Dorms/University Housing	1.65 (1.92)	0.03	-0.49 (1.23)	-0.01
Fraternity/Sorority	-2.05 (2.45)	-0.03	-0.35 (1.45)	-0.01
Intercollegiate Sports	0.13 (1.84)	0.00	-2.00 (2.07)	-0.02
Recreational Sports	-0.85 (0.88)	-0.03	-1.67 (1.03)	-0.04
Greek Member	-0.91 (1.48)	-0.02	-2.87 (0.99)	-0.07**
Constant	29.86		32.82	
Adjusted R ²	0.11		0.15	
F for ΔR^2	0.85		2.46*	

Note. Baseline model comprise of individual characteristics and psychological distress: male adjusted R² = 0.11, F for ΔR^2 = 8.04*** female adjusted R² = 0.14, F for ΔR^2 = 18.73***

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

Risk Factors for Obesity

Table 4.3 shows the multivariate logistic regression analysis for Aim 2 examining the association between obesity, individual characteristics, and social context factors stratified by gender. Among males, individual characteristics of age (OR = 1.08, 95% CI = 1.03, 1.13), Hispanic/Latino (OR = 2.08, 95% CI = 1.40, 3.09), and financial strain (OR = 1.14, 95% CI = 1.01, 1.28), were associated with *increased* odds of obesity. Social context factors were not associated with obesity. Among females, individual characteristics of age (OR = 1.05, 95% CI = 1.02, 1.08), Hispanic/Latino (OR = 1.75, 95% CI = 1.28, 2.37), and sophomore standing (OR = 1.92, 95% CI = 1.11, 3.33), were associated with *increased* odds of obesity. Conversely, Asian race was associated with *decreased* odds of obesity (OR = 0.61, 95% CI = 0.40, 0.92). The only social context factors associated with *decreased* odds of obesity was Greek membership (OR = 0.54, 95% CI = 0.31, 0.95). Overall, results from Aim 2 indicated that the individual characteristics of age, race, class standing, and financial strain were significantly associated with obesity. Greek membership was predictive of obesity for women, but not men.

Table 4.3

Association between Obesity, Individual Characteristics, and Social Context Factors Stratified by Gender, College Lifestyle and Wellbeing Study, 2009-2010

	Male		Female	
	OR	95% CI	OR	95% CI
Individual Characteristics				
Age	1.08**	1.03, 1.13	1.05**	1.02, 1.08
Nativity (referent U.S. Born)	0.91	0.60, 1.38	0.75	0.50, 1.12
Race (referent White)				
Hispanic/Latino	2.08***	1.40, 3.09	1.75***	1.28, 2.37
Asian	0.88	0.59, 1.30	0.61*	0.40, 0.92
Black/African American	1.41	0.45, 4.43	1.80†	0.96, 3.36
Multi-Race/Other	1.08	0.65, 1.79	1.05	0.70, 1.58
Class Standing (referent Freshmen)				
Sophomore	1.51	0.76, 3.01	1.92*	1.11, 3.33
Junior	1.17	0.66, 2.10	1.00	0.59, 1.70
Senior	1.09	0.59, 2.02	1.44	0.84, 2.47
Post-bac/Graduate	1.85	0.75, 4.54	1.07	0.55, 2.09
GPA	0.90	0.76, 1.06	0.89	0.77, 1.03
Units Enrolled	0.99	0.94, 1.04	1.02	0.98, 1.06
Hours Employed	1.00	0.99, 1.01	1.01	1.00, 1.02
Financial Strain	1.14*	1.01, 1.28	1.09†	0.99, 1.20
Social Context Factors				
Living Arrangement (referent Parents)				
Spouse or Sig Other	1.17	0.61, 2.23	0.90	0.59, 1.39
Relatives	0.99	0.46, 2.14	0.77	0.39, 1.50
Apartments	1.22	0.86, 1.75	0.86	0.62, 1.21
Dorms/University Housing	1.17	0.49, 2.79	0.73	0.37, 1.47
Fraternity/Sorority	1.07	0.37, 3.11	0.94	0.45, 1.96
Intercollegiate Sports	0.58	0.25, 1.34	1.25	0.44, 3.59
Recreational Sports	1.26	0.86, 1.83	0.58†	0.33, 1.03
Greek Member	1.02	0.54, 1.92	0.54*	0.31, 0.95
Pseudo R ²	0.11		0.09	
Chi-Square p value	0.21		0.53	

Note. Obesity status coded as 0=under/normal weight (BMI < 24.9) and 1=overweight/obese (BMI > 25)

Baseline model comprise of individual characteristics and obesity: male pseudo R² = 0.10, Chi-

Square p = 0.54, female pseudo R² = 0.08, Chi-Square p = 0.02

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Psychological Distress and Obesity

Aim 3 tests the focal relationship between psychological distress and obesity with gender split sequential logistic regression. First, preliminary analysis with Pearson product-moment correlation revealed no significant association between distress composite score and obesity (using continuous BMI) among males ($r = .02$, $p = .491$) and females ($r = .04$, $p = .174$). Bivariate analysis with logistic regression showed no relationship between distress and obesity (using binary BMI) for males (OR = 1.00, 95% CI = 0.99, 1.02) (Figure 4.2a), but a significant relationship for females (OR = 1.02, 95% CI = 1.00, 1.03) (Figure 4.2b). Multivariate logistic analysis further revealed a significant association between distress and obesity among females ($p < .05$). As shown in Table 4.4, distress was not associated with obesity among males, holding constant all individual and social context factors (OR = 1.00, 95% CI = 0.98, 1.01). Among females, however, distress was associated with obesity, holding constant all individual and social context factors (OR = 1.02, 95% CI = 1.00, 1.03). These pattern of results indicate gendered differences in obesity risk, and likely a suppression effect such that individual characteristics and social context factors were masking the effects of distress on obesity among females.

Figure 4.2a. Bivariate association between distress and obesity among male college students

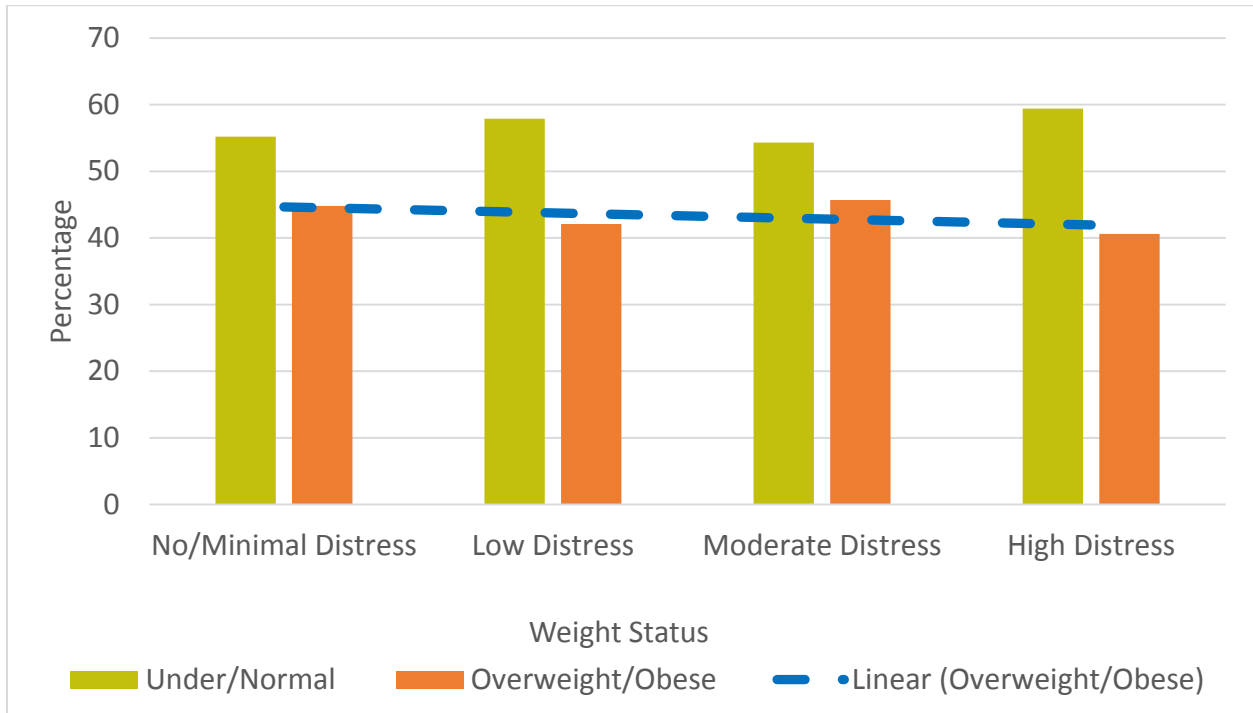


Figure 4.2b. Bivariate association between distress and obesity among female college students

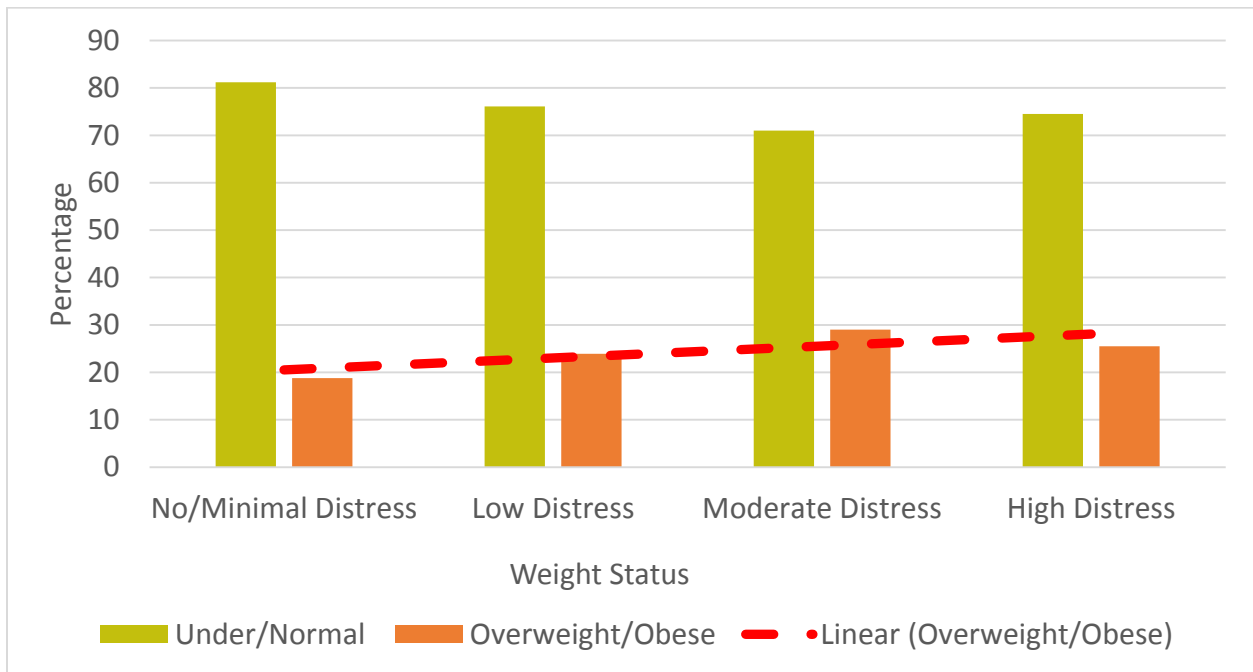


Table 4.4

*Gender Stratified Logistic Regression Analysis of Psychological Distress and Obesity (Full Model),
College Lifestyle and Wellbeing Study, 2009-2010*

	Male		Female	
	OR	95% CI	OR	95% CI
Psychological Distress	1.00	0.98, 1.01	1.02*	1.00, 1.03
Individual Characteristics				
Age	1.08**	1.03, 1.14	1.05**	1.02, 1.08
Nativity (referent U.S. Born)	1.00	0.65, 1.53	0.73	0.49, 1.09
Race (referent White)				
Hispanic/Latino	2.10***	1.40, 3.15	1.76***	1.29, 2.40
Asian	0.88	0.59, 1.32	0.59*	0.38, 0.90
Black/African American	1.38	0.44, 4.33	2.01*	1.06, 3.80
Multi-Race/Other	1.05	0.62, 1.79	1.01	0.66, 1.53
Class Standing (referent Freshmen)				
Sophomore	1.38	0.68, 2.79	1.87*	1.06, 3.29
Junior	1.05	0.58, 1.90	1.04	0.61, 1.80
Senior	1.01	0.54, 1.88	1.53	0.88, 2.66
Post-bac/Graduate	1.83	0.73, 4.61	1.12	0.57, 2.19
GPA	0.86 [†]	0.73, 1.02	0.93	0.80, 1.08
Units Enrolled	0.99	0.94, 1.04	1.02	0.98, 1.07
Hours Employed	1.00	0.99, 1.01	1.01	1.00, 1.02
Financial Strain	1.16*	1.02, 1.31	1.05	0.95, 1.16
Social Context Factors				
Living Arrangement (referent Parents)				
Spouse or Sig Other	1.29	0.65, 2.54	0.94	0.61, 1.46
Relatives	0.94	0.42, 2.09	0.77	0.39, 1.52
Apartments	1.24	0.86, 1.78	0.88	0.63, 1.23
Dorms/University Housing	1.17	0.49, 2.79	0.78	0.39, 1.57
Fraternity/Sorority	0.87	0.29, 2.64	1.00	0.47, 2.09
Intercollegiate Sports	0.61	0.26, 1.41	1.28	0.45, 3.70
Recreational Sports	1.30	0.88, 1.92	0.60 [†]	0.34, 1.06
Greek Member	1.05	0.55, 2.00	0.53*	0.30, 0.96
Pseudo R ²	0.11		0.09	
Chi-Square p value	0.14		0.75	

Note. Obesity status coded as 0=under/normal weight (BMI < 24.9) and 1=overweight/obese (BMI > 25)
Baseline model comprise of distress and obesity for male: OR = 1.00, 95% CI = 0.99, 1.02,
pseudo R² = 0.00, Chi-Square p = 0.20; female OR = 1.02, 95% CI = 1.00, 1.03, pseudo R² =
0.01, Chi-Square p = 0.002. Model 2 comprise of distress, individual characteristics, and obesity
for male: OR = 1.00, 95% CI = 0.98, 1.01, pseudo R² = 0.11, Chi-Square p = 0.73; female OR =
1.02, 95% CI = 1.01, 1.03, pseudo R² = 0.08, Chi-Square p = 0.69

[†] $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Discussion

The present investigation was prompted by the growing prevalence of overweight and obesity among college-attending young adults and the need to better understand the associated psychosocial risk factors. The overarching goal of the present study was to determine the extent to which psychological distress is associated with increased odds of obesity among college students in the College Lifestyle and Wellbeing Study. Results showed that psychological distress increased odds of obesity among female college students. In addition, there are gendered patterns in individual and social context risk and protective factors.

Individual Characteristics

A key finding that emerged from the present study is that obesity risk is nearly two times greater among female sophomores compared to female freshmen. This suggests that the traditional notion of risks associated with college transition may persist well beyond the first year and may not fully manifest until the second year in college, indicating that weight gain at college is a continual process. This result was contrary to those suggesting that college experience is protective against weight gain irrespective of age (Baum, 2017). Although the current findings of this study do not support the “Freshman 15” phenomenon, weight gain is likely to have begun in the first year (Levitsky, Halbmaier, & Mrdjenovic, 2004; Vadeboncoeur, Townsend, & Foster, 2015). A closer examination of weight distribution of first and second year students revealed that among females, about 16% were overweight or obese during their freshmen year, but nearly 30% were overweight or obese during sophomore year.¹ Given the design of the College Lifestyle and Wellbeing was cross-sectional, it cannot be determined how much weight change occurred during the first year. However, the two-fold difference in obesity rates between first- and second year

¹ Older, returning students are likely to experience college differently than younger students. There are also young people starting college a year or two later as opposed to immediately after high school, and thus their pre-college experience may contribute to different health behavior and obesity risk patterns. Mean age distributions across freshman, sophomore, junior, senior, and post-bac/grad among males were 18.4, 19.7, 22.7, 23.9, and 28.77 for respectively. Mean age distributions among females were 18.5, 19.2, 22.4, 23.8, and 27.4, respectively. The higher average age among upperclassmen, particularly juniors is likely due to enrollment of transfer students from community colleges during junior standing.

students suggest a real and likely trend in which weight gain starts to accumulate after students enter college, with one third reaching overweight and obese status by the time they are sophomores. This pattern was not observed among males. Perhaps this is because males are more likely to remain physically active after high school (Shifrer, Pearson, Muller, & Wilkinson, 2015), and are less likely to gain significant weight from stress than females (Finch & Tomiyama, 2015). Moreover, substantially more males than females are already overweight/obese as freshman (33%) and sophomore (42%), and the rates remained high for male juniors (45%) and seniors (44%). These findings highlight the need to understand obesity risk factors beyond the freshman year, and more intervention efforts should be directed towards students who are in the sophomore year, particularly females.

Another key finding from the present study is that accounting for all other individual characteristics and social context factors, financial strain is the strongest predictor of distress for both males and females. This is not surprising, as existing literature report this association has shared connections with academic stress (Covarrubias & Fryberg, 2015; Wood, Harrison, & Jones, 2016), employment status (Wood, Harrison, & Jones, 2016), and minority status (Adams, Meyers, & Beidas, 2016). Financial strain is also associated with increased odds of obesity among males. This is consistent with findings among the general population, that lower socioeconomic status and personal resource can influence health behavior adoption and maintenance (Emmons, 2000).² Moreover, maladaptive coping behaviors in response to distress can increase the risk for weight gain (Hemmingsson, 2014). However, in the present study, the link between financial strain and obesity is only marginally significant among females, and nonsignificant once psychological distress is accounted for. Perhaps for females, financial strain has a spillover effect to other aspects of mental wellbeing, affecting perceived stress and mood as captured by the overall distress score. For males, financial strain is more likely to influence health behaviors, such as

² Supplemental analysis showed no racial differences in financial strain, $F(4, 2386) = .83, p = .504$.

eating more affordable fast foods and less healthy foods. This pattern of results indicate that college students are vulnerable to higher levels of distress and rates of obesity due to real or perceived lack of financial security (Archuleta, Dale, & Spann, 2013; Roberts, et al., 2000). And given the ubiquitous influence of financial strain among college students who are constantly balancing work and school, more research is needed to better understand the observed gender differences and targeted intervention efforts to address this risk factor.

Social Context Factors

Unlike previous research reporting students who lived off-campus were more likely to be overweight or obese compared to students who lived on campus or with their families (Brunt & Rhee, 2008), current results did not indicate that students' living arrangements were associated with higher rates of obesity. Interestingly, Greek membership is associated with both lower distress and odds of obesity among females, suggesting a protective effect of these social contexts. Perhaps being part of a sorority decreased obesity through decreasing psychological distress, acting as a buffer (Luk, Fairlie, & Lee, 2017). This is contrary to literature suggesting that being a member of Greek organizations is associated with higher risk of obesity through increased social use of alcohol and consumption of unhealthy food (Scott-Sheldon et al., 2016). It is also plausible that there is a selection bias, that sororities are more likely to recruit and select thin and non-obese women as members. It is worth noting that although the results for males are nonsignificant, the odds of obesity were higher among those who are part of a fraternity. Also, although non-Greek members may less likely to engage in health risk behaviors, they are also not reaping the social benefits of being a part of Greek membership, particularly a sorority. Hence, Greek membership may serve both as a risk and protective factor that can be an important point of intervention among the college population. Future research should examine the underlying mechanisms of the effects of Greek membership, such as member dynamics, social support, structural/physical characteristics of Greek housing, and Greek culture/mentality.

Although not all of the social context variables were statistically significant, the results do indicate gendered patterns. For example, social context in general has a protective effect on psychological distress, and that association is stronger among females (15% of variability explained) than do males (11% of variability explained). In addition, social context factors seem to play a more important role in shaping obesity among females. With the exception of intercollegiate sports, all the odds ratio were less than one, indicating that off-campus living arrangement, sorority membership, and participating in recreational sports may have a protective effect on obesity. On the other hand, among males, all social context factors except living with relatives and intercollegiate sports had odds ratios of greater one, suggesting living off-campus, fraternity membership, and recreational sports may increase risk of obesity. These gendered patterns may explain the inconsistent findings in prior research, and therefore warrant further investigation of formally testing gender differences.

Distress-Obesity Link

Aim 3 of this study tested the focal relationship between psychological distress and obesity and revealed that distress is associated with increased odds of obesity among females; this association remained after all individual and social context factors were controlled for. No relationship was found among males. The findings are consistent with Marshall (2014) who suggested that the link between depression and obesity is especially strong in women. This is likely due to gender differences in distress coping. For example, women are more prone to unhealthy eating during psychological distress than men, which could lead to obesity (Leske et al., 2015; Oliver, Wardle, and Gibson, 2000). Indeed, there is growing support of the idea of “comfort food” serving as a way of suppressing negative emotions (Tomiya, Finch, & Cummings, 2015), and maladaptive habits formed to cope with continual stressors could lead to higher rates of obesity. It is also possible that the observed increase in odds ratio among females was due to measurement bias among gender groups. For example, women have a higher tendency to express their feelings than men, or more likely to have negative body image resulting

in over-reporting of weight, thus resulting in higher distress and obesity score. Nonetheless, the gender stratified design of the present study provides a better understanding of the unique risk and protective factors of college obesity. Future research is needed to more closely examine the interaction between distress and health behaviors in order to reveal the nuanced influence of psychological distress on obesity among the college population.

Patterns of individual and social context risk factors in the distress-obesity linkage were similar for both genders in terms of age and race. Hispanic males were two times more likely and Hispanic females were 1.75 times more likely to be overweight or obese than their non-Hispanic white counterparts. Non-Hispanic black females were also two times more likely to be overweight and obese, whereas Non-Hispanic Asians have lower odds of obesity, a trend that mirrors national data (Hales, Carroll, Fryar, & Ogden, 2017). As previously noted, one key risk factor among females is sophomore standing, which is associated with higher levels of distress as well as nearly a two-fold increase in odds of obesity, adjusting for psychological distress and other predictors. One possible reason why sophomores are at higher risk is perhaps in the second year of college, the sense of novelty and motivation associated with this important life stage transition (i.e., starting college) has weaned off; or the stress of living away from home starts to take its toll. It is likely that the higher levels of distress and obesity among female sophomores are evidence of stress accumulating from their freshman year, possibly more pronounced among those without effective coping strategies or positive social support. Interestingly, no substantial increase in distress or obesity were observed among males. This points to a need to better understand the gender-specific risk factors that may lead to poorer mental and physical health outcomes. An important implication of this finding is that the traditional notion of stress associated with transitioning from high school to college is likely to persist well beyond the freshman year, with distress and unhealthy weight status manifesting in the second year and beyond.

Overall, the findings provide further evidence on the interconnections of psychological distress and obesity, that both are likely to co-occur. In addition, the critical findings of gendered

patterns highlight the importance of creating meaningful, gender- and time point-specific interventions to prevent weight gain and obesity among the college population.

Limitations

There are a few limitations of the present study that may affect the interpretation of these findings. First, the study was cross-sectional therefore causal inference cannot be made. It is possible that obesity leads to higher level of distress rather than the reverse. However, follow-up analysis do not support this hypothesis (see Appendix A), which is consistent with prior research, that depression is associated with a higher risk of obesity but smaller or insignificant association in the opposite direction (Mannan, Mamun, Doi, & Clavarino; 2016). Second, although the College Lifestyle and Wellbeing Study dataset is comprised of racially and economically diverse students from a large, public university, it is not a population or national level study, thus limited in its generalizability. Nevertheless, local data representative of Orange County demographics and studies inclusive of minority student population is severely lacking in existing research, particularly given the high prevalence of overweight and obesity rates in the county: over two-thirds of Latino and one third of Asian adults are overweight or obese (OC Public Health Services, 2013). It should be noted also, that the study population mirrored both campus and Orange County demographics, which was comprised primarily of non-Hispanic whites, Hispanics, and Asians. Although non-Hispanics blacks make up only 3% of the study population, it is congruent with the study campus's and Orange County's racial/ethnic composition and nonetheless contributes to our understanding of college obesity. A third limitation of the study is that self-reports are susceptible to reporting bias, possibly affected by social desirability, or misreporting of survey questions. For example, respondents commonly under-report weight and over-report height resulting an under estimate of the rate of overweight or obese students. There could also be certain underlying conditions (e.g.,

anorexia) among those with extremely low BMI that may distort the analysis.³ By using a binary category of BMI, potential misclassification is less likely to occur. Response bias was also limited by collecting data in-class with the all students participating complete each section simultaneously to ensure full understanding of the question instructions. Future studies should address these limitations by using a longitudinal design, include more underrepresented racial minorities, and incorporating objective measures of obesity.

Strengths and Contributions

A key strength of the present study is adding to existing knowledge of a high risk but often understudied population in obesity research: college-attending young adults. This is important because early adulthood is a time where excess adiposity starts to accumulate and often continues into middle adulthood, increasing the risk of obesity over time (Zheng et al., 2017). Understanding and curbing obesity at this critical stage of the life course could have a significant long-term effect in terms of also reducing the incidence of obesity in the overall population.

Another important contribution is the broad conceptualization of individual-level and social context risk and protective factors, which afforded a better understanding of the nuanced relationship between psychological distress and obesity. First, risk factors for obesity among college students appear to be dynamic and not static. Although older age is associated with increased odds of obesity, it is potentially class standing that is most telling, with overweight and obesity rates either persisting over the college years or manifesting in the second year of college. This finding underscores the importance of the life course approach to understand risk factors and how their effects on obesity may appear “dormant” and only manifest at certain transitions and turning points. Second, risk factors may be ubiquitous but also gender specific. Financial strain was predictive of psychological distress for both men and women, but only associated with

³ Sensitivity analysis conducted excluding the underweight group showed similar results; Significant distress-obesity association among females (OR=1.02, 95% CI=1.01, 1.03) but not males. Continuous BMI using OLS regression not significant for both genders.

increased odds for obesity among males. In addition, results highlighted the protective effects of social context in distress and obesity, particularly among females. Third, and more importantly, this study contributes to the larger literature of the distress-obesity linkage, and that enhancing psychological well-being may be an effective point of intervention to address the rising rates of obesity among college students.

In line with the Healthy Campus Initiative, the importance of social context is recognized as crucial in shaping health and wellbeing, and this study is unique in its inclusion of both individual and social context factors as well as a diverse student population. The current results may have the potential to re-frame the discussion on college obesity beyond the Freshman 15 phenomenon—that weight gain during the first year of college should not be the only focus, but instead may well persist or exacerbate throughout the college years, particularly among females. More importantly, the study revealed gendered risk patterns in the distress and obesity association, with the potential to better inform campuses in designing more tailored prevention and interventions.

CHAPTER 5

STUDY 2: LIFESTYLE HEALTH BEHAVIORS AND PSYCHOLOGICAL DISTRESS IN RISK OF OBESITY AMONG COLLEGE STUDENTS

Introduction

There is a growing epidemic of obesity among U.S. college students. Recent reports from the American College Health Association indicate that over one-third of young adults in colleges are either overweight or obese (ACHA-NCHA-II, 2017). This is a serious problem among this population despite evidence that young adults retain an overall lower obesity prevalence than older adults (Hales, Carroll, Fryar, & Ogden, 2017). The observed patterns are particularly alarming because of the size and distinct risk factors facing this population. Recent reports indicate that nearly 20 million, or about half of Americans ages 17-24 are enrolled in U.S. postsecondary institutions (National Center for Education Statistics, 2016). Young adults in this distinct period of development of late teens to mid- or late 20s are known as *emerging adults*. This period is characterized by exploration, change, and instability of life directions as well as identity formation and role experimentation (Arnett, 2014). Lifestyle behaviors formed during emerging adulthood can have lasting health implications, including risk for overweight and obesity which increases risk of later-life chronic health conditions (Zheng et al., 2017). Numerous efforts aiming to improve health behaviors have yielded minimal impact in reducing obesity rates. Therefore, additional research is needed to identify the factors that contribute to these adverse outcomes and inform more effective prevention and intervention efforts to reduce obesity among the college student population.

One important risk factor of weight gain in the general population is psychological distress (Block, He, Zaslavsky, Ding, & Ayanian, 2009; Halfon, Larson, & Slusser, 2013). Studies show that college-attending young adults experience elevated rates of psychological distress and disorders such as anxiety or depression due to stress associated with the transition to college

(ACHA-NCHA-II, 2017; Blanco et al., 2008). Although fewer have examined the impact of distress on college student obesity, the high rates of distress among the college population points to the need to further examine this relationship. Given that psychological distress is especially pronounced in this population, understanding the underlying mechanisms connecting psychological distress and obesity in the college context may be critical to curbing the rising obesity rate.

A key pathway linking psychological distress and obesity is health behavior. Commonly noted in the literature is the positive connection between psychological distress and unhealthy eating habits (Leske et al., 2015). For example, maladaptive eating may form as a way of suppressing negative emotions to cope with continual stressors that build up over time (Tomiya, Finch, & Cummings, 2015). This may explain weight gain among the college population, since the social context of college is often associated with a significant increase in stressors. However, even though health behaviors and obesity have been studied extensively in the general population, our understanding of how positive behaviors may be different or negative behaviors exacerbated in the presence of distress within the context of college obesity is limited. This lack of knowledge may be attributed to, in part, that much of the existing literature has focused on diet as a mediating factor in the relationship between psychological distress and obesity; few have assessed how health behaviors, particularly those beyond eating habits, may interact with psychological distress to shape obesity risk among the college student population.

This study, therefore, bridges a significant gap in the literature by examining three key health behaviors—diet, physical activity, and sleep—while also accounting for the role that individual characteristics, college social context factors, and psychological distress may play in the rising obesity rates among college students. The inclusion of multiple domains of health behaviors in the distress-obesity relationship allows for a more comprehensive approach to understanding the increasing obesity rate among college students.

The Role of Psychological Distress in Shaping Obesity Risk among College Students

Distress is a risk factor for obesity and it may be especially important for college-attending young adults. Not only are college students a nontrivial population with their own epidemic of obesity, they are also a vulnerable population in terms of mental health. College students experience elevated risk of psychological distress compared to the general population due to a range of academic, social, and financial stress in addition to the distress that may arise from being away from home. Recent national data indicated that 56% of college students report experiencing moderate to high level of stress and nearly 22% report depressive mood the past year (ACHA-NCHA-II, 2017). In another report from The Higher Education Research Institute, about 12% freshmen report frequently depressed, and among those with a psychological disorder, over half (52%) report frequently depressed. (Eagan, Stolzenberg, Zimmerman, Aragon, Whang Sayson, & Rios-Aguilar, 2017). Thus, the unique social context of college predisposes students to higher level of distress that may affect their health behaviors and obesity risk. It is therefore important to evaluate this full range of process—psychosocial and behavioral risk and protective factors—to identify effective intervention.

The positive association between psychological conditions such as depression and anxiety with obesity is well-documented in general research (Chaput, Pérusse, Després, Tremblay, & Bouchard, 2014; Dalrymple, Walsh, Rosenstein, Chelminski, & Zimmerman, 2017). However, the underlying mechanisms between psychological distress and overweight/obesity among college students remain poorly understood. Data from human and animal models suggest the path from psychological distress to obesity could be indicative of mechanisms that stem from several possible sources. Most notably, extant literature points to the role of distress in shaping dietary behaviors. For example, depression is associated with appetite modulation (Schweinfurth et al., 2016). Individuals under distress may experience neurobiological adaptations such as elevation of the hypothalamic pituitary adrenal axis (HPA) activity and appetite stimulation which

leads a person into consuming more unhealthy, calorie dense and highly palatable foods such as snacks and sweets (Adam & Epel, 2007; Morris, Beilharz, Maniam, Reichelt, & Westbrook, 2015).

Although the relationship between dietary behavior and obesity is well-researched, studies among college students have typically focused on the impact of single health behaviors (e.g., diet or exercise) on weight status or weight perception (e.g. Coco et al., 2014). As such, a wide range of other psychosocial or behavioral risk/protective factors and the role of distress in shaping health behaviors of college students has often been overlooked. This is problematic because health behaviors are not engaged in isolation but are influenced by the social and structural environment of the college campus.

More importantly, health behaviors may change or become exacerbated when individuals experience distress. For example, prior research has found that eating behavior may either increase or decrease in the presence of stress (Sinha & Jastreboff, 2013). In addition, gender variations in distress and health habits could make interpreting the direction of the association and disentangling the individual effects difficult. Gender plays an important role because there are well-documented differences in obesity and psychological distress in males and females, suggesting there might be distinct mechanisms at work in shaping the distress-obesity linkage and associated behavioral risk factors. Yet, few studies have investigated such within gender variations. Thus, there is a need to examine the role of psychological distress in shaping multiple behavioral pathways that may give rise to the increasing rates of obesity among the college population, and consider the potential distinct variations among women and men.

Obesity-Related Health Behaviors among College Students

For many young adults, attending college means transitioning to their first experience of independent living, managing academic and financial pressures, and adopting new lifestyle behaviors. College students often eat less healthy and are less physically active as they adjust to new social context and school-work balance. According to the annual National College Health Assessment, only 4% of college students reported eating the recommended five fruits and

vegetables a day. The majority (63%) reported eating only one to two servings of fruits and vegetables, and over half (56%) of the college students do not meet the recommendation for moderate-vigorous exercise (ACHA-NCHA II, 2017). Attending college is one of many experiences of a young adult's life--an important period because lifestyle behaviors formed during this formative stage of emerging adulthood tend to endure and can have a lasting impact on weight status and overall health in later adulthood (Arnett, 2014; Larson et al., 2008). Although risk behaviors such as alcohol consumption may also contribute to weight gain, health behaviors outside of dietary habits are, as a whole, less researched in the college-obesity context. Hence, this study will examine three key health-related behaviors among college students: dietary behavior, physical activity, and sleep habits.

Dietary Behavior. Dietary factors are the most studied lifestyle health behavior related to obesity. Poor dietary habits such as excess food and unhealthy food are key drivers of weight gain and obesity. Since eating (and drinking) determines a person's caloric intake, and weight gain is primarily an imbalance of caloric intake and burning, it is the most direct pathway leading to increases in BMI (Manore, Larson-Meyer, Lindsay, Hongu, & Houtkooper, 2017). Excess eating may come about in a number of ways; for example, one common reason for overeating is that "comfort food" is one of the mechanisms for coping with stress or other forms of psychological distress (Hemmingsson, 2014). Additionally, factors such as depression can affect the body's physiological appetite modulation, thereby increasing eating (Schweinfurth et al., 2016). Another source of increased appetite—and the resultant overeating—is the side effect of antidepressants that are commonly prescribed to treat depression or anxiety (Wurtman & Wurtman, 2017). Thus, depressive symptoms and its biomedical treatments may both cause an increase in appetite. This points to the need that obesity interventions must address the mental health component beyond overt eating behavior.

Overeating is not, however, the only aspect of dietary habits that affects obesity. While the quantity of food that one consumes does have an effect, another factor with an important influence

on obesity is the quality of food consumed. Not all types of food have equal caloric content, and a significant cause of obesity is the western, or “obesogenic” diet. Diet comprised mainly of processed foods high in fat and sugars is one of the driving force behind the increase in obesity rate (e.g. Thorburn, 2014). The western diet has also been linked to an increased incidence of psychological conditions as a part of the emerging field of nutritional psychology (García-Toro et al., 2016). Sweet and fats are high in sugar and fats but low in nutritional value, making them a high source of calories but a poor source of nutrition; these foods are generally eaten as snacks (Manzel et al., 2014). By contrast, fast food is a broader category of foods that are generally prepared at the eponymous fast food restaurants. While fast food is “real” food rather than just fatty and sugary snacks, it tends to be prepared in ways that make it cost efficient but high calorie and nutritionally weaker than foods cooked in a traditional fashion (Janssen, Davies, Richardson, & Stevenson, 2017). College students often eat what is most convenient and affordable, and most do not eat the recommended five servings of fruits and vegetables a day. Hence, this study will consider both fats and sweets (snacks) and fast foods as indicators of unhealthy diet as well as fruits and vegetables intake as indicators of healthy diet in the psychological distress and obesity relationship.

Physical Activity. The positive impact of physical activity on obesity risk and other chronic health conditions is well-documented. Whereas eating and a poor diet drives obesity through increasing caloric intake, physical activity can alleviate obesity through burning off calories (Bullard, 2016). Physical activity is relevant in the context of college for several reasons. First, a majority (56%) of college students do not meet the recommended standards for daily physical activity (ACHA-NCHA II, 2017). Research generally shows that level of physical activity decline significantly after high school. As young adults enter college, time for structured physical activity often decreases, and more demands from work and school means less time for recreational activities. Nevertheless, college may also create opportunities for physical activity through the availability of student recreation centers, gyms or pools, and organized recreational/intercollegiate

sports. Sports participation may have both positive and negative effects on psychological wellbeing. Additionally, the high incidence of stress and depression in the college context can serve to hamper physical activity, as psychological distress makes a person less likely to be physically active (Roshanaei-Moghaddam, Katon, & Russo, 2009). Thus, it is critical to assess physical activity in the contexts of psychological distress and obesity.

Sleep Habit. While one might not expect sleeping habits to directly influence obesity, the association between sleep and weight has been documented across a variety of populations. For example, based on a meta-analysis of 11 longitudinal studies among children and adolescents, a strong inverse relationship between sleep duration and obesity was found (Fatima & Mamun, 2015). Similar results have been reported in cross-sectional research among adolescents, which suggests that decreased sleep duration is linked to increased incidence of obesity (Chaput & Dutil, 2016). Among older adults, inconsistent sleeping habits are also a significant predictor of obesity (Patel et al., 2014). In one study of college students, poor sleep quality was correlated with an increased incidence of body fat (Kahlhöfer, Karschin, Breusing, & Bosy-Westphal, 2016). Thus, lack of sleep or poor sleep quality is as serious a risk for obesity, as is a poor diet or a lack of adequate physical activity. Although sleep has been demonstrated to have an impact on weight gain, this relationship has rarely been considered in parallel with psychological distress in the college context.

Sleep is highly relevant for understanding of obesity among college students because this demographic is disproportionately likely to experience sleep deprivation and tiredness (Patrick, Griffin, Huntley, & Maggs, 2018). Sleep has also been linked to psychological distress, with depressive symptoms associated with worsening sleep problems in college (Doane, Gress-Smith, & Breitenstein, 2015). College students tend to have poor sleeping habits due to distress induced from increased academic and social pressures as well as the competing demands of work and school. Moreover, recent studies suggest that technology use has been evolving in a way that inhibits proper sleep, with time spent in bed significantly correlated with sleep-interrupting

behaviors such as texting and social media usage, particularly among first year college students (Whipps, Byra, Gerow, & Guseman, 2018). Indeed, the transitional nature of college can be a vulnerable stage of life where these sleep-inhibiting technology habits worsen due to more freedom (from parental monitoring) and the changing dynamics of socialization among peer groups. Thus, sleep deprivation may increase young adults' risk of psychological distress and obesity, but our understanding of the impact of distress-sleep association in explaining college obesity is limited.

In sum, multiple behavioral mechanisms are at work in shaping obesity risk, yet our understanding of these mechanisms in the growing obesity rates among the college population remains poorly understood. There are several key limitations that may contribute to the lack in knowledge. First, few obesity research has considered the role of psychological distress in shaping health behaviors, and rarely do they examine the relationship separately for women and men. It is important to examine within-gender variations because of documented between-gender differences, with the link between depression and obesity especially strong in women (Marshall, 2014). Findings from Study 1 of this dissertation further revealed the odds of obesity increased with higher levels of psychological distress among women but not men, suggesting distinct mechanisms may be at work in shaping the distress-obesity linkage. For example, depression is associated with certain subconscious traits that control appetite (Schweinfurth, Walter, Borgwardt, & Lang, 2016), and eating is a common self-regulatory behavior that often changes when individuals are under distress, with women more prone to unhealthy eating during stress than men (Oliver, Wardle, & Gibson, 2006). This may be due to body image dissatisfaction and internalized stigma against one's own weight, as well as binge eating disorders as a coping mechanism that may be particularly pronounced for women (O'Brien et al., 2016). What is less clear, though, is the extent to which psychological distress influences health behaviors beyond diet that may lead to increased risk of obesity among the college population. Thus, it is important

to examine multiple health behaviors in the distress-obesity link separately among men and women.

Second, extant literature rarely considers a broad range of health behaviors, particularly within the unique context of college. For example, college social context can influence health-risk behaviors, such as fraternity/sorority membership, especially since they are linked with increasing alcohol usage and the “party” lifestyle (Luk, Fairlie, & Lee, 2017). In addition, over half of college students work to contribute to their educational expenses (Carruthers & Özek, 2016), which is source of financial strain and sleep deprivation. On the other hand, college also presents students with numerous opportunities to engage in health-promoting behaviors, such as recreational or intercollegiate sports (Marques, Ekelund, & Sardinha, 2016). Participation in these activities can help to create healthy habits. However, traditionally, diet has been the central focus of most obesity research (Manore et al., 2017). Dietary factors and physical activity need to be understood in the context of one another, as both are key lifestyle behaviors in determining weight status. Equally important is the role of sleep, given its documented linkages with distress and obesity. Overall, the ways in which the college experience shapes students’ health behaviors and obesity risk are a complex function of how students revolve around the college experience and interaction with multiple health behaviors. Thus, this study aims to disentangle the individual-level and social context risk factors associated with health behaviors and their impact in the distress-obesity relationship.

Third, there is a lack of understanding in other possible pathways between psychological distress and obesity, with existing research focusing more on the mediating role of health behaviors. That is, psychological distress causes changes in health behaviors which in turn, leads to weight gain. For example, depression is commonly associated with increasing food consumption (Schweinfurth et al., 2016). Psychological distress may also make a person less likely to be physically active (Roshanaei-Moghaddam, Katon, & Russo, 2009) and have more sleep problems (Doane, Gress-Smith, & Breitenstein, 2015). Thus, multiple behavioral

mechanisms are at work because of their known risks associated with overweight and obesity. What is less known, however, is the interplay between distress and health behavior. In other words, to what extent do health behaviors modify the distress-obesity relationship? The growing body of literature showing a direct association between distress and obesity suggests health behaviors may also play a moderating role. For example, it is likely that distress and obesity are associated for those who eat as a way of coping (the idea of “comfort food”), but not so among those who do not eat to cope (Tomiya, Finch, & Cummings, 2015). Similarly, the distress-obesity linkage may be stronger among those who are sleep deprived than those who are not. Interestingly, although distress is associated with not enough sleep (i.e., less than six hours), distress is also correlated with sleeping too much (i.e., over nine hours) among the general population (Cunningham, Wheaton, & Giles, 2015). Thus, a dose-response relationship likely exist, but this has rarely been studied in the context of college obesity.

Study Purpose

Given these limitations, the purpose of the present study is to examine health behaviors as risk and protective factors in the association between psychological distress and obesity, and how this relationship varies for men and women. The three specific aims for this study are:

AIM #1: Identify the (a) *individual characteristics* (i.e., age, race, nativity, class level, GPA, enrollment status, employment, financial strain) and (b) *social context factors* (i.e., living arrangement, intercollegiate sports, recreational sports, Greek membership) associated with *health behaviors* (i.e., diet, physical activity, and sleep) among male and female college students.

Hypothesis 1.1: Units enrolled and employment hours are negatively associated with diet, physical activity, and hours of sleep among college students.

Hypothesis 1.2: Social context factors of off-campus living are associated with unhealthy diet and extracurricular sports are associated with more physical activity among college students.

AIM #2: Examine the association between *psychological distress* and *health behaviors* among male and female college students.

Hypothesis 2.1: Psychological distress is negatively associated with healthy diet, physical activity, and hours of sleep among college students.

AIM #3: Evaluate the extent to which *health behaviors* (i.e., diet, physical activity, and sleep) explain the relationship between *psychological distress* and *obesity* among college students.

Hypothesis 2.1: Health behaviors of diet, physical activity, and sleep explain the association between distress and obesity. Specifically, odds of obesity is lower in the distress-obesity linkage when health behavior is examined than without.

AIM #4: Assess whether *health behaviors* (i.e., diet, physical activity, and sleep) moderate the association between *psychological distress* and *obesity* among college students.

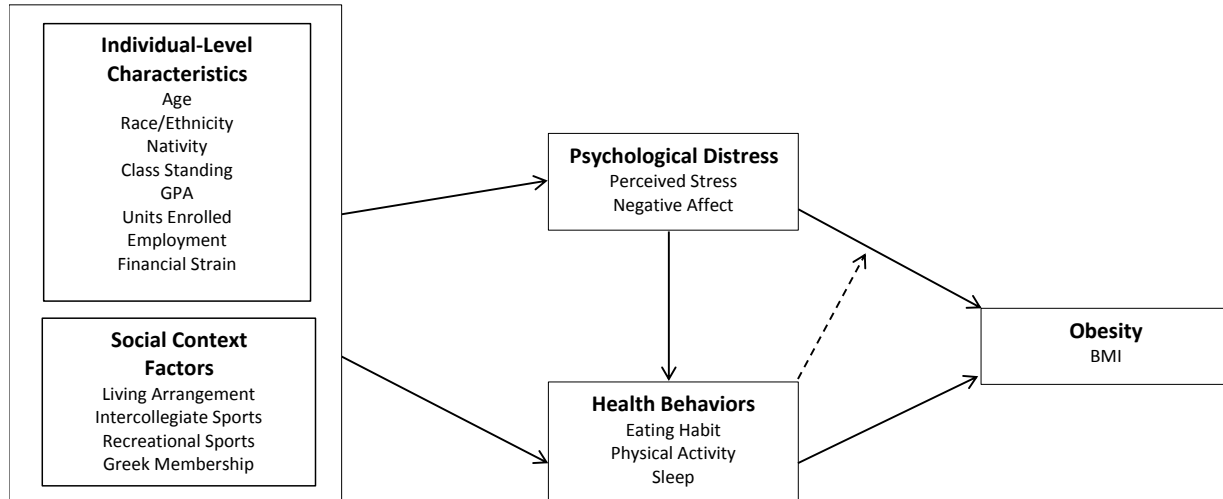
Hypothesis 3.1: The association between psychological distress and obesity is stronger when college students consume more “comfort foods” (e.g., snacks/sweets). That is, a positive interaction is expected such that the association between psychological distress and obesity is stronger as unhealthy dietary behavior increase.

Hypothesis 3.2: The association between psychological distress and obesity is weaker when college students are more physically active.

Hypothesis 3.3: The association between psychological distress and obesity is stronger when college students sleep fewer hours.

Together, the consideration of multiple domains of health behaviors as moderating factor and a within-gender approach as opposed to between-gender comparisons will allow for a more fine-tuned model of the distress-obesity relationship. Such an approach may better inform campuses in developing targeted interventions to reduce and prevent college obesity and turn the tide on this epidemic among a major segment of the adult population.

Figure 5.1. Conceptual model of the relationship between psychological distress, health behaviors, obesity, and associated individual and social context risk/protective factors among college students



Methods

Data & Sample Description

The data used in this dissertation come from the *College Lifestyle and Wellbeing Study*, a survey of undergraduate and graduate students in a large public university in Southern California. The study was a cross-sectional survey collected between spring of 2009 and spring of 2010 (See Chapter 3 for a complete description of the methods). For the present study, only students who consented to participate in the 7-day food intake questionnaire portion of the study were included. Students with more than four days of missing food data were excluded, resulting in the sub-sample of 690 students that comprise the analytic sample.

Measures

Dependent Variable

Obesity. In the present analyses, obesity is a binary variable defined as (0) *under/normal weight* and (1) *overweight/obese*. These categories were based on calculated body mass index

(BMI) from respondents' weight and height. BMI is generally defined as: underweight (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), obese (and > 30 kg/m²). BMI is a widely used index as a screening tool and indicator of body fat, obesity, and clinical outcomes (CDC, 2015).

Independent Variables

Psychological Distress. Psychological distress is a continuous variable derived from two measures, the Perceived Stress Scale and Affect Balance Scale. A composite score of the two scales is computed, with range of 0-80 and higher score indicating more distress. The *Perceived Stress Scale* (PSS) is a widely used measure developed by Cohen, Kamarck and Mermelstein (1983) for assessing the degree to which people feel their lives are uncontrollable, unpredictable, and overloaded, and it includes questions that ask directly about the levels of stress they are currently experiencing. Four positive items were reversed scored, and all 10 items summed to derive a total score, with higher values indicating more perceived stress. Cronbach's alpha = .85. The *Affect Balance Scale* (ABS: Bradburn, 1969) is a measure of psychological well-being used extensively in a wide variety of settings and populations (Bolin & Dodder, 1990). It is a 10-item rating scale containing five statements reflecting positive feelings and five statements reflecting negative feelings. Five positive affect items were reversed scored, and all 10 items summed to derive a total score, with higher values indicating more negative affect. Cronbach's alpha = .74.

Health Behaviors. *Eating habits* is operationalized as seven-day total frequency of consumption of *fruits* and *vegetables* (healthy behavior), seven-day frequency of *snacks and sweets* (unhealthy behavior), and seven-day frequency of *fast foods* (unhealthy behavior). Healthy eating is assessed using the two items "How often did you eat fruits today?" and "How often did you eat vegetables today?" Responses ranged from (0) = none to (5) = 5+ times per day. Unhealthy eating is assessed using the two items "How often did you eat snacks and sweets today?" and "How often did you eat fast foods today?" Examples of snacks and sweets are chips, candies, cookies, ice cream, cake, donuts, pudding, etc. Examples of fast foods provided to the

participants include all types of burgers, fried foods, tacos, hot dogs, pizzas, etc. Responses for frequency of eating snacks/sweets/fast food ranged from (0) = none to (5) = 5+ times per day.

Physical activity is operationalized as frequency of vigorous/moderate aerobic activities (e.g., running, swimming, brisk walking) and strengthening/toning activities (e.g., push-ups, sit-ups, weight lifting) during the past seven days. Responses ranged from 1 = “never” to 5 = “5-7 days per week.”

Sleep habit is operationalized as duration of sleep in hours per night. Respondents were asked the open-ended question, “During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spent in bed.)”

Covariates

Individual Characteristics. Health disparities across various sociodemographic groups such as age, gender and race, as well as psychosocial factors such as financial strain are well established. For example, women tend to report higher levels of perceived stress than men; women in general, have more fat than men; and non-Hispanic blacks and Hispanics are disproportionately affected by obesity. Within the limits of available data collected in the *Student Health Survey*, the following variables were included: age, race/ethnicity, nativity status, class standing/year in college, grade points average (GPA), units enrolled, hours employed, and financial strain. Age is a continuous variable with a range of 17-66 years. There are five *race/ethnicity* groups: Asian/Pacific Islander, Hispanic/Latino, Black/African American, White, non-Hispanic (reference group), and Multi-race/other (which include Native and Alaskan American). *Nativity* status was assessed by a yes/no question, “Were you born in the U.S.?” with U.S. born coded as the reference group. *Year in college* comprise of the following categories: freshman (reference group), sophomore, junior, senior, graduate/post-bac. *GPA* is an ordinal variable categorized into four categories: mostly As (3.5-4.0), mostly Bs (3.0-3.4), mostly Cs (2.5-2.9), and Cs and below (less than 2.4). *Number of units* is a continuous variable assessed by an open-ended question, “How many units are you taking this semester?” Students who answered

“yes” to the question, “Are you employed?” reported their average *hours of work* per week. *Financial strain* is an ordinal variable assessed by students’ rating of their satisfaction with their material comforts, including home, food, conveniences, and financial security on a scale of (1) = *terrible* to (7) = *delighted*. Response scale was reverse scored such that higher value indicate more financial strain.

Social Context Factors. Young adults on college campuses are exposed to, and experience, unique social and contextual factors that influence health and health behaviors (Beck et al., 2008; Emmons, 2000; Stockdale, et al. 2007). Within the limits of available data collected in the *Student Health Survey*, the following variables were included as indicators of social context factors: *Living arrangement* is a discrete variable with five categories: parents (reference group), dormitory/university housing, non-university housing/apartments, significant other/spouse/partner, other relatives, and fraternity or sorority house. Participation in social or extracurricular organizations/activities included the following binary yes/no items: “Are you currently a member of an *intercollegiate athletic* team?”, “Are you a member of a *recreational sports* team?” and “Are you a member of a *fraternity or sorority*?”

Analytic Strategy

All analyses were conducted using SPSS 25 using gender split design with significance determined at $p < .05$ and 95% confidence interval.

Univariate and Bivariate Analyses

Univariate distributions of all predictor and outcome variables were examined with histograms, frequencies or percentages, measures of central tendency (e.g., means, median) and dispersion (e.g., range, standard deviation). Non-normally distributed data were log-transformed. Due to expected differences between males and females on the outcome variable, analyses were split by gender. Bivariate associations among individual characteristics, college social context factors, psychological distress, health behaviors and obesity were tested using Chi-square if both

IV and DV are categorical, t-test or ANOVA if IV is categorical and DV is continuous, and Pearson correlation for continuous IVs and DVs.

Multivariate Analysis

Assumptions for multiple linear regression were first examined, including linearity, normality, homoscedasticity, independence, and multicollinearity. The *F*-statistic was used to determine if the regression model created is a valid or robust model in predicting the dependent variable. The R^2 statistic was used to show if the regression model has a strong or weak explanatory power. The beta coefficients of the regression were examined to determine the magnitude of the contributions of the independent variables on the dependent variable. The sign of the regression coefficient indicates whether the relationship between the independent and dependent variables is positive or negative.

Logistic regression was conducted on aims with a binary dependent variable. The model produced by logistic regression is based on a nonlinear function of the best linear combination of predictors, and the linear regression equation creates the logit or log of the odds. For the test results, goodness-of-fit test was used to evaluate the models, Wald test was used to evaluate the contribution of individual predictors, Nagelkerke R square was used to determine strength of association. The B coefficients are the natural logs of the odds ratio, or odds ratio = e^B . Odds ratios greater than 1 indicate an increase in odds of an outcome of 1 with a one-unit increase in the predictor. Conversely, odds ratio less than 1 indicate a decrease in odds.

Aim 1 was tested by regressing each of the lifestyle health behaviors: 1) *healthy eating index*: sum of z-score transformed fruits, vegetables, reversed snacks/sweets, reversed fast food; 2) *physical activity index*: sum of z-score transformed vigorous/moderate and strengthen/toning activities; and 3) *sleep* on individual characteristics and college social context factors using multiple OLS linear regression because each of the health behavior variables is a continuous variable. Each domain of health behavior (i.e., diet, physical activity, and sleep) was tested separately as outcome variables. In the first model, all individual characteristics were entered as

independent variables and a health behavior as the dependent variable. In model two, all college social context factors were entered as independent variables and a health behavior as the dependent variable. Last, in the full model, the individual characteristics were inputted as block one, followed by college social context factors in block two using the enter method with a health behavior as the dependent variable. Hence, the regression equation for the full model of research aim one is:

$$Y_{\text{Health behavior}} = A_{\text{Constant}} + B_1X_{\text{Age}} + B_2X_{\text{Race/Ethnicity}} + B_3X_{\text{Nativity}} + B_4X_{\text{Year in College}} + B_5X_{\text{GPA}} + B_6X_{\text{Full-time Enrollment}} + B_7X_{\text{Employment}} + B_8X_{\text{Financial Strain}} + B_9X_{\text{Living Arrangements}} + B_{10}X_{\text{Intercollegiate Sports}} + B_{11}X_{\text{Recreational Sports}} + B_{12}X_{\text{Greek Membership}}$$

Aim 2 was tested by regressing each lifestyle health behaviors 1) *healthy eating index*; 2) *physical activity index*; and 3) *sleep* on psychological distress using multiple OLS linear regression. Each of the health behavior (i.e., diet, physical activity, and sleep) will be tested separately as outcome variables. In the first model, psychological distress was entered as independent variables and a health behavior as the dependent variable. In model two, psychological distress was entered in the first block and social context factors as the second block. In the full model, distress was inputted as block one, followed by college social context factors in block two, and individual characteristics inputted as block three using the enter method with a health behavior as the dependent variable. The regression equation for the full model of research aim two is:

$$Y_{\text{Health behavior}} = A_{\text{Constant}} + B_1X_{\text{Age}} + B_2X_{\text{Race/Ethnicity}} + B_3X_{\text{Nativity}} + B_4X_{\text{Year in College}} + B_5X_{\text{GPA}} + B_6X_{\text{Full-time Enrollment}} + B_7X_{\text{Employment}} + B_8X_{\text{Financial Strain}} + B_9X_{\text{Living Arrangements}} + B_{10}X_{\text{Intercollegiate Sports}} + B_{11}X_{\text{Recreational Sports}} + B_{12}X_{\text{Greek Membership}} + B_{13}X_{\text{Psychological Distress}}$$

Aim 3 was tested with using logistic regression as obesity is a binary variable. Four separate models were tested to examine each health behavior domains in the association

between psychological distress and obesity. In the first model, psychological distress was inputted as block one with individual and social context as covariates and healthy eating index entered as block two. In the second model, psychological distress was inputted as block one with individual and social context as covariates and physical activity index entered as block two. In the third model, psychological distress was inputted as block one with individual and social context as covariates and hours of sleep entered as block two. Last, in the full nested model, psychological distress was inputted as block one with individual and social context as covariates, then all three types health behaviors as block two, and as block three using the enter method with obesity as the dependent variable.

Aim 4 was tested with logistic regression. Here, psychological distress is the independent variable (continuous), health behaviors are the moderating variables (continuous), and obesity is the dependent variable (dichotomous). To test the moderation effect of health behaviors, three interaction terms were created: distress x healthy eating, distress x physical activity, and distress x sleep. A significant interaction term would indicate a particular health behavior moderates the distress-obesity relationship. The independent variable and interaction terms were mean centered to reduce multicollinearity in the regression models. In each model, the interaction terms were added to the moderated logit model. Hence, full logit model would be:

$$\begin{aligned} \text{logit}[P(Y=1)]_{\text{Obesity}} = & A_{\text{Constant}} + B_1X_{\text{Age}} + B_2X_{\text{Race/Ethnicity}} + B_3X_{\text{Nativity}} + B_4X_{\text{Year in College}} + \\ & B_5X_{\text{GPA}} + B_6X_{\text{Full-time enrollment}} + B_7X_{\text{Employment}} + B_8X_{\text{Financial Strain}} + B_9X_{\text{Living Arrangements}} + \\ & B_{10}X_{\text{Intercollegiate Sports}} + B_{11}X_{\text{Recreational Sports}} + B_{12}X_{\text{Greek Membership}} + B_{13}X_{\text{Distress Centered}} + \\ & B_{14}X_{\text{Health Behavior Centered}} + B_{15}X_{\text{Distress Centered}} * \text{Health Behavior Centered} \end{aligned}$$

Graphical figures were generated to facilitate interpretation of the interactions. Gender stratified analysis were conducted in all models to examine variations within female and male students in the distress-health-behaviors-obesity relationship.

Results

Sample Characteristics

Table 5.1 shows the descriptive statistics of the key study variables stratified by gender. The mean age of the sample was 22.15 ($SD = 4.74$) and born in the U.S. (83.6%). The racial composition was 33.3% White/non-Hispanic, 24.6% Hispanic/Latino, 26.3% Asian/Pacific Islander, 11.7% Multi-race/other, and 4.1% Black/African American. The majority of the students were upperclassmen comprising of juniors and seniors (70.4%), enrolled full-time (88.5%), and living with parents/relatives (60.4%). Approximately 29% of the students were either overweight or obese. The mean score for psychological distress was 32.7 ($SD = 10.4$, range 0-80). As expected, significant gender differences were found across BMI categories and psychological distress. More males than females were overweight or obese ($p < .001$), and females reported higher levels of distress than did males ($p < .01$). For health behaviors, more males than females engaged in higher frequencies of moderate/vigorous and strengthen/toning physical activities. Gender differences also were found with individual characteristics of race and GPA. Among social context factors, significant gender variations were found across all variables with the exception of Greek membership.

Table 5.1

Study 2 - Descriptive Statistics of Study Variables by Gender, College Lifestyle and Wellbeing Study (N=690)

Variables (range)	Full % or M (SD)	Male % or M (SD)	Female % or M (SD)
BMI***			
Under/Normal Weight	71.3	60.0	76.0
Overweight/Obese	28.7	40.0	24.0
Psychological Distress			
Distress Composite (0-80)**	32.66 (10.38)	30.81 (10.38)	33.39 (10.29)
Health Behaviors			
Vegetable Frequency			
0 times per day	1.4	12.3	0.6
1-2 times per day	96.3	57.2	97.3
>3 times per day	2.2	30.5	2.1
Fruit Frequency			
0 times per day	8.9	14.8	6.6
1-2 times per day	88.6	81.8	91.1

>3 times per day	2.5	3.5	2.3
Moderate/Vigorous Physical Activity***			
0 days	18	12.3	16.3
1-3 days	57.1	57.2	57.7
>4 days	24.8	30.5	26
Strengthen/Toning Physical Activity***			
0 days	32.6	21.2	35
1-3 days	50.8	49.2	50.8
>4 days	16.6	29.6	14.2
Sleep			
<5 hrs	12.6	10.3	10.1
5-7 hrs	56.1	54.2	58
>7 hrs	31.3	35.5	31.9
Individual Characteristics			
Age (17-66)	22.15 (4.74)	22.3 (3.75)	22.09 (5.11)
Gender		29.6	70.4
Race**			
White non-Hispanic	33.3	35.5	32.2
Hispanic/Latino	24.6	22.7	25.6
Asian/Pacific Islander	26.3	33	23.6
Black/African American	4.1	2.5	4.5
Multi-race/Other	11.7	6.5	14
U.S. Born	83.6	84.8	82.9
Class Level			
Freshman	12.3	13.2	11.8
Sophomore	15.6	10.8	17.6
Junior	34.7	33.3	35.2
Senior	35.7	40.7	34
Post Bac/Graduate	1.6	2	1.4
GPA*			
Mostly As	23.4	20.7	24.5
Mostly Bs	38.5	35	39.8
Mostly Cs	31.3	33.5	30.5
Cs and below	6.8	10.8	5.2
Full-Time Enrollment (12+ units)	88.5	89.7	88.1
Employment per week			
Not employed	37.5	41.7	35.4
1-19 hrs	22	24	21.2
20-29 hrs	25.6	19.6	28.4
>30 hrs	14.8	14.7	15
Financial Strain (1-7)	2.86 (1.29)	2.77 (1.28)	2.90 (1.29)
Social Context Factors			
Living Arrangement**			
Parents or relatives	60.4	63.8	59.3
Spouse/Significant other	8.4	3.4	10.5
Apartments	22.2	25.5	20.7
University housing/Dorms	6.5	5.4	6.8
Fraternity/Sorority	2.5	2	2.7
Intercollegiate Sports**	1.7	3.9	0.8
Recreational Sports***	8.9	17.6	5.4
Greek Membership	7.3	4.9	8.5

Note. Gender differences tested with t-test for continuous and Chi-square for categorical variables.

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

Risk and Protective Factors for Health Behaviors

Dietary Behavior. Table 5.2 depicts the multivariate OLS regression analysis for Aim 1 examining the association between health behaviors, individual characteristics, and social context factors stratified by gender. Among males, individual characteristics of multi-race was *positively* associated with healthy eating index ($B = 1.71$; $\beta = 0.16$, $p < .05$), after adjusting for social context factors. Social context factors were not associated with healthy eating. The full model explained about 6% of the variance in eating behavior for males. Among females, individual characteristics of Hispanic ($B = -0.55$; $\beta = -0.11$, $p < .05$) and black ($B = -1.31$; $\beta = -0.12$, $p < .05$) were *negatively* associated with healthy eating, after adjusting for social context factors. Social context factors of living in dorms ($B = -0.86$; $\beta = -0.10$, $p < .05$) and sorority membership ($B = -1.12$; $\beta = -0.14$, $p < .01$) were *negatively* associated with healthy eating. On the other hand, living with a partner/significant other ($B = 0.87$; $\beta = 0.12$, $p < .05$) and intercollegiate sports ($B = 2.37$; $\beta = 0.10$, $p < .05$) were *positively* associated with healthy eating. However, Greek membership became marginally significant ($p = 0.06$) and only intercollegiate sports remained significant ($p = .027$) after adjusting for individual characteristics. Both individual characteristics and social context factors accounted for 8% of the variance in eating behavior for females.

Physical Activity. Among males, individual characteristics of post-bac or graduate level standing was *negatively* associated with physical activity (PA) index ($B = -3.04$; $\beta = -0.21$, $p = .01$), after adjusting for social context factors. Social context factors of Greek housing was *negatively* associated with PA ($B = -2.46$; $\beta = -0.20$, $p < .01$), and dorms approached significance ($B = -1.16$; $\beta = -0.15$, $p = .055$) after adjusting for individual characteristics. As expected, intercollegiate sports ($B = 1.97$; $\beta = 0.22$, $p < .01$), and recreational sports ($B = 1.21$; $\beta = 0.26$, $p < .001$) were *positively* associated with PA, after adjusting for individual characteristics. The full model explained about 18% of the variance in PA for males. Among females, all individual characteristics of race with the exception of blacks were *negatively* associated with PA index, after adjusting for social context factors. Higher class standing (i.e., sophomores, juniors, and

seniors) were also associated with less PA. Similar to males, social context factors of intercollegiate sports ($B = 2.95$; $\beta = 0.15$, $p < .001$), and recreational sports ($B = 0.77$; $\beta = 0.10$, $p < .05$) were *positively* associated with PA, after adjusting for individual characteristics. Living in dorms was *positively* associated with PA ($B = 1.00$; $\beta = 0.14$, $p < .01$), but only in the unadjusted model. Both individual characteristics and social context factors accounted for 8% of the variance in physical activity for females.

Sleep Habit. Among males, individual characteristics of employment hours was *negatively* associated ($B = -0.03$; $\beta = -0.37$, $p < .001$), but junior class standing was *positively* associated with hours of sleep ($B = 0.84$; $\beta = 0.31$, $p < .05$), after adjusting for social context factors. Social context factors were not associated with sleep. The full model explained about 15% of the variance in sleep hours for males. Among females, individual characteristics of age ($B = -0.04$; $\beta = -0.18$, $p < .01$), Asian ($B = -0.41$; $\beta = -0.15$, $p < .05$), and employment hours ($B = -0.02$; $\beta = -0.21$, $p < .001$) were *negatively* associated with sleep, after adjusting for social context factors. Similar to males, social context factors were not associated with sleep. Both individual characteristics and social context factors accounted for 10% of the variance in sleep hours for females.

Taken together, findings from Aim 1 indicated that social context was associated with PA for both genders, but only associated with dietary behavior among women, suggesting gendered patterns in risk and protective factors. There was also a shared risk factor; individual characteristics of employment was associated with less sleep for both male and female students.

Table 5.2

OLS Regression Summary of the Association between Individual Characteristics, Social Context Factors, and Health Behaviors Stratified by Gender, College Lifestyle and Wellbeing Study, 2009-2010

	Dietary Behavior				Physical Activity				Sleep			
	Male		Female		Male		Female		Male		Female	
	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β	<i>B</i> (<i>SE</i>)	β
Individual Characteristics												
Age	-0.03 (0.07)	-0.05	0.04 (0.03)	0.09	0.04 (0.05)	0.09	0.01 (0.02)	0.02	0.03 (0.03)	0.10	-0.04 (0.01)	-0.18**
Nativity (ref. U.S. Born)	0.66 (0.57)	0.09	0.36 (0.29)	0.06	-0.20 (0.36)	-0.04	-0.15 (0.22)	-0.03	0.14 (0.26)	0.04	0.18 (0.16)	0.06
Race												
White (referent)												
Hispanic/Latino	-0.77 (0.53)	-0.12	-0.55 (0.28)	-0.11*	-0.62 (0.33)	-0.15 [†]	-0.50 (0.21)	-0.12*	-0.33 (0.25)	-0.11	-0.27 (0.15)	-0.10 [†]
Asian	0.11 (0.49)	0.02	-0.21 (0.30)	-0.04	0.51 (0.31)	0.14 [†]	-0.54 (0.23)	-0.13*	-0.22 (0.23)	-0.08	-0.41 (0.16)	-0.15*
Black/African American	-0.27 (1.27)	-0.02	-1.31 (0.51)	-0.12*	1.02 (0.79)	0.09	-0.41 (0.40)	-0.05	-0.98 (0.58)	-0.12 [†]	-0.52 (0.27)	-0.09 [†]
Multi-Race/Other	1.71 (0.83)	0.16*	-0.34 (0.33)	-0.05	0.33 (0.52)	0.05	-0.56 (0.26)	-0.11*	-0.16 (0.38)	-0.03	-0.32 (0.18)	-0.09 [†]
Class Standing												
Freshmen (referent)												
Sophomore	-1.08 (0.82)	-0.13	-0.42 (0.41)	-0.07	-0.81 (0.52)	-0.14	-0.69 (0.31)	-0.15*	0.65 (0.38)	0.16 [†]	0.25 (0.22)	0.08
Junior	1.06 (0.73)	0.19	0.03 (0.38)	0.01	-0.65 (0.46)	-0.17	-0.63 (0.30)	-0.17*	0.84 (0.34)	0.31*	0.36 (0.21)	0.14 [†]
Senior	-0.04 (0.78)	-0.01	-0.25 (0.40)	-0.05	-0.87 (0.49)	-0.24 [†]	-0.65 (0.31)	-0.17*	0.08 (0.36)	0.03	0.37 (0.22)	0.15 [†]
Post-bac/Graduate	-0.82 (1.88)	-0.04	0.72 (0.92)	0.04	-3.04 (1.17)	-0.21***	-0.58 (0.71)	-0.04	-0.33 (0.86)	-0.03	0.36 (0.49)	0.04
GPA	0.39 (0.21)	0.14 [†]	0.12 (0.12)	0.05	0.00 (0.13)	0.00	0.09 (0.10)	0.04	0.14 (0.10)	0.11	-0.09 (0.07)	-0.07
Units Enrolled	-0.05 (0.07)	-0.06	-0.03 (0.04)	-0.04	0.05 (0.05)	0.07	0.02 (0.03)	-0.04	-0.03 (0.03)	-0.06	-0.03 (0.02)	-0.07
Hours Employed	0.01 (0.02)	0.04	0.01 (0.01)	0.08 [†]	-0.00 (0.01)	0.00	-0.01 (0.01)	-0.10 [†]	-0.03 (0.01)	-0.37***	-0.02 (0.00)	-0.21***
Financial Strain	-0.23 (0.16)	-0.11	-0.01 (0.08)	-0.01	-0.13 (0.10)	-0.10	-0.07 (0.06)	-0.05	-0.04 (0.07)	-0.04	-0.07 (0.04)	-0.07
Social Context Factors												
Living Arrangement												
Parents (referent)												
Spouse/Sig Other	0.88 (1.14)	0.06	0.43 (0.38)	0.06	-0.75 (0.71)	-0.08	-0.10 (0.30)	-0.02	-0.61 (0.52)	-0.09	0.18 (0.20)	0.05
Relatives	0.02 (0.83)	0.00	-0.71 (0.61)	-0.05	-0.40 (0.52)	-0.06	-0.44 (0.48)	-0.04	-0.45 (0.38)	-0.09	0.32 (0.33)	0.05
Apartments	0.17 (0.45)	0.03	-0.35 (0.27)	-0.06	0.07 (0.28)	0.02	0.12 (0.21)	0.03	-0.21 (0.21)	-0.07	0.20 (0.14)	0.07
University Housing/Dorms	-0.49 (0.96)	-0.04	-0.77 (0.46)	-0.08 [†]	-1.16 (0.60)	-0.15 [†]	0.30 (0.36)	0.04	0.47 (0.44)	0.08	0.26 (0.25)	0.05
Fraternity/Sorority	-1.51 (1.39)	-0.08	-0.59 (0.64)	-0.04	-2.46 (0.87)	-0.20**	0.01 (0.50)	0.00	0.55 (0.64)	0.06	0.39 (0.34)	0.05
Intercollegiate Sports	-1.51 (1.02)	-0.11	2.50 (1.12)	0.10*	1.97 (0.64)	0.22**	2.95 (0.87)	0.15**	0.28 (0.47)	0.04	-1.12 (0.60)	-0.09 [†]
Recreational Sports	0.83 (0.52)	0.12	-0.23 (0.45)	-0.02	1.21 (0.32)	0.26***	0.77 (0.35)	0.10*	0.12 (0.24)	0.04	0.08 (0.24)	0.01
Greek Membership	-1.02 (0.94)	-0.08	-0.73 (0.39)	-0.09 [†]	0.48 (0.59)	0.06	0.02 (0.30)	0.00	0.38 (0.43)	0.06	-0.13 (0.21)	-0.03
Constant	0.25		-0.50		-0.13		0.38		6.25		8.71	
Adjusted R ²	0.06		0.08		0.18		0.08		0.15		0.05	
<i>F</i>	1.55 [†]		2.90***		2.93***		2.85***		2.52***		2.16**	

[†] $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Psychological Distress and Health Behaviors

Unadjusted Model. Among males, distress was *negatively* associated with healthy eating ($B = -0.04$; $\beta = -0.17$, $p < .05$) and physical activity ($B = -0.02$; $\beta = -0.13$, $p < .05$). Distress was not significantly associated with sleep ($B = -0.02$; $\beta = -0.13$, $p = .074$). Among females, distress was *negatively* associated with healthy eating ($B = -0.04$; $\beta = -0.20$, $p < .001$), physical activity ($B = -0.03$; $\beta = -0.18$, $p < .001$), and sleep ($B = -0.01$; $\beta = -0.10$, $p < .05$).

Adjusted Model. Among males, healthy eating was marginally significant after accounting for individual and social context factors ($B = -0.04$; $\beta = -0.16$, $p = .053$). Physical activity was no longer significant after accounting for individual and social context factors. Sleep remained nonsignificant. Among females, health eating ($B = -0.04$; $\beta = -0.20$, $p < .001$), physical activity ($B = -0.03$; $\beta = -0.17$, $p < .001$), and sleep ($B = -0.01$; $\beta = -0.13$, $p < .01$) all remained significant after controlling for individual and social context factors.

Table 5.3 depicts the multivariate OLS regression analysis for Aim 2 examining the association between psychological distress and health behaviors stratified by gender. Overall, results from Aim 2 showed that psychological distress was associated with less healthy eating among males, and distress was associated with all three domains of health behaviors among females.

Table 5.3

Gender Stratified OLS Regression Analysis of Psychological Distress and Health Behaviors, College Lifestyle and Wellbeing Study, 2009-2010

	Unadjusted			Adjusted		
	B (SE)	β	Adj R^2	B (SE)	β	Adj R^2
Dietary Behavior						
Male	-0.04 (0.02)	-0.17*	0.02	-0.04 (0.02)	-0.16 [†]	0.07
Female	-0.04 (0.01)	-0.20***	0.04	-0.04 (0.01)	-0.20***	0.11
Physical Activity						
Male	-0.02 (0.01)	-0.14*	0.02	-0.02 (0.01)	-0.12 [†]	0.20
Female	-0.03 (0.01)	-0.18***	0.03	-0.03 (0.01)	-0.17***	0.10
Sleep						
Male	-0.02 (0.01)	-0.13 [†]	0.01	-0.01 (0.01)	-0.10	0.15
Female	-0.01 (0.01)	-0.10*	0.01	-0.01 (0.01)	-0.13**	0.06

Note. Beta weights are adjusted for individual characteristics (age, race, nativity, class standing, GPA, enrollment, employment, financial strain) and social context factors (living arrangement, intercollegiate sports, recreational sports, Greek membership).

[†] $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.

Psychological Distress, Health Behaviors, and Obesity

Among males, distress was not associated with obesity, net of individual and social context factors (OR = 1.00, 95% CI = 0.96, 1.04). Health behaviors of diet, PA, and sleep did not improve model fit, net of individual and context factors. The combination of all three health behaviors were not significant in the full model and there was no significant distress x health behaviors interaction. Among females, distress was positively associated with obesity, net of individual and social context factors (OR = 1.03, 95% CI = 1.01, 1.06). Distress remained significant with dietary behavior in the model (OR = 1.03, 95% CI = 1.01, 1.05), as well as PA (OR = 1.03, 95% CI = 1.01, 1.05) and sleep (OR = 1.03, 95% CI = 1.01, 1.05). Both diet and PA were not associated with obesity net of distress and the covariates. However, sleep was negatively associated with obesity (OR = 0.81, 95% CI = 0.66, 0.99), net of all other variables. Although the odds ratio and confidence interval for distress remain relatively unchanged in the full model, Wald test statistic indicated no significant association between distress and obesity after accounting for

diet, PA, and sleep simultaneously ($p = .102$). In addition, all three health behaviors were not significant in the full model and there was no significant distress x health behaviors interaction.

Table 5.4 shows the nested logistic regression models separately for males and females.

Table 5.4a

Multivariate Logistic Regression Summary of Psychological Distress, Health Behaviors, and Obesity among Male College Students, College Lifestyle and Wellbeing Study, 2009-2010

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Psychological Distress	0.97	0.92, 1.03	0.97	0.92, 1.03	0.98	0.92, 1.04
Dietary Behavior			0.97	0.80, 1.17	0.97	0.78, 1.21
Physical Activity			1.05	0.77, 1.42	1.18	0.85, 1.64
Sleep			1.25	0.86, 1.81	1.44	0.94, 2.20
Distress x Diet					1.02	0.99, 1.05
Distress x PA					1.01	0.97, 1.05
Distress x Sleep					0.97	0.93, 1.01

Note. Odds ratio are adjusted for individual characteristics (age, race, nativity, class standing, GPA, enrollment, employment, financial strain) and social context factors (living arrangement, intercollegiate sports, recreational sports, Greek membership).

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

Table 5.4b

Multivariate Logistic Regression Summary of Psychological Distress, Health Behaviors, and Obesity among Female College Students, College Lifestyle and Wellbeing Study, 2009-2010

	Model 1		Model 2		Model 3	
	OR	95% CI	OR	95% CI	OR	95% CI
Psychological Distress	1.03*	1.00, 1.07	1.03	1.00, 1.06	1.02	0.99, 1.06
Dietary Behavior			0.94	0.82, 1.07	0.95	0.83, 1.08
Physical Activity			0.90	0.75, 1.08	0.89	0.73, 1.07
Sleep			0.81	0.62, 1.04	0.82	0.63, 1.06
Distress x Diet					1.00	0.98, 1.01
Distress x PA					1.01	0.99, 1.03
Distress x Sleep					0.99	0.96, 1.02

Note. Odds ratio are adjusted for individual characteristics (age, race, nativity, class standing, GPA, enrollment, employment, financial strain) and social context factors (living arrangement, intercollegiate sports, recreational sports, Greek membership).

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

Overall, results from Aim 3 and 4 revealed there are gendered patterns in the relationship between distress, health behaviors, and obesity. Among males, distress was not associated with obesity with or without health behaviors in the model. Dietary behavior, physical activity, and sleep did not improve model fit separately or collectively. Among females, distress was associated with obesity with and without health behaviors in the model, adjusting for individual and social context factors. Health behaviors did not moderate the association between distress and obesity for both genders.

Discussion

Public health efforts to address the increasing rates of college obesity have primarily focused on behavioral interventions, overlooking psychological distress as a key determinant of both health behaviors and obesity. However, understanding the complex links among psychosocial and behavioral factors may be critical to curbing the rising obesity rate. The purpose of the present study was to examine multiple domains of health behaviors as risk and protective factors in the association between psychological distress and obesity among college students.

What Shapes Health Behaviors for College Students?

Most college students are young adults in their late teens to mid- or late 20s, a distinct period of development known as *emerging adulthood* (Arnett, 2014). Health habits adopted during this formative stage could have lasting health implications, including overweight and obesity. Findings from this study indicated that a constellation of individual, contextual, and psychosocial factors uniquely shape health behaviors among this population. For many college students, balancing school-work demand is a major stressor, as evidenced in the fewer hours of sleep with increasing hours of employment. Among both men and women, higher level of distress is associated with less healthy eating habits. Among females, distress is also associated with less physical activity and fewer hours of sleep. Importantly, social context of college played a key role in shaping health behaviors. First, Greek membership is associated with less healthy eating habits among females. Second, off-campus living posed both as risk and protective factor for negative

health behaviors. Female students living in dorms were more likely to have unhealthy eating habits, but also reported more physical activity. On the other hand, male students living in Greek housing is associated with less physical activity.

These pattern of results suggest that social context matters among the college population, that it differs for women and men, and is behavior specific. This sheds additional light on the nuanced relationship between context, behavior, and obesity risk that is critically lacking in extant knowledge. The findings also highlight the importance of social context in influencing what environmental affordances are present for a student. For example, the unhealthy eating habits can be linked to more social gatherings along with increased use of alcohol and consumption of “junk” food among close-knit peer groups, such as Greek organizations (Scott-Sheldon et al., 2016). The increase in physical activity among female college students may further explain why Greek membership may serve as an enjoyable activity that helps students cope with stress (Luk, Fairlie, & Lee, 2017), thereby decreasing obesity risk through healthy lifestyle habits and lower levels of distress.

Current findings are consistent with prior research showing a negative association between depression and health behaviors (e.g., Doane, Gress-Smith, & Breitenstein, 2015; Roshanaei-Moghaddam, Katon, & Russo, 2009; Schweinfurth et al., 2016). Interestingly, among males, eating behavior was not associated with distress once individual and social context factors were considered. Examination of individual food groups showed that snacks and sweets consumption is not associated with individual and social context factors for both genders, but is associated with distress. This is consistent with the stress-eating hypothesis (Morris, Beilharz, Maniam, Reichelt, & Westbrook, 2015), that individuals tend to increase consumption of higher calorie, or “comfort” foods when under distress. However, fast food was not associated with distress for both genders. This suggests that fast food, given its affordability and convenience, is ubiquitous among college students and less likely to be influenced by other proximal or distal factors.

These findings are important because not only do they highlight the need to consider psychological wellbeing in our understanding of health behaviors and obesity risk, but also contextualizing the behavior within the college experience. Focusing primarily on changing behavior but neglecting the context that shapes them is likely one factor that overweight and obesity rates remain high among the college population. The observed differences among the gender groups points to the need to tailor prevention and intervention efforts separately for men and women college students, with women's eating habits more influenced by social context. Future studies will want to explore the reasons for the various gendered patterns.

Are Health Behaviors the Reason Why Distress Has Such a Negative Impact on Obesity?

Distress is a significant risk factor of obesity, particularly among women. The increased odds holds even after accounting for individual and social context factors. Interestingly, health behaviors did not have the level of impact as one would expect based on prior literature. Both dietary behavior and physical activity did not explain the association between distress and obesity.

Another important finding that emerged from the present analysis is that although sleep did not explain the distress-obesity linkage, it was the only significant behavioral predictor of obesity, net of all individual, context, and distress factors. Specifically, fewer hours of sleep was associated with increased odds of obesity. This relationship has been documented across various populations in previous research, including children, adolescents, and college students (Fatima & Mamun, 2015; Kahlhöfer, Karschin, Breusing, & Bosy-Westphal, 2016). However, few studies have examined sleep in the context of distress and obesity. The present study revealed that not only is lack of sleep a risk factor for obesity, it is also associated with higher levels of psychological distress. Thus, a new point of obesity intervention on campuses may be focusing on ways to help students manage their level of distress, time, and sleep quality.

Overall, the current results indicate that health behaviors, although important in overweight and obesity, were not the key mechanism in the distress-obesity linkage. Instead, the evidence suggest that distress may independently shape obesity risk. This is highly significant within the

college context, given the majority of students experience some form of psychological distress. Hence, campuses will want to continue targeting behavioral interventions as well as incorporate strategies for reducing distress.

Do Negative Behaviors Make the Impact of Distress on Obesity Worse? Do Positive Behaviors Protect Against the Effects of Distress on Obesity?

In general, results from Aim 4 of the present analysis showed no significant interaction between distress and health behavior index variables. However, examining individual food types revealed that the impact of distress on obesity was worse for men who consumed more “junk” food (See Appendix A). In other words, odds of obesity is higher among males who had higher level of distress and more frequency of snacks and sweets consumption than males with less frequency of snacks and sweets consumption. This is surprising, as prior work have reported that women are more likely to be emotional eaters and unhealthy eaters during stress (Leske et al., 2015; Oliver, Wardle, & Gibson, 2006). One possible explanation for this finding is that women in general consume more snacks and sweets than do men, and thus a potential ceiling effect. Indeed, more female than male students in the present study reported consuming at least one or more times of snacks and sweets per day (81.3% vs. 68%). Another possibility is that instead of eating in response to distress, female college students may be responding or coping with distress in different ways. Future research may want to explore other non-behavioral factors, and also place more emphasis on psychological distress intervention among male students.

Limitations

These results should be interpreted within the context of several limitations. One limitation of the present analysis is the representativeness of the sample. There were twice as many female than male students who participated in the 7-day food intake portion of the study, thereby limit the generalizability of the findings. However, with the exception of race and GPA, there were no significant differences between gender groups in terms of individual and sociodemographic characteristics. In addition, although the data source is racially and economically diverse that

mirrors Orange County demographics, it is nonetheless a regional sample. The nature and impact of social context may vary greatly across U.S. colleges due to geographical region (e.g., rural vs. urban), size and enrollment (e.g., large vs. small), and campus culture (e.g., party vs. sports), thus creating distinct risk and protective factors that shape distress, behavior, and obesity. Similarly, there are other contextual factors that are important to consider beyond those examined in the present study, such as campus-wide policies, departmental level support, other clubs/organizations, and social resources among students. Future research will want to consider these college-specific social context factors as they may individually or collectively model and influence health behaviors, and more importantly, provide the environmental affordances that could either protect or exacerbate students' risk for obesity.

Strengths and Contributions

A primary strength of this study is the examination of the pathways linking psychological distress, health behaviors, and obesity separately for women and men. This approach revealed gendered patterns and the nuanced relationship among these key variables. In addition, social context matters in shaping the relationship between psychological distress and unhealthy lifestyle behaviors. This illustrates the distinct risk and protective factors college students face, creating or exacerbating negative behaviors or promote positive behaviors. Social context factors are more likely to influence female students' frequency of eating healthy food, but more likely to influence male students' frequency of engaging in physical activity.

Another conceptual strength of the present study is the inclusion of multiple domains of lifestyle health behaviors—a departure from most obesity research which focuses on dietary behavior. This study indicates that sleep may be key in combating the obesity epidemic, as it is associated with both distress and obesity and was the only significant behavioral predictor of obesity. From a methodological perspective, a key strength of this study is the week-long food intake measure instead of the traditional single or 3-day snapshot. This allows for a better representation of the dietary habits of college students.

Given the high rates of obesity among the college population, and that more campuses around the nation are adopting the Healthier Campus Initiative, this study highlights the need to reevaluate the traditional approaches to obesity prevention and intervention that focuses primarily on nutrition and physical activity. Instead, future research and behavioral interventions should consider the unique social context of college students, and design intervention strategies that aim to prevent or lower psychological distress among overweight or obese students.

CHAPTER 6

STUDY 3: SOCIAL RELATIONSHIPS, EATING HABITS, AND COMORBID DISTRESS- OBESITY STATUS AMONG U.S. COLLEGE STUDENTS: A LATENT VARIABLE STRUCTURAL EQUATION MODELING APPROACH

Introduction

The rising obesity rates among U.S. college students is a major public health issue, with over one-third are either overweight or obese (ACHA-NCHA, 2017). Prior research shows that college students also experience high levels of psychological distress, a significant correlate and driving factor of obesity (Block, He, Zaslavsky, Ding, & Ayanian, 2009; Halfon, Larson, & Slusser, 2013). Moreover, college-attending young adults are a distinct risk population due to the transitional nature of young adulthood, lifestyle changes, and their exposure to college-related stressors. Despite research showing that depression and obesity commonly co-occur in the general population, few studies have examined their dual nature and shared risk and protective factors. As such, less is known regarding the co-occurrence of distress and obesity or its implications for overall obesity risk among this group. Additional research is needed to clarify these linkages and improve obesity rates among the college population.

Eating Habits among College Students

Prior research has primarily focused on the health behaviors of diet and physical activity to understand weight gain among the college population. Dietary behavior is especially important because of its direct impact on overweight and obesity (Manore, Larson-Meyer, Lindsay, Hongu, & Houtkooper, 2017). However, eating is not just behavioral or physiological, but it is also multidimensional in that it is comprised of cognitive and psychological components. These dimensions are influenced by various psychosocial factors such as gender, attitude, stress, and

social context (Akan & Grilo, 1995; Morris, Beilharz, Maniam, Reichelt, & Westbrook, 2014).⁴ For example, many people engage in “comfort eating,” which includes the consumption of foods that are calorie-dense and highly palatable. This is just one of the numerous mechanisms linking stress exposure, coping, and eating behaviors to obesity risk (Adam & Epel, 2007; Hemmingsson, 2014).

Social context and social relationships also play critical roles in shaping dietary behavior. Social context influences food consumption in terms of both the consumed food’s variety and quantity (Nakata & Kawai, 2017). For example, findings from Study 2 of this dissertation showed that students who were sorority members and living off-campus reported more unhealthy eating habits. The transition to college and first experience of independent living often means eating habits are changed due to new psychosocial risk factors. In addition, the distinct social context of college may also influence social relationships with parents, peers, and romantic partners. Because eating is fundamentally a social activity in many contexts and social relationships play a vital role in shaping eating behavior (Allgower, Wardle, & Steptoe, 2001; Luk et al., 2017; Umberson, Crosnoe, & Reczek, 2010), it is important to evaluate the impact of social relationships on college obesity rates.

Linking Social Relationships to Health and Health Behaviors: Quality versus Source

Due to the transitional nature of young adulthood, attending college is often a time when young adults develop new and nurture existing social relationships that may impact health behaviors, psychological wellbeing, and risk for obesity in later life (e.g. Arnett, 2014; Oliveira et al, 2013; Umberson, Crosnoe, & Reczek, 2010). Prior studies have identified numerous pathways

⁴ There are other levels of influence beyond individual factors. From a social-ecological framework, microenvironments or behavior settings operate within macroenvironments or broader sectors. There is a synergistic relationship among individual factors (genetic, cognitive, behavioral), interpersonal factors (social networks and social support), institutional factors (culture, norms, structure, regulations), community factors (services and community organizing), public policy and physical environment (safety, climate etc.) (Plotnikoff, Lightfoot, Spinola, Predy, & Barrett, 2008; Sallis, Owen, & Fisher, 2008) that influence lifestyle behaviors. The Analysis Grid for Environment Linked to Obesity (ANGELO) is another framework developed for identifying obesogenic factors in the environment and potential interventions (Swinburn, Egger, & Raza, 1999).

through which social relationships can impact the health of the general population. These include cognition, emotions, behavior, and as a stress-buffer (see Figures 6.1 and 6.2).

Figure 6.1a Social relationships' effects on physical and psychological health

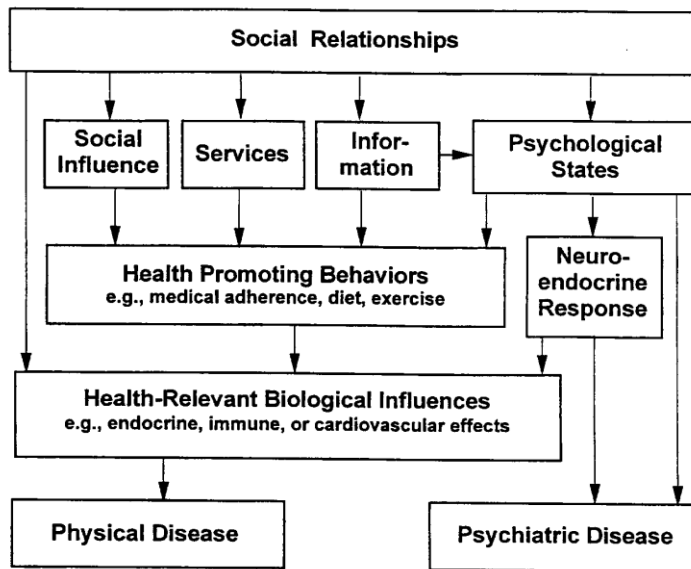
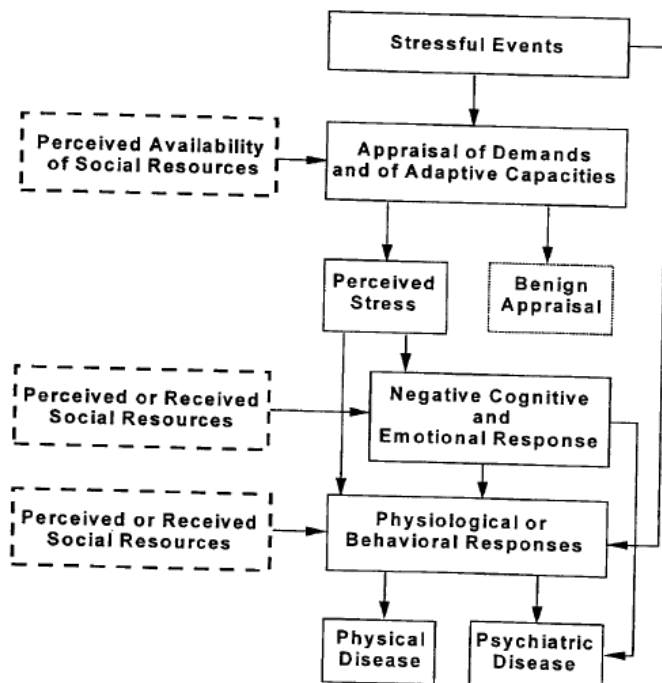
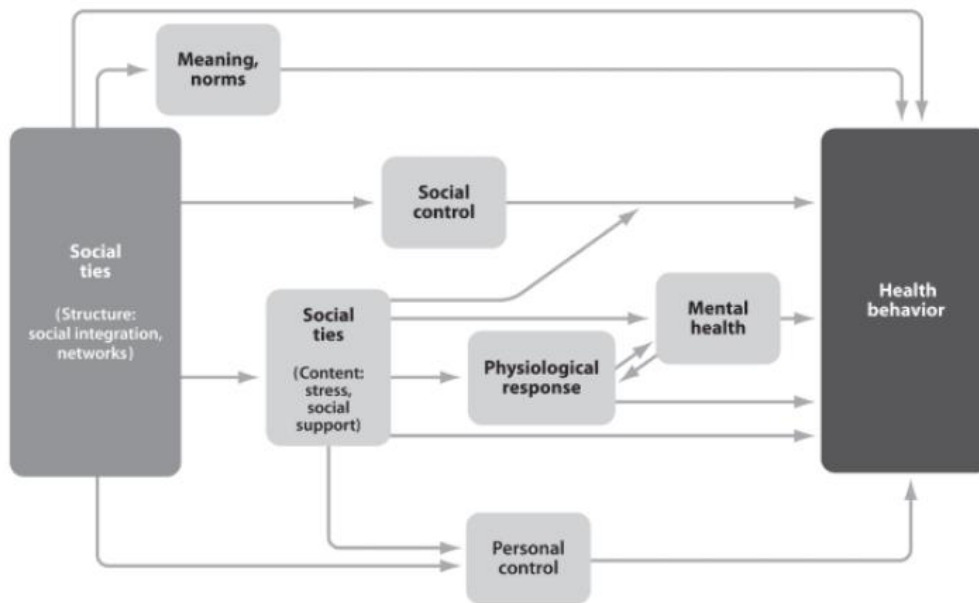


Figure 6.1b Stress-Buffering Model of social relationships on physical and psychological health



Source: Cohen et al., 2000

Figure 6.2. Mechanisms linking social ties to health behavior.



Source: Umberson, Crosnoe, & Reczek, 2010

As illustrated in the above figures, there are multiple mechanisms through which social relationships can potentially shape distress and obesity among college students. In addition, there are two specific dimensions of social relationships associated with health and health behavior: quality and source.

Quality of relationships can involve both positive (e.g., emotional or informational support) and negative aspects (e.g., conflict and strain). Positive social relationships may exert a protective influence on preventive health behaviors such as wearing seat belts (Broman, 1993) and more motivation to lose weight (Reed, Barnard, & Butler, 2015). Negative social relationships may contribute to psychological distress, leading to an increased risk of internalized weight stigma and poor body image, which are harmful to weight loss efforts (Ratcliffe & Ellison, 2015).

Source of relationships are individuals such as family, friends, and romantic partners who provide either tangible or nontangible support. Both positive and negative aspects of social relationships are important in influencing health, but their impact will also vary by the source. For example, strong parental relationships can protect against many kinds of distress (Anderson, Salk, & Hyde, 2015). Friendship and especially romantic partners' support can also significantly buffer the negative effects of stressful events on psychological wellbeing (Furman & Rose, 2015). Social relationships could also be protective whereby a person's peer group favors a healthy diet, which encourages that person to eat healthier. Conversely, poor parental relationships (Aloia & Solomon, 2015), rivalries, demanding peer relationships, social comparisons (Fox & Moreland, 2015), and troubled romantic relationships may all elicit feelings of distress and diminish wellbeing (Anderson et al., 2015). Elevated levels of psychological distress may, in turn, undermine one's social networks and opportunities to receive social support. Given the interconnectedness of these processes, however, the net effect of social relationships on psychological distress among college students is not wholly clear.

Social relationships can also have indirect effects on obesity, serving to motivate or assist weight loss efforts. For example, parental control and encouragement can be a significant driver of weight loss for students who live at home (Lydecker, O'Brien, & Grilo, 2017). Similarly, overweight students in a romantic relationship—or seeking out such a relationship—may become more motivated to lose weight in order to increase their perceived physical attractiveness (Reed, Barnard, & Butler, 2015). As peer perceptions can be a dangerous source of stigma, poor peer relationships may lead to overweight or obese students being stigmatized by their friends (Ratcliffe & Ellison, 2015). It should also be noted that the wrong kind of positive support may also be harmful. Studies show that an increasing number of people are willing to accept being overweight today than in the past (Snook et al., 2017). As a result, support from peers who are accepting of one's obesity status may be psychologically beneficial while also seriously undermining weight loss efforts. Therefore, social relationships may help or hinder one's obesity

risk. Given the critical role of social relationships for shaping distress and obesity among college students, distinguishing between the source and type of relationships is key.

Social Relationships and Eating Habits among College Students

Not only do social relationships affect psychological and physiological responses and outcomes, but they are also associated with health promoting or health compromising behaviors. Importantly, social relationships from different sources can positively or negatively impact eating behavior, a key determinant of overweight and obesity. Three main sources of relationships for college students are parents, peers, and romantic partners.

Parents

From a life course perspective, early parental influence on diet and exercise may contribute to childhood obesity that in turn, increases risk for adult chronic conditions (Ferraro et al, 2003). Parental relationships may continue its effects into college years, both because of their presence and their absence (Deliens, Clarys, De Bourdeaudhuij & Deforche, 2014). On the one hand, parents who motivate their children to maintain healthy behaviors can serve as a protective factor against development of poor eating habits and risk for obesity (Lydecker, O'Brien, & Grilo, 2017). On the other hand, for those with negative relationships, parental control can result in the adoption of poor eating habits in college, as students pushback against their parent's prior control of food consumption (Deliens et al., 2014). A lack of control from parents also may result in increased overeating and alcohol consumption among college students (Deliens et al., 2014). In addition, the nature of the parent-child relationship often shifts when young adults start college, with parents taking on the role of either a stressor or a supporter, usually from afar as opposed to the more direct role they would have in children's health habits (de Vos et al., 2015). As a result of this dynamic relationship, the influence of parental relationships for obesity risk among the college population is an interesting consideration, although has not been fully considered in prior studies. Further research is needed to understand its significance.

Peers/Close Friends

Peer relations often play a key role in risk behavior adoption during adolescence and young adulthood (Bachman et al. 2002; Luk et al., 2017). In the college context, peer relationships may promote partying and increased consumption of alcohol and junk food, thereby worsening eating habits and contributing to obesity risk (Luk et al., 2017). Friends have an especially strong impact on dietary habits since eating in the college context is often communal, with students eating together in dining halls, fraternity/sorority houses, restaurants, and at parties. This effect may be particularly pronounced in the fraternity context, wherein social interactions and expectations lead to significant increases in junk food and alcohol consumption (Luk et al., 2017). Evidence also suggests higher food consumption when a meal is consumed in the presence of friends and family compared to the presence of individuals with lower familiarity (Nakata & Kawai, 2017). Overall, research suggests that social relationships among peers have important influences on the type and amount of food that college students consume (Deliens, Clarys, De Bourdeaudhuij, & Deforche, 2014; Stok, de Vet, de Ridder, & de Wit, 2016). However, the effect is not exclusively negative. Peer relationships can also provide social support that helps to protect against obesity, although the efficacy of social support has been demonstrated more conclusively for women than men (Cho et al., 2014). Nevertheless, one study recently reported that social support buffers the effects of social stress on eating during the transition to college for men (Darling, Fahrenkamp, Wilson, Karazsia, & Sato, 2017). These findings underscore the need to further examine the underlying mechanisms for such gender variations.

Romantic Partner/Significant Other

Romantic relationships largely follow the same patterns as peer relationships, although research in this area has been scant. Existing evidence suggests that a romantic partner can be a positive influence for weight loss through social support and “team effort”, by accommodating partner’s needs and helping with implementation of schedule and dietary changes, and providing logistical assistance (Dailey, 2017). On the contrary, failed or troubled romantic relationships can

be a significant source of stress and lead to overeating (Chow, Ruhl, & Buhrmester, 2015). Therefore, the shared environment of partners as well as the impact of romantic relationships may potentially have mixed effects on college student obesity.

Purpose of the Study

Hence, different sources of social relationships can have both beneficial and harmful effects on health behaviors and health outcomes. Given the formative period of young adulthood and changing lifestyle habits, examining social relationships within the unique social context of college may provide new, additional insights into college students' eating habits and rising obesity rate. However, there are several limitations with prior research that impedes our understanding of these linkages and high prevalence of college obesity.

One reason for the limited knowledge is that psychological distress and obesity often manifest together, and despite their common co-occurrence few studies have examined both concurrently. This is problematic because risk factors for obesity may be obscured in the presence of distress. In addition, many have examined social relationships under the framework of the stress-buffering hypothesis (e.g., social relationships as a moderator), the direct and indirect influence of the quality of social relationships from multiple sources (e.g., parents, peers, romantic partners) on comorbid distress and obesity has rarely been considered. Examining distress and obesity as a joint health outcome circumvents the causal priority between the two and may provide a better understanding of their shared risk factors.

Another limitation is that although studies have shown that eating behavior is influenced by social relationships, few have considered its nuanced association with distress and obesity and how this linkage varies among male and female college students. At the same time, research on college students primarily focuses on the manifested behavior of food intake, often overlooking the psychological and cognitive factors that give rise to overall eating habits which in turn, play a role in influencing distress and obesity. Therefore, conceptualizing eating habits as a multidimensional construct better captures the underlying complexity of this key health behavior.

Rather than traditional regression analysis, a more rigorous methodological approach is needed to disentangle the various causal pathways of multiple variables.

In light of these limitations and the dual-nature of distress and obesity, this study builds on Study #1 and Study #2 by evaluating the role by which social relationships shape comorbid distress-obesity. It examines the underlying motivations of eating habits, taking into consideration the multidimensional aspect of eating (i.e., behavioral, psychological, cognitive). This study will also assess these relationships separately for males and females by testing the hypothesized pathways using a latent variable structural equation modeling approach that allows simultaneous analyses of multiple observed and latent variables (Ullman & Bentler, 2003). As with all statistical techniques, there are important issues and assumptions to consider when using SEM. Although an exploratory or model generation approach can be used, SEM is primarily a theory-driven technique that relies heavily on the researchers' prior knowledge and *a priori* hypothesized relationships among variables. Although causal inferences may be made among variables, inferring causation starts with the design of the study, including theory, temporality of the variables, replication, and causal assumptions. Results generated from SEM can be interpreted as whether the model is consistent with the data. Causal inferences is plausible if the model is a good fit with the data (Kline, 2016).

The aims of this study are:

AIM #1: Identify the comorbidity patterns of psychological distress and obesity among college students and assess the *individual* and *social contextual* correlates of *distress-obesity* status within female and male college students.

Hypothesis 3.1: There will be distinct comorbidity patterns in distress and obesity among college students.

Hypothesis 3.2: Financial strain and social context of off-campus living are positively associated with comorbid distress-obesity status.

AIM #2: Examine the associations between *social relationships* (i.e., parents/relatives, close friends, spouse/significant other) and (a) *individual characteristics* (i.e., age, race, nativity, class level, GPA, enrollment status, employment, financial strain); and (b) *social context factors* (i.e., living arrangement, intercollegiate sports, recreational sports, Greek membership) among male and female college students

Hypothesis 3.3: Financial strain is negatively associated with social relationships among college students.

Hypothesis 3.4: College social context factors of Greek membership and extracurricular sports are positively associated with social relationships among college students.

AIM #3: Evaluate the association between *social relationships* (i.e., parents/relatives, close friends, spouse/significant other) and (a) *eating habits*; (b) *psychological distress*; (c) *obesity*; and (d) *distress-obesity comorbidity status*.

Hypothesis 3.5: Social relationship is negatively associated with unhealthy eating habits.

Hypothesis 3.6: Social relationships is inversely associated with psychological distress among college students, net of the effects of individual characteristics and college social context factors.

Hypothesis 3.7: Social relationships is inversely associated with obesity among college students, net of the effects of individual characteristics and college social context factors.

Hypothesis 3.8: Social relationships is inversely associated with comorbid distress-obesity status among college students, net of the effects of individual characteristics and college social context factors.

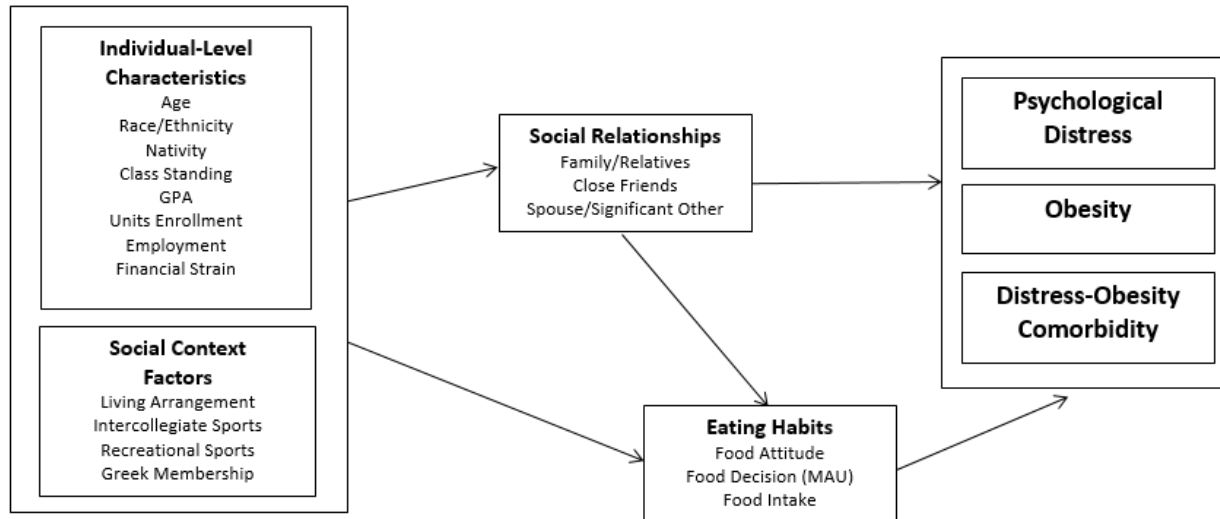
AIM #4: Use a latent variable structural model to explore the associations among social relationships, eating habits and comorbid distress-obesity.

Hypothesis 3.9: Social relationships have direct effects on eating habits and distress-obesity status.

Hypothesis 3.10: Eating habits have direct effects on distress-obesity status.

Hypothesis 3.11: Social relationships have indirect effects on distress-obesity status through the intermediary variable of eating habits.

Figure 6.3. Conceptual model of the relationship between social relationships, eating habits, comorbid psychological distress-obesity, and associated individual and social context risk/protective factors among college students



Methods

Data & Sample Description

The College Lifestyle and Wellbeing Study was a cross-sectional survey of undergraduate and graduate students from a large public university in Southern California conducted between spring of 2009 and spring of 2010 (See Chapter 3 for a complete description of the methods). For the present study, students who consented to participate in the 7-day online food questionnaire with at least four days of completed data were included, resulting in the analytic sample of 690 students. The mean age of the sample was 22.2 (SD = 4.74), mostly female (70.4%), and upperclassmen (i.e., 34.6% junior and 36% senior standing). The racial/ethnic composition was 33.2% non-Hispanic white, 26.3% Asian, 24.7% Hispanic, 11.8% Multi-race/other, and 3.9% black.

Operationalization of Variables

Dependent (Endogenous) Variables

Psychological Distress. Psychological distress is derived from two measures, the Perceived Stress Scale and Affect Balance Scale. The *Perceived Stress Scale* (PSS) is a widely used measure developed by Cohen, Kamarck and Mermelstein (1983) for assessing the degree to which people feel their lives are uncontrollable, unpredictable, and overloaded, and it includes questions that ask directly about the levels of stress they are currently experiencing. Four positive items were reversed scored, and all 10 items summed to derive a total score, with higher values indicating more perceived stress. Cronbach's $\alpha = .85$. The *Affect Balance Scale* (ABS: Bradburn, 1969) is a measure of psychological well-being used extensively in a wide variety of settings and populations (Bolin & Dodder, 1990). It is a 10-item rating scale containing five statements reflecting positive feelings and five statements reflecting negative feelings. Five positive affect items were reversed scored, and all 10 items summed to derive a total score, with higher values indicating more negative affect. Cronbach's $\alpha = .74$. A composite score of the two scales is computed and higher score indicate more distress.

Obesity. Body mass index (BMI) was calculated based on respondents' self-reported height and weight (kg/m^2) and defined as: underweight ($< 18.5 \text{ kg}/\text{m}^2$), normal weight ($18.5\text{-}24.9 \text{ kg}/\text{m}^2$), overweight ($25\text{-}29.9 \text{ kg}/\text{m}^2$), obese (and $> 30 \text{ kg}/\text{m}^2$). BMI is a widely used index as a screening tool and indicator of body fat, obesity, and clinical outcomes (CDC, 2015).

Independent (Exogenous) Variables

Social Relationships. Quality of social relationships is operationalized as perception of satisfaction of relationships with *parents/relatives*, *close friends*, and *spouse/significant other*. The items were derived from the Quality of Life Scale, a 15-item self-reported questionnaire to assess a wide-range of life domains, including physical/material wellbeing and personal relationships (Flanagan, 1978; Flanagan, 1982). Respondents were asked how satisfied they were during the past month, and responses were coded on a seven-point scale (1) = terrible, (2) = unhappy, (3)

= mostly dissatisfied, (4) = mixed, (5) = mostly satisfied, (6) = pleased, and (7) = delighted. A composite score of the three items is computed with higher score indicate better quality.

Intermediary Variable

Eating Habits. Eating habits is operationalized as (1) *Behavioral* food intake of seven-day average frequency consumption of fruits, vegetables, snacks/sweets, and fast foods. A healthy eating index score was computed based on the four food types. (2) *Cognitive* process of food choice decision as measured by the three constructs of the multi-attribute utility (MAU) decision-making model: subjective value, subjective likelihood (probability) and momentary salience (importance) of an expected outcome or consequence of eating a healthy diet. Items that measure the three constructs of the MAU have adequate internal consistency of .64, .72, and .73 for subjective value, subjective likelihood, and momentary salience, respectively. The total MAU score is the sum of the products which was calculated by multiplying subjective value, subjective likelihood and momentary salience of each consequence attached to healthy eating and then summing the resulting products for all consequences (Weiss, Weiss, and Edwards; 2009). Higher score indicate greater subjective utility of eating a healthy diet. The MAU model was predictive of fruit and vegetable intake among college students in a prior study (Hanlon, Weiss, McMahan, & Cheng, 2012). (3) *Psychological* attitudes about food was measured by the Health and Taste Attitude Questionnaire to assess orientations toward the health and hedonic characteristics of foods (Roininen, Lahteenmaki, & Tuorila, 1999). There are 12 items that make up the taste-related factor with two subscales: *food as a reward* and *food as pleasure*. A sample question of food as a reward is "I reward myself by buying something really tasty" and sample question of food as a pleasure is "When I eat, I concentrate on enjoying the taste of food". Response scale range from (1) = Disagree strongly to (4) = Agree strongly. A composite score is derived from summing six items for the reward and six items for the pleasure subscales.

Covariates

Individual Characteristics. Health disparities across various sociodemographic groups such as age, gender and race, as well as psychosocial factors such as financial strain are well established. For example, women tend to report higher levels of perceived stress than men; women in general, have more fat than men; and non-Hispanic blacks and Hispanics are disproportionately affected by obesity. Within the limits of available data collected in the Student Health Survey, the following variables will be included: age, gender, race/ethnicity, nativity status, class standing/year in college, grade points average (GPA), units enrolled, and hours employed and financial strain. Age is a continuous variable with a range of 17-66 years. Gender is dichotomous and coded as (0) = *male* (reference group) and (1) = *female*. There are five race/ethnicity groups: Asian/Pacific Islander, Hispanic/Latino, Black/African American, White, non-Hispanic (reference group), and Multi-race/other (which include Native and Alaskan American). Nativity status was assessed by a yes/no question, "Were you born in the U.S.?" with US born coded as the reference group. Year in college variable comprise of the following categories: freshmen (reference group), sophomore, junior, senior, graduate/post-bac. GPA is an ordinal variable categorized into four categories: mostly As (3.5-4.0), mostly Bs (3.0-3.4), mostly Cs (2.5-2.9), and Cs and below (less than 2.4). Number of units is a continuous variable assessed by an open-ended question, "How many units are you taking this semester?" Students who answered "yes" to the question, "Are you employed?" reported their average hours of work per week. Financial strain is an ordinal variable assessed by students' rating of their satisfaction with their material comforts, including home, food, conveniences, and financial security on a scale of (1) = *terrible* to (7) = *delighted*. Response scale was reverse scored such that higher value indicate more financial strain.

Social Context Factors. Young adults on college campuses are exposed to, and experience, unique social and contextual factors that influence health and health behaviors (Beck et al., 2008; Emmons, 2000; Stockdale, et al. 2007). Within the limits of available data collected

in the Student Health Survey, the following variables will be included as indicators of social context factors: Living arrangement is a discrete variable with five categories: parents (reference group), dormitory/university housing, apartments, significant other/ spouse/partner, other relatives, and fraternity or sorority house. Participation in social or extracurricular organizations/activities included the following binary yes/no items: “Are you currently a member of an intercollegiate athletic team?”, “Are you a member of a recreational sports team?” and “Are you a member of a fraternity or sorority?”

Data Analysis

Preliminary Analyses

Univariate distributions of all predictor and outcome variables were examined with histograms, frequencies or percentages, measures of central tendency (e.g., means, median) and dispersion (e.g., range, standard deviation). Non-normally distributed data were log transformed. Due to expected differences between males and females on the outcome variable, analyses were split by gender. Bivariate associations among individual characteristics, college social context factors, social relationships, eating habits, psychological distress, and obesity were tested using Chi-square if both IV and DV are categorical, t-test or ANOVA if IV is categorical and DV is continuous, and Pearson correlation for continuous IVs and DVs. All analyses were conducted using SPSS 25, significance determined at $p < .05$ and 95% confidence interval.

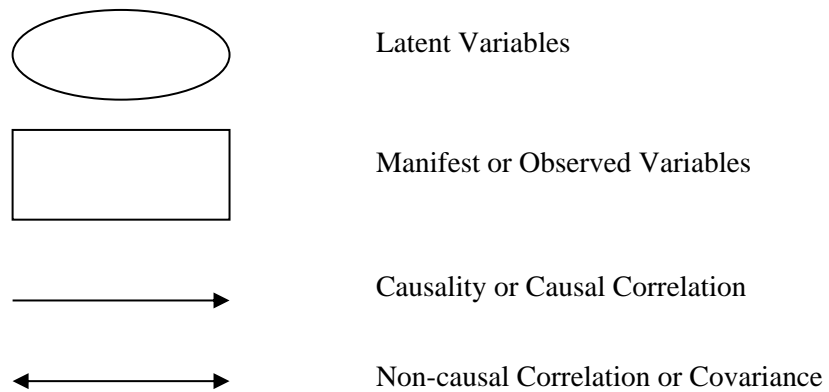
Study Aims Analyses

Aim 1 entailed examining frequency distributions, measures of central tendency and cross-tabulations of distress and obesity to identify comorbidity patterns. Given the dual nature of distress and obesity, a combined outcome variable were created to better capture the comorbidity status of distress and obesity (Lincoln, Abdou, & Lloyd, 2014). Hence, *distress-obesity* is a categorical variable created by the join classification of psychological distress and obesity with four groups: (1) low distress and normal BMI; (2) distressed and normal BMI; (3) low distress and overweight/obese BMI; and (4) distressed and overweight/obese BMI. Low distress vs. distress

is determined by median split of the distress composite variable. BMI categories were based on the CDC established cut-offs for (< 18.5 kg/m²), normal weight (18.5-24.9 kg/m²), overweight (25-29.9 kg/m²), obese (and > 30 kg/m²). Because of the small sample size of underweight students, they were collapsed with the normal weight groups. Next, multinomial logistic regression were conducted to assess the association between individual characteristics, social context, and distress-obesity status.

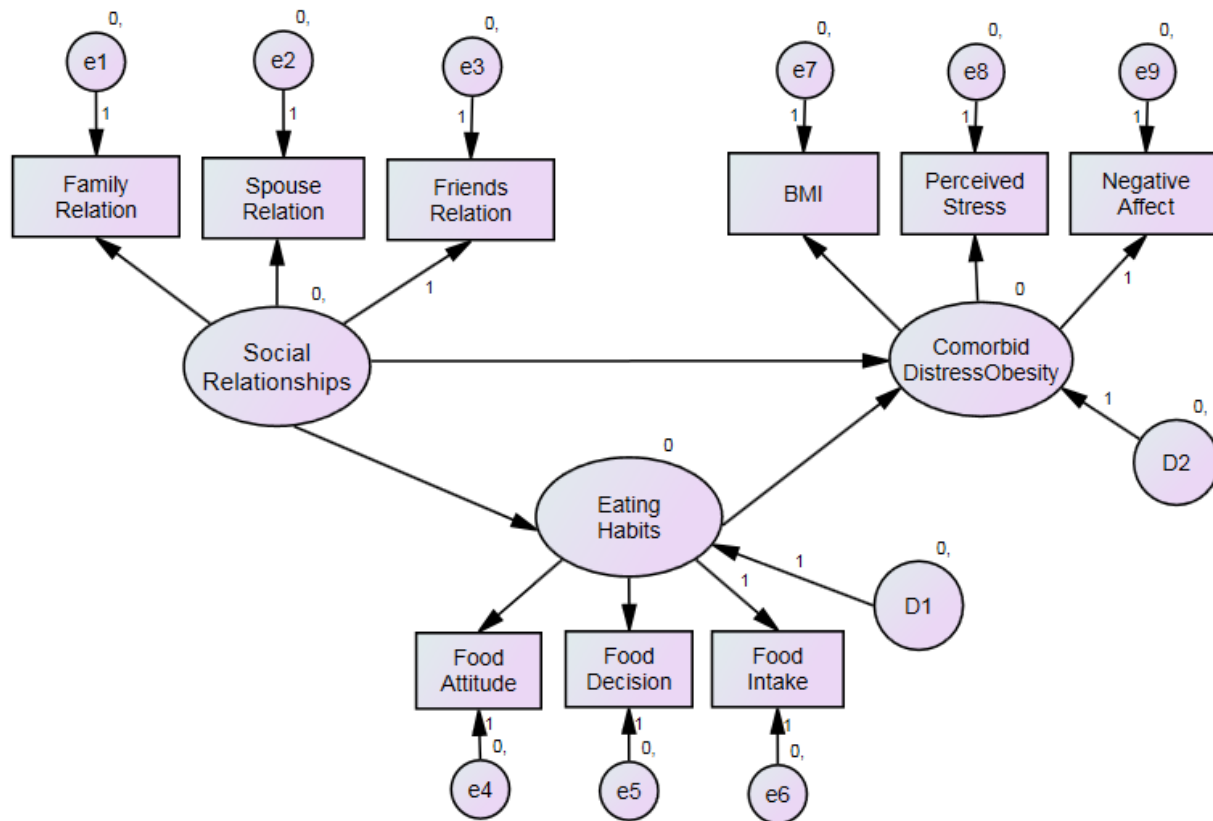
Aim 2 was tested using multiple OLS linear regression by regressing *social relationships* (i.e., parents/relatives; close friends; spouse/significant others) on *individual characteristics* and college *social context factors*. *Aim 3* was tested with using multiple OLS linear regression for *eating habits, psychological distress* and *obesity*; and multinomial logistic regression for *comorbid distress-obesity*. For each analysis, the dependent variables (i.e., eating habits, psychological distress, obesity, distress-obesity) were regressed on the independent variable of *social relationships* (i.e., parent/relatives; close friends; and spouse/significant other) and covariates (i.e., individual characteristics and social context).

Aim 4 were analyzed using structural equation modeling (SEM) with maximum likelihood estimation to test the theorized pathways simultaneously in the form of a latent variable structural model. SEM combines multiple regression, factor analysis and path analysis to determine the direct and indirect effects of the independent variable on the dependent variable. The unobserved variables analyzed in the model are latent variables, which represents the underlying construct of the measured or observed variables (Ullman & Bentler, 2003). The symbols used to annotate these variables in SEM are shown below:



The hypothesized SEM model is presented in Figure 6.4. Social relationships is an exogenous latent variable with three indicators (parents/relatives, spouse/significant other, close friends), eating habits is a latent mediating variable with three indicators (food attitude, food decision-making, food intake), and comorbid distress-obesity is a latent endogenous variable with three indicators (negative affect, perceived stress, and BMI). Model fit was assessed using chi-square test, the comparative fit index (CFI) and the root mean square error of approximation (RMSEA). These model fit measures assess how well the proposed model captured the covariance between all the items or measures in the model. Following commonly accepted procedures in the literature, model fit indices of a nonsignificant chi-square statistic, CFI greater than .95, and RMSEA less than .06 are considered good fit (Hu & Bentler, 1999). SEM analyses were conducted using AMOS 25 and separate models were tested for males and females.

Figure 6.4. Hypothesized latent variable structural model of the association among social relationships, eating habits, and comorbid distress-obesity



Results

Preliminary and Bivariate Analyses

Table 6.1 shows the descriptive statistics of the key study variables with the full sample and also stratified by gender. Nearly 30% of the students were overweight or obese, regardless of distress levels, and about half were classified as distressed, regardless of weight status. Females reported better quality of relationships with spouse/significant others than did the males ($p < .05$). Gender differences were observed with food attitude with females rating higher than males on food as reward and pleasure ($p = .001$). Females also had higher MAU scores, indicating greater likelihood of healthy eating decisions than do males ($p < .001$).

Comorbid Distress-Obesity Pattern

About 13% of the students were classified as low distress and overweight/obese, and 16% classified as distress and overweight/obese. Significant gender differences were found with the joint-outcome of distress and obesity ($p < .001$). Specifically, greater proportion of males than females were low distress and overweight/obese. The opposite was observed with greater proportion of females than males were distress and normal BMI. Figure 6.5 shows the distributions of comorbid distress-obesity status by gender.

Table 6.1

Study 3 - Descriptive Statistics of Study Variables by Gender, College Lifestyle and Wellbeing Study (N = 690)

	Full % or M (SD)	Male % or M (SD)	Female % or M (SD)
Distress/Obesity Status			
Low Distress & Normal BMI	39.2%	38.8%	39.3%
Low Distress & Overweight/Obese***	13.2%	21.9%	9.5%
Distress & Normal BMI***	32.1%	21.9%	36.4%
Distress & Overweight/Obese BMI***	15.5% 24.26 (4.62)	17.3% 25.41 (4.20)	14.8% 23.78 (4.71)
Social Relationships			
Family & Relatives	5.34 (1.30)	5.38 (1.25)	5.32 (1.32)
Spouse/Significant other*	5.02 (1.74)	4.77 (1.71)	5.13 (1.74)
Close friends	5.59 (1.19)	5.58 (1.16)	5.59 (1.21)
Social Relationships Composite	15.79 (3.24)	15.54 (3.21)	15.90 (3.25)
Eating Habit			
Food Index	0.01 (2.41)	-0.04 (2.72)	0.03 (2.27)
Food Attitude***	30.62 (5.33)	29.59 (5.16)	31.06 (5.34)
MAU Decision Making***	8.61 (4.92)	7.48 (4.50)	9.08 (5.01)
Eating Habit Index	0.01 (1.59)	-0.04 (1.61)	0.02 (1.59)

Note. Gender differences tested with t-test for continuous and Chi-square for categorical variables.

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

Figure 6.5. Distribution of comorbid distress-obesity by gender

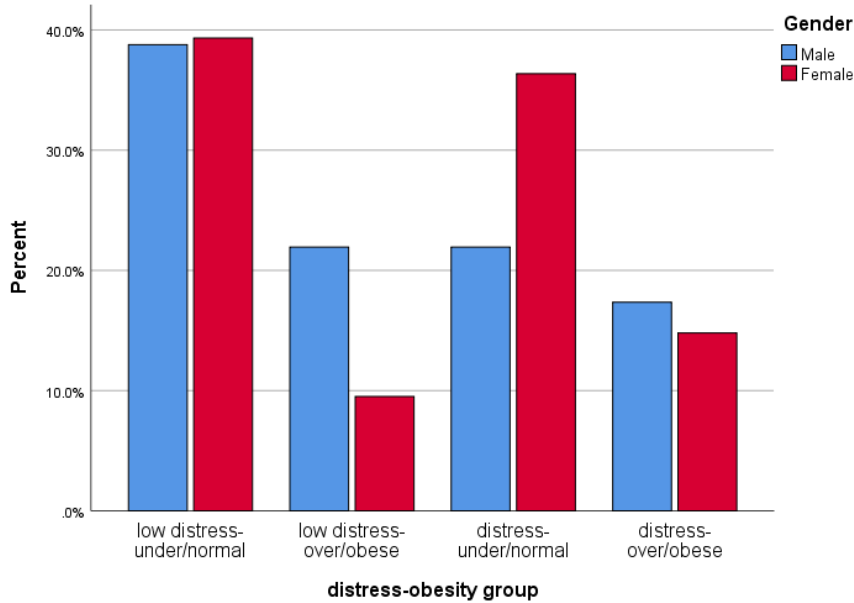


Table 6.2a and 6.2b shows the correlation coefficients split by gender. Among males, family and spousal/partner relations were not associated with eating habits. However, peer relations were positively associated with healthy food decisions. Family and peer relations were negatively associated with perceived stress, negative affect, and BMI. Spousal/partner relations were negatively associated with perceived stress and negative affect, but not BMI. Among females, family and spousal/partner relations were positively associated with healthy food intake. Spousal/partner and peer relations were negatively associated with perceived stress, negative affect, and BMI. Family relations were also negatively associated with perceived stress and negative affect, but not BMI.

Table 6.2a*Correlation Coefficient of Study Variables – Males (N = 204)*

Variables	1	2	3	4	5	6	7	8	9
1. Family relations	–	.42***	.33***	.11	.00	.11	-.43***	-.42***	-.15*
2. Partner relations		–	.37**	.05	.02	.07	-.37***	-.44***	-.11
3. Peer relations			–	.12	.06	.15*	-.34***	-.43***	-.14*
4. Food intake				–	.19**	.24**	-.19**	-.18**	-.02
5. Food attitude					–	-.08	-.19**	-.11	-.04
6. Food decision						–	-.18*	-.22**	-.02
7. Perceived stress							–	.61***	.14†
8. Negative affect								–	.17*
9. BMI									–

† $p < .10$. * $p < .05$. ** $p < .01$. *** $p < .001$.**Table 6.2b***Correlation Coefficient of Study Variables – Females (N = 486)*

Variables	1	2	3	4	5	6	7	8	9
1. Family relations	–	.23***	.35***	.11*	.07	.06	-.34***	-.40***	-.02
2. Partner relations		–	.37***	.14**	.09†	-.08†	-.36***	-.37***	-.12**
3. Peer relations			–	.09†	-.01	.06	-.35***	-.41***	-.10*
4. Food intake				–	.20***	.11*	-.18***	-.15**	-.05
5. Food attitude					–	-.07	-.18***	-.07	-.03
6. Food decision						–	-.01	-.21***	-.04
7. Perceived stress							–	.52***	.06
8. Negative affect								–	.04
9. BMI									–

* $p < .05$. ** $p < .01$. *** $p < .001$.**Multivariate Analyses***Relationships with Family*

Males. Multi/other race ($B = -1.13$; $\beta = -0.22$, $p < .01$) and financial strain ($B = -0.39$; $\beta = -0.40$, $p < .001$) were associated with lower quality of relationships with parents/relatives. Living in dorms was associated with higher quality of relationships with parents/relatives ($B = 0.78$; $\beta = 0.14$, $p < .05$).

Females. Asian race ($B = -0.33$; $\beta = -0.11$, $p < .05$), post-bac/graduate status ($B = -1.00$; $\beta = -0.09$, $p < .05$), and financial strain ($B = -0.38$; $\beta = -0.37$, $p < .001$) were associated with lower quality of relationships with parents/relatives. Living in dorms was associated with higher quality of relationships with parents/relatives ($B = 0.56$; $\beta = 0.11$, $p < .05$).

Relationships with Peers

Males. Blacks ($B = -1.00$; $\beta = -0.14$, $p < .05$), juniors ($B = -0.61$; $\beta = -0.25$, $p < .05$), post-bac/graduate status ($B = -1.65$; $\beta = -0.20$, $p < .05$), hours employed ($B = -0.04$; $\beta = -0.29$, $p < .001$), and financial strain ($B = -0.22$; $\beta = -0.24$, $p < .001$) were associated with lower quality of relationships with close friends. On the other hand, older age was associated with higher quality of relationships with close friends ($B = 0.06$; $\beta = 0.20$, $p < .05$). Social context factors were not associated with peer relationships.

Females. Financial strain was associated with lower quality of relationships with close friends ($B = -0.22$; $\beta = -0.24$, $p < .001$). Sorority membership was not significantly associated with peer relationships, but approached significance ($B = 0.38$; $\beta = 0.09$, $p = .058$).

Relationships with Romantic Partners

Males. Blacks ($B = -2.66$; $\beta = -0.25$, $p < .001$), and financial strain ($B = -0.36$; $\beta = -0.28$, $p < .001$) were associated with lower quality of relationships with spouse/significant other. No significant associations were found with social context factors.

Females. Multi/other race ($B = -0.64$; $\beta = -0.13$, $p < .01$), GPA ($B = -0.20$; $\beta = -0.10$, $p < .05$), and financial strain ($B = -0.24$; $\beta = -0.18$, $p < .001$) were associated with lower quality of relationships with spouse/significant other. On the other hand, junior ($B = 0.67$; $\beta = 0.19$, $p < .05$), senior standing ($B = 0.65$; $\beta = 0.18$, $p < .05$), and living with a partner ($B = 0.85$; $\beta = 0.15$, $p < .001$) were associated with higher quality of relationships with spouse/significant other.

Overall Social Relationships

Males. Blacks ($B = -3.74$; $\beta = -0.18$, $p < .01$), multi/other race ($B = -2.39$; $\beta = -0.18$, $p < .01$), and financial strain ($B = -1.03$; $\beta = -0.41$, $p < .001$) were associated with lower quality of

relationship composite score. No significant association was found with social context factors and eating habits. Social relationship was negatively associated with psychological distress ($B = -1.69$; $\beta = -0.53$, $p < .001$) and obesity ($B = -0.24$; $\beta = -0.19$, $p < .01$) holding constant individual characteristics and social context factors. However, once individual characteristics were accounted for, the association between social relationship and obesity became nonsignificant.

Females. Multi/other race ($B = -1.07$; $\beta = -0.11$, $p < .05$), and financial strain ($B = -0.81$; $\beta = -0.32$, $p < .001$) were associated with lower relationship composite score. On the other hand, senior standing ($B = 1.01$; $\beta = 0.15$, $p < .05$) and living with a partner ($B = 1.23$; $\beta = 0.12$, $p < .05$) were associated with higher relationship composite score. Social relationship was positively associated with healthy eating habits ($B = 0.07$; $\beta = 0.14$, $p < .01$), negatively associated with psychological distress ($B = -1.62$; $\beta = -0.52$, $p < .001$), and negatively associated with obesity ($B = -0.16$; $\beta = -0.11$, $p < .05$) holding constant both individual characteristics and social context factors.

Risk and Protective Factors of Comorbid Distress-Obesity

Gender stratified multinomial logistic regression models were tested between social relationships, eating habits, and distress-obesity with those with low distress and normal BMI as the referent category. Each pair of comparisons are presented below.

Low Distress/Overweight-Obese vs. Referent (Low Distress/Normal BMI). Individual characteristics and social context factors were not significantly associated with comorbid distress-obesity status among both males and females. Among females, those with higher ratings of social relationships were less likely to be low distress and overweight/obese ($OR = 0.83$, $95\% CI = 0.74$, 0.94).

Distress/Normal BMI vs. Referent (Low Distress/Normal BMI). Among males, those with higher GPA were more likely to be distress and normal BMI ($OR = 1.98$, $95\% CI = 1.12$, 3.53). No significant association was found for social context factors. Those with higher ratings of social relationships were less likely to be distress and normal BMI ($OR = 0.73$, $95\% CI = 0.64$, 0.84).

Among females, compared with students born in the U.S., non-U.S. born students were more likely to be distress and normal BMI (OR = 2.35, 95% CI = 1.14, 4.84). Females with more financial strain were also more likely to be distress and normal BMI (OR = 1.50, 95% CI = 1.22, 1.86). No significant association was found for social context factors. Those with higher ratings of social relationships were less likely to be distress and normal BMI (OR = 0.68, 95% CI = 0.62, 0.74).

Distress/Overweight-Obese vs. Referent (Low Distress/Normal BMI). Among males, older age (OR = 1.40, 95% CI = 1.06, 1.84) and financial strain (OR = 3.10, 95% CI = 1.72, 5.59) were associated with greater odds of distress and overweight/obese. No significant association was found for social context factors. Those with higher ratings of social relationships were less likely to be distress and overweight/obese (OR = 0.70, 95% CI = 0.60, 0.82). Among females, units enrolled (OR = 1.17, 95% CI = 1.02, 1.33) and financial strain (OR = 1.32, 95% CI = 1.01, 1.71) were associated with greater odds of distress and overweight/obese. No significant association was found for social context factors. Those with higher ratings of social relationships were less likely to be distress and overweight/obese (OR = 0.70, 95% CI = 0.64, 0.78).

Taken together, results from *Aim 1* indicated that among males, age, GPA, and financial strain were risk factors for increased odds of comorbid distress-obesity status. Among females, nativity, units enrolled and financial strain were risk factors for increased odds of comorbid distress-obesity status. Results from *Aim 2* showed that among males, race and financial strain were associated lower quality of social relationships. Among females, race and financial strain were associated with lower quality of social relationships. Conversely, senior class standing with living with a partner were associated with better social relationships. Of particular importance is that among all the individual and social context factors, financial strain consistently emerged as a significant correlate of social relationships and comorbid distress-obesity. Results from *Aim 3* indicated that among males, social relationships were protective factors for psychological distress and obesity. Among females, social relationships were protective factors for eating habits, psychological distress, obesity, and comorbid distress-obesity status.

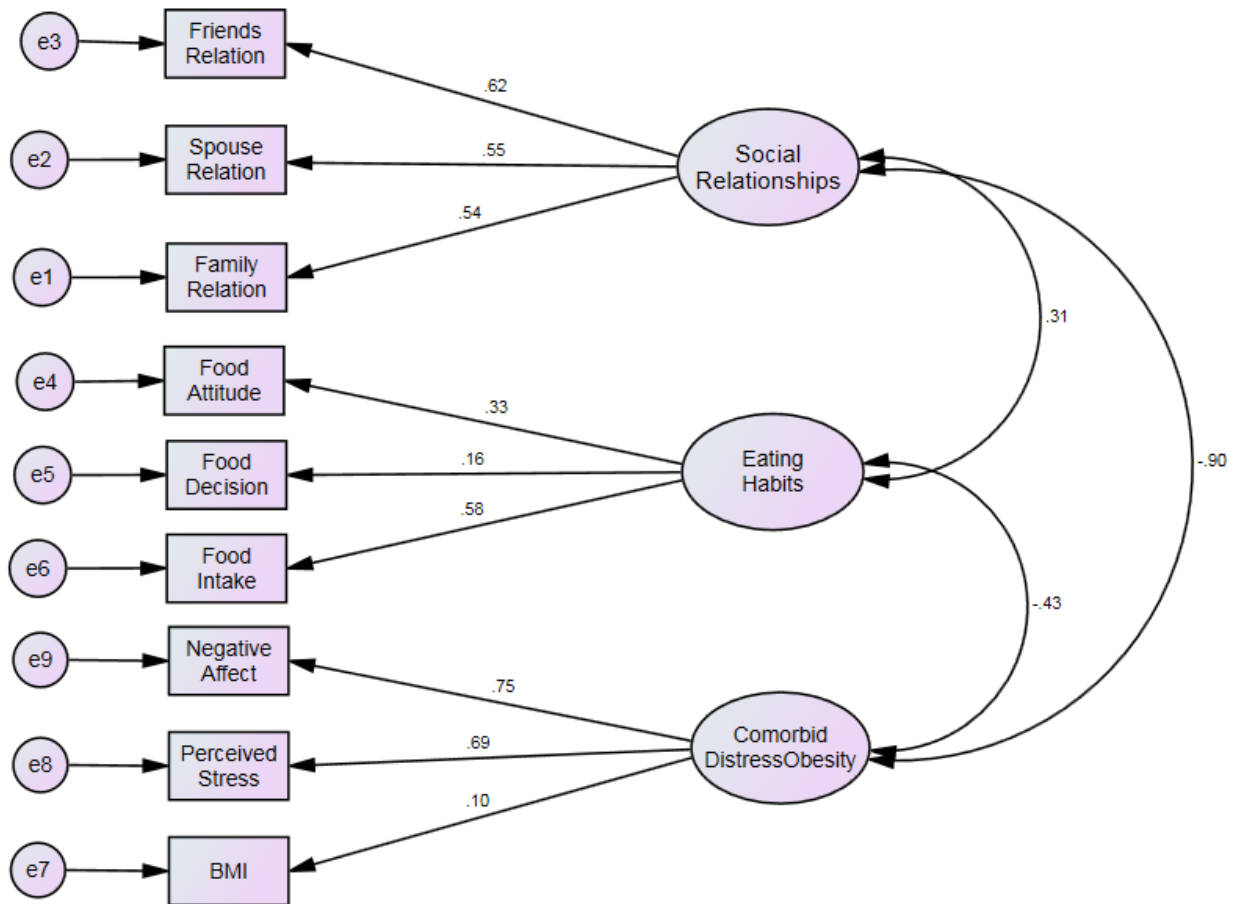
SEM Analyses

Measurement Model

Confirmatory factor analysis (CFA) was conducted for the latent constructs. Social relationships comprised of three indicators, family relationship, peer relationship, and spouse/sig other relationship. Eating habits comprised of behavioral measure of healthy eating index, cognitive indicator of food decision making MAU score, and psychological attitudes toward food scale. A comorbid distress and obesity latent variable was constructed from Perceived Stress Scale, Affect Balance Scale, and BMI.

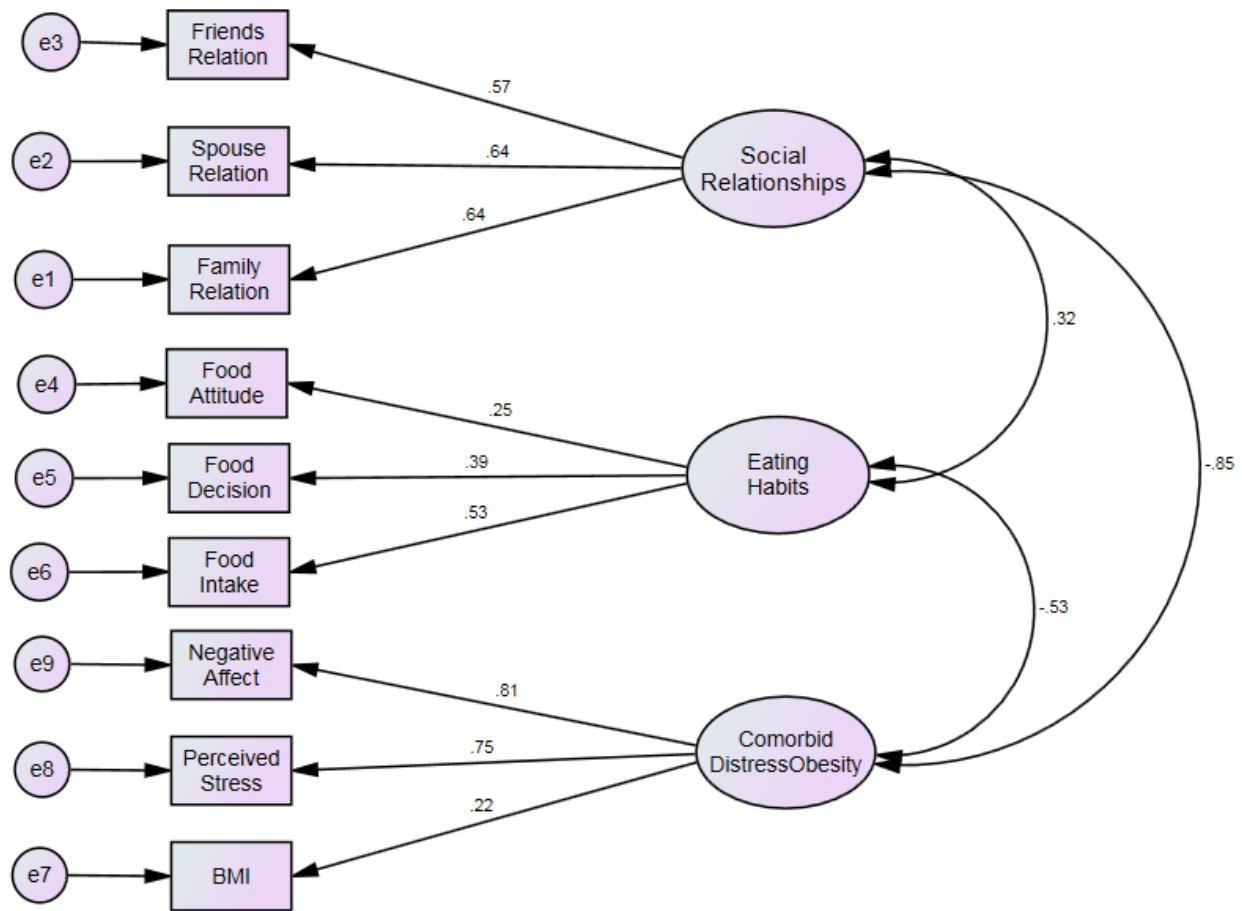
Females. With the exception of food attitude, MAU, and BMI, all indicators have loading above .40. Fit indices for the measurement model indicated acceptable fit: χ^2 (24, N = 486) = 69.55, $p < .001$, CFI = .92, RMSEA = .06. Given the larger sample size (i.e., over 200) of female students, a nonsignificant chi-square statistic is less likely to be attained. Figure 6.6 depicts the confirmatory factor analysis model with factor loadings for each of the latent constructs.

Figure 6.6. CFA model for females



Males. With the exception of food attitude, MAU, and BMI, all indicators have loading above .40. Fit indices for the measurement model indicated good fit: $\chi^2(24, N = 204) = 21.69, p = .598, CFI = 1.00, RMSEA = .000$. Figure 6.7 depicts the confirmatory factor analysis model with factor loadings for each of the latent constructs.

Figure 6.7. CFA model for males



Structural Model

The hypothesized SEM model tested the associations among social relationships, eating habits, and comorbid distress-obesity. Multiple fit indices including the chi-square statistic, the comparative fit index (CFI), and root-mean-square error of estimation (RMSEA) were evaluated. Regression weights significant at the $p < .05$ were indicated with an asterisk (*) in the model.

Females. Figure 6.8 shows the standardized parameter estimates of the SEM model. Marginal support was found for the hypothesized model $\chi^2 (24, N = 486) = 69.55, p < .001, CFI = .92, RMSEA = .06$.

Males. Figure 6.9 shows the standardized parameter estimates of the SEM model. The model fit the data well, $\chi^2 (24, N = 204) = 21.69, p = .598, CFI = 1.00, RMSEA = .000$.

Figure 6.8. Standardized parameter estimates of the SEM model for females

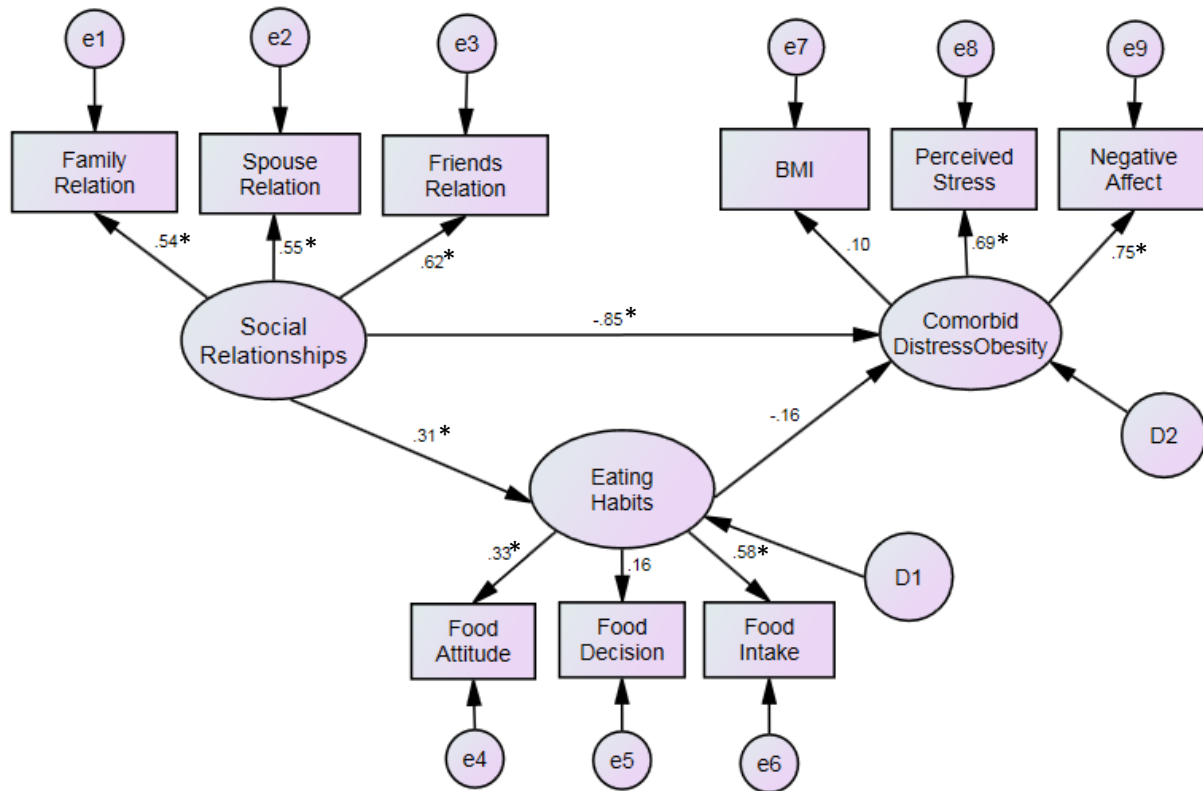
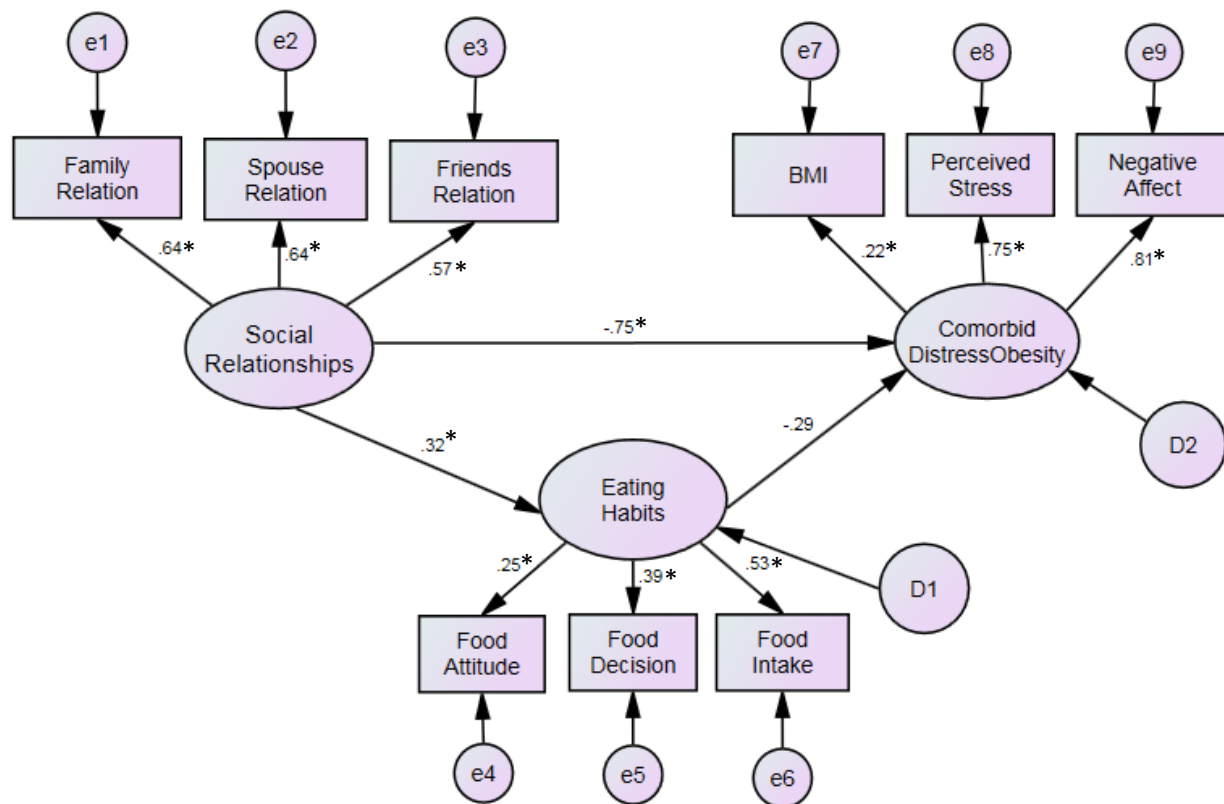


Figure 6.9. Standardized parameter estimates of the SEM model for males



Overall, results for Aim 4 indicated that poor social relationship was significantly associated with comorbid distress-obesity status among both females and males, but not mediated by eating habits. Quality of social relationship was also associated with more healthy eating habits for both genders. Eating habits was not associated with comorbid distress-obesity.

Discussion

While attending college, many young adults form new social relationships, change eating habits, and experience elevated levels of distress, which may all lead to higher risk for obesity. Given the prevalence of co-occurring distress and obesity, which may obscure risk patterns among this group, the present study aimed to examine the comorbidity status of distress and obesity and associated risk and protective factors among college students. Three key findings emerged from the present study.

First, comorbidity patterns differ significantly for men and women. More males than females are overweight/obese & low distress. More females than males are normal weight & distressed. This result is consistent with known variations between women and men in body mass index (BMI) and depression (Clarke, O'Malley, Johnston, & Schulenberg 2008; Leske et al., 2015). Interestingly, despite this difference, both genders shared an individual level risk factor: financial strain. Experiencing financial strain was associated with poor social relationships with parents/relatives, peers, and romantic partners among both male and female students. Financial strain was also associated with a greater likelihood of comorbid distress and overweight/obese status than comorbid low distress and normal BMI among both genders. In particular, financially-strained males have a three-fold increase in odds of being distressed and overweight/obese. These patterns highlight the need to allocate more resources to counseling and other efforts to alleviate the financial burden of college attendance for students.

Second, relationship quality emerged as an important protective factor against psychological distress and obesity among both genders. Compared to low distress and normal weight students, those with better social relationships were less likely to be comorbid distressed-normal weight or distressed-overweight/obese. In addition, college students with better social relationships also reported healthier eating habits. This is not surprising, as eating is very much a social behavior, and the significance of social relationships as both a risk and protective factor in shaping health behaviors across the life span has been widely documented (Broman, 1993; Umberson, Crosnoe, & Reczek, 2010). On another note, social relationships may also be a key mechanism that explains links between social context factors (i.e. living arrangement and Greek membership) and eating behaviors among college students, as found in Study 2 (see Chapter 5). For most college students, balancing the demands of school and work often means that interpersonal relationships are neglected. Hence, fostering positive social relationships with family, peers, and significant others should be a renewed focus in mental health and obesity intervention efforts on campus.

Third, results from the SEM analysis testing the relationships among social relationship, eating habits, and comorbid distress-obesity simultaneously showed that low quality social relationships were significantly associated with comorbid distress-obesity status among both females and males. Findings also indicate that this relationship was not explained by differences in eating habits. This direct effect of social relationship may be explained by the relational regulation theory (Lahey & Orehek, 2011), which suggests that day-to-day interactions with those important to us help us regulate thoughts, cognitions, and affect that is associated with positive mental health outcomes.

Limitations

These results should be interpreted within the context of several limitations. One limitation of the present analysis is that its cross-sectional design does not allow for disentangling the bidirectionality of perceived support and distress or their reciprocal effects over time. The strong correlation between poor social relationships and psychological distress suggests the two may share another underlying construct. It is also possible that the relationship may be explained by personality traits and other social influences. Prospective or longitudinal studies will be necessary to fully understand and confirm the causal relationship.

Another limitation is that self-reports are prone to response bias, hence the observed relationship could be an artifact of measurement, such as social desirability and current mood status. Because depression and anxiety are linked to negative thoughts, how individuals form perceptions of self, others, and the relational process as well as how they respond to survey questions may be highly influenced by negative affect. Nonetheless, current mood is relatively independent across individuals thus should not introduce a systematic source of error (Diener, Sandvik, Pavot, & Gallagher, 1991). Lastly, social relationships are often conceptualized and measured in various ways, making comparisons across studies difficult. In the present study, social relationship was operationalized as satisfaction of relationship from three key sources: family, close friends, romantic partners. Although items were derived from the quality of life scale,

a validated measure, the specific function of the perceived relationship cannot be ascertained—such as emotional, belonging, informational, or tangible support—hence limiting the interpretation of the findings and its implications with comorbid distress-obesity status.

Strengths and Contributions

Despite these limitations, this study provides several important contributions. One strength of the present study is examining distress and obesity as a joint health outcome, revealing shared risk and protective psychosocial factors and the nuanced relationship with eating habits. Another strength of this study is the multidimensional measurement of eating habits that is rarely considered in obesity research. Similarly, the inclusion of various sources or providers of social relationship shed additional insights to what shapes them among college students, as well as their influence on distress and obesity.

A methodological contribution of the study is using latent variable structural equation modeling that allow for the simultaneous testing of multiple relationships among latent variables, which is more congruent with the multidimensional conceptualization of social relationships, eating habits, and comorbid distress and obesity. A major limitation with traditional regression analysis is it assumes that the independent variables are measured without error. If an unmeasured predictor is correlated with a measured predictor, then their errors are also correlated which not only violates the independence of errors assumption, it can lead to biased estimates of the coefficients. Structural equation modeling (SEM), also known as casual modeling or analysis of covariance structure, is a causal inference statistical technique that allows simultaneous analyses of multiple observed and latent variables (i.e., hypothetical constructs not directly observable). Error terms are explicitly specified in SEM, rather than assuming no error variances in the measured variables. There is less emphasis on significance testing of individual effects as with traditional statistical techniques. Instead, SEM focuses on evaluating entire models and provides better estimates of effect sizes for observed variables and controls Type I error (Ullman & Bentler, 2003).

Findings from this study contribute to the broader literature by demonstrating that social relationships not only have a main impact on mental health, but significantly shapes obesity as well. This has important public health implication in terms of designing more effective strategies for weight reduction and psychological distress intervention among the college student population.

CHAPTER 7

CONCLUSION

The overall goal of this dissertation was to evaluate the contextual, psychosocial, and behavioral factors associated with obesity among college students. Results from the three studies indicated that psychological distress is a significant correlate of and risk factor for obesity, over and above the effects of health behavior; there are also gendered patterns in risk and protective factors within the unique social context of college.

A few unexpected findings emerged from this dissertation project. *First*, results from Study 1 revealed that second-year female students have greater odds of obesity than first-year female students. This goes against the traditional notion that links obesity with the transition from high school to college, or the “Freshman 15” phenomenon. Instead, these results suggest that weight gain at college is more likely a continuous process, with the risk of obesity peaking during sophomore year. This finding highlights the need to understand obesity within the unique context of college beyond the freshman year, and future studies should examine the reasons for the observed gender differences.

Second, although distress was associated with unhealthy eating habits, results from Study 2 indicated that health behaviors were not the key mechanism in the distress-obesity linkage. Instead, evidence suggests that distress may independently shape obesity risk. Given that many young adults experience distress in college, future studies should explore the theoretical or non-behavioral underpinnings of this linkage and also place more emphasis on psychological distress prevention and intervention. *Third*, although gender patterns were observed among both individual and social context factors, results from Study 3 showed that financial strain emerged as the most robust correlate and determinant of comorbid distress-obesity status shared by both men and women, and was associated with poor social relationships with family, peers, and romantic partners. The spill-over effect of financial stress among college attending young adults

is alarming, given there are more than 20 million college students in the U.S. and over half are paying for their education by working, work-study aid, or loan. An implication of this finding is more efforts are needed to educate students about managing school-work balance and for campuses to provide adequate financial resources and psychological support to students.

Findings from this dissertation need to be interpreted within the context of several limitations. First, although the sample was racially and economically diverse and drawn from a large public university, it is not a population or national-level study. Thus, caution should be exercised in generalizing these results to broader populations. Second, temporal sequencing of certain variables cannot be ascertained given the cross-sectional design of the study, thus making it difficult to draw causal inferences. Future work should consider prospective or longitudinal studies to better understand and confirm the causal relationship. Finally, psychosocial and behavioral measures in the present study were based on self-reports, which are susceptible to reporting bias and social desirability. Inclusion of a social desirability scale, cross-informant or other objective measures in future studies can improve the validity of the self-reported measures.

Notwithstanding these limitations, this dissertation significantly contributes to extant knowledge in several ways. A primary strength of this project is its examination of the pathways linking psychological distress, health behaviors, and obesity separately for women and men, revealing gendered patterns and the nuanced relationships among these key variables. This lends further support for the distinct risk factors that college students face, which creates or exacerbates the growing prevalence of obesity among this population. Another important implication from the findings is that enhancing psychological well-being may be an effective point of intervention to address the rising rates of obesity among college students. This is because many young adults experience some form of psychological distress in college, and that distress is significantly associated with obesity. Another key contribution of the present study is adding to existing knowledge of a high risk but often understudied population in obesity research: college-attending young adults. This is important because early adulthood is a time where excess adiposity starts

to accumulate and continues into middle adulthood, increasing the risk of obesity over time. Understanding and curbing obesity at this critical stage of the life course could have a significant long-term effect in terms of also reducing the incidence of obesity in the overall population.

Public Health Implications

Research

This dissertation aimed to better understand the distress-obesity linkage and distinct risk and protector factors among college students. Examining a multidimensional set of contextual, psychosocial, and behavior factors revealed the nuanced relationships among distress and obesity and how risk factors varied among gender groups. For example, social context and psychological distress were important in shaping obesity risk among females, but financial strain and unhealthy snacks consumption mattered more for men. Moreover, identifying patterns of distress-obesity comorbidity better clarified the associated risk factors and their relationship with obesity. Compared to the comorbid low distress/normal BMI group, age and financial strain were significant correlates of distress/overweight-obese comorbidity among males. Among females, however, enrollment status and financial strain were associated with distress/overweight-obese comorbidity among females. This highlights the need to consider their co-occurrence and delineate gender variations in future research. Other theoretical and non-behavioral underpinnings of this linkage should also be explored. For example, public health can draw from psychological research on coping styles, emotion regulation, and cognitive appraisal, as well as relational regulation theory on social relationships and interpersonal interactions to shed additional light on the observed gendered risk patterns and design more tailored interventions. In addition to the psychosocial processes, recent work on the psychobiology of stress and allostatic load model on the cumulative effects of stress on health suggest such biological approach may provide new insights to enhance our understanding of the underlying mechanisms between distress and obesity among the college population.

Policy

The findings of this dissertation show that the distinct risk factors of college importantly shape psychological distress and obesity among the college population. Given the significance of the contextual, psychosocial, and behavioral factors for shaping obesity risk, a more holistic approach is needed to reduce the obesity epidemic. This starts with reducing stigmas surrounding mental health and incorporate college-based mental health resources as a key component of obesity intervention. As financial strain is a modifiable risk factor central to the distress-obesity linkage, policies aiming to reduce the financial burden of college on families should be a national priority. Thus, a two-pronged approach at the state and local level should be employed. First, schools and local government should reach out to families with students and provide information on college education financial planning early on, well before students enter high school. Currently, nearly all financial planning is offered through private businesses that charge a significant fee for this service. Second, at the federal and state-level, more funding should be allocated toward mental health and overall college wellbeing programs. Given that distress is closely linked to unhealthy eating habits, colleges should have policies aimed at reducing unhealthy food choices on campus, particularly those offered in vending machines and in dining halls. This includes design new or reevaluate existing meal plan options for students who live on campus. Following the footsteps of the Menus of Change initiative (Culinary Institute of America, 2018), campuses should also adopt policies that promote healthy, sustainable, and good-tasting foods in cafeterias, dining halls, and independently-owned/franchised establishments.

Practice

The social and physical environment of colleges and universities provide unique opportunities to improve health and wellbeing for many Americans, particularly during the formative and transitional period of emerging adulthood. While attending college, young people are often forging relationships and adopting new health habits; at the same time, they may experience high levels of distress during a critical period for weight gain. This makes college

campuses ideal places to intervene because of the public health significance in reaching an at-risk population within a closed context. This controlled setting means that interventions on college campuses may have a better chance of influencing the health status of our nation. Campuses across the U.S. are already turning the wheels in this effort by implementing the Healthier Campus Initiative (HCI)—part of a nationwide effort to improve health and wellbeing by creating campus environments that encourage and support greater physical activity and healthier eating habits. Efforts such as the HCI requires the engagement of the whole campus including students, faculty, and staff in prioritizing, creating, and supporting a culture of health and wellbeing (Slusser, Malan, Watson, & Goldstein, 2018). Hence, campuses should to continue targeting behavioral interventions as well as incorporate strategies for reducing psychological distress. In addition, given sleep and social context are significant correlates of distress and obesity, these should be incorporated as key points of intervention, such as programs and workshops offered in residence hall or Greek housing to help students manage their level of distress, time, and sleep quality.

Taken together, this dissertation project not only highlights the importance of considering psychological wellbeing within the context of health behaviors and obesity, but also the need to contextualize obesity risk within the college experience. The observed differences among the men and women further points to the need to create meaningful, gender- and context-specific interventions to prevent weight gain and obesity among the college population. One reason why overweight and obesity rate remains high is because public health efforts to curb obesity have largely focused on behavioral interventions, overlooking psychological distress as a key determinant of both health behaviors and obesity. Focusing primarily on changing behavior but neglecting the context that shapes them is likely to yield less effective or short-term results. As noted by Glass & McAtleen (2006):

The study of health behavior in isolation from the broader social and environmental context is incomplete, and has contributed to disappointing results from experiments in behavior change. The solution requires a shift in emphasis, a reorientation of theories and new methods. (p. 15)

APPENDIX FOR CHAPTER 4

Appendix A

Supplemental analysis testing reverse pathway with obesity as IV and distress as DV showed no significant bivariate association among males ($B = 0.06$, $\beta = 0.02$), $p = 0.495$ and among females ($B = 0.08$, $\beta = 0.03$), $p = 0.191$. Multivariate analysis also revealed no association between obesity and distress for both genders (See Table 1.5).

Table 4.5

Gender Stratified OLS Regression Analysis of Obesity (IV) and Psychological Distress (DV), College Lifestyle and Wellbeing Study 2009-2010

	Male			Female		
	B (SE)	β	p	B (SE)	β	p
BMI	-0.01 (0.08)	-0.01	0.883	0.06 (0.06)	0.03	0.315
Constant	30.43			31.43		
Adjusted R ²	0.11			0.15		

Note. Beta weights are adjusted for individual characteristics (age, race, nativity, class standing, GPA, enrollment, employment, financial strain) and social context factors (living arrangement, intercollegiate sports, recreational sports, Greek membership).

APPENDIX FOR CHAPTER 5

Appendix A

Figure 5.2a. Significant distress x snacks/sweets interaction in the association between distress and obesity among males

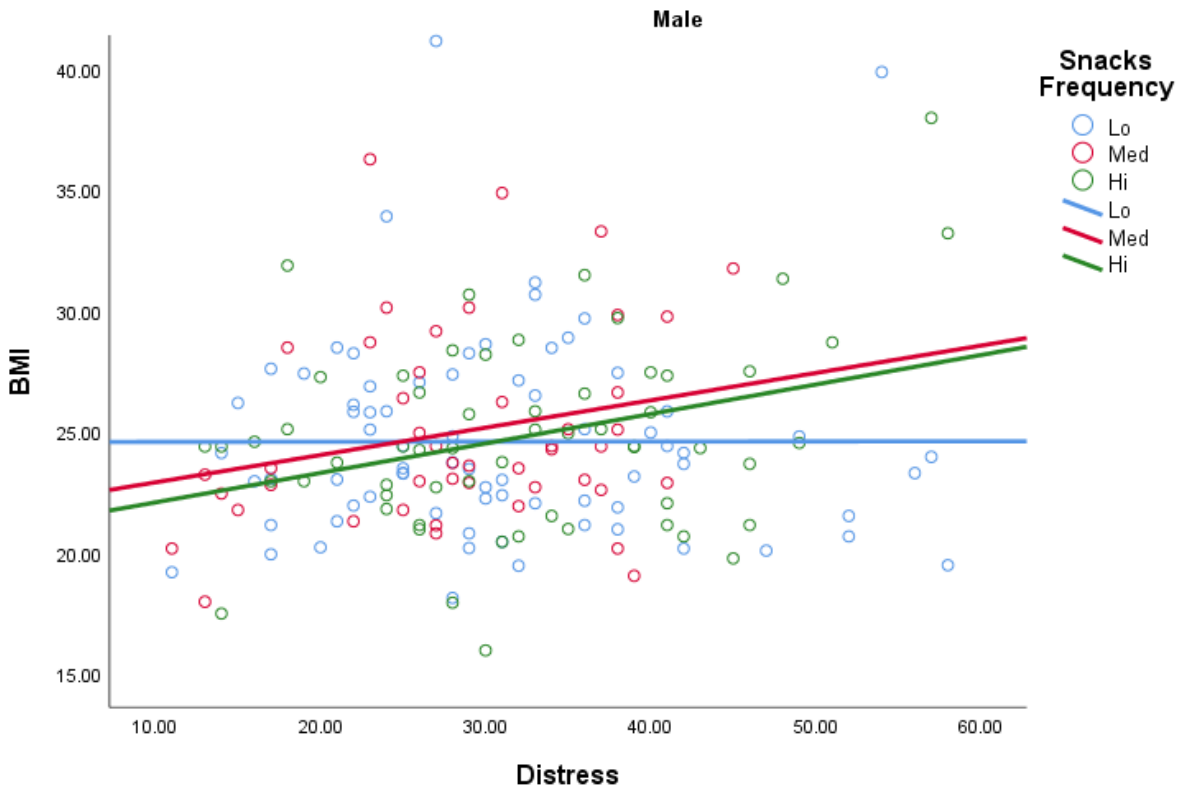
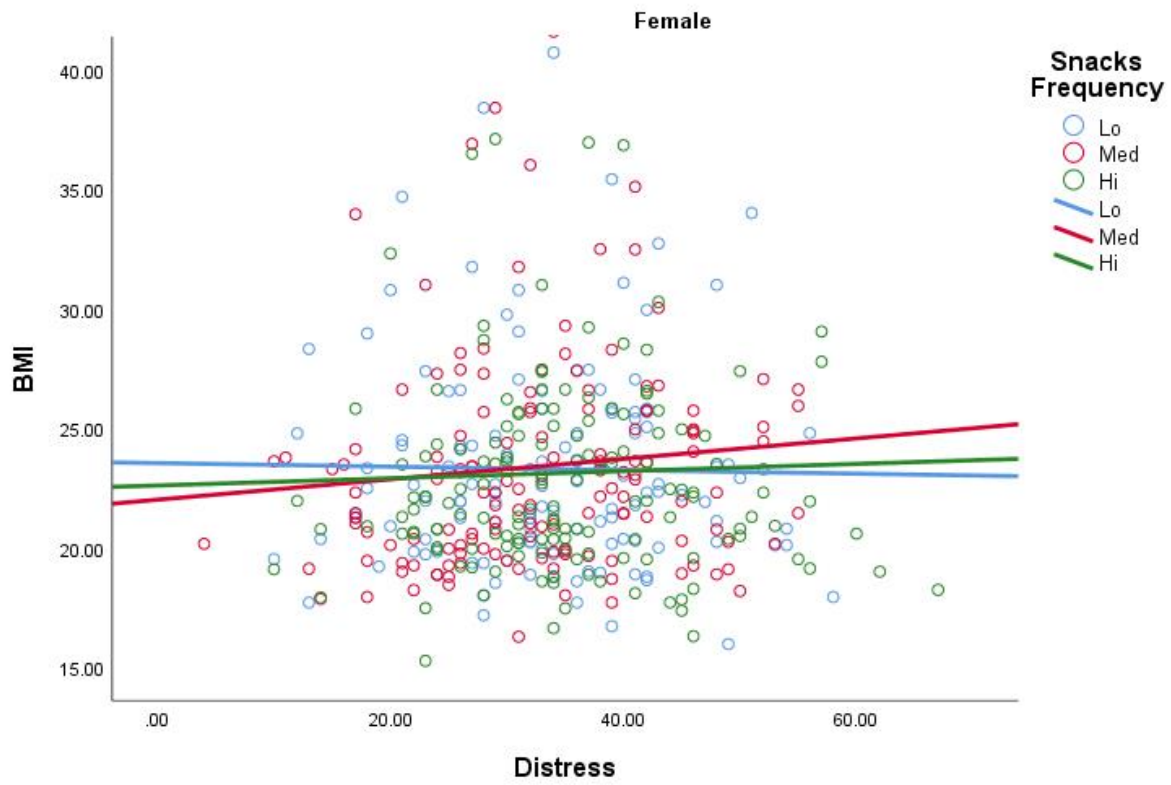


Figure 5.2b. Significant distress x snacks/sweets interaction in the association between distress and obesity among females



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