The Relationship Between Friend's Weight Management Advice, Self-Perception of Weight, Weight Change Intentions, Physical Activity, and Eating Habits in College Freshmen

by

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ABSTRACT

Background: College freshmen are exposed to a variety of environmental and social factors that can alter changes to health habits and encourage weight gain. Weight-related conversations had with friends may be related to self-perception of weight and alterations to health behaviors, but this association has yet to be assessed in the college population.

Objective: This study aims to examine the relationship between friend advice about weight management, self-perception of weight, and alterations to weight change intentions, physical activity, and eating habits in college freshmen over time.

Methods: College freshmen from ASU with complete data for three time points (n=321) were found to be predominantly female (72.2%) and non-white (53.2%) with a mean age of 17.5±41. Complete data included responses for items included in analysis which were related to friend encouragement about weigh management, self-perception of weight, physical activity, eating behaviors, and weight change intentions. A longitudinal multivariate mediation analysis using negative binomial regression adjusted for sociodemographics and clustering by dorm was used to assess the relationship between 1) friend encouragement about weight management at time 1 and behavioral outcomes at time 3, 2) friend encouragement about weight management at time 1 and self-perception of weight at time 2, and 3) self-perception of weight at time 2 and behavioral outcomes at time 3.

Results: A small proportion of population perceived friend encouragement about weight loss (18.3%) and weight gain (14.4%) at time 1. Half the population (50.9%) had the self-perception of overweight at time 2. At time 3, more than half (54.3%) of individuals

performed at least 60 minutes of MVPA and consumed at least ½ a serving of sugar-sweetened beverages each day, while nearly half (48.6%) consumed at least 2 servings of fruits and vegetables each day. Males perceived more friend encouragement to gain weight (27.4%; $p<0.01$), but more females had the self-perception of overweight (54%; $p=0.04$) and were attempting to lose weight (59.3%; $p<0.01$). Individuals who perceived friend encouragement to lose weight at time 1 had a 14.8% greater prevalence ($p<0.001$) of overweight perception of time two, and a 9.6% and 6.9%; decreased prevalence ($p<0.001$) of weight change and weight loss intentions ($p=0.023$) at time three respectively. Individuals who perceived friend encouragement to gain weight had a 34.9% decreased prevalence of ($p<0.001$) of self-perception of overweight at time 1. In individuals with the self-perception of overweight at time 2, there was a 18.1% increased prevalence ($p<0.001$) of consuming at least ½ a serving of sugar-sweetened beverages/day and an increased prevalence of 22.8% and 24.0% for weight change intentions and weight loss intentions at time 3 ($p<0.001$).

Conclusion: These findings suggest that there was not a mediation effect of self-perception of overweight in the relationship between friend encouragement about weight management and behavioral outcomes in the current sample. However, the increased prevalence of overweight perception in individuals who perceived friend encouragement about weight management may inform future interventions to focus on how weight-related conversations with friends is related to overweight perception. More research about the relationship between weight-related conversations had with friends, self-perception of weight, and health behaviors is needed to confirm these findings.

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CHAPTER 1

INTRODUCTION

Overview

The period of growth that extends from late adolescence in high school to young adulthood in college is known as emerging adulthood.[1] This period of transition has been shown to expose individuals to environmental and social factors that have the potential to alter health habits related to weight management, physical activity, and eating behaviors.[2-4] The alterations in health habits during the freshman year have been shown by some to generate weight gain totaling an average of 1.9±2.4kg just within the initial 12 weeks of college.[5] Unfortunately, weight gained during this period is not always temporary, and may not be reduced over time. Studies have observed that weight gained during the freshman year establishes a positive trajectory where students continue to gain weight throughout college, and even into adulthood.[6-8]

Addressing these weight gain trends that contribute to increases in obesity is of primary concern for public health prevention programs, as these trends have been associated with an increase in the risk for chronic health outcomes in the American population.[8] Despite numerous intervention efforts made to reduce these obesity rates, data from the most recent analysis of obesity in the United States show absolutely no decline.[9] As a result of these alarming statistics, it is of great importance to target obesity prevention efforts to critical time points throughout the lifespan when individuals are the most vulnerable to weight gain. The period of late adolescence or emerging adulthood, ages 17-23, is a time when individuals typically experience significant and rapid weight gain.[6,7] Given that the majority of individuals within this age range are typically entering

college, the freshman year is a significant period to observe in order to better understand contextual factors that are related to weight gain and consequential increases in obesity rates.

There have been a few studies that have analyzed psychosocial factors, such as body dissatisfaction, that have been related to weight gain during the freshman year of college. For example, Provencher et al. observed that females who restrained their eating were more likely to gain weight over time and were also more likely to experience high levels of body weight dissatisfaction and drive for thinness.[11] However, among males, different associations were observed were those who lost weight had higher levels of negative body weight perception when compared to those who gained weight. Furthermore, males who entered college with higher rates of body dissatisfaction were also more likely to gain weight.[11] Based on these observations, body dissatisfaction can greatly increase an individual's risk for weight gain during the freshman year, thus justifying further research into what factors may influence body dissatisfaction during this period.

Interestingly, body dissatisfaction has been associated with incorrect weight perception in both sexes, where men typically underestimate and females overestimate their weight when body weight dissatisfaction is present. [11-27] The interaction of body weight dissatisfaction and incorrect self-perception have been associated with alterations to health habits such as weight change intentions, diet, and physical activity in the adolescent population, but have yet to be observed in the college population[28].

Furthermore, self-perception of weight has been shown to be a stronger predictor of weight loss intentions that was BMI or weight measurements.[19]

Self-perception of body weight has been shown to be influenced by a myriad of external factors such as sociocultural body ideals, which are reinforced daily via social interaction.[27, 29-31] One such route by which these ideals are assimilated is by interactions with peers and close friends.[31] Establishing new social networks upon entering college presents the opportunity for sociocultural body ideals to be transmitted in a new way, which could potentially influence the relationship between self-perception of weight and alterations to health habits. Although research has observed that weight-related conversations had with friends may have a negative relationship with self-perception of weight in the adolescent population;[31] the association of these conversations with self-perception of weight has yet to be analyzed in the college population.

Purpose of the Study

The purpose of this study is to examine the relationship between friend advice about weight management and self-perception of weight, and thus the relationship between self-perception of weight and subsequent changes to weight intentions, physical activity, and eating habits in college freshmen over time. This study will provide a better understanding of factors that are related to health behaviors related to weight status in college freshmen. Findings may also provide greater insight into how social influences operating through friend advice about weight management are related to self-perception of weight overtime and how these changes are related to weight change intentions, physical activity, and eating habits in college freshmen. This knowledge could be used in

the future to develop intervention programs that target the college population in preventing weight gain and obesity. If advice from friends about weight management is related to an individual's perception of weight, weight change intentions, physical activity, and eating habits, this could suggest opportunities to intervene at a social level. Intervening at a social level amongst friends could provide a more effective strategy to transmit healthy behaviors so as to better regulate weight status during the college years.

To provide a framework for understanding the current deficit in the literature, a mediation analysis is suggested as indicated by the mediation diagram shown below (Figure 1). It is hypothesized that health habits, specifically weight change intentions, physical activity, and eating habits will be related to weight management advice from friends and that self-perception of weight will mediate this relationship. (1) Friend advice about weight management at Time 1 will be associated with weight change intentions, physical activity, and eating habits at Time 3, (2) friend advice about weight management at Time 1 will be associated with self-perception of weight at Time 2, (3) self-perception of weight at Time 2 will be associated with weight change intentions, physical activity, and eating habits at Time 3. It is also suggested that self-perception of weight at Time 2 will mediate the relationship between friend advice about weight management at Time 1 and weight change intentions, physical activity, and eating habits at Time 3.

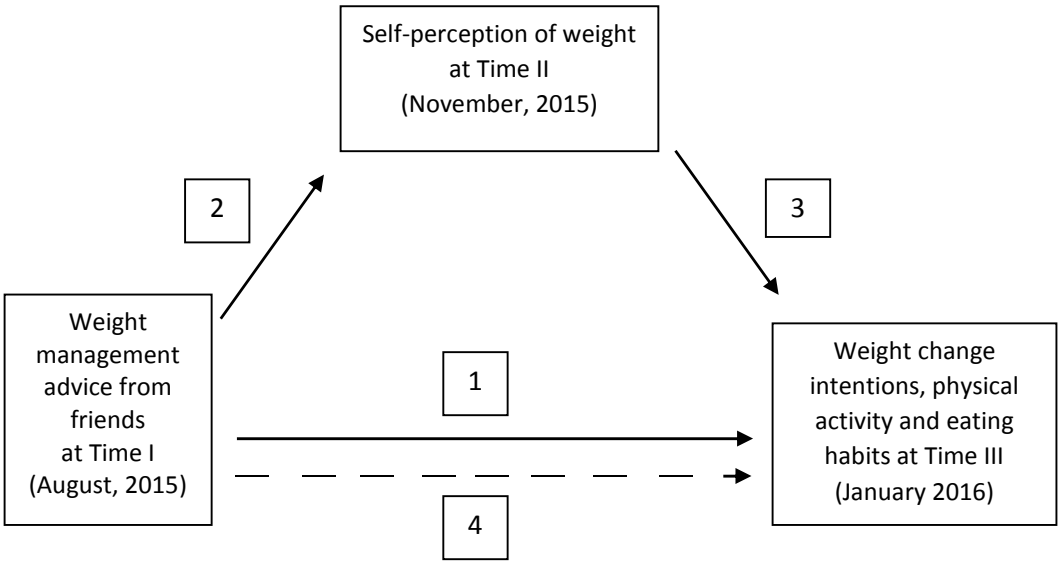


Figure 1: Relationships being assessed

Although the relationships between weight-related conversations had with friends and self-perception of weight in the adolescent population[1-3] as well as the relationship between body weight perception and weight gain in the college population[5-6,21] has been researched, the potential mediation of self-perception of weight on the relationship between weight management advice from friends and behavioral outcomes in college freshmen has yet to be assessed. By observing how weight-related advice from friends is related to self-perception of weight, it may be possible to analyze how this relationship is associated with health habits related to weight change intentions, physical activity, and eating behaviors in college freshmen.

This research is important for future strategies to better address the contextual factors, such as friend encouragement about weight management, that may be related to changes in health habits that occur during the freshman year. These changes may potentiate weight gain, thus contributing to the high rates of obesity prevalent in the

college population. By identifying relationships that are involved in health outcomes during the freshman year, it may be possible to target these mechanisms in order to better address the obesity epidemic among emerging adults.

Primary Research Question/Hypotheses

Study Aim 1) Determine if friend encouragement about weight management at Time 1 is related to self-perception of weight at Time 2, and weight change intentions, physical activity, and eating habits at Time 3.

Study Aim 2) Determine if self-perception of weight is related to weight change intentions, physical activity, and eating habits at Time 3.

Study Aim 3) Determine if self-perception of weight at Time 2 mediates the relationship between friend encouragement about weight management at Time 1 and weight change intentions, physical activity, and eating habits at Time 3.

Research question I: How is friend encouragement about weight management at Time 1 related to self-perception of weight, MVPA, sugar-sweetened beverage consumption, weight change intentions, and weight loss intentions in freshmen at Time 3?

> H_1: Self-perception of overweight will be more prevalent in individuals who receive weight management encouragement from friends.
>
> H_2: MVPA will be more prevalent in individuals who receive weight management encouragement from friends.

H_3: Sugar-sweetened beverage consumption will be less prevalent in individuals who receive weight management encouragement from friends.

H_3: Fruit and vegetable consumption will be less prevalent in individuals who receive weight management encouragement from friends.

H_4: Weight change intentions will be more prevalent in individuals who receive weight management encouragement from friends.

H_5: Weight loss intentions will be more prevalent in individuals who receive weight management encouragement from friends.

Research question II: How is self-perception of weight related to MVPA, sugar-sweetened beverage consumption, weight change intentions, and weight loss intentions in freshmen at Time 3?

H_6: MVPA will be less prevalent in individuals with self-perception of overweight.

H_7: Sugar-sweetened beverage consumption will be more prevalent in individuals with self-perception of overweight.

H_8: Weight change intentions will be more prevalent in individuals with self-perception of overweight.

H_9: Weight loss intentions will be more prevalent in individuals with self-perception of overweight.

Research question III: Does self-perception of weight at Time 2 mediates the relationship between friend encouragement about weight management at Time 1 and weight change intentions, physical activity, and eating habits at Time 3.

$H_{10:}$ Self-perception of weight will mediate the relationship between friend encouragement about weight management and weight change intentions, physical activity, and eating habits in college freshmen.

Definition of Terms

Rapid weight gain: significant weight gain experienced during the first 3 months of college.[31]

Emerging adulthood: Emerging adulthood is proposed as a new conception of development for the period from the late teens through the twenties, with a focus on ages 18–25.[25]

Body weight perception: The way in which an individual interprets their weight based on appearance. Can be scored as very underweight, slightly underweight, about the right weight, slightly overweight, and very overweight[46]. This scale has been used to observe a strong association between self-perceived weight status, BMI and weight control habits.

Body mass index (BMI): A number that reflects the categorization of an individual based on height and weight measurements. Calculated as kg/m^2, it helps evaluate risk for developing health conditions associated with weight status.[54] Classifications are as follows:

Underweight: BMI less than 18.5

Normal weight: BMI from 18.5 to 24.9

Overweight: BMI from 25.0 to 29.9

Obese: BMI greater than 30.0

Overweight perception: A self-perception of weight that reflects and individuals believe that they are overweight. This may not actually reflect true body weight status, but rather how an individual perceives their body's appearance.[46]

Research Design

Secondary data analysis was performed using data from the primary longitudinal devilSPARC study. Subjects were recruited from select residence halls from the Tempe, Downtown, and West Campus at Arizona State University. Subjects were included if they were enrollment as an ASU student, had status as a "freshman" during the Fall 2015 semester and resided in an on-campus dorm. Written consent was received from all subjects (Appendix A). The questions used for the purposes of this research were derived from the original survey used in the primary data analysis (Appendix B).

CHAPTER 2
LITERATURE REVIEW

Introduction

Self-perception of weight is the way in which an individual classifies their own body weight and is considered one of many psychosocial variables that interact with body image and body satisfaction. Given this interpretation, self-perception of overweight has emerged in the literature to be a predictor of disordered eating and other detrimental weight control methods[1-3]. Due to the impact that body weight perception has on weight change intentions, recent research has focused on the relationship between self-perception of weight as a predictor of current and future weight status in adolescents.[1-12]

The majority of studies have found that self-perception of overweight is a better predictor of BMI, risk for weight gain, attempted weight loss episodes, eating styles, and physical activity when compared to current weight status as an indicator.[6, 8, 9, 13] Given the significance that analyzing self-perception of weight has in predicting these outcomes, there has been a focus on the prevalence of inaccurate self-perception of weight in the adolescent population where vulnerability to weight gain has been shown to be very high. To highlight the current state of how adolescents perceive their weight, it has been observed that a large portion of adolescents do not accurately perceive their weight, which has significant repercussions for health outcomes related to weight management[1]. In one study, nearly 29-33% of adolescents misperceived their weight status such that underweight females had overweight perception and males had underweight perception; males misperceived their weight more often than females.[9] The incongruencies between perceived and actual weight status presents a problem, especially when an individual is

truly at risk for obesity but perceives their weight to be normal. As a result of this troublesome reality, the need to analyze the contextual factors that are related to self-perception of weight is of particular significance when attempting to alter the poor health habits.[9]

The majority of research on self-perception of weight has focused on the impressionable adolescent years, in that these immature minds are still establishing a sense of identity and perceptions of their body based on comparisons to their peers.[11-27] Although the present literature is heavily based on the experience of adolescents, studies have shown that the period when students are transitioning from high school to college represents a highly vulnerable time not only for weight gain, but for changes to body image and therefore changes to self-perception of weight.[14, 15, 17-21] To highlight the downstream significance this weight gain has, it has been observed that college students not only gain a significant amount during the freshman year, but continue to gain weight that often persists into adulthood.[22, 23] The observation that the college years establish a positive trajectory of weight gain into adulthood indicates that more research is needed in order to better understand the contextual factors within the college environment that are related to weight gain in college freshmen.

Students entering college for the first time are embarking on a challenging path to establish independence, find a new social support system, and create habits that may be solidified into adulthood. Habits and behaviors, especially those related to health, have been shown to be highly impressionable and subject to change based upon one's social environment.[27, 29-31] Given the status that self-perception of weight has earned as a

predictor of weight change intentions and related health outcomes, the relationship that one's social environment may have on self-perception of weight status needs investigation in order to better understand how weight gain can be prevented. The purpose of this review is to analyze the current research on self-perception of weight and how friends may influence this as a predictor of health outcomes such as weight change intentions, physical activity, and eating habits. A better understanding of how self-perception is related to health outcomes may provide a sounder foundation for interventions that can better address the present trends in overweight and obesity in the college-age populations.

Persistence of Obesity

The majority of prevention efforts directed towards chronic health outcomes in the American population have been focused on reducing the rising rates in obesity trends. Furthermore, data from the most recent analysis of obesity in the United States show absolutely no decline in the most recent prevalence of obesity[9]. In fact, an analysis of 10-year trends in weight gain and obesity status in men and women indicate that overweight status has increased over time and that the prevalence of obesity has actually increased twofold for all races and ethnicities.[22] Another longitudinal study of US adolescents from 1996 to 2008 examined the rates and persistence of obesity from childhood into adulthood and found that overtime obesity increased from 13.3% at baseline to 36.1% in only twelve years' time.[23] Furthermore, 32.3% of adults aged 20 years or older were found to be obese in this population.[22, 23] To further support these trends in weight gain, Deshmukh-Taskar et al observed that obesity status established during the ages of 15-17

was maintained into young adulthood in 90% of individuals tracked over the course of nine years.[13] These results exhibit how obesity rates are not only rapidly increasing, but are persisting through multiple time points in an individual's lifespan making the identification of vulnerable time points for weight gain crucial to altering these rates.

College as a Vulnerable Time Point for Weight Gain

As a result of these alarming statistics, it is of great importance to target obesity prevention efforts to the specific time points that indicate greater risk for weight gain. In studies using national data, trends in weight changes starting from adolescence into adulthood ("emerging adulthood") have identified specific periods of time when individuals are most vulnerable to gain weight. When comparing weight versus age throughout time in these studies, it has been shown that throughout the period of late adolescence, ages 17-23, individuals experience significant and rapid weight gain.[14, 22, 26-28] This weight gain has been seen to continue into adulthood and persists among both sexes and all ethnicities. Furthermore, it has been seen that these trends in rapid increases in weight are not reversed over time and can be used to predict negative health outcomes for this population.[22, 23] In recent research, it has been observed that the transition from adolescence in high school to young adulthood is a critical period for weight gain.[26] Given that the majority of individuals within the ages of 17-23 are typically entering college, the freshman year is a significant period to analyze in order to better understand the contextual factors that are related to weight gain, thus contributing to these observed trends in overweight and obese status.

Weight Gain in College

A large proportion of individuals within the period of 17-23 are entering the college environment for the first time. Similar trends in persistent weight gain have been observed in this population such that students who do gain weight during the freshman year continue to gain weight overtime. [26] When comparing baseline weight status taken at the beginning of freshman year compared to the end, it has been observed that the proportion of overweight and obese individuals increased substantially overtime.[26] To put in context the quantitative weight gain that occurs during freshman year, one study observed that freshmen gain 1.9 ± 2.4kg just within the first 12 weeks of college.[30] This significant weight gain within such a short span of time further exemplifies that the freshman year is a vulnerable time point for weight gain and increases in obese status. An analysis of total weight gain throughout all four years of college observed that those who gain weight during the freshman year tend to continue to gain weight over the remainder of time spent in college, which increases their likelihood of reaching overweight or obese status in adulthood.[30] Given the rising rates of obesity and the rapid and persistent increases in weight accumulated during the college years, college freshmen are a key group to analyze in order to better analyze the contextual factors that are related to health behaviors contributing to weight management.

College as an Environment for Alterations in Health Habits

Although the relationship between contextual factors and weight gain in this population have yet to be made clear, there appears to be some association between gaining weight and transitioning from high school to college. Interestingly, this transition

period has been characterized by high levels of variability and instability in behavior to the extent that many health habits related to self-perception of weight, physical activity, and eating behaviors are altered.[14, 24] The changes observed during this period exemplify how college freshman are highly impressionable and subject to ad lib alterations in behavior that affect overall health status. Changes to social network, physical environment, and academic workload may have the ability to alter health-related decisions and alter previous habits.[14, 16-21, 31] Combined, these changes create a unique setting for students to establish new health behaviors, either negative or positive, that often time represent permanent lifestyles changes, thus implicating future health habits and outcomes.[14, 24, 27-32] This observation further reinforces the importance of analyzing the contextual factors that are related to changes in health habits established during the freshman year. These contextual factors could hold the solution for effective intervention in health habits so as to prevent weight gain and obesity.

Differences in College Weight Gain by Gender

Interestingly, weight gain does not appear to impact all college freshmen equally. It has been observed that there are gender-specific factors that influence weight gain in this population. Weight gain seen in males has been positively correlated with high peer pressure to consume alcohol as well as low levels of perceived academic confidence. Conversely, weight gain in females has been related to increased academic work load over the year and inadequate fruit and vegetable consumption.[39] Students who subscribe to restrained eating and live on campus[40] and females who have experienced weight changes as a result of past dieting[41] have also been shown to experience greater amounts of weight gain during freshman year. This exemplifies that there are gender-specific

factors related to the college environment that place certain freshmen students at a greater risk for weight gain compared to others. Based on these observations, further analysis of how college men and women are different in terms of health behaviors must be considered so that appropriate interventions can be formed based on these gender differences.

Body Weight Dissatisfaction

To address one of these contextual factors that differ by gender, it has been observed that body weight dissatisfaction promotes rapid weight gain.[42] Provencher et al observed that females who restrained their eating due to body weight dissatisfaction were more likely to gain weight over time and were more likely to have a higher drive for thinness.[42] It was further observed that females who were preoccupied with their weight and eating were more vulnerable to weight gain during their freshman year when compared to students who were not concerned with weight status or eating. In males, different associations were observed where those who lost weight had higher levels of negative body weight perception when compared to those who gained weight. Furthermore, males who entered college with higher rates of body dissatisfaction were also more likely to gain weight.[42]

These findings exhibit the effect that gender has on the association between levels of body weight satisfaction, diet habits, and weight change that needs further investigation. Body weight dissatisfaction has been found to increase during the transition from middle to high school, and continue to increase during the transition into college.[43] Along with this increase, there is a significant association between increases in body dissatisfaction and BMI, even when increases in dissatisfaction are controlled for.[43]

Given that there appears to be a powerful relationship between increases in body weight dissatisfaction during the transition to college and increases in BMI, the majority of students transitioning to college may be at a great risk for weight gain as a result of dissatisfaction with their body weight. This recently discovered association has begun to be recognized as a significant predictor of future health outcomes related to weight status issues such as eating disorders, caloric restraint, and weight gain.[43-46]

Self-Perception of Body Weight

In numerous studies, body weight dissatisfaction has been correlated to an inaccurate perception of body weight in both males and females.[1-3, 5, 8-12, 44, 47-48] Self-perception of body weight has also been linked to weight change intentions, diet, and physical activity habits in the adolescent population.[6] In fact, a study performed by Duncan et al observed that perceived weight status is a stronger predictor of weight loss intentions than is actual body fat or weight measurements.[11] Furthermore, self-perception of overweight has been shown to have a stronger association with trying to lose weight in comparison to a BMI indicating overweight.[9] It has also been observed that overweight adolescents with an accurate perception of weight status have a greater likelihood to attempt weight loss when compared to adolescents who are unaware of their overweight status.[13] In fact, those who perceive themselves to be overweight are more likely to report weight loss efforts compared to those who underestimate their true weight status. Provided that self-perception of weight has emerged as a significant predictor of weight change intentions and health habits, analyzing self-perception of weight in college freshmen may reveal an opportunity to intervene and circumvent weight gain.

Consequences of Inaccurate Self-Perception of Body Weight

Although self-perception of weight has been shown to be a strong predictor of lifestyle alterations such as increases in physical activity, not all reported weight loss efforts are healthy or desirable. [3, 8, 11] It is important to realize that adolescents with overweight perception of weight who report weight loss efforts are typically not found to participate in positive dietary habits such as higher fruit and vegetable consumption when compared to those not attempting weight loss.[11] In a recent comparison of weight loss and muscle gaining behaviors in adolescents, it was observed that girls reported trying to lose weight more than boys, and reported using exercise and skipping meals as the most common weight loss methods. Males were engaged in more muscle building behaviors and utilized a higher protein diet and weight lifting to achieve this desired modification. Males also reported higher use of supplements for muscle gain, whereas females reported higher use of diet pills for weight loss. Interestingly, boys also reported higher instances of vomiting and laxative/diuretic use as a method of weight loss in comparison to females.[40]

When comparing genders and weight loss efforts as a result reference of body weight perception, females are more likely than boys to attempt weight loss regardless of their true weight status due to the perception of overweight.[8] Males are more likely to be attempting weight gain via an increase in muscle mass and a decrease in fat-mass. The male interpretation of *gain/put on weight* typically refers to muscle gain, indicating that poor self-perception of body weight in males more accurately represents dissatisfaction with muscle mass and shape, whereas for females, poor self-perception of weight refers to actual body weight and a desire to become thinner.[10] Thus, boys are more likely to

report themselves as underweight whereas females are more likely to report themselves as overweight.[9] Additionally, Edwards et al observed that nearly 29-33% of adolescents underestimate their weight even when they fall in the category of overweight or obese.[1] Specifically, males misperceive their overweight status 40.2% of the time while females misperceive their weight only 22.6% of the time.[1]

This inaccuracy in weight perception is cause for great concern because there has been an association between weight misperception, weight loss efforts, eating disorders, and other unhealthy weight loss methods in this population.[9] It is also concerning that those who are truly overweight or obese but who do not perceive themselves as so generally report lower amounts of physical activity, which may be counterproductive to public health efforts to reduce obesity rates.[11,12] It has also been observed that accurate perception of overweight status leads to significantly higher participation in unhealthy weight control behaviors such as vomiting or laxative use in the female population.[1] The utilization of dangerous weight-loss methods exemplifies how self-perception of weight is an incredibly strong predictor of both positive and negative health habits in this population.

Based on the literature regarding poor body image and weight-loss behaviors in adolescents, it appears that within rather than between groups of friends share similar behaviors regarding the weight management behaviors previously mentioned.[48] This indicates that friend groups tend to be similar in health habits, but more importantly that friends may influence self-perception of weight. This relationship indicates that friends may play a pivotal role in the establishment of self-perception of weight during college. It is therefore critical to analyze how interaction with friends is related to self-perception of

weight, as self-perception of weight has been strongly correlated to health behaviors in adolescents. However, this association between friendships and self-perception of weight has yet to be observed in the college population.

Conversations with Friends about Weight Management

In studies observing adolescent populations, weight-related conversations had with friends have been seen to impact appearance ideals and self-perception of weight differently for males and females. For example, it has been observed that girls are affected by conversations with friends that mostly revolve around concern about body ideals and overall dissatisfaction with their bodies. In boys, is has been shown that self-perception of weight and appearance ideals are strongly related to a desire to portray the muscular physique depicted in the media.[48] Other studies in adolescents have shown that boys are more receptive to teasing from peers about small body builds, resulting in a heightened desire to gain weight through muscle mass.[4] This social interaction about body weight for both boys and girls has been referred to as appearance training, and may come in the form of teasing, bullying, comments made about weight, or advice given about weight management from peers.[48]

In particular, peer experiences that have been seen to contribute the most to the internalization of body ideals and body concerns are appearance conversations and appearance criticism.[49] Appearance conversations function to impact body image and weight perception by perpetuating a focus on appearance, weight related issues, and reinforcement of socio cultural expectations of body type.[50] Similarly, peer criticism through weight management comments or advice about dieting and physical activity have been routinely observed in younger female populations and have been shown to

negatively impact body image and weight perception.[51] Jones et al observed that appearance conversation and peer appearance criticism were significantly correlated to the internalization of body type ideals and disturbed body image in both boys and girls.[49] This supports the ideology that social interactions with friends, particularly focused on weight status and management, are key in understanding how friends impact self-perception of weight. While the impact of peer influence on body satisfaction, body weight perception, and idealized body-type has been well documented in the adolescent population, this relationship has yet to be observed in the college-aged population. By analyzing how weight-related conversations had with friends is related to self-perception of weight in freshmen, it may be possible to better inform the understanding of factors that contribute weight gain during freshman year. Given the relationship between this piece and how self-perception of overweight influences weight change intentions, physical activity, and eating habits in the adolescent population, it seems logical that friends may impart some effect on the health behaviors of college freshman that contribute to weight fluctuations. However, the relationship between friends and self-perception of weight and health behaviors in the college population has yet to be assessed, indicating the need for further analysis.

Summary

Self-perception of weight has recently emerged as a strong predictor of future weight status, BMI, weight change intentions, and weight control methods in the adolescent population.[6, 8, 9, 13] It has been observed that accurate perception of weight in overweight and obese adolescents leads to greater weight loss intentions.[11] While weight loss in the overweight and obese population is desirable, the methods that adolescents

utilize to achieve this are not. Overall it has been shown that adolescents attempting weight loss typically consume a diet reduced in nutrient rich foods such as fruits and vegetables, partake in less physical activity, and engage in detrimental methods of weight loss such as laxative use and vomiting.[3, 8, 11, 40]

While there have been studies that observed how friends advice is related to weight change intentions and body satisfaction in the adolescent population, this relationship has not been assessed in the college age population. The relationship between friend advice about weight management and self-perception of weight also has yet to be observed. These overarching deficiencies present the opportunity for further research into the relationship of friend influences on self-perception.

The current literature also has not come to an agreement on whether self-perception of weight imparts a positive or negative affect on future health habits in the general population.[1, 6, 7] While it has been shown that self-perception of overweight is related to weight loss intentions in the obese adolescent population, this has yet to be observed in the college-age population. Given that self-perception of overweight is such a strong predictor of health habits and weight change intentions, this concept must be analyzed in the college population as well when weight gain is very prevalent.

The concept of friend influence on self-perception of weight and resulting differences in weight change intentions and health habits has yet to be applied to the college-aged population. This presents the opportunity for further research into how self-perception of overweight is related weight change intentions, physical activity, and eating behaviors. Given the significant association between self-perception of overweight in the obese adolescent population and increased weight loss intentions, this relationship may

present a new foundation for a more effective way to circumvent weight gain during freshmen year. Provided that obesity rates continue to increase[20] especially during the college years,[27] research is needed into the contextual factors, such as friend advice about weight management, that are related to self-perception of overweight which has been related to future obese status in the college freshmen population.

CHAPTER 3
METHODS

Study Design

This was a secondary data analysis of college freshmen participating in the longitudinal, prospective study SPARC (**S**ocial impact of **P**hysical **A**ctivity and nut**R**ition in **C**ollege) that examined how friendship networks impact nutrition and physical activity behaviors and the risk for excessive weight gain change during the freshman year in college. The present study observed how friend's encouragement about weight management influences self-perception of weight, and how this relationship mediates subsequent weight change intentions, physical activity, and eating habits. Study staff and volunteers recruited students living the dorms that are being sampled from ASU campuses in metro Phoenix.

Participants provided consent (Appendix A) and completed three different surveys (Appendix B) consisting of a 129-item survey for Time 1 in August, a 114-item survey for Time 2 in November, and a 107-item survey for Time 3 in January. Participants had the opportunity to earn up to $110 in Amazon gift cards in addition to novelty items such as sunglasses, water bottles, etc. for full participation in the devilSPARC. The Institutional Review Board at Arizona State University approved all study protocols (Appendix C).

Sample

Participants were selected from the primary longitudinal study population and were enrolled as an ASU student and resided in an on-campus residence hall.

There were a total of 411 participants with complete longitudinal data for time points 1-3. Based on the purpose of this investigation being to observe freshman students at ASU, any data from individual without freshman standing (n=49) were excluded. One participant reported "gender" as transgender and was therefore excluded from the sample due to the necessity for binomial coding in analysis. Extreme outliers (n=2) in response to sugar-sweetened vegetable consumption and MVPA were also excluded to avoid any skewing of the data. Finally, for the outcome variable of individuals attempting weight change, there were only 22 individuals who reported attempting to lose weight. A sensitivity analysis excluding these 22 individuals was performed for steps including weight loss intentions as the outcome variable. The remaining data for times 1-3 resulted in a sample of 321 college freshmen.

Measures Used by Time Point

Friend encouragement about weight management

The survey assessed social influences on weight-related behaviors. One such question contained scaled items asking the participant to rate (*strongly disagree, disagree, agree, strongly agree*) that their friends encourage weight management strategies ("*My friends often encourage me to diet to lose weight or keep from gaining weight")* and a second item assessing encouragement from friends to gain weight ("*My friends often encourage me to gain weight").* These items have been used as a measure of social influences on BMI and weight loss intentions in young adults.[55] These items were used to assess the impact of social influence through friend's encouragement about

weight management at Time point 1. Based on responses to these questions, a friend encouragement about weight loss and a friend encouragement about weight gain variables were created by recoding responses of *strongly disagree, disagree, agree, strongly agree*. To dichotomize these responses, strongly disagree and disagree were combined and coded to = 0. Strongly agree and agree were combined and coded to = 1.

Self-perception of weight

Self-perception of weight has been shown to be a strong predictor of weight change intentions, physical activity, and eating habits in adolescents.[9, 11] The survey also assessed self-perception of weight according to an item that assessed current perception of weight status (*"At this time, do you feel that you are": very underweight, slightly underweight, about the right weight, slightly overweight, very overweight).* This scale has been used as a measure of weight perception in the adolescent population.[53] This measure of weight perception was used at Time point 2 and all responses were based on gender specific differences in weight perceptions. Based on responses to this question, a self-perception of weight variable was created by recoding responses of *very underweight, slightly underweight, about the right weight, slightly overweight, very overweight*. The prevalence for each response was heavily skewed as the majority of individuals had the self-perception of overweight. These responses were dichotomized to overweight (*slightly overweight and overweight*) vs other (*very underweight, slightly underweight, about the right weight).*

Weight Change Intentions

Weight change intentions were measured through the use of three separate items related to weight change intentions and methods. The first item assessed current efforts to change weight status (ex. "*Are you currently trying to": lose weight, stay the same weight, gain weight, I am not trying to do anything about my weight).* This has been a used as measure of weight change intentions in adolescent populations[54] and was assessed at Time point 3. Based on responses to this question, individuals were either attempting to lose weight (n=197) or change weight (*lose weight gain weight*; n=225). Based on this distribution, a weight loss variable (*lose weight)* and a weight change variable (*lose weight* and *gain weight)* was created. The lose weight variable was coded as either attempting to lose weight =1, or not = 0. The weight change variable was coded in the same fashion. To account for sensitivity in the analysis of weight loss, responses indicating weight gain (n=22) were excluded from analysis.

Weight Change Behaviors

Weight loss behaviors: The second item assessed methods utilized within the past 30 days to keep from gaining weight (ex. "*During the past 30 days, which of the following did you do to lose weight or keep from gaining weight"? (select all that apply): 1. I did not try to lose weight or keep from gaining weight, 2. dieted, 3. exercised, 4. ate more fruits and/or vegetables, 5. drank less soda (not including diet soda), 6. controlled my portion sizes, 7. made myself vomit, 8. took diet pills, 9. used some other method (please specify*). This has been a used as a measure of unhealthy weight control behaviors in adolescents.[56] Prevalence for the following weight loss/maintenance methods were provided for the following:

Dieted, 3. exercised, 4. ate more fruits and/or vegetables, 5. drank less soda (not including diet soda), 6. controlled my portion sizes, 7. made myself vomit, 8. took diet pills,

Weight gain behaviors: The third item assessed methods utilized in the past 30 days to gain weight/muscle mass (ex. "*During the past 30 days, which of the following did you do to gain weight/muscle mass?" (select all that apply) 1. I did not try to gain weight/muscle mass, 2. used protein powder or shakes, 3. used steroids, 4. used other muscle-building substances (such as creatine, amino acids, DHEA, or growth hormones), 5. used some other method (please specify)*). This has been used as a measure of weight and muscle gain intentions in adolescents.[57] These measures of weight change intentions were assessed at Time point 3. Prevalence was provided for the following weight gain methods:

2. used protein powder or shakes, 3. used steroids, 4. used other muscle-building substances (such as creatine, amino acids, DHEA, or growth hormones)

Physical Activity

The Godin-Shepard Leisure-Time Physical Activity Questionnaire was used to assess strenuous, moderate and mild exercise[58]. These items assessed how many hours (none, less than ½ hours a week, ½-2 hours a week, 4 ½ - 6 hours a week, more than 6 hours a week) in a usual week the individual participated in the following activities:

Strenuous exercise (heart beats rapidly)?

Examples: biking fast, aerobic dancing, running, jogging, swimming laps, rollerblading, skating, lacrosse, tennis, cross-country skiing, soccer, basketball, football, Zumba

Moderate exercise (not exhausting)?

Examples: walking quickly, baseball, gymnastics, easy bicycling, volleyball, skiing, dancing, skateboarding, snowboarding

Mild exercise (little effort):

Examples: walking slowly to school, to friends house etc.), bowling, golf, fishing, snowmobiling, yoga).

Based on responses to these questions, an MVPA variable was created by recoding responses for strenuous, moderate, and mild exercise. Participants chose 1 0f 6 response options ranging from 0 to more than 6 hours of activity per item. Strenuous and moderate PA were combined and divided by 7 to create the MVPA/day variable. Based on the sample distribution for this variable, MVPA was cut at the average of 60 minutes/day.

Eating Habits

Using select items from the Dietary Screener Questionnaire in the NHANES 2009-2010, eating habits were assessed by the amount of sugar-sweetened beverages and fruit and vegetables consumed in the past month.[59]

Sugar-sweetened beverages: (*"During the <u>past month</u>, how often did you drink):*

*1) "**Regular** soda or pop that contains sugar? Do **not** include diet soda";*

*2) "Coffee or tea that had **sugar** or **honey** added to it? Include coffee and tea you sweetened yourself and presweetened tea and coffee drinks such as Arizona Tea and Frappuccino. Do **not** include artificially sweetened coffee or diet tea";*

*3) "**Sweetened fruit drinks** such as Kool-Aid, Lemonade, or cranberry drink? Include fruit drinks you made at home and added sugar to. Do **not** include diet drinks or artificially sweetened drinks";*

*4) "**Sports drinks** such as Gatorade, Powerade, Vitamin Water, etc.? Do **not** include diet drinks or artificially sweetened drinks";*

*5) "**Energy drinks** such as Red Bull, Monster, Rockstar, etc.? Do **not** include diet drinks or artificially sweetened drinks."*

Responses for each question includes: *1. Never 2. 1-time last month 3. 2-3 times last month 4. 1 time per week 5. 2 times per week 6. 3-4 times per week 7. 5-6 times per week 8. 1 time per day 9. 2 or more times per day.*

Fruit and Vegetables: (*"During the <u>past month</u>, how often did you eat):*

*1)"Fruit? Include fresh, frozen, or canned fruit. Do **not** include juices."*

*2) **100% pure fruit juices** such as orange, mango, apple, grape and pineapple juices? Do **not** include fruit-flavored drinks with added sugar or fruit juice you made at home and added sugar to.*

*3) "Green leafy or lettuce **salad**, with or without other vegetables?"*

*4) Any kind of **fried potatoes**, include French fries, home fries, or hash brown potatoes?*

*5)Any **other kind of potatoes**, such as baked, boiled, mashed, sweet potatoes, or potato salad?*

*6) Refried beans, baked beans, beans in soup, pork and beans or any other type of cooked dried beans? Do **not** include green beans.*

*7)Mexican-type **salsa** made with tomato?*

***8) Tomato sauces** such as with spaghetti noodles or mixed into foods such as lasagna? Do **not** include tomato sauce on pizza.*

*9) "**Other vegetables**" (not including previously mentioned green salads, potatoes, or cooked dried beans)?"*

> Responses for each question includes: *1. Never 2. 1-time last month 3. 2-3 times last month 4. 1 time per week 5. 2 times per week 6. 3-4 times per week 7. 5-6 times per week 8. 1 time per day 9. 2 or more times per day.*

These have been a used measure of food frequencies in adolescents.[59] These measures of food frequencies to assess dietary habits were used at Time point 3. Based on the numerical value for each response options shown above, a fruit/vegetable variable was created by summing all values and then dividing by seven to provide a daily average. Based on the distribution, the average intake was 2 servings of fruits & vegetables/day. This variable was then recoded as ≥2 servings/day. A similar procedure was used to create the sugar-sweetened beverage (SSB) protocol. The average consumption was ½ a serving of SSB/day as such, this variable was then recoded as ≥1/2 serving of SSB/day vs other.

Sociodemographics and Covariates

To address several variables that may be related to self-perception of weight and weight intentions, physical activity, and eating habits, multiple questions were asked on the survey. Race/ethnicity, gender, Pell Grant status, international student status, and highest parental education were assessed. To assess race and ethnicity, participants were asked "*how do you usually describe yourself? (check all that apply)*, possible responses include: "*White, Black or African American, Hispanic or Latino/a, Asian or Pacific Islander, American Indian or Alaska Native, some other race (please specify)"*. The following codes were used: 1= *White, 2= Black or African American, 3= Hispanic or Latino/a, 4= Asian or Pacific Islander, 5= American Indian or Alaska Native, Some other race.* To assess gender, participants were asked "what is your gender", with

possible responses being *Male, Female, Transgender.* The necessity for dichotomous coding required all responses indicating transgender (n=1) to be dropped from analysis. Males were then coded as 1 and females were coded as 0. Pell Grant status was determined by the question: "*are you a Pell Grant recipient?"* and responses could be: "*yes, no, I don't know*". To create a dichotomous variable, those indicating *I do not know* were included with responses to *No.* To assess residency, participants were asked "a*re you an international student?*" and responses were coded as: "yes = 1, or no = 0". Highest parental education was assessed by asking "*what is the highest degree or level of education that your:* a) *dad, or other parental/guardian figure* and b) *mom, or other parental/guardian figure completed?*" Responses include: "*some high school (no degree), high school diploma (or equivalent), some college (no degree), associate's degree/Trade/Technical/Vocational training, bachelor's degree, graduate or professional degree, not applicable*". Responses were coded as follows: 1= No degree/ high school diploma (or equivalent), 2= Some college (no degree), 3= Bachelor's degree, 4= Graduate or professional degree, 5= NA.

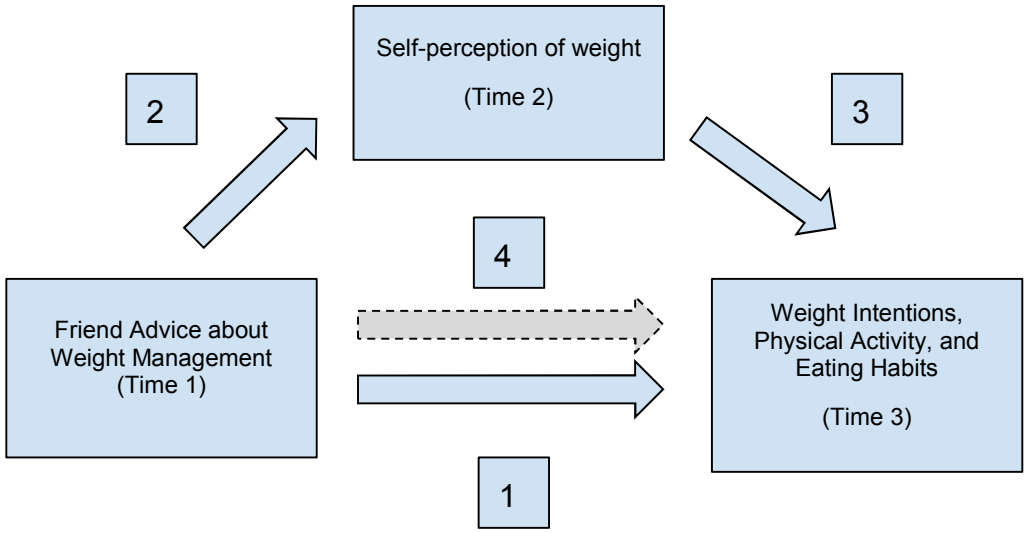
Statistical Analysis

Descriptive statistics was conducted on friend encouragement about weight management at time 1, self-perception of weight at time 2, and weight change intentions, physical activity, and eating habits at time 3. Bivariate analysis (t-test and χ-square) stratified by sex, was conducted between friend encouragement about weight management at time 1 and self-perception of weight at time 2, friend encouragement about weight management at time 1 and weight intentions, physical activity, and eating

habits at time 3, and between self-perception of weight at time 2 and weight intentions, physical activity, and eating habits at time 3. Longitudinal multivariate mediation analyses using negative binomial regression was conducted to determine if friend encouragement about weight management at time 1 mediated the relationship between self-perception at time two and weight intentions, physical activity, and eating habits at time 3. The independent variable was friend encouragement about weight at time 1, and the dependent variables were self-perception of weight at time 2, and weight change intentions, physical activity, and eating habits at time 3. For the second model, self-perception of weight at time 2 was the dependent variable and weight change intentions, physical activity, and eating habits at time 3 were the dependent variables. Step 1 measured the relationship between friend encouragement about weight management at time 2 and weight change intentions, physical activity, and eating habits at time 3. Step 2 measured the relationship between friend encouragement about weight management at time 1 and self-perception of weight at time 2. Step 3 measured the relationship between self-perception of weight at time 2 and weight intentions, physical activity, and eating habits at time 3. Step 4 measured how self-perception of weight at time 2 mediates the relationship between friend encouragement about weight management at time 1 and MVPA, sugar-sweetened beverage consumption, and weight change/loss intentions at time 2. These models controlled for weight status, race and ethnicity, Pell Grant status, residency, highest parental education, major, and the clustering of participants within dorm. Additionally, baseline physical activity, sugar-sweetened beverage and fruits and vegetable consumption, and weight change/loss intentions were adjusted for in all models

with these variables (steps 1, 3, and 4). Among each test, a p-value of <0.05 was used to indicate significance. The described relationships are shown below in Figure 2.

Figure 2



CHAPTER 4

RESULTS

Descriptive Characteristics

There were a total of 411 participants with complete longitudinal data for time points 1-3. Based on the purpose of this investigation being to observe male and female freshman students at ASU, any data from individual without freshman standing, not living in residence halls, and not exclusively male or female (n=50) were excluded. Extreme outliers (n=2) in responses for sugar-sweetened beverages and MVPA and individuals reporting "NA" (n=16) in responses were also excluded to avoid any skewing of the data. The remaining data for times 1-3 resulted in a sample of 321 college freshmen.

Socio-demographics of Friend Encouragement about Weight Management, Self-Perception of Weight, and Behavioral Outcomes Among College Freshmen

Participants of the sample were predominantly female (72.2%) and non-white (53.2%) with a mean age of 17.5±0.41. Only a small portion of the sample reported being an international student (2.2%). Barrett Honors student represented only a fraction of the sample (16.3%) while 35.3% of respondents reported being a Pell Grant recipient.

A small proportion of the population reported receiving friend encouragement about weight loss at Time 1 (18.3%), and similar results were observed for friend encouragement about weight gain (14.4%). However, nearly half of the population had a self-perception of overweight at Time 2 (50.9%). Based on 348 observations for MVPA,

the average amount of time spent performing moderate to vigorous physical activity per day was 67.97 mins with 54.32% of participants meeting or achieving this amount. Out of 346 observations for sugar-sweetened beverage (SSB) consumption, the average serving per day was .974 (± 1.14) with 56.3% of individuals consuming at least ½ a serving of SSB per day. Based on 349 observations for fruit and vegetable consumption, the average serving per day was 1.21 (±1.14) with 56.3% of the population meeting this standard. Interestingly, 62.5% of individuals were attempting weight change, 55% was attempting weight loss and 25% was attempting weight gain. Of the 55% that were attempting weight loss, and only 6% were attempting weight gain.

Table 1: Socio-demographics of friend encouragement about weight management, self-perception of weight, and behavioral outcomes among college freshmen (n=354)

Characteristics	Total
Gender *%(n)*	
Female	72.2% (262)
Male	25.7% (91)
Age *mean ± SD*	17.5 ± .41
Highest Parental Education Level *%(n)*	
No degree/ high school diploma (or equivalent)	16.95% (60)
Some college (no degree)	21.19% (75)
Bachelor's degree	32.77% (116)
Graduate or professional degree	27.68% (98)
NA	1.41% (5)
Race/Ethnicity *%(n)*	
White	46.8% (166)
Black or African American	10.7% (38)
Hispanic or Latino	9.3% (33)
Asian or Pacific Islander	9.3% (33)
Mixed/Other	23.7% (84)
International Student Status *%(n)*	
International	2.2% (8)
Barrett Honors *%(n)*	
Barrett Honors Student	16.3% (56)
Pell Grant Recipient *%(n)*	
Recipients	35.3% (125)
Friend Encouragement to Lose Weight at Time 1 *%(n)*	
Agree	18.3% (65)
Friend Encouragement to Gain Weight at Time 1 *%(n)*	
Agree	14.4% (51)
Self-Perception of Weight at Time 2 *%(n)*	
Overweight	50.9% (180)
MVPA (min/day) at Time 3 *(Mean ± SD)*	
Observations (n)	359

MVPA (min/day)	67.97±42.43
60+/day *%(n)*	54.32% (195)
Sugar-Sweetened Beverages (SSB) at Time 3 *(Mean ± SD)*	
Observations (n)	351
SSB (total serving/day)	.974 ± 1.14
SSB (1/2 serving/day) *%(n)*	56.3% (200)
Fruit and Vegetables/day at Time 3 *(Mean ± SD)*	
Observations (n)	350
FV servings/day	2.21 ± 1.03
2 serving/day *%(n)*	48.6% (173)
Weight change intentions at Time 3 *%(n)*	62.5% (225)
Weight loss intentions at Time 3 *%(n)*	55.2% (195)
Weight gain intentions at Time 3 *%(n)*	6% (22)

Differences in Friend Encouragement for Weight Management, Self-Perception of Weight, and Behavioral Outcomes Among College Freshmen

Perceived friend encouragement to lose weight was relatively uncommon (18.3%) in this sample of college freshmen. Although males perceived more weight loss advice (23.0%) compared to females (16.7%), these prevalence differences were not found to be significant ($p=0.178$). Similarly, perceived friend encouragement to gain weight was uncommon (18.3%). Despite this low prevalence, frequency differences ($p<0.001$) were observed where males perceived more weight gain advice (27.4%) compared to females (9.8%). Interestingly, slightly more than half (50.9%) of individuals had the self-perception of overweight. Females perceived themselves as overweight (54.0%) slightly more than males (42.0%), and these frequencies were found to be statistically significant ($p=0.04$). More than half (63.2%) of freshmen were attempting to change their weight, and nearly half (42.1%) were attempting weight loss. Significant prevalence differences ($p<0.01$) were observed among individuals attempting weight loss were more than half (59.3%) of females and nearly half (43%) of males were attempting to lose weight. A large proportion (54.3%) of individuals met or exceeded 60 minutes of MVPA per day. Only a small proportion (45.1%) of freshmen consumed at least 2 servings of fruits and vegetables per day. Nearly two-thirds (56.3%) of individuals consumed less than ½ a serving of sugar-sweetened beverages per day.

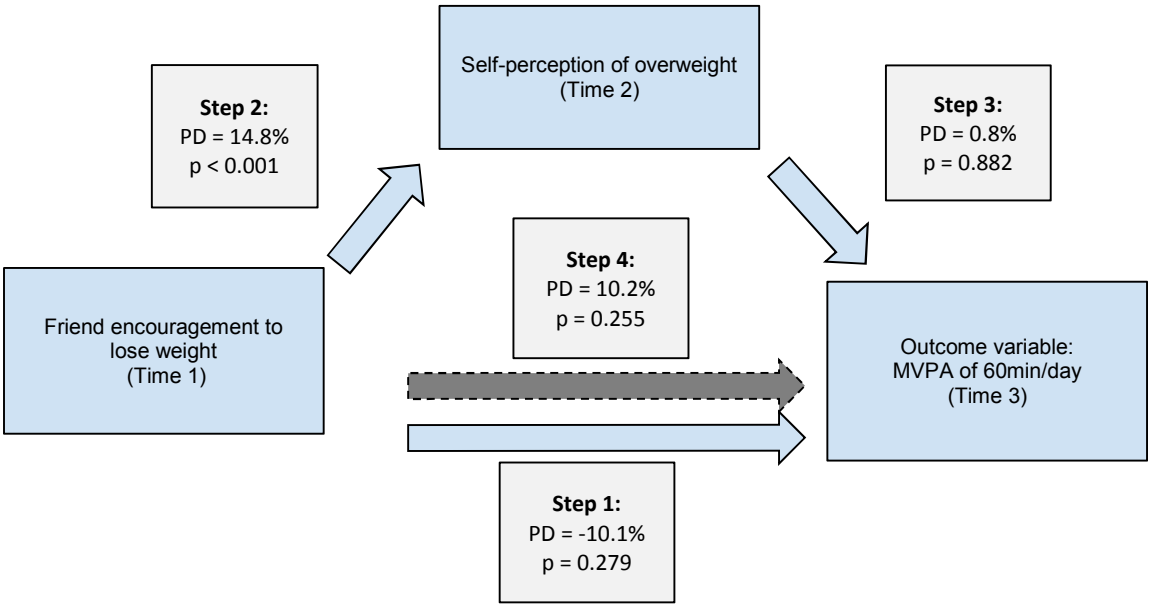
Table 2: Differences in friend encouragement for weight management, self-perception of weight, and behavioral outcomes among college freshmen (n=354)

Predictor Variable	Total % N = 354	Females n=263	Males n=91	p-value
Friend encouragement for weight loss *%(n)*				0.178
Agree	18.3% (65)	16.7% (44)	23.0% (21)	
Friend encouragement for weight gain *%(n)*				<0.01
Agree	14.4% (51)	9.8% (26)	27.4% (25)	
Self-perception of weight *%(n)*				0.044
Overweight	50.9% (180)	54.0% (142)	42.0% (38)	
Attempting weight change (gain/loss) *%(n)*				0.708
Attempting to change weight	63.2% (223)	63.7% (167)	62.2% (56)	
Attempting to lose weight *%(n)*				<0.01
Attempting to lose weight	42.1% (149)	59.3% (156)	43.0% (39)	
MVPA of 60 min/day *%(n)*				0.714
≥ 60 min/day	54.3% (195)	54.9% (146)	52.7% (49)	
Servings of fruit &veg/day *%(n)*				0.478
2 servings/day	45.1% (160)	43.0% (113)	47.3% (43)	
Servings of SSB/day *%(n)*				0.696
≥ ½ serving SSB/day	56.3% (200)	55.7% (146)	58.1% (54)	

Mediation Results of Friend Encouragement for Weight Management, Self-Perception of Weight, and Behavioral Outcomes Among College Freshmen (Figures 3-12)

The longitudinal mediation analysis of friend encouragement for weight management, self-perception of weight, and behavioral outcomes among college freshmen produced the following results. It was observed (figure 3) that in individuals who perceived friend encouragement to lose weight at time 1 there was no prevalence difference in achieving at least 60 minutes of MVPA/day at time 3. In individuals who perceived friend encouragement to lose weight at time 1 there was a 14.8% ($p < 0.001$) greater prevalence of self-perception of overweight at time 2. In individuals with the self-perception of overweight at time 2 there was no prevalence difference in achieving at least 60 minutes of MVPA/day at time 3.

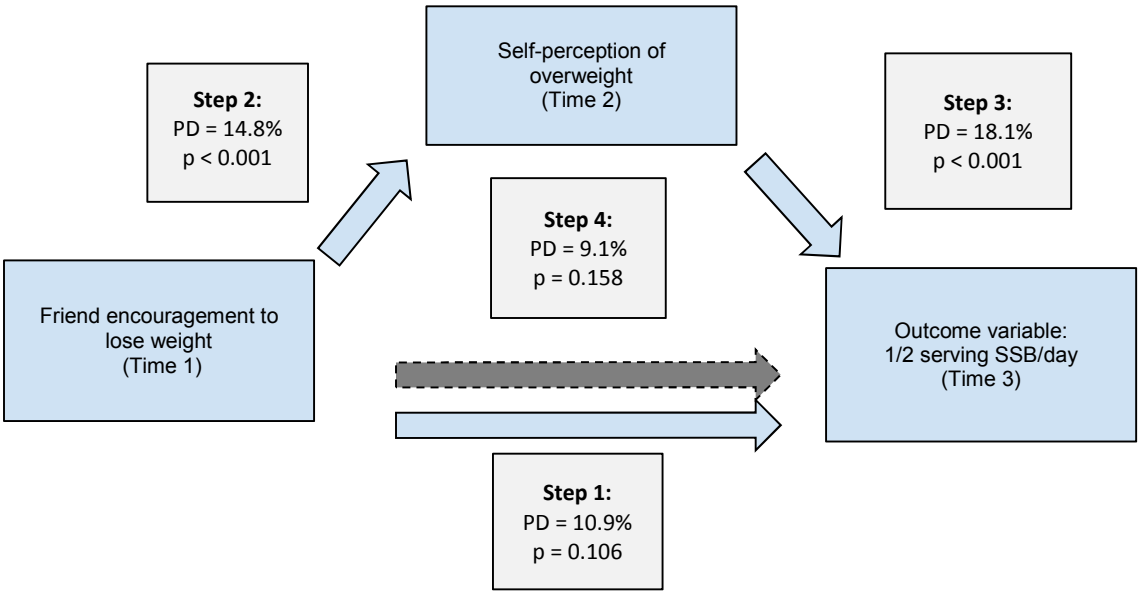
Figure 3: Mediation results of self-perception of weight in the relationship between friend encouragement to lose weight and MVPA



PD = Prevalence Difference

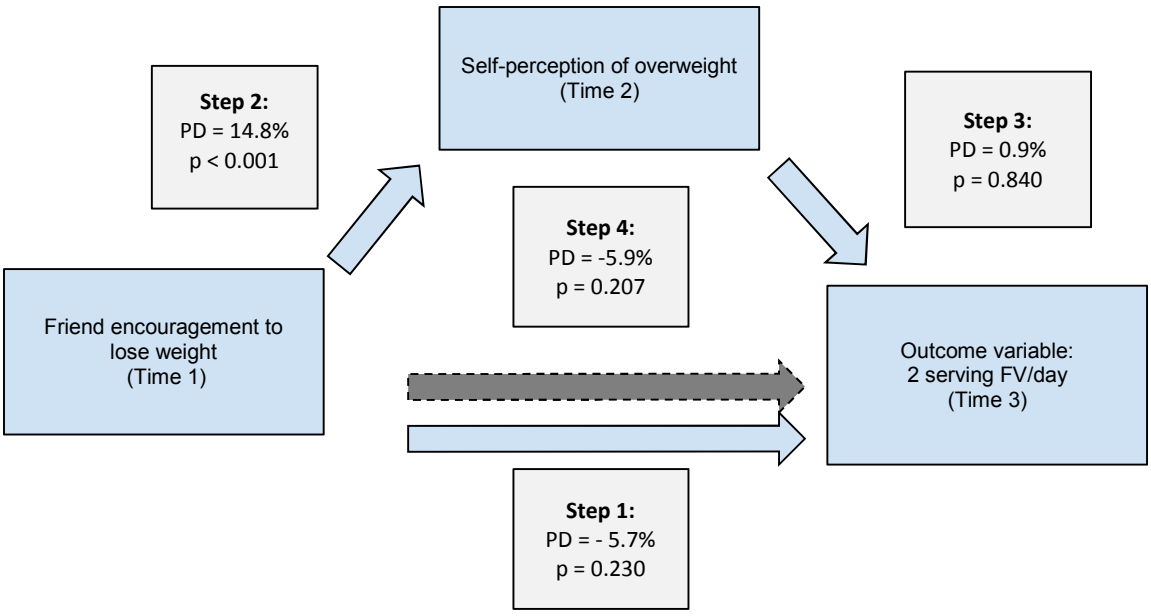
It was observed (figure 4) that when individuals who perceived friend encouragement to lose weight at time 1 there was no prevalence difference in consuming at least ½ serving of sugar-sweetened beverages (SSB)/day at time 3. In individuals who perceived friend encouragement to lose weight at time 1 there was a greater prevalence in overweight perception at time 2 by 14.8% ($p < 0.001$). In individuals with the self-perception of overweight at time 2 there was a 18.1% ($p<0.001$) greater prevalence in consuming at least ½ serving of sugar-sweetened beverages (SSB)/day at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to lose weight and reports of sugar-sweetened beverage consumption.

Figure 4: Mediation results of self-perception of weight on the relationship between friend encouragement to lose weight and consumption of sugar-sweetened beverages (SSB)



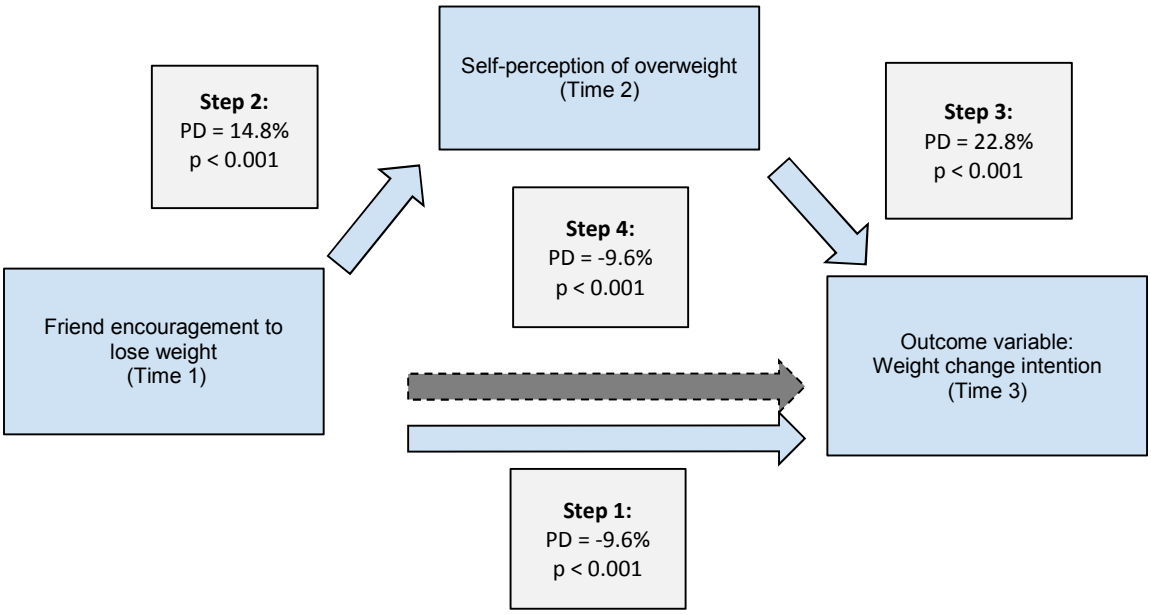
It was observed (figure 5) that when individuals perceived friend encouragement to lose weight at time 1 there was no prevalence difference in consuming at least 2 servings of fruits and vegetables/day at time 3. In individuals who perceived friend encouragement to lose weight at time 1 there was a 14.8% ($p < 0.001$) greater prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was no prevalence difference in consuming at least at least 2 servings of fruits and vegetables/day at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to lose weight and reports of fruit and vegetable consumption.

Figure 5: Mediation results of self-perception of weight on the relationship between friend encouragement to lose weight and consumption of fruits and vegetables (FV) per day



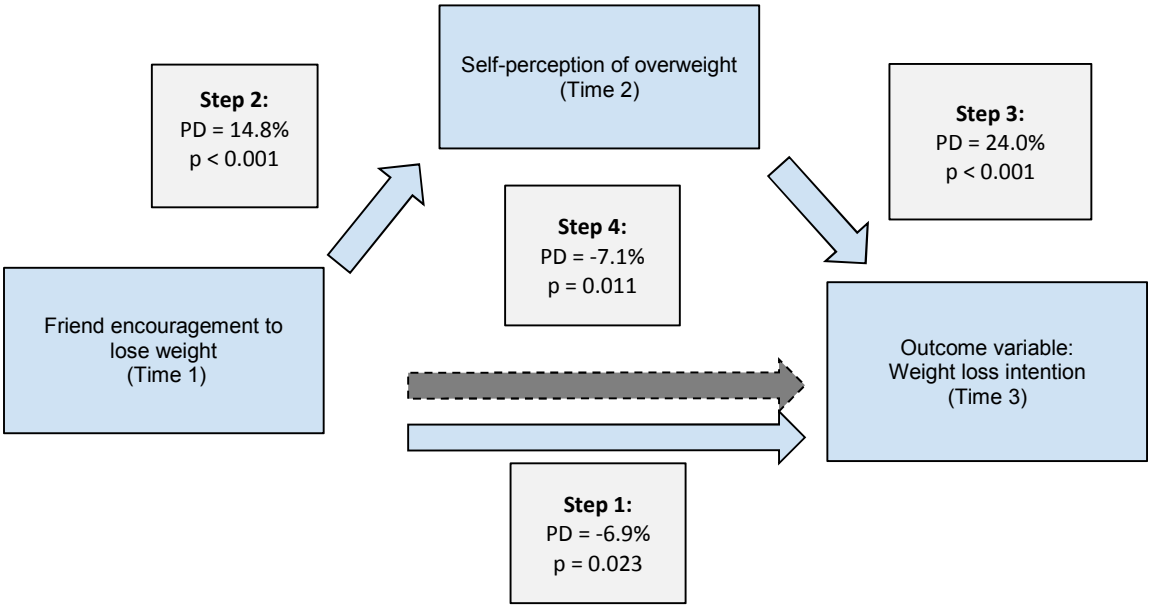
It was observed (figure 6) that in individuals who perceived friend encouragement to lose weight at time 1 there was a 9.6% ($p<0.001$) decreased prevalence of weight change intentions at time 3. In individuals who perceived friend encouragement to lose weight at time there was a 14.8% ($p < 0.001$) greater prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was a 22.8% ($p<0.001$) greater prevalence of weight change intentions at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to lose weight and reports of weight change intentions.

Figure 6: Mediation results of self-perception of weight on the relationship between friend encouragement to lose weight and intention to change weight (lose/gain)



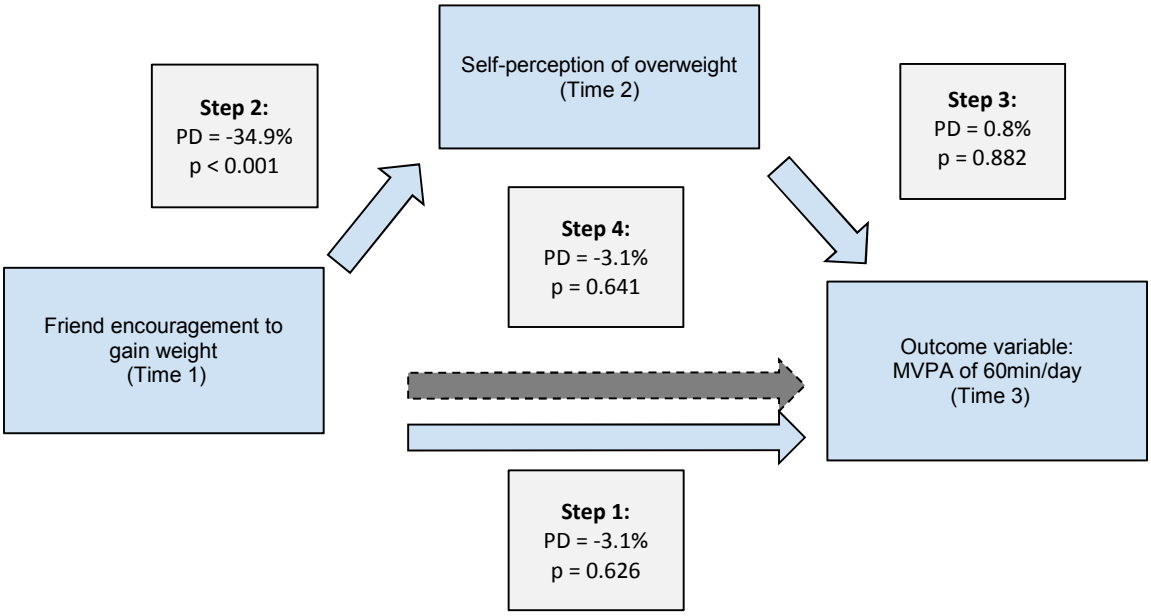
It was observed (figure 7) that in individuals who perceived friend encouragement to lose weight at time 1 there was a 6.9% ($p<0.023$) greater prevalence for weight loss intentions at time 3. In individuals who perceived friend encouragement to lose weight at time there was a 14.8% ($p < 0.001$) greater prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was a 24.0% ($p<0.001$) greater prevalence of weight loss intentions at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to lose weight and reports of weight loss intentions.

Figure 7: Mediation results of self-perception of weight on the relationship between friend encouragement to lose weight and intention to lose weight.



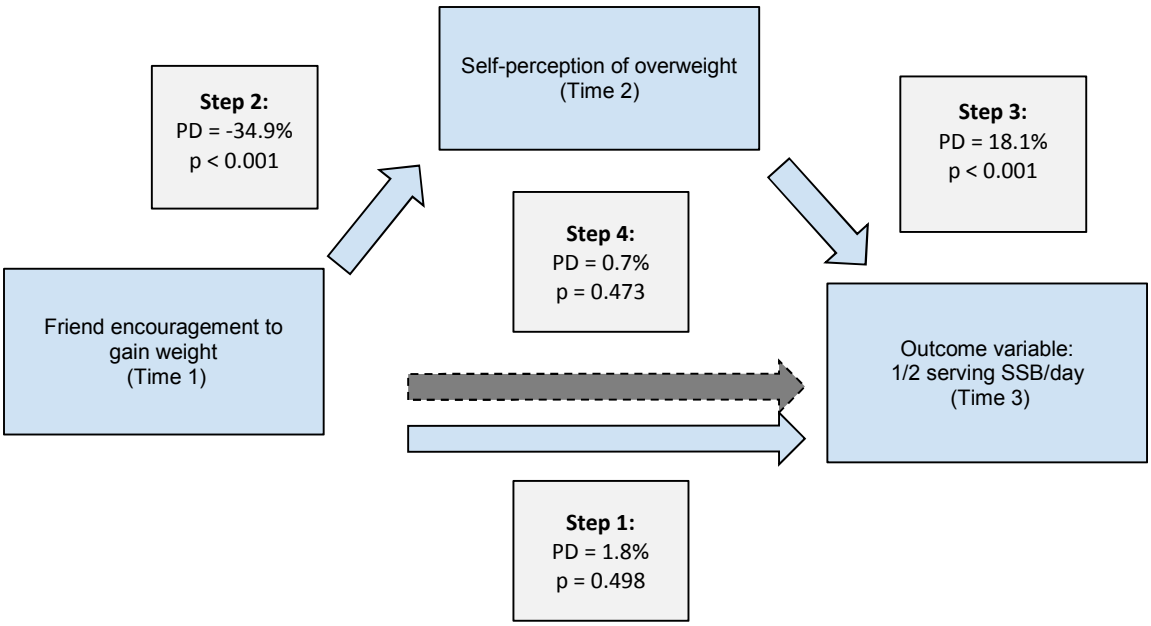
It was observed (figure 8) in individuals who perceived friend encouragement to gain weight at time 1 that there was no prevalence difference in achieving at least 60 minutes of MVPA/day at time 3. In individuals who perceived friend encouragement to gain weight at time 1 there was a 34.9% ($p < 0.001$) decreased prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was no prevalence difference in achieving at least 60 minutes of MVPA/day at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to gain weight and reports of MVPA.

Figure 8: Mediation results of self-perception of weight on the relationship between friend encouragement to gain weight and MVPA



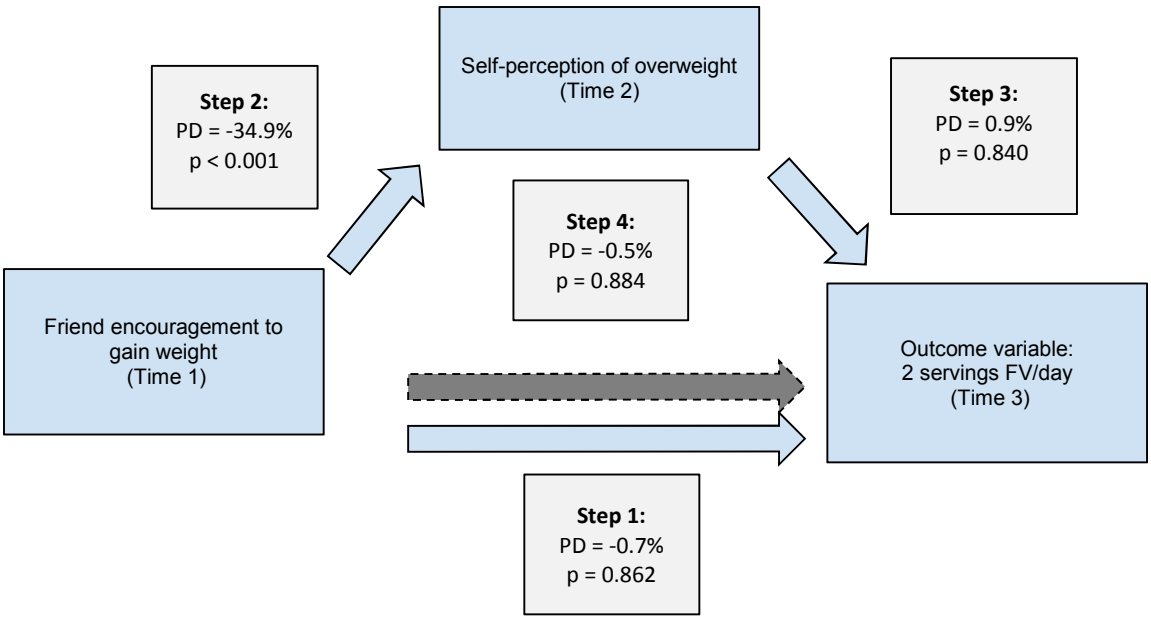
It was observed (figure 9) in individuals who perceived friend encouragement to gain weight at time 1 there was no prevalence difference of consuming at least ½ serving of sugar-sweetened beverages (SSB)/day at time 3. In individuals who perceived friend encouragement to gain weight at time 1 there was a 34.9% ($p < 0.001$) decreased prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was a 18.1% ($p<0.001$) decreased prevalence of consuming at least ½ serving of sugar-sweetened beverages (SSB)/day at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to gain weight and reports of sugar-sweetened beverage consumption.

Figure 9: Mediation results of self-perception of weight on the relationship between friend encouragement to gain weight and consumption of sugar-sweetened beverages (SSB)



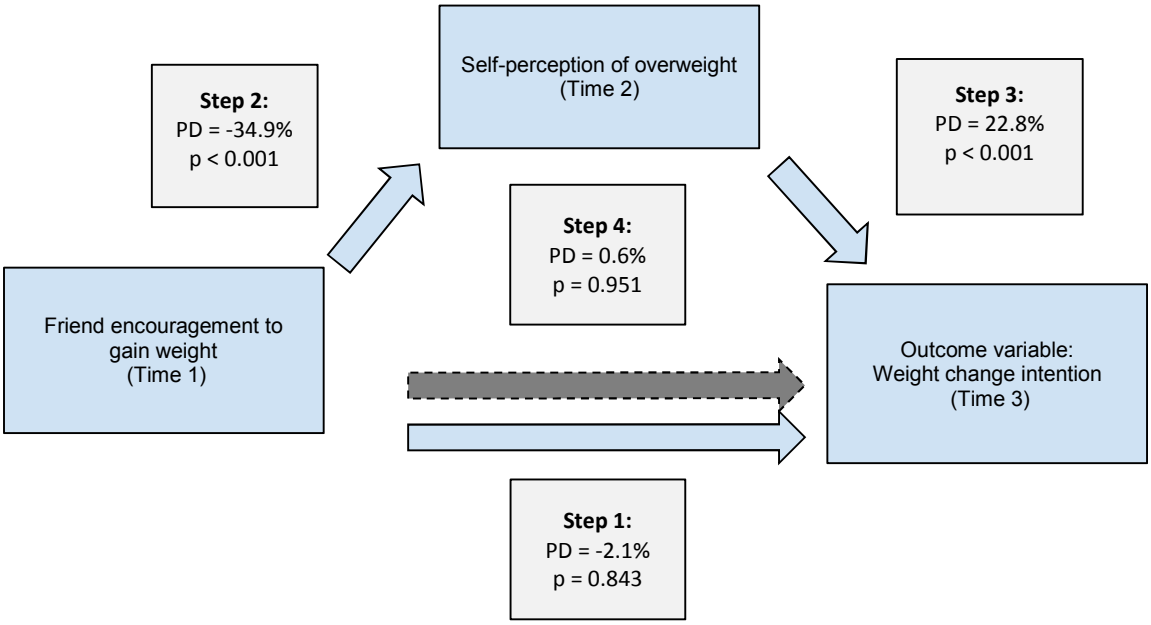
It was observed (figure 10) that in individuals who perceived friend encouragement to lose weight at time 1 there was no prevalence difference in consuming at least 2 servings of fruits and vegetables/day at time 3. In individuals who perceived friend encouragement to gain weight at time 1 there was a 34.9% ($p < 0.001$) decreased prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was no prevalence difference in consuming at least 2 servings of fruits and vegetables/day at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to gain weight and reports of fruit and vegetable consumption.

Figure 10: Mediation results of self-perception of weight on the relationship between friend encouragement to gain weight and consumption of fruits and vegetables (FV) per day



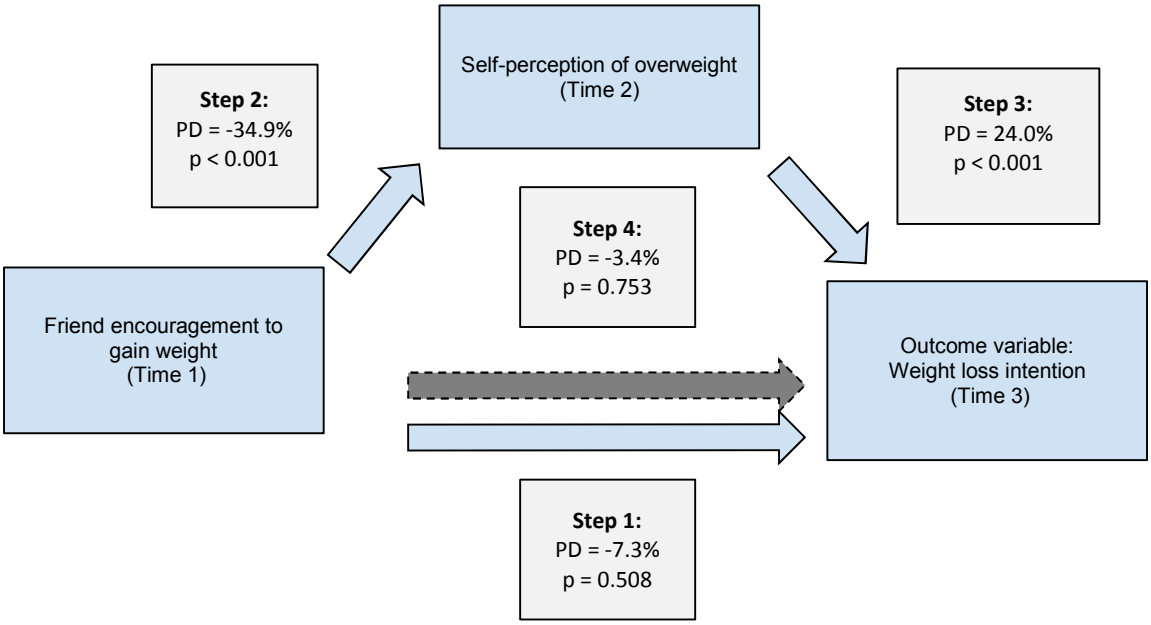
It was observed (figure 11) that in individuals who perceived friend encouragement to gain weight at time 1 there was no prevalence difference in weight change intentions at time 3. In individuals who perceived friend encouragement to gain weight at time 1 there was a 34.9% ($p < 0.001$) decreased prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was a 22.8% ($p<0.001$) greater prevalence of weight change intentions at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to gain weight and reports of weight change intentions.

Figure 11: Mediation results of self-perception of weight on the relationship between friend encouragement to gain weight and intention to change weight (lose/gain)



It was observed (figure 12) that in individuals who perceived friend encouragement to gain weight at time 1 there was no prevalence difference in weight loss intentions at time 3. In individuals who perceived friend encouragement to gain weight at time 1 there was a 34.9% ($p < 0.001$) decreased prevalence of overweight perception at time 2. In individuals with the self-perception of overweight at time 2 there was a 24.0% ($p<0.001$) greater prevalence for weight loss intentions at time 3. There was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to gain weight and reports of weight loss intentions.

Figure 12: Mediation results of self-perception of weight on the relationship between friend encouragement to gain weight and intention to lose weight.



CHAPTER 5

Discussion

The primary purpose of this study was to examine the relationship between friend advice about weight management, self-perception of weight, and differences in weight change intentions, physical activity, and eating habits in college freshmen over time. Based on the current gaps in the literature, this study aimed to bridge the gap between what is known about weight-related conversations had with friends, self-perception of weight, and health-related behavioral outcomes in college freshmen. Research exists on these relationships in the adolescent population[1-3,8,11,12], but none have examined this relationship in the college population. Additionally, no studies have analyzed the potential mediation effect of self-perception of weight in the relationship between friend encouragement about weight management and behavioral outcomes.

Overall, the present study indicated no mediation effect of the self-perception of overweight in the relationship between friend encouragement to gain or lose weight and reports of MVPA, eating behaviors, or weight change intentions. However, the results did indicate relationships between weight loss advice from friends and self-perception of overweight, weight change intentions, and weight loss intentions while weight gain advice from friends was also related to self-perception of overweight. Furthermore, differences in the prevalence of perceived of weight gain advice from friends, intention to lose weight, and self-perception of overweight were observed between males and females. The differences in prevalence of these variables may indicate that college men and women respond differently to perceived friend encouragement about weight

management. These differences will be important to consider in future research when analyzing how friends are involved in health outcomes among college freshmen.

Friend Encouragement about Weight Management and Behavioral Outcomes

Overall, research examining the effect of weight-related conversations on body image, dieting behaviors, and eating habits have been based in the adolescent population.[1,11-12] In the present study, significant relationships were observed between friend encouragement about weight loss and weight change intentions such that individuals who perceived weight loss encouragement from friends also had greater amounts of weight change and weight loss intentions. The increased prevalence of weight loss intentions among individuals who perceived advice about weight management from friends is consistent with observational studies in adolescents[51-53] that examined the relationship between weight related conversations with friends and intentions to lose weight. In particular, when adolescents perceived more appearance conversations and criticism with their friends, there were also more frequent reports of weight change intentions.[49]

Conversations related to appearance seem to perpetuate a focus on body image and weight related concerns that may influence weight loss behaviors.[50] Similarly, peer criticism through weight management comments or advice about dieting and physical activity have been routinely observed in younger female populations and have been shown to increase dieting behaviors.[51] Jones et al observed that body-weight conversations were significantly correlated to greater amounts of ideal body type internalization as well as greater amounts of disturbed body image in both boys and

girls.[49] Combined, these observations all support that social interaction focused on body weight is related to greater amounts of weight change intentions in adolescents.

The findings of the present study are comparable with the results of these observational studies in that individuals who perceived weight-related conversations with friends also had greater amounts of weight change and weight loss intentions. It is important to utilize these findings to better understand how important perceived friend advice about weight management can be when understanding factors that are related to weight change and loss intentions in college students. The greater prevalence of weight change/loss intentions among individuals who perceived weight management advice from friends may indicate that perception is an important factor involved with weight management. If interventions could be designed to inform individuals how to have healthy and beneficial weight-related conversations with their friends, perhaps more appropriate weight management attempts among individuals who perceive this advice would occur. Although the present data does not indicate if these weight change/loss attempts were successful, the greater prevalence of the *intention* to alter weight status does indicate an important opportunity for intervention so as to transmit healthful weight management strategies. If this study could be performed again, an analysis of how perceived weight management advice from friends is related to actual weight alterations would be assessed to determine if perception of friend advice is related to objective changes in body weight. This information could be useful for future interventions so as to provide a better understanding of the strength of downstream effects due to the relationship between friend advice and weight management.

Friend Encouragement about Weight Management and Self-Perception of Weight

The current literature examining the relationship between weight-related conversations had with friends and self-perception of weight is limited to the adolescent experience. In the present study, the relationship between weight-related conversations had with friends and self-perception of weight was assessed. Results indicated that perceived weight management advice was related to self-perception of weight in this sample of college freshmen. For example, among individuals who perceived weight loss advice from friends, there was a greater prevalence of the self-perception of overweight. These findings are consistent with observational studies in adolescents that analyzed the contribution of friend conversations and peer criticism on body image in adolescents. Jones et al observed that when adolescents reported conversations had with friends about weight criticism, they were more likely to internalize these criticisms, resulting in intentions to lose weight.[51] Paxton et al observed that internalization of body image concerns transmitted through weight criticism within friendship cliques was associated with dietary restraint, increased weight-loss behaviors, and increased body weight dissatisfaction in adolescents.[52] Furthermore, Provencher et al observed that when adolescents were dissatisfied with their body weight, they were more likely to attempt weight loss and have an inaccurate self-perception of weight.[44] In general, it appears that when adolescents perceive weight loss advice from friends, they also report greater amounts of weight loss intentions and have an inaccurate self-perception of body weight. Interestingly, conversations with friends about recommendations to gain weight[49,52] has also been correlated with increased amounts of body weight dissatisfaction and internalization of body type ideals in adolescents. In the present study, when individuals

perceived weight gain advice from friends, there were decreased amounts of overweight self-perception.

The differences in perceived weight loss or weight gain advice and prevalence of self-perception of overweight may be related to the type of advice given. If weight loss advice is perceived as criticism but weight gain advice is not, dissatisfaction with body weight and self-perception of overweight may be less common among individuals receiving weight gain advice. Although the present findings about decreased amounts of overweight perception among perceivers of weight gain advice is not supported in the adolescent literature,[49,52] it may be possible that gender differences are acting on this decreased prevalence. Given that the current sample did not assess gender differences in the relationship between weight management encouragement and self-perception of weight, it may be possible that males and females respond dichotomously to friend advice. For example, in the present study, more males than females perceived weight gain advice from friends, however the sample was predominately female. Furthermore, in adolescent literature males typically have the self-perception of underweight when body weight dissatisfaction is present. Combined, these reported gender differences as well as the disproportionate amount of males in females in the present study could have skewed the relationship between weight gain advice and self-perception of weight. It may also be possible that weight gain advice imparts the perception of underweight, thus decreasing the prevalence of overweight perception in this sample of college freshmen.

The differences in the relationships between friend encouragement to lose/gain weight and self-perception of overweight suggest that the type of perceived weight management advice is important when considering self-perception of weight. Given the

findings in adolescent literature that males and females respond differently to the type of weight management advice from friends, ideally this study would be performed again with a larger sample size so that males and females could be analyzed separately. These differences could provide insight into how perception of advice from friends is related to self-perception of weight. If true weight status could then be compared to these perceptions, interventions could be designed to address inaccurate self-perceptions of weight so as to prevent resulting negative health behaviors such as unnecessary weight loss attempts or disordered eating. Furthermore, if an inaccurate self-perception of weight is found to be very prevalent amongst individuals receiving weigh management advice from friends, it would then be important to intervene at a social level so as to address appropriate ways to talk about weight management amongst friends.

Self-Perception of Weight and Behavioral Outcomes

The current literature examining the relationship between self-perception of weight and behavioral outcomes is limited to the adolescent experience. In the adolescent population, it has been observed that when individuals are trying to change their weight, they are significantly more likely to have an inaccurate perception of weight. However, very little is currently known about how self-perception of weight is related to weight related behavioral outcomes in college freshmen. Literature exists that suggests when college students have a greater body discrepancy score, they were less likely to be attempting to change their body weight.[5] The findings of the present study somewhat conflict these findings in that individuals with the self-perception of overweight also reported greater amounts of weight change and weight loss intentions. It could be that because the literature in adolescents did not assess self-perception of weight via similar

questionnaire items, the results were different. Perhaps the difference between the report at weight change/loss attempts were not congruent with actual weight alteration attempts. It could also be the case that other types of weight-perception are not related to weight change or weight loss attempts which would be supported by the adolescent literature. In the present study, only reports of weight change/loss intentions were assessed based on overweight perception. This could have negated the relationship between underweight self-perception and weight alteration intentions in this sample. If this study could be performed again, it would be important to analyze the relationship between different types of weight perception and resulting reports of weight change/loss intentions. Once these differences were observed, it would be necessary to compare objective weight status to perceived weight status so as to identify individuals at risk for unnecessary weight change or loss. In doing so, future interventions could act to prevent unhealthful weight management behaviors such as poor diet quality and food restriction among others.

The relationship between self-perception of weight, physical activity, and eating habits in adolescents[8,11,46] appears to be relatively consistent with the results of the present study. For example, an overall decrease in diet quality exemplified by less consumption of fruits and vegetables and decreased physical activity has been observed in adolescents with inaccurate self-perception of weight. [8,11,46] The present study observed that when individuals had the self-perception of overweight, they also reported consuming at least ½ a serving of sugar-sweetened beverages/day more frequently and also had greater amounts of weight change/loss intentions. These are somewhat consistent with findings from observations in adolescents where individuals who had an

inaccurate self-perception of overweight were more likely to attempt to change their weight via weight loss as well as muscle gain.[1] No significant relationships were observed in the present study among individuals with overweight self-perception and their reports of achieving at least 60 mints of MVPA or at least 2 servings of fruits and vegetables per day.

These findings are somewhat conflicted by the literature in adolescents which shows that individuals who had the self-perception of overweight reported consuming less vegetables (≥ 4 servings) each day and also reported being active on ≥ 4 days of the week.[1] Although individuals with the self-perception of overweight in the present study did not report decreased fruit and vegetable consumption, they did report greater consumption of sugar-sweetened beverages (SSB). Perhaps the lacking association between self-perception of overweight and reports of fruit and vegetable consumption in the present study is merely a function of poor diet quality in college students in that college students are in general lacking in their consumption of fruits and vegetables. However, the findings that there was a greater prevalence of SSB consumption among individuals with the self-perception of overweight may indicate that these individuals have an even poorer diet quality compared to those without self-perception of overweight. A better designed version of this study would include analysis of how self-perception of weight is related to a more diverse food frequency assessment as well as diet quality in the college population. A better understanding of this relationship could provide ample opportunity to intervene at the individual level to help alleviate poor diet quality among individuals with the self-perception of overweight.

Mediation effect of the self-perception of overweight in the relationship between friend encouragement about weight management and behavioral outcomes.

In the present study, there was no mediation effect of the self-perception of overweight in the relationship between friend encouragement to lose or gain weight and reports of MVPA, fruit and vegetable consumption, or weight change intentions. To the best of our knowledge, no prior study has assessed this relationship. However, literature in adolescents that analyzed the relationship between self-perception of weight and health behaviors such as weight change intentions have been assessed.[1-3] It has also been observed that weight-related conversations had with friends is significantly associated with body dissatisfaction.[1-3] When individuals are dissatisfied with their body weight, they were more likely to attempt weight loss.[51] In adolescent populations, it has been observed that when individuals are trying to lose weight, they are significantly more like to have an inaccurate perception of weight and less likely to be satisfied with their weight.[1] Based on the relationship between weight-related conversations with friends, body dissatisfaction, weight loss intentions, and self-perception of weight, the present study proposed a mediation effect of the self-perception of weight in the relationship between friend encouragement about weight management and health outcomes in college freshmen. The lack of findings in this model could indicate that self-perception of weight does not mediate this relationship, but is directly related to health outcomes. A direct relationship between self-perception of weight and health outcomes was supported in the present study in that individuals with the self-perception of overweight reported greater amounts of SSB consumption and greater amounts of weight change and loss intentions. Based on the relationship between perceived friend advice about weight management and

differing amounts of overweight perception in the present study, a redesigned version of this study would analyze the mediation affect friend advice about weight management in the relationship between self-perception of weight and health outcomes in college freshmen. If friend advice did mediate this relationship, intervention strategies could focus on coaching individuals to have positive weight-related conversations so as to increase reports of beneficial health outcomes such as more frequent physical activity and fruit and vegetable consumption among college students. It may also be true that different types of self-perception of weight mediates the relationship between friend encouragement for weight management and health outcomes. A redesigned version of the present study could analyze how different types of self-perception of weight interact with the relationship between friend encouragement and health outcomes in college freshmen. These specifications could provide better insight into how friend encouragement for weight management, self-perception of weight, and health outcomes are related in college freshmen. A better understanding of the relationship between these variables could better inform how contextual factors of the college environment, such as social influence, are related to alterations to health habits during the freshmen year. In turn, this could provide better insight into how health behaviors can be established so as to prevent weight gain that can perpetuate into adulthood and contribute to obese status.

Conclusion

The freshmen year of college is a vulnerable time point for weight gain. Weight-related conversations had with friends may impart feelings of dissatisfaction with one's weight. Dissatisfaction with weight has been associated with increased intentions for

weight loss in adolescents. In the present study, individuals who perceived weight loss advice from friends at time 1 reported 9.6% ($p<0.001$) more weight change and 6.9% ($p=0.023$) more weight loss intentions at time 3.

Weight-related conversations had with friends has been related to increased amounts of body weight dissatisfaction and inaccurate self-perception of weight in adolescents. The present study observed that individuals who perceived friend advice about weight loss had a 14.8% greater prevalence ($p<0.001$) of the self-perception of overweight. Within those who perceived weight gain advice from friends, there was a 34.9% decreased prevalence ($p<0.001$) of the self-perception of overweight. Self-perception of weight has emerged as a strong predictor of health habits in adolescents, but this relationship has yet to be observed in college freshmen. In the present study, those with the self-perception of overweight had a 18.1% greater prevalence ($p<0.001$) of consuming at least ½ a serving of sugar-sweetened beverages/day, a 22.8% increased prevalence ($p<0.001$) of weight change intentions, and a 24.0% greater prevalence ($p<0.001$) of weight loss intentions. Although individuals with the self-perception of overweight had a higher prevalence in some of the behavioral outcomes assessed, there was no mediation effect of the self-perception of overweight in the relationship between friend encouragement for weight management and behavioral outcomes in this sample of college freshmen. The observed prevalence differences in behavioral outcomes based on perceived friend encouragement about weight management and the self-perception of overweight may indicate that these individuals behave differently than those who do not perceive friend encouragement about weight management and do not have the self-

perception of overweight. Further research is needed to better understand how the differences in these groups is related to health additional health behavior outcomes related to weight states in college freshmen.

Assumptions, Limitations, and Strengths

The present research assumes that all responses provided in the questionnaires are an accurate and honest representation of the participant's experiences as a freshman at ASU. As with any self-reported data, bias may have influence on the responses recorded, and thus is a limitation of the study. Furthermore, the sampling protocol for this research is very specific in that eligibility is contingent upon the individual having "freshman" status for the fall of 2015 and residency in one of the eight dorms that are being sampled from. These specifications limit the generalizability to populations outside of ASU. This specificity also impacts the sample population eligibility, resulting in a limited sample size. Furthermore, changes in self-perception of weight at time 2 and the outcome variables at time 3 were not assessed over time. As a result of this, prevalence differences in the relationship between predictor and outcome variables cannot indicate causality. Self-perception of weight was not adjusted for at time 1, so no inference can be made about the influence of friend advice about weight management on weight perception. Lastly, poor compliance across the three time points being used for analysis may be a limitation of the study in that lack of data will limit the ability to perform longitudinal analyses and may limit the ability to answer the research questions.

One particular strength of this study is that to the best of our knowledge, this is a novel topic of research that will aid in the understanding of how friend's advice about

weight management is related to self-perception of weight, and how this potentially mediates the relationship between weight perception and physical activity and eating habits in college freshmen. Self-perception has been shown to be a strong predictor of BMI status and weight change intentions, which is a significant factor to analyze when thinking about strategies to prevent weight gain during the freshman year of college. Additionally, data was collected during the freshman year, which has been shown to be a very vulnerable time point for weight gain. These findings can provide greater insight into how individuals who perceive weight management advice from friends and who have the self-perception of overweight are different from their counterparts. These differences can provide insight into how the health behaviors of these individuals can be acted upon via interaction with friends. These types of strategies can be useful in understanding how social interactions are related health-related habits such as physical activity and changes to eating patterns in college freshmen.

REFERENCES

1. Fredrickson, J., et al. (2015). "Weight perception in overweight adolescents: Associations with body change intentions, diet and physical activity." Journal of Health Psychology 20(6): 774-784.

2. Edwards, N. M., et al. (2010). "Where perception meets reality: self-perception of weight in overweight adolescents." Pediatrics 125(3): e452-e458.

3. Keel, P. K., et al. (2007). "A 20-Year Longitudinal Study of Body Weight, Dieting, and Eating Disorder Symptoms." Journal of abnormal psychology 116(2): 422-432.

4. McVey, G., et al. (2005). "Correlates of weight loss and muscle-gaining behavior in 10-to 14-year-old males and females." Preventive medicine 40(1): 1-9.

5. DeBate, R., et al. (2008). "Similar but Different: Sociocultural Attitudes towards Appearance, Body Shape Dissatisfaction, and Weight Control Behaviors among Male and Female College Students." American Journal of Health Education 39(5): 296-302

6. Reel, J. J., et al. (2007). "Relations of body concerns and exercise behavior: a meta-analysis." Psychological reports 101(3 Pt 1): 927.

7. Heinberg, L. J., et al. (2001). "Body image dissatisfaction as a motivator for healthy lifestyle change: Is some distress beneficial?"

8. Gillison, F. B., et al. (2006). "Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure-time exercise behaviour: a self-determination theory approach." Health education research 21(6): 836-847.

9. Yost, J., et al. (2010). "Assessing weight perception accuracy to promote weight loss among US female adolescents: a secondary analysis." BMC public health 10(1): 465.

10. Ojala, K., et al. (2007). "Attempts to lose weight among overweight and non-overweight adolescents: a cross-national survey." The international journal of behavioral nutrition and physical activity 4(1): 50-50.

11. Duncan, J. S., et al. (2011). "Associations between weight perceptions, weight control and body fatness in a multiethnic sample of adolescent girls." Public health nutrition 14(01): 93-100.

12. Lenhart, C. M., et al. (2011). "Is accuracy of weight perception associated with health risk behaviors in a diverse sample of obese adolescents?" The Journal of School Nursing 27(6): 416-423.

13. Deshmukh-Taskar, P., et al. (2006). "Tracking of overweight status from childhood to young adulthood: the Bogalusa Heart Study." European journal of clinical nutrition 60(1): 48-57.

14. Nelson, M. C., et al. (2008). "Emerging adulthood and college□aged youth: an overlooked age for weight□related behavior change." Obesity 16(10): 2205-2211.

15. Hajhosseini, L., et al. "Changes in Body Weight, Body Composition and Resting Metabolic Rate (RMR) in First-Year University Freshmen Students." Journal of the American College of Nutrition 25(2): 123-127.

16. Cason, K. L. (2006). Family mealtimes: more than just eating together. Journal of the American Dietetic Association, 106(4), 532-533.

17. Unusan, N. (2006). University students' food preference and practice now and during childhood. Food Quality and Preference, 17, 3620368.

18. Centers for Disease Control. (2010). Behavioral Risk Factor Surveillance System-Prevalence and Trends Data- United States. Office of Surveillance, Epidemiology, and Laboratory Services.

19. Racette, S., et al. (2005). "Weight Changes, Exercise, and Dietary Patterns During Freshman and Sophomore Years of College." Journal of American College Health 53(6): 245-251.

20. Ferrara, C. M. (2009). "The college experience: Physical activity, nutrition, and implications for intervention and future research." Journal of Exercise Physiology 12(1): 23-35.

21. Doerksen, S. E., Umstattd, M. R., & McAuley, E. (2009). Social cognitive determinants of moderate and vigorous physical activity in college freshmen. Journal of Applied Social Psychology, 39(5), 1201-1213.

22. Lewis, C. E., et al. (2000). "Weight gain continues in the 1990s 10-year trends in weight and overweight from the CARDIA study." American Journal of Epidemiology 151(12): 1172-1181.

23. Gordon-Larsen, P., et al. (2010). "Longitudinal trends in obesity in the US from adolescence to the third decade of life." Obesity (Silver Spring, Md.) 18(9): 1801-1804.

24. Ogden, C. L., et al. (2006). "Prevalence of overweight and obesity in the United States, 1999-2004." JAMA 295(13): 1549-1555.

25. Arnett, J. J. (2000). Emerging adulthood: A theory of development from the late teens through the twenties. American Psychologist, 55, 469 – 480.

26. Vella-Zarb, R. A., et al. "The 'Freshman 5': A Meta-Analysis of Weight Gain in the Freshman Year of College." Journal of American College Health 58(2): 161-166.

27. Anderson, D. A., et al. (2003). "The freshman year of college as a critical period for weight gain: An initial evaluation." Eating Behaviors 4(4): 363-367.

28. Caballero, B. (2007). The global epidemic of obesity: an overview. Epidemiologic Reviews, 29(1), 1-5.

29. Huang, T. T.-K., et al. (2003). "Assessing overweight, obesity, diet, and physical activity in college students." Journal of American College Health 52(2): 83-86.

30. R.J Kuczmarski, K.M Flegal, S.M Campbell, C.L Johnson Increasing prevalence of overweight among US adults: the National Health and Nutrition Examination surveys, 1960 to 1991 JAMA, 272 (1994), pp. 205–211

31. Levitsky, D. A., et al. (2004). "The freshman weight gain: a model for the study of the epidemic of obesity." International journal of obesity 28(11): 1435-1442.

32. Hoffman, D., et al. "Changes in Body Weight and Fat Mass of Men and Women in the First Year of College: A Study of the "Freshman 15"." Journal of American College Health 55(1): 41.

33. Hodges, C. N. y. (1993). "The "Freshman 15": Facts and Fantasies About Weight Gain in College Women." Psychology of women quarterly 17: 119.

34. Lowry, R., et al. (2000). "Physical activity, food choice, and weight management goals and practices among U.S. college students." American Journal of Preventive Medicine 18(1): 18-27.

35. Buckworth, J. and C. Nigg (2004). "Physical activity, exercise, and sedentary behavior in college students." Journal of American College Health 53(1): 28-34.

36. Wengreen, H. J. and C. Moncur (2009). "Change in diet, physical activity, and body weight among young-adults during the transition from high school to college." Nutrition journal 8(1): 32-32.

37. Han, J. L., et al. (2008). "Changes in women's physical activity during the transition to college." American Journal of Health Education 39(4): 194-199.

38. Allender, S., Hutchinson, L. & Foster, C. (2008). Life-change events and participation in physical activity: a systematic review. Health Promotion International, 23(2). doi:10.1093/heapro/dan012

39. Butler, S. M., et al. (2004). "Change in Diet, Physical Activity, and Body Weight in Female College Freshman." American Journal of Health Behavior 28(1): 24-32.

40. Cluskey, M. and D. Grobe (2009). "College weight gain and behavior transitions: male and female differences." Journal of the American Dietetic Association 109(2): 325-329.

41. Economos, C. D., et al. "College freshman stress and weight change: differences by gender." American Journal of Health Behavior 32(1): 16.

42. Pliner, P. and T. Saunders (2008). "Vulnerability to freshman weight gain as a function of dietary restraint and residence." Physiology & Behavior 93(1): 76-82.

43. Lowe, M. R., et al. (2006). "Multiple types of dieting prospectively predict weight gain during the freshman year of college." Appetite 47(1): 83-90.

44. Provencher, V., et al. (2009). "Who gains or who loses weight? Psychosocial factors among first-year university students." Physiology & Behavior 96(1): 135-141.

45. Strong, K. A., et al. (2008). "Weight gain prevention: identifying theory-based targets for health behavior change in young adults." Journal of the American Dietetic Association 108(10): 1708-1715. e1703.

46. Bucchianeri, M. M., et al. (2013). "Body dissatisfaction from adolescence to young adulthood: Findings from a 10-year longitudinal study." Body Image 10(1): 1-7.

47. Ackard, D. M., et al. (2002). "Dieting frequency among college females: Association with disordered eating, body image, and related psychological problems." Journal of psychosomatic research 52(3): 129-136.

48. Neumark-Sztainer, D., et al. (2005). "Obesity and eating disorders in older adolescents: Does early dieting make things better or worse?" Journal of Adolescent Health 36(2): 152-153.

49. Carlson Jones, Diane "Body Image Among Adolescent Girls and Boys": A Longitudinal Study. Developmental Psychology 40.5 (Sep 2004): 823-835.

50. Eisenberg, M. E., et al. (2006). "Five-year change in body satisfaction among adolescents." Journal of psychosomatic research 61(4): 521-527.

51. Jones, D. C., et al. (2004). "Body Image and the Appearance Culture Among Adolescent Girls and Boys: An Examination of Friend Conversations, Peer Criticism, Appearance Magazines, and the Internalization of Appearance Ideals." Journal of Adolescent Research 19(3): 323-339.

52. Paxton, S. J., et al. (1999). "Friendship clique and peer influences on body image concerns, dietary restraint, extreme weight-loss behaviors, and binge eating in adolescent girls." Journal of abnormal psychology 108(2): 255.

53. Levine, M. P., et al. (1994). "The Relation of Sociocultural Factors to Eating Attitudes and Behaviors among Middle School Girls." Journal of Early Adolescence 14(4): 471-490.

54. CDC. (2012). Defining overweight and obesity. Retrieved from http://www.cdc.gov/obesity/adult/defining.html

55. Leahey TM, LaRose JG, Fava JL, Wing RR. Social influences are associated with BMI and weight loss intentions in young adults. Obesity 2011;19(6):1157-1162.

56. American College Health Association-National College Health Assessment II. In. Hanover, MD: American College Health Association; 2013.

57. Godin G, Shephard RJ. A simple method to assess exercise behavior in the community. Canadian journal of applied sport sciences. Journal canadien des sciences appliquees au sport 1985;10(3):141-146.

58. National Cancer Institute. Dietary Screener Questionnaire in the NHANES 2009-10. In; 2009.

59. Neumark-Sztainer D, Croll J, Story M, Hannan PJ, French SA, Perry C. Ethnic/racial differences in weight-related concerns and behaviors among adolescent girls and boys: findings from Project EAT. Journal of psychosomatic research 2002;53(5):963-974.
60. The Center for Disease Control and Prevention. Youth Risk Behavior Surveillance System (YRBSS). In; 2014.

61. Eisenberg ME, Neumark-Sztainer D. Friends' dieting and disordered eating behaviors among adolescents five years later: findings from Project EAT. Journal of Adolescent Health 2010;47(1):67-73.

APPENDIX A

CONSENT/ASSENT FORM

CONSENT/ASSENT FORM

devilSPARC, Fall 2015

INTRODUCTION: The purpose of this form is to provide you information about our study that may affect your decision to participate in this research, and to record the consent of those who agree to be involved in the study.

RESEARCHER(S): Professor Meg Bruening, PhD, MPH, RD from the College of Health Solutions is partnering with the College of Liberal Arts and Sciences to invite you to participate in a research study.

STUDY PURPOSE: The purpose of this study is to assess eating and physical activity among college students.

DESCRIPTION OF RESEARCH STUDY: If you decide to be a part of this study, you will be asked to complete the following related to eating, physical activity behaviors and weight:

STUDY ACTIVITIES	**PARTICIPANT'S INITIALS INDICATING UNDERSTANDING**
Check-in survey (4 times throughout the year)	_____
Height, weight, waist, hip measurements (4 times throughout the year)	_____
devilSPARC app surveys (4 times throughout the year. App will be downloaded to your phone) *The mobile app will prompt you to complete a short (1-minute) questionnaire about your current activities. You will be asked to complete these brief surveys randomly 8 times per day (between 9am and 11pm) for a total of 4 days at each time point.*	_____
SunCard *Researchers will have limited access to view your SunCard activity throughout the year, including entrance/exit of ASU's dining halls, food receipt data, and on-campus gym facilities.*	_____

Participation in this study is voluntary. You can choose to stop at any time. Your survey responses will be kept **strictly confidential**, and will only be compiled as a group, not individually. Your decision to participate and your responses, should you choose to participate, will not affect your enrollment status at Arizona State University in any way. If you agree to participate, your time spent participating will total around 5-6 hours.

We may have additional opportunities to participate in other studies. If you are willing to be contacted about these opportunities, please initial here: _____ *(participant's initials indicating willingness)*

RISKS: Once installed, the mobile app will run in the background on your phone. This may lead to battery drain, and will capture some information about your location during participation. We are working with an outside vendor, Twilio, to send you text messages for you to complete the devilSPARC app surveys; we have an agreement to maintain your confidentiality with this company. You should only receive messages from us from this company unless you have signed up for other services through other vendors. Your SunCard activity may also include information about your location. Additionally, you may feel uncomfortable providing personal information about yourself in the study questionnaires. At every point, the researcher will de-identify data so that your questionnaire responses and information about your location will not be linked to you personally. However, as in any research, there is some possibility that you may be subject to risks that have not yet been identified.

BENEFITS: There are no direct benefits to participation. However, indirect benefits of your participation include helping the researcher understand ways to promote nutrition and physical activity. These data will also add to the general scientific knowledge about college students' contextual factors related to nutrition and physical activity behaviors among friendship networks over time.

CONFIDENTIALITY: All information obtained in this study is strictly confidential. The results of this research study may be used in reports, presentations, and publications, but the researchers will not identify you by name. In order to maintain confidentiality of your records, Dr. Bruening will assure that your name will only appear on this consent form and the intake form. Study data will not be transmitted via the Internet. Study data will be stored on a password protected server. To these extents, confidentiality is not absolute.

WITHDRAWAL PRIVILEGE: Participation in this study is completely voluntary. It is ok for you to say no at any time. Even if you say yes now, you are free to say no later, and withdraw from the study at any time.

COSTS AND PAYMENTS: You will receive up to $110 in Amazon gift cards for completing this study. In addition, if 60% of the students under the direction of your Community Mentor complete the study, your floor may receive extra incentives such as lanyards, t-shirts and water bottles.

VOLUNTARY CONSENT/ASSENT: Any questions you have concerning the research study or your participation in the study, before or after your consent, will be answered by the researcher, Dr. Meg Bruening at devilSPARC@asu.edu or 480.269.7454.

If you have questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board through the ASU Office of Research Integrity and Assurance, at 480.965.6788.

This form explains the nature, demands, benefits and any risk of the project. By signing this form you agree knowingly to assume any risks involved. Remember, your participation is voluntary. You may choose not to participate or to withdraw your consent and discontinue participation at any time without penalty or loss of benefit. In signing this consent form, you are not waiving any legal claims, rights, or remedies. A copy of this consent form will be given to you for your records.

Your signature below indicates that you consent to participate in the above study.

_____

_____

Subject's Signature Printed Name
Date

INVESTIGATOR'S STATEMENT: "I certify that I have explained to the above individual the nature and purpose, the potential benefits and possible risks associated with participation in this research study, have answered any questions that have been raised, and have witnessed the above signature. These elements of Informed Consent conform to the Assurance given by Arizona State University to the Office for Human Research Protections to protect the rights of human subjects. I have provided the subject/participant a copy of this signed consent document."

Signature of Investigator_____
Date_____

APPENDIX B

SURVEY QUESTIONS

Q4 What is your gender?

- Male
- Female
- Transgender

Q5 What is your birth date?

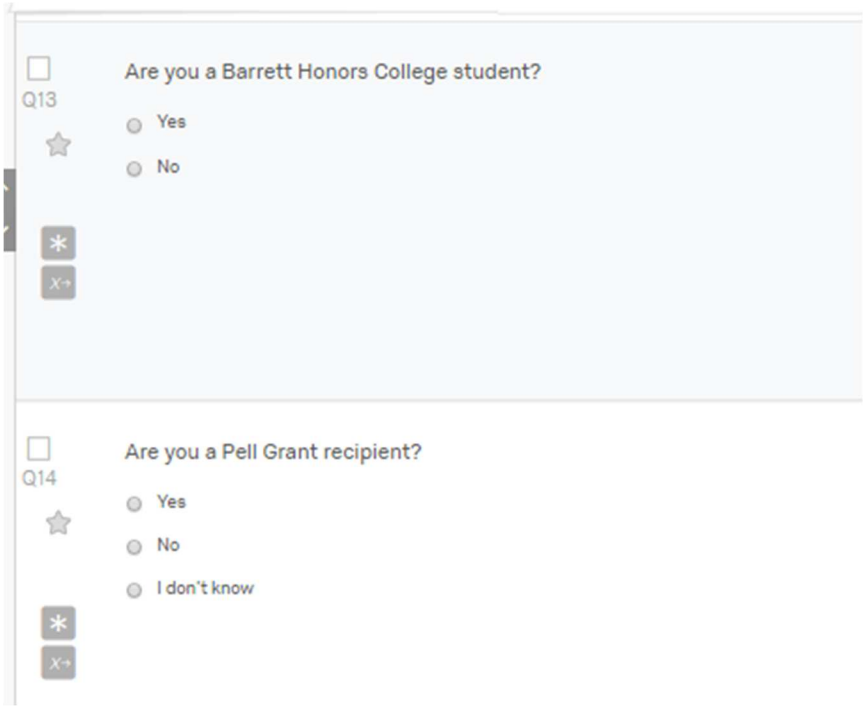
	Month	Day	Year
Please select:			

Q6 How do you usually describe yourself? (check all that apply)

- White
- Black or African American
- Hispanic or Latino/a
- Asian or Pacific Islander
- American Indian or Alaska Native
- Some other race (please specify):

Q10 Are you an international student?

- Yes
- No


Q13
Are you a Barrett Honors College student?
Yes
No
Q14
Are you a Pell Grant recipient?
Yes
No
I don't know

Q64 What is the highest degree or level of education that your **dad** (other parental/guardian figure) completed?

- Some high school (no degree)
- High school diploma (or equivalent)
- Some college (no degree)
- Associate's degree/Trade/Technical/Vocational training
- Bachelor's degree
- Graduate or professional degree
- Not applicable

Q65 What is the highest degree or level of education that your **mom** (other parental/guardian figure) completed?

- Some high school (no degree)
- High school diploma (or equivalent)
- Some college (no degree)
- Associate's degree/Trade/Technical/Vocational training
- Bachelor's degree
- Graduate or professional degree
- Not applicable

During the past month, how often did you drink:

	Never	1 time last month	2-3 times last month	1 time per week	2 times per week	3-4 times per week	5-6 time per week	1 time per day	2-3 times per day	4-5 times per day	6 or more times per day
Regular soda or pop that contains sugar? *Do not include diet soda.*	○	○	○	○	○	○	○	○	○	○	○

Coffee or tea that had **sugar** or **honey** added to it? Include coffee and tea you sweetened yourself and presweetened tea and coffee drinks such as Arizona Tea and Frappuccino. *Do **not** include artificially sweetened coffee or diet tea.*	○	○	○	○	○	○	○	○	○	○	○
Sweetened fruit drinks such as Kool-Aid, Lemonade, or cranberry drink? Include fruit drinks you made at home and added sugar to. *Do **not** include diet drinks or artificially sweetened drinks.*	○	○	○	○	○	○	○	○	○	○	○
Sports drinks such as Gatorade, Powerade, Vitamin Water, etc.? *Do **not** include diet drinks or artificially sweetened drinks.*	○	○	○	○	○	○	○	○	○	○	○
Energy drinks such as Red Bull, Monster, Rockstar, etc.? *Do **not** include diet drinks or artificially sweetened drinks.*	○	○	○	○	○	○	○	○	○	○	○

During the past month, how often did you eat:

	Never	1 time last month	2-3 times last month	1 time per week	2 times per week	3-4 times per week	5-6 times per week	1 time per day	2 or more times per day
Fruit? Include fresh, frozen or canned fruit. *Do **not** include juices.*	○	○	○	○	○	○	○	○	○
Green leafy or lettuce **salad**, with or without other vegetables?	○	○	○	○	○	○	○	○	○
Any kind of **fried potatoes**, including French fries, home fries, or hash brown potatoes?	○	○	○	○	○	○	○	○	○
Any **other kind of potatoes**, such as baked, boiled, mashed, sweet potatoes, or potato salad?	○	○	○	○	○	○	○	○	○
Refried beans, baked beans, beans in soup, pork and beans or any other type of cooked dried beans? *Do **not** include green beans.*	○	○	○	○	○	○	○	○	○
Other vegetables (not including previously mentioned green salads, potatoes, cooked dried beans)?	○	○	○	○	○	○	○	○	○
Mexican-type **salsa** made with tomato?	○	○	○	○	○	○	○	○	○

Tomato sauces such as with spaghetti noodles or mixed into foods such as lasagna? *Do not include tomato sauce on pizza.*	○	○	○	○	○	○	○	○	○

Now, we'd like to ask you a few questions about your physical activity habits. Remember, there are no right or wrong answers; so for each question, please choose the response that best represents you.

In a **usual week,** how many hours do **you** spend doing the following activities:

	None	Less than 1/2 hour a week	1/2-2 hours a week	2 1/2-4 hours a week	4 1/2-6 hours a week	More than 6 hours a week
Strenuous exercise (heart beats rapidly)? Examples: biking fast, aerobic dancing, running, jogging, swimming laps, rollerblading, skating, lacrosse, tennis, cross-country skiing, soccer, basketball, football, zumba	○	○	○	○	○	○
Moderate exercise (not exhausting)? Examples: walking quickly, baseball, gymnastics, easy bicycling, volleyball, skiing, dancing, skateboarding, snowboarding	○	○	○	○	○	○
Mild exercise (little effort)? Examples: walking slowly (to school, to friend's house, etc.), bowling, golf, fishing, snowmobiling, yoga	○	○	○	○	○	○

Are you currently trying to:

- Lose weight
- Stay the same weight
- Gain weight
- I am not trying to do anything about my weight

At this time, do you feel that you are:

- Very underweight
- Slightly underweight
- About the right weight
- Slightly overweight
- Very overweight

During the **past 30 days**, which of the following did you do to lose weight or keep from gaining weight? (select all that apply)

- ☐ ⊗ I did not try to lose weight or keep from gaining weight
- ☐ Dieted
- ☐ Exercised
- ☐ Ate more fruits and/or vegetables
- ☐ Drank less soda (not including diet soda)
- ☐ Controlled my portion sizes
- ☐ Made myself vomit
- ☐ Took diet pills
- ☐ Used some other method (please specify): _____

During the **past 30 days**, which of the following did you do to gain weight/muscle mass (select all that apply)

- ☐ ⊗ I did not try to gain weight/muscle mass
- ☐ Used protein powder or shakes
- ☐ Used steroids
- ☐ Used other muscle-building substances (such as creatine, amino acids, DHEA, or growth hormones)
- ☐ Used some other method (please specify): _____

How strongly do you agree with the following statements?

	Strongly disagree	Disagree	Agree	Strongly agree
My friends are physically active	○	○	○	○
My friends eat healthy	○	○	○	○
My friends are health conscious	○	○	○	○
Many of my friends diet to lose weight or keep from gaining weight	○	○	○	○
Many of my friends are trying to gain weight	○	○	○	○
My friends encourage me to diet to lose weight or keep from gaining weight	○	○	○	○
My friends encourage me to gain weight	○	○	○	○

APPENDIX C

IRB APPROVAL

Arizona State University Office of Research Integrity and Assurance 660 S. Mill Avenue Suite 315 Arizona State University Tempe AZ 85287-6111 (Mail Code 6111) Email: **research.integrity@asu.edu** Phone: 480-965-6788 Fax: (480) 965-7772		*For Office Use Only:* Date Received: HS Number:

SOCIAL BEHAVIORAL APPLICATION HUMAN SUBJECTS

PROTOCOL INFORMATION

Protocol Title: Date: 9/3/13

The Role of Friendship Networks on BMI and Behaviors among College Freshmen

PRINCIPAL INVESTIGATOR (PI)

Please note that the PI's CV and human subject's protection training certification must be attached with this application.

Name and Degree(s):

Meg Bruening, PhD, MPH, RD

Department/Center:

Nutrition/School of Nutrition and Health Promotion

Mailing Address:

500 North 3rd Street | Phoenix, AZ 85004 | MC3020

Email:	Phone:	Fax:
meg.bruening@asu.edu	602.827.2266	602.827.2253

University Affiliation:

☐ Professor

☐ Associate Professor

☒ Assistant Professor

☐ Instructor

☐ Other: Please specify. ("Other" categories may require prior approval. Students cannot serve as the PI)

CO-INVESTIGATORS (CO-I)

- A Co-I is anyone who has responsibility for the project's design, implementation, data collection, data analysis, or who has contact with study participants**.**
- If the project involves medical procedures or patient care that the PI is not certified or licensed to conduct, a responsible physician or other certified or licensed professional must be included as a Co-I. The application must include a copy of supporting documentation for this individual (CV, license, board certification etc).

[see online form]

PROJECT FUNDING

1a) How is the research project funded? (A copy of the grant application **must** be provided prior to IRB approval)

☐ Research is **not funded** (Go to question 2)
☐ Funding decision is pending
☒ Research is **funded**

b) What is the source of funding or potential funding? (Check all that apply)

☒ Federal ☐ Private Foundation ☐ Department Funds

☐ Subcontract ☐ Fellowship ☐ Other

c) Please list the name(s) of the sponsor(s): NIH, Early Investigator Award (DP5)

d) What is the grant number and title? 1DP5OD017910 – 01/The Role of Friendship Networks on BMI and Behaviors among College Freshmen

e) What is the ASU account number/project number? Pending

f) Identify the institution(s) administering the grant(s): ASU

PROJECT SUMMARY

2. Provide a **brief** description of the **background, purpose, and design** of your research. Avoid using technical terms and jargon. Describe all interactions with potential study participants (e.g., how identified, how recruited) including all of the **means you will use to collect data** (e.g. instruments, measures, tests, questionnaires, surveys, interview schedules, focus group questions, observations). Provide a short description of the tests, instruments, or measures**.** (If you need more than a few paragraphs, please attach additional sheets.) **Attach copies of all instruments and questionnaires. FOR ALL OF THE QUESTIONS, WRITE YOUR ANSWERS ON THE APPLICATION RATHER THAN SAYING "SEE ATTACHED".**

Emerging evidence indicates that friends may be one of the critical determinants of obesity among young people[1-6] and is often missing from models focused of individual[7,8] and societal level[9,10] factors. Research on friendship networks describes how health behaviors and outcomes are shared, transferred, and influenced through social ties. However, the mechanisms by which friendship networks are integral to patterns of eating and physical activity (PA) are not well understood. Having a better scientific grasp of the pathways by which friendship networks impact weight-related behaviors and outcomes is crucial for researchers designing effective behavioral and obesity prevention interventions.

This study aims to use mixed methods to assess the role in which friendship networks are involved in nutrition and PA behaviors and risk for excess weight gain among college freshmen, capitalizing on the unique opportunities at Arizona State University (ASU), the largest public US college with a very diverse student populations (40% low-income; 40% minority). The literature presents inconsistent findings about what portion of the relationship between friends' weight-related behaviors and outcomes can be attributed to different mechanisms such as shared routines, social learning, social

pressure, friend selection, friendship ideals, shared access, norms, and influence. This **longitudinal observational study** will prospectively track how friendships are created and better describe the mechanisms by which friends are associated with weight-related behaviors and outcomes.

Strong formative and epidemiological data are needed on the changes (e.g., new friendships, activities/ behaviors done together) that occur among friends to better understand the mechanisms impacting the relationships of friends' behaviors/outcomes. Thus, in the proposed study, perceived, direct reports and social network analysis of friends' relationship to nutrition, PA behaviors, and weight status will be tracked repeatedly across a school year, using focus groups and cell phone-based ecological momentary assessments (EMA), web-based surveys, and student card data from ASU freshmen living in dormitories. The expected outcome from this aim is that we will identify the most salient mechanisms to use to promote healthy behaviors among friends in interventions.

With the multiple data collection approaches, we will be able to explain if key times exist throughout the day in which college freshmen friends spend more time eating and being physically active together, informing when and where interventions would be best developed. We will explore how associations differ among college roommates (randomly assigned at ASU) and best friends compare with the associations in the larger friendship network (dorms, dorm floors) and whether demographic differences are apparent in associations among friends' behaviors and weight status overtime.

The current study deliberately gathers qualitative and quantitative data; each method will provide information on behavior and friendship networks, allow for corroboration of findings from the complementary data collection efforts, and address each specific aim by examining the data with the most relevant social network methodology.[23] The rich dataset will include multiple layers, including individual and interpersonal behaviors/outcomes and environmental factors.

During the first phase, the ***formative phase***, qualitative and preliminary research will be conducted. **Focus groups** will be conducted to assess perceptions of the mechanisms in which friendship networks are related to the key behaviors and outcomes (see Appendix A & B for focus group script, demographic survey, recruitment tools, and consent forms). These perceptions will help shape how mechanisms are assessed in the next phase. Also in the formative phase, **an EMA app will be developed, tested, and validated** (see Appendix C-E for assessment tools).

The second phase is the ***epidemiological phase*** in which we **will gather information on behaviors, outcomes and social networks longitudinally** (see Appendix E-G for assessment tools). Data will be collected in waves throughout their first year at ASU from freshmen students living in dormitories. Three separate approaches (web-based surveys, EMA app, and university database of student card [SunCards] activity) will be used (see Appendix F-H for assessment tools), each approach providing unique, specific information that will help us understand the mechanisms and the contextual factors related to friendship networks' role in eating, PA,

and weight overtime. The EMAs will be administered dorm-by-dorm with each student. We have planned to group dorms into two waves, over the 4 times frames in which the EMA will be administered. For the estimated 20-30% of college students who do not have smart phones,[66-68] we will loan them smart phones with the EMA app during each week of data collection for their respective dorm, a method that previous studies found successful.[69,70]

devilWASTE substudy:

The purpose of the study is to learn more about intestinal microbes and how helath behaviors during freshmen year of college impact these microbes. Bacteria and other microbes occur naturally within and on the body. Most of these organisms are not harmful to us and may play an important role in how we digest food. Microbes in your intestine may be impacted by things other than diet, including levels of physical activity and social groups/friends.

In a substudy of 1 dorm, Participants in the study will be asked to collect three fecal/stool samples while enrolled in the devilSPARC study (IRB #: 1309009596). Each participant will be provided with stool collection kits that contain everything they will need to collect the samples. Upon genomic sequencing of the stools, information about the microbes that live in the gut will be compared to demographic, dietary, physical activity and social data collected in the devilSPARC study.

Aim 1: Characterize the fecal microbiota of college-aged freshman males and females in relation to dietary choices. Our approach will be to:

a) Collect fecal samples from college-aged freshmen for MiSeq Illumina sequencing. All procedures used for collection and fecal processing will follow NIH Human Microbiome Project protocols (noted below).
b) Assess possible dietary determinants of gut microbiota diversity and composition in relation to habitual dietary intakes, assessed by 24-dietary recalls.

Aim 2: Characterize fecal microbiota of college-aged freshman males and females in relation to self-reported friend networks and how this relates to health behaviors among friends. Our approach will be to:

a) Characterize social and environmental influences on dietary and physical activity behaviors using data from devilSPARC surveys with college freshman students.
b) Assess clustering patterns among fecal microbiota profiles, health behaviors and social networks at the macro (dorm floor) and micro (friend, roommate) level.

Study Measurements and Sample Collection: As part of Dr. Bruening's NIH-funding project (IRB #: 1309009596), longitudinal data regarding dietary (24-h dietary recalls and university dining data) and physical activity behaviors are already being collected. Additionally, questionnaires about social networks will be completed. For the sub-study, participants will provide three fecal samples during their freshman year at Arizona State University. Collections will occur in August, November and April. New participants in November and January and participants who did not provide samples in November will be allowed to provide a sample in January (still a total of 3 samples). Fecal samples will be collected at the dormitories and students will be provided with sample collection kits

at the time of each collection. Samples will be prepared for microbiome analysis as detailed below and all fecal collection and processing procedures will be in accordance with NIH Human Microbiome Project (HMP) standards (http://www. Hmpdacc.org/doc/).

DNA extraction and analysis: Microbial genomic DNA will be extracted from fecal samples using the PowerSoil DNA isolation kit in our laboratory as described by the manufacturer (MoBio Laboratories Ltd, Carlsbad, CA). The samples will be homogenized using a beadbeater (BioSpec, Bartlesville, OK). Bacterial 16S rRNA gene sequences from each sample will be amplified by triplicate PCRs performed in 96-well plates. Barcoded universal primers 515F and 806R; http://www.earthmicrobiome.org/emp-standard-protocols/16s/,[24] containing Illumina adapter sequences which target the highly conserved V4 region will be used to amplify the microbiome from individual samples. PCR reactions, amplicon cleaning and quantification will be performed as outlined.[24] Equimolar ratios of amplicons from individual samples will be pooled together before being sequenced on the Illumina platform in Dr. Rosa Krajmalnik-Brown's laboratory. Quantitative PCR (qPCR) will be performed to assess the presence of methogenic Archaea while next-generation sequencing will be used to assess microbial community proportions. Depending on the microbial sequencing results, additional chemical analyses such as chromatography to detect short chain fatty acids (SCFA) will be performed.

A stool collection kit that contains everything participants will need to collect samples will be provided by the study staff during each wave of data collection. Sample collection materials will already be labeled with subject ID numbers and research staff contact information. Participants will be allowed to collect their samples in dormitory bathrooms. Each sample must be kept cold so participants will be provided with a cooler and ice packs which must be returned with each sample within 24 hours of collection. Study staff will be available in the dorms for immediate sample retrieval between 8 am and 8 pm during the weeks of devilSPARC data collection. If participants choose to complete sample collection in the dorms, they can drop the sample off in the lobby of Palo Verde West (Tempe Campus) during the mentioned timeframe, or call the research staff to pick it up from their residence hall if outside this time range. At each collection time point, participants will answer questions about prebiotic, probiotic, antibiotic and antifungal use to statistically control for any effects of medication use on the intestinal microbiome.

Female participants will be asked to provide the first date of their last menstrual cycle to adjust statistical models for microbiome variation due to changes in hormone levels.

STUDY DURATION

3a) What is the expected duration of the study through data analysis? (Include a timeline, if applicable).
Oct 2013-Oct 2018

	Proposed study period																			
	2013-2014				2014-2015				2015-2016				2016-2017				2017-2018			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
• Conduct focus groups																				
• Analyze focus groups																				
• Develop manuscripts																				
• Create app																				

• Pilot test app					
• Adapt app					
• Validate app					
• Recruit					
• Baseline web data					
• Midterm web data					
• Final web data					
• EMA/Sun Card data					
• Clean/analyze data					
• Develop manuscripts					
• Develop intervention grant proposal					

devilWASTE substudy

The timeline of this sub-study should last approximately 9 months.

The duration anticipated to enroll all study participants will be 1-2 weeks because recruitment and consenting will be completed in ASU dormitories to decrease the burden of those interested in enrolling in this sub-study.

The estimated date of completion for this sub-study, including primary analyses, will be 1.5 years.

b) When is the expected date that you wish to begin research? (MM/DD/YY) 10/01/2013(must be after submission date) Note: Protocols are approved for a maximum of 1 year. If a project is intended to last beyond the approval period, continuing review and reapproval are necessary. Research cannot begin until you have received an approval letter.

IRB APPROVAL

4a) Has this project been reviewed by another IRB? ☐ Yes ☒ No (If yes, please complete the information below and attach a copy of the IRB approval materials).

b) What is the name of the institution?

c) What is the current IRB approval date/status of IRB application?

STUDY SITES

5. Where will the study be conducted? (Check all that apply)

☒ On campus (Please indicate building(s) and room number (s) when known) This study will recruit and administer the study in dormitories on the Tempe campus. We have support from ASU Provost, Dr. Phillips for this study. (Appendix J)

☐ Off campus (Please provide location and letter of permission, where applicable)

SAMPLE SIZE/DURATION

6a) What is the expected number of individuals to be screened for enrollment? 3000

b) What is the **MAXIMUM** number of subjects that you plan to enroll in the study? 2500

c) What is the approximate number of: 1250 Males 1250 Females

d) Indicate the age range of the participants that you plan to enroll in your study. 17 to 27

e) What is the expected duration of participation for each subject? (at each contact session and total) At each phase, we will recruit a new cohort of students:

- Focus groups: 90 minutes
- EMA mobile phone application pilot testing: 1-2 weeks (total contact time 60-120 minutes)
- Epidemiological phase: 1 academic year (3 in person assessments taking 60-90 minutes each, and 6 waves of data collection 1 week each, totaling 60 minutes or less each wave).

SUBJECTS

7a) Will the study involve any of the following participants? (Please check all that apply if your study specifically targets these populations)

☐ Children (under 18) ☐ Pregnant women

☐ Prisoners or detainees ☐ Persons at high risk of becoming detained or imprisoned

☐ Decisionally impaired ☐ Patients- what is the status of their health?

☐ Fetuses ☐ Native Americans

☐ Non-English speakers (Include copy of all materials in language of participants and certification of the translation and back-translation: http://researchintegrity.asu.edu/humans/forms)

b) If **any** of the above categories have been checked, please state how you will protect the rights and privacy of these individuals. N/A

c) Please provide the rationale for the choice of the subjects including any inclusion criteria.

d) Will any ethnic/racial or gender groups be excluded from this study? If so, provide the rationale for the exclusion criteria. No

devilWASTE substudy:

Inclusion Criteria: English-speaking college freshman males and females who are living in on-campus housing, who are already participating in Dr. Meg Bruening's devilSPARC study (IRB #: 1309009596) will be eligible to participate in this study.

Exclusion Criteria: Exclusion criteria will include a history of eating disorders, malabsorption diseases, HIV infection, current high blood pressure and diabetes. Individuals will also be excluded for habitual use of prebiotics, probiotics, antibiotics and / or antifungals within the last month prior to sample collection. Participants will be screened prior to the consenting process by verbally asking each participant if they have any of the specified exclusions. This will be done individually.

Up to 800 college residents, Arizona will be expected to participate in this research study. A prior fecal microbiome analysis compared dietary intakes with intestinal microbiota and found correlations between bacterial diversity and dietary fiber in a cross sectional study of 30 children.[18] Our proposed study design will be adequately powered to see differences in diet with the addition of physical activity and social network data. Utilizing a population from the Arizona State University dormitories will also increase the power to see differences by reducing the variation expected when recruiting across broader geographical locations. Data will be analyzed by Drs. Whisner and Krajmalnik-Brown using QIIME, SAS and R; results will be considered significant if $p<0.05$.

RECRUITMENT

8a) Describe the process(es) you will use to **recruit participants** and inform them about their role in the study. (Attach copies of any recruitment materials.)

Focus groups: Participants will be recruited via emails from their Residence Life and flyers posted in dormitories. (See Appendix 1-2).

Mobile app testing: Participants will be recruited via emails from their RA and flyers posted in dormitories. See Appendix 3-4 for the app beta testing and Appendix 5-6 for the mobile app validation.

Longitudinal study: We will recruit from freshmen residence halls on the ASU campuses where we will consent participants and have them complete the first of 4 check-ins, which will consist of downloading the app to their phone (or signing up to borrow a phone), completing a web-based survey, and measurements (height, weight, waist and hip circumference). We will return for additional participants, as needed, to recruit additional eligible participants. In addition, we will employ snowball sampling methodology to recruit the social network of participants. Participants will provide the names and contact information of friends, who will subsequently invited (and consented) into the study. In addition, we will post flyers on the respective campuses so that eligible students can set up appointments at their convenience to enroll in the study.

devilWASTE substudy:

Recruitment will be completed per the specifications of IRB Study # 1309009596. This sub-study will be mentioned at the time of recruitment for the parent study and interested males and females will be proved with a copy of the consent form. Study personnel will explain the sub-study at that time and answer all questions that the participants have regarding study design and procedures. If participants in IRB Study # 1309009596 are not approached during recruitment for the parent study, an invitation letter will be sent via email that contains the attached recruitment flyer. Once a participant indicates interest in the study, a consent form will be sent to them. After all participant questions regarding the sub-study procedures are answered, the consent form will be signed in the presence of study staff. Once consented, participants will be individually screened for exclusion and inclusion criteria. If all criteria are met, the study staff will coordinate with the participant for stool collection by providing them with a collection kit. If participants do not meet all eligibility criteria they will be excluded from participating further in the devilWASTE portion.

In the event that a participant would like to withdrawal from the research, the consent form will provide instructions on how to withdrawal completely or partially with continued data collection. In brief, the participant will be told that they can either call or email the principal investigator to inform the study staff of their wish to withdrawal. At that time, the principal investigator will inquire as to the participants interest in fully or partially withdrawing from this sub-study. They will be reminded that no negative academic consequence will result from their withdrawal.
Samples will be collected in dormitory restroom facilities. Sample processing and analyses will occur in both the ABC-1 clinical lab (ASU Downtown Phoenix Campus) and the Biodesign Institute- ASU, Swette Center for Environmental Biotechnology lab A107.

b) Will any of the following be used? (Check all that apply and attach copies)

☒ Internet/Email

☐ Newspapers/radio/television advertising

☒ Posters/brochures/letters

☒ Other

c) Does any member of the research team have a relationship (i.e., teacher, coach, physician, therapist, service provider, etc) with individuals who will be recruited for this study or with institutions that will be used to recruit for this study? If yes, describe this relationship in detail and explain how the research

process will avoid any potential problems (e.g., coercion or appearance of possible coercion in recruiting) or conflicts of interest arising from this investigator's dual roles.

The PI and the Co-Is are all faculty at ASU where participants will be recruited. In the consent form, it will outline that participation or declining to participate will in no way affect their standing at ASU. It is not likely that any of the faculty will be involved directly in the students' academic or social life at ASU.

DECEPTION

9a) Does the proposed research require that you deceive participants in any way? ☐ Yes ☒ No

b) If your response is "yes," describe the type of **deception** you will use, indicate why it is necessary for this study, and provide a copy of the debriefing script.

COMPENSATION

10a) Will any type of compensation be used? (e.g. money, gift, raffle, extra credit, etc)

☒ Yes (Please describe what the compensation is) ☐ No (go to question 11)

- Focus groups: Participants will receive $10 incentive for their participation
- Mobile phone app testing: Participants will receive a $25 incentive for beta-testing for 1 week; $40 incentive for validation against gold standard surveys.
  Longitudinal study: There will be ~~3~~ 4 web-based surveys and 4 in-person measurements. For the first, students will receive $15 dollars; they must complete both the survey and the measurements to receive the incentive. For the next 3time points, students are told that they will receive an additional $10 gift card. We would like the flexibility for this to be $15 at each of the time points if needed, or to provide bonus at the end if they complete all of the assessments. In addition, we would like to provide additional small incentives (mugs, t-shirts, lanyards, ear buds, etc) at each of these data collection time points. If a participant brings a friend from the dorm to enroll in the study, we would like to give them an extra small incentive (mugs, t-shirts, lanyards, ear buds, etc).~~.~~ For the ~~-~~6 waves of ecological momentary assessments (completed on their cell phone), students will receive 1 point for completing each assessment. After 10 completed assessments, they will automatically be emailed a $5 Amazon gift card. If students complete at least 75% of their ecological momentary assessments in a given wave, they will receive an additional $5 bonus.~~.~~ In order to incentive social networks for completing questionnaires, dorm level and dorm floor incentives will be given to those groups who have 60% participate rates (e.g., each student receives a small gift like an ASU lanyard). Participants who bring a friend to participate in the study will earn an additional $5 Amazon gift card. In addition, for every eligible friend who enrolls in the study, the referee will receive an entry into a raffle for an additional $10, $25, $50 or $100.

We will also provide a $5 bonus gift card for participants who download a new version of the app.

We will also have raffles for $20 cash for those who complete measurements and surveys.

We will provide a bonus $5 gift card to Tango or Amazon for those that complete at least 5 app surveys in wave 4.

We will provide a bonus $10 gift card to Tango or Amazon for those attend the last check-in in April.

- devilWASTE substudy: Fecal sample 1: t-shirt
  Fecal sample 2: $10 cash
  Fecal sample 3: $10 cash
  Bonus: If all three sample collections are completed by a participant they will receive an additional $40 cash as a bonus for completing the entire study.

b) Explain why the compensation is reasonable in relation to the experiences of and burden on participants.

The incentives are reasonable for the amount of time and burden required from participants.

c) Is compensation for participation in a study or completion of the study? (Note: participants must be free to quit at any time without penalty including loss of benefits).

☒ Participation ☐ Completion

d) If any of the participants are economically disadvantaged, describe the manner of compensation and explain why it is fair and not coercive. The incentives are slightly less than the minimum wage, but are reasonable given the amount of effort required.

INFORMED CONSENT

11. Describe the procedures you will use to **obtain and document informed consent and assent**. **Attach copies of the forms that you will use.** In the case of secondary data, please attach original informed consent or describe below why it has not been included. Fully justify a request for a waiver of written consent or parental consent for minors.

(The ASU IRB website has additional information and sample consent and assent forms.)

Focus groups: In person explanation and delivery of the information form. (Appendix 12)

Mobile app testing: In person explanation and delivery of the consent form (Appendix 13 & 14)

Longitudinal study: In person delivery of the consent form on by each floor. Updated forms attached

devilWASTE substudy:

In brief, once participants have received information about this study, either at the time of enrollment in the parent study or via letter / recruitment flyer, written consent will be obtained in person. Dr. Corrie Whisner will oversee this process and schedule a time to meet with participants in the dormitories or at one of the two research facilities to answer their questions regarding the study. Participants will be screened for exclusion and inclusion criteria at this time. Once all of the participant's questions have been answered, the participant will sign the consent form. Each participant will be provided with a copy of their consent form for their records. This process will take up to 30 minutes to complete and to assure that participants understand the study procedures, they will be asked to summarize the study in their own words prior to signing the consent document.

RISKS

12a) What are the potential risks of the research? (Check all that apply)

☐ Physical harm

☐ Psychological harm

☒ Release of confidential information

☐ Other

c) Describe any potential risks to human subjects and the steps that will be taken to reduce the risks. Include any risks to the subject's well-being, privacy, emotions, employability, criminal, and legal status. There are two potentially identifiable sources of information that will be collected via the smartphone applications in the mobile app validation study and longitudinal study. First, timestamps for user entries will be recorded. These time stamps will include both a date and time of recording the information. Second, a truncated (i.e., 4 digits), anonymized IMEI number will be collected. This latter piece of information is needed to allow research staff to link data sent via the smartphone application to other data recorded during the study (e.g., web-based surveys). This truncated number will serve a similar purpose as a study ID number would except will be automatically generated during each data upload to ASU servers. There is a very small data security risk because timestamp and anonymized IMEI numbers will be collected in tandem. However, it is highly unlikely that timestamp data of this type (without location or other contextual data) could allow a person to be identified. Also, while a full IMEI number (which is 15-17 digits) does provide a unique identifier of an individual's smartphone, a truncated number (we will only be recording the final 4 digits) will make identification virtually impossible. The ID numbers will also be used as mask-ID numbers to link to the SunCard data, which will be de-identified for research staff. We are working with an outside vendor, Twilio, to send the student text-message prompts. This company will have a list of the cell phone numbers of the participants, but will not use it in any way (ASU staff controls when and to whom the prompts are received). There should be minimal risks from this partnership.

devilWASTE substudy:

The risks to participants in this sub-study will be no more than that incurred in daily life. However, participants may feel some social or psychological discomfort related to collecting fecal samples in the dorm environment. To minimize the chance of participants feeling such emotional discomfort, collection kits and transport containers have been designed to look like small lunch boxes.

Additionally, participants may come into contact with their stool during collection. This risk will be minimized by providing participants with gloves and other collection tools.

BENEFITS

13a) What are the potential benefits to the individual subject, if any, as a result of being in the study? Immediate benefits to the participants include a raised awareness regarding their own dietary and activity behaviors and factors influencing these behaviors. These benefits are expected to outweigh any possibilities of excessive preoccupation with food, activity and weight. In addition, participants will receive graduated incentives for their participation (see above).

We will also provide participants with a print-out of their behaviors as compared to their dorm, as compared to national recommendations if requested.

devilWASTE substudy:

If desired, participants will be provided with a print-out of their intestinal microbe communities. They will be asked to specify their interest in this option after the screening process by completing a brief study enrollment questionnaire.

b) What are the potential benefits, if any, to others from the study? Outreach work will also be done by staff to share the findings with campus health-care professionals who work with college students in professional meetings and conferences. Potential benefits to others include improved knowledge of how friends can support healthy student development in regards to weight status, dietary intake, and physical activity. The findings are expected to lead to a greater understanding of how friends and friendships networks can be engaged to help young people maintain a healthy weight, eat a nutritious diet and be active, to the subsequent development of more effective interventions. This knowledge is particularly important in light of the high prevalence of obesity and the serious consequences of poor eating and physical activity for young people. Societal benefits outweigh the possible risks to study participants, which are expected to be minimal.

DATA USE

14. How will the data be used? (Check all that apply)

- ☒ Dissertation
- ☒ Publication/journal article
- ☒ Thesis
- ☒ Undergraduate honors project
- ☒ Results released to participants/parents
- ☐ Results released to employer or school
- ☐ Results released to agency or organization
- ☒ Conferences/presentations
- ☐ Other *(please describe):*

PROTECTION OF CONFIDENTIALITY

15a) Describe the steps you will take to ensure the confidentiality of the participants and data. The data will be securely stored on the ASU file server for a minimum of 7 years. Mask IDs will be created for students' Sun Card data, working with the Business Office at ASU. Access to all data will be limited to the study's research staff. No links to any individuals will be included.

b) Indicate how you will safeguard data that includes identifying or potentially identifying information (e.g. coding).

Consent forms with identifying data (names) will be stored in a locked cabinet separately from the data.

We expect these procedures will minimize the possibility of disclosure of confidential information. Phone numbers of the Principal Investigator will be provided in cases where participants have questions. The smartphone applications will be made available to participants via a secured website maintained by ASU servers where each participant will be given a website link and unique code to enter which will direct them to a page that is unique to them. This page will contain links to download the smartphone applications that they have been uniquely assigned to. This application download process will not collect any information from the participant except that it will log the time that the applications were downloaded.

There are two potentially identifiable sources of information that will be collected via the smartphone applications. First, timestamps for user entries will be recorded. These time stamps will include both a date and time of recording the information. Second, a truncated (i.e., 4 digits), anonymized IMEI number will be collected. This latter piece of information is needed to allow research staff to link data sent via the smartphone application to other data recorded during the study (e.g., Web-based surveys). This truncated number will serve a similar purpose as a study ID number would except will be automatically generated during each data upload to ASU servers. There is a very small data security risk because timestamp and anonymized IMEI numbers will be collected in tandem. However, it is highly unlikely that timestamp data of this type (without location or other contextual data) could allow a person to be identified. Also, while a full IMEI number (which is 15-17 digits) does provide a unique identifier of an individual's smartphone, a truncated number (we will only be recording the final 4 digits) will make identification virtually impossible. ASU has no intention to collect full IMEI numbers or IP addresses at any point during the study.

devilWASTE substudy: The privacy interests of study participants, in relation to collecting fecal samples, will be addressed by having all sample collection kits labeled with subject identification codes so that if a sample is misplaced or lost, it cannot be connected back to the study participant. Only study personnel will have access to subject identification codes, samples and data and no personal information will be connected to the data generated from fecal bacteria sequencing. If a participant changes their mind about allowing researchers and study staff to have access to their fecal bacteria sequencing data, they can email Dr. Corrie Whisner to request that their data be removed from the study.

Data Analyses: Sequences will be analyzed using QIIME.[24; 25] This will include quality filtering to remove short and long sequences (truncated sequence should be > 75 bases long), sequences with primer mismatches, uncorrectable barcodes and ambiguous bases. A closed reference Greengenes database will be used to pick operational taxonomic units (OTUs) and assign taxonomy. Alpha (within sample) and Beta (between sample) diversity will be calculated.

R and SAS statistical software will be used to generate heat maps of dietary intake data and fecal microbiota profiles to screen for potential dietary modulation of the microbiota. These relationships will then be assessed more closely at the genus and species level by performing correlations between microbiota data and specific dietary components, such as carbohydrate, soluble and insoluble dietary fiber. Initially, t-test and non-parametric tests will be used to compare fecal microbiota between college freshman friend networks. ANOVA will be used to compare differences in microbial proportions at the phylum, family and genus level between student groups based on physical activity and dietary behaviors. In order to elucidate potential mechanisms, principal components analysis will be used to identify factors related to friend networks, dietary intake and physical activity behaviors in relation to microbial community structures. The outcome variables will be the microbiota frequency and proportion. Important factors identified in PCA analysis will be used in multivariate models. These models will include fixed effects (time) and random effect (subjects). For all of these analyses, appropriate methods to correct for multiple comparisons (such as the Benjamini-Hochberg procedure or Bonferroni correction) will be applied. Non-normal microbiome frequencies and relative proportion data will be transformed if needed to fit the assumptions of the statistical models.

Data Management and Confidentiality: To maintain subject confidentiality, all participants will be assigned a random letter or number sequence which will be used for study identification. All stool sample containers will be labeled with the subject identifier before being distributed so that names or personal information will not need to be included on the containers. Questionnaire data generated from the parent study will be de-identified using these same subject identification codes, as soon as they are received from participants. Once these data are received in the lab, only the code numbers will be used to refer to subject information. Consent forms and any identifying information will be kept in a separate file that is maintained in Dr. Corrie Whisner's office, within a locked file cabinet. To ensure the security of data, all paper copies of survey data will be stored in locked filing cabinets in the parent study PI's office (Dr. Meg Bruening). Digital data from stool sample analyses will be stored on the Biodesign Institute server. De-identified data used for statistical analyses will be saved on a secure ASU server, within a shared collaborator folder so that all 3 researchers can share access to the data as needed. Data will be retained for 10 years and all paper forms will be shredded and digital files erased at that time.

Sample Handling: Sample transport between campuses or for receiving from participants in dormitories will be overseen by Dr. Corrie Whisner. When transporting, all samples will be labeled only with subject identification codes, rather than names or other identifying information. Any staff assisting with sample processing and analyses will only be exposed to subject identification codes and will never be given personal information related to the participants. Processed samples will be stored in freezers at either the ABC-1 laboratory or the Biodesign Institute- ASU, Swette Center for Environmental Biotechnology lab A107; these facilities will be locked at all times and require key card access.

c) Indicate when identifiers will be separated or removed from the data. ID numbers will be used to identify data rather than names based on truncated IMEI number will be used to de-identify the data and link each data source.

d) Will the study have a master list linking participants' identifying information with study ID codes, and thereby, their data? If so, provide a justification for having a master list. (Note: In many cases, the existence of a master list is the only part of a study that raises it above minimal risk, that is, places participants at risk.) We will need a master list for the longitudinal study, which is needed to link the data sources (cell phone app to survey data) as well as to send participants their incentives via email. The master list will be stored on a password protected ASU server, in which only the PI, the study coordinator, and the staff programmer, Kevin Hollingshead, control access to. During enrollment, all study staff will be assigned a username and ID to enter data into the master list. They will be provided temporary (only during that day of enrollment) access to edit only those participants whom they entered into the system.

This allows us to correct mistakes in data entry. Only the PI and the programmer will have access to these data otherwise.

e)If you have a master list and/or data with identifiers, where on campus will the list and/or data be kept? (**Data sets with identifiers and master lists, whether electronic or in hard copy, should be securely stored on an ASU campus except in unusual circumstances (e.g., research conducted out of the state or country).)**

A master list will be encrypted and stored on ASU servers. Only the PI and the programmer will have access to the password to this data source.

f) If you have a master list, when will it be destroyed? The master list will be destroyed within 3 years of the completion of the grant.

g) How long do you plan to retain the data? At least 7 years

h) How will you dispose of the data? Deidentified data may be maintained on secure file server for an indefinite period due to ongoing data analysis.

i) Where on campus will you store the signed consent, assent, and parental permission forms (If applicable)? (**Consent, assent, and parent permission forms should be securely stored on an ASU campus)** The forms will be stored in a locked drawer in the Nutrition Program. Only the PI will be able to provide access to the drawer.

INVESTIGATOR INTERESTS

16a) Has the Principal Investigator filed a current annual conflict of interest questionnaire with the ASU Office of Research Integrity and Assurance? It is the COEUS module at: http://researchintegrity.asu.edu/coi ☒ Yes ☐ No

b) Do any of the researchers or their family members, have a financial interest in a business which owns a technology to be studied and/or is sponsoring the research? ☐ Yes ☒ No (If yes, please describe and disclose in the consent form.)

c) Are there any plans for commercial development related to the findings of this study?

☐ Yes (If yes, please describe.) ☒ No

d) Will the investigator or a member of the investigator's family financially benefit if the findings are commercialized?

☐ Yes (If yes, please describe.) ☒ No

e) Will participants financially benefit if the findings are commercialized?

☐ Yes (If yes, please describe.) ☒ No

BIOLOGICAL MATERIALS

17a) Will biological materials be collected from subjects or given to subjects? ☐ Yes ☒ No (If no, please skip to question 18)

b) Provide a description of the material (blood, tissue, vectors, antibodies, etc.) that will be used:

c) If the study involves human blood, do you have the required ASU Biosafety disclosure on file? ☐ Yes ☐ No(If yes, what is the Biosafety Disclosure number.)

d) Will any of the material being used in the study come from a third party? ☐ Yes ☐ No (If yes, attach copy of the Material Transfer Agreement if required.)

e) Does this study involve transfer of genetic material of animal tissue into humans? ☐ Yes ☐ No

(If yes, please cite the ASU Institutional Biosafety Disclosure number).

PRINCIPAL INVESTIGATOR

In making this application, I certify that I have read and understand the ASU Procedures for the Review of Human Subjects Research and that I intend to comply with the letter and spirit of the University Policy. Changes in to the study will be submitted to the IRB for written approval prior to these changes being put into practice. **I also agree and understand that informed consent/assent records of the participants will**

be kept for at least three (3) years after the completion of the research. Attach a copy of the PI's CV unless one is already on file with the Office of Research Integrity and Assurance.

Name (first, middle initial, last):

Meredith M Bruening

Signature:  Date: 9/3/13

FOR OFFICE USE:	This application has been reviewed by the Arizona State University IRB: ☐ Full Board Review ☐ Expedite Categories: ☐ Exempt Categories: ☐ Approved ☐ Deferred ☐ Disapproved ☐ Project requires review more often than annual Every months
	Signature of IRB Chair/Member: Date: