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# Psychological and Behavioral Correlates of Freshman BMI Change

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PSYCHOLOGICAL AND BEHAVIORAL CORRELATES OF  
FRESHMAN BMI CHANGE

A Thesis

Presented to

The Faculty of the Department of Nutrition, Food Science, and Packaging  
San José State University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Rebecca K. Jackl

December 2010

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The Designated Thesis Committee Approves the Thesis Titled  
PSYCHOLOGICAL AND BEHAVIORAL CORRELATES OF  
FRESHMAN BMI CHANGE

by

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APPROVED FOR THE DEPARTMENT OF NUTRITION, FOOD SCIENCE  
AND PACKAGING

SAN JOSÉ STATE UNIVERSITY

December 2010

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## ABSTRACT

### PSYCHOLOGICAL AND BEHAVIORAL CORRELATES OF FRESHMAN BMI CHANGE

By Rebecca K. Jackl

This observational research examines body-mass-index (BMI) changes in multicultural freshmen attending a large public urban university. It explores psychological and behavioral factors associated with gains and loss in BMI. The study utilizes an online survey distributed in September 2008 and again in December 2008. All 3,509 freshmen were eligible to participate. Initial survey response rate was 29%; in December, 40% of initial respondents completed both surveys (n = 355). A subset of respondents (n = 65) had height, weight, and body composition measured to compare to self-reported data. Mean BMI change was a gain of 0.23 units, but those who gained BMI units (“Gainers”) gained an average of 1.00 BMI units while BMI “Losers” lost an average of 0.95 BMI units. The overall sample increased alcohol intake and decreased physical activity over the semester. Increased stress was associated with both BMI gain and loss. Those who were underweight or normal weight lost the most, while those who were overweight or obese gained the most. There was a corresponding increase in underweight and overweight/obese students.

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## **PREFACE**

The journal article was written and formatted according to the publication guidelines of the journal *Eating Behaviors*. The remainder of the manuscript was written according to the 6<sup>th</sup> Edition of the Publication Manual of the *American Psychological Association* (2010).

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## CHAPTER 1

### INTRODUCTION AND REVIEW OF THE LITERATURE

## Introduction

College is thought to be a critical time for weight gain. The popular press commonly cites that freshmen gain 15 lb (the “Freshman 15”) during their first year of college (Brown, 2008). However, a recent review and a recent meta-analysis reported mean weight gain over the course of freshman year was less than 5 lb (Brown, 2008; Vella-Zarb & Elgar, 2009). Not all freshman students, however, gain weight. Over 30% have been reported to lose weight (Gropper et al. 2009). Thus, looking at mean weight gain across the entire freshman population fails to account for those students who lose weight and may underestimate the amount of weight that students who gain weight actually gain.

Many male adolescents 17-18 years of age have not yet reached their adult height. Examining weight change without examining concomitant height change may further mischaracterize weight status. Because body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) accounts for height change, use of BMI to assess weight status is a more appropriate measure than body weight. The Centers for Disease Control (CDC) use BMI categories to define weight status. In adults over the age of 20, underweight is defined as  $BMI < 18.5 \text{ kg/m}^2$ , normal weight as  $BMI 18.5-25.0$ , overweight as  $BMI 25-29.9$ , and obesity as  $BMI \geq 30$  in individuals 20 years of age and older. In contrast, for children and adolescents under the age of 20, CDC BMI categories are age and sex-specific and are often referred to as BMI-for-age. For most individuals, BMI correlates with percent body fat and can be used as an estimate for health risks

(CDC, 2007). The literature of weight gain in college students exclusively uses the adult categorizations.

The main objective of this study was to determine the magnitude of, and factors associated with, BMI change (both gain and loss, based on self-report) among first semester college freshmen. Behavioral data, including fruit, vegetable, and dairy intake, alcohol use, physical activity, and frequency of self-weighing, were collected to replicate past findings that associated these behaviors with weight change (Adams & Rini, 2007; Anderson, Shapiro & Lundgren, 2003; Butler, Black, Blue & Gretebeck, 2004; Hajhosseini, et al. 2006; Levitsky, Garay, Nausbaum, Neighbors & DellaValle, 2006; Levitsky, Halbmaier & Mrdjenovic, 2004; Racette, Deusinger, Strube, Highstein & Deusinger, 2005). Psychological data including perception of one's weight status, concern about college weight gain, standardized measures of depression, anxiety, stress, and disordered eating, and self-reported diagnosis of depression, anxiety or an eating disorder, were also collected. These measures have also been associated with weight change (Adams & Rini, 2007; Atlas, 2004; Cooley & Toray, 2001; Delinsky & Wilson, 2008; Economos, Hildebrandt & Hyatt, 2008; Graham & Jones, 2006; O'Connor & O'Connor, 2004; Pliner & Saunders, 2008; Sassaroli & Ruggiero, 2005; Vella-Zarb & Elgar, 2009). A sub-sample of participants had their height and weight measured to evaluate the accuracy of self-reported data and to assess composition of weight change.

## **Review of the Literature**

### *Obesity: Prevalence and Consequences*

According to the National Health and Nutrition Examination Survey (NHANES) 2007-2008, over two thirds of American adults are overweight or obese (Flegal, Carroll, Ogden, & Curtin, 2010). The large increase in obesity over the past two decades is the result of increased energy intake and decreased physical activity (DHHS, 2001). Obesity and overweight status are major public health concerns because they are linked to chronic diseases including hypertension, coronary artery disease, respiratory disease, liver and gall bladder disease, and certain types of cancers. They also increase the risk of metabolic syndrome, diminished reproductive function and osteoarthritis (Kopelman, 2007).

Rates of overweight status and obesity are also high in children and adolescents (Singh, Kogan, & van Dyck, 2010). Higher BMI in children and adolescents increases the risk of adult overweight status and obesity, with increased risk as one gets older (Guo, Wu, Chumlea, & Roche, 2002). For example, up to age 18, an overweight female will have a probability of 20-39.9% of being obese at age 35, while between the ages of 18 and 20, the probability of being obese at age 35 increases to 40-59.9%. For overweight males up to age 17, the probability of being obese at age 35 is  $\leq 20\%$ , but between the ages of 17 and 20, the probability increases to 20-59.9% (Guo et al., 2002). Thus preventing or treating overweight students of college age could potentially do much to decrease the development and continuation of obesity later in life.

*The “Freshman 15”—The First Year of College as a Critical Period for Weight Gain*

One of the critical periods for weight gain in young people’s lives is believed to be their first year of college. The term “Freshman 15” originated in the 1990s and refers to the 15 lb reputedly gained by freshmen their first year of college, despite the fact that most scientific research has found an actual mean weight gain of less than 5 lb (Brown 2008, Vella-Zarb & Elgar, 2009). A recent meta-analysis of studies on freshman weight gain found mean weight gain over the course of freshmen year was  $3.86 \text{ lb} \pm 1.63$  (Vella-Zarb & Elgar, 2009). However, when interpreting the research, it is important to distinguish between the mean weight change reported across the population of freshman students versus the average amount of weight gained by those who gain weight. Not all students gain weight. A sizeable minority (over 30%) lose at least 5 lb their first year of college (Gropper et al., 2009), which may bring down the mean weight gain. It is when looking at just those students who gain weight where the magnitude of the mean weight gain is apparent. That is, while not everyone gains weight his or her first year of college, those who do may gain a significant amount (Adams & Rini, 2007; Anderson et al, 2003; Butler et al, 2004; Delinsky & Wilson, 2008; Economos, Hildebrandt & Hyatt, 2008; Graham & Jones, 2006; Hajhosseini et al., 2006; Levitsky et al., 2004; Levitsky et al., 2006; Pliner & Saunders, 2008; Racette et al., 2005; Vella-Zarb & Elgar, 2009).

Recent studies have examined the magnitude of weight gain by college students as well as associations that may be responsible for the gain (Adams & Rini, 2007; Anderson et al, 2003; Butler et al, 2004; Delinsky & Wilson, 2008; Economos, Hildebrandt & Hyatt, 2008; Graham & Jones, 2006; Hajhosseini et al., 2006; Levitsky et

al., 2004; Levitsky et al., 2006; Pliner & Saunders, 2008; Racette et al., 2005; Vella-Zarb & Elgar, 2009). Study duration ranged from the first semester of freshman year through four years of college. Examining only the weight change associated with the first semester or year of college, most studies have found at least some minimal amount of weight gain in the majority of students, with a subset of students gaining significant amounts of weight (Adams & Rini, 2007; Anderson et al, 2003; Butler, et al, 2004; Delinsky & Wilson, 2008; Economos, Hildebrandt & Hyatt, 2008; Graham & Jones, 2006; Hajhosseini et al., 2006; Levitsky et al., 2004; Levitsky et al., 2006; Pliner & Saunders, 2008; Racette, et al., 2005; Vella-Zarb & Elgar, 2009). Vella-Zarb and Elgar (2009) performed a meta-analysis of 24 journal articles examining freshman weight gain, of which 22 reported significant weight gain. Factors associated with weight gain were a decrease in physical activity levels or low physical activity over the year, high “junk food” consumption, recent dieting, higher baseline weight or BMI, high levels of perceived stress, and alcohol consumption in males.

#### *Diet and Physical Activity: Relationships to College Weight Gain*

One study examining diet and exercise changes in female college freshmen found an average weight gain of only 1.56 lb in a five-month period, with no mention of average weight gain among those who gained weight (Butler et al., 2004). Although the authors reported that caloric intake decreased significantly according to food frequency data (almost 350 kcal/day), food frequency measures are not sensitive enough to detect this small a difference in calorie intake. There were also significant decreases in



measures of physical activity (e.g., occupational and sports related physical activity) that were suggested as a possible explanation of the weight gain (Butler et al; 2004).

Another study reported students in their first semester gained an average of 2.86 lb, with 26% gaining at least 5 lb (Anderson, Shapiro & Lundgren, 2003). Furthermore, overweight status or obesity increased from 20% to 31%. A subset of the sample was followed through their second semester and although no significant weight gain occurred by the end of the second semester, 33% of subjects had gained at least 5 lb and 13% had gained at least 10 lb during the first year of college. Clearly for some college students, weight gain may be quite significant.

In a study of freshman students at Cornell University, the mean weight gain in the first 12 weeks of college was  $4.18 \pm 5.28$  lb (Levitsky, Halbmaier & Mrdjenovic, 2004). After adjusting for initial body weight, almost half of the variance of the weight gain could be explained by the consumption of “junk foods” and higher frequency of meals and number of snacks (Levitsky, Halbmaier & Mrdjenovic, 2004). The weight gain experienced by participants in this study was explained by an extra 174 kcal a day, which the authors hypothesized to be due to large portions and all-you-can-eat dining halls found on a typical college campus, both of which may promote overeating and contribute to weight gain (Levitsky, Halbmaier & Mrdjenovic, 2004).

In a 2-year longitudinal study tracking students from beginning of freshman to the end of sophomore years of college, Racette, Deusinger, Strube, Highstein & Deusinger (2005) found that during the freshman year alone, average weight increased  $5.5 \pm 11$  lb. By the end of sophomore year, 70% of students had gained weight for an overall gain

averaging  $9.02 \pm 7.92$  lb. At both the beginning and end of the study, few students met the recommended exercise guidelines or recommended intake of fruits and vegetables and over half of the students reported eating high-fat fried or fast foods at least three times a week. These percentages did not change significantly over the 2-year period other than a small reduction in consumption of fried foods. Thus, there was no apparent association of weight change with exercise or diet patterns. Racette, Deusinger, Strube, Highstein and Deusinger (2008) later extended their previous research to follow the students during their last two years of college. Essentially, weight change by senior year was quite variable, with mean weight gain of  $5.5 \pm 11.7$  lb. Some of the weight gain by the end of sophomore year (average of 9 lb) reported in Racette et al.'s previous (2005) study had leveled off. However, while only 15% of freshman students were classified as overweight or obese at the beginning of freshman year, by the end of senior year, the prevalence had increased to 23% (Racette et al., 2008). Thus the impact of weight gain during college appeared to result in a moderately increased rate of overweight and obesity.

#### *Psychological Factors Associated With College Weight Gain*

A study by Pliner and Saunders (2008) investigated the effects of residence (living at home or on campus) and dietary restraint on changes in body weight. The construct of dietary restraint was originally conceptualized as being the cognitive tendency to restrict intake as a means of maintaining or losing body weight (Herman & Mack, 1975). Unrestrained eaters living at home or on campus gained less than 3 lb on average, while restrained eaters living on campus gained significantly more weight (9 lb)

during the same period of time (Pliner & Saunders, 2008). Restraint was assessed using the Herman/Polivy Restraint Scale, which some have criticized as measuring disinhibition in addition to just restraint (Van Strien, 1996). This means that those reported to be high in restraint using this scale would be more responsive to external or environmental cues such as the sight or smell of food (Pliner & Saunders, 2008). With the wide variety and easy availability of food on college campuses, those vulnerable to these external cues could be more prompted to overeat.

Another study seeking to explain variables responsible for weight gain during freshman year examined both stress and health related behaviors (Economos, Hildebrandt & Hyatt, 2008). Average weight gain was  $5.3 \pm 7.2$  lb and among those who gained weight (80% of students), the average weight gain was  $7.8 \pm 5.2$  lb. Few variables were significant predictors of weight change. The biggest predictors of weight gain were an increase in alcohol consumption in men (4.2 lb gain predicted) and an increased school workload in women, which the authors believed may have promoted stress-induced eating and weight gain (2.9 lb weight gain). Overall, variables relating to weight change (both gain and loss) accounted for only 18% and 11.5% of the variability in data for males and females, respectively (Economos, Hildebrandt & Hyatt, 2008).

Using predictive variables from a Health Risk Appraisal at Arizona State University, Adams and Rini (2007) sought to explain weight gain over a two year period among college students. The study was retroactive, and data were collected from 1992 to 1994 so the extent of weight change and the variables affecting it may have changed in the last 15 years. Overall, the regression model created for men was not significant

(Adams & Rini, 2007). In contrast, the regression model for women identified several variables associated with weight gain that accounted for 90% of the variance. Women who gained weight were more likely to drink alcohol, to use maladaptive coping behaviors, to consume caffeine, and to eat foods low in fiber. They were less likely to be stress-free, to eat cruciferous vegetables, and to refrain from eating high-cholesterol foods (Adams & Rini, 2007). Clearly diet was a major predictor overall and stress and coping methods were also important considerations.

*Worries about the “Freshman 15”: Does it Increase Disordered Eating?*

Two recent studies examined the weight change associated with the freshman year of college, and the association between awareness of the “Freshman 15” and weight gain. Delinsky and Wilson (2008) found that women gained an average of  $3.36 \pm 7.4$  lb their freshman year of college and that among those who gained weight (63% of the sample), the mean gain was  $7.32 \pm 5.9$  lb. About two thirds of the sample reported at least moderate concern about the “Freshman 15” at the beginning of their freshman year, and degree of concern at this time significantly correlated with weight and shape concerns at the end of their freshman year (Delinsky & Wilson, 2008). Overall, scores of dietary restraint and shape concern (markers of eating pathology) increased significantly by the end of the year and although participants were not more likely to meet criteria for overweight or obesity, they were more likely to describe themselves as overweight.

In a similar study conducted in female freshman students, although actual weight did not change significantly by the end of the year, participants thought they had gained an average of 4.1 lb (Graham & Jones, 2006). At the beginning of freshman year, over

65% of subjects expressed at least moderate concern about gaining weight. Although concern about weight gain did not predict weight change, it did predict a perceived weight gain such that those most afraid of weight gain at the beginning of the year were those who thought they had gained the most weight by the end of the year. It was also associated with poor body image, higher scores of disordered eating and being more likely to classify themselves as overweight (Graham & Jones, 2006). A major limitation of this study is that students who had complete data had more disordered eating scores than those students who failed to complete the study, thus biasing the results. This study still suggests, however, that introducing the notion of the “Freshman 15” to those who are already preoccupied with weight and eating issues may be more harmful than helpful. While weight gain does appear to be a reality for many students their first year of college, it appears that exaggerating its magnitude and its inevitability is not helpful to students who are already vulnerable to disordered eating.

#### *Changes in Body Composition*

Although most studies focus only on weight change, some studies have assessed both body weight and body composition changes (Hajhosseini, Holmes, Mohamadi, Goudarzi, McProud, & Hollenbeck, 2006; Hoffman, Policastro, Quick, & Lee, 2006). Hoffman et al. (2006) found that across all subjects there was a mean weight gain of 2.86 lb (1.63 lb fat) and among those who gained weight, there was a mean gain of 6.82 lb (2.64 lb fat). In a similar study by Hajhosseini, Holmes, Mohamadi, Goudarzi, McProud, and Hollenbeck (2006), mean body weight over the course of the first semester of freshmen year increased by 3.0 lb. However, 59% of subjects gained at least 3 lb and

22% of subjects gained at least 6 lb. The percentage of fat mass increased and lean body mass decreased significantly over that time. Mean calorie intake did not change significantly but physical activity was not assessed, so it is unclear what factors contributed to the changes in body weight and composition (Hajhosseini et al, 2006). These two studies specifically measuring body composition as well as weight changes demonstrate that energy imbalance during college years has the potential to increase body weight and fat mass in many students in a relatively short period of time—troubling because increased fat mass may increase the risk of metabolic diseases (Hoffman et al., 2006).

#### *Self-Monitoring for Weight Control*

Strategies for treating obesity include dietary intervention, physical activity, behavior modification, pharmacotherapy, and bariatric surgery (Levy, Finch, Crowell, Talley & Jeffery, 2007). Behavior modification for weight loss includes self-monitoring (Levy et al., 2007). Self-monitoring involves recording variables such as food intake, exercise, and body weight so as to become more aware of eating and activity patterns as well as their antecedents and consequences. It can also help assess progress and improve compliance with behavior change (Levey et al., 2007). Self-monitoring records don't necessarily have to be long-written records; studies have shown that greater weight loss is associated with more frequent record keeping, regardless of length or format (Helsel, Jakicic & Otto, 2007; Yon, Johnson, Harvey-Berino, Gold & Howard, 2007).

Self-monitoring aids weight maintenance (Elfhag & Rossner, 2005; Wing & Hill, 2001). Wing and Hill (2001) examined the characteristics of members of the National

Weight Control Registry, a group of people who have maintained a weight loss of at least thirty lb for a minimum of one year. Although many other factors such as frequent and intensive exercise and consumption of a low-calorie, low-fat diet were associated with improved success of weight loss maintenance, frequent self-weighing was a common theme among Registry members, with over 44% weighing themselves at least daily and 31% weighing themselves at least once a week (Wing & Hill, 2001).

Because weight loss and maintenance is so difficult, some efforts are focusing more on weight gain prevention (Linde, Jeffery, French, Pronk & Boyle, 2005; Levitsky, Garay, Nausbaum, Neighbors & DellaValle, 2006). One study designed to prevent weight gain in adults found subjects in the intervention group increased weighing frequency over the course of the trial relative to those in the control group. Furthermore, daily weighing was associated with weight loss 12 and 24 months into the trial, while other weighing categories were associated with weight gain (Linde, et al, 2005).

In a study designed to determine if regular self-weighing is a tool that can help prevent weight gain in newly enrolled college freshman students in the intervention group were provided scales and asked to weigh daily and to email the weight to the researcher (Levitsky, Garay, Nausbaum, Neighbors & DellaValle, 2006). Two independent trials were performed, each one semester in length, and in the first trial the researchers emailed back a slope of the weight change to subjects in the intervention group, while in the second trial, the researchers emailed back caloric feedback based on the weight change. The untreated controls gained  $6.82 \pm 1.12$  lb and  $4.4 \pm 1.43$  lb, respectively, while weight gain of both experimental groups was not significantly different from zero (Levitsky et

al., 2006). It is unclear whether the feedback of the slope or calorie information was necessary or whether simply the act of weighing themselves was sufficient to help prevent weight gain.

In a study of overweight young adults between the ages of 21 and 35, the researchers randomized participants to a daily self-weighing group or to a standard behavioral treatment group that had weekly group weigh-ins (Gokee-LaRose, Gorin & Wing, 2009). As an objective measure of self-weighing, participants were required to bring their digital scale with memory of weigh-ins to treatment sessions and follow-up. Although both groups experienced significant weight loss, the daily self-weighing participants were more likely to maintain the frequency of weigh-ins by follow-up and there was a positive association across groups between frequency of weighing at follow-up and greater overall weight loss.

#### *Psychological Effects of Weighing*

While the use of weighing for weight control purposes seems promising, there is another body of literature suggesting that weighing can be psychologically harmful and associated with obsessive compulsive behaviors such as eating disorders. However, the studies that show this effect is usually specific to young, often normal weight females. Studies of adults show either no relationship between weighing and negative psychological effects or, to the contrary, they actually show an improvement in depression. For example, one study that examined psychological effects of participants in a weight maintenance intervention found that increases in self-weighing were associated with decreases in depression and in binge eating episodes (Wing, Tate, Gorin,



Raynor, Fava & Machan, 2007). However, levels of depression and binge eating were so low at baseline there may not have been much room to show an effect. Another study, limited only to women between the ages of 45 and 65, examined the association of weighing frequency with depression (Linde, Jeffery, Finch, Simon, Ludman, Operskalski, Ichikawa & Rohde, 2007). While the data are only correlational and limited to a very specific population, the authors found no statistically significant differences in levels of depression among those who weighed themselves more or less frequently.

In the self-weighing study by Gokee, LaRose and Wing (2009), psychological measures for depression, disordered eating, and body image were assessed for two treatment groups of overweight young adults aged 21 to 35 years of age. More frequent self-weighing was associated with greater weight loss and with no negative effects on psychological measures. Indeed, there was an improvement in psychological measures for both treatment groups.

In contrast, studies in normal weight, usually female populations, seem to show the greatest psychological risks from weighing. Ogden and Wyman (1999) instructed female college students to weigh themselves daily while a control group weighed only at the beginning and end of a 2-week period. In just two weeks, those who weighed themselves daily showed increased depression, anxiety, and decreased self-esteem iff their weight remained stable or increased. On the other hand, those who weighed themselves only at baseline and the end of the study had stable ratings of depression, anxiety, and self-esteem that were not affected by weight change. Dieting status at the beginning of the study was not related to these psychological effects (Ogden & Wyman,

1999). Because only subjects who owned a scale were included in the study, this may have biased the results by only including people who were already more focused on weight.

Even a single weighing session has been shown to worsen mood in studies wherein the scale is manipulated to read artificially high or low to gauge its psychological effects. In a study by McFarlane, Polivy, and Herman (1998), female college students were randomly assigned to being weighed either 5 lb heavier or lighter than their actual weight. As an effect of the weighing, subjects high in dietary restraint who were told they were 5 lb heavier than they expected experienced lower self esteem, fewer positive moods, and more negative moods than did non-restrained subjects, whose mood did not vary across weighing conditions. Even restrained eaters who were weighed on the artificially light scales reported increased anxiety, likely due to the psychological importance they placed on the scale's reading. In a final part of the study, when cookies were provided as a "taste test" after the weighing, restrained eaters who were weighed 5 lb heavy consumed significantly more food than any other group, which is consistent with research showing that negative affect causes disinhibition of restraint in restrained eaters (McFarlane, Polivy & Herman, 1998). In a similar study by Winstanley and Dives (2005), female college students were randomly assigned to being weighed on an accurate scale or one designed to be heavy by 7 lb. Subjects who were given the inaccurately high weight feedback had significantly higher scores of anxiety and depression compared to subjects given the accurate feedback. However, baseline measures of anxiety and depression were not collected so it's unclear if the groups could have differed before the

experiment. In addition, the effects of inaccurate weight feedback may not be able to be generalized to all weight feedback.

Despite methodological issues, current research supports negative effects of weighing are likely limited to a specific population (young females who are already vulnerable to excessive focus on weight and disordered eating) and that care must be taken with this population when recommending frequent weighing as part of self-monitoring for weight control (McFarlane, Polivy, and Herman, 1998; Ogden & Wyman, 1999; Winstanley & Dives, 2005).

*Focus on Weight: Relationship to Disordered Eating*

Frequent weighing may be psychologically harmful if it induces someone to become ultra-focused on controlling their weight. Although no cause and effect can be established, Laliberte, Newton, McCabe and Mills (2007) found that focusing on controlling one's weight, regardless of the consequences, is related to more disturbed eating, higher body dissatisfaction and lower self esteem. In contrast, they reported that focusing on achieving a healthy lifestyle and accepting the weight that comes with it is associated with a much healthier psychological profile.

If focusing on weight leads to dieting, the very act of dieting may result in increased obsessions or mood issues. Dieters have been shown to be significantly more obsessed with food and eating relative to non-dieters (Hart, 1991; Hart & Chiovari, 1998). Obsessive-compulsive tendencies in areas unrelated to food and eating are similar across groups (Hart, 1991). Interestingly, among the National Weight Control Registry subjects, although most participants reported improvement in degree of obsession about

food, 14% of participants reported increased obsession about food compared to before they dieted and 20% reported increased obsession about weight compared to before dieting (Wing & Hill, 2001). It would be useful to determine why some people have increased obsession but others don't.

Along those lines, in developing an intervention for college freshmen to prevent or treat weight gain, one must consider risk factors unique to this population. Women in general are more at risk of worrying they are overweight when they are not (Kuchler & Variyam, 2002; Kuchler & Variyam, 2003). College women, relative to college men, are more likely to think they're overweight when they're not and more likely to be trying to lose weight, with 15% of female students trying to lose weight using extreme methods such as vomiting, laxatives, or diet pills (Lowry, Galuska, Fulton, Wechsler, Kann & Collins, 2000). Another study reports that 83% of college females think that they would be more attractive if they weighed less (regardless of current weight) and they report frequent dieting, which may include maladaptive weight loss methods such as skipping breakfast or smoking cigarettes (Malinauskas, Raedeke, Aeby, Smith & Dallas, 2006). Female college students with an inflated body weight perception are significantly more likely to engage in unhealthy weight management strategies and report depressive symptoms than are females with an accurate body weight perception (Harring, Montgomery, & Hardin, 2010).

While not all the focus on weight and dieting methods are necessarily harmful, for some female college students (up to 25%) their worries about and behaviors relating to food can be considered to be obsessive compulsive and/or disordered (Humphreys,

Clopton & Reich, 2007; Roberts, 2006). Indeed, the most frequent age of onset of eating disorders has been found to be bimodal, emerging most commonly around age 14 or 18, which means that the beginning of college is a critical time in the emergence of eating disorders (American Psychiatric Association, APA, 2000). Stress is often cited as a significant contributor to this increased negative focus on weight. For example, when stressed, students can be induced to focus their energy on losing weight or they may overeat as a coping mechanism (O'Connor & O'Connor, 2004). These responses to stress seem to be mediated by factors such as perfectionism, dietary restraint, or conscientiousness, among others (O'Connor & O'Connor, 2004). During stressful situations, low self-esteem, perfectionism, and worrying are associated with increased symptoms of disordered eating (Sassaroli & Ruggiero, 2005). Cooley & Toray (2001) followed college students for three years and reported that the only significant predictor of eating disorder onset was baseline high body dissatisfaction. Atlas (2004) determined that sensitivity to criticism and rejection as well as sensitivity about one's appearance was related to more disordered eating. It remains to be seen whether qualities such as these can predict a negative psychological effect and increased disordered eating through the use of regular self-weighing.

### *Summary*

In sum, overweight and obesity are major public health concerns that have increased among children and young adults as well as in the overall population. College is viewed as a critical period for weight gain, though the name "Freshman 15" is misleading, given that average weight gain is more likely under 5 lb. However, while

many students may gain a sizeable amount of weight, we cannot overlook the fact that many others lose weight. Many studies have sought to find factors associated with college weight gain in order to treat or prevent undesirable gain that will be difficult to lose. Studies have also explored weight loss strategies such as use of frequent self-weighing as part of self-monitoring. However, focus on weight and weight loss strategies is a double-edged sword as it can also lead to the emergence of disordered eating. In fact, college is a major time for the emergence of eating disorders. Clearly more research on psychological and behavioral correlates of both college weight gain as well as loss is needed.

CHAPTER 2  
JOURNAL ARTICLE  
PSYCHOLOGICAL AND BEHAVIORAL CORRELATES OF  
FRESHMAN BMI CHANGE

**Abstract**

*Objective:* to determine behavioral and/or psychological factors mediating body mass index (BMI) change in first-semester college students.

*Methods:* Participants were 355 male and female students who completed questionnaire measures of BMI, eating and exercise behaviors, depression, anxiety, stress, and eating disorder pathology in September and December 2008.

*Results:* 80% of students reported a BMI change, with mean change a gain of  $0.23 \pm 1.11$ . In those whose BMI increased (“gainers”), the average BMI change was + 1.00. In those whose BMI decreased (“losers”), the average BMI change was -0.95. In both groups, maladaptive weight loss behaviors increased while healthful behaviors decreased. An increase in stress was the only significant psychological association with BMI change in both groups.

*Discussion:* Although average BMI change in first semester freshmen is relatively small, the magnitude of change can be significant among those whose BMI status changes. The resultant decrease in percentage of normal weight students may have long-term societal and health implications if the trend is maintained over time.

Keywords: Weight gain; Weight Loss; College; Overweight; Obesity; Underweight; BMI



## 1. Introduction

College is thought to be a critical time for weight gain. The popular press commonly cites that during their first year of college, freshmen gain 15 lb (the “Freshman 15”) (Brown, 2008). However, a recent review and a recent meta-analysis reported mean weight gain over the course of freshman year was less than 5 lb (Brown, 2008; Vella-Zarb & Elgar, 2009). Not all freshman students, however, gain weight. Over 30% have been reported to lose weight (Gropper, et al., 2009). Thus, looking at mean weight gain across the entire freshman population fails to account for those students who lose weight, and may underestimate the amount of weight that students who gain weight actually gain.

Many male adolescents 17-18 years of age have not yet reached their adult height. Examining weight change without examining concomitant height change may further mischaracterize weight status. Since body mass index (BMI) (calculated as weight in kilograms divided by height in meters squared) accounts for height change, use of BMI to assess weight status is a more appropriate measure than body weight. The Centers for Disease Control (CDC) use BMI categories to define weight status. Underweight is defined as  $BMI < 18.5 \text{ kg/m}^2$ , normal weight as  $BMI 18.5-25.0$ , overweight as  $BMI 25-29.9$  and obesity as  $BMI \geq 30$  in individuals 20 years of age and older. For most individuals, BMI correlates with percent body fat and can be used as an estimate for health risks (CDC, 2007). The literature on college students uses these BMI categories although the CDC recommends using BMI z-scores for persons under age 20. According

to convention, this study also followed the adult BMI categories in classifying participants' BMI status.

The main objective of this study was to determine the magnitude of BMI change among college freshmen their first semester and to determine what behavioral and/or psychological factors were associated with this change. This study is unique in that it used a multi-ethnic freshmen sample and that part of its objective was to focus on not just BMI gain but on BMI loss, something that is often ignored in the literature. This study incorporated standardized psychological tests assessing anxiety, depression, stress and disordered eating to examine whether these psychological factors mediated BMI change. Additional psychological data that might predict weight change were collected, including perception of one's weight status, concern about college weight gain and self-reported diagnosis of depression, anxiety or eating disorder (Adams & Rini, 2007; Atlas, 2004; Cooley & Toray, 2001; Delinsky & Wilson, 2008; Economos, Hildebrandt & Hyatt, 2008; Graham & Jones, 2006; O'Connor & O'Connor, 2004; Pliner & Saunders, 2008; Sassaroli & Ruggiero, 2005; Vella-Zarb & Elgar, 2009).

Behavioral data were collected to replicate past findings such as associations of weight change with food intake (fruits, vegetables, dairy) alcohol use, physical activity, and frequency of self-weighing (Adams & Rini, 2007, Anderson, Shapiro & Lundgren, 2003; Butler, Black, Blue & Gretebeck, 2004; Hajhosseini, Holmes, Mohamadi, Goudarzi, McProud, & Hollenbeck, 2006; Levitsky, Garay, Nausbaum, Neighbors & DellaValle, 2006; Levitsky, Halbmaier & Mrdjenovic, 2004; Racette, Deusinger, Strube, Highstein & Deusinger, 2005; Vella-Zarb & Elgar, 2009). In addition, this study used a

subsample to gauge accuracy of self-reported anthropometric information, as well as to determine body composition change (change in fat versus lean body mass).

## **2. Methods**

### *2.1 Participants*

All participants ( $n=3509$ ) were newly enrolled culturally diverse college freshmen at a large metropolitan university.

### *2.2. Procedures*

At the beginning of the fall semester (September, 2008), participants received an email invitation to participate in an online survey entitled the “Freshman Experience” ([www.SurveyMonkey.com](http://www.SurveyMonkey.com), Portland, OR). Twenty-nine percent ( $n=1017$ ) provided responses. At the end of fall semester (late November to early December), 42% ( $n=429$ ) of initial survey respondents completed a second, identical survey. Sixty-six cases with missing data, and eight cases with implausible height or weight data such as a loss of over 2 in of height or a gain of 100 lb were discarded, leaving a final sample of 355. In exchange for a t-shirt, pedometer, or water bottle, a subset of these subjects ( $n=91$ ), who responded to a follow-up prompt at the end of the on-line survey, came to the nutrition laboratory where their height, weight, and body composition were measured. Of these students, 71% ( $n=65$ ) returned for follow-up measurements. This research and all procedures were reviewed and approved by the San Jose State University Institutional Review Board.

### 2.3 Measures

1. *Brief Symptom Inventory* (BSI, Derogatis, 1993). The BSI is a 53 item scale that assesses the level of psychological distress along nine dimensions. Only 12 items comprising the Depression and Anxiety subscales of the BSI were included. Instructions for the BSI direct respondents to report how much discomfort each item caused them during the past week, including the current day, on a 5-point scale of distress ranging from 0 (not at all) to 5 (extremely). The BSI has strong validity, correctly identifying approximately 80% of people who are later judged by a psychiatrist as being clinically distressed (Derogatis, 1993).

2. *Eating Attitudes Test* (Garner et al., 1982). The EAT-26 is a standardized measure of symptoms and concerns indicative of an eating disorder. It is comprised of 26 statements about food and weight that are scored on a scale of 0 to 3. While the EAT-26 does not directly diagnose an eating disorder, it can “flag” subjects requiring referral for further assessment and treatment. Scoring 20 or above on the EAT-26 is considered significantly elevated above the “normal range” of disordered eating. The EAT-26 has high internal consistency ( $\alpha = .90$ ) and mean scores differ significantly between clinical and non-clinical samples. The majority of non-clinical subjects scoring high on the EAT-26 are later identified through psychiatric interviews as having abnormal eating patterns that interfere with their lives (Garner et al., 1982).

3. *Perceived Stress Scale* (Cohen, Kamarck, & Mermelstein, 1983). The Perceived Stress Scale is a 10-item scale that assesses perceived stress within the past month. It is

relatively content free and can thus be used with a general population. Scores are on a 5-point scale from 0 (never) to 4 (very often).

4. *Demographic variables.* Participants were asked their height, weight, ethnicity (Caucasian, Asian, or Hispanic, or African American, Filipino, Mixed or other not listed, which were compressed to one category, Other), and residence (on campus or off campus). BMI was calculated for each participant by dividing weight in pounds by height in inches squared and multiplying by 703.

5. *Height, weight and body composition.* Height and weight were measured without shoes by a medical grade Stadiometer (Seca Corporation, Hanover, MD). For the purpose of accurate weight measurement, subjects were asked to remove chains, watches and other accessories. Subjects were weighed in street clothes without shoes, jackets, or items in their pockets. Body composition was measured by total body bioelectrical impedance (BIA) (Physiological Event Analyzer, RJA Systems; Clinton Twp, MI). The subjects were asked to remove any metal objects touching the body as well as their right shoe and sock, and to lie in a supine position. Two electrodes were attached to right wrist and right ankle and an electrical current passed through their body. Based on the difference in the resistance to electricity between lean body mass and adipose tissue, the body fat percent was estimated.

6. *Other variables.* Participants were asked about their food and alcohol intake. Dietary questions referred to current and past intake of fruit, vegetable and dairy intake based on USDA MyPyramid.gov serving sizes within the food category (USDA, [www.mypyramid.gov](http://www.mypyramid.gov)). Participants were asked how many servings they consumed on

an average day (from 0 servings to 4 or more servings per day). For alcohol, students answered whether they drank alcohol at all (yes or no) and responded how many days per week they drank and how many servings of alcohol they consumed in a sitting using sample serving sizes. Total alcohol was estimated by multiplying servings per sitting times days per week. Exercise questions asked about light, moderate and vigorous physical activity in days per week and hours per day. Metabolic equivalents (METS) were calculated using the Godin Leisure-Time Exercise Questionnaire protocol, which involves multiplying days per week times duration of light, moderate and vigorous physical activity, using cofactors of 2, 4, and 7, respectively, and summing the three for overall level of physical activity (Godin & Shephard, 1985). Participants were asked their own assessment of their weight (from very underweight to very overweight), and frequency of self-weighing from never to daily. In addition, at the beginning of the semester they were asked how concerned they were about gaining or losing weight during their first semester of college, from not at all concerned to extremely concerned.

#### *2.4. Statistical plan*

The sample was first analyzed using Chi-square analysis for differences between completers and non-completers. Afterward, the main data set was analyzed starting with differences by gender (independent and paired-*t* tests) and ethnicity (ANOVA). African Americans, Filipinos, and Mixed ethnicity were compressed into a single group, Other. Next, in order to determine correlates of weight loss or gain, the sample was divided into three groups: “BMI Losers” (those whose BMI change was  $<0$ ), “BMI Neutral” (those whose BMI change equaled 0) and “BMI Gainers” (those whose BMI change  $>0$ ). The

three groups were compared to each other using ANOVA to compare means on starting and ending BMI, BMI change, scores on psychological tests (depression, anxiety, disordered eating, and stress) as well as physical activity levels. Chi square analysis was used to compare the groups by fruit, vegetable, dairy, alcohol consumption, frequency of self-weighing, perception of body weight, and use of weight-loss behaviors. Chi square assessed differences based on gender, ethnicity and residence. The percentage of respondents weighing themselves at least weekly (every week or every day) was collapsed into one group comprising frequent self-weighers. For perception of weight status, categories were collapsed into underweight, about the right weight, and overweight. For fear of weight gain or loss during the first semester of college, those who responded as being concerned or very concerned about weight gain were collapsed into one category. Because vomiting/laxatives and diet pills use were rare, they were collapsed into a single category. Within groups, paired *t*-tests compared changes over the semester. For the sub-sample for which body composition data were collected, paired *t*-tests compared self-reported height and weight data with measured data to assess accuracy of self-report.

### **3. Results**

#### *3.1 Completers compared to non-completers*

Analyses demonstrated that completers of the survey were more likely to live off-campus ( $\chi^2=4.545, p=.033$ ) and had a higher proportion of Asian students relative to those participants who dropped out of the study after filling out the September survey,

$\chi^2=12.088, p=.007$ . Additionally, non-completers had a higher percentage of students in the heaviest BMI category, indicating heavier students dropped out,  $\chi^2=12.088, p=.007$ .

### 3.2 Demographics

Table 1 shows the demographics of the sample at two time points (September and December).

Table 1  
Characteristics of Students Participating in the “Freshman Experience” Survey (N=355)

	September n (%)	December n (%)
<b>Gender</b>		
Male	137(39)	
Female	218(61)	
<b>Ethnicity</b>		
Asian	101(29)	
White, non-Hispanic	116(33)	
Hispanic/Latino	69(19)	
Other	69(19)	
<b>Residence</b>		
On Campus	180(51)	
Off Campus	175(49)	
<b>BMI Category</b>		
Mean	22.8 ±3.7*	23.0±3.9*
Under Weight <18.5	26(7)	32(9)
Normal Weight 18.51-24.99	253(71)	242(68)
Over Weight 25-29.99	56(16)	58(16)
Obese ≥30	20(6)	23(7)
<b>Total</b>	<b>355(100)</b>	<b>355(100)</b>
<b>Note.</b>		
* <b>P &lt; 0.001</b>		

The proportion of students at normal weight decreased and the percentage of both underweight as well as overweight and obese increased over the semester.



Mean BMI change from September to December was 0.23; however, BMI change ranged from -4.69 to 4.86. Although mean weight/BMI of both groups was equal in September, by December, the mean weight/BMI were significantly different, with the “BMI Gainers” having gained an average of 1.00 BMI units and the “BMI Losers” having lost an average of 0.95 BMI units ( $p < .001$ ). Table 2 shows the demographics of the sample divided into “BMI Gainers” versus “BMI Losers” for September and December.

Table 2  
Demographic Characteristics of “BMI Gainers” and “BMI Losers”

	“BMI Gainers” (n=179)		“BMI Losers” (n=104)	
	September n (%)	December n (%)	September n (%)	December n (%)
<b>Gender</b>				
Male	58(32)		44(42)	
Female	121 (68)		60 (58)	
<b>Ethnicity</b>				
Asian	46(26)		33(32)	
White, non-Hispanic	62(35)		34(33)	
Hispanic/Latino	32(18)		19(18)	
Other	39(22)		18(17)	
<b>Residence</b>				
On Campus	97(54)		49(47)	
Off Campus	82(46)		55(53)	
<b>BMI Category</b>				
Mean*	22.8 ±3.4 <sup>x</sup>	23.8±3.8 <sup>y</sup>	23.0 ±4.1 <sup>x</sup>	22.0±3.9 <sup>z</sup>
Under Weight <18.5	10(6)	5(3)	10(10)	21(20)
Normal Weight 18.51-24.99	131(73)	126(70)	68(65)	62(60)
Over Weight 25-29.99	31(17)	35(20)	19(18)	17(16)
Obese ≥30	7(4)	13(7)	7(7)	4(4)
<b>Total</b>	<b>179(100)</b>	<b>179(100)</b>	<b>104(100)</b>	<b>104(100)</b>
<b>Note.</b>				
* P < 0.001				

\* Mean BMI in September is significantly different from that in December,  $p < .001$ .

In the subset of “BMI Gainers,” the proportion of underweight subjects decreased while the proportion of both overweight and obese subjects increased. In the case of “BMI Losers,” the group started with a higher proportion of underweight people relative to the “BMI Gainers” group and the absolute number of underweight students doubled.

Tables 3 and 4 depict the distribution of students by residence, gender, ethnicity, and BMI status in September and December, respectively.

Table 3  
September Distribution of BMI Categories According to Gender, Ethnicity and Residence (N=355)

	Underweight (n=26)		Normal Weight (n=253)		Overweight (n=56)		Obese (n=20)	
	On campus (n=13)	Off campus (n=13)	On campus (n=119)	Off campus (n=134)	On campus (n=33)	Off campus (n=23)	On campus (n=15)	Off campus (n=5)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<b>Ethnicity</b>								
White	4 (31)	2 (15)	53 (44)	33 (25)	14 (42.4)	4 (17)	5 (33.3)	1 (20)
Asian	6 (46)	7 (54)	32 (27)	45 (34)	5 (15.2)	5 (22)	0 (0)	1 (20)
Hispanic	1 (8)	3 (23)	15 (13)	30 (22)	6 (18.2)	8 (35)	5 (33.3)	1 (20)
Other	2 (15)	1 (8)	19 (16)	26 (19)	8 (24.2)	6 (26)	5 (33.3)	2 (40)
<b>Gender</b>								
Male	3 (23)	4 (31)	53 (44)	44 (33)	14 (42)	9 (39)	7 (47)	3 (60)
Female	10 (77)	9 (69)	66 (56)	90 (67)	19 (58)	14 (61)	8 (53)	2 (40)

Table 4  
December Distribution of BMI Categories According to Gender, Ethnicity and Residence (N=355)

	Underweight (n=32)		Normal Weight (n=242)		Overweight (n=58)		Obese (n=23)	
	On campus (n=15)	Off campus (n=17)	On campus (n=113)	Off campus (n=129)	On campus (n=34)	Off campus (n=24)	On campus (n=18)	Off campus (n=5)
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<b>Ethnicity</b>								
White	4 (27)	3 (18)	54 (48)	31 (24)	12 (35.3)	5 (20.8)	6 (33)	1 (20)
Asian	8 (53)	6 (35)	28 (25)	46 (35.7)	7 (20.6)	5 (20.8)	0 (0)	1 (20)
Hispanic	0 (0)	4 (23.5)	14 (12)	28 (21.7)	8 (23.5)	8 (33.3)	5 (28)	2 (40)
Other	3 (20)	4 (23.5)	17 (15)	24 (18.6)	7 (20.6)	6 (25)	7 (39)	1 (20)
<b>Gender</b>								
Male	3 (20)	6 (35)	52 (46)	42 (33)	14 (41)	9 (38)	8 (44)	3 (60)
Female	12 (80)	11 (65)	61 (54)	87 (67)	20 (59)	15 (62)	10 (56)	2 (40)

In both September and December, males and females were equally distributed across BMI categories and were equally likely to live on or off campus. Asian and Hispanic students were significantly more likely to live off campus, while Whites and Other ethnicities were significantly more likely to live on campus,  $\chi^2=16.608, p=.001$ . In September, overweight and obese students exhibited a trend toward being more likely to live on campus,  $\chi^2=7.606, p=.055$  and by December, this was statistically significant,  $\chi^2=10.186, p=.017$ . At both time points, Asian students were significantly more likely to be underweight and less likely to be overweight or obese,  $\chi^2=18.772, p=.027$ .

Gender and residence were not associated with differential BMI change; however, among “BMI Losers”, Asians lost significantly more relative to other ethnicities,  $F(3,100)=3.272, p=.024$ . Weight status was also associated with BMI change, with underweight and normal weight students losing significantly more weight relative to

overweight and obese students ( $F(3,100)=3.357, p=.002$ ), and overweight and obese students gaining significantly more weight relative to normal and underweight students ( $F(3,175)=12.015, p<.001$ ).

### *3.3. Accuracy of Self-Reported Height and Weight Data*

Self-reported height and weight from the survey were compared to measured height and weight for body composition participants. Paired  $t$  tests showed that across the group, self-reported BMI in September were, on average, 0.43 BMI units lower than measured BMI ( $t(63)=-3.073, p=.003$ ) and in December, self-reported BMI was on average, 0.69 BMI units lower than measured BMI ( $t(64)=-6.17, p<.001$ ).

When the sample was divided into “BMI Gainers” and “BMI Losers”, self-reported height and weight were compared to measured height and weight so as to determine if the misreporting was for height, weight, or both, and if there was a difference in accuracy by those who gained versus lost BMI units over the semester.

Paired  $t$  tests showed that in both September and December, there was no significant difference between “BMI Gainers” or “Losers” in accuracy of self-reported height, with both tending to overstate their height by about one third to half an inch, likely due to the tendency to round up (for September,  $t(63)=.452, p=n.s.$  and for December,  $t(63)=.715, p=n.s.$ ). In September, “BMI Gainers” and “Losers” did not differ significantly in accuracy of self-reported weight, although there was a trend for “Gainers” to under report their weight slightly and for “Losers” to underreport their weight slightly ( $t(62)=-.629, p=n.s.$ ). However, in December, accuracy of self-reported weight did differ between “Gainers” and “Losers” such that “Gainers” underreported their weight by an

average of 3.67 lb while “Losers” very accurately reported their weight (overreporting by just .03 lb on average) ( $t(63)=-3.573, p=.001$ ).

### *3.4 Body Composition and Body Mass Index*

Subjects who had their body composition assessed were divided into “BMI Gainers” and “Losers” and analyzed separately according to weight change by measured weight and body fat change by BIA. “BMI Gainers” gained an average of 0.92 BMI units (4.95 lb) and increased their percent body fat by 2.02%. In contrast, “BMI Losers” lost an average of 0.14 BMI units (1.70 lb) and lost 0.09 % body fat.

Body mass index (BMI) is used to estimate health risks from excess body fat; however, someone can have a high BMI but have a low percent body fat. To compare differences between BMI categories and body fat categories, males and females were analyzed separately, since females require a higher percent body fat for health.

The percent of overweight or obese subjects was calculated as a BMI greater than or equal to 25 for both males and females. In females, high body fat was defined as body fat greater than or equal to 32% (standards from the American Council on Exercise). For males, high body fat was set as greater than or equal to 25% (also from the American Council on Exercise).

In September, 6 of 23 (26.1%) of males had a BMI defining them as overweight or obese, but only 2 of 23 (8.6%) had excess body fat. These proportions did not change in December. In contrast, in September, 21.4% of females had a high BMI yet 33.3% had excess body fat. In December, 26.2% of females were considered overweight or obese by BMI standards, and 42.9% had excess body fat.

No body composition participants had unhealthily low body fat (below 10% for females, below 2% for males) and no males were underweight at any time point. However, 2 of 42 (4.76%) of females were underweight by BMI standards in September, and this increased to 3 of 42 (7.14%) in December.

### *3.5 Eating Behaviors and Alcohol Use*

There were few differences in frequency of meal consumption or intake of fruits, vegetables, dairy or alcohol among “BMI Gainers,” “Neutral,” or “Losers.” For the overall sample, mean breakfast consumption in September and December, respectively, was  $4.2 \pm 2.3$  and  $4.1 \pm 2.0$ . Mean lunch consumption in September and December was  $5.6 \pm 1.7$  and  $5.6 \pm 1.6$ . Mean dinner consumption in September and December was  $6.3 \pm 1.2$  and  $6.3 \pm 1.3$ . Mean fruit consumption in September and December was  $2.1 \pm 1.1$  and  $1.7 \pm 1.1$ . Both “BMI Gainers” ( $t(df=151)=4.705, p<0.001$ ) and Losers ( $t(df=85)=4.206, p<0.001$ ) significantly decreased their fruit intake over the semester while “BMI Neutral” students maintained their intake. Mean vegetable intake in September and December, respectively, was  $1.7 \pm 1.1$  and  $1.6 \pm 1.0$ , a decrease that approached significance ( $p=0.05$ ). Mean dairy intake in September and December was  $1.9 \pm 1.1$  and  $1.8 \pm 2.1$ . “BMI Gainers” had significantly higher intake of dairy in September relative to those who were “BMI Neutral” or “Losers” ( $\chi^2 = 18.053, p=0.21$ ). In addition, “BMI Neutral” students significantly decreased their dairy intake over the semester,  $t(df=63)=3.192, p=.002$ . Students living on campus significantly decreased frequency of meals in the campus Dining Commons,  $t(df=179) = 27.214, p<0.001$ . All students also significantly increased alcohol consumption,  $t(df=49)= -2.789, p=0.008$ .

There were no differences in food intake or alcohol consumption by residence, but there were differences in food intake by ethnicity. In September, Asian students consumed breakfast less frequently than all other ethnicities ( $F(3,345)=4.806, p=.003$ ). Hispanics consumed dinner less frequently than all other ethnicities in both September ( $F(3,344)=5.195, p=.002$ ) and in December ( $F(3,344)=4.979, p=.002$ ). Asians consumed dairy less frequently in September relative to White and Hispanic students ( $F(3,342)=3.326, p=.020$ ). Finally, Hispanics consumed fewer vegetables in December relative to Whites and Asians ( $F(3,325)=2.989, p=.031$ ).

### *3.4 Physical Activity*

The overall sample significantly decreased physical activity over the semester ( $t(df=278)=4.631, p<.001$ ), with no differences in average METS for “BMI Gainers,” “Neutral,” or “Losers.” Gender and ethnic differences in physical activity were apparent, with males being more active than females in both September ( $t(df=319)=2.908, p=.004$ ) and December ( $t(df=299)=3.353, p=.001$ ). Among ethnic groups, White and Other ethnicities were significantly more active than Asian students in September ( $F(3,317)=2.913, p=.035$ ) and December ( $F(3,297)=2.919, p=.034$ ). In September, on-campus students were significantly more active relative to off-campus students ( $t(df=319)=2.031, p=.043$ ) but there was no difference in physical activity by residence in December.

### *3.6 Weighing Frequency and Perception of Weight Status*

Frequency of self-weighing was compared between “BMI Gainers,” “BMI Neutral” and “BMI Losers” in September and December. Weighing frequency was not

associated with greater BMI gain ( $F(4,174)=1.069, p=n.s.$ ) or loss ( $F(4,99)=2.248, p=n.s.$ ). In September, 28% (50/179) of “BMI Gainers” weighed themselves frequently versus 21% (37/179) in December. In contrast, 18% (13/72) of “BMI Neutral” students weighed themselves frequently in September and 13% (9/72) in December. Finally, 20% (21/104) of “BMI Losers” weighed themselves frequently in both September and in December. Although fewer “BMI Losers” weighed frequently in September relative to “BMI Gainers,” those who did so remained constant over the semester versus the decrease in frequency seen in “BMI Gainers.” Those who reported their BMI to stay the same had the lowest frequency of self weighing at both time points.

In September, although 6% (10/179) of “BMI Gainers” were underweight, 11% (18/179) perceived themselves as underweight. Although 73% (131/179) were normal weight, 55% (90/179) perceived themselves to be the right weight. Although 21% (38/179) were overweight or obese, 34% (56/179) saw themselves as overweight. In December, the percentage of underweight had declined to 3% (5/179) and 9% (15/179) saw themselves as underweight. Seventy percent (126/179) were normal weight while 48% (80/179) saw themselves as about right. Finally, 27% (48/179) were overweight or obese whereas 43% (73/179) saw themselves as overweight.

In comparison, among those who were “BMI Neutral,” 8% (6/72) of students were underweight in September and 5% (3/72) saw themselves as such. Seventy-five percent (54/72) were normal weight and 72% (52/72) described themselves as about right. Seventeen percent (12/72) were overweight or obese and 17% (12/72) saw themselves as such. The percentages by BMI category stayed the same in December but



the perceptions of weight status changed, with 10% (7/72) viewing themselves as underweight, 64% (43/72) viewing themselves as the right weight, and 25% (17/72) describing themselves as overweight.

Finally, in September, 10% (10/104) of “BMI Losers” were underweight, though 18% (17/97) saw themselves as underweight. 65% (68/104) were normal weight, while 55% (53/97) saw themselves as such. 25% (26/104) were overweight or obese, while 28% (27/97) saw themselves as overweight. In December, 20% (21/104) of the sample was underweight, whereas 19% (19/99) saw themselves as such. 60% (62/104) were normal weight and 53% (53/99) saw themselves as about right. 20% (21/104) were overweight or obese, while 27% (27/99) perceived themselves as overweight.

### *3.7 Fear of Weight Gain and Weight Control Behaviors*

Concern over weight loss was rare (ranging from 11-14% among the three BMI change categories). In September, 36% (59/164) of “BMI Gainers” were concerned about freshmen weight gain versus 31% (30/96) of “BMI Losers.” Only 24% (16/66) of “BMI Neutral” students were concerned about weight gain. Degree of concern about weight gain in September was not associated with differential weight change.

The use of various weight control behaviors (e.g. exercise, dieting, vomiting/laxatives or diet pills) within the past 30 days was assessed. The majority of weight control behaviors were exercise and diet. Among “BMI Gainers” in September, 50% (89/179) exercised to lose weight, 20% (35/179) dieted, and 1% (2/179) vomited, used laxatives or diet pills. In December, 39% (70/179) exercised, 22% (40/179) dieted, and 1% (2/179) vomited, used laxatives or diet pills. Among “BMI Neutral” students in

September, 36% (26/72) exercised to lose weight, 8% (6/72) dieted, no one vomited, used laxatives or diet pills. In December, 36% (26/72) exercised, 11% (8/72) dieted, and 4% (3/72) vomited, used laxatives or diet pills. In contrast, among “BMI Losers” in September, 39% (41/104) exercised to lose weight, 18% (19/104) dieted, and 1% (1/104) vomited, used laxatives or diet pills. In December, 30% (31/104) exercised, 14% (15/104) dieted, and 4% (4/104) vomited, used laxatives or diet pills.

### *3.8 Psychological Characteristics*

The reported stress levels in both “BMI Gainers” and “Losers” increased from September to December, resulting in significantly higher levels of reported stress compared to “BMI Neutral” students,  $F(2,352)=4.418, p=.013$ . Overall, scores for disordered eating decreased over the semester, ( $t(df=316)=3.724, p<.001$ ). It should be noted that at neither time point were mean EAT scores significantly elevated to the point of being considered “disordered eating.” Females were more stressed than males in September ( $t(df=353)=-2.436, p=.015$ ) and in December ( $t(df=353)=-2.875, p=.004$ ). Females had a significantly higher level of disordered eating relative to males in September only ( $t(df=323)=-2.598, p=.010$ ). Again, mean EAT scores were below the cut-off for being considered “disordered eating.” Asians were significantly more depressed than Whites and Hispanics and Other ethnic groups were more depressed than Hispanics in September,  $F(3,325)=4.949, p=.002$ .

When asked if they had ever been diagnosed with depression, anxiety, or an eating disorder, in September 11% (19/179) of “BMI Gainers” reported depression, 8% (15/179) reported anxiety, and 3% (6/179) reported an eating disorder. In December,

these rates increased to 15% (26/179) of “BMI Gainers” with depression, 11% (20/179) with anxiety, and 5% (8/179) with an eating disorder. In contrast, in September, 11% (8/72) of “BMI Neutral” students reported depression, 10% (7/72) reported anxiety, and 1% (1/72) reported an eating disorder. In December, these rates were 14% (10/72) for depression, 4% (3/72) for anxiety, and 3% (2/72) for an eating disorder. Finally, in September, 13% (13/104) of “BMI Losers” reported a depression diagnosis, 9% (9/104) reported anxiety, and 6% (6/104) reported an eating disorder. In December, the rates were 11% (11/104) for depression, 10% (10/104) for anxiety, and 2% (2/104) for an eating disorder.

#### **4. Discussion**

This study found that BMI of ethnically diverse freshmen students at an metropolitan university increases slightly, on average, during their first semester of school, and that these BMI changes do not differ by gender or place of residence. This study found that Asian students tended to show a decrease in BMI relative to other ethnicities. In addition, this study determined that a substantial proportion (almost 30%) of students actually loses BMI units and that when the freshmen population is divided into “BMI Gainers” versus “Losers,” BMI change can be significant.

Body composition data suggests that all students had a tendency to slightly overestimate their height (having a tendency to round up). In addition, those who lost BMI units tended to more accurately portray their height and weight at both time points. However, these data call into question the accuracy of reported weight data for those who gained BMI units. Interestingly, they tended to more accurately report their weight in

September and only significantly underreported their weight in December. It is unclear if they were unaware of their weight gain, if they were in denial or embarrassed about it, or if they had weighed themselves prior to starting school and not since then. In any case, if the trend from this sub-sample holds true for the overall sample, the magnitude of BMI gain may be far greater than the survey data alone would suggest.

In the overall sample, in those students whose BMI increased, the percentage of overweight and obese increased and the proportion of underweight and normal weight decreased. In those students whose BMI decreased, the percentage of overweight and obese decreased and the percentage of underweight doubled. Although most of the focus in the literature is on weight gain and the increase in overweight and obesity, it is important to note the health consequences of weight loss and underweight as well, (especially in those who are already underweight to begin with). These may include undernutrition, compromised immunocompetence, increased risk for osteoporosis later in life, and infertility (Health Canada, 2003). Furthermore, those who were already normal or underweight lost the most, while those who were already overweight or obese gained the most.

Overall, behavioral trends of concern were the decrease in physical activity (Butler et al, 2004; Freedman, 2010) and the increase in alcohol consumption over the semester (Adams & Rini, 2007; Economos, Hildebrandt & Hyatt, 2008). Furthermore, although it is recommended that at least five fruits and vegetables and three servings of dairy are consumed each day, average intake was lower than recommendations (Adams & Rini, 2007; Freedman, 2010; Racette, Deusinger, Strube, Highstein & Deusinger,

2005). Although disordered eating scores using the EAT scale decreased from September to December, mean scores at both time points were far below the cut-off that signifies disordered eating and are thus of little concern in this sample. When assessed by separate questions addressing specific weight control behaviors, it was apparent that more healthful practices such as exercise decreased while maladaptive behaviors such as vomiting, laxatives, and diet pills increased in frequency (although these maladaptive behaviors were still very rare overall).

Although “BMI Gainers,” “BMI Neutral” students and “BMI Losers” were similar in most respects, some trends were observed that set the groups apart. Stress was associated with both BMI gain and loss, but not with staying the same BMI (Adams & Rini, 2007; O’Connor & O’Connor, 2004). Ethnicity played a role in that Asians were more likely to have a decrease in BMI relative to other groups and were more likely to be underweight relative to other groups, a finding that supports that of Freedman (2010) using the same university population, that reported Asians were more likely to be underweight; however, BMI distribution was not different based on residence. There was a trend for overweight and obese students to be more likely to live on-campus. This information may be useful to campus dietitians who can target those at risk for health complications from being too thin or too heavy when designing and implementing nutrition education interventions.

Limitations of this study include the fact that only 40% of the initial survey respondents completed the December survey. Those who completed the study differed from the initial respondents in terms of ethnicity, residence, and BMI status, with survey

completers more likely to be Asian and to live off-campus. Those who dropped out had higher BMIs. Therefore, it is impossible to determine whether these students would have gained more weight or lost it. Another limitation relates to the body composition analysis, as BIA is dependent on hydration status. Females' water weight tends to fluctuate more than males' water weight, and thus changes in their percent of body fat may have been disproportionately affected relative to male subjects. Other limitations include that height, weight, and food intake were all self-reported. However, strengths of the research include the diversity of the subjects relative to most studies which are mostly white, non-Hispanic students. The study was described as the "Freshman Experience" so as not to attract only students interested in nutrition and weight issues. Furthermore, validated scales were used to assess psychological variables and this study determined accuracy of self-reported height and weight data by assessing a subset of the overall sample, which is sorely lacking from much research yet necessary because of notorious inaccuracy of this type of data. Finally, the study investigated BMI loss as well as BMI gain, a topic that has been mostly overlooked in the literature yet is potentially a health risk as well if it leads to an increase in underweight students. Future research may be able to further clarify the associations and ultimately the causes of BMI loss or gain during the first semester of freshmen year of college.

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CHAPTER 3  
SUMMARY AND RECOMMENDATIONS

## Discussion

In this study, it was found that ethnically diverse freshmen students at a metropolitan university show slight increases in BMI, on average, their first semester of school, and that these BMI changes do not differ by gender or place of residence. We reported that Asian students tended to show a greater decrease in BMI relative to other ethnicities. In addition, we determined that almost 30% of students show a decrease in BMI and that, when the freshmen population is divided into “BMI Gainers” versus “Losers,” BMI change can be significant.

Body composition data confirm prior findings that all students had a tendency to slightly overestimate their height (to round up). In addition, those who lost BMI units tended to fairly accurately portray their height and weight both at the beginning and the end of the semester. However, these data call into question the accuracy of reported weight data for those who gained BMI units. Interestingly, those students who gained BMI units tended to more accurately report their weight in September and only significantly underreported their weight in December. It is unclear if they were unaware of their weight gain or if they were in denial or embarrassed about it (only some of many possible reasons that should be explored). In any case, if the trend from this subsample holds true for the overall sample, the magnitude of BMI gain may be far greater than the survey data alone suggest.

In the overall sample, in those students whose BMI increased, the percentage of overweight and obese students increased and the proportion of underweight and normal

weight decreased. In those students whose BMI decreased, the percentage of overweight and obese decreased and the percentage of underweight doubled. Although most of the focus in the literature is on weight gain and the increase in overweight and obesity, it is important to be aware of the health consequences of weight loss and underweight as well, which include undernutrition, compromised immunocompetence, osteoporosis later in life, and infertility (Health Canada, 2003). Furthermore, those who were already normal or underweight lost the most, while those who were already overweight or obese gained the most.

The literature cites low or decreased physical activity as being associated with freshmen weight gain (Butler et al., 2004; Racette et al., 2005). Other factors include stress and alcohol consumption (Adams & Rini, 2007; Economos, Hildebrandt & Hyatt, 2008). Similar to these studies, our research found a decrease in physical activity and an increase in alcohol consumption across the population as well as increased stress among those who both gained or lost BMI units. Stress is often cited as a contributor to an increased negative focus on weight, either by focusing energy on losing weight or by overeating as a coping mechanism (O'Connor & O'Connor, 2004). This could explain the fact that higher stress was associated with both BMI gain and loss, but not staying the same BMI. Furthermore, although it is recommended that at least five fruits and vegetables and three servings of dairy are consumed each day, average intake was much lower than recommendations (Adams & Rini, 2007; Racette, Deusinger, Strube, Highstein & Deusinger, 2005). These eating patterns might affect weight change.

Studies have shown close to two-thirds of freshmen students are concerned about the “Freshmen 15” and while concerns are not associated with actual weight gain, they are related to perceiving themselves as overweight or believing themselves to have gained weight when they had not (Delinsky & Wilson, 2008; Graham & Jones, 2006). Our research found a smaller percentage of students were concerned with the “Freshmen 15” (closer to 30-35% of “BMI Gainers” and “Losers” were concerned about college weight gain). Similar to the research, worries of college weight gain were not linked to actual weight change. It is unclear as to whether those students who feared college weight gain were more likely to perceive themselves as overweight or to believe that they had gained weight.

Dieting has been associated with obsessions with food and eating (Hart, 1991; Hart & Chiovari, 1998) and college students, particular females, are more at risk than the general population of worrying that they are overweight when they are not (Kuchler & Variyam, 2002; Kuchler & Variyam, 2003) and to be trying to lose weight, often through unhealthful means such as vomiting, laxatives, or diet pills (Lowry et al., 2000; Malinauskas et al, 2006). Furthermore, female college students with an inflated body weight perception are not only more likely to engage in unhealthy weight management strategies but also more likely to report depressive symptoms than females with an accurate body weight perceptions (Harring, Montgomery & Hardin, 2010).

Our research confirmed that freshmen students had distorted perceptions of their body weight, usually by believing themselves overweight when they were not. Although the use of maladaptive weight loss behaviors was rare, it did increase slightly in the few



months of the study period. Perception of weight status was not compared to psychological test scores, but it would be informative to determine if there were an increase in depression for those students who inaccurately perceived themselves as either underweight or overweight. Furthermore, high body dissatisfaction has been linked to the onset of eating disorders during college (Cooley & Toray, 2001). This study found a decrease in the mean EAT scores, but mean scores were far below the cut-off for signifying an eating disorder. The small percentage of students with clinically elevated EAT scores may be at risk for eating disorders and the health risks they present.

Although “BMI Gainers,” “BMI Neutral” students and “BMI Losers” were similar in most respects, some trends were observed that set the groups apart. Stress was associated with both BMI gain and loss, but not with staying the same BMI (Adams & Rini, 2007; O’Connor & O’Connor, 2004). A new finding was that ethnicity played a role in BMI change; this study reported that the BMI of Asians tended to decrease relative to other groups, Asians were more likely to be underweight relative to other groups and there was a trend for overweight and obese students to be more likely to live on-campus. This would help focus interventions in targeting who is at risk for health complications from being too thin or too heavy.

This study has some limitations such as the fact that only 40% of the initial survey respondents followed up in December. Those who completed the study differed from the initial respondents in terms of ethnicity, residence, and BMI status, with survey completers more likely to be Asian and to live off-campus. Those who dropped out had a higher BMI to begin with. Another limitation relates to the body composition analysis, as

BIA is dependent on hydration status. Females' water weight tends to fluctuate more than do males, and thus changes in their percent body fat may have been disproportionately affected relative to male subjects. Other limitations include that height, weight, and food intake were all self-reported. However, strengths of the research include the diversity of the subjects relative to most studies which are mostly white, non-Hispanic students. The study was described as the "Freshman Experience" so as not to attract only students interested in nutrition and weight issues. Furthermore, validated scales were used to assess psychological variables and this study determined accuracy of self-reported height and weight data by assessing a subset of the overall sample, which is sorely lacking from much research yet necessary because of notorious inaccuracy of this type of data. Finally, the study investigated BMI loss as well as BMI gain, a topic that has been mostly overlooked in the literature yet is potentially a health risk as well if it leads to an increase in underweight students. Future research may be able to further clarify the associations and ultimately the causes of BMI loss or gain during the first semester of freshmen year of college.

## APPENDIXES

*Appendix A: Consent Forms***Agreement to Participate in Research**

Responsible Investigator(s): Rebecca K. Jackl and Marjorie R. Freedman, Ph.D  
Title of Protocol: The Freshman Experience

You have been asked to participate in a research project investigating the effects of mood on food intake and body weight.

You will be asked to complete several questionnaires related to your eating and exercise habits, mood, and different events occurring in your life at school and with family. You may be asked to complete follow-up assessment forms at the end of the semester, and again in the spring. If you agree, you will have your height, weight and body composition measured by the researcher at the beginning and end of the study.

You understand that this research project involves no foreseeable risks by completing the questionnaires. There are no expected benefits to you from participating in this study. However, your participation will help advance our understanding of factors that may influence food intake and body weight of freshman students.

You understand that with this research project, anonymous information about the progress of all of the participants will be published. However, no specific information about you will be published, and your name will not be entered into any database. An identification number will be used to link my data to information that will allow you to be contacted for the follow-up assessment as well as to notify you if you win a prize. However, this identification number will not be kept in any storage area that will compromise your identity as a participant.

You understand that your participation in this study is voluntarily, and that you will not be compensated for participating. However, if you complete all measures for the semester-long study, you will be eligible to enter a raffle with prizes such as an iPod or \$25 or \$50 in Gold Points.

You understand that participation in this study is not required and that after the study has begun, you may refuse to participate further without penalty or prejudice.

Questions about this research study can be answered by contacting Marjorie R. Freedman, Ph.D. at the Department of Nutrition and Food Science, San Jose State University at (408) 924-3105. Complaints about the research may be presented to Lucy McProud, Ph.D., R.D., Department Chair, Nutrition and Food Science Department, at (408) 924-3100. Questions about research subjects' rights or research related injury may

be presented to Pamela Stacks, Ph.D., Associate Vice President for Graduate Studies and Research at (408) 924-2427.

By signing below, you agree to participate in this study and have received a copy of this consent form.

\_\_\_\_\_  
Participant's Signature

\_\_\_\_\_  
Date

\_\_\_\_\_  
Investigator's signature

\_\_\_\_\_  
Date

Title of Protocol: The Freshman Experience

You have been asked to participate in a research study relating to the freshmen experience. Participation in this research is voluntary, and the information provided below is supplied to enable you to decide whether to do so, in which case you will need to give your informed consent.

Your height and weight will be measured using a standard medical scale. Your body composition, which includes body fat percentage will be measured by standard bioelectrical impedance apparatus. The risk involved in participating in this study is very low and will be no greater than the risk encountered in everyday life.

Although the results of this study may be published, no information that could identify you will be included.

Questions about this research may be addressed to Marjorie Freedman, PhD at [Marjorie.freedman@sjsu.edu](mailto:Marjorie.freedman@sjsu.edu). Complaints may be presented to Dr. Lucy McProud, Ph.D., RD, Chair, Nutrition, Food Science, and Pkg Dept (408) 924-3100. Questions about a research subjects' rights, or research-related injury may be presented to Pamela Stacks, Ph.D., Associate VP Graduate Studies and Research, at (408) 924-2488.

If you complete two assessments you will receive \$10 and be entered into a raffle for \$100. You will receive an individual report with your weight and body composition. The information about you that will be collected for this research will be kept in a locked file cabinet and may be shared with other named investigators. No service of any kind, to which you are otherwise entitled, will be lost or jeopardized if you choose to "not participate" in the study. If you volunteer to participate, you may withdrawal at any time without penalty.

I understand the procedures described above. My questions have been answered to my satisfaction, and I agree to participate in this study. I have been provided a copy of this form.

\_\_\_\_\_  
Name of Participant (*please print*)

\_\_\_\_\_  
Signature of Participant

\_\_\_\_\_  
Date

In my judgment the participant is voluntarily and knowingly providing informed consent  
Marjorie Freedman, PhD 9/10/08

*Appendix B: IRB Approval*



**San José State**  
UNIVERSITY

**Office of the Provost  
Associated Vice President  
Graduate Studies & Research**

One Washington Square  
San Jose, CA 95192-0025  
Voice: 408-924-2427  
Fax: 408-924-2477

E-mail: gradstudies@sjsu.edu  
http://www.sjsu.edu

To: Dr. Marjorie Freedman  
Department of Nutrition and Food Science  
San Jose State University  
One Washington Square  
San Jose, CA 95192-0058

Rebecca Jackl

From: Pamela Stacks, Ph.D. *Pamela Stacks 7/8/08*  
Associate Vice President  
Graduate Studies and Research

Date: July 1, 2008

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

“Food and mood: Issues affecting the freshman experience”

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to all data that may be collected from the subjects. The approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Dr. Pamela Stacks, Ph.D. immediately. Injury includes but is not limited to bodily harm, psychological trauma, and release of potentially damaging personal information. This approval for the human subject's portion of your project is in effect for one year, and data collection beyond July 1, 2009 requires an extension request.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services that the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2480.

Protocol # F0802086

The California State University:  
Chancellor's Office  
Bakersfield, Channel Islands, Chico,  
Dominguez Hills, East Bay, Fresno,  
Fulerson, Humboldt, Long Beach,  
Los Angeles, Maritime Academy,  
Monterey Bay, Northridge, Pomona,  
Sacramento, San Bernardino, San Diego,  
San Francisco, San Jose, San Luis Obispo,  
San Marcos, Sonoma, Stanislaus

*Appendix C: Survey Instruments*

1. How old are you?
2. What is your gender?
  - a) Male
  - b) Female
3. What ethnicity do you most identify with?
  - a) Asian
  - b) Caucasian
  - c) Hispanic
  - d) Other (any combination of the above) or other not listed
4. Do you live on or off-campus?
  - a) On campus
  - b) Off campus
5. Who do you live with off-campus?
  - a) Alone
  - b) With parents
  - c) With relatives other than parents
  - d) With friends
  - e) Other
6. How many meals a week do you currently eat in the Dining Commons? Please include weekdays as well as weekends.
7. For Perceived Stress Scale, refer to:  
Cohen, S., Kamarck, T., Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385-396.
8. How tall are you?  
Feet \_\_\_\_\_ Inches \_\_\_\_\_
9. How frequently do you weigh yourself?
  - a) Every day
  - b) Every week
  - c) About once a month
  - d) A few times a year
  - e) Never



10. Has your weight changed since starting school at SJSU?
- Yes, I have gained weight
  - No, my weight has stayed the same
  - Yes, I have lost weight
11. How much weight have you gained or lost since starting school?
- 1 lb
  - 2 lb
  - 3 lb
  - 4 lb
  - 5 or more lb
12. When was the last time you were weighed (for example, in the doctor's office) or weighed yourself?
- Within the past month
  - Within the past 6 months
  - Within the past year
  - More than a year ago
13. How do you think your weight now compares to your weight the last time you weighed yourself or were weighed?
- I think I weigh a lot more now (more than a 5 lb difference)
  - I think I weigh a little more now (less than a 5 lb difference)
  - I think I weigh about the same now
  - I think I weigh a little less now (less than a 5 lb difference)
  - I think I weigh a lot less now (more than a 5 lb difference)
14. Within the past 30 days, did you do any of the following? (Choose all that apply)
- Exercise to lose weight
  - Diet to lose weight
  - Vomit or take laxatives to lose weight
  - Take diet pills to lose weight
  - I did not do any of these things in the past 30 days
15. How often (times per week) do you eat the following meals?
- Breakfast
  - Lunch
  - Dinner

16. Thinking about milk and dairy intake, and using the following serving sizes as a guide, how many servings of milk and dairy products did you typically consume each day BEFORE STARTING YOUR FRESHMAN YEAR and how many are you CURRENTLY consuming? Make sure to include intake at all meals and snacks.

Note: do not forget to include milk and/or cream that you add to cereal, coffee and tea.

Each of the following is ONE SERVING, so add up all you eat to get your daily intake:

1 cup (8 oz) milk or yogurt

1.5 oz cheese-about 1 thick slice (cheddar, swiss, jack)

2 oz processed cheese (cheese spread, American cheese)

2 cups cottage cheese

1 cup frozen yogurt

1 cup pudding made with milk

1.5 cups ice cream

1/2 Starbucks Caffe Latte (Grande-16 oz)

	None (0)	1 serving/d	2 servings/d	3 servings/d	4 or more servings/d
Past intake (before starting SJSU)					
Current intake					

17. These questions ask about your physical activity.

About how many days per week do you do physical activity?

How many TOTAL minutes do you do that type of activity each day?

How long ago did you start this routine?

	Days per week	Daily duration of exercise activity	How long have you been doing this activity?
Light activity (such as walking around campus, including to/from your car or dorm)			
Moderate physical activity such as walking briskly (3.5 miles per hour or 17 minutes/mile), hiking, dancing, golf, or biking (< 10 miles per hour).			
Vigorous physical activity such as running/jogging (5 miles per hour or 12 minutes/mile), biking (> 10 miles/hour), swimming, aerobics, walking fast (4.5 miles per hour), or competitive sports (basketball, football, soccer, tennis).			
Weight or resistance training			
Stretching, yoga, or pilates			

18. How does your CURRENT level of physical activity compare with how active you were before coming to SJSU?

- a) I am much less active
- b) I am somewhat less active
- c) My activity level is about the same
- d) I am somewhat more active
- e) I am much more active

19. For Brief Symptom Inventory, refer to:

Derogatis, L. R. (1993). *Brief Symptom Inventory (BSI): Administration, scoring, and procedures manual, 4th Ed.* Minneapolis, MN: Pearson.

20. Do you consume alcoholic beverages?

- a) Yes
- b) No

21. How many days a week do you CURRENTLY drink alcoholic beverages and how much do you TYPICALLY drink each time?  
Use the following serving sizes as a guide to determine how many alcoholic beverages you consume

Each of the following is ONE DRINK, so add up all you drink to get your usual intake (in one sitting):

12 oz beer (one regular sized can or bottle)

8 oz malt liquor

5 oz wine (full wine glass)

1.5 oz or a “shot” of 80-proof distilled spirits or liquor (gin, rum, whiskey, vodka, etc.)

	Days per week	Amount consumed each time
Intake of alcohol		

22. Have you ever been diagnosed with or do you believe you have a problem with any of the following conditions? (Please check all that apply)

- a) Type 2 diabetes
- b) Asthma
- c) Depression
- d) Food Allergies
- e) Anxiety
- f) Lactose intolerance
- g) Celiac disease
- h) Eating Disorder

23. How do you describe your weight?

- a) Very underweight
- b) Slightly underweight
- c) About the right weight
- d) Slightly overweight
- e) Very overweight

24. For Eating Attitudes Test, refer to:

Garner, D. M., Olmsted, M. P., Bohr, Y., and Garfinkel, P. E. (1982). The Eating Attitudes Test: Psychometric features and clinical correlates. *Psychological Medicine*, 12, 871-878.

25. Thinking about your CURRENT FEELINGS, please answer the following questions

	Not at all concerned	Somewhat concerned	Neutral/ no opinion	Concerned	Very concerned
How concerned are you that you will GAIN WEIGHT this semester?					
How concerned are you that you will LOSE WEIGHT this semester?					

27. Thinking about vegetable intake (NOT INCLUDING FRENCH FRIES), and using the following serving sizes as a guide, how many servings of vegetables did you typically consume each day BEFORE STARTING YOUR FRESHMAN YEAR and how many do you currently consume? Please think about meals and snacks.

Each of the following is ONE SERVING, so add up all you eat to get your daily intake:

½ cup vegetables -the size of a light bulb (carrots, tomatoes, zucchini, mushrooms, corn, peas, green beans, broccoli)

1 cup salad - medium sized bowl (lettuce, spinach)

½ cup (4 oz) vegetable juice

½ cup cooked vegetables in soup, stew, stir fry, or other dishes including vegetables

	None (0)	1 serving/d	2 servings/d	3 servings/d	4 or more servings/d
Past intake					
Current intake					

28. Thinking about fruit intake, and using the following serving sizes as a guide, how many servings of fruit did you typically consume each day BEFORE STARTING YOUR FRESHMAN YEAR and how many do you currently consume? Please think about meals and snacks.

Each of the following is ONE SERVING, so add up all you eat to get your daily intake:

- 1 medium piece of fruit (apple, orange, banana, peach, plum, mango)
- ½ cup fresh fruit --the size of a lightbulb (watermelon, cantaloupe, strawberries, pineapple, blueberries)
- ½ cup (4 oz) 100% fruit juice
- ½ cup frozen or canned fruit
- ¼ cup dried fruit

	None (0)	1 serving/d	2 servings/d	3 servings/d	4 or more servings/d
Past intake					
Current intake					