EFFECTS OF REGULAR SELF-WEIGHING ON WEIGHT MANAGEMENT: RESTRAINED AND UNRESTRAINED EATERS IN FIRST-YEAR UNIVERSITY

by

Rachel Strimas

Master of Arts, York University, 2007

Bachelor of Kinesiology (Honours), McMaster University, 2005

A thesis

presented to Ryerson University

in partial fulfillment of the

requirements for the degree of

Master of Arts

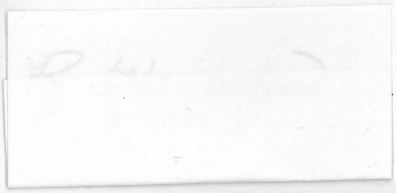
in the Program of

Psychology

Toronto, Ontario, Canada, 2009

I hereby declare that I am the sole author of this thesis.

I authorize Ryerson University to lend this thesis to other institutions or individuals for the purpose of scholarly research.



I further authorize Ryerson University to reproduce this thesis or dissertation by photocopying or by other means, in total or in part, at the request of other institutions or individuals for the purpose of scholarly research.

Abstract

Effects of Regular Self-Weighing on Weight Management: Retrained and Unrestrained Eaters in First-Year University

Master of Arts, 2009

Rachel Strimas

Psychology, Ryerson University

Obesity poses a global health concern. Prevention has emphasized the utility of weight monitoring, but its effect on restrained eaters is unstudied. This study examined the interactive effects of self-weighing and restrained eating on the body mass index of first-year university students over a three-month period. Participants ($N = 100$) were randomized into one of three groups: Group 1 ($n = 36$) weighed themselves daily; Group 2 ($n = 31$) weighed themselves weekly; and Group 3 ($n = 33$) measured their heart rate weekly. Results revealed that weekly weighing assisted in weight control among restrained eaters, while daily weighing led to significant weight gain ($p = 0.003$). There was modest support for the utility of regular weighing to assist in the prevention of weight gain among unrestrained eaters. Overall findings suggest that interventions designed to aid in weight control should be implemented judiciously. Further consideration of individual differences may ultimately help to tailor clinical and public health recommendations aimed at weight management.

Acknowledgements

I would like to express my thanks to my advisor, Dr. Michelle Dionne, for her significant contributions of knowledge and time. Dr. Dionne's insight and feedback were essential in the design and completion of this study. Special thanks are extended to Sarah Royal, Amy Brown-Bowers and Elizabeth Wong, whose help with data collection was essential in the completion of this project.

Secondly, I would like to express my appreciation to Dr. Traci McFarlane for her early review of this paper and valuable suggestions. Thanks also to Dr. Stephen Want for his insightful feedback as a member of the examining committee.

For financial support, I thank the Ontario Graduate Scholarship Council.

I also wish to extend my thanks to my Psychology Research & Training Centre neighbors for their support and friendship. Lastly, thanks as always to my family and friends for their continual confidence in my pursuits.

Table of Contents

List of Tables

List of Figures

List of Appendices

Introduction

Rationale and Purpose

The high prevalence of obesity currently poses a global health concern (World Health Organization [WHO], 2008). Currently, over 14 million Canadian adults, representing almost 60% of the adult population, are classified as overweight (Statistics Canada, 2005a). Roughly 5.5 million Canadian adults are considered obese. This is of concern because excess body mass is associated with a host of noncommunicable disease outcomes, as well as psychological comorbidities (WHO, 2008). Further, research has shown that the majority of people who lose excess weight will regain it within a short time period (Mann et al., 2007; Sarwer & Wadden, 1999). Poor long-term treatment outcome, in combination with the growing number of overweight and obese individuals, suggests that prevention of weight gain may be an essential element to weight control.

Entry into university presents a unique combination of variables (e.g., availability of energy dense food, change in caloric expenditure) that appear to render first-year students susceptible to weight gain (Adams & Rini, 2007). This weight gain has been dubbed the "Freshman Fifteen" and has been documented among males and females (Holm-Denoma, Joiner, Vohs, & Heatherton, 2008), in ethnically diverse groups (Delinsky & Wilson, 2008), and appears to be less prevalent in age and sex-matched peers who do not attend university (Hovell, Mewborn, Randle, & Fowler-Johnson, 1985). Health professionals have been eager to study this weight gain further in attempt to intervene in the process. One suggested strategy involves weight monitoring (Levitsky, Garay, Nausbaum, Neighbors, & DellaValle, 2006), with the rationale that those who are made aware of small increases in weight can take steps to intervene before there is a bigger problem. Indeed, this has met with some success in recent studies.

However, some researchers (e.g., Dionne & Yeudall, 2005) have suggested that this "one-size-fits-all" solution is in fact too simple, and may even have negative consequences for those who have previously failed in attempts to manage their weight. A repeated failure to control weight is a distinguishing characteristic of what is termed "restrained" eating. Although dietary restraint involves the use of chronic dieting in an attempt to achieve or maintain a certain body weight, it ironically is often associated with significantly greater weight gain over time relative to non-dieting individuals (Field et al., 2003). Indeed, although the restriction of caloric intake should lead to weight loss, it instead appears that this restraint eventually gives way to temptation and overeating (see Polivy, 1996). Moreover, a common precipitant of overeating in restrained eaters is emotional upset. We believe that for most non-dieters, indeed, weight monitoring may provide a system that can help keep weight in check. But for restrained eaters who have never had much success at weight control, weight monitoring may serve only as a reminder of their unsuccessful efforts to manage weight. Associated negative emotions could very well precipitate disinhibition and overeating, and perhaps even attrition from a weight control program that utilizes frequent bodyweight monitoring.

The purpose of this study was to extend previous work on weight change among first-year university students by considering the interactive role of dietary restraint and self-weighing (daily, weekly, or not at all) on weight gain. As a secondary research question, we explored whether adherence to the recommended weighing schedule differed between daily and weekly weighers, and by dietary restraint status. Importantly, the present study was not aimed at weight loss; rather, we aimed to determine whether weight monitoring aids or impedes weight control efforts, and for whom.

Literature Review

Overweight and obesity are important public health concerns because these conditions are associated with disease and diminished quality of life in diverse sociodemographic groups (WHO, 2008). Worldwide, it is estimated that over 1.6 billion adults are overweight and at least 400 million adults are obese (WHO, 2008). The World Health Organization (2008) has projected that by 2015, more than 2.3 billion adults will be overweight and approximately 700 million will be obese. Currently, overweight- and obesity-related morbidity is increasing in every Canadian province (Statistics Canada, 2005a). If action is not taken to prevent and treat this health problem, increasing numbers of people worldwide are expected to suffer from an array of negative health sequelae (WHO, 2008).

Although several factors may be driving the increase in obesity, the Canadian Community Health Survey and dietary and physical activity data from the United States suggest that the growing trends in North American weight gain are largely attributable to social and environmental explanations, rather than internal physiological mechanisms (Christakis & Fowler, 2007; see Levitsky, 2005; McCrory, Suen, & Roberts, 2002, for reviews). Importantly, the causes of obesity are thought to be multivariable and result from a combination of increased energy intake and decreased energy expenditure, which ultimately result in positive energy balance (McCrory et al., 2002). However, increased caloric consumption appears to play the largest role in this growing health crisis (Gross, Li, Ford, & Liu, 2004; Schmitz, Jacobs, Leon, Schreiner, & Sternfeld, 2000). Recent reviews of the causes of weight gain have therefore focused on variables that impact eating behaviours and lead to weight gain through overeating. McCrory et al. (2002) and Levitsky (2005), for instance, emphasize the role of increased snacking, dietary variety, portion sizes, social facilitation, and consumption of fast-foods and

restaurant foods. Christakis and Fowler (2007) evaluated the impact of social ties on obesity in 12, 067 participants assessed repeatedly over a 32-year period. After controlling for a number of variables (e.g., previous weight status), results indicated that a person's chance of becoming obese increased by 57% if he or she had a friend who became obese. This effect was also seen among siblings and spouses, but was not seen among neighbors, suggesting that the nature of social ties, rather than geographic region, is of greater importance in weight gain. Notably, although connected persons may also share common environments, similar social events and other common factors (e.g., genetics) that impact bodyweight, the authors concluded that a more important role exists for the person-to-person "spread" of obesity. Specifically, it appears that obesity in one person may influence obesity in another through psychosocial means, such as changing one's norms about the acceptability of being overweight and/or directly influencing one's eating behaviours (i.e., by affecting food consumption).

The way in which weight gain is conceptualized has important implications for its prevention and treatment. When weight gain is viewed primarily as a biological problem, then the putative solutions include biological interventions, such as medication and surgery. However, the evidence that weight gain is primarily associated with lifestyle factors, rather than biological factors, suggests that many risk factors are modifiable. Within the purview of psychology and nutrition, it should therefore be possible to curb unnecessary weight gain by first identifying, and then targeting appropriate risk factors using cognitive and/or behavioural intervention strategies.

Freshman Weight Gain

The move from high-school into university has been established as a critical period for weight gain (e.g., Anderson, Shapiro, & Lundgren, 2003). This weight gain has been coined

"The Freshman Fifteen," which refers to the notion that students gain 15 lbs (6.8 kg) during their first year of school. Although research has not demonstrated a gain of this magnitude (Vella Zarb & Elgar, in press), the weight gain is not insignificant. Moreover, such weight gain seems to be greater than that seen among peers who do not attend post-secondary schooling (Hovell et al., 1985). Research generally demonstrates that the majority of weight gain occurs in the first semester of university and stablizes in the second semester (Anderson et al., 2003; Holm-Denoma et al., 2008). Further, the weight gain appears ubiquitous, as it has been reported among males and females (e.g., Hoffman, Policastro, Quick, & Lee, 2006) and across various ethnic groups (e.g., Delinsky & Wilson, 2008; Economos, Hildebrand & Hyatt, 2008).

It is evident that weight gain among first-year university students is much less than the alleged 15 lbs, but it is nonetheless significant. In a sample of 135 freshman students, Anderson et al. (2003) collected weight measurements in September and December of students' freshman year and a subset of participants (n = 46) provided data in May. Results showed that participants gained a significant amount of weight during their first semester (1.3 kg). By December, nearly one third of the sample was classified as overweight, compared with about one fifth in September. Of the subset who returned in May, results showed that participants had gained a mean of 1.7 kg, suggesting that the majority of weight gain had occurred from September to December. Hoffman et al. (2006) collected height and weight measures of 67 freshman students during the last three weeks of September and the last two weeks in April. Average weight gain was 1.3 kg and no significant ethnic differences in weight gain emerged. In a sample of 924 students, Holm-Denoma et al. (2008) measured self-reported weight gain during the first nine months of college and found that both men and women reported a significant weight increase (1.6 kg and 1.8 kg, respectively). Weight gain occurred before November of the first semester

and was maintained throughout the academic year. Economos et al. (2008) examined associations among health-related behaviours and weight gain among 396 freshman students. Baseline self-report measures of height and weight were completed prior to arriving at the university; follow-up anthropometric assessments were experimenter-measured and completed in April of the freshman year. Results indicate that 80% of students gained weight; specifically, students gained an average of 2.4 kg over the freshman year, with males gaining an average of 2.3 kg and females gaining 2.5 kg. It is noteworthy that this weight gain occurred despite more than 30% of males and 60% of females reporting attempts to lose weight during this period. On the other hand, Graham and Jones (2002) followed 49 freshman students over their first year of university and found no significant weight gain. Likewise, Hodge, Jackson, and Sullivan (1993) followed 61 female first-year students over the first six months of university and found that average weight at Time 2 was not significantly different from baseline calculations. Taking the available data into consideration, it appears that freshman weight gain is not entirely uniform; although most students seem to gain weight, there are individuals who maintain their baseline weight and others still who lose weight.

Environmental and lifestyle changes occurring during the freshman year of university, including poor dietary quality, increased alcohol intake, decreased exercise and increased leisure time, have been proposed to contribute to the weight gain (e.g., Anderson et al., 2003; Economos et al., 2008). For instance, Economos et al. (2008) found that increased alcohol consumption had a positive effect on weight gain among males, whereas an increase in workload was positively associated with weight gain among females. Access to all-you-can-eat dining halls and altered sleeping patterns have also been cited as significant contributors to freshman weight gain (e.g., Graham & Jones, 2002). Adams and Rini (2007) conducted a study of the predictors of weight

gain among 116 freshman students. Variables hypothesized to impact BMI included: chronic medical conditions (e.g., asthma, arthritis, and diabetes); smoking status; eating habits (e.g., protein, fruit, vegetable, starch, cholesterol, and fiber consumption); caffeine and alcohol consumption; exercise status; and social support. No measured predictors of weight change were significant among males. On the other hand, females who gained weight were: 1) more likely to consume alcohol and caffeine, and eat foods low in fiber and high in cholesterol; and 2) were less likely to eat vegetables. Thus, although the freshman weight gain occurs among both genders, the risk factors may vary. Together these findings underscore the importance of understanding exactly who gains weight and why so that interventions may target the individuals who are most susceptible. That being said, researchers have begun to examine individual differences that may predispose freshman to gain weight, with preliminary studies emphasizing the role of dietary restraint in this association.

Restrained Eating

Dieting is popularly employed as a means of reducing or controlling one's weight by the reduction of caloric intake (see Polivy, 1996). Relative to those who occasionally diet to lose weight (e.g., before an important occasion or after holiday festivities), chronic dieters, also known as restrained eaters, embark on a day-in-day-out mission to alter or control their bodyweight. Restrained eating may therefore be conceptualized as a way of life, a mindset or an individual difference that is characterized by chronic (or at least frequent intermittent) dieting (Polivy, 1996). Notably, the terms *restrained eater* and *dieter* are often used interchangeably within the literature (Polivy, 1996), whereas the term *nondieter* is used to refer to those who do not diet, or do so relatively infrequently.

On the surface, the link between dieting and long-term weight gain may seem

counterintuitive, since by definition, restrained eating involves a reduction in caloric intake. However, experimental studies of chronic dietary restraint indicate that over time, dieting does not result in weight loss as restrained eaters appear to alternate between caloric restriction and subsequent bouts of overeating or bingeing (Polivy & Herman, 1985), which can result in excess body mass. In a classic study of food restriction (Keys, Brozek, Henschel, Mickelsen, & Taylor, 1950), 36 normal-weight men severely restricted their food intake for six months. This was followed by three months of gradual refeeding. During the semi-starvation phase of this study, the men began to experience drastic psychological changes, one of which was an increasing obsession with food. Indeed, the men became so preoccupied with food that they were unable to concentrate on their day-to-day activities. Additionally, despite implementing an honor system to encourage men to stick to the diet, a number of men reported a loss of control over eating and began to gorge themselves with food. One participant reported eating several cookies, a bag of popcorn and two bananas while working at a grocery store. Chronic dieting behaviour had actually appeared to induce overeating in a sample of previously normal eaters.

Dieting requires one to ignore internal hunger signals in an attempt to lose or maintain weight. However, deliberately training the body not to eat in response to hunger increases the dieter's susceptibility to other signals to eat, including social and environmental influences of eating behaviour (Polivy, 1996). Indeed, a wealth of studies spanning several decades demonstrate that the eating behaviour of dieters differs fundamentally from that of nondieters (see Polivy, 1996; Polivy & Herman, 1987, for reviews). For instance, nondieters are likely to eat in response to physiological cues of hunger and stop in response to satiety. Dieters, on the other hand, may eat in response to physiological cues, but they eat relatively small amounts compared to nondieters and stop when they have reached their predetermined caloric quota for

the day. Of importance is that if this predetermined caloric boundary is surpassed (e.g., due to forced caloric preloading in the laboratory) the dieter will eat significantly more than the nondieter (e.g., Herman & Polivy, 1980; Polivy, Coleman, & Herman, 2005). Experimental studies of coed university students reveal that approximately 50% of participants demonstrate this classic restrained eating pattern (restrictive eating, disinhibition in response to a forced preload, overconsumption of food) and the other 50% display an unrestrained, nondieting pattern (i.e., eating more when deprived of food than when given a preload, and more when calm than when agitated; see Polivy, 1996). Additional research suggests that increased anxiety (Polivy, Herman, & McFarlane, 1994), depression (Polivy & Herman, 1976a), low mood (Ruderman, 1985), alcohol use (Polivy & Herman, 1976b) and perceived weight gain (McFarlane, Polivy, & Herman, 1998) can precipitate overeating among dieters. Therefore, as restrained eaters alternate between periods of caloric restriction and subsequent overeating (Polivy & Herman, 1985), poor weight control seems inevitable.

Several studies have indeed examined the association between dieting and weight gain. In a prospective study of 8203 females and 6769 males aged 9 to 14 years, Field et al. (2003) found that dieting adolescents were more likely to binge eat than non-dieting adolescents, and gained significantly more weight over three years than their non-dieting peers. Binge eating occurred more often among females, yet was significantly associated with dieting among both sexes. Field et al. (2003) concluded that dieting to control bodyweight among adolescents is not only ineffective, but it actually appeared to promote weight gain. Returning to Keys et al.'s (1950) study, during the refeeding phase the men initially gained weight very rapidly, likely because the men were overeating in response to the starvation they had experienced during the study. After eight months, their weights were above their baseline weight. After fourteen

months, however, with the return of normalized eating patterns (i.e., no dieting and no overeating), their weight had returned to within a few pounds of their pre-experiment weight. Unfortunately, dieters may not stop at one weight lose attempt, and oscillating between food restriction and overeating may therefore take precedence over normalized eating. Together these reports support the contention that diets do not work and instead, promote behaviours that are counterproductive and lead to weight gain in the long run.

Restrained Eating and Freshman Weight Gain

As stated above, although dietary restriction should theoretically lead to weight loss, it instead appears that this restraint eventually gives way to temptation, overeating, and ultimately, significant weight gain (Polivy, 1996). Among 60 first-year students who were followed prospectively for 12 weeks, Levitsky, Halbmaier and Mrdjenovic (2004) found a mean significant weight gain of 1.9 kg. Two regression models were proposed to predict such weight gain. In Model 1, previous dieting (measured by asking, "Did you purposely engage in dieting activity or try to lose weight?") accounted for 3% of the total variance. In Model 2, when baseline weight was used as a covariate, the second best predictor of weight gain was dieting, explaining 9% of the total variance. In a sample of 69 students, Lowe et al. (2006) found that weight gain averaged 2.1 kg over the first year of study. However, individuals who reported currently dieting to lose weight gained twice as much (5.0 kg) as that of students who were former dieters (2.5 kg) and three times as much as students who had never dieted (1.6 kg). Using the Herman/Polivy Revised Restraint Scale (1980), Pliner and Saunders (2008) measured dietary restriction and weight gain in 72 first-year students and found that restrained eaters gained an average of 4.1 kg over 22 weeks; unrestrained eaters gained approximately 1.2 kg in the same period. When living accommodations were examined, restrained eaters living in residence were

found to gain the most weight, suggesting that this group of students is at the greatest risk of weight gain. Notably, changes in eating habits (i.e., decreased consumption of vegetables and fruit and increased consumption of sweet, savory and high-fat foods) were a significant predictor of weight gain among these students.

In another recent study, Delinsky and Wilson (2008) explored whether 149 freshman females demonstrated a prospective relation between current dieting (measured using the Restraint subscale of the Dutch Eating Behaviour Questionnaire [DEBQ]; Strien, Frijters, Bergers, & Defares, 1986) and weight gain during their freshman year. In support of prior findings, participants gained an average of 1.5 kg. Among those who gained weight, the average increase was 3.3 kg. In contrast to the abovementioned reports, however, dietary restraint measured by the DEBQ in September did not predict weight gain in April. Taken together, the above findings suggest that restrained eating may be an important predictor of weight gain among freshman students. As such, attention in the literature has turned to proposing various interventions to ameliorate this weight gain, with some recent studies emphasizing the possible utility of bodyweight monitoring.

Self-Weighing and Weight Management

As highlighted by Dionne and Yeudall (2005), recent efforts aimed at weight-management among the general population have attempted to determine the most effective strategies for weight control. Descriptive and correlational research shows that weight monitoring is a common behavioural strategy employed by many individuals who successfully lose and maintain their weight (Klem, Wing, McGuire, Seagle, & Hill, 1997). As an example, approximately 75% of participants in the National Weight Control Registry in the United States stated that weight monitoring was a key component of their maintenance of weight loss (Klem et

al., 1997). Forty-four percent of participants stated that they weighed themselves at least daily, and 31% reported that they weighed themselves once per week (Klem et al., 1997).

The effect of *frequency* of weighing on weight management has recently come under study. Linde, Jeffery, French, Pronk and Boyle (2005), for instance, prospectively examined self-reported changes in BMI with weighing frequency and found that daily self-weighing of 1226 adults enrolled in a weight gain prevention trial was associated with weight loss at 12 and 24 months. Less frequent self-weighing (categorized as: never, about once a year or less, every couple months, every month, and every week) was associated with weight gain. In another study of 1800 adults enrolled in a weight loss trial, monthly, weekly, and daily self-monitoring of weight was associated with weight loss at 12 and 24 months; less frequent self-weighing (categorized as: never, about once a year or less, and every couple of months) was associated with weight gain (Linde et al., 2005). The rationale behind this strategy for weight control is simple. In the same way that widespread blood pressure monitoring leads to awareness of a health issue for those who are hypertensive, weight monitoring can lead first to the recognition of excess weight, and then motivate change.

Therefore it is quite expected that the first attempts to circumvent the freshman weight gain would target weight monitoring. To our knowledge, however, only one study of self-weighing among freshman students has been devised. Levitsky et al. (2006) found that daily weight monitoring sessions for 12 weeks were highly effective in blunting the freshman weight gain among 34 college students. In this study, female students were randomized into either a daily weight-monitoring group or a control group. Both groups were provided with basic nutritional information and baseline anthropometric measures were obtained by staff during the second week of school. Students randomized into the experimental arm of the study were

provided with a personal analog scale and were instructed to weigh themselves each morning. Experimental participants then emailed their daily weight to staff. At the end of each week, research staff calculated whether the individuals had experienced a gain, loss, or no change in weight. This information was then communicated via email to each participant. Results revealed that first-year university students who weighed themselves each morning gained an average of 0.1 kg, whereas the control group who did not weigh themselves gained an average of 3.1 kg. Only two of the 11 participants in the experimental group gained more than 1 kg, whereas 14 of the 15 participants in the control group gained more than 1 kg.

Despite these encouraging results, a few methodological limitations are worth mentioning. As Levitsky et al. (2006) note, there is evidence to suggest that individuals who are successful at maintaining their weight have more communication with their researchers than those who do not maintain contact (e.g., Baum, Clark, & Sandler, 1991; Harvey-Berino et al., 2002). Thus, the weekly feedback that experimental participants received may have positively influenced their ability to maintain their weight. To control for this possible effect, a practical solution may have been to communicate with the control group on a weekly basis as well. Second, due to recruitment issues, this study did not include male students. However, given that freshman weight gain also occurs among males (e.g., Economos et al., 2008) and that weight monitoring appears to be an effective tool for weight control among both genders (Klem et al., 1997), the utility of this technique to curb weight gain among freshman males is certainly worth exploring. Third, despite providing the experimental group with personal scales to objectively measure their weight, Levitsky et al. (2006) relied upon accurate self-reports of weight. An alternative is to have the experimenter repeatedly calculate BMI directly from measures of height and weight. That being said, incorporating daily experimenter-measures of weight is impractical

both for research purposes and practical applications (as it not *self*-weighing), and may have caused additional challenges with recruitment and retention of participants.

Self-weighing and restrained eating. The utility of weight monitoring to prevent weight gain among first-year university students has therefore been met with some initial success. However, some researchers have raised the question of whether weight monitoring should be used for everyone, and argued that this strategy may even have negative consequences for those vulnerable individuals who may feel more demoralized than invigorated by weight feedback (Dionne & Yeudall, 2005). Particularly, it is possible that individual differences in restrained eating may moderate the positive effects of weight monitoring. In effect, for most unrestrained eaters, weight monitoring may provide an early warning system that can help keep weight in check. But for restrained eaters who notoriously strive to attain an "ideal" weight, yet appear to gain more weight than unrestrained eaters over time (Pliner & Saunders, 2008), self-weighing may serve *only* as a reminder of their futile efforts to manage weight. This could very well precipitate emotional upset, disinhibition, overeating, and perhaps even attrition from a weight management program. Therefore, the ultimate irony is that the individuals who are most likely to pursue weight control treatment options are the ones who may be most at risk for negative effects of the intervention. Given that a one-size-fits-all attitude to weight management may not be sensible, it is important to consider how individual differences in restrained eating behaviour moderate the effectiveness of weight monitoring so that the best solutions can be proposed to clients in such programs.

Purpose

Entry into university presents a unique combination of variables that may render first-year students susceptible to weight gain. However, due to their heightened sensitivity to

environmental cues and their tendency to overeat in response to dietary deprivation, restrained eaters may be especially predisposed to weight gain. The present study expanded primarily on the research of Levitsky et al. (2006), who emphasized the utility of weight monitoring to circumvent freshman weight gain, and Pliner and Saunders (2008), who reported that restrained eaters were especially susceptible to weight gain during the first year of university. However, the purpose of this study was to extend this body of literature by considering the *interactive* effect of weight feedback (daily, weekly, or not at all) and restrained eating on change in BMI using an experimental paradigm. As a secondary research question, we explored whether adherence to the recommended schedule of weighing differed between daily and weekly weighers, and by dietary restraint status.

In sum, a logical step in curtailing the increasing prevalence of obesity is to prevent initial weight gain among the general population. First-year university students have been identified as an especially susceptible population and preliminary work suggests that weight monitoring may be an important step in preventing such weight gain. Next, it is important to consider how individual differences in restrained eating might moderate the effectiveness of self-weighing. We further suggest that greater clarity surrounding adherence to the recommended weighing schedule will help to inform prevention and treatment recommendations.

Hypotheses

In relation to our primary objective, we proposed that weight monitoring would not be a consistently useful tool for weight control among all participants and in particular, that the effect of self-weighing on weight would be influenced by restraint status. For unrestrained eaters we hypothesized that weight monitoring would serve as an early warning system that could help keep weight in check. Thus, we predicted that more frequent weighing would be associated with

non-significant changes in BMI (i.e., maintenance of BMI). Given the well-established relationship between restrained eating and poor weight control and research indicating that restrained eaters become disinhibited and overeat when provided with undesirable weight feedback (McFarlane et al., 1998), we anticipated that the self-weighing feedback may elicit overeating and additional weight gain. As such, for restrained eaters we predicted that more frequent self-weighing would be associated with significant increases in BMI, and poorer adherence to the self-weighing schedule, relative to unrestrained eaters.

Method

Participants

The present analyses included 103 students from Psychology 102 and another 13 recruited from on-campus posters[1]. Participation was voluntary and providing participants were fluent in English, between 17 and 19 years of age, and self-defined as first-year university students, they were eligible to participate. Participants registered in Psychology 102 were compensated with one hour of academic credit following each lab visit. Participants not registered in Psychology 102 were compensated with $5.00 following each visit. To encourage the retention of participants, those who completed the final session (December 2008) were also entered into a raffle for the chance to win an iPod™. Based on Statistics Canada's classification of race (2008), participants classified themselves as White (41%), East Asian (20%), South East Asian (11%), South Asian (10%), Black (9%), and Arab/West Asian (9%).

[1] Altogether, 155 first-year university students were recruited and tested at baseline. In order to make meaningful comparisons with the literature on freshman weight gain in particular, however, the analyses of the present study included only those participants between the ages of 17 and 19 years (n = 116).

Measures

Participants individually completed self-report measures at baseline and final lab sessions. Height and weight were measured by the investigator at both lab sessions. These measures are detailed below.

1. The *Restraint Scale* (Herman & Polivy, 1980) is a 10-item questionnaire that was developed to assess those who are chronically concerned with their weight and who attempt to control it by restricting their food intake. Items refer to the participant's normal eating pattern and include questions on dieting, weight concerns, eating or overeating concerns, and weight fluctuations. This scale consists of two factors: Concern for Dieting and Weight Fluctuation (Ruderman, 1982). The Concern for Dieting factor assesses eating behaviour and thoughts regarding food (6 items; e.g., "Do you give too much time and thought to food?"). The Weight Fluctuation factor assesses weight fluctuations (4 items; e.g., "What is your maximum weight gain within a week?"). According to Polivy, Herman and Howard (1988), the global scale reflects patterns of eating behaviours characteristic of restrained eaters, as the items reflect attempts to restrain eating and periodic loss of control. In the present study, participants completed this scale at baseline and final sessions and, as is customary within the literature (e.g, McFarlane et al., 1998; Pliner & Saunders, 2008; Polivy, Herman, & Warsh, 1978; Roth, Herman, Polivy, & Pliner, 2001), females scoring ≥ 15 and males scoring ≥ 11 at baseline were considered restrained eaters. Participants scoring below the respective cutoffs were considered unrestrained eaters. Several studies have demonstrated good psychometric properties for this scale. For instance, in a sample of normal weight females who were mostly college students, an alpha value of 0.78 was reported (Laessle, Tuschl, Kotthaus, & Pirke, 1989). In the present study, Cronbach's alpha was 0.77 demonstrating acceptable internal consistency.

2. *Demographic information* was obtained from questions asking about age, race/ethnicity, country of birth, number of years living in Canada and current living accommodations. This information was collected during the baseline session only. As well, in order to ascertain whether participants were attempting to lose, maintain or gain weight during the first semester of university, or were not attempting to control their weight at all, information about participants' weight management goals was collected during the final session.

3. *Body Mass Index* (BMI; kg/m^2) was calculated from experimenter-measured height and weight at baseline and final sessions. This is a reliable and convenient measure of weight controlled for height that correlates well with body density measures (e.g., skinfold thickness, arm circumference; Micozzi, Albanes, Jones, & Chumlea, 1986). Bodyweight, measured with participants standing in stocking feet and wearing indoor clothing, was measured to the nearest 0.1 kg using an analog scale (Seca, model 760 1126009). Height was measured to the nearest 0.1 cm using a fixed measuring tape, with participants standing in stocking feet with their heels against the wall. To determine the absolute change in BMI, baseline BMI was subtracted from final BMI, such that positive scores indicate an increase in BMI over the semester. BMI change was then used as the primary dependent variable.

Procedure

Baseline (September). All participants provided written informed consent at the outset of the session. Participants were informed that the study investigated "healthy living among first-year university students" and that more information about the variables of interest would be provided at the end of the study. Next, participants individually completed the self-report questionnaires and measures of height and weight were taken by the investigator. All participants also monitored their heart rate for 15 seconds. Participants were then randomized by

the investigator into a 'Daily Weighing' experimental group, a 'Weekly Weighing' experimental group, and a 'Heart Rate Monitoring' control group. At this time, the investigator ensured that each participant understood how to carry out the applicable behaviour (i.e., using the scale or monitoring heart rate) and how to report their data in a secure online form (see Appendix A). Individuals that were randomized into a weighing group were provided with a personal analog scale to take home (Sunbeam, model SAB998CO-01). Baseline sessions required 45 minutes to complete.

Self-monitoring (September – December). Similar to previous research, our instructions to the experimental groups emphasized the importance of regular self-weighing; however, we also made specific recommendations regarding the frequency of weigh-ins. Each participant in the daily weighing group was instructed to weigh him or herself *once a day only* immediately upon rising from bed, in light clothing and stocking feet. Each participant in the weekly weighing group was instructed to weigh him or herself *once a week only on Sundays* immediately upon rising from bed, in light clothing and stocking feet. Participants were asked to record their weigh-ins using the online form, either on a daily or weekly basis. These respective instructions (see Appendix B) were given to participants at the end of the baseline session. Completion of these sessions took 5 to 10 minutes each week.

Participants in the control group were instructed to count their number of heart beats for 15 seconds and multiply this number by four *once a week only on Sundays* immediately upon rising from bed. Participants recorded their heart rate online on a weekly basis. Additionally, participants were instructed to not weigh themselves for the duration of the study. These instructions (see Appendix B) were given to participants at the end of the baseline session. Completion of these sessions required less than 5 minutes each week.

Final (December). During the final session, all participants again individually completed the self-report measures, and measures of weight were taken by the investigator. At the end of the session, the investigator provided each participant with a debriefing handout, which explained the nature of the study in detail. This handout included contact information should the participant have any future questions or concerns. The final session required 30 minutes to complete.

Results

Results are presented for the 100 participants who completed both the baseline and final lab sessions. Among the 16 participants who withdrew from the study, three were from the daily weighing group, eight were from the weekly weighing group, and five were from the control group. The difference in drop-out between groups was not statistically significant ($\chi^2(2) = 2.715$, $p = 0.257$). Compared to those who withdrew from the study, participants who completed the study had significantly higher baseline BMIs ($M = 22.40$ versus $M = 19.40$, $p < 0.001$) and restrained eating scores ($M = 13.93$ versus $M = 10.25$, $p = 0.05$). There were no statistically significant differences in age between those who completed the study and those who withdrew from the study. As in Pliner and Saunders' (2008) study, we speculate that attrition was primarily due to two factors: 1) Some students had already completed the required course participation credits and therefore lacked motivation to return to the lab; and 2) The semester was nearing the end and students were busy with final assignments and so did not schedule the final visit. The final sample, on which the results of this study are based, included 87 females ($n = 43$ restrained; $n = 44$ unrestrained) and 13 males ($n = 6$ restrained; $n = 7$ unrestrained). Similar to other studies (e.g., Pliner & Saunders, 2008; Roth et al., 2008), restrained eaters comprised

roughly 50% of the sample. All analyses were performed with SPSS 16.0 (SPSS Inc., Chicago, Ill.). BMI change, the dependent variable, was analyzed as a continuous variable. As is customary within the literature, restrained eating was analyzed as a dichotomous variable.

1. *Descriptive Statistics*

Means and standard deviations (*SD*) for baseline and final measures are presented in Table 1. First, absolute values for skewness and kurtosis were calculated for baseline BMI and restrained eating, and final BMI in order to examine the distribution of the data. According to critical values, these variables were fairly normally distributed so we were confident in proceeding with the analyses without transforming the data. To ensure that random assignment had resulted in groups being roughly equivalent on baseline characteristics, two subsequent analyses of variance (ANOVA) were performed. Results indicated that daily weighers, weekly weighers and control participants did not differ significantly on measures of baseline BMI ($F(2, 97) = 1.278$, $p = 0.283$) or baseline restrained eating scores ($F(2, 97) = 1.064$, $p = 0.349$).

Table 1. Means and standard deviations (*SD*) for baseline and final BMI, and baseline restrained eating, by group

Group	Daily Weighing ($n = 36$)	Weekly Weighing ($n = 31$)	No Weighing ($n = 33$)
September 2008			
BMI	21.93 (3.45)	22.03 (3.07)	23.25 (4.61)
Restrained Eating	14.72 (6.50)	12.71 (5.30)	14.21 (5.41)
December 2008			
BMI	22.21 (3.49)	21.97 (3.34)	22.32 (4.21)
Restrained Eating	14.39 (6.31)	15.14 (4.88)	13.81 (6.00)

Note. Univariate analysis of variance indicated that baseline BMI and baseline scores on the Restraint Scale did not differ significantly between groups.

2. *Self-Weighing and BMI Change*

The primary objective of this study was to examine the interactive effect of self-weighing and restrained eating on BMI over students' first semester of university. Thus, a 3 (group: daily

weighing, weekly weighing, or control) x 2 (restraint status: restrained or unrestrained) mixed measures ANOVA was conducted to examine change over time in participants' BMIs (i.e., between baseline and final sessions; see Table 2). Results revealed non-significant main effects of group, $F(2, 98) = 1.777$, $p = 0.175$, partial $\eta^2 = 0.035$, restraint status, $F(1, 98) = 0.228$, $p = 0.634$, partial $\eta^2 = 0.002$, and time, $F(1, 98) = 1.050$, $p = 0.308$, partial $\eta^2 = 0.011$. As hypothesized, a significant 3-way interaction was found between group, restraint status, and time $F(2, 98) = 3.833$, $p = 0.025$, partial $\eta^2 = 0.075$, which accounted for approximately 8% of the variance in BMI change (a small effect according to Cohen's, 1988, guidelines).

Table 2. Means and standard deviations (*SD*)for baseline and final BMI, and BMI change, by group and restrained eating status

	Daily Weighing (n = 36)		Weekly Weighing (n = 31)		No Weighing (n = 33)	
	Restrained (n = 19)	Unrestrained (n = 17)	Restrained (n = 13)	Unrestrained (n = 18)	Restrained (n = 17)	Unrestrained (n = 16)
September BMI	22.93 (3.62)	20.80 (2.95)	23.76 (3.56)	20.78 (1.94)	25.05 (5.59)	21.34 (2.08)
December BMI	23.46 (3.59)	20.81 (2.85)	23.43 (3.96)	20.92 (2.42)	24.98 (5.04)	21.56 (2.08)
Change in BMI	+0.53 (0.78)	+0.01 (0.39)	-0.33 (1.06)	+0.14 (1.01)	-0.07 (0.85)	+0.21 (0.38)

Next, to determine the pattern of effect in this interaction on average BMI change over time, restraint status was examined individually for daily weighing, weekly weighing, and control participants (see Figure 1). Fisher's Least Significant Difference (LSD) post-hoc analysis with bonferroni correction was used to determine significant differences (i.e., a $p \leq 0.013$ indicated a significant effect). Among unrestrained eaters, BMI change was non-significant when comparing daily versus weekly weighers ($p = 0.619$), and daily weighers versus controls ($p = 0.453$). Average weight change for the daily weighers, weekly weighers and controls was 0.03 kg, 0.43 kg and 0.60 kg, respectively. Among restrained eaters, BMI change was significantly higher in the daily weighing group as compared to those in the weekly weighing group ($p = 0.003$), but was not significantly greater when compared to the no self-

weighing (heart rate only) control group ($p = 0.024$). Restrained eaters in the daily self-weighing group gained an average of 1.36 kg, while those in the weekly self-weighing group and control group lost 0.77 kg and 0.24 kg, respectively[2].

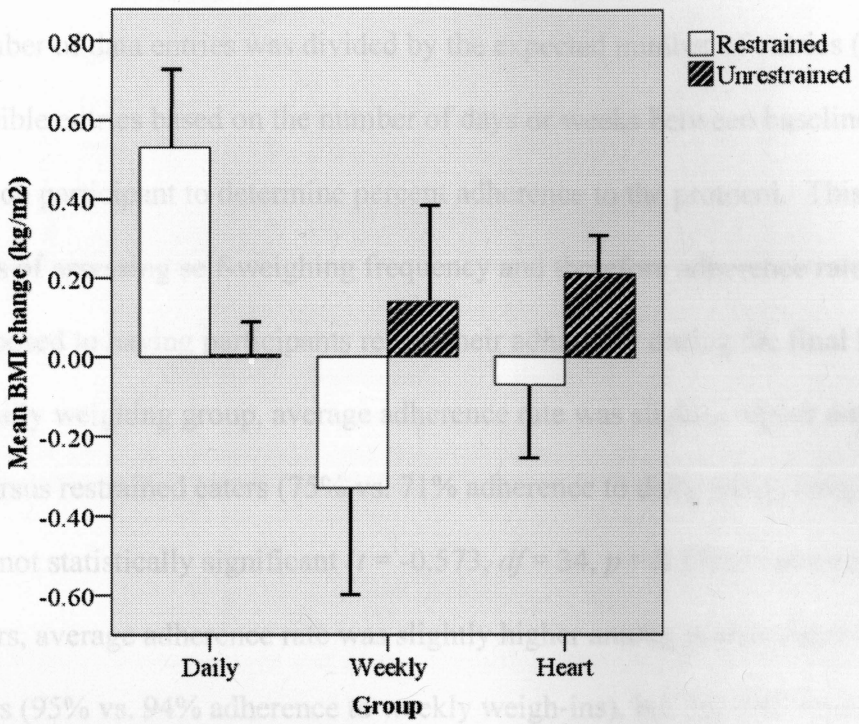


Figure 1. Mean BMI change by group and restrained eating status. Bars represent standard errors of mean

3. *Adherence to the Self-Weighing Schedule*

A secondary objective of this study was to examine whether adherence to the weighing schedule differed between daily and weekly weighers. We were also interested in exploring the

[2] Although it is customary for researchers using the Restraint Scale to dichotomize this variable, multiple linear regression analysis was also performed on the data. In this model predicting change in BMI, restrained eating was included as a continuous variable, group membership was "dummy" coded, and the restrained eating by group interaction terms were included to determine if the association between restrained eating and BMI change differed as a result of group. Results from the analysis (see Appendix C) were similar to those obtained in the ANOVA. That is, no significant "main" effects of restrained eating or group membership were found. The results also indicated a marginally significant interaction between restrained eating and daily weighing ($p = 0.091$). Specifically, as in the ANOVA, the pattern of results showed that as restrained eating increased, BMI increased among those in the daily weighing group. Additionally, there was a non-significant effect of restrained eating on BMI change among weekly weighers and control participants. Note that there was evidence of some marginally influential outliers in the data, but none that significantly altered the pattern of results.

impact of restrained eating on adherence to the schedule. To this end, adherence to the prescribed self-weighing schedule was calculated from the total number of data entries recorded in the online reporting form. Recall that daily weighing participants were asked to record their weight on a daily basis, while weekly weighers were asked to record their weight once weekly. Thus, total number of data entries was divided by the expected number of entries (i.e., total number of possible entries based on the number of days or weeks between baseline and final sessions) for each participant to determine percent adherence to the protocol. This tool provided us with a means of assessing self-weighing frequency and therefore adherence rates in the moment, as opposed to having participants report their adherence during the final lab session.

In the daily weighing group, average adherence rate was slightly higher among unrestrained versus restrained eaters (75% vs. 71% adherence to daily weigh-ins), although this difference was not statistically significant ($t = -0.573$, $df = 34$, $p = 0.570$). Likewise, among weekly weighers, average adherence rate was slightly higher among unrestrained eaters versus restrained eaters (95% vs. 94% adherence to weekly weigh-ins), but this difference was also not statistically significant ($t = -0.525$, $df = 28$, $p = 0.604$). These results were in contrast with our hypothesis that more frequent weighing would be associated with poorer adherence to the weighing schedule in restrained eaters. On average, restrained eaters were significantly more adherent to weekly weigh-ins compared to daily weigh-ins (94% versus 71%; $t = -3.597$, $df = 29$, $p = 0.001$), as were unrestrained eaters (95% versus 75%; $t = -3.641$, $df = 33$, $p = 0.001$). Overall, these results suggest that participants – whether restrained or unrestrained eaters – are significantly more adherent to a weekly weighing schedule (see Figure 2).

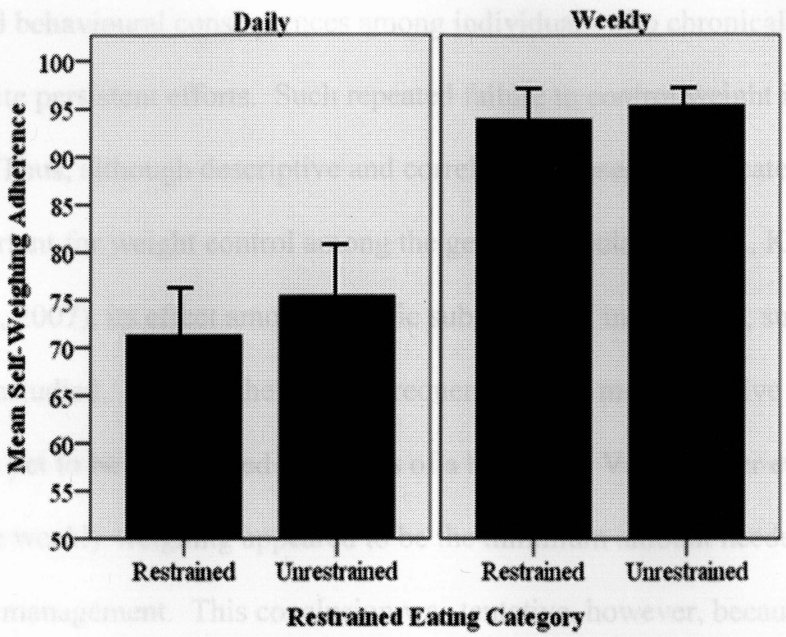


Figure 2. Mean self-weighing adherence by group and restrained eating status

Discussion

The prevalence of overweight and obese Canadians has increased dramatically in recent years, mirroring a worldwide phenomenon (WHO, 2008). Moreover, research suggests that the majority of people who successfully lose excess weight will regain it within a short period of time (Mann et al., 2007). Poor long-term treatment outcome, in combination with rising rates of obesity, suggests that *prevention* of weight gain may be a fruitful means of combating the crisis, and is therefore an increasingly valuable area of investigation.

Regular self-weighing has been a recent focus of attention in the weight management literature. In a systematic review of 12 studies, VanWormer, French, Pereira, and Welsh (2008) concluded that "frequent" self-weighing (defined as daily or weekly weighing) appeared to aid in weight loss, prevention of weight regain, and avoidance of initial weight gain among adults. Despite these encouraging findings, there remain at least two unexplored avenues of research.

First, some have cautioned against weight monitoring due to the potential for negative psychological and behavioural consequences among individuals who chronically fail to manage their weight despite persistent efforts. Such repeated failure to control weight is a hallmark of restrained eaters. Thus, although descriptive and correlational research indicate that self-weighing is important for weight control among the general population (e.g., Klem et al., 1997, Linde et al., 2005, 2007), its effect among specific subgroups of individuals, such as restrained eaters, is as yet unstudied. Second, the precise frequency of the most effective prescription for self-weighing has yet to be determined. In terms of a threshold, VanWormer et al. (2008) reported that once weekly weighing appeared to be the minimum amount needed to see positive effects on weight management. This conclusion was tentative, however, because the analyses of self-weighing and BMI change were based on cross-sectional data (Linde et al., 2005, 2007). In light of such conclusions, it seemed timely to investigate different frequencies of self-weighing using an experimental design, while also considering the role that individual differences in restrained eating might play. Differential effects found among restrained and unrestrained eaters, as well as strengths, limitations and directions for future research are discussed in turn below.

Self-Weighing and Weight Management

As discussed in the Introduction of this paper, we hypothesized that the association between weighing frequency and weight change among restrained eaters would be linear, with greater self-weighing frequency associated with greater weight gain. As expected, the absence of regular weighing seemed to have a relatively benign effect on weight control among restrained eaters as the trend in data suggested little weight change over three months (0.24 kg). Also as expected, daily weigh-ins were associated with an increase in bodyweight (1.36 kg). However, the unanticipated finding that weekly weigh-ins were associated with a decrease in weight (0.77

kg) made it important to consider possible explanations for this effect. We posit that dissatisfaction with weight feedback may have impacted the effect of weight monitoring on weight management. On the one hand, 'dissatisfaction' may be a direct result of the number on the scale and therefore reflect body dissatisfaction – in this case, with one's weight. On the other hand, research has demonstrated that undesirable weight feedback can elicit a cascade of effects in which the dissatisfaction one initially experiences causes the individual to devalue other aspects of self-worth and functioning that are not directly related to bodyweight (e.g., social competence; McFarlane, McCabe, Jarry, Olmsted, & Polivy, 2000). In this instance, it is not the number on the scale per se that causes upset; rather, it is what the number on the scale signifies to the individual and how such dissatisfaction generalizes to other domains of functioning. The tendency to evaluate self-worth based on weight and/or shape is known as weight-related self-evaluation (WRSE) and is characteristic of those with anorexia nervosa and bulimia nervosa (American Psychiatric Association, 1994). However, this feature is not unique to eating-disordered individuals. In a study of eating-disordered patients, restrained eaters, and unrestrained eaters, McFarlane et al. (2000) found that WRSE fell along a continuum, with disordered-eating patients falling at one extreme (i.e., high WRSE), unrestrained eaters (i.e., low WRSE) falling at the other extreme, and restrained eaters falling somewhere in the middle of the continuum. Individuals with eating disorders reported more negative WRSE than did restrained eaters, who reported more negative WRSE than did unrestrained eaters. Similar to those with eating disorders, McFarlane et al.'s (2000) results suggest that self-evaluation among restrained eaters is unduly influenced by weight and shape.

How such dissatisfaction – whether body dissatisfaction or otherwise – may have affected participants' weight was our next consideration. Heinberg, Thompson, and Matson (2001) have

previously proposed that some dissatisfaction with body shape and size is favorable if it inspires healthy changes in dietary habits. The authors suggested that the relationship between dieting behaviour and body dissatisfaction is shaped like an inverted U in which moderate levels of body dissatisfaction lead to healthy dietary changes; conversely, very low and very high levels of distress are thought to lead to ineffective and sometimes dangerous dieting behaviours. Recall that restrained eaters persistently strive to achieve an "ideal" weight, yet actually gain significant weight over time. Recall also that regular weighing is conceptualized to work by increasing one's awareness of changes in weight, which then prompts adjustments in behaviour. Thus, if Heinberg et al.'s (2001) reasoning is correct, daily reminders that one has failed to reach his or her goal might increase dissatisfaction past an "optimal" threshold, which in turn may lead to disinhibition, overeating, and further weight gain in the long run. Weekly monitoring, on the other hand, may provide sufficient feedback to identify lapses in progress, but not so much feedback that the individual becomes overwhelmed and frustrated with his or her progress. The role of dissatisfaction is currently speculative and the exact point at which 'reasonable' dissatisfaction becomes significant distress has not yet been defined (Dionne & Yeudall, 2005). Whether dissatisfaction mediates the effect of repeated weighing on bodyweight is a question worthy of future research.

In contrast to our findings among restrained eaters and in line with our primary hypothesis, results revealed a non-significant difference in unrestrained participants' average weight gain over a three-month period. Average weight change for the daily, weekly, and non-weighing participants was 0.03 kg, 0.43 kg and 0.60 kg, respectively. Although the difference in weight change between groups was not statistically significant, these results suggest that more frequent weighing amounted to the greatest control of bodyweight. Given a larger sample size

and longer follow-up period, it is possible that significant differences would have emerged. Notably, such non-significant changes in weight largely corresponded with participants' goals as only 18% of unrestrained eaters were attempting to lose weight, while the other 82% were trying to gain (14%) or maintain their weight (33%), or were not trying to control their weight at all (35%). Moreover, the vast majority of unrestrained participants were categorized as being normal weight (78%), so we would not expect these individuals to have gained or lost a significant amount of weight. These findings provide modest support for the utility of regular weighing to assist in the prevention of weight gain. Overall, these results are consistent with others who have found that regular weighing helps to maintain weight (e.g., Klem et al., 1997; Linde et al., 2005).

That being said, we again emphasize that weight monitoring is unlikely to aid in weight management consistently among all individuals. Indeed, our collective findings support our contention that self-monitoring of bodyweight has differential effects on weight management, depending on individual differences. While weekly weigh-ins seemed to aid in weight control among restrained eaters, daily weighing actually impeded their efforts to manage weight. Among unrestrained eaters who expressed little desire to lose weight, there was some support for the utility of regular weighing to assist in the prevention of weight gain. Further exploration of individual differences would undoubtedly aid in clarifying the value of self-weighing and in turn, help to formulate clinical and public health recommendations for healthy weight management.

Although not a primary focus of the current work, the inclusion of a non-weighing control group allowed us to examine weight change among first-year students and in effect, to investigate the proverbial freshman weight gain in the absence of experimental manipulation. In the present study, weight gain among the non-weighers was 0.17 kg, which corresponds to a

BMI change of 0.07 kg/m^2 (t = -0.496, df = 32, p = 0.623). A recent meta-analysis of 24 studies found that weight gain among first-year students averaged 1.75 kg and ranged from an average of 0.73 kg over a five-month period in one study (Butler, Black, Blue, & Gretebeck, 2004) to 3.99 kg over a 12-month period in another (Hovell et al., 1985).

Our results suggest that the weight change amongst first-year Ryerson University students was considerably less than what some have documented. One reason for the reduced weight gain may have been because two-thirds of our non-weighing group lived off-campus. Pliner and Saunders (2008) found that students living in residence were more vulnerable to weight gain than those living off-campus. Others have found that increased alcohol consumption (Economos et al., 2008), access to all-you-can-eat dining halls (Graham & Jones, 2002), and poor dietary quality (Adams & Rini 2007) – factors that would presumably vary as a function of living accommodations – were significant predictors of freshman weight gain. Thus, it is possible that weight gain among the present participants may have more closely resembled the literature had a larger proportion of the sample been living in residence. On the other hand, our results are consistent with both Graham and Jones' (2002) study and Hodge et al.'s (1993) study, which found no significant weight change among incoming university students. Each of these studies followed a predominately female sample over a 6-month (Hodge et al., 1993) and 12-month (Graham & Jones, 2002) period. Interestingly, however, the participants in Graham and Jones' (2002) study all lived on-campus, which suggests that change in living accommodations is not the only factor that renders incoming students vulnerable to weight gain. Ultimately, these results underscore the fact that the freshman weight gain is not entirely uniform and although some individuals do indeed gain weight, the surplus is much less than the alleged 15 pounds.

Strengths, limitations, and directions for future research

The effect of repeated weighing on weight management has been explored in several large-scale cross-sectional studies; however, these studies are correlational in nature and it is not possible to discern whether repeated weight monitoring leads to weight loss and maintenance or whether those who successfully lose and maintain their weight are more likely to weight monitor. It is reasonable to assume that the participants who remained in such studies were those who successfully managed their weight, which suggests that self-selection bias may have been present. Thus, a strength of the present study was the prospective, between-subjects design, which allowed us to compare drop-out between groups (which was non-significant) and to assess whether significant differences existed between three conditions (daily weighing, weekly weighing, and no weighing).

A second methodological limitation in the self-weighing literature is the potential for measurement bias. Thus far, studies of weight monitoring have relied exclusively on subjective reports of weighing frequency (see VanWormer et al., 2008). Compounding this problem are study protocols in which participants are asked to recall the frequency of their self-weighing long after having engaged in the behaviour. Thus, the weighing frequency that participants recall is largely susceptible to memory inaccuracies and may not accurately reflect the degree to which participants weighed themselves throughout the study period. In the present study, adherence to the prescribed weighing schedule was assessed using a secure online reporting form. Specifically, self-weighing participants were asked to enter their weights online on either a daily or weekly basis (depending on group assignment). This tool provided us with a means of assessing self-weighing frequency in the moment, as opposed to having participants recall their self-weighing frequency over the course of the entire study during the final lab session.

Needless to say, we cannot be certain that participants actually weighed themselves and did not simply record a value online to satisfy the study stipulations. Given the fraction of time it takes to weigh-in though, it seems unlikely that this would have been the case. Additionally, participants' final online weight entry was significantly correlated with final measurements of weight taken in the lab ($r = 0.985$, $p < 0.0001$), suggesting that participants were indeed completing the instructed regular weigh-ins. An alternative means to assess self-weighing frequency would have been to use scales that electronically record the times and dates of weigh-ins. This method has specific challenges of its own, however, including the cost associated with purchasing such equipment for all participants in the study and the possibility that non-participants might occasionally use the scale, recording irrelevant data. Overall, we believe that our real-time measurement of weighing frequency dramatically decreased the likelihood of over- or underestimation bias, which is a significant methodological improvement in this body of literature.

In light of the strengths of this study, some limitations and directions for future research must be addressed. Future research should first aim to replicate these preliminary findings using a larger sample. Incidentally, a post-hoc power analysis indicated that a sample size of 200 would be necessary to detect significant differences between baseline and final measures of BMI using multiple linear regression. In the present study, we were interested in examining weight gain among first-year university students, so it was critical for us to recruit participants before suspected weight gain occurred. Limited time and resources, however, restricted the number of participants we could recruit. Additionally, because our follow-up period of three months is a relatively small timeframe to see significant differences in weight emerge, future studies may wish to follow participants over a longer period of time. In fact, since restrained eating is

conceptualized as an individual difference that is characterized by chronic dietary restraint, we would expect to see further weight gain among this group over time.

Despite our efforts to include male participants, our sample primarily consisted of females, likely owing to the large number of female students typically enrolled in introductory psychology classes. Additionally, the present sample was solely comprised of young undergraduate students from a single campus. This, in turn, limits the generalizability of our findings across the general population. One important objective of future studies should be to investigate the construct of restraint in populations that thus far, have received relatively little attention. To date, restrained eating has primarily been studied among students aged 18 to 25 years. But the notion of restrained eating is relevant to those over age 25 since, by definition, restrained eating is chronic. Moreover, the demographic profile of those most often presenting for weight management services involves middle-aged individuals (see VanWormer et al., 2008). And, given that obesity rates are highest among middle-aged adults (Statistics Canada, 2005a) and the fact that Canada faces significant aging of its population, weight management among adults is a pressing issue. These seldom-studied populations are certainly worthy of investigation. Moreover, a community-based sample would have the added advantage of reducing the time pressure for enrolling study participants and the opportunity to recruit a larger proportion of males.

Based on Statistics Canada's detailed classification of race (2008), participants self-identified as White (41%), East Asian (20%), South East Asian (11%), South Asian (10%), Black (9%) and Arab/West Asian (9%) and were therefore fairly diverse. However, while the present sample more closely reflected Canada's demographic profile (Statistics Canada, 2005b) than previously published studies (e.g., Adams & Rini, 2007; Economos et al., 2008; Holm-

Denoma et al., 2008), we did not have enough data to examine potential differences across ethnic groups. Given that ethnicity has been implicated as a risk factor for excess body mass (DiGioacchino, Topping, & Sargent, 2001), an objective of future research might be to examine whether there is a differential effect of self-weighing on bodyweight across ethnic groups. Lastly, given the well-documented emotional and physical health consequences of dietary restraint and their risk of gaining excess body weight and developing obesity, a different avenue for future research might be to attempt to identify factors that predict restrained eating, with the long-term goal of ameliorating these factors altogether. Potential predictors of restrained eating may include the following psychosocial variables: sociocultural attitudes towards appearance; perfectionism; self-esteem; and body dissatisfaction. Briefly, Griffiths et al. (1999) have proposed that restrained eaters are more likely to internalize social pressures surrounding thinness. Emmons (2000) has proposed that traits such as perfectionism may predispose a person to dieting and more severe eating pathology. Self-esteem may also predict restrained eating as those with low self-esteem and body dissatisfaction may be inclined to subscribe to prescribed appearance ideals in an effort to gain acceptance (Stice et al., 1994). Although previous research has provided valuable information regarding the possible antecedents of restrained eating, the majority of studies have examined variables in isolation. Incidentally, a 3 (group) x 2 (time) mixed measures ANOVA was conducted post-hoc to examine change in participants' restrained eating scores between baseline and final sessions. Results revealed a significant interaction between group and time, $F(2, 98) = 5.655$, $p = 0.005$, partial $\eta^2 = 0.104$, which accounted for approximately 10% of the variance in restrained eating scores. Fisher's LSD post-hoc analysis with bonferroni correction indicated that restrained eating significantly increased when comparing weekly weighers versus daily weighers ($p = 0.012$) and weekly

weighers versus controls ($p = 0.012$). Thus, in addition to examining predictors of restrained eating, future research may wish to examine how restrained eating changes over time with regular self-weighing.

Alternatively, researchers may wish to concentrate their efforts on reducing the tendency of restrained eaters to overeat in response to negative emotions. Given that chronic disinhibition is the norm rather than the exception among restrained eaters, it is surprising that strategies to circumvent such disinhibition have not received more attention. One study by Heatherton, Polivy, Herman, and Baumeister (1993) investigated this issue by hypothesizing that self-awareness might mediate the link between emotional distress and overeating. In this study, 80 female participants were exposed to either emotionally neutral performance feedback or a failure condition on a problem-solving task. Failure participants were randomized to one of three groups: Group 1 watched a video clip of their poor performance; Group 2 watched a distracting video that had no relevance to their performance; and Group 3 sat quietly for 10 minutes. In an ostensible taste task, participants then ate as much ice cream as they wanted. Amount eaten was determined by weighing the bowls before and after consumption. Heatherton et al. (1993) reasoned that, in the first condition, the presence of a video camera, viewing of themselves, and subsequent interaction with the investigator about their poor performance would force participants to maintain a high level of self-awareness. Conversely, the second and third failure conditions were thought to facilitate low self-awareness. The control group who received neutral feedback was thought to allow low self-awareness. As hypothesized, restrained eaters in the low self-awareness conditions (Groups 2 and 3) ate more ice cream than did restrained eaters in the high self-awareness (Group 1) and control conditions. The results of this study therefore confirmed previous findings that emotional distress leads to increased eating among restrained

eaters. More importantly, however, increased self-awareness appeared to mitigate disinhibition. Whether increased self-awareness after self-weighing might also decrease disinhibition in restrained eaters is uncertain. Indeed, regular self-weighing is thought to aid in weight management by increasing one's self-awareness of bodyweight and since restrained eaters with daily weight reminders actually had poorer weight control than those with fewer reminders, it is difficult to imagine how further increasing self-awareness would be beneficial. Perhaps such work would focus on teaching participants that frequent weighing may prompt negative emotions and lead to disinhibition, so increased awareness would focus on eating habits. That being said, given the paucity of research examining the prevention of disinhibition among restrained eaters, future research may wish to first experimentally manipulate self-awareness to investigate how altered awareness after weigh-ins affects BMI change over time.

Other strategies aimed at reducing the tendency of restrained eaters to disinhibit may also prove useful. For instance, researchers may wish to focus on eliminating dietary deprivation so as to lessen the likelihood of subsequent overeating or binge eating. Another strategy to reduce restrained eaters' tendency to disinhibit might be to encourage processing of emotions after weigh-ins. This avenue of research has yet to be examined among restrained eaters; however, guidelines from the eating disorders literature allow us to speculate on how this procedure might also be useful for restrained eaters. Regular self-weighing is an important part of eating disorders treatment. Weekly weight checks among patients with anorexia nervosa provide a gauge of the patient's medical status and treatment progress (Garner, Vitousek, & Pike, 1997). Weekly self-weighing among patients with bulimia nervosa or eating disorder not otherwise specified provide patients with concrete evidence about their weight and demonstrate that improving eating habits and decreasing eating disorder symptoms does not necessarily result in

weight gain (Fairburn, Marcus, & Wilson, 1993). In general, weight checks can stimulate discussion about patients' concerns about their weight. Patients are encouraged to discuss their thoughts and feelings about their weight and in return, are provided with feedback from qualified healthcare professionals. Thus, this behavioural intervention provides accurate knowledge about bodyweight and also conveys patients' core weight and shape concerns to the therapist (Fairburn et al., 1993). Given that individuals with eating disorders and restrained eaters share similar weight and shape concerns (Polivy & Herman, 1987), such procedures could also be tested among restrained eaters and if found useful, could be integrated into weight management programs. Such guidelines may not only aid weight control, but would have the added benefit of improving emotional well-being.

Summary and Conclusions

Overall, we found that the effect of regular weighing on bodyweight differed between restrained and unrestrained eaters. This finding is in line with our primary hypothesis and is the most significant finding of this paper as it highlights the need to consider alternative or modified strategies for weight management among subgroups of individuals. These preliminary findings must now be replicated among larger samples of adults over a longer period of time. Overall, our findings highlight the importance of considering individual difference and underscore the fact that strategies intended to aid in weight management must be implemented judiciously. Further consideration of subgroups of individuals may ultimately help to tailor clinical and public health recommendations aimed at healthy weight management.

Appendix A

Screenshots of Participants' Login and Data Entry[3]

Login Id:

Password:

Login

If you are experiencing login problems, please contact as soon as possible:
healthstudy@psych.ryerson.ca
416-979-5000 ext. 4694

Daily Weighing group

Please enter your daily weight (in pounds):

Save

Weekly Weighing group

Please enter your weekly weight (in pounds):

Save

Heart Rate Monitoring group (control group)

Please enter your heart rate:

Save

[3] Note that participants saw only the instructions pertaining to his or her specific group assignment (i.e., Daily Weighing, Weekly Weighing, *or* Heart Rate Monitoring control group).

Appendix B

Instructions

Daily self-weighing group instructions. "Thank you for choosing to participate in this study: Healthy Living Among First-Year University Students. You have been selected to participate in Group 1. For the purpose of this study, please weigh yourself once a day only immediately upon rising from bed, in light clothing and stocking feet. Stand firmly with both feet on the scale. Read the dial to the nearest pound to figure out how much you weigh. Please record your weigh-ins everyday using the online form for the duration of the study."

Weekly self-weighing group instructions. "Thank you for choosing to participate in this study: Healthy Living Among First-Year University Students. You have been selected to participate in Group 2. For the purpose of this study, please weigh yourself once a week only immediately upon rising from bed, in light clothing and stocking feet. Stand firmly with both feet on the scale. Read the dial to the nearest pound to figure out how much you weigh. Please record your weigh-ins on Sunday of each week using the online form for the duration of the study."

Control group instructions. "Thank you for choosing to participate in this study: Healthy Living Among First-Year University Students. You have been selected to participate in Group 3. For the purpose of this study, we first ask that you do not weigh yourself at all for the duration of this study. Additionally, please take your pulse once a week only immediately upon rising from bed. Touch the thumb-side of your wrist lightly until you feel your pulse/heart beat. Count the amount of heart beats for 15 seconds and multiply by four – this will give you your pulse rate. Please record your pulse rate on Sunday of each week using the online form for the duration of the study."

Appendix C

Multiple Linear Regression Results

Table 3. Multiple linear regression analysis for BMI change, using restrained eating as a continuous variable; dummy coding for feedback group; and associated interaction terms.

Variable	β	Standard Error	*t*	*p*-value
Constant	0.361	0.396	0.910	0.365
Baseline Restrained Eating	-0.021	0.026	-0.792	0.430
Group 1	-0.612	0.518	-1.181	0.241
Group 2	-0.051	0.548	-0.093	0.926
Restraint x Group 1	0.057	0.033	1.708	0.091
Restraint x Group 2	-0.008	0.038	-0.217	0.829

Note. $R^2 = 0.078$.

Group membership was dummy coded, whereby Group 1 = 1 if the participant was in the daily weighing group and Group 1 = 0 if the participant was not in the daily weighing group; Group 2 = 1 if the participant was in the weekly weighing group and Group 2 = 0 if the participant was not in the weekly weighing group.

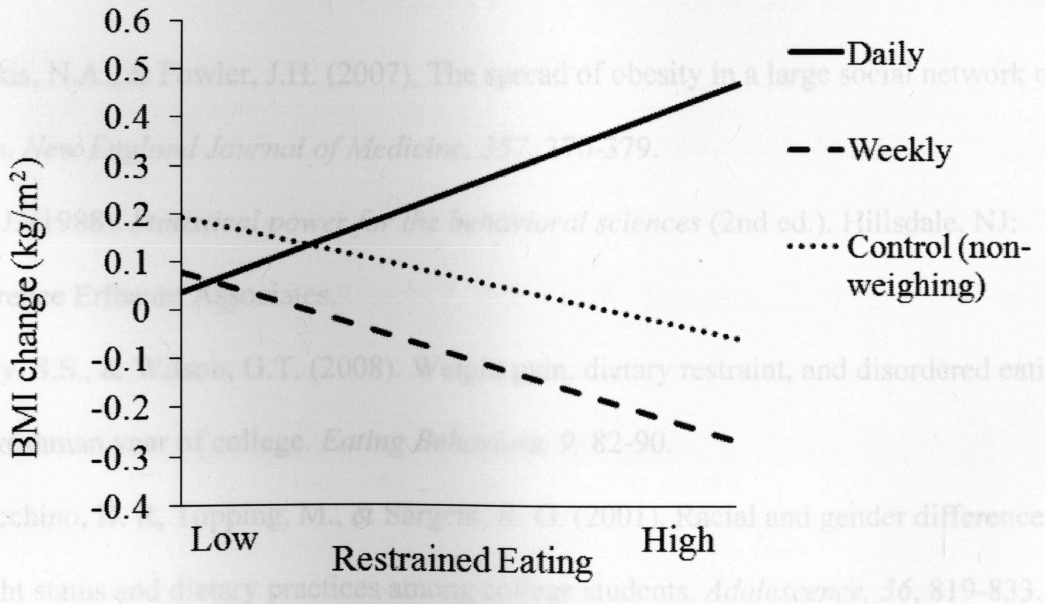


Figure 3. Mean BMI change by restrained eating as a continuous variable in daily weighing, weekly weighing, and control (non-weighing) groups

References

Adams, T., & Rini, A. (2007). Predicting 1-year change in body mass index among college students. *Journal of American College Health, 55,* 361-365.

American Psychiatric Association. (2000). *Diagnostic and Statistical Manual of Mental Disorders* (4th ed., text revision). Washington, DC: Author.

Anderson, D.A., Shapiro, J.R., & Lundgren, J.D. (2003). The freshman year of college as a critical period for weight gain: An initial evaluation. *Eating Behaviors, 4,* 363-366.

Baum, J.G., Clark, H.B., & Sandler, J. (1991). Preventing relapse in obesity through posttreatment maintenance systems: Comparing the relative efficacy of two levels of therapist support. *Journal of Behavioral Medicine, 14,* 287-302.

Butler S.M., Black, D.R., Blue, C.L., & Greteback, R.J. (2004). Change in diet, physical activity, and body weight in female college freshman. *American Journal of Health Behavior, 28*, 24-32.

Christakis, N.A., & Fowler, J.H. (2007). The spread of obesity in a large social network over 32 years. *New England Journal of Medicine, 357,* 370-379.

Cohen, J. (1988). *Statistical power for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Delinsky, S.S., & Wilson, G.T. (2008). Weight gain, dietary restraint, and disordered eating in the freshman year of college. *Eating Behaviors, 9,* 82-90.

DiGioacchino, D. R, Topping, M., & Sargent, R. G. (2001). Racial and gender differences in weight status and dietary practices among college students. *Adolescence, 36*, 819-833.

Dionne, M., & Yeudall, F. (2005). Monitoring of weight in weight loss programs: A double-edged sword? *Journal of Nutrition Education and Behavior, 37,* 315-318.

Economos, C.D., Hildebrandt, M.L., & Hyatt, R.R. (2008). College freshman stress and weight change: Differences by gender. *American Journal of Health Behavior, 32,* 16-25.

Emmons, L. (1994). Predisposing factors differentiating adolescent dieters and nondieters. *Journal of the American Dietetic Association, 94,* 725-732.

Fairburn, C.G., Marcus, M.D., & Wilson, G.T. (1993). Cognitive-behavioral therapy for binge eating and bulimia nervosa: a comprehensive treatment manual. In C.G. Fairburn & G.T. Wilson, (Eds.), *Binge eating: nature, assessment and treatment* (pp. 361-404). New York, NY: Guilford Press.

Field, A.E., Austin, S.B., Taylor, C.B., Malspeis, S., Rosner, B., Rockett, H.R., et al. (2003). Relation between dieting and weight change and preadolescents and adolescents. *Pediatrics, 112,* 900-906.

Garner, D.M., Vitousek, K., & Pike, K.M. (1997). Cognitive behavioral therapy for anorexia nervosa. In D.M. Garner & P.E. Garfinkel (Eds.), *Handbook of treatment for eating disorders* (2nd ed., pp. 94-144). New York, NY: Guilford.

Graham, M.A., & Jones, A.L. (2002). Freshman 15: Valid theory or harmful myth? *Journal of American College Health, 50,* 171-173.

Griffiths, R.A., Beumont, P.J.V., Russell, J., Schotte, D., Thornton, C., Touyz, S.W., et al. (1999). Sociocultural attitudes towards appearance in dieting and nondieting disordered subjects. *European Eating Disorders Review, 7,* 193-203.

Gross, L.S., Li, L., Ford, E.S., & Liu, S. (2004). Increased consumption of refined carbohydrates and the epidemic of type 2 diabetes in the United States: An ecologic assessment. *American Journal of Clinical Nutrition, 79,* 774-779.

Harvey-Berino, J., Pintauro, S., Buzzell, P., DiGiulio, M., Casey Gold, B., Moldovan, C., et al. (2002). Does using the Internet facilitate the maintenance of weight loss? *International Journal of Obesity and Related Metabolic Disorders, 26,* 1254-1260.

Heatherton, T.F., Polivy, J., Herman, C.P., & Baumeister, R.F. (1993). Self-awareness, task failure, and disinhibition: How attentional focus affects eating. *Journal of Personality, 61,* 49-61.

Heinberg, L.J., Thompson, J.K., & Matson, J.L. (2001). Body image dissatisfaction as a motivator for healthy lifestyle change: is some distress beneficial? In R.H. Striegel-Moore & L. Smolak (Eds.), *Eating disorders: Innovative directions in research and practice* (pp. 215-232). Washington, DC: American Psychological Association.

Herman, C.P., & Polivy, J. (1980). Restrained eating. In A.J. Stunkard (Ed.). *Obesity*, 208-225. Philadelphia: Saunders.

Hodge, C.N., Jackson, L.A., & Sullivan, L.A. (1993). The "freshman 15": facts and fantasies about weight gain in college women. *Psychology of Women Quarterly, 17*, 119-126.

Hoffman, D.J., Policastro, P., Quick, V., & Lee, S-K. (2006). Changes in body weight and fat mass of men and women in the first year of college: A study of the "Freshman 15". *Journal of American College Health, 55,* 41-45.

Holm-Denoma, J.M., Joiner, T.E., Vohs, K.D., & Heatherton, T.F. (2008). The "Freshman Fifteen" (the "Freshman Five" actually): Predictors and possible explanations. *Heath Psychology, 27,* S3-S9.

Hovell, M.F., Mewborn, C.R., Randle, Y., & Fowler-Johnson, S. (1985). Risk of excess weight gain in university women: A three-year community controlled analysis. *Addictive Behaviors, 10,* 15-28.

Keys, A., Brozek, J., Henschel, A., Mickelsen, O., & Taylor, H. L. (1950). *The Biology of Human Starvation* (2 volumes), Minneapolis, MN: University of Minnesota Press.

Klem, M.L.,Wing, R.R., McGuire, M.T., Seagle, H.M., & Hill, J.O. (1997). A descriptive study of individuals successful at long-term maintenance of substantial weight loss. *American Journal of Clinical Nutrition, 66,* 239-246.

Laessle, R.G., Tuschl, R.J., Kotthaus, B.C., & Pirke, K.M. (1989). A comparison of the validity of three scales for the assessment of dietary restraint. *Journal of Abnormal Psychology, 98,* 504-507.

Levitsky, D.A. (2005). The non-regulation of food intake in humans: Hope for reversing the epidemic of obesity. *Physiology & Behavior, 86,* 623-632.

Levitsky, D.A., Garay, J., Nausbaum, M., Neighbors, L., & DellaValle, D.M. (2006). Monitoring of weight daily blocks the freshman weight gain: A model for combating the epidemic of obesity. *International Journal of Obesity, 30,* 1003-1010.

Levitsky, D.A., Halbmaier, C.A., & Mrdjenovic, G. (2004). The freshman weight gain: A model for the study of the epidemic of obesity. *International Journal of Obesity, 28,* 1435-1442.

Linde, J.A., Jeffery, R.W., Finch, E.A., Simon, G.E., Ludman, E.J., Operskalski, B.H., et al. (2007). Relation of body mass index to depression and weighing frequency in overweight women. *Preventive Medicine, 45*, 75-79.

Linde, J.A., Jeffery, R.W., French, S.A., Pronk, N.P., & Boyle, R.G. (2005). Self-weighing in weight gain prevention and weigh loss trials. *Annals of Behavioral Medicine, 30,* 210-216.

Lowe, M.R., Annunziato, R.A., Tuttman Markowitz, J., Didie, E., Bellace, D.L., Riddell, L., et al. (2006). Multiple types of dieting prospectively predict weight gain during the freshman year of college. *Appetite, 47,* 83-90.

Mann, T., Tomiyama, A.J., Westling, E., Lew, A-M., Samuels, B., & Chatman, J. (2007). Medicare's search for effective obesity treatments. *American Psychologist, 62,* 220-233.

McCabe, R.E., McFarlane, T., Polivy, J., & Olmsted, M.P. (2000). Eating disorders, dieting, and the accuracy of self-reported weight. *International Journal of Eating Disorders, 29,* 59-64.

McCrory, M.A., Suen, V.M.M., & Roberts, S.B. (2002). Biobehavioral influences on energy intake and adult weight gain. *Journal of Nutrition, 132,* 3830S-3834S.

McFarlane, T., McCabe, R., Jarry, J., Olmsted, M.P., & Polivy, J. (2000). Weight-related and shape-related self-evaluation in eating-disordered and non-eating-disordered women. *International Journal of Eating Disorders, 29,* 328-335.

McFarlane, T., Polivy, J., & Herman, C.P. (1998). Effects of false weight feedback on mood, self-evaluation, and food intake in restrained and unrestrained eaters. *Journal of Abnormal Psychology, 107,* 312-318.

Micozzi, M.S., Albanes, D., Jones, D.Y., & Chumlea, W.C. (1986). Correlations of body mass indices with weight, stature, and body composition in men and women in NHANES I and II. *American Journal of Clinical Nutrition, 44,* 725-731.

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

Polivy, J. (1996). Psychological consequences of food restriction. *Journal of the American Dietetic Association, 96,* 589-592.

Polivy, J., Coleman, J., & Herman, C.P. (2005). The effect of deprivation on food cravings and eating behavior in restrained and unrestrained eaters. *International Journal of Eating Disorders, 38,* 301-309.

Polivy, J., & Herman, C.P. (1976a). Clinical depression and weight change: A complex reaction. *Journal of Abnormal Psychology, 86,* 338-340.

Polivy, J., & Herman, C.P. (1976b). The effects of alcohol on eating behavior: Disinhibition or sedation? *Addictive Behaviors, 1,* 121-125.

Polivy, J., & Herman, C.P. (1985). Dieting and binging: A causal analysis. *American Psychologist, 40,* 193-201.

Polivy, J., & Herman, C.P. (1987). Diagnosis and treatment of normal eating. *Journal of Consulting and Clinical Psychology, 55,* 635-644.

Polivy, J., Herman, C.P., & Howard, K.I. (1988). Restraint Scale: Assessment of dieting. In M. Hersen & A.S. Bellack (Eds.), *Dictionary of behavioral assessment techniques* (pp. 377-380). New York: Pergamon.

Polivy, J., Herman, C.P., & McFarlane, T. (1994). Effects of anxiety on eating: Does palatability moderate distress-induced overeating in dieters? *Journal of Abnormal Psychology, 103,* 505-510.

Polivy, J., Herman, C.P., & Warsh, S. (1978). Internal and external components of emotionality in restrained and unrestrained eaters. *Journal of Abnormal Psychology, 87,* 497-504.

Roth, D.A., Herman, C.P., Polivy, J., & Pliner, P. (2001). Self-presentational conflict in social eating situations: a normative perspective. *Appetite, 36,*165–171.

Ruderman, A.J. (1982). The restraint scale: A psychometric investigation. *Behaviour Research and Therapy, 21,* 253-258.

Ruderman, A.J. (1985). Dysphoric mood and overeating: A test of restraint theory's disinhibition hypothesis. *Journal of Abnormal Psychology, 94,* 78-85.

Sarwer, D.B., & Wadden, T.A. (1999). The treatment of obesity: What's new, what's recommended. *Journal of Women's Health and Gender-Based Medicine, 8,* 483-493.

Schmitz, K.H., Jacobs, Jr. D.R., Leon, A.S., Schreiner, P.J., & Sternfeld, B. (2000). Physical activity and body weight: Associations over ten years in the CARDIA study. Coronary Artery Risk Development in Young Adults. *International Journal of Obesity and Related Metabolic Disorders, 24*, 1475-1487.

Statistics Canada. (2005a, July 06). *Canadian Community Health Survey: Obesity among children and adults.* Retrieved January 04, 2008, from www.statcan.ca/Daily/English/050706/d050706a.htm

Statistics Canada. (2005b, March 22). *Study: Canada's visible minority population in 2017.* Retrieved June 13, 2009, from www.statcan.gc.ca/daily-quotidien/050322/dq050322b-eng.htm

Statistics Canada. (2008, July 25). *Race. Detailed classification.* June 13, 2009, from www.statcan.ca/english/concepts/definitions/ethnicity01.htm

Stice, E., Schupak-Neuberg, E., Shaw, H.E., & Stein, R.I. (1994). Relation of media exposure to eating disorder symptomatology: An examination of mediating mechanisms. *Journal of Abnormal Psychology, 103,* 836-840.

Strien, T., Frijters, J.E., Bergers, G.P., & Defares, P.B. (1986). The Dutch Eating Behavior Questionnaire (DEBQ) for assessment of restrained, emotional, and external eating behaviour. *International Journal of Eating Disorders, 5,* 295-315.

VanWormer, J.J., French, S.A., Pereira, M.A., & Welsh, E.M. (2008, November 4). The impact of regular self-weighing on weight management: A systematic literature review. *International*

Journal of Behavioral Nutrition and Physical Activity, 5. Retrieved April 1, 2009, from http://www.ijbnpa.org/content/5/1/54

Vella-Zarb, R., & Elgar, F.J. (in press). The 'Freshman 5': A Meta-analysis of weight gain in the freshman year of college. *Journal of American College Health.*

World Health Organization. (2008). *Obesity*. Retrieved July 24, 2008, from www.who.int/topics/obesity/en/