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A Randomized Clinical Trial of a Brief Motivational Intervention (BMI) for Obesity in College Students

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A RANDOMIZED CLINICAL TRIAL OF A BRIEF MOTIVATIONAL INTERVENTION (BMI) FOR OBESITY IN COLLEGE STUDENTS

by

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ABSTRACT

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Young adults are at an increased risk for weight gain as they begin college and this has implications for the onset of future health consequences such as Type II Diabetes, heart disease, hypertension, and some cancers. Brief motivational interventions (BMIs) have been found to be effective with college students for reducing risky health behaviors such as alcohol consumption, but have not been developed and tested with a primary goal of reducing obesity. BMIs have been developed and tested for the treatment of obesity and weight-related health behaviors (WRHB) in other populations, such as adults and adolescents, with promising results. The purpose of the following study was to develop and test the efficacy of a BMI for weight loss among overweight and obese college students. Seventy undergraduate students (85.7% female, 57.1% African American) completed an assessment about WRHBs and then were randomized to either receive a single 60-minute BMI plus a booster phone call, or to assessment only. T-tests revealed within group differences between baseline and post-session readiness to increase level of exercise, reduce dietary intake, and to reduce weight. However, this increase in motivation did not predict change at follow up. Additionally, at three months, after controlling for baseline measures, there were no significant differences between the intervention group and the assessment only group on body mass index or WRHBs, and minimal change was evidenced overall in either group. It was concluded that the one-session nature of the session might not have been enough to produce significant change in weight or WRHBs.

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As young adults transition from high school to college they are more likely to engage in health-compromising behaviors such as drug, alcohol, and tobacco use, risky sexual behaviors, and irregular sleep patterns (National College Health Assessment, 2009). Behavior changes associated with weight gain are of particular importance due to their implications for adult health status. Weight-gain during young adulthood increases risk for the development of chronic diseases such as diabetes, heart disease, hypertension and some cancers (National Heart, Lung, and Blood Institute, 1998). Research has also found that there are psychological consequences of obesity associated with social stigma. Obese individuals are viewed less favorably and face more discrimination and prejudice than their normal weight peers (Friedman & Brownell, 2005).

Epidemiological studies have suggested that unwanted weight gain is especially prevalent during the young adult years (ages 18 - 34). According to data from the 2001 National College Health Risk Behavior Survey, about 35% of college students may be overweight or obese (Huang et al., 2003; Lowry, 2003) and the transition to college appears to be an especially risky period (Matvienko, Lewis, & Shafer, 2001). More recent data from the National College Health Assessment (2009) suggests that over 37% of male college students and almost 29% of female college students are overweight or obese. The "Freshman Fifteen" is a term used in the United States to describe weight gained by students during their freshman year of college. Holm-Denoma, Joiner, Vohs, and Heatherton (2008) found the average freshman year weight gain to be actually around 5 pounds, a one-year weight gain rate that is nevertheless significantly higher rate than average non-student American adults.

In light of the importance of weight gain during college, several studies have identified weight-related health behaviors (WRHB) to be the key contributors to weight gain during the college years. These include low levels of physical activity and unhealthy diets (Huang et al., 2003). Regarding physical activity, Grubbs and Carter (2002) suggest that decline in exercise during the college years may be associated with the extinction of mandatory physical education classes in high school and college. Less than half of college students receive the recommended levels of physical activity (NCHA, 2009). About 20% of college students report that they engage in moderate physical activity 0 times per week, and 41% report 0 days of weekly vigorous physical activity (NCHA, 2009). Regarding diet, only 4.8% of male and 5.2% of female college students consume the recommended minimum of 5 total fruits and vegetables per day (NCHA, 2009). West, Bursac, Quibmy, and collegues (2006) found that about 65% of college students engaged in daily consumption of sugar sweetened beverages such as soda, fruit drinks, energy drinks, sports drinks, and sweet iced tea.

Despite the documented prevalence and public health- related implications of obesity and WRHB in college students, there is little empirical research evaluating interventions tailored to prevent or reduce excess weight gain within this population. Brief motivational interventions (BMIs) aim to increase motivation for behavior change within the context of one to two short sessions. Although BMIs have been developed and tested in other populations (such as adults and adolescents) for the treatment of WRHB, no studies have examined the efficacy of BMIs primarily focusing on the treatment of obesity in college students. Most of the available literature on BMIs with college students focuses on the treatment of alcohol abuse (Carey, Carey, Maisto, & Henson, 2006; Miller

& Sanchez, 1994; Murphy et al., 2001). It is possible that these alcohol focused BMIs, which have been found to be efficacious for reducing alcohol use in college students, could be modified to target obesity and WRHB. The following introduction will review the literature on the main BMI components in general, and those used to treat obesity and WRHB in adult populations and their utility for college obesity treatment will be discussed. Next, components from behavioral weight loss programs and the alcohol BMIs implemented in college students will be discussed to determine whether any could be used in BMIs focused on obesity treatment. Finally, the current study, a BMI for obesity treatment tailored for use in college students, will be described.

Brief Overview of BMI: Definitions and Approach

BMIs often combine personalized risk feedback along with motivational interviewing (MI) to help students resolve ambivalence to change within the context of one to two sessions. MI (Miller & Rollnick, 2002) has been defined as "a directive, client-centered counseling style for eliciting behavior change by helping clients explore and resolve ambivalence" (Rollnick & Miller, 1995, p. 326). Key components of the MI approach include empathetic and reflective listening, instilling a sense of self-efficacy, using open-ended questions to explore current behaviors, being open-minded to the client's beliefs and presentation, prompting the client to achieve greater self-awareness, and collaborating with the client to promote motivation to change.

Throughout the course of the MI session, the clinician helps the client to explore and resolve ambivalence about his or her health behaviors and to create an atmosphere of collaboration during the session, adopting the role of a consultant who listens to and gently directs the client towards a greater understanding of his or her problems and

options for change. The interviewer explores risks and consequences of current behaviors, but remains open-minded about the need for change. Additionally, the interviewer "rolls with resistance," rather than opposing it, using reflective listening skills. The interviewer selectively summarizes and highlights the client's words to develop discrepancy between real (current) and ideal (value-driven) behaviors. An explicit assumption of MI is that the client alone is responsible for any behavior changes. In many cases, however, the clinician will be able to enhance problem recognition and motivation to consider or pursue behavior change. Options for change often emerge over the course of the session with the participant's active involvement and input and are summarized through a goal setting exercise at the conclusion of the session.

In addition to MI, BMIs typically include personalized feedback highlighting the risks and costs associated with the target behavior (Miller & Sanchez, 1994). The client's assessment data is used to create personalized feedback that is delivered during the BMI to provide information about how his or her current behaviors compare to those of their age-mates (normative feedback) and how his or her behaviors may place them at increased risk for negative consequences. BMIs also frequently include a decisional balance exercise. A decisional balance exercise encourages clients to identify and discuss the benefits and costs of the target behavior(s). The theory behind the decisional balance exercise is that motivation requires a recognition that the benefits of change outweigh the benefits of the status quo, and the costs associated with change (Janis & Mann, 1977). Other common brief intervention components include goal setting, the distribution of self-help materials (e.g., diaries, behavior logs, etc.) and follow-up contact (Fleming, 2003).

Brief interventions are appealing as a low cost yet efficacious intervention option. Numerous studies across a variety of health and addictive behaviors have shown that brief interventions are more efficacious relative to a variety of control conditions and in some cases as efficacious as longer more intensive treatments (Bien, Miller, & Tonigan, 1993; Wilk, Jensen, & Havighurst, 1997). Wilk, Jensen, and Havighurst (1997) conducted a meta-analysis and found that heavy drinkers receiving a BMI were twice as likely to moderate their drinking 6 to 12 months after the intervention as participants who received no intervention. Thus, BMIs are cost effective and have the potential to reach a large segment of the population, including those who are not interested in completing extended behavioral treatment programs.

Transtheoretical Model for Stages of Change

The style and theory behind MI was originally based on a framework provided by Prochaska and DiClemente's Transtheoretical Model for stages of behavior change (Prochaska & DiClemente, 1982). The transtheoretical model posits that an individual's level of motivation to change is a predictor of actual change, and that lasting change generally entails movement through a series of stages. As described by Prochaska and DiClemente, there are five primary stages of change: precontemplation (individual is not thinking about changing behaviors), contemplation (individual is not sure whether or not he or she desires behavior change), preparation (individual is ready to change), action (individual is actively making behavior changes), and maintenance (individual is sustaining behavior change). Within the MI framework, stage of change influences the presentation of intervention components. For example, a MI clinician would refrain from formal goal setting with an individual who is in the precontemplation stage of change;

rather, the intended outcome of a session with a "precomtemplator" would be to promote awareness of current behaviors in a non-judgmental way and to have discussions that *may* encourage the individual to start developing discrepancy or cognitive dissonance between actual and ideal behaviors. With an individual who is in the preparation stage, conversely, the clinician might spend less time trying to develop discrepancy and more time goal setting for future behavior change. Several studies have been done matching participants to treatments aimed to increase physical activity based on stage of change and have had promising results, suggesting that meeting a participant where they are in terms of motivation may increase the efficacy of health behavior change interventions (Dunn, Marcus, Kampert et al., 1999; Marcus, Bock, Pinto et al., 1998; Marcus, Lewis, Williams et al., 2007; Marcus, Napolitano, King et al., 2007).

Review of BMI Studies and Their Application in Obesity Prevention and Treatment

Research in Adult and Adolescent Populations

As mentioned previously, several studies have tested the efficacy of BMIs for treatment of WRHB and obesity in adult/adolescent populations, but very few have been implemented with *any* BMI components in college populations.

Because there are only two published studies using any BMI components for weight loss within college students (Fischer & Bryant, 2008; Werch et al., 2007), research done in other populations will first be examined to explore the possible feasibility, translation, and salience for future research within college populations.

Currently, BMIs for encouraging change in WRHB have been used within the following adult and adolescent populations: African Americans in a church setting (Resnicow et al., 2005), African American women (Befort et al., 2008), British adults in a primary care setting (Harland, White, Drinkwater, Chinn, Farr, & Howel, 1999; Hillsdon et al. 2002), police officers (Anshel & Kang, 2008), patients at risk for coronary heart disease (Hardcastle, Taylor, Bailey, & Castle, 2008), patients being treated with antipsychotics (Ohlsen, Treasure, & Pilowsky, 2004), patients with hyperlipideamia (Mhurchu, Margetts, & Speller, 1998), patients with cardiovascular disease (Scales, 1998), patients with fibromyalgia (Ang, Kesavalu, Lydon, Lane, & Bigatti, 2007), overweight women with type II diabetes (West, DiLillo, Bursac, Gore, & Greene, 2007), adolescents (Berg-Smith et al., 1999; Werch et al., 2005), postmenopausal females (Bowen et al., 2002), and in obese adults as a supplement to a primarily behavioral intervention (Carels et al, 2007). In general, BMIs within these populations have been found to be more efficacious than various control conditions for changing WRHB in a positive direction and suggest potential promise for the efficacy of such interventions in college students. These studies are reviewed below, with particular attention paid to identifying the specific treatment components used to target obesity and WRHB.

Carels and colleagues (2007) designed and tested a behavioral weight loss program for obese and sedentary adults and added an MI component to supplement treatment in participants who were unable to meet their personal weight loss goal within an allotted time period. Eligible participants met with a doctoral student in clinical psychology for 45-60 minute sessions. The purpose of the MI session was to resolve ambivalence toward behavior change. The authors did not describe the specific

components included in the MI. Participants who received the MI lost significantly more weight and engaged in significantly more physical activity than participants who only received the behavioral weight loss program. It is important to note that this study was not a randomized trial; instead, any participants who were not responding to the treatment were assigned to receive MI sessions. Nevertheless, results from this study suggest that MI can be efficacious as a supplement to behavioral weight loss programs among participants who are having difficulty adhering to a treatment plan.

BMIs have been used with patients who have medical illnesses that may be associated with or worsened by obesity or low levels of physical activity (Ang et al., 2007; Mhurchu et al., 1998; West et al., 2007). Ang and colleagues (2007) developed a phone intervention, utilizing MI techniques, to encourage home-based physical activity in patients with fibromyalgia. The interventionist delivered six 25-minute sessions that included the following BMI components: a) enhancing motivation to exercise by eliciting self-motivational statements about the patient's recognition, concern, and intention to change the problem behavior, b) strengthening commitment to exercise by helping the client to develop a plan for change, and c) preventing relapse by praising and reinforcing progress. At 12 and 30-week follow-ups, patients reported experiencing significantly less pain than at baseline and also reported being significantly more physically active. This study not only provides evidence for the use of MI to encourage positive health behavior changes associated with weight status, but also suggests that MIs delivered via telephone conversations may also be efficacious in promoting change. Because this study was not randomized and the treatment group was not compared to a control, these results should be interpreted with caution.

Mhurchu and colleagues (1998) delivered MI style sessions to patients with hyperlipidaemia to motivate weight loss and found that patients who received MIs did not differ in overall weight loss 12-weeks post-intervention as compared to a standard care group. Sessions were described as "motivational interviews," but specific intervention components were not discussed. West and colleagues (2007) delivered a similar intervention to obese women with type II diabetes and found that patients who received an MI session lost significantly more weight than a control group. Some of the main components of the intervention were eliciting change talk and commitment language and resolving ambivalence about eating behaviors. Follow-up measures were collected up to 18 months after completion of the intervention. These findings might highlight the need for longer follow-up sessions when measuring weight loss as a primary outcome variable due to the amount of time required to achieve weight loss following changes in WRHBs.

In a UK study conducted by Hillsdon and colleagues (2002), many components used in BMIs for the treatment of alcohol use were utilized to test whether a BMI would be more efficacious in increasing physical activity than advice giving in a primary care setting. The purpose of the intervention was to examine and resolve ambivalence in the context of a brief session. Six strategies were employed for the 30 minute session: a) feedback about physical activity levels versus the recommended guidelines, b) assessment of motivation and confidence in increasing physical activity, c) a decisional balance exercise regarding the pros and cons of increasing physical activity, d) information about the importance of physical activity, e) discussion of concerns about changing their current level of physical activity, and f) interventionist-facilitated decision making for future behavior change. Participants in the MI group exercised 10% more

than those in the direct advice group post-intervention. However, as the authors discuss, this finding was not statistically significant, possibly due to the loss of power associated with high dropout rates at follow up.

Seven additional studies have been published in the adult literature and will be described briefly because they share many of the same components as the previously reviewed studies. Three of the studies (Anshel & Kang, 2008; Bowen et al., 2002; Hardcastle et al., 2008; Resnicow et al., 2001) yielded significant findings, while three did not (Befort et al., 2008; Harland et al., 1999; Ohlsen, Treasure, & Pilowsky, 2004). Anshel and Kang (2008) tested the efficacy of 10 MI sessions including a decisional balance and self-monitoring exercise, education on diet and exercise, goal setting, and building self-efficacy in order to increase fitness levels and lower lipid profiles in police officers. Follow up data at 10 weeks revealed a significant within-group difference on both of these measures. Bowen and colleagues (2002) found that assessment of stage of change, self-monitored food intake, and a decisional balance exercise were efficacious in lowering fat intake levels as compared to a non-treatment control at one year post-intervention. The sample included 175 women recruited from three clinical centers. Resnicow and colleagues (2001) delivered MI style interventions to African Americans in the church setting in order to increase fruit and vegetable consumption. Participants who received the MIs consumed significantly more fruits and vegetables 1 year post-intervention than both a control and education group. Harland and colleagues (1999) were interested in testing the efficacy of MI style sessions for promotion of physical activity; although results were not statistically significant, at one year follow up, participants who received 6 MI sessions participated in more vigorous physical activity

than those who received one MI and control. Ohlsen and colleagues (2004) also did not find significant differences in weight loss between participants who received 3 MI style sessions and a control group. However, interpretation of these findings is complicated by the fact that all participants were patients who have experienced weight gain due to the pharmacological effects of antipsychotics. Hardcastle and colleagues (2008) found that patients at risk for coronary heart disease were more likely to significantly increase their levels of physical activity as compared to a control group at a 6-month follow up. Befort and colleagues (2008) implemented a behavioral weight loss treatment for African American women. Participants were randomized to either motivational interviewing or education during the last four weeks of treatment. No significant differences were found in terms of either adherence to the behavioral weight loss treatment or changes in WRHBs between groups.

In addition to the adult studies, there have been two studies of BMIs for WRHBs in adolescents (Berg-Smith et al., 1999; Werch et al., 2005). An adolescent multihealth behavior study, implemented by Werch and colleagues (2005), utilized brief intervention for physical activity promotion. A single 12-minute one-on-one intervention integrating alcohol avoidance messages with fitness promotion messages and other positive health behaviors decreased the likelihood of engagement of other risky health behaviors one year later. Additionally, participants who received the brief interventions reported participating in significantly more vigorous and moderate exercise 3 months post-treatment as compared to an assessment only control group. Berg-Smith and colleagues (1999) also utilized BMI components in an intervention for adolescents with elevated cholesterol levels. As part of their intervention, participants received feedback on how

their cholesterol levels compared to that of their peers. Within group comparisons revealed that adolescents who received the BMI had significantly lower levels of cholesterol and calories from fat 4-8 weeks post-intervention. In sum, many of the interventions for treatment of WRHB in adult/adolescent populations utilized MI style sessions; some of them incorporated behavioral strategies such as self-monitoring, and others included personalized feedback, decisional balance exercise, and education in order to motivate behavior change. Eight of the 14 studies reviewed in this section reported significant findings in positive changes in WRHB (6/10 total studies) or weight loss (2/4 total studies). Of the 4 weight loss studies, effect sizes ranged from negative and very small (cohen's d = -.27 for between group weight loss baseline to 16 week follow up; Befort et al., 2008) to large (cohen's d = .86 for between group weight loss baseline to 6-month follow up; West et al., 2007).

Research in the College Student Population

Only two studies have investigated the efficacy of interventions utilizing any features of BMIs with a focus on increasing positive WRHB in college students. No brief intervention studies have directly targeted weight loss in college students. Werch and colleagues (2007) piloted a brief multiple behavior intervention in the college student health care setting investigating a myriad of health behaviors (e.g., physical activity, exercise, diet, sleep, stress management, alcohol, cigarette, and marijuana use). Students in one group the received a brief, tailored consultation addressing each of the health-risk behaviors he or she reported in the screening. The comparison group signed a contract committing to "improve" one of four health behaviors (physical activity, alcohol use, other substance use, and "other" health behavior). Results of the study indicated that

students in the brief intervention group engaged in significantly more physical activity over time, but the exact time between delivery of the intervention and follow up was not reported. It is important to note that this study did not assess weight status or include an explicit weight loss component. Although motivational interviewing techniques were not utilized in this intervention, these results support the efficacy of brief sessions for encouraging behavior change in college students.

Another study investigated the efficacy of a decisional balance questionnaire to increase physical activity in college females. The decisional balance questionnaire measured perceived benefits of and barriers to participating in physical activity. All participants completed the decisional balance measure, and half of these participants were randomly assigned to a one-on-one consultation with a personal trainer. Students who completed the decisional balance measure in addition to the personal training session participated in significantly more physical activity than students who only completed the decisional balance assessment measure over the course of a semester (Fischer & Bryant, 2008). Participants also did not receive a formal MI intervention session, but findings from this study might suggest possible utility of referral to see a personal trainer in the context of a BMI session. Again, weight loss was not a component of treatment and physical measure data was not collected pre or post intervention.

Summary of Major BMI Components Utilized in WRHB Studies

Taken together, it appears that most of the available studies for treatment of WRHB combine MI/BMI techniques with some behavioral and/or educational ones (Golay, 2006). The primary assessment domains included in the BMI studies were a) stage of change and confidence in ability to change (Bowen et al., 2002; Hillsdon et al.,

2002; Mhurchu et al., 1998), b) current level of physical activity and dietary consumption (Bowen et al., 2002; Carels et al., 2007; Mhurchu et al., 1998), and c) barriers to change (Resnicow et al., 2001). Some of the main intervention components found in the BMIs for WRHB include: a) a decisional balance exercise (Anshel & Kang, 2008; Bowen et al., 2002; Hillsdon et al., 2002), b) personalized feedback on how the participant compares to the national recommendations (Berg-Smith et al., 1999, feedback on cholesterol levels); Hillsdon et al., 2002, feedback on physical activity levels), c) discussion of barriers that contribute to maintaining a problem behavior (Ang et al., 2007; Bowen et al., 2002, Resnicow et al., 2001), and d) goal setting. The purpose of the decisional balance exercise in this case is to explore the costs and benefits associate with changing diet or physical activity. The personalized feedback that compares the participant's current behaviors to national recommendations for exercise or dietary intake may aid in increasing self-awareness and discrepancy. Discussing barriers to change can also enhance discrepancy, particularly if one of the barriers directly conflicts with information given in the decisional balance section (i.e., the clinician may use a double-sided reflection such as, "So, on one hand you feel as though being tired keeps you from engaging in physical activity, but on the other hand, you mentioned earlier that you like exercising because it seems to make you feel more energetic"). Goal setting was a common component of the interventions; clinicians encouraged motivated students to set specific, attainable goals for behavior changes in the immediate and distant future. Behavioral approaches utilized within the context of the BMIs included self-monitoring of WRHB behaviors (Bowen et al., 2002; Carels et al., 2007; Mhurchu et al., 1998), behavioral prescriptions, and education on diet and exercise (Ang et al., 2007). Specific

behaviors that were self-monitored across studies varied depending upon the study's main outcome measures. For example, Bowen and colleagues (2002) were interested in decreasing daily fat intake and asked participants to record their dietary intake in the form of daily fat scores throughout the course of the treatment phase. In a study conducted by Carels and colleagues (2007), participants were asked to record physical activity and included type and duration of daily activity to determine a weekly total. Another study required participants to complete a 7-day food record (Mhurchu et al., 1998). Ang and colleagues (2007) incorporated a behavioral prescription for exercise (handwritten prescribed plan for exercise for 30 weeks) and two educational sessions about the importance of exercise into their methods in addition to a MI session.

In the studies reviewed, 11 of the 16 studies reported significant positive changes in WRHB or weight loss. Of the 11 studies, 8 found significant differences on WRHB/weight loss as compared to a control group and 3 studies found within group differences between pre- and post-test. Only 4 of the studies targeted weight loss (Befort et al., 2008; Carels et al., 2007; Ohlsen et al., 2004; West et al., 2007), while the rest targeted specific WRHB or measures such as physical activity, cholesterol levels, fat intake, and fruit and vegetable intake. Two out of four studies targeting weight loss yielded significant weight decreases at 6-18 months post intervention. The most common element in BMIs for WRHB was using MI style counseling sessions to motivate change. However, regarding specific BMI components, studies were variable. Because of this, it is difficult to identify main BMI components that appear to be efficacious across studies. There is no visible pattern between studies that yielded significant results favoring BMI over control and those with non-significant results. Additionally, primary outcomes vary

depending on the population of interest, which makes it difficult to find commonalities between studies. Furthermore, many of the studies reviewed did not provide sufficient detail with regard to specific BMI components utilized. This might suggest that there is a need for more standardized procedures for BMIs for WRHB and also a need to determine the intervention elements most associated with behavior change. Despite these limitations, it may be concluded that many of the interventions reviewed for treatment of WRHB/weight loss in adult/adolescent populations utilized MI style counseling sessions. Some of them incorporated behavioral strategies such as self-monitoring, and others included personalized feedback, decisional balance exercise, and education in order to motivate behavior change.

Application of Behavioral Weight Loss Strategies

Behavioral weight loss strategies aim to manipulate and control behaviors and environmental cues around exercise and eating behaviors. Such strategies have proven successful in moderate weight loss (about 14.55 lbs on average) within the context of about 18 weeks of treatment. Across studies, about 66% of participants maintain this weight loss at 52 weeks follow up (Foreyt & Goodrick, 1993). Although behavioral treatments have historically been the gold standard for weight loss interventions, they have also been criticized for high relapse rates and length of treatment. Because the typical college lifestyle leaves little time to commit to such an intense, long-term treatment plan, behavioral treatments might not be ideal for this population. However, empirically supported behavioral interventions for obesity treatment contain some active ingredients that could be utilized in the context of a brief session. Additionally, some behavioral strategies have already been included in the BMI studies for treatment of

WRHB described previously (Bowen et al., 2002; Carels et al., 2007; Mhurchu et al., 1998). Self-monitoring of WRHB (dietary intake and physical activity levels) and stimulus control are two of the primary behavioral weight loss strategies that have gained empirical support (Cooper & Fairburn, 2002). Self-monitoring of WRHB through the use of food and/or exercise logs increases awareness of health behaviors and is associated with behavior changes. Additionally, it might give the participant useful information towards conducting a "functional analysis," such as identifying times of the day when he or she is at highest risk for overeating. Stimulus control can be defined as setting up ones environment in a way that might result in either increasing or decreasing behaviors. For example, to increase exercise, it might benefit participants to set an alarm so that he or she is given a cue to remind them that it is time to go to the gym. Another example would be to place workout clothes in a location where they will serve as a reminder to exercise. In this same way, avoiding fast food restaurants or unhealthy aisles of the grocery store might help to decrease the likelihood of one making poor food selections, and controlling portion size might decrease the likelihood of overeating.

BMIs for Alcohol Use in College Students

Efficacy of BMIs for Alcohol Use in College Students

Because BMIs have not yet been developed for the treatment of obesity in college students, but have been used for the treatment of alcohol use, this literature will be briefly reviewed to provide a model for interventions that could be applied to obesity treatment. In a 2006 meta-analysis of 15 studies investigating the efficacy of MI for reduced alcohol consumption, Vasilaki, Hosier, and Cox (2006) concluded that MI was an effective treatment for alcohol use across populations and that the effectiveness was strengthened

in younger, college-aged adults who were heavy and low-dependent drinkers. Three of the studies reviewed (Baer, Kivlahan, Blume, McKnight, & Marlatt, 2001; Marlatt et al., 1998; Murphy et al., 2001) focused specifically on the effectiveness of BMIs in the college population and found that BMIs were more effective than an assessment-only control group for alcohol consumption reduction. Murphy and colleagues (2001) found that for heavier drinkers, the BMI showed greater reductions in weekly alcohol consumption and binge drinking episodes as compared to controls and to an education-only group. A number of other studies have also found that BMIs are associated with decreased alcohol consumption and risk reduction within the college student population (Carey et al., 2006; Carey et al., 2007; Miller & Sanchez, 1994). These findings suggest that students are able to make substantial lifestyle changes after a brief encounter that includes MI components and that BMIs might translate well for use in treatment obesity and other WRHB.

Intervention Components in Alcohol-Focused BMIs

As described in the BMI studies reviewed focused on WRHB, the primary BMI intervention components for alcohol treatment include normative feedback on drinking levels, a decisional balance exercise, discussion of a range of change options, encouraging goal setting (when appropriate), and providing self-help and educational materials. In addition to these components, alcohol-focused BMIs often include feedback on risk related to family history, and a review of self-reported consequences of alcohol consumption. Discussion of these measures may aid in promoting self-awareness of the potential risk associated with drinking, thereby contributing to discrepancy or dissonance between drinking and other priorities such as health or educational attainment.

Conclusions

College students engage in numerous behaviors that are associated with excess weight gain. Weight gain that occurs during college has strong implications for adult weight status and the possible future development of chronic diseases such as heart disease, diabetes, hypertension, some cancers. To date, however, there are no published studies investigating BMIs with the primary goal of obesity treatment among college students. This gap is a significant one in the literature and suggests an important area to explore given that overweight and obese students are at the highest risk for negative consequences.

As reviewed previously, only three published BMI studies reported weight loss outcomes in the adult literature. Two of the studies reported significant weight loss in the MI group as compared to a control group (Carels et al., 2007; West et al., 2007). Unfortunately, specific brief intervention components included in these interventions were not described in detail, beyond the fact that both included individual motivational interviewing counseling sessions. Ohlsen and collegues (2004) also targeted weight loss, but participants did not experience significant weight loss. This study was limited, however, by the fact that it was a within subjects design and all participants were on antipsychotics which cause substantial weight gain (Gabriele, Dubbert, & Reeves, 2009).

Although there are many questions unresolved by the literature about key obesity treatment components that are efficacious, some specific WRHB are culprits of weight gain in college students and therefore should be targeted in an intervention tailored for college students. For example, relying on fast food for cheap, quick meals, consumption of sugary sweetened beverages and energy drinks, and restrictions on healthy food

options are common practices for many college students and are associated with risk for obesity (Fischer, Anderson, & Smith, 2004; Huang et al., 2003; Mattes, 1996; Vickers et al., 2004). Additionally, irregular sleep patterns and mealtimes in conjunction with high levels of stress might also be contributing to the obesity problem in college students. Therefore, it might be important for students to receive feedback on these behaviors and education on how they might be affecting their health (e.g., calories in fast food items, sugar sweetened beverages). Students might also benefit from problem solving to develop strategies to improve their diet and physical activity patterns. Furthermore, drawing from the main components utilized in the treatment of WRHB in adult BMIs and more behavioral weight loss programs, and from the methodology of the college alcohol studies, it can be concluded that self-monitoring, personalized feedback, decisional balance exercise, and education are promising intervention elements to motivate weight loss in college students.

Over 35% of college students are overweight or obese according to national data (Huang et al., 2003; Lowry, 2003). Habits formed in young adulthood have a high likelihood of continuing through adulthood, and obesity in adulthood has serious implications for chronic disease. Furthermore, the studies reviewed above indicate that single session alcohol-focused BMIs can result in lasting behavior change among college students (Larimer & Cronce, 2007), with outcomes perhaps more successful than in general adult or adolescent populations. Thus, BMI for weight loss in college students are potentially efficacious intervention for an important public health problem.

The purpose of this study was to develop a BMI for overweight and obese college students focused on decreasing body mass index and to determine whether this

intervention is efficacious as compared to an assessment-only control condition. The proposed study aims to promote weight loss by providing personalized feedback on specific WRHB relative to national recommendations (i.e., giving students feedback on diet and current levels of physical activity as compared to the CDC recommendations for physical activity), and facilitating problem solving to increase physical activity, fruit and vegetable intake, increasing self-efficacy to make healthier food choices, and to decrease the consumption of calorie-dense beverages.

Specifically, the objectives and corresponding hypotheses of the study were as follows:

1. To examine whether overweight and obese college students who receive a BMI with a goal of weight loss have *significantly lower body mass indices* than a control group three-months post-intervention.

H1: Participants who receive the BMI will significantly decrease their body mass indices as compared to their non-treatment peers.

2. To determine whether students who receive a BMI with a goal of weight loss show significant changes on variables that contribute to weight loss as compared to a control group at three months post-intervention.

H2: Overweight and obese students who receive the BMI will report significant improvements in WRHBs relative to control participants. Specifically, they will report greater levels of physical activity, greater fruit and vegetable consumption, less frequency of consumption of fast food, fried food, and sweets, and lower consumption of calorie-dense beverages.

H3: These changes in WRHB will mediate the relationship between treatment and changes in body mass index from baseline to follow-up. Participants assigned to BMI will report improvements in WRHB and these improvements will lead to lower follow-up body mass indices.

Methods

Participants

Participants were University of Memphis undergraduate students (n = 70).[1] One thousand three hundred twenty-five students completed a screening questionnaire. The data was first screened to recruit participants for another study, and therefore 134 participants were eliminated from the screening pool, leaving 1,191 students to screen for eligibility for the current study. Three-hundred seventeen students were eligible, and 70 enrolled in the study (see Figure 1). Eighty-five percent of the participants were female (n = 60). The reported ethnicity of the sample was 57.1% African American, 32.9% Caucasian, 2.9% Hispanic/Latino, 2.9% Asian, 1.4% Hawaiian/Pacific Islander and 2.9% Other. The mean age of the sample was 19.69. Fifty percent of the sample were college Freshmen, 28.6% were Sophomores, 14.3% were Juniors, 4.3% Seniors, and 2.9% Other.

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[1] A power analysis (Cohen, 1992) was conducted based upon a desired power of .80, an estimated medium effect size (.53), and a one-tailed alpha level of .05. The effect size estimate was based on effect sizes from 4 previous studies utilizing MI for targeting WRHB in adult populations (Burke, Arkowitz, & Menchola, 2003). It was estimated that a sample size of 66 (n = 33 MI, n = 33 assessment only control) would be necessary to detect a significant treatment group differences in body mass index and change in weight-related behaviors.

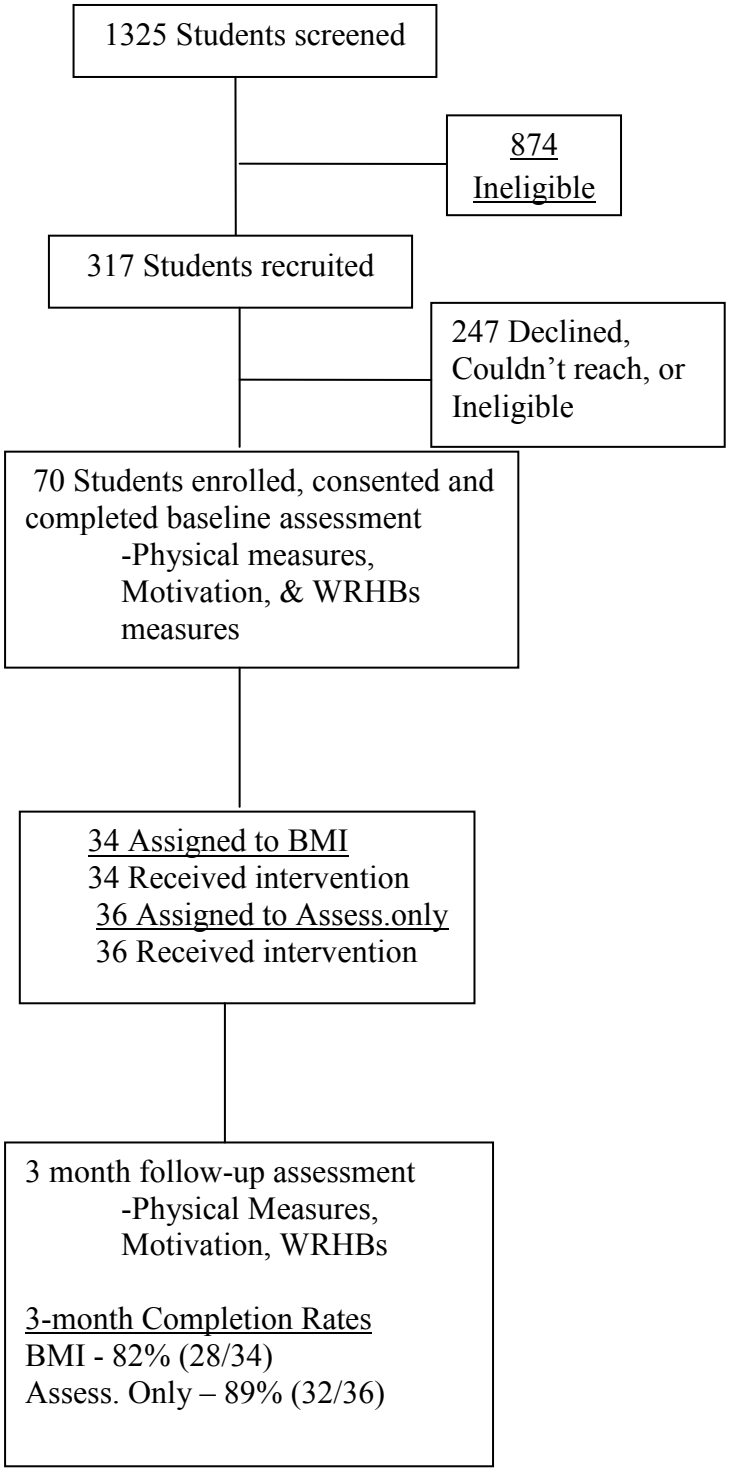

Figure 1. Flow of Participants through Each Stage of Study

Mean weight in pounds was 196.15 and mean body mass index was 32.83. Seventy percent of participants fell in the obese range for body mass index, while 30% were overweight.

Screening

Participants were college students recruited from a larger screening that occurred in undergraduate courses. Students were told that they were invited to participate in a study about college student health behaviors. Students were informed that if they completed the brief screening questionnaire, they might be eligible to participate in a second part of the study that would be compensated through research credit. They were assured that their responses were confidential, participation was not mandatory, and they could withdrawal from the study at any time. Students were consented and then instructed to complete the 5-minute survey. The screening questionnaire assessed height and weight and demographic information.

Students who volunteered to complete the screening assessment were asked to report their current height and weight. Eligibility was determined by current weight status. Body mass index was calculated for all screening participants by using the following formula: (weight in pounds * 703)/ height in inches squared. According to CDC weight classifications, body mass indices of 25-29.9 indicate overweight and 30 and over, obese. Students with a body mass index of 25-39 by self-report were eligible for the study. Students were excluded from the study at screening if his or her body mass index was 40+ (classifying them as Obese-Class III), he or she had been previously diagnosed with a metabolic disorder or had physical limitations that precluded him or her from engaging in moderate physical activity, and any female participants were pregnant at the

time of study enrollment (or were planning to become pregnant in the 3 months following screening). Refer to Appendices A-C for screening questionnaire, telephone script, and study consent, respectively.

Measures

Eligible participants completed a battery of measures at baseline and three month follow-up. Measures assessed demographic information (Appendix D) (i.e., age, gender, ethnicity, year in school, socioeconomic status, residency information) and self-reported physical activity, fruit and vegetable consumption, and dietary intake, as these variables have been found to be key predictors of weight gain during the college years (Huang et al., 2003). Additionally, family history of obesity, obesity consequences, stage of change, and barriers to engaging in physical activity were also assessed. Participants' height and body weight were taken at baseline and follow up sessions in order to calculate their body mass index at each meeting. Completion time for these measures was approximately 20-30 minutes.

Physical Activity. Physical activity was measured in three different ways. First, weekly Moderate PA was assessed by asking participants, "In the past month, how many days per week did you engage in moderate physical activity for at least 30 minutes? Moderate physical activity includes brisk walking, bicycling with moderate effort, using a stairmaster or elliptical machine with moderate effort, yoga, recreational swimming, and dancing." Weekly vigorous PA was assessed by asking participants, "In the past month, how many days per week did you engage in vigorous physical activity for at least 20 minutes? Vigorous physical activity includes running/jogging, bicycling with vigorous effort, using a stairmaster or elliptical machine with vigorous effort, aerobics, martial arts

training, competitive games such as basketball and volleyball, vigorous swimming, and tennis/racquetball/handball." Response options were "0 days per week," "1-2 days per week," "3-4 days per week," "5+ days per week" for both questions. These self-report measures of physical activity are similar to other measures used in national research studies examining physical activity among college students (e.g., American College Health Association, 2009; Nelson, Gortmaker, Subramanian, Cheung, & Wechsler, 2007) and self-report of physical activity is positively correlated with more objective measurement (Leenders, 2000). Additionally, to increase the sensitivity of the measure, we asked participants to answer two separate questions to describe how many minutes per week they engaged in moderate/vigorous PA. "In the past month in a typical WEEK, how many MINUTES have you engaged in vigorous (or moderate) physical activity for at least ten minutes (United States Department of Health and Human Services, 2008)?" Finally, we asked participants to recall a typical week in the past month and to complete a one-week exercise recall for each day of the week. For each day of the week, participants were asked what type of exercise they did, how many minutes, and whether or not they were sweating and breathing hard. See Appendix E.

Fruit and Vegetable Consumption. The CDC recommends that adults consume 5-9 servings of fruits and/or vegetables per day. To assess for fruit and vegetable intake, students were asked how many servings of fruit and how many servings of vegetables they had consumed each day during a typical week over the past month. A detailed description of the amount of one serving per fruit/vegetable was included in order to facilitate in determining how many servings are consumed per day (i.e. one serving of vegetables equals 10 baby carrots, 5 broccoli florets, one green pepper, etc.). These

assessments were similar to other measures of fruit and vegetable intake among college students (e.g., American College Health Association, 2009). Please see Appendix F.

Dietary Intake. Dietary intake was assessed by an adapted version of the Food Frequency Questionnaire (FFQ; Bowen et al., 2002; Resnicow et al., 2001). The FFQ consists of 122 food items and food groups and the respondents are asked to report how frequently they consume the given items. The adapted version used in this study was a 19-item version divided into 3 subscales: frequency of fruit and vegetable intake (5 items), frequency of beverage consumption (9 items), and frequency of snack consumption (5 items). Response items include "never," "1-3 times per month," "1-6 times per week," "1-2 times per day," "3 or more times per day." Participants also complete a food intake recall where they were asked to describe the time, location, food and beverage consumed, and amount consumed for each meal/snack during a typical weekday and a typical weekend day. Finally, participants were asked to complete a fast food frequency questionnaire where they were asked how frequently they consume specific fast food items (e.g. pizza, hamburger, fried chicken) and whether or not they were consumed on or off campus. Response options include "less that once a month," "once or twice a month," "once a week," and "more than once a week." See Appendix G.

Stage of Change. Stage of change for weight loss and WRHB were also assessed. Motivation for weight loss was evaluated by asking the participant to respond on a 0 (not motivated at all)-10 (very motivated) scale, "How motivated are you, at the moment, to reduce your weight?" (Rollnick, 1996). Stage of change for physical activity was assessed by asking the participant "How motivated are you, at the moment, to

increase your current level of physical activity?" Stage of change for diet was assessed by asking the participant "How motivated are you, at the moment, to change your diet?" These items were derived from The Contemplation Ladder (Biener & Abrams, 1991), a continuous measure that asks participants to rate what thoughts they have on changing their drinking. Motivation was assessed so that the interventionist was aware of the stage of change before entering the session and also to measure how the student varied on stage of change over time. See Appendix H.

Family History. Family history of medical illnesses associated with obesity was assessed (Appendix I). This measure has been adapted from similar measures used to assess family history for alcohol problems in the BMI for alcohol treatment studies. Participants were asked to provide this information for biological parents, grandparents, and siblings. Information about family history of obesity related disorders was discussed during the intervention session. This feedback was given to highlight increased risk for the development of obesity related medical consequences in students with a positive family history.

Obesity Consequences. The Obesity Consequences Scale was developed for use in this study in order to highlight self-reported consequences of being overweight within the context of the intervention session (Appendix J). The students were asked to indicate whether or not they have experienced any of the following consequences as a result of their weight. Examples of items are as follows: "My weight has kept me from doing something I enjoy." "I have felt overly tired." "I have felt badly about myself." Internal consistency of the consequences measure in this sample was excellent (Cronbach's Alpha = .89).

Procedures

Assessment and Intervention. Students who met study criteria were contacted by phone and told that they were eligible to participate in a study about health and fitness among college students (see Appendix E for telephone script). At this point, an additional phone screening took place to ensure that participants met all eligibility criteria. Students verbally consented to answer three additional screening questions (i.e., pregnancy, metabolic disorder, physical problems interfering with exercise). If students answered no to each question, they were informed of study procedures (e.g., they will be weighed, complete questionnaires, and complete an hour long conversation with a research assistant). They were then invited to set up a time to come to the laboratory to enroll in the study. Students who chose to enroll in the study met with a research assistant in the research lab where they read and signed the consent form (Appendix F) and completed the baseline assessments.

Next, anthropometric measures were taken. Student height and weight were taken in their regular clothing, with shoes removed. Height was measured to the nearest $1/8^{th}$ inch using a vertical tape measure board. Weight was measured to the nearest 0.1 pound using a standard digital scale. Both height and weight measurements were taken twice, with a third reading taken if the difference between the first two was greater than 0.3 pounds for weight and ¼ inch for height. An average of the two/three readings was used for the final measure of height and weight.

Students were randomized by use of a random numbers generator. Randomization was stratified by gender and weight status (obese vs. overweight). Students randomized to the control condition completed the assessment, received

handouts related to weight loss and fitness (described below), and were then told that they would be contacted in three months to complete follow-up questionnaires. After completing the assessment session, students randomized to the MI condition completed a 50-60 minute session administered by a trained graduate student (described below). Following the session they were given a folder of materials related to making changes in nutrition and exercise and were told that they would be contacted in two weeks for a booster phone call, and again in three months to complete follow-up questionnaires. The same materials were distributed to control participants. The distributed materials included information about the on-campus recreation center, websites that might be helpful for those interested in making changes in diet/exercise (e.g., The Daily Plate, Weight Watchers, etc.), self-monitoring sheets for both diet and exercise, contact information for a free, online dietitian, portion control information, nutrition facts for common fast food and sugar sweetened beverage items, and contact information for the recreation center personal trainer. Participants were compensated with research credit for the initial baseline session and $10 at three months when they completed the study questionnaires at follow up. Identical questionnaires and physical measures were completed in the same research lab at follow up.

BMI Intervention. Following the baseline assessment, participants assigned to the MI intervention completed a 50-60 minute intervention that included information intended to encourage students to increase their physical activity, monitor portion size, increase intake of fruits and vegetables, and decrease consumption of fast food and calorie dense beverages in order to decrease body mass index. BMIs were conducted by three graduate students in clinical psychology, all of whom had completed 20 hours of

training in motivational interviewing and had previous experience conducting motivational interviews related to weight loss/fitness with college students. Graduate student clinicians received a manual to follow for the sessions and received regular supervision from a doctoral-level psychologist with extensive experience in conducting and supervising BMIs.

The session began by encouraging the student to talk about his or her thoughts about health and fitness and to talk about what 'being healthy' means to them (5-10 minutes). The student then received personalized feedback on how his or her physical activity and fruit and vegetable intake and body mass index compare to the CDC recommended guidelines, how many calories they consume in calorie-dense beverages, fast food items, fried food, and sweet food. Additionally, they received feedback on the % of their daily caloric intake they consumed with each of these items and how long it would take to burn off the calories consumed with these items by walking at a moderate pace (10 minutes). Psychoeducation on portion control was discussed, followed by personalized feedback developed from the mypyramid.gov website on recommended daily caloric intake and serving size of each food group based on participant age, gender, weight, and current activity level. The feedback section concluded with a discussion on family history of obesity-related illness and self-reported consequences of obesity (<10 minutes). The feedback section was introduced as a way of finding out more specific information about their diet and exercise practices, which might help them to decide what changes they might want to make, if any. The clinician discussed the feedback with the students and, if the student was interested, provided individually tailored advice on increasing physical activity and fruit and vegetable intake, adapting

healthy eating habits (focusing particularly on attending to portion size, recording all food/beverage consumption, and avoiding especially calorie dense foods such as fast food, fried foods and desserts), and reducing consumption of calorie-dense beverages such as sodas, juices, and other sweetened beverages (10 minutes). Next, goal setting regarding these issues in hopes to increase self-efficacy for change was discussed (15 minutes). Here, if the stage of change was appropriate, the interventionist suggested stimulus control techniques or other strategies that seem relevant to the barriers presented by the student. A goal setting sheet was provided so that the clinician and the participant could work on generating specific and attainable goals for behavior change. Students were also encouraged to share their goals with others in order to bolster social support (Wing & Jeffery, 1999). Specifically, they were encouraged to identify 1-2 support people and to record their names on their goal sheet. After goals were set, a decisional balance exercise helped the student to identify the pros and cons of making their desired changes. Problem-solving around cons or barriers to making the changes was then facilitated. The session was concluded with an educational portion centered around self-help materials, distribution, description and explanation on how to keep a food/exercise log, and recommendations for other supportive services available on campus (e.g., PSC, counseling center, personal training at recreation center) and online (e.g., CDC page, the "daily plate", weight watchers).

BMI Session Clinician Style. Throughout the course of the session, the clinician aimed to help the student to explore and resolve ambivalence about his or her health behaviors and to create a collaborative atmosphere, adopting the role of a consultant who listens to and gently directs the participant towards a greater understanding of his or

her problems and options for change. The clinician was instructed to explore risks and consequences of current behaviors, but to remain open-minded about the need for change and the variety of ways in which one can improve health or achieve weight loss. If appropriate, the clinician was trained to foster problem recognition and the desirability of engaging in behavior change through reflections. One goal of the session was that options for change would emerge over the course of the discussion with the participant's active involvement and input, but consistent with motivational interviewing principles, this was not a necessary outcome of the interview. Importantly, the clinician was instructed to avoid a judgmental tone and was to maintain a supportive tone, while facilitating an interactive session.

Post-Session Measurement and MI Integrity Assessment. Immediately following the BMI session, feedback on the intervention and interventionist, as well as re-assessment of stages of change for exercise, dietary changes, and weight loss was collected. Participants were asked thirteen questions to assess how they felt about their clinician and whether or not the clinician was MI consistent throughout session (e.g., "The person I met with was concerned about me/was easy to talk to/helped me to believe I could change my current behaviors if I wanted to"). Responses were on a 4-point Likert scale from "strongly agree" to "strongly disagree." Additionally, participants rated on a scale from 1 (*not at all effective*) to 10 (*very effective*) how effective they believed the session would be at modifying his/her eating/exercise patterns.

Booster Phone Call. Students receiving the BMI were called 2 weeks following the intervention to follow-up on goals set in session, provide support/encouragement,

answer any questions, and to problem solve around potential barriers they have discovered since intervention. Interventionists did not introduce new information, but discussed goals as set by the participant, problem solved around any barriers that came up over the two-week period, and responded to questions if necessary. Clinicians were able to reach 31 or the 34 participants who completed the BMI session. Average booster session length was 5-10 minutes.

Data Analytic Plan

The analysis focused on determining whether there were statistically significant differences between students who receive the BMI and those who do not on post-treatment body mass index and WRHB (exercise, frequency of dietary consumption of fast food, and sweets, and consumption of high calorie beverages). Variables were checked for outliers and deviations from normality prior to analysis. Outliers greater than 3.29 *SD*s above the mean were re-coded following the Tabachnick and Fidell (2006) guidelines. Minutes of weekly moderate and vigorous physical activity, fruit and vegetable consumption, and weight in pounds were the variables in which outliers were found and re-coded. Square root transformations were used to correct for significant skewness to weight and WRHB variables, and this resulted in normal distribution. An intent-to-treat approach was used to compare the two conditions on weight, meaning that non-completers were assumed to have remained at their baseline weight at follow up. Separate regression analyses were used in addressing hypotheses 1 and 2 (outlined in Introduction), with body mass index and weight-related health behavior variables (physical activity, frequency of consumption of fast food, sweets, and consumption of calorie dense beverages, fruit and vegetable consumption) serving as the dependent variables, respectively. The hierarchical approach to regression

model building (Pedhazur, 1997) was used to test for the significance of treatment effects after controlling for baseline values and relevant covariates. Covariates (gender and baseline scores on the dependent variable) were entered in step one. Then group (BMI or assessment only) was entered as a second step to see if the group variable was significant. The change in variance (R-square) associated with the group variable was used to provide a measure of intervention effect size. Tests of significance and increase in model R-square was preformed to assess significance of effects of group in predicting body mass index and change in WRHBs. We also conducted repeated measures ANOVAs to determine if there were changes in outcome variables over time (across conditions). All statistical tests were performed at the .05 level of significance. Because our hypotheses are directional we used one tailed tests. Additionally, exploratory analyses were conducted to test for potential moderating effects of gender, ethnicity, high vs. low motivation to change, and higher vs. lower body mass index at baseline on baseline to follow-up weight changes. These tests were performed using two tailed tests.

Results

Treatment Integrity and Session Evaluations

Participants in the treatment group completed post-session measures of MI treatment integrity and evaluated the session. One-hundred percent of participants reported that they 'strongly agreed' or 'somewhat agreed' that their clinician was easy to talk to, was concerned about the participant, understood the participant, seemed competent and well-trained, seemed well organized, gave the participant an opportunity to express his/her thoughts about health and fitness, helped the participant to believe that he/she could change his/her behaviors if he/she was interested, made the participant feel as though it was up to him/her to make

decisions about changing health behaviors, and the clinician gave the participant an opportunity to ask questions, as well as offering helpful suggestions about making changes in health behaviors. When asked to rate on a scale from 1-10 (with 1 being not interesting and 10 being very interesting) how interesting the participant found the session, 72.7% rated the session a 9 or a 10 (M = 8.85, SD = 1.33). When asked how personally relevant the participant found the session, 81.8% rated the session a 9 or a 10 (M = 9.27, SD = 1.04. Ninety-four percent of participants reported that they believed that the session would be effective in modifying college students' weight related health behaviors and 78% said they thought it would be effective in modifying their health behaviors (these participants rated the effectiveness an 8 or above). All participants rated the overall session as an 8, 9, or 10 (M = 9.36, SD = .74). Participants were also asked whether or not they thought the session benefited them in some way or if they would recommend it to friends. Response options ranged from 0 (no, definitely not) to 3 (yes, definitely), with a score of 1 and 2 assigned to "no, I don't think so" and "yes, I think so", respectively. One-hundred percent of participants responded either "yes, definitely" or "yes, I think so", indicating that the session benefited them in some way and that they would recommend it to friends and other students.

Baseline Characteristics

Baseline mean height was 64.74 inches (SD = 2.91) and mean weight was 196.15 (SD = 33.96). Mean body mass index was 32.83 (SD = 4.68). At baseline, 27.1% of the participants reported 0 days of moderate physical activity in a typical week and 44.3% reported 0 days per week of vigorous physical activity. Thirty percent of participants reported engaging in 1-2 days of moderate exercise, while 37.1 reported 1-2 days of vigorous physical activity. Less than half of participants (42.8%) reported 3 or more days of moderate physical

activity per week, and 18.6% reported 3 or more days of vigorous physical activity per week (13/70 participants total). On average, participants reported engaging in 73.38 minutes of vigorous physical activity per week (*SD* = 122.36) and 102.35 minutes of moderate exercise (*SD* = 152.92). Both of these means fall beneath the recommendations for weekly physical activity released by the United States Department of Health and Human Services in 2008, which recommend at least 75 minutes of vigorous aerobic activity per week or at least 150 minutes of moderate physical activity per week (United States Department of Health and Human Services, 2008).

Mean daily servings of fruit and vegetable consumed was low (*M* = 1.88, *SD* = 2.19 and *M* = 1.99, *SD* = 2.18, respectively). Less than half of the participants reported weekly consumption of salad (44.3%). Over 60% of participants reported consumption of French fries (62.8%) on a weekly (1-6 times/week) or daily basis. Regarding calorie-dense beverages, 48.6% of participants reported regular consumption of fortified fruit drinks, 64.3% reported regular consumption of regular sodas or sweet tea, 24.3% reported regular consumption of milkshakes/sweet coffee drinks, and 24.3% reported regular consumption of Kool Aid or lemonade. Over one-third of participants reported weekly or daily consumption of sweet foods such as cookies, cakes, pies, or snack cakes, 30% reported regular ice cream consumption, 35.7% reported regular consumption of chocolate candy bars, and 40% reported other sugary-candy consumption.

Regarding fast food, 25.7% of participants reported weekly consumption of Mexican fast food (e.g., Taco Bell), 15.7% reported weekly consumption of food from a fast food pizza restaurant (e.g., Pizza Hut), 52.9% reported weekly consumption of food from a fast food burger restaurant (e.g., McDonald's), and 61.5% reported eating at a sandwich fast food

restaurant one or more times in a week (e.g., Subway). Frequency of weekly food consumption from a fried chicken restaurant (e.g., KFC) was 48.6%, from a Chinese food restaurant was 11.4%, from a fried fish restaurant (e.g., Captain D's) was 11.4%, and from a fast food breakfast restaurant was 32.8%. On average, at baseline participants fell between the contemplation and preparation stages of change for reducing weight, changing diet, and increasing physical activity.

Baseline Between-Group Differences

There were no significant between group differences in weight, body mass index, physical activity, fruit and vegetable consumption, food/drink consumption frequency, or demographic variables at baseline. All randomized participants completed the intervention. Three-month follow-up rates were 86% (n = 60), with no between-group differences in rates of study completion (χ^2 (1) = 2.15, p = .143; see Figure 1). There were no demographic or baseline differences between completers and non-completers. Table 1 includes baseline total sample characteristics as well as baseline characteristics by group.

Primary Outcomes and Regression Results

Overall, at 3 months, 23 participants lost weight (13 in the BMI group), 32 gained (14 in the BMI group), and 15 stayed the same (7 in the BMI group). After controlling for baseline body mass index and gender, regression results revealed that there were no between group differences for body mass index at 3-month follow up (β = .11, p = .64). Separate hierarchical models were analyzed to test for between-group differences on weight (β = .01, p = .78), minutes of weekly moderate (β = -.88, p = .56) and vigorous (β = -.431, p = .80) physical activity, frequency of fast food (β = .22, p = .07), sweetened beverage (β = .20, p = .12), fruit (β = -.14, p = .40) and vegetable (β = -.27, p = .17) and sweet food (β = .19, p =

Table 1

Baseline Sample Characteristics (% or M (SD))

	Total Sample	BMI Group	Assessment Only
N	70	34	36
Age	19.69 (2.01)	19.47 (1.20)	19.89 (2.04)
Gender (%)			
Female	85.7	85.3	86.1
Male	14.3	14.7	13.9
Ethnicity (%)			
White	32.9	32.4	33.3
African-American	57.1	55.9	58.3
Weight in pounds	196.15 (33.96)	202.86 (36.10)	189.81 (30.98)
Body Mass Index	32.83 (4.68)	33.43 (4.88)	32.26 (4.49)
Minutes/Week Vig PA	70.32 (110.12)	73.41 (109.40)	67.23 (112.40)
Minutes/Week Mod PA	97.43 (132.21)	85.95 (128.55)	108.58 (136.60)
Stage of Change PA	7.84 (2.06)	8.15 (1.73)	7.56 (2.31)
Stage of Change Diet	7.36 (2.36)	7.26 (2.48)	7.44 (2.27)
Stage of Change Weight	7.51 (2.70)	7.26 (2.72)	7.75 (2.69)
Vegetable Consumption	1.90 (1.74)	1.62 (1.81)	2.17 (1.65)
Fruit Consumption	1.82 (1.96)	1.83 (2.18)	1.81 (1.75)
Fast Food Consumption	2.12 (.45)	2.13 (.47)	2.10 (.43)
Sweet Food Consumption	2.38 (.46)	2.38 (.43)	2.39 (.50)
Sugar Sweetened Beverage Consumption	2.27 (.48)	2.29 (.53)	2.25 (.42)

Note: Higher scores on the sweet food and sugar sweetened beverage consumption frequency measures indicated more consumption of these items. The responses were on a 5-point scale: 1 =“never,” 2 =“1-3 times per month,” 3 =“1-6 times per week,” 4 =“1-2 times per day,” and 5 = “3 or more times per day.” Higher scores on the fast food consumption measure also indicated higher consumption of fast food, but response options were on a 4-point scale: 1 =“less that once a month,” 2 =“once or twice a month,” 3 =“once a week,” and 4 =“more than once a week.”

.20) consumption at 3-months, but no significant differences were found. Frequency of fast food consumption trended toward significance, with more reductions in frequency of fast food consumption made in the BMI group as opposed to the assessment only group.[2] Regression results are presented in Table 2. Pre to post means, standard deviations, and within-subjects effect sizes are presented in Table 3.

Overall Changes in Weight Variables

Repeated measures ANOVAs revealed a significant main effect for time for body mass index ($F(1, 68) = 4.03$, $p = .049$), vegetable consumption ($F(1, 58) = 4.31$, $p = .04$), frequency of sweet food consumption ($F(1,56) = 8.14$, $p = .01$), and frequency of fast food consumption ($F(1, 51) = 7.63$, $p = .01$). Body mass index and vegetable consumption increased significantly over time, while frequency of sweet food and fast food consumption decreased. There were no main effects for time for weight ($F(1, 68) = .63$, $p = .43$), vigorous physical activity ($F(1,54) = .05$, $p = .82$), moderate physical activity ($F(1,54) = 3.85$, $p = .06$), fruit consumption ($F(1,58) = 2.0$, $p = .16$), or frequency of sweet beverage consumption ($F(1,56) = 1.60$, $p = 212$).

Motivation to Change Results

A paired-samples t-test revealed within-group differences between baseline and post-session motivation to lose weight (t (33) = -4.36, $p < .001$), change diet (t (32) = -4.18, $p < .001$), and increase physical activity (t (33) = -2.64, $p = .01$) in the BMI group.

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[2] Analyses were rerun without imputed values ($n = 60$) and results were identical. Additionally, due to the low number of males in the sample ($n = 10$), analyses were rerun with females only, with no differences in overall findings as compared to results with the entire sample.

Table 2

Main Outcome Regression Results

Model	B	S.E. B	B	T	ΔR^2	p-value
Body Mass Index						
Gender	-0.48	0.35	-0.04	-1.37		0.18
Baseline	0.98	0.03	0.99	36.87		<.001
Condition	0.11	0.24	0.01	0.47	.00	.64
Weight						
Gender	-0.14	0.07	-0.04	-2.07		0.04
Baseline	0.98	0.02	0.98	47.70		<.001
Condition	0.01	0.05	0.01	0.28	.00	0.78
Fruit Consumption						
Gender	0.06	0.21	0.03	0.27		.792
Baseline	0.03	0.10	0.35	2.79		0.01
Condition	-0.14	0.16	-0.11	-0.85	0.01	0.40

(Table continues)

Table 2

Main Outcome Regression Results

Model	B	S.E. B	B	T	ΔR^2	p-value
Vegetable Consumption						
Gender	0.10	0.25	0.05	0.39		0.69
Baseline	0.23	0.13	0.23	1.76		0.08
Condition	-0.27	0.19	-0.18	-1.39	0.03	0.17
Vigorous PA						
Gender	-2.39	2.15	-0.15	-1.11		0.27
Baseline	0.28	0.13	0.28	2.12		0.04
Condition	-0.43	1.65	-0.03	-0.26	.001	0.80
Moderate PA						
Gender	3.79	2.02	0.26	1.88		.07
Baseline	0.10	0.11	0.13	0.13		0.37
Condition	-0.88	1.49	-0.08	-0.60	0.01	0.56

(Table continues)

Table 2

Main Outcome Regression Results

Model	B	S.E. B	B	T	ΔR^2	p-value
Sweet Food						
Gender	0.69	0.21	0.04	0.33		0.74
Baseline	0.42	0.16	0.34	2.55		0.01
Condition	0.19	0.15	0.16	1.29	0.03	0.20
Fast Food						
Gender	-0.08	0.17	-0.06	-0.46		0.65
Baseline	0.53	0.15	0.45	3.64		0.001
Condition	0.22	0.12	0.23	1.81	0.05	0.07
Beverage						
Gender	-0.22	0.17	-0.16	-1.30		0.20
Baseline	0.59	0.15	0.48	4.01		<0.001
Condition	0.20	0.12	0.19	1.59	0.04	0.12

Note: Higher scores on the sweet food and sugar sweetened beverage consumption frequency measures indicated more consumption of these items. The responses were on a 5-point scale: 1 =“never,” 2 =“1-3 times per month,” 3 =“1-6 times per week,” 4 =“1-2 times per day,” and 5 = “3 or more times per day.” Higher scores on the fast food consumption measure also indicated higher consumption of fast food, but response options were on a 4-point scale: 1 =“less that once a month,” 2 =“once or twice a month,” 3 =“once a week,” and 4 =“more than once a week.”

Table 3

Pre-Post Means (SD) and Within Group Effect Sizes

Variable	Baseline BMI	Follow-up BMI	*d*	Baseline Assessment only	Follow-up Assessment only	*d*
Body Mass Index	33.43 (4.88)	33.61 (4.70)	-0.04	32.26 (4.49)	32.56 (4.60)	-0.07
Weight	202.86 (36.10)	203.59 (35.97)	-0.02	189.81 (30.98)	191.13 (31.30)	-0.04
Vigorous Physical Activity	75.88 (119.28)	68.67 (97.71)	0.07	70.88 (127.12)	74.87 (194.50)	-0.02
Moderate Physical Activity	90.21 (147.27)	69.62 (79.11)	0.17	114.14 (159.46)	66.0 (93.67)	0.37
Fruit Intake	1.96 (2.60)	2.39 (1.91)	-0.19	1.81 (1.75)	1.93 (1.46)	-0.07
Vegetable Intake	1.79 (2.63)	2.93 (2.45)	-0.45	2.18 (1.65)	2.27 (2.13)	-0.05
Sweet Food Intake	2.38 (.43)	2.06 (.51)	0.68	2.40 (.50)	2.27 (.667)	0.22
Fast Food Intake	2.13 (.47)	1.88 (.44)	0.51	2.10 (.43)	2.02 (.53)	0.17
Sugar-Sweetened Beverage	2.23 (.53)	2.07 (.54)	0.30	2.25 (.42)	2.30 (.54)	-0.10

Note: Negative effect sizes indicate a counter-therapeutic pre-post change for some variables (i.e., increase in body mass index, weight, consumption of sweet food, fast food, and sugar-sweetened beverages), but not for others (i.e., increase in physical activity and fruit and vegetable consumption. Higher scores on the sweet food and sugar sweetened beverage consumption frequency measures indicated more consumption of these items. The responses were on a 5-point scale: 1 =“never,” 2 =“1-3 times per month,” 3 =“1-6 times per week,” 4 =“1-2 times per day,” and 5 = “3 or more times per day.” Higher scores on the fast food consumption measure also indicated higher consumption of fast food, but response options were on a 4-point scale: 1 =“less that once a month,” 2 =“once or twice a month,” 3 =“once a week,” and 4 =“more than once a week.” Means in table were calculated without the outliers removed; regression analyses were conducted with the values adjusted for outliers.

Within-subject effect sizes from baseline to post-session were moderate (d = .56 and .50 for motivation to change weight and physical activity, respectively) to large (d = .75 for motivation to change diet). However, this increase in motivation did not predict actual change at 3 months. Additionally, across both groups, baseline motivation to lose weight, change diet, and increase physical activity was not predictive of actual weight loss or behavior change at 3 months (β = .14, p = .29; β = -.12, p = .44; β = .12, p = .35, respectively).

Exploratory Analyses: Moderation Results

Potential moderating effects for baseline variables on baseline to follow-up weight changes were explored. No moderating effects were found for gender (β = .56, p = .68), ethnicity (β = -.29, p = .43), high vs. low motivation to change weight (β = .37, p = .22), diet (β = -.34, p = .61), and physical activity (β = -.29, p = .34) and higher vs. lower body mass index (β = .01, p = .98).

Discussion

The purpose of this study was to determine whether or not overweight and obese college students who received a single 60-minute BMI would lose weight and make health behavior changes associated with weight loss over a 3-month period. Findings from the current study indicated that the intervention was not associated with statistically significant improvements in weight, diet, or exercise. Both the intervention and the assessment only group gained small amounts of weight over time (less than 2 pounds on average in the assessment only group and less than 1 pound on average in the BMI group). More participants in the BMI group lost weight (and fewer gained) than did participants in the assessment only group; however, this difference was not significant.

There were also no between-group differences on moderate and vigorous physical activity. Within the BMI group, both types of exercise actually decreased. In the assessment only group, moderate physical activity decreased while vigorous increased over the 3 month period. However, this increase was only 4 minutes per week and not statistically significant. It is surprising that despite the fact that the BMI group received tailored information about how their levels of physical activity compared to the national recommended guidelines and, overall, reported an increase in motivation to change their current level of physical activity, this did not translate into behavior change. It is possible that the timing of the assessments contributed to these outcomes. Over a quarter of the 3-month data were collected during the winter season, which, for many students, may tend to be a less active time of year (Riddoch, Mattocks, Deere, Saunders, Kirkby, Tilling et al., 2007). It is also possible that feedback about how current physical activity compares to the recommendations is not enough to encourage behavior change. Hillsdon and colleagues (2002) provided this type of feedback to participants and found that on average, participants in the intervention group increased their exercise by 10% more than the control group. However, this difference was not significant. Incorporating supervised exercise or personal training into the intervention might be more effective in producing behavior change (Fischer & Bryant, 2008). Participants were given information about the on campus recreation center and were encouraged to consider personal training sessions, but these sessions are relatively costly, and providing these services to students free of charge might increase motivation to commit to an exercise plan.

Although there were no statistically significant differences on any of the dietary intake measures between groups, the BMI group showed moderate effect size increases in vegetable intake and reductions in sugar-sweetened beverages, fast food, and sweet food

intake. The control group effect sizes for all of these dietary changes were small or negative. The largest difference between groups was on change in fast food consumption; there was a nonsignificant trend on this outcome in favor of the BMI group ($p = .07$, $\Delta R^2 = .05$; mean change from 2.13 at baseline to 1.88 at follow up; 2 = consumption of fast food once or twice/month and 1 = less than once/month). The session included giving participants feedback about the frequency of fast food items consumed, and the calories associated with these food items. It is possible that this feedback was particularly salient for college students, and that this portion of the session may have resulted in the development of discrepancy between real and ideal behaviors regarding fast food consumption. Although it appears that participants in the BMI group did reduce some high risk foods as a result of the intervention, these changes were not associated with overall changes in weight. It might be the case that participants were reducing consumption of some of the high risk foods, but were compensating by eating other foods, or that changes in weight would require larger and more enduring reductions in these foods. Future studies would benefit from measuring caloric intake at baseline and follow up to determine whether these reductions in some high-risk foods were associated with a net calorie reduction.

Within the BMI group, motivation to lose weight, change diet, and increase physical activity increased slightly from baseline to post-session. On average, participants increased over 1 unit on the 10-point scale, increasing the mean stage of change from contemplation to preparation. Despite this within-group difference, however, participants in the intervention group did not change any more than the assessment only group in terms of weight lost or changes in WRHB. This is counter to what some studies have found in terms of motivation to change predicting actual behavior change (e.g., Velicer, Redding, Xiaowu, & Prochaska,

2007). There have been other studies, however, that have not found evidence for motivation as a mechanism of change (e.g., Apodaca & Longabaugh, 2009; Borsari, Murphy, & Carey, 2009). Further, across both groups, baseline motivation to change did not predict actual change at follow up. Thus, students who reported a higher level of motivation to make changes were no more likely to make the changes than students who reported lower motivation to change. One possible explanation for this might be that the relatively small increase in motivation was inadequate to generate behavior change. It might be possible that there was not as much of an increase in motivation because most students came into the session already relatively motivated (mean motivation to change diet, weight, and physical activity ranged from 7.36-7.84 for the total sample), resulting in a ceiling effect, or that the intervention was not potent enough to result increase motivation to the extent necessary to generate behavior change. Another possible explanation might be the limited variability on changes in body mass index. Participants on average did not change their weight and this might have made it difficult for motivation changes to predict any outcome changes. Future research would benefit from exploring other potential mechanisms of change such as self-efficacy (Roach, Yadrick, Johnson, Bourdreaux, Forsythe et al., 2003), or normative or self-ideal discrepancy (Anton, Perri, & Riley, 2001) to determine what variables might have predict weight loss for students who did lose weight.

Exploratory moderation analyses were performed to determine whether gender, ethnicity, motivation to change, or baseline weight category predicted 3-month outcomes. No moderating effects were found for any of these variables. The relatively small sample size may have made it difficult to detect moderating effects. Additionally, in the case of gender, it is possible that moderating effects were not detected due to the small number of male

participants as compared to female participants in the sample.

Session ratings were positive and indicated that participants found the session to be relevant, interesting, effective, and beneficial. They also reported that they would recommend the session to friends. Interestingly, they reported high levels of self-reported likelihood that they would change behaviors associated with weight loss as a result of the session. This finding suggests that students left the session interested in making changes, but this did not result in actual behavior change. It is possible that although they had interest and even intention to change, the one-session plus booster phone call format was not enough to ensure a full commitment to a specific dietary and exercise plan.

The brief intervention in this study was developed by drawing from two bodies of literature: a) studies on the efficacy of a BMI for treatment of risky drinking among college students (e.g., Baer et al., 2001; Marlatt et al., 1998; Murphy et al., 2001) and b) studies on the efficacy of a BMI for treatment of obesity and WRHB in adults/adolescent populations (e.g., Carels et al., 2007; Ohlsen et al., 2004; West et al., 2007). Both literatures have shown promising results in most cases, with at least small to moderate between-group effect sizes in favor of the intervention group (Rubak, Sandbæk, Lauritzen, & Christensen, 2005).

Given the complexity of weight loss, it might be the case that targeting multiple health behaviors might have overwhelmed the participants, and may have resulted in "ego depletion", or an inability to maintain self-regulatory behaviors as a result of task complexity or overall fatigue from repeated attempts to maintain self-control in multiple areas (Hagger, Wood, Stiff, Chatzisarantis, 2010). For example, a participant might have had a goal to eat fewer desserts, increase physical activity, and drink less soda, but in trying to make these initial changes might have lacked the self-regulatory capacity to make all of these changes

simultaneously. According to Hagger and colleagues (2010), this attempt to make multiple changes may lead to frustration, "ego depletion", and failed attempts to make change behavior. Indeed, many experts recommend that overweight individuals who are sedentary focus on making dietary changes first, and only attempt to begin an exercise program after those are in place (Paharia & Case, 2008). However, on the other hand, given that long term weight loss is unlikely without regular exercise (Hill & Wyatt, 2005), it might have been better to have 2-3 spaced sessions, each focusing on targeting a single behavior.

Results of this study were also inconsistent with more general reviews of the effectiveness of motivational interviewing across a wide variety of health behaviors (Rubak et al., 2005). A few hypotheses associated with study design might partially explain this discrepancy. The most likely explanation is that a single session was inadequate. In the BMI studies reviewed for obesity and WRHBs in adults, the number of sessions varied from 1-24 sessions, and the time of each session ranged from 25-60 minutes. Only one study in adults was a single-session intervention and the results did not reveal any statistically significant between-group differences (Hillsdon et al., 2002). The next fewest number of sessions was 3, and findings were mixed in these interventions; two studies found statistically significant differences (Bowen et al., 2002; Resnicow et al., 2001) and two did not (Mhurchu et al., 1998; Ohlsen et al., 2004). The stepped care approach is used in medical settings and posits that the least intensive, most cost-effective intervention should first be attempted, and if this is not effective, then a higher dose intervention should be administered next (Van Korff & Tiemens, 2000). Results from the current study may suggest that one 60-minute BMI (plus a 5-10 minute booster phone call) may not be enough to affect significant behavior change and weight loss within overweight and obese college students. A meta-analysis completed by

Rubak and colleagues (2005) yielded similar findings and revealed that although some 1-session interventions were efficacious, studies that included multiple sessions were more likely to find treatment effects for MI. Future research should consider increasing the number of sessions to at least 3 to see whether or not a more extensive (but still relatively brief) intervention would result in weight loss. This might also allow for targeting individual health behaviors each session to avoid trying to cover a broad range of health behaviors in one session as mentioned previously. The current study included one additional phone booster session 2 weeks after the intervention. Future studies could also consider increasing either the duration or the number or phone calls made to see if additional contact and problem solving might help students to better adhere to the goals they set in session. Rubak and colleagues also suggest that effect sizes are positively correlated with follow-up length. The follow up period in the current study was relatively brief, and future studies may consider extending this follow up period to detect possible delayed intervention effects.

There might be some noteworthy differences between participant characteristics in this college sample as compared to other adult samples that may have had an effect on outcomes. First, as previously mentioned, the college student population is generally relatively young and healthy. Although being overweight and obese in the college years increases future risk for the development of chronic disease, only a small portion of participants reported current health consequences due to their weight (1 participant reported a diagnosis of Type II Diabetes, 9 participants reported a diagnosis of Asthma). Although the participants generally found the sessions interesting and motivating, in the absence of chronic health conditions, motivation to lose weight may have been fleeting. It appears that additional intervention techniques may be required to generate weight related behavior

change in this high risk, but not yet medically compromised population.

There are several possible explanations for why college students might respond to a BMI for risking drinking, but not for obesity. First, weight loss involves simultaneously changing several health behaviors; eating less, eliminating specific calorie dense foods, exercising more, and in some cases reducing alcohol consumption. . Successful weight loss typically requires a daily sizable reduction in calories and an increase in physical activity. In contrast, treatment goals for brief alcohol interventions often entail relatively minor changes in consumption amounts that occur during 2-3 weekly drinking episodes. Decisions about weight and exercise occur multiple times every day, potentially making this a more difficult behavior to change after only a single session. Furthermore, weight loss is a longer term commitment, and making changes in WRHBs is not usually associated with immediate reinforcement. In obese individuals, it takes time and significant weight loss for individuals to experience noticeable changes. Making reductions in alcohol consumption presents its own challenges, and there are sometimes social consequences for making changes (e.g., not 'fitting in' at parties; Collins, Parks, & Marlatt, 1985; Park, 2004). However, the consequences of consuming too much alcohol, or the benefits associated with reductions of drinking, are more immediately reinforced (e.g., the absence of a hangover) and therefore this behavior might be more easily modified in a brief intervention.

This study has several notable limitations. First, the small sample size may have decreased the likelihood of finding significant differences between groups at follow up. Although a power analysis suggested that the sample was adequately powered to detect medium effect size differences, the sample was not powered to detect the small effect size differences observed for fast food and sweet beverage consumption. As mentioned

previously, it is hypothesized that the intervention might have been too short, and that future researchers should consider increasing the number of sessions to at least 3. Because weight loss involves multifaceted behavior change, it might be beneficial to have one session focus on weight loss, one on nutrition, and the third on physical activity, or to have a flexible approach that proceeds to a new goal only after the previous goal is met. Additionally, a longer follow up period may have resulted in greater MI effects over time (Rubak et al., 2005). Another noteworthy limitation was the self-report nature of our WRHB measures. The gold standard for obtaining subjective daily food consumption data is the 24-hour dietary recall (Guenther, DeMaio, Ingwersen, & Berlin, 2007) which would have provided a more detailed measurement of daily caloric intake both at baseline and follow up that might have been more sensitive to potential intervention effects. Unfortunately, conducting dietary recalls is time-intensive for both participants and researchers and was not logistically possible in this study. In terms of physical activity, future studies would benefit from more objective measurements such as weekly pedometer recordings at baseline and follow up (Tudor-Lock, Williams, Reis, & Pluto, 2002). It is possible that the retrospective, self-report measurements used in this study may not have been able to detect subtle changes in activity levels. Although objective measurement of weight and body mass indices were available, future studies may consider including additional objective measurements of obesity such as % body fat or waist measurements. The use of a single interventionist for most participants (27/34 of the sessions were conducted by one interventionist) is a notable limitation. Although there were no interventionist effects, the study was not powered to detect possible effects and results largely reflect the outcomes associated with a single therapist. Finally, the fact that only a small percentage of eligible participants were enrolled in the study limits the

generalizability of the results.

Despite these limitations, the current study was the first to implement a BMI for obesity among college students and suggests several directions for future research. These include: a) incorporating supervised exercise or personal training into interventions to increase exercise self-efficacy and to ensure an increase in physical activity (Fischer & Bryant, 2008), b) collecting baseline and follow up daily caloric intake to increase the specificity of the food consumption measurement via 24 hour diet recall or a daily food diary, c) increasing the number of either in person or phone sessions and divide up physical activity and dietary information into distinct sessions, d) using more objective measurements for physical activity (e.g., pedometer readings), e) collecting additional physical measures at baseline and follow up (e.g., waist measurement, % body fat), and f) extending the follow up period to determine whether or not the effect of MI increases over time. Additionally, given the lack of effects, future studies of similar relatively brief interventions should consider powering for small effect size reductions.

Treatment of obesity has become an important public health priority. The college years could be an ideal time to intervene to prevent continued weight gain throughout the adult years. Despite the overall null findings in the current study, post-session measurement within the intervention group suggests that the intervention was associated with significant increases in motivation to change, at least initially. Within-subject effect sizes from baseline to post-session were moderate (d = .56 and .50 for motivation to change weight and physical activity, respectively) to large (d = .75 for motivation to change diet). These findings suggest a disconnect between self-reported motivation to change and actual behavior change (Apodaca & Longabaugh, 2009; Borsari, Murphy, & Carey, 2009). However, increasing the

number of sessions, consistent with other obesity treatment studies, may help to translate the treatment related motivation into sustained behavior change and weight loss.

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Appendix A

Screening Questionnaire

SCREENING SURVEY FORM

Health Related Behavior Questionnaire

1. Gender: 1) Male 2) Female

2. Age: ___ ___ years

3. What is your current weight in pounds? _____lbs

4. What is your current height? _____ft _____inches

5. What term(s) below best describes your race/ethnicity?
{Choose all that apply}
( ) White or Caucasian
( ) Hispanic or Latino
( ) Asian
( ) Black or African American
( ) American Indian or Alaska Native
( ) Other: _____

6. Year in school as of the Fall 2008 semester:
1) Freshman 3) Junior
2) Sophomore 4) Senior 5) Graduate Student

7. In the past month, how many days did per week did you engage in **Moderate** physical activity for at least 30 minutes? Moderate physical activity includes brisk walking, bicycling with moderate effort, using a stairmaster or elliptical machine with moderate effort, yoga, recreational swimming, and dancing.
a. 0 days
b. 1 – 2 days
c. 3-4 days
d. 5+ days

8. In the past month, how many days did per week did you engage in **Vigorous** physical activity for at least 20 minutes? Vigorous physical activity includes running/jogging, bicycling with vigorous effort, using a stairmaster or elliptical machine with vigorous effort, aerobics, martial arts training, competitive games such as basketball and volleyball, vigorous swimming, and tennis/racquetball/handball.

a. 0 days
b. 1 – 2 days
c. 3-4 days
d. 5+ days

9. In the past month, how many servings of fruits and vegetables did you have on a typical day. One serving of a fruit/vegetable includes one medium sized fruit (e.g., an apple or orange), one-half cup of canned fruit or vegetables (e.g., canned green beans), one-half cup of beans, one cup of raw/leafy vegetables (e.g., spinach, lettuce)

a. 0
b. 1 – 2
c. 3 – 4
d. 5+

Appendix B

Telephone Script for Intervention Study Recruitment

Telephone Script for Intervention Study Recruitment

Hello, this is (name) from the University of Memphis. I am calling to invite you to participate in an additional component of the research project on college health. This is the study that you participated in last week where you completed a brief survey on physical activity and eating habits. Do you have a minute so that I can tell you a bit about the study? The next phase of this study will entail measuring your current height and weight, completing a more comprehensive series of questionnaires, and then possibly meeting with someone for approximately 1 hour to discuss physical activity and eating habits. Each session will take about 2 hours. Two weeks after you meet with us, a research assistant will call you to check up on you and remind you about the three month follow up meeting. All information collected about you will remain confidential. If you choose to participate in this phase, you will receive research credit after the first meeting, and then $10.00 after completing follow-up questionnaires in approximately three months. You are not obligated to participate, and you may choose to withdraw participation at any time. If you decide to participate in this part the research project, we will schedule a convenient time for you to come to room 353 in the Psychology Building. Are you interested in participating?

Appendix C

Study Consent Form

Consent Form: Intervention Study

College Student Health Behaviors Study

1. Purpose of the Project

You are being asked to take part in a University of Memphis research project. The purpose of this study is to evaluate the effects of two approaches for improving college students' overall health.

2. Explanation of Procedures

You will be asked to complete several questionnaires related to your overall physical health. You may then complete a one-on-one conversation about your health behaviors including receiving individualized feedback about your physical activity, eating habits, and other associated health behaviors. Or, you may receive printed educational materials about physical activity and healthy eating. We do not know whether one of these approaches is more helpful than the other. The group you are assigned to is a matter of chance. A procedure similar to a flip of a coin (called randomization) will be used to figure out which approach you receive. You will receive extra credit after completing the first session. If you complete the one-on-one conversation, a research assistant will call you two weeks following to check in with you and to remind you about the three month follow up.

Weight and height. Your weight will be measured using a standard medical scale and height will be measured using a stadiometer (measuring stick attached to a vertical board with a moveable headboard). You will only be asked to remove their shoes for these measurements. In-person follow-up assessments will be held 3 months from now. During these sessions you will complete the additional questionnaires related to your physical activity and eating habits. You will receive $10 for completing this follow-up assessment.

In order for this project to have scientific value, we need to know whether our intervention was helpful. Therefore, we will make every effort to contact you for these follow-up interviews. As part of your participation in this project, we will ask your permission to contact another person who knows you well enough to know how to contact you over the next 3 months. We will not inform any individual about the nature of research study or speak with them about any of the confidential material you have given us as part of this study.

Audiotapes may be made of the sessions so that we can check to make sure the project procedures are being implemented as planned. Audiotapes will be identified only by an identification number and will be stored separately from all other information. Audiotapes will be destroyed at the end of the study.

3. Risks or Discomforts

The risks in this study are considered minimal. These questionnaires are commonly used in research. You may experience some emotional discomfort in discussing your experiences physical activity and eating.

4. Benefits

We cannot guarantee that you will receive any benefits from this study. A possible benefit is that you may learn more about your behaviors associated with physical activity and healthy eating.

5. Alternative Sources of Health-Related Information.

If you choose not to participate in this study, we can provide you with information on other resources for obtaining information on physical activity and healthy eating.

6. Confidentiality

Participation in this study and information gathered from this study will be kept confidential to the extent of the law. The findings of the study may be published and individual students will not be identified. By law, there are a few limits to confidentiality. These limits were developed in part to insure the safety of research participants. The researchers are required by law to take some action if there is suspicion that you may harm yourself or somebody else or there is suspicion that a child may be in danger. If any of these situations should occur, we would attempt to contact you prior to taking any action.

6. Decision to participate and right to quit at any time

Participation is voluntary and you may quit at any time. A decision to quit the study will not affect your relationship with the University of Memphis. You also may skip or not answer any question(s) you do not want to answer.

Questions about the study should be directed to Joanna Buscemi or Faculty Advisor, Dr. Jim Murphy at 6787-2630. For questions regarding your rights as a research participant contact the Chair of the Institutional Review Board for the Protection of Human Subjects at 678-2533. The University of Memphis does not have any funds budgeted for compensation for injury, damages, or other expenses.

CONSENT TO PARTICIPATE

I HAVE READ THE CONSENT FORM AND FULLY UNDERSTAND IT. ALL MY QUESTIONS HAVE BEEN ANSWERED. I AGREE TO TAKE PART IN THE STUDY, AND I WILL RECEIVE A COPY OF THIS COMPLETED FORM.

_____ _____

Signature of student Date

Appendix D

Demographic Questionnaire

DEMOGRAPHICS Participant # _____

1. Gender: 1) Male 2) Female

2. Age: ___ ___ years

3. What term(s) below best describes your race/ethnicity?
{Choose all that apply}
( ) White or Caucasian
( ) Hispanic or Latino
( ) Asian
( ) Black or African American
( ) Native Hawaiian or Other Pacific Islander
( ) American Indian or Alaska Native
( ) Other: _____
(please specify)

4. Year in school:
1) Freshman
2) Sophomore
3) Junior
4) Senior
5) Other _____

5. Where are you living? (Circle all that apply)
1) Residence hall or other university housing
2) Fraternity or sorority
3) House or apartment

6. With whom are you living?
With roommates
Alone
With one or both parents, or other adult relatives
Other

7. Do you belong to a fraternity or sorority?
0) No
1) Yes

8. How many course credits are you registered for the current semester? _____

9. Do you participate in intercollegiate sports?
0) No

1)Yes: If yes, what do you play?_____

10. Do you participate in intramural sports?
    0) No
    1)Yes

11. What is your current weight in pounds? _____lbs

12. What is your current height? _____ft _____inches

Appendix E

Physical Activity Measures

Physical Activity

1. In the past month, how many days per week did you engage in Moderate physical activity for at least 30 minutes? Moderate physical activity includes brisk walking, bicycling with moderate effort, using a stairmaster or elliptical machine with moderate effort, yoga, recreational swimming, and dancing.
   a. 0 days per week
   b. 1 - 2 days per week
   c. 3-4 days per week
   d. 5+ days per week

2. In the past month, how many days per week did you engage in Vigorous physical activity for at least 20 minutes? Vigorous physical activity includes running/jogging, bicycling with vigorous effort, using a stairmaster or elliptical machine with vigorous effort, aerobics, martial arts training, competitive games such as basketball and volleyball, vigorous swimming, and tennis/racquetball/handball.
   a. 0 days per week
   b. 1 - 2 days per week
   c. 3-4 days per week
   d. 5+ days per week

1. In the past month in a typical WEEK, how many MINUTES have you engaged in vigorous physical activity for at least ten minutes? _____

2. In the past month, in a typical WEEK, how many MINUTES have you engaged in moderate physical activity for at least ten minutes? _____

Please complete the following exercise chart based on a typical week in the past month.

Day	Sun	Mon	Tues	Wednesday	Thurs	Friday	Saturday
What did you do to exercise?							
How long did you do it (minutes)?							
Were you breathing	Y N	Y N	Y N	Y N	Y N	Y N	Y N

hard and sweating?							

Appendix F

Fruit and Vegetable Consumption Measure

Fruit/Vegetable Consumption

1. Over the month, during a typical WEEK, how many servings of fruit have you had, on average, each day? _____

2. Over the month, during a typical WEEK, how many servings of vegetables have you had, on average, each day? _____

A serving size is:

- One medium-size fruit
- 1/2 cup raw, cooked, frozen or canned fruits (in 100% juice) or vegetables
- 3/4 cup (6 oz.) 100% fruit or vegetable juice
- 1/2 cup cooked, canned or frozen legumes (beans and peas)
- 1 cup raw, leafy vegetables
- 1/4 cup dried fruit

For example, one apple, orange, or banana would be considered a serving, as would one large green pepper, five broccoli florets, or six baby carrots.

Appendix G

Dietary Intake Measures

FRUITS, VEGETABLES, beverages, and snacks

Please check ☑ the box showing how often you eat or drink each of these items.

Fruits and Vegetables				
1. Green Salad				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
2. French fries and fried potatoes				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
3. Other potatoes, including boiled, baked, and potato salad				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
4. Not counting salad or potatoes, how often do you usually eat a serving of vegetables?				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
5. Not counting juices, how often do you usually eat a serving of fruit?				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day

Beverages				
6. Orange juice or grapefruit juice				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
7. Other fruit juices, fortified fruit drinks				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
8. Regular soda, sugar sweetened tea				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
9. Diet soda, unsweetened tea, other sugar-free flavored drinks				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
10. Milkshakes, sweetened coffee drinks (i.e. “Frappuccino”)				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
11. Kool-Aid, lemonade				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day

12. Chocolate or flavored milk				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
13. Whole or Vitamin D milk				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
14. 2%, 1%, skim, or fat-free milk				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day

Snacks				
15. Cookies, cake, pie, snack cakes				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
16. Ice cream, ice cream bars, frozen yogurt, popsicles, pudding				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
17. Chocolate candy (bars and pieces)				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
18. Other candy (including bubble gum, hard candy, and gummies)				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day
19. Low-fat and/or low-sugar cookies or candy				
☐1 Never	☐2 1-3 times per month	☐3 1-6 times per week	☐4 1-2 times per day	☐5 3 or more times per day

Take out or delivery

Please mark how often you eat the following foods from a restaurant **and** identify whether you eat it **more often** on campus or off campus. **Check only one box within the frequency section and check only one box within the location section. You should check two boxes, one from the frequency section and one from the location section for each question.**

*How often do you eat the following foods **from a restaurant**…*	**FREQUENCY**				**LOCATION**	
	Less than once a month	Once or twice a month	Once a week	More than once a week	On campus	Off campus
1. Tacos, burritos, nachos (**like** Taco Bell or other Mexican)	☐1	☐2	☐3	☐4	☐1	☐2
2. Pizza (**like** Pizza Hut or Papa John's)	☐1	☐2	☐3	☐4	☐1	☐2
3. Hamburgers/cheeseburgers or hotdogs, fries (**like** McDonalds, Wendy's, Sonic, Krystal's or Burger King)	☐1	☐2	☐3	☐4	☐1	☐2
4. Sandwiches (**like** Arby's or Subway)	☐1	☐2	☐3	☐4	☐1	☐2
5. Fried and baked chicken, biscuits, vegetables (**like** Kentucky Fried Chicken, Chic-fil-a, or Mrs. Winners)	☐1	☐2	☐3	☐4	☐1	☐2
6. Chinese (**like** Manchu Wok, etc.)	☐1	☐2	☐3	☐4	☐1	☐2
6. Fried and baked fish, fries, and vegetables (**like** Captain D's or Long John Silver's)	☐1	☐2	☐3	☐4	☐1	☐2
7. Breakfast: sausage/egg biscuit sandwich, pancakes, hash browns, etc. (**like** Hardees, McDonalds, Mrs. Winners, Krystal's)	☐1	☐2	☐3	☐4	☐1	☐2
8. Ice cream, frozen yogurt, milkshakes (**like** Baskin Robbins, TCBY, or Sonic)	☐1	☐2	☐3	☐4	☐1	☐2

9. Other (please list)_____	☐1	☐2

Food Intake Recall

Please indicate the foods you consume on a typical weekday.

Meal	Time	Location	Food and Beverage Consumed	Amount
Breakfast				
Morning Snack				
Lunch				
Afternoon Snack				
Dinner				
Evening Snack				
Other				

Please indicate the foods you consume on a typical weekend day.

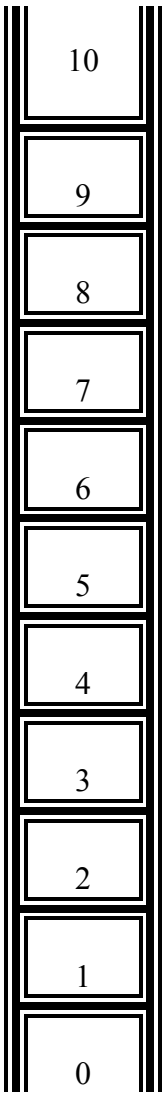
Meal	Time	Location	Food and Beverage Consumed	Amount
Breakfast				
Morning Snack				
Lunch				
Afternoon Snack				
Dinner				
Evening Snack				
Other				

Appendix H

Stage of Change Questionnaire for Weight loss, changing diet, and increasing Physical Activity

Each rung of this ladder represents where a person might be in thinking about changing their current weight.

CIRCLE THE NUMBER ON THE LADDER that best represents where you are now. How motivated are you, at the moment, to reduce your weight? (0=not motivated at all, 10=very motivated)



10 Taking action to lose weight (e.g., decreasing calorie intake and/or increasing physical activity)

8 Starting to think about how to change my weight.

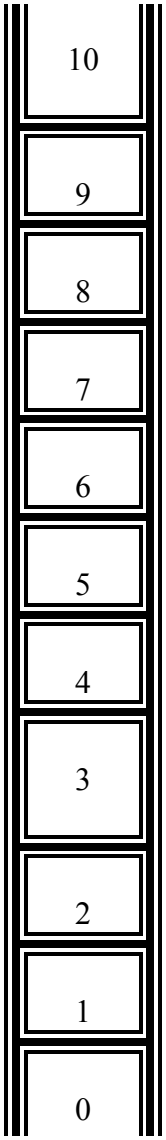
5 Think I should lose weight, but not quite ready.

3 Think I need to consider changing my weight someday.

0 No thought of changing my weight.

Each rung of this ladder represents where a person might be in thinking about changing their current diet.

CIRCLE THE NUMBER ON THE LADDER that best represents where you are now. How motivated are you, at the moment, to make positive changes in your diet? (0=not motivated at all, 10=very motivated)



Taking action to change (e.g., currently eating more healthy foods)

Starting to think about how to increase my eating patterns.

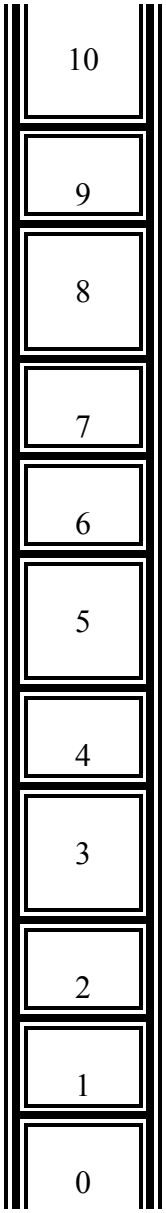
Think I should change my eating patterns, but not quite ready

Think I need to consider changing my eating patterns someday.

No thought of changing my eating patterns

Each rung of this ladder represents where a person might be in thinking about changing their current level of physical activity (exercise).

CIRCLE THE NUMBER ON THE LADDER that best represents where you are now. How motivated are you, at the moment, to increase your current level of physical activity? (0=not motivated at all, 10=very motivated)



10 Taking action to change (e.g., currently increasing frequency and duration of physical activity)

8 Starting to think about how to increase my current level of exercise.

5 Think I should change my current level of exercise, but not quite ready

3 Think I need to consider changing my current level of exercise someday.

0 No thought of changing my current level of exercise

Appendix I

Family History Questionnaire

OBESITY INFORMATION ABOUT YOUR BIOLOGICAL PARENTS AND GRANDPARENTS

INSTRUCTIONS FOR COMPLETING SECTION 1

Step 1 – Begin with Column A. In first row, write in the first name of your biological father. If you do not know his name, write "99" in Column A and leave the other columns blanks.

Step 2 – Continuing left-to-right across the page, answer the other questions. If you do not know the answer to any of the questions circle DK (don't know) .

Step 3 – Repeat Steps 1 through 2, for your biological mother, then for each grandparent.

A	B	C	D	E
INFORMATION ABOUT YOUR PARENTS AND YOUR GRANDPARENTS	Relationship: Only include Biological relatives	Was this person overweight or obese?	Did this person have medical complications due to obesity? (e.g. heart disease, hypertension, diabetes)	Did this person pass away due to an obesity related medical disorder?
Enter First Name If unknown, enter "99"				
	Biological Father	No Yes DK	No Yes DK	No Yes DK
	Biological Mother	No Yes DK	No Yes DK	No Yes DK
	Mother's Father	No Yes DK	No Yes DK	No Yes DK
	Mother's Mother	No Yes DK	No Yes DK	No Yes DK

	Father's Father	No Yes DK	No Yes DK	No Yes DK
	Father's Mother	No Yes DK	No Yes DK	No Yes DK

OBESITY INFORMATION ABOUT YOUR BIOLOGICAL BROTHERS AND SISTERS

INSTRUCTIONS FOR COMPLETING SECTION 2

Step 1 – Begin with Column A. First list the names of all your BIOLOGICAL sisters and brothers (including half siblings). Enter a "99" for any sibling you don't actually know.
Step 2 – In Column B, fill in the sex of each sibling ("M" for male, "F" for female).
Step 3 – In Column C, fill in the ONE response that best describes your biological relationship to each brother or sister.
Step 4 – Complete Columns D through J for ALL the brothers and sisters you listed below.
*If you run out of lines for siblings on this page, continue on another page.

A	B	C	D	E
INFORMATION ABOUT YOUR BROTHERS AND SISTERS	Male or Female?	Do you and this sibling share the same mother, father, or both?	Is this person overweight or obese?	Has this Person ever been diagnosed with an obesity related medical problem?
Enter First Name If unknown enter "99"				
	Circle One M F	Mother Father Both	No Yes DK	No Yes DK
	Circle One M F	Mother Father Both	No Yes DK	No Yes DK
	Circle One M F	Mother Father Both	No Yes DK	No Yes DK
	Circle One M F	Mother Father Both	No Yes DK	No Yes DK
	Circle One M F	Mother Father Both	No Yes DK	No Yes DK

	Circle One M F	Mother Father Both	No Yes DK	No Yes DK
	Circle One M F	Mother Father Both	No Yes DK	No Yes DK
	Circle One M F	Mother Father Both	No Yes DK	No Yes DK

Appendix J

Obesity Consequences Questionnaire

Experiences with Weight Concerns

Please select either YES or NO to indicate whether or not you have experienced any of the following as a result of their weight **IN THE PAST SIX MONTHS.**

In the **past six months.**...

		NO	YES
1.	My weight has kept me from engaging in activities that I enjoy.	no	yes
2.	I have been overly tired.	no	yes
3.	I have not been able to engage in physical activity.	no	yes
4.	I have been made fun of or laughed at.	no	yes
5.	I have felt badly about myself.	no	yes
6.	I have not been able to wear the latest fashions.	no	yes
7.	I have been ashamed.	no	yes
8.	I have cancelled plans to spend time with friends and family.	no	yes
9.	I have had gastrointestinal problems.	no	yes
10.	I have done poorly in school.	no	yes
11.	I have had difficulty motivating myself to accomplish daily tasks.	no	yes
12.	I have been depressed.	no	yes
13.	I have had difficulty approaching a member of the opposite sex.	no	yes
14.	I have had difficulty making new friends.	no	yes
15.	I have suspected unfair or discriminatory treatment due to my weight.	no	yes
16.	I have consumed too much alcohol.	no	yes
17.	I haven't felt good in my own skin.	no	yes
18.	I have avoided taking pictures.	no	yes
19.	I have felt hopeless.	no	yes
20.	I have overeaten.	no	yes
21.	I have given up on my appearance.	no	yes
22.	I have felt uncomfortable.	no	yes
23.	I have had difficulty walking around campus or walking up stairs.	no	yes
24.	I have been diagnosed with a weight-related medical disorder (hypertension, type 2 diabetes, sleep apnea, etc.)	no	yes