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MALE WEIGHT CONTROL: CROWDSOURCING AND AN INTERVENTION TO  
DISCOVER MORE

A Dissertation Presented

by

Tiffany Rounds

to

The Faculty of the Graduate College

of

The University of Vermont

In Partial Fulfillment of the Requirements  
for the Degree of Doctor of Philosophy  
Specializing in Animal, Nutrition and Food Sciences

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## ABSTRACT

Men and women have similar rates of obesity but the combined prevalence of overweight and obesity is higher among men. Men who are overweight are a high-risk group for many obesity-related chronic diseases, as they are more likely to carry excess weight in the abdomen, which is generally more harmful than weight stored in the lower body. Men are also less likely than women to perceive themselves as overweight, and thus are less likely to initiate weight loss through organized weight loss programs. On average, less than 27% of weight loss trial participants have been men.

Internet-based research is a low-cost, efficient way to produce novel hypotheses related to weight loss that may have previously escaped weight loss professionals. Additionally, incentives are an effective tool to motivate behavior change, and there is ample evidence to support the use of incentives to encourage many health-promoting behaviors, such as weight loss. The purpose our initial study was to facilitate intervention development by using crowdsourcing to detect unexpected beliefs and unpredicted barriers to male weight loss. The aim of our main study was to evaluate the impact of financial incentives to facilitate weight loss in men, delivered as part of a weight loss intervention.

Two separate studies were conducted. In the first project, participants were recruited to a crowdsourcing survey website which was used to generate hypotheses for behaviors related to overweight and obesity in men. Participants provided 21,846 responses to 193 questions. While several common themes seen in prior research were revealed such as previous health diagnoses and physical activity participation, other potential weight determinants such as dietary habits, sexual behaviors and self-perception were reported. Crowdsourcing in this context provides a mechanism to further investigate perceptions of weight and weight loss interventions in the male population that have not previously been documented. These insights will help guide future intervention design.

For the main project, a randomized trial compared the Gutbusters weight loss program (based on the REFIT program) alone with Gutbusters with escalating incentives for successful weight loss. The six-month intervention was conducted online with weekly in-person weight collections for the first 12 weeks. Gutbusters encouraged participants to make six 100-calorie changes to their daily diet, utilizing a variety of online lessons targeting specific eating behaviors. Measures included demographic information, height, weight, waist circumference, and body fat percentage.

Participants (N=102, 47.0 ± 12.3 yrs old, 32.5 kg/m<sup>2</sup>, 80.4% with at least two years of college) were randomized in a 1:1 ratio to Gutbusters or Gutbusters+Incentive. Significantly more Gutbusters+Incentive participants lost at least 5% of their baseline weight compared to the Gutbusters group at both 12 and 24 weeks. Similar to the aforementioned REFIT program, Gutbusters participants were able to achieve clinically significant weight loss. The Gutbusters+Incentive achieved greater rates of weight loss than the Gutbusters alone group, further supporting the value of incentives in promoting health behaviors.

## CITATIONS

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## **CHAPTER 1: COMPREHENSIVE LITERATURE REVIEW**

### **Prevalence and Costs of Overweight and Obesity**

Overweight and obesity are a global concern. The classification of adult weight status based on body mass index (BMI) used by the World Health Organization is the most commonly used measurement worldwide (BMI  $\geq$  25 for overweight, BMI  $\geq$  30 for obese) (Lobstein, 2011).

Over the last decade, rates of obesity and severe obesity (BMI  $\geq$  40) in US adults have climbed considerably, while trends among youth seem to have plateaued (Hales, Fryar, & Carroll, 2018). In 2015-2016, the prevalence of obesity was 39.8% and affected approximately 93.3 million adults in the United States, marking a significant increase from previous years. The rates of obesity differ between age groups, as well as racial/ethnic groups. Obesity rates are greater in middle-aged adults, aged 40-59 (42.8%), than in younger adults, aged 20-39 (35.7%), for both men and women. Hispanic and non-Hispanic black adults have a higher prevalence of obesity than non-Hispanic white adults. Women in general have a higher prevalence of obesity than men in many racial/ethnic groups, except for non-Hispanic white adults, where men and women exhibit approximately equal obesity rates (Hales, Carroll, Fryar, & Ogden, 2017).

#### *Healthcare Costs*

Overweight and obesity have a considerable influence on the healthcare system in the United States, with overweight and obese individuals costing far more than those of normal weight (Finkelstein, Trogon, Cohen, & Dietz, 2009; Tsai, Williamson, & Glick, 2011; Winthrow & Alter, 2011). Excess weight has been associated with a variety of expensive chronic conditions including insulin resistance, cardiovascular disease, some

cancers, type 2 diabetes, sleep apnea and more. Surprisingly, medical costs related to obesity have been similar to (and sometimes greater than) those for smoking in the United States (Sturm, 2002). In 1998, healthcare costs related to obesity were \$78.5 billion, with about half of the costs funded by Medicare and Medicaid. In a recent, updated cost analysis, Finkelstein et al. have estimated that the annual medical burden of obesity has risen to nearly 10% of all medical spending, reaching \$147 billion annually in 2008. Compared to someone of normal weight, medical spending per capita is approximately 42 percent higher for an obese individual, totaling about \$1429 per year (Finkelstein et al., 2009). Projections indicate that by the year 2030, the United States will have an additional 65 million obese adults and the associated increase in medical costs could be as great as \$48-\$66 billion per year (Wang, McPherson, Marsh, Gortmaker, & Brown, 2011).

### *Indirect Costs*

Besides the direct healthcare costs, there are many indirect costs related to obesity-related poor health, including, but not limited to, the financial value of lost work, disability, decreased productivity and increased utilization of community resources. These additional costs can be challenging to calculate but are valued to be as high, if not higher than direct healthcare costs (Lobstein, 2011). Obesity is directly related to absenteeism (habitual absence from work) as well as presenteeism (reduced productivity in the workplace because of an illness, injury or other condition) (Goettler, Grosse, & Sonntag, 2017). A recent review of the literature on workplace obesity costs observed overweight and obese employees used more sick days and reported a greater number of workplace injuries, costing employers more money through worker's compensation

claims (Schmier, Jones, & Halpern, 2006). In the United States, obese employees take an average of one to three additional sick days per person, per year compared to their normal weight colleagues (K. Neovius, Johansson, Kark, & Neovius, 2008). Obesity is also associated with permanent work loss, including long-term disability support and premature death (K. Neovius et al., 2008; K Neovius, Johansson, Rössner, & Neovius, 2008).

Obesity can have a remarkable effect on salary and wages as well. Obese men and women experience lower wages than their non-obese counterparts. One unit increase in BMI for women is associated with a 1.8% decrease in salary, although this does not hold true for heavy men (Baum & Ford, 2004; Han, Norton, & Powell, 2011). This negative effect is even larger in occupations requiring greater levels of front-facing client services or more social interaction (Han, Norton, & Stearns, 2009). Unfortunately, excess body weight also has a negative effect on employability, with lower rates of hiring and more time spent unemployed during working years for obese men and women (Han et al., 2009; Morris, 2007; Paraponaris, Saliba, & Ventelou, 2005).

### *Individual Costs*

The individual costs of obesity include both monetary and social expenses. Not only are obese individuals often paid less at work, but they are also more likely to pay higher life insurance premiums (\$14 to \$111 more annually) (Dor, Ferguson, Langwith, & Tan, 2010) and many health insurance policies do not cover obesity treatment (Gibbs, 1995). In general, individual healthcare expenditures increase with weight status. Arterburn and colleagues estimate that an overweight person will personally spend \$346 more per year on medical expenses than a normal weight individual. In contrast, a

moderately obese person will spend \$807, a severely obese individual will spend \$1,566 and a morbidly obese person will pay \$2,845 for out of pocket medical costs related to obesity (Arterburn, Maciejewski, & Tsevat, 2005). It is also likely that overweight and obese individuals face higher costs for other personal expenses, including increased food costs, the need for regular clothing replacement and even gasoline purchases.

Approximately one billion extra gallons of vehicle fuel are consumed each year due to passenger weight increases since 1960, with obese drivers spending an additional projected \$30 to \$36 per year (Jacobson & McLay, 2006).

Weight bias is another significant personal cost of overweight and obesity. The scientific literature has identified extensive bias directed at overweight and obese persons. Rejection from peers is often quite challenging in an overweight or obese child's educational setting, beginning at a young age. Studies have found that weight bias is formed as young as 8 years of age and that overweight children 9 to 11 years old already report significantly lower self-esteem than their non-overweight peers (Pierce & Wardle, 1997; Tiggermann & Anesbury, 2000). In the workplace, negative perceptions of obese people have been those of laziness, lack of self-discipline and decreased competency. Negative attitudes towards those carrying excess weight have also been reported in the healthcare system, schools, law enforcement, supermarkets, restaurants and society as a whole (Puhl & Brownell, 2012). Obesity can be more stigmatizing in the United States than a criminal record or serious disfigurement or handicap (Homant & Kennedy, 1982; Maddox, Back, & Liederman, 1979). In several experimental studies simulating workplace settings, more negative feedback from participants was given for overweight employees or managers than their normal weight equals (Decker, 1987; Klesges et al.,

1990; Larkin & Pines, 1979). In a study done reviewing hypothetical job applicants for a sales position, study participants described the obese applicants as having poor self-hygiene as well as a lack of self-discipline and an unprofessional appearance (Rothblum, Miller, & Garbutt, 1988). Unfortunately, these prejudices are not only held by the normal-weight population, and obese individuals themselves are likely to possess some of these anti-fat beliefs. In fact, overweight/obese individuals with greater negative attitudes towards other overweight individuals report higher levels of depression, body image insecurity and weaker levels of self-esteem (Friedman et al., 2012). Curiously, men experience weight stigma at BMI levels of both underweight as well as obesity and report experiencing weight stigma most frequently during adolescence. Similar to women, men report the most common sources of stigma as family members, peers and strangers (Himmelstein, Puhl, & Quinn, 2018). These outcomes help demonstrate the strong emotional effect of excess weight on an individual, beyond the clear financial repercussions.

### *Summary*

Rates of overweight and obesity continue to rise in the United States, with severe health consequences for men and women alike. Besides the immediate health repercussions, there are staggering costs associated with higher weight status, including increased healthcare costs, indirect costs associated with decreased productivity or disability, and weight-related stigma both personally and professionally.

### **Overweight and Obesity in Men**

More than one third of adults in the United States are obese and a staggering 74% of American men are classified as overweight or obese (Flegal, Carroll, Kit, & Ogden,

2012; Ogden, Carroll, Kit, & Flegal, 2014). Historically, women have been more likely to be obese, though men have consistently been more likely to be overweight. Conversely, in the past ten years, rates of obesity have stabilized for women and jumped appreciably for men. Recent estimates suggest that men and women have almost equivalent rates of obesity but the pooled prevalence of overweight and obesity is a great deal higher for men (Flegal et al., 2012; Flegal, Carroll, Kuczmarski, & Johnson, 1998). Men who are overweight or obese are a high-risk group for obesity-related chronic disease (Morgan, Lubans, et al., 2011; Young, Morgan, Plotnikoff, Callister, & Collins, 2012). Overweight and obese men are more likely than women to carry excess body fat around their abdomen and waist, which is associated with an increased risk of many health problems, including cardiovascular disease, type 2 diabetes and colorectal cancer (Sabinsky, Toft, Raben, & Holm, 2007; Wirth & Steinmetz, 1998).

Health disadvantages related to gender are often connected with women instead of men. In fact, very few countries globally have national strategies for men's health. Ireland was the first country in the world to adopt a national men's health policy, which wasn't released until 2008 (only Australia, Brazil and Ireland have such policies) (Baker, 2015). However, for all age groups, male life expectancy is lower, male mortality is higher than that of females, men access primary health services less frequently than women and are less likely to seek help when ill. Men who assume a more traditional masculine role are less open to messages of health promotion and are more likely to participate in risky behaviors such as smoking, drinking and reckless driving (Baker, 2016). Men are also more likely to be exposed to occupational hazards, such as physical injury or chemical exposure (Baker, 2016; Davidson, Lloyd, & Banks, 2001). Gender

roles certainly play a significant role in self-care and unfortunately, traditional perceptions of masculinity appear to inhibit critical aspects of health and help-seeking. Men see physicians less often and are less likely to report health problems than women (O'Kane, Craig, & Sutherland, 2008). Men's perspectives on a healthy body and 'healthy' behaviors often differ from women's, which can also increase health risks for men (White, Young, & McTeer, 1995). Sabo and Gordon found that "'health" seems to be one of the most clear-cut areas in which the damaging impacts of traditional masculinity are evident' (Sabo & Gordon, 1995).

### *Summary*

Almost two thirds of men in the United States classify as overweight or obese. Men have a lower life expectancy and are more likely to participate in poor health behaviors, yet are less likely to seek medical attention when needed. In general, traditional masculinity norms seem to hinder health-promoting behaviors.

### **Obesity Treatment**

#### *Behavioral Weight Control*

Weight loss treatment is typically suggested for adults with a BMI of  $30\text{kg/m}^2$  or greater, as well as individuals with a BMI of  $25\text{kg/m}^2$  with weight-related comorbidities, including insulin resistance, hypertension, and dyslipidemia (Butryn, Webb, & Wadden, 2011; Khaodhiar, McCowen, & Blackburn, 1999).

Two lifestyle modification interventions, the Diabetes Prevention Program and the Look AHEAD trial have become the models for behavioral treatment programs (D. P. P. R. Group, 2002; T. L. A. R. Group, 2006). Behavioral treatment is typically provided on a weekly basis for groups of 10 to 15 individuals for four to six months initially. Some



programs may be longer, especially if they focus on weight loss maintenance skills. Group sessions have been found to be at least as effective, if not more effective than individual therapy and they provide social support and healthy competition that can be beneficial for weight loss (Renjilian et al., 2001; Wadden & Foster, 2000). Examples of behavioral skills taught by facilitators in these group sessions include exhibiting portion control, making more nutritious choices when dining out and building social support networks to encourage healthy behavior change.

Goal setting is a critical component of behavioral weight loss treatment. Setting well-defined goals that can be measured allows for objective assessment of both behavior change and weight loss progress. Frequently patients will have established goals for daily caloric intake, minutes of weekly physical activity, and number of days for completing a food log (Butryn et al., 2011). Self-monitoring, or the personal recording of dietary intake, weight or physical activity, is another essential element in behavioral weight loss treatment. Self-monitoring requires individuals to pay attention to their actions and provides feedback about objective behaviors (Burke, Wang, & Sevick, 2012). Patients who regularly monitor their dietary intake and weight reliably have the highest rates of weight loss (Boutelle & Kirschenbaum, 1998; Butryn, Phelan, Hill, & Wing, 2007).

Overall, individuals who participate in a comprehensive behavioral weight loss program lose an average of 8-10 kg, or 8-10% of their initial weight, providing a clinically significant amount of weight loss (NHLBI, 1998; Wadden, Butryn, & Wilson, 2007). Additionally, roughly 80% of patients who initiate treatment complete it (Wadden et al., 2007).

Intensive behavioral treatment programs, like the Diabetes Prevention Program and Look AHEAD trials, have demonstrated terrific success rates but can be expensive, time-consuming, and inaccessible to the majority of overweight/obese people. Most of these treatment programs are conducted at university research centers, and as a result, are not available to populations who don't live in larger metropolitan areas.

Traditional obesity treatment includes dietary modification and increased exercise, which in combination can result in approximately 10% of initial body weight lost (Jacob & Isaac, 2012; Wadden et al., 2007). In order to help support these lifestyle changes, a number of health behavior change theories can and should be implemented. These theories include Social Cognitive Theory and Self-Determination Theory.

Social Cognitive Theory. Social cognitive theory is credited to psychologist Albert Bandura. The theory, used frequently in the fields of psychology, business and education, states that acquiring knowledge is directly related to observing others. To demonstrate that people learn from watching others, Bandura and his research team conducted a series of experiments with children playing with a Bobo doll. They found that children who watched others behave aggressively towards the Bobo doll were more likely to behave aggressively themselves. Bandura asserts three factors, behavior, people and environment (both social and physical) all interact to shape an individual's ability to replicate an observed behavior.

According to Bandura, self-efficacy is the personal belief that one has the ability to complete an action or behavior and that the action or behavior will lead to the desired outcome. In the weight loss setting, self-efficacy is typically expressed as the impression of control over eating in challenging circumstances (emotional distress, social pressure,

availability of unhealthy food, etc.) and escalations in self-efficacy during a weight loss intervention have been shown to also increase weight lost (Clark, Abrams, Niaura, Eaton, & Rossi, 1991; Sallis, Pinski, Grossman, Patterson, & Nader, 1988; Stubbs et al., 2011).

Self-regulation is the reflective process of self-monitoring, goal setting, feedback acceptance, and self-reward. Self-monitoring through regular weighing or food journaling is a technique widely used in behavioral weight management (Burke et al., 2012; Burke et al., 2005; Peterson et al., 2015).

Outcome expectancies are a person's expectations about the consequences of a particular action. Some negative outcome expectancies reported by men during intervention focus groups and previous weight loss trials is the belief that weight loss is too time consuming, programs are only tailored to women and the only way to lose weight is through strict dietary restriction without accommodations for things like treats or alcohol (Egger & Mowbray, 1993; Morgan, Warren, Lubans, Collins, & Callister, 2011).

Self-Determination Theory. Self-determination theory is a theory of intrinsic and extrinsic motivation initially established by Edward Deci and Richard Ryan. According to Deci and Ryan, there are three things needed for individuals to operate optimally: feeling related to those around them, behaving in accordance with their own wishes rather than external stresses, and when they feel they are competent in the behavior they are performing. Extrinsic motivation is represented by an individual performing an activity or behavior because of some external reward or benefit when the task is complete. Intrinsic motivation, on the other hand, refers to an activity or behavior that is performed due to some form of internal personal satisfaction or sense of accomplishment. Self-

determination theory centers on the degree to which an individual's behavior is self-determined and/or self-motivated (Deci & Ryan, 1985).

Many health-promoting behaviors are driven by external motivation because it is the positive outcome and not the behavior itself that motivates an individual. External motivation is not necessarily undesirable and can still be autonomous. Most health-related behavior change agendas work to develop autonomous external motivation to perform the desired health promoting behaviors. Autonomous motivation in weight loss trials has been associated with efficacious weight loss (Teixeira et al., 2006; Webber, Tate, Ward, & Bowling, 2010; Williams, Grow, Freedman, Ryan, & Deci, 1996).

Ryan and Deci recommend several methods for increasing autonomous motivation. A focus on autonomy support is imperative. Autonomy support incorporates urging participants to set personal goals based on what is directly important to them and providing them with choices in behavior (Deci & Ryan, 2008). Promoting comprehension of why a behavior is personally relevant can also increase autonomous motivation (Ryan & Deci, 2000).

There are a variety of other treatment options including extreme diet modification, drugs or surgery. Very-low-calorie diets (VLCDs) are one type of extreme diet modification. VLCDs provide 450-800 kcal per day, and are relatively high in protein. They contain the full amount of the recommended daily allowance (RDA) for vitamins, minerals, electrolytes and fatty acids and are typically consumed in liquid form. They replace all other food intake and are designed for use for a short period of time (12-16 weeks, typically). VLCDs may be prescribed for highly motivated individuals with a BMI >30 kg/m<sup>2</sup> who have failed at other more conservative weight loss programs. These

diets can produce large weight loss in the majority of patients. VLCDs have resulted in average weight loss of 1.5 to 2.0 kg/week in women and 2.0 to 2.5 kg/week in men. Unfortunately, there are a number of minor adverse effects of VLCDs including fatigue, weakness, and constipation as well as significant side effects such as gout, gallstones and cardiac disturbances. Additionally, the long-term weight loss maintenance is no more successful than other forms of obesity treatment (Atkinson et al., 1993).

Weight-loss medications work in several different ways. Some work as an appetite suppressant or increase feelings of satiety and others prevent fat absorption from foods that are consumed. They are typically only prescribed for patients with a BMI  $>30$  kg/m<sup>2</sup> or a BMI of  $>27$  kg/m<sup>2</sup> with other health-related comorbidities, such as high blood pressure. The addition of prescription weight-loss medication to a lifestyle program produces weight loss of 3-9% more of initial body weight than individuals who participate in a lifestyle program alone (Diseases, 2018). On average, individuals who take prescription weight loss medication lose 10 percent or more of their starting weight (Yanovski & Yanovski, 2014). Unfortunately weight loss medications can have significant side effects and often are not covered by insurance plans.

For individuals who are unable to lose weight through diet and exercise, weight loss surgery may be a viable option. Weight loss surgery most frequently limits the amount of food that can be consumed, but also may affect how food is digested and nutrients are absorbed. There are three types of bariatric surgery most frequently performed in the United States: gastric band, gastric bypass and gastric sleeve. On average, bariatric surgery patients lose between 15-30% of their initial weight. Evidence shows that these surgeries can improve many obesity-related health conditions, including

type 2 diabetes, high blood pressure and sleep apnea. Like with all surgical procedures, however, there are significant risks, which may include infection, hernias and nutritional deficiencies due to poor absorption. Lifestyle modification after surgery is essential to long-term bariatric surgery success in order to avoid weight regain, and approximately 20% of bariatric surgeries are considered a failure. Failure is defined as not meeting initial weight loss benchmarks, not experiencing metabolic improvement, or not maintaining appropriate weight loss. Overall, however, bariatric surgery can be a cost-effective and clinically beneficial intervention for obese individuals compared to non-surgical interventions (Picot et al., 2009).

### **Incentives and Weight Management**

One difficulty with many health-promoting behaviors is that humans are present-biased, meaning they give stronger weight to more immediate payoffs than payoffs down the road (O'Donoghue & Rabin, 1999). For example, eating a doughnut right now will taste good (immediate payoff), but choosing not to eat the doughnut may make you healthier and/or help prevent weight gain in the longer term. In fact, studies have shown that humans are more likely to make healthy choices when they are making decisions about their future behaviors, but often are quite myopic and select the more unhealthy behavior in the present moment (e.g. "I will definitely start that new diet on Monday, after this fun weekend!") This is especially true for decisions about physical activity or dietary choices (Read & Leeuwen, 1998). Behavioral economics suggests a few antidotes to address present-bias. One of which, is incentives.

Incentive theory argues that people are primarily extrinsically motivated and that they are more motivated to perform an action if they receive some sort of reward or prize

after. Incentives are an excellent example of an extrinsic motivator and are designed to motivate an individual to perform an action or behavior, such as eating healthy, exercising or losing weight. According to operant conditioning, incentives are a form of behavior reinforcement. They can be positive (addition of an incentive in response to a behavior) or negative (removal of an incentive in response to a behavior) (Skinner, 1953). No consensus has been reached regarding the perfect combination of incentive size, duration or delivery, but the literature tends to agree that incentives for weight management work, at least in the short term (Augurzky, Bauer, Reichert, Schmidt, & Tauchmann, 2015; Finkelstein, Brown, Brown, & Buchner, 2008; Finkelstein, Linnan, Tate, & Birken, 2007; Volpp et al., 2008).

#### *Incentive Structure*

Incentives can be utilized in a variety of different ways, with deposit contracts, lottery systems and fixed or escalating payments employed most commonly. There is ample evidence that both cash and lottery rewards are beneficial in encouraging weight loss and greater levels of physical activity (Butsch et al., 2007; Cawley & Price, 2009; Finkelstein et al., 2008; Finkelstein et al., 2007; Jeffery, Forster, et al., 1993; Jeffery & French, 1999; Jeffery, Wing, et al., 1993; Kullgren et al., 2013).

Deposit contracts are an incentive system in which participants invest their own money towards losing weight, which they get back if they achieve their goals, and forfeit if they fail to lose the weight. Deposit contracts operate based on loss aversion. Loss aversion refers to the tendency people have to value gains and avoid losses, and that the ache of a loss of \$5 is greater than the gain of receiving \$5 as a reward (Kahneman, Knetsch, & Thaler, 1991). Based on the theory of loss aversion, individuals who have

contributed to a deposit contract should be more motivated to lose weight in order to avoid losing their initial financial contribution. They are also designed on the belief that humans can be over-optimistic (that they will achieve their weight loss goal) and therefore are willing to invest their own money. Primarily as a result of loss aversion, deposit contracts should be more effective than weight loss programs that depend on incentive rewards. However, the research has shown inconsistent results (Jeffery, Forster, et al., 1993; John et al., 2011; Kullgren et al., 2013; Kullgren et al., 2016; Volpp et al., 2008). Deposit contracts are highly economical, as the participants are providing the money with which they will be paid, but they can also impede program participation, as many individuals are not interested in spending money they may not get back.

Lottery incentives are a form of variable reinforcement and may be more effective long term than a regular, fixed incentive (Bandura, 1969). In a lottery incentive system, participants are eligible to win money if they meet their weight loss goals. Similar to other forms of lottery, like Powerball or scratch off tickets, humans have a tendency to over weight small probabilities and overestimate their likelihood of winning. Regret aversion is a powerful construct in lottery incentives, and they are designed to stimulate anticipated regret and enhance personal motivation (participants can only receive lottery winnings if they achieve their weight loss goals). Two separate studies capitalized on regret aversion and in order to maximize regret, participants whose lottery numbers were drawn but did not achieve their goals were subsequently notified of how much money they *would* have received if they had been successful (John, Loewenstein, & Volpp, 2012; Volpp et al., 2008).



Cash payments can be given in a variety of ways, and research has shown that even small rewards can be a powerful motivator if they occur both frequently and close to the rewarded behavior (Bandura, 1969; Kirby, 1997). One effective direct payment structure is that of escalating rewards with the ability to “reset” to the beginning of the payment scheme if the daily/weekly/monthly behavior goal is not met. In a 2000 study on smoking cessation, Roll and Higgins implemented three separate direct payment incentive schedules: fixed-value reinforcement for smoking abstinence, increasing-value reinforcement for smoking abstinence, and increasing-value reinforcement for smoking abstinence with a reset contingency. In the increasing-value reinforcement groups, the cash rewards increased with every occurrence of smoking abstinence. For participants in the reset contingency group, if they failed to meet their smoking abstinence goal during a visit, their reinforcement level was ‘reset’ to the beginning of the payment scheme at their following appointment. Roll and Higgins hypothesized that the escalating payment schedule would be motivating, as participants know there is a larger loss of incentive in the upcoming weeks should they falter from their goal (Roll & Higgins, 2000; Roll, Higgins, & Badger, 1996). Until recently, this escalating payment scheme with reset had not been used in a weight management intervention. Pope and Harvey utilized this escalating payment scheme with a reset contingency in a randomized controlled trial aimed at increasing exercise in first year college students. Students were incentivized to meet weekly fitness-center goals, but payments returned to baseline for two weeks if students failed to achieve the weekly objective. Students receiving the escalating incentives met the goal number of fitness-center visits significantly more often than

students in the control condition. Unfortunately, those fitness-center visits were not maintained when the incentives were discontinued (Pope & Harvey, 2013).

### *Incentive Results*

Despite the generally encouraging findings, there is some concern over the long-term effects of financial incentives. Some researchers believe that incentives may be detrimental to intrinsic motivation, and once the incentive is removed, people may revert back to more unhealthy behaviors than at baseline (Heyman & Ariely, 2004; Kane, Johnson, Town, & Butler, 2004). Acland and Levy found continued high levels of exercise after the financial incentive ended, but found subjects experienced a significant decline in exercise levels several months later (Acland & Levy, 2013). However, several studies have reported that financial incentives for exercise were successful in establishing a positive habit in people who did not previously exercise regularly (Charness & Gneezy, 2009; Pope & Harvey-Berino, 2013). Perhaps a more feasible approach would be to provide incentives on a variable-interval schedule (which could reduce the cost burden of a long-term financial incentive) rather than discontinuing incentives altogether, as suggested by Pope and Harvey (Pope & Harvey, 2013). Irrespective of the format, research results chiefly report that financial incentives as a means of encouraging health-promoting behavior, like weight loss and physical activity, are an effective tool (Jeffery, 2012).

In a current evaluation of theory in weight loss programs with incentives, several consistencies were observed. To begin, a fixed-ratio schedule appears to be more effective when the reinforcement is negative (e.g., a reimbursement) than when the reinforcement is positive (e.g., a payout or reward). Supporting the idea of loss aversion,

in the investigated studies, participants expressed higher levels of motivation when there was the possibility of losing their own money, as opposed to earning extra money.

Contrary to public opinion, variable-ratio schedules with positive reinforcement, like a lottery, were not especially effective when compared to other incentive structures (Burns et al., 2012).

Some recent research has been done investigating the effects of incentives on long term weight maintenance with no difference found between the incentive group and the control group (Yancy et al., 2018). These results are consistent with previous studies in which participants regained weight post-incentive funded intervention (Jeffery, 2012; John et al., 2011; Volpp et al., 2008). Challenges with weight loss maintenance are not unique to incentive programs, and instead maintenance is a problem in the majority of weight management programs.

#### *Unique Incentives in Previous Weight Loss Studies*

One novel use of behavioral economics for weight loss is providing an economic incentive for enrollment in a weight loss program. Researchers at the University of Alabama designed a study to examine a reimbursement incentive that paid 50 percent of a \$300 professional weight control program (EatRight Lifestyle Program) as long as participants attend ten of the twelve sessions and lost 6 percent of their initial body weight. The program itself was a 12-week medically supervised program with weekly group sessions concentrating on behavior modification, exercise and eating habits. Interestingly, the potential for partial reimbursement had no significant effect on study enrollment, nor was there a significant effect on weight loss. There was, however, a greater number of participants who attended a greater number of the group sessions and

overall increased attendance at the group sessions was associated with greater weight loss, although the majority did not meet the 6 percent weight loss required for reimbursement (Butsch et al., 2007).

The Singapore based TRial on Incentives for Obesity (TRIO) tested an alternative approach to a more traditional incentive scheme. One hundred sixty one subjects were recruited to the twelve-month intervention and were required to pay the program entry fee (approximately \$300USD). A portion of the fee covered the Obesity Management (OBM) program and the remainder of the fee allowed the participant to gain access to the incentive scheme. Participants were randomized 1:2 (control:reward) and if randomized to the control group, were refunded the portion of the initial fee that covered the incentives. Subjects randomized to the reward group selected one of the two reward categories: a guaranteed cash payment for meeting weight loss goals, or a lottery with a 1/10 chance of winning ten times the guaranteed amount. All participants participated in the OBM program which included a fitness assessment, personalized diet advice from a dietitian, as well as group and individual sessions focusing on meal planning, goal setting and reading food labels. Average weight loss was more than twice as much in the reward arm compared to the control, and remained statistically higher through the end of the study. This study demonstrated that some individuals are willing to pay for access to a rewards program within a behavioral weight loss intervention (user satisfaction was above 80%) and this proved to be a very cost-effective way to offer incentives for weight loss (Finkelstein, Tham, Haaland, & Sahasranaman, 2017).

In another randomized-controlled trial, 700 patients were enrolled during their final week at an inpatient rehabilitation clinic in Germany. As part of his or her discharge

procedures, the clinic physician set an individual weight loss target (weight reduction of 6-8 percent) for each participant that was to be achieved within the following four months. After the weight loss goal was established, participants were randomized to one of three experimental arms, one control and two treatment groups (one could earn up to 150 Euros for meeting their weight loss goal, the other could earn up to 300 Euros). All three arms received medical advice and counseling. Patients were required to meet at least 50 percent of their original goal to be eligible for any financial payout (which was dispensed proportionally after 50% so the full payment was only received if they achieved their weight loss goal). The results showed that financial incentives effectively encouraged obese individuals to lose weight across all subgroups, consistent with other study results. Of note, there was also evidence that certain subgroups (women and migrants) were motivated by increases in incentive (as the incentive increased, weight loss also increased in these two groups), indicating perhaps that large financial incentives could be especially influential for those who are economically disadvantaged. Of all the participants, the male subgroup achieved at least a 5% weight reduction across all treatment groups and had the greatest average weight loss for the nonpayment condition, suggesting men are perhaps more motivated to lose weight than previously thought (Paloyo, Reicher, Reuss-Borst, & Tauchmann, 2015)?

### **Weight Loss in Men**

A variety of studies have demonstrated that men are less likely to perceive themselves as overweight (men regularly sense they are overweight at a much higher BMI than women do), and therefore are less likely to attempt weight loss or participate in a weight loss program (Andersson & Rössner, 1997; Brown et al., 2015; Collins, Morgan,

Warren, & Lubans, 2011; Crawford & Campbell, 1999; Lemon, Rosal, Zapka, Borg, & Andersen, 2009; Morgan, Lubans, et al., 2011; Young et al., 2012). Interestingly, women typically report losing weight as more important to them than men do and report the willingness to do more to achieve weight loss than men (Harris, Waschull, & Walters, 1990). Men are less likely than women to maintain any weight loss (Kramer, Jeffery, Forster, & Snell, 1989). Nevertheless, millions of Americans each year attempt to lose weight. In 2013, approximately \$2.4 billion was spent on weight loss services and estimations approach \$2.7 billion will be spent in 2018. Unfortunately only a small proportion of current weight loss participants are men (approximately 27%), both commercially and in the research setting (Franz et al., 2007; Pagoto et al., 2012).

Perhaps the most striking example is when asked about barriers to weight loss, men have stated that weight loss is a feminine activity and the majority of weight loss programs are targeted towards women only, and that they therefore are not interested (Gough & Conner, 2006; Sabinsky et al., 2007; Souza & Ciclitira, 2005).

## **Previous Obesity Interventions for Men**

### *Rates of Participation*

As previously mentioned, a recent analysis of weight of 80 weight loss trials between 1997 and 2004 revealed the average study sample contained about 27 percent men. In a separate systematic review of weight loss interventions conducted online, less than 23% of the 5700 participants were men (Neve, Morgan, Jones, & Collins, 2010). Although it is not entirely clear why men choose to participate in weight loss less frequently than women, we do know that it is possible men perceive too many barriers to weight loss and/or the currently available programs do not appeal to them, because they

are inconvenient, seem catered to women, or don't have other participants the men believe they can relate to (Morgan, Warren, et al., 2011; Sabinsky et al., 2007).

### *Male Weight Management Programs*

*In-Person Interventions.* To date, there have only been a handful of weight management interventions designed specifically for men. In 1984, Jeffery et al. recruited 89 middle-aged obese men from a random community sample in Minneapolis – St. Paul. Participants were first contacted by mail, and then by telephone. Treatment was a 15-week behavioral intervention including weekly group meetings emphasizing behavior control techniques such as increasing everyday activity, daily weighing, reduced snacking, and implementing a regular exercise program. Participants were followed for two years. Mean weight loss after the treatment period was  $-29.7 \pm 12.3$  lbs. Mean weight loss at the one-year follow up was  $-16.1 \pm 15.2$  lbs and at the two year follow-up was  $-11.2 \pm 15.4$  lbs. High attendance was associated with greater weight loss and more successful weight maintenance. The behaviors most strongly predictive of success during this intervention were regular self-weighing, regular exercise and improved food selection. This study also found a strong inverse relationship between successful weight loss and prior participation in a structured weight loss program. Surprisingly, spousal attendance at the group sessions was inversely related to successful weight loss at one year, suggesting that joint programs may not be helpful (Jeffery et al., 1984).

The 'Gustaf' study conducted in Sweden recruited 86 men by invitation from an outpatient obesity unit for a two-year program consisting of weekly small group sessions. During these hour-long sessions, weight management themes were discussed such as physical activity, self-monitoring, nutrition education and eating techniques. In addition

to the weekly group sessions, the men attended a joint cooking session four times a year and met with a study physician every six months. At the end of the intervention, BMI, weight and waist circumference had decreased in study completers (the cumulative drop-out rate at two years was 34%). The mean weight decreased from  $121 \pm 16$  kg to  $115 \pm 19$  kg after two years. Study participants were able to significantly reduce several other obesity-related risk factors, such as blood pressure, serum triglycerides and blood glucose. However, long-term, in-person group treatment for overweight and obese individuals is both pricey and time-intensive (Andersson & Rössner, 1997).

Ross et al. compared diet-induced weight loss to exercise-induced weight loss in 52 men with abdominal obesity through a University research center. Randomized to one of four groups: weight loss by diet, exercise intended for weight loss, exercise not designed for weight loss, or control. At baseline and 12 weeks, researchers measured weight, total body fat, abdominal body fat, muscle and physical fitness. Men in both the diet and exercise weight loss programs lost an average of 16 pounds. There was no change in weight for the other two groups. Body fat decreased in both weight loss groups, but the men who performed exercise for weight loss lost more body fat than the men who completed the dietary program for weight loss. Plasma glucose and insulin resistance also improved in both weight loss conditions. While the weight loss groups were successful, the results may not be generalizable to other populations (women, individuals with nonabdominal obesity or less obese individuals). Furthermore, the study was brief (12 weeks total) so long-term results are unclear (Ross et al., 2000).

Using an experimental design conducted during a US Naval deployment, Dennis et al. compared two groups of men (thirty-nine total men) during a six-month deployment



who had previously failed their Physical Readiness Test (PRT) due to overweight or obesity. One group was randomly assigned an intervention that included nutrition and cognitive-behavior treatment, the other operated as the control group and was assigned exercise alone (which would be the customary Naval treatment after failing such an exam). During the 16-week program, both groups lost a significant amount of weight (-8.6 ± 5.0 kg weight loss in the treatment group, -5.0 ± 4.1 kg weight loss in the control group), but most men did not lose enough to meet the PRT standards, even though the average weight loss of 8% would be considered clinically significant. While the success of this program is apparent, the results are not generalizable to a larger population, as this was run in a group of military personnel required to meet certain physical benchmarks and was completed in a tightly controlled aircraft carrier setting (Dennis, Pane, Adams, & Qi, 1999).

Previous behavioral weight loss research has established that giving subject meals during a weight loss program can improve treatment outcomes (Jeffery, Wing, et al., 1993). Using this as a knowledge base, researchers at the University of Illinois enrolled 60 men to a randomized controlled study focusing on diet alone for 8 weeks. Men were recruited through a mailed flyer and an associated screening website. One group of men was instructed to self-select their diet based on the USDA Food Guide Pyramid. The second group was provided with free frozen entrees for all meals (also based on the USDA Food Guide Pyramid recommendations). Both diets were prescribed to be about 1700 kcal per day and had similar macronutrient proportions. Both groups lost a statistically significant amount of weight (-5.1 ± 4.0 kg weight loss in the food pyramid group, -7.4 ± 3.1 kg weight loss in the frozen entrée group) and the group who consumed

only the frozen entrees experienced significantly more weight loss. The frozen entrée group also had a greater reduction in body fat, waist circumference and blood pressure. Unfortunately, this study was only conducted for 8 weeks, and more lasting lifestyle changes would need to take effect for long-term weight loss maintenance (Hannum et al., 2006).

Another research group evaluating diet was Wilma Leslie and colleagues in Glasgow, Scotland. The study used a randomized, controlled design and participants were randomized to one of the four prescribed diets including an overall daily energy deficit goal or a generalized low-calorie diet. Potential participants were recruited from a large industrial worksite and 122 men enrolled between 18 and 55 years of age. Data analysis revealed no statistically significant difference between the groups, but reported an overall average weight loss of 4% (mean weight was reduced from  $96.4 \pm 13.6$  kg at baseline to  $92.6 \pm 14.0$  at week 12). This study was effectively completed at a worksite, which has been thought to be a prime location for health promotion in the male population (Leslie, Lean, Baillie, & Hankey, 2002; Morgan, Collins, et al., 2011).

*Internet-Based Interventions.* Philip Morgan et al. have completed three separate weight loss studies for men in Newcastle, Australia. The first of which, Self-Help, Exercise, Diet and Information Technology (SHED-IT) was the first internet-based randomized controlled trial exclusively for men. The program and messages within were designed specifically to appeal to men, based on previous research. The SHED-IT program compared the efficacy of two relatively ‘low-dose’ weight loss plans including an internet-based program and an information only program that acted as the control. Online-weight loss trials have established that the internet is an appropriate tool for

delivery of a successful weight loss intervention (Saperstein, Atkinson, & Gold, 2007; Weinstein, 2006). Overweight and obese men were recruited from advertisements on University notice boards and a website and 65 men enrolled in the program. The internet-based program involved a single in-person information session where they received a program booklet with weight loss lessons for men, followed by three months of online support to assist with goal setting, social support and self-monitoring. The control group also completed the in-person information session and received the booklet, but did not participate in any online support. Following the three month online component, significantly more participants in the internet program had achieved at least a 5 percent weight loss ( $-13.8 \pm 2.1$  kg weight loss) compared to the control ( $-12.2 \pm 4.3$  kg weight loss), however both groups lost a significant amount of weight as well as other improvements in health outcomes. The SHED-IT study contributed valuable knowledge to the field of internet weight management programs and low-level weight loss interventions specifically designed for men. Limitations of the study included the lack of a true control (a waitlist control group may improve weight status based on eligibility by BMI classification for the study). (Morgan, Lubans, Collins, Warren, & Callister, 2009).

The second male weight loss study conducted by Morgan et al. was a three-month workplace-based program for male shift workers at an Australian aluminum plant. Not only are male weight loss studies uncommon, but blue collar workers are also underrepresented in the weight loss literature (Anderson et al., 2010). One hundred ten men were randomized to one of two groups: the Workplace POWER (Preventing Obesity Without Eating like a Rabbit) program or a waitlist control. Similar to the SHED-IT trial, the majority of the program information was disseminated online, with only one in-

person information session provided at the beginning of the trial. Results demonstrated a significant improvement in weight, blood pressure, resting heart rate, waist circumference and physical activity, with medium to large effect sizes. Weight loss at 14 weeks was -0.3 (-0.1, 1.7) kg for the control group and -4.0 (-5.1, 2.9) kg for the intervention group. This was the first weight loss program to target male shift workers and added a notable contribution to the weight loss literature as well as health promotion in the workplace due to its overall success and relatively low level of interaction due to the internet-based delivery. The program had no long-term follow-up after the 14-week time point and was executed at only one worksite, which could limit generalizability (Morgan, Collins, et al., 2011).

The final weight loss trial by Morgan and colleagues was the ‘Healthy Dads, Healthy Kids’ program aimed at overweight fathers and their children, in order to help overweight fathers lose weight and provide an example of healthy behaviors to their children. Previous family based interventions had primarily targeted mothers. Fathers alone had not been a previous program target. Fifty-three men and their primary school-aged children were recruited through school newsletters and local newspaper advertisements and were randomized to the ‘Healthy Dads, Healthy Kids’ (HDHK) program or a waitlist control. The HDHK program lasted for three months and required eight in-person group sessions. Five of the sessions were for the fathers only and three were for both the fathers and their children. Program goals were to assist the fathers in reaching their weight loss goals, promote healthy behavior in the children and enhance healthy role model behavior for dads. Over the course of the intervention, the HDHK group lost (and maintained) a statistically significant amount of weight at both three and

six months (-6.7 (-8.2, -5.1) kg weight loss at three months, -7.6 (-9.2, -6.0) kg weight loss at six months) compared to the control group (-0.4 (-1.9, 1.1) kg weight loss at three months, 0.0 (-1.4, 1.6) kg weight loss at six months). Additionally, the children in the HDHK group increased their physical activity at three months and maintained the increase at six months. The HDHK trial was a success for a family intervention and provides a solid framework for future studies with overweight fathers. The in-person component requires a significant time commitment from both participants and researchers, which could be detrimental to participation and long-term feasibility (Morgan, Lubans, et al., 2011).

Finally, Tanaka et al. in Fukuoka, Japan designed a computer-based weight loss program with no face-to-face interaction between subject and researcher once the program commenced. Fifty-one middle-aged working men were randomized to the Kenkou-tatsujin™ (KTP) computer program or a control. Recruitment was conducted through a newspaper advertisement in Kyoto, Japan. The KTP program collected self-reported weight, daily steps, and performance on dietary/physical activity behaviors including alcohol consumption, restricting intake of sweet beverages, choosing low-fat dairy, and more. The program was set up to help users set goals and provided individualized feedback based on their evaluation of adherence to the targeted behaviors (adherence was evaluated as good, fair and poor). Primary outcomes were measured at one month and then collected once monthly for the following six months. Weight loss was greater in the KTP group compared to the control at one month ( $-1.1 \pm 1.4$  kg vs.  $-0.3 \pm 1.0$  kg) and continued through month seven ( $-2.4 \pm 3.2$  kg vs.  $-1.6 \pm 1.8$  kg). While the KTP program was cost-effective and required little time-commitment from the research

team, there was so little interaction from study participants over the course of the program, it is hard to definitively state that any weight loss was due to the intervention or whether it was due to some other external influence (Tanaka, Adachi, Adachi, & Sato, 2009).

### *Rethinking Eating and FITness (REFIT)*

The six-month REFIT intervention was designed and executed by Melissa Crane et al. at the University of North Carolina. The objective of the intervention was to help participants alter their daily lifestyle behaviors surrounding eating and physical activity in order to achieve weight loss of one to two pounds per week (up to 10 percent of initial body weight). REFIT was created to provide a clear framework for subjects to work within while also allowing room for personal autonomy. The intervention was devised using theoretical constructs from social cognitive theory and self-determination theory (see below). Subjects were randomized 1:1 to the REFIT intervention or a waitlist control group.

The REFIT program included education and recommendations for nutritional intake, physical activity and self-monitoring, delivered via two, in-person group sessions and thirteen weekly online check-ins. Each weekly check-in included individualized feedback, guidance in target behavior selection and assistance with SMART goal setting. To establish baseline behaviors, participants were asked to track eating patterns and physical over a one-week period prior to study commencement. During this week, subjects were also encouraged to weigh themselves regularly to begin a habit of self-monitoring and to recognize the link between personal behaviors and weight.

The goal of REFIT was to reduce daily caloric intake through at least six 100-calorie changes from typical eating habits in order to create a daily calorie deficit of 600 calories, adding up to 4200 calories for the week. In order to make the six 100-calorie changes, participants used REFIT lessons that concentrated on certain eating behaviors or food groups. Many of the targeted behaviors have been used in prior studies of weight loss (D. P. P. R. Group, 2002). Examples of REFIT lesson topics included portion control, eating in social situations, managing meat consumption, and reducing fat. Each of the lessons included specific examples of 100-calorie changes to better guide subjects to meet their goal. All lessons from the original REFIT intervention focused on diet changes, as evidence indicates men have greater trouble making diet modifications than increases in physical activity (Collins et al., 2011).

There were sixteen REFIT lessons available, however participants self-selected one target behavior and related lesson each week, and not all participants selected each of the sixteen lessons. One target behavior and lesson allowed the men to focus on one behavior and consider the impact of the behavior on their weight. If they were successful in accomplishing the goal weight loss that week, they were permitted to carry on with the same strategy or select a different one for the following week.

While increasing exercise was not a primary objective of REFIT, exercise plans were included to guide subjects towards increasing their moderate to vigorous physical activity over the six-month program (up to 225 minutes per week). Three different plans were available based on self-reported baseline physical activity, beginning at 50, 100 or 175 minutes per week.

Each week, participants were asked to complete one online check-in. The check-in was administered via an online survey platform and participants reported their weight, number of daily 100-calorie changes made during the previous week, days of self-weighing, and minutes of physical activity. REFIT subjects also selected their target behavior/lesson during the online check-in and automated feedback was emailed to each man after check-in completion, based on his entries.

In-person assessments were completed at baseline, three months and six months. During assessment, height, weight, waist circumference, total body fat and demographic information was collected. Subjects were also asked to complete a variety of questionnaires at each assessment time point.

The REFIT group lost significantly more weight than the waitlist control at three (-5.0 kg (95% CI: -6.1, -3.9) vs. -0.6 kg (CI: -1.7, 0.5)) and six months (-5.3 kg (95% CI: -6.5, -4.2) vs. -0.6 kg (95% CI: -1.8, 0.5)). The REFIT group also had significant reductions in body fat and waist circumference, and on average more REFIT group men achieved at least a 5 percent weight reduction. REFIT participants also reported a significantly greater number of calories expended through physical activity at the three and six month assessment time points. Overall, the REFIT intervention demonstrated compelling weight loss and physical activity results, sustained high levels of program utilization (participants reported making an average of 27.7 of the 42 100-calorie changes per week) as well as program satisfaction, and maintained great subject retention over the six months.

Social Cognitive Theory in REFIT The REFIT weight loss intervention was designed in part based on theoretical constructs from Social Cognitive Theory. Self-



efficacy, self-regulation and outcome expectation constructs from Social Cognitive Theory were all used in the REFIT intervention and have been associated with weight loss in previous weight loss trials (McAlister, Perry, & Parcel, 2008).

REFIT boosted self-efficacy in a variety of ways. Through the selection of small 100-calorie changes, REFIT participants were able to increase feelings of mastery, which is directly related to self-efficacy, while achieving small goals (which ultimately lead to the greater goal, successful weight loss) (Bandura, 1991). Self-efficacy was also augmented through positive reinforcement delivered in the individualized feedback provided after each weekly check-in (McAlister et al., 2008).

Self-regulation was an integral component of the REFIT program, as participants self-monitored their weight, dietary choices, and physical activity on a regular basis, which was consistently reported during the weekly online check-in.

Some negative outcome expectancies reported by men during intervention focus groups and previous weight loss trials is the belief that weight loss is too time consuming, programs are only tailored to women and the only way to lose weight is through strict dietary restriction without accommodations for things like treats or alcohol (Egger & Mowbray, 1993; Morgan, Warren, et al., 2011). REFIT helped modify these outcome expectancies through the basic program design (which clearly was targeting men), allowing men to practice autonomy when selecting their 100-calorie dietary changes and necessitating only 15-30 minutes on a weekly basis for the online check-ins.

Self-Determination Theory in REFIT One component of Self-Determination Theory, developed by Ryan and Deci, is autonomous motivation. Autonomous motivation includes motivation from both internal and external sources (as long as the

individual finds the activity to be valuable and feels the activity aligns with their sense of self).

Ryan and Deci recommend several methods for increasing autonomous motivation. A focus on autonomy support is imperative. Autonomy support incorporates urging participants to set personal goals based on what is directly important to them and providing them with choices in behavior (Deci & Ryan, 2008). Promoting comprehension of why a behavior is personally relevant can also increase autonomous motivation (Ryan & Deci, 2000). Utilizing these recommendations, the REFIT program delivered information and choice in a mode that was autonomy supportive. The lessons highlighted why each behavior was important to the overarching weight loss goal and participants exercised autonomy each week within the structured program to select a dietary behavior and associated lesson to concentrate on.

### **Summary and Statement of Purpose**

The obesity epidemic in the United States is an enormous public health problem. Rates of obesity continue to climb, especially for men, presenting huge economic and social costs. Diet modification and exercise continue to be the gold standard for obesity treatment across all settings (physician-promoted weight loss, commercial weight loss programs and research weight loss interventions). Men, however, remain difficult to enroll in weight loss programs and continue to be underrepresented in the weight loss literature.

Not only are there very few research weight loss programs targeted for male participants, but there are even fewer that include incentives for weight loss or that target lower education men in their eligibility criteria. Philip Morgan and colleagues were the

first (and only) research team to recruit male blue-collar shift workers to a highly successful weight loss intervention. Similarly, only one weight loss trial for men has utilized a modest group-based financial incentive (the work crews with the highest mean weight loss at one month and program conclusion were given a \$AU50 gift card) however, they were unable to draw any clear inferences about the effect of the incentive on the success of the intervention, leaving a sizeable gap in the male weight loss literature (Morgan, Collins, et al., 2011).

The benefits of weight loss have been well documented. Incentives are an effective tool to motivate behavior change, and there is ample evidence to support the use of incentives to encourage many health-promoting behaviors, such as weight loss. Motivating weight loss in men by using financial incentives in a previously tested successful weight loss program contributes to the male weight loss and incentives for health promotion literature, alike. Therefore, the goal of this study was to evaluate the impact of financial incentives to facilitate weight loss in men with two years of college education or less, delivered as part of a weight loss intervention.

## **CHAPTER 2: A Crowdsourcing Approach to Understand Weight and Weight Loss in Men**

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## **Introduction**

Obesity and overweight are key contributors to chronic disease and pose a large public health challenge, with approximately 74% of American men classified as overweight or obese[1]. In the United States in 2008, the medical costs associated with obesity reached \$147 billion, and annual estimated medical costs are currently \$1500 higher for individuals with obesity[2]. In 2013, approximately \$2.4 billion was spent on weight loss services provided by over 29,000 companies, and 85% of consumers of the services were women[3].

Men who are overweight or obese are generally recognized as a hard to involve, yet high-risk group for obesity-related chronic disease treatment[4, 5]. A variety of studies have demonstrated that men are less likely to perceive themselves as overweight, and therefore are less likely to attempt weight loss or participate in a weight loss program[4-9]. In a systematic review of weight loss interventions conducted online, notably less than 23% of the 5700 participants were men[10]. However, while both qualitative and quantitative studies suggest limitations to the current literature related to weight loss interventions, there is less information on why men may be reluctant to seek out weight loss treatment in the first place. This illustrates a visible and pressing need to identify novel approaches and program elements that can effectively engage men in initial weight loss and successful long-term weight maintenance. Crowdsourcing has the ability to generate large amounts of data from a broader and more diverse population of men, thus ameliorating some of the limitations and bias inherent in other previously collected data.

Crowdsourcing is a strategic model used to draw insights from an interested group of individuals who are able to suggest solutions beyond those offered by traditional forms of research. In other words, the crowd “solves” the problem that has scientific professionals puzzled[11]. Web-based crowdsourcing is an inexpensive, fast method to build new hypotheses and uncover unforeseen problems that experts may have previously overlooked[12]. Crowdsourcing is a mixed methods approach with a form of qualitative methodology (the questions being submitted by the subjects) and a quantitative component (the numerical scoring of the answers to posed questions). Therefore, crowdsourcing provided the ideal methodology to use in this study where professionals are “stumped” about the issues surrounding male participation in weight loss interventions and are looking to generate new questions that haven’t come with a more traditional type of qualitative research methodology. The goal of the study was to utilize crowdsourcing to detect possible unexpected or new predictors of barriers to weight loss in men in order to guide future intervention design and successful recruitment of men to a weight loss study.

## **Materials and Methods**

### *Recruitment*

Participants were recruited for participation in this study through direct email from investigators, advertisements posted in a widely distributed University of Vermont email newsletter, and reddit.com, which is a social networking and news website with user-submitted content. The notice on reddit.com was posted in a specific section focused on weight loss [www.reddit.com/r/loseit](http://www.reddit.com/r/loseit) where many users spend time reading and commenting on other users’ posts, links and photos. Reddit.com was specifically chosen

due to the interactive nature of the website, the high number of users (approximately 900,000 unique visits each day), and the fact that seventy one percent of Reddit users are men [13].

### *Crowdsourcing Methodology*

The website used in this study was based on two prior experiments designed to study individual body mass index and the monthly electric energy consumption of a homeowner. While body mass index and energy consumption are not directly linked, the methodology employed and the two crowdsourcing websites operated in similar ways. These websites were reconstructed to collect crowdsourced predictors of BMI for men only[14]. The survey was designed so users could answer questions and pose new questions they believed could predict obesity. Our goal was to gather men's and women's insight about predictors, challenges, barriers and aspects related to male weight loss as well as investigate the relationship between male BMI and the answers to the crowdsourced survey questions. To provide a more interactive experience, users were asked to enter their real BMI at the beginning of the survey and the computer displayed their "predicted" BMI after each question was answered, based on the association of other users' responses and their self-reported BMI. Research participants who visited the website, titled "The Great Weight Debate", were first asked to enter their height, weight and gender in order to calculate body mass index (BMI) and track gender for data collection purposes. While this study was specifically interested in predictors of male BMI, women were not prevented from answering and posing questions. However, female responses were excluded from all analyses. We permitted women to ask and answer questions in order to gather more potentially useful information (Do women have ideas

about male weight loss that men perhaps have not considered?) We were specifically interested in the relationship between the survey questions and male BMI, which was why female responses were not included in the analyses. Users also had the opportunity to create a “profile” using their email address in order to be eligible for one of the three lottery-selected financial incentives (\$100 VISA gift card) designed to encourage participants to answer all questions on the website at the time of their visit. Previous studies suggested the importance of an incentive to encourage users to answer more questions in the survey[14, 15].

### *Crowdsourcing Survey*

The home page for the survey provided a brief introduction to crowdsourcing and our research project, as well as a quick video demonstrating how to navigate the website. Contact information for the Principal Investigator and a ‘Frequently Asked Questions’ link were also available.

The survey was ‘seeded’ with six questions the investigators expected to be related to male BMI, based on previous research[16-18]. The seed questions were “Have you ever been diagnosed with diabetes?”, “Have you ever been diagnosed with high blood pressure?”, “Are you married?”, “Do you participate in an organized sports league?” (all yes/no responses) and, “How concerned are you with your appearance? (5 point Likert Scale with 1=not at all concerned and 5= very concerned)”. All questions were given to participants in random order. Throughout the survey each question screen displayed the participant’s actual BMI alongside their predicted BMI. The predicted BMI was calculated in real-time by performing linear regression on all of the questions and



responses from earlier survey users and was updated each time the participant answered a question.

Users were able to pose questions of their own, that they believed would help predict male BMI, at any time throughout the survey with one of three different response formats: yes/no, a Likert scale rating 1-5, or a numerical answer. They were unable to pose open-ended questions, for data collection purposes. The survey monitor reviewed all suggested questions and approved questions were added to the survey expeditiously to be answered by other participants visiting the site. Questions were not approved for the survey if they were duplicates of questions already in the survey, contained profanity, or were not deemed to be serious (e.g., “Can you crush an entire bag of cheese doodles in one sitting?”) All questions were presented to users randomly, each with an equal chance of appearing for the user to answer. Figure 1 outlines the crowdsourcing survey format as described by Bevelander and colleagues in a crowdsourcing study for childhood predictors of adult obesity[15].

Data were collected for a two-week cycle in December 2015. Similar to previous studies, no target sample size was established, as it is impossible to estimate the number of participants or the number of questions and answers collected[14, 15]. For this study, the two-week fixed time frame was established during pre-study design and the sample size was the number of participants during that period.

### *Statistical Analysis*

Correlations between question responses and BMI were calculated between self-reported BMI and responses to questions for all male respondents. Pearson correlations were calculated for Likert scale and numerical responses and Spearman’s rho was

calculated for yes/no responses. All questions that received fewer than 50 responses were excluded from analyses due to insufficient response numbers to appropriately assess correlations.

Anonymity is one of the advantages of the crowdsourcing mechanism, however this introduces a level of reporting bias in that survey users may not accurately represent themselves in the study (providing incorrect BMI information, untruthfully answering questions, etc.) After collecting all questions and responses, we encountered six obviously falsified answers (responses with numbers that were astronomical in size, e.g. 1,261 servings of dairy consumed on an average day), which were removed from all analyses.

## **Results**

Five hundred twenty-two visitors initiated the survey during the two-week survey period. Males comprised 57% of respondents, therefore the sample size for data analysis was 298, once we removed participants who reported an implausible BMI. Men with obesity (BMI>30) comprised 43.3% (n=129) of the sample, overweight (BMI 25.0-29.9) 33.6%, (n=100) healthy weight (BMI 18.5-24.9) 23.1%,(n=69) and underweight (BMI<18.5) 0%.

In addition to the six ‘seed’ questions supplied by the researchers, participants proposed 192 new questions, 188 of which were approved and added to the survey. In total, participants provided 21,846 responses to the 193 questions. Participants could only answer each question once. On average, each question was answered 126 times. Twenty-six questions were excluded due to fewer than 50 responses.

Out of the total 193 questions that were posted to the survey, 37 questions were significantly correlated with self-reported BMI ( $p < .05$ ), 21 of which were significant to  $p < .01$ . Table 1 presents those questions scaled from the highest correlation to the lowest. The two most highly correlated predictors of high BMI were “Do you think your BMI is above average?” and “How many servings of dairy products do you typically consume on an average day?” The most highly correlated predictors of healthy BMI were “Are you happy with your weight?” and “Are you happy with your body?”

Table 2 shows some of the most frequently answered questions, categorized by popular themes and sorted for significance.

## **Conclusions**

Findings from this study demonstrated that the crowd was able to suggest many well-documented factors related to BMI. For example, prior obesity research suggests that many overweight or obese individuals are concerned about their appearance, body image and health[19-21]. This was also true of men in our study who were significantly more likely to answer (and ask) questions such as “Are you happy with your body” and “I am comfortable in a swimsuit.” Additionally, survey users suggested a variety of other factors known to be associated with weight including physical activity (e.g. participating in organized sports, planning outdoor activities, walking or biking to work), dietary intake (e.g. diet soda, breakfast, snacking habits), and screen time (e.g. television viewing, video games)[22-26].

By contrast, several unexpected finding emerged. Several questions were related to dairy product consumption, but many did not support previous research. Number of reported daily dairy servings was positively significantly correlated with BMI, which

could make sense if individuals are consuming high fat, high calorie dairy products. Some previous research found that high dairy product consumption was associated with lower body fatness[27, 28] although recent consensus is that dairy consumption alone has no substantive impact on weight one way or the other[29, 30]. Curiously, reported weekly consumption of ice cream/frozen yogurt/gelato was negatively significantly correlated with BMI and milk consumption was not significantly correlated at all. Crowdsourcing is not a recognized valid dietary intake measurement, and it is not clear what all this means. Regardless, dairy product consumption, rather than say, meat intake, was asked and answered by men.

Some unique, potentially sedentary activities (watching home improvement shows, reading books, watching video games) posed by men were correlated with higher BMI. While moderating the comment stream on reddit.com, the discussion of both playing and watching others play video games in online forums was mentioned regularly, perhaps providing some insight on an interesting male activity. There are several studies on video game use in children, but the literature on adult video game playing as well as watching others play, is quite limited [31]. Certainly, sedentary behavior is an independent predictor of chronic disease[32] and should be targeted along with activity to improve health. The suggestion that men not only play video games but watch others play could have important implications for intervention research.

The crowdsourcing survey brought forth many questions about physical activity. The correlation between physical activity and BMI is nothing new or unexpected, but it is interesting that many of the questions posed are related to the enjoyment of physical activity instead of strictly the practice (i.e., type, intensity, duration). Research indicates

that increasing exercise improves body image in men[33]. Because body image came up a bit more frequently than expected, this would appear to be more of a “hook” into treatment for men than previously thought. Increasing enjoyment of physical activity may not only help to sustain the behavior in men, but may have an important feedback to body image enhancement.

Many other well-documented weight-related factors were not significantly associated with BMI in this study. Sleep has been negatively correlated with BMI in a variety of studies, but was not found to have any correlation in this investigation[34-36]. Regular self-monitoring in the form of frequent weigh-ins or food journaling[37, 38] has also been shown to have an association with lower BMI, which was not evident in our study. Intimate personal relationships and sexual behaviors did not correlate with BMI, although previous crowdsourcing research related to BMI would suggest a strong correlation[14]. More specifically, questions about marital status and having a partner with similar diet goals were not significantly correlated with male BMI.

#### *Limitations and Future Research*

While crowdsourcing is a novel approach, there are limitations to utilizing this methodology that could be addressed in future studies. It is important to consider that not all participants answered each question. Over 300 users answered the first six questions, but the last few questions only collected 2-3 answers. While we did offer a lottery-selected financial incentive to answer all questions posted on the site at the time of each participant’s initial visit, a different incentive structure to motivate participants to return to the site as more questions are added could be beneficial for further data collection. It

may also be beneficial to log how long participants spent on the site, as a measure of seriousness of the survey participants.

We are particularly intrigued by the introduction of video games as a significant sedentary behavior with high correlation to BMI as well as the very small number of proposed questions relating to intimate personal relationships and their impact on weight. It is certainly understood in the literature that sedentary behavior is associated with higher weight, and perhaps further investigation of this population of men who participate in “gaming” is worth pursuing. Additionally, future intervention design could focus on the relationship between weight and relationship status/household roles (who does the cooking, grocery shopping, etc.) perhaps to better decipher the consistent external influences on weight management for men.

Finally, while we hoped to gather ideas related to male motivation and engagement in weight loss studies, the nature of crowdsourcing does not allow us to dictate what information we will receive from the “crowd”. Crowdsourcing allows researchers to pose questions, and while we could have perhaps guided our research question a bit differently to better target interest and enthusiasm, it was also our goal to not guide the discussion in one way or another and instead see what the “crowd” came up with. We did not end up collecting many ideas of how to better target men for weight loss interventions, but we were able to collect valuable information surrounding why men are perhaps overweight in the first place. In order to appropriately design a successful weight loss program for men, it is important to better understand the background and the behaviors to change; such as less time spent playing/watching video games or more time

spent participating in organized physical activity such as team sports or planned outdoor activities.

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### **Conflicts of Interest**

The authors declare no conflicts of interest.

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## Tables

Chapter 2 – Table 1: Questions Significantly Correlated with BMI for Men

Question	Correlation	Number of Responses	<i>p</i> -value
<b><i>Likert Scale</i></b>			
I enjoy watching home improvement shows.	.221	95	.032
I prefer salty snacks over sweet snacks.	.174	153	.032
I am comfortable in a swimsuit.	-.302	164	<.001
I buy organic even if it is more expensive.	-.172	151	.035
I always choose the healthy snack when given a choice.	-.170	170	.027
<b><i>Yes/No</i></b>			
Do you think your BMI is above average?	.623	151	<.001
Is anyone in your immediate family overweight?	.341	154	<.001
Have you lost weight and regained all or some of it?	.313	98	.002
Have you ever been diagnosed with high blood pressure?*	.257	172	.001
Have you tried home workout videos or programs?	.242	100	.015
Are you concerned with calorie and fat content of the foods you eat?	.212	164	.006
Do you own a cat?	.199	130	.023
Do you own a car?	.188	115	.045
Do you own a pet?	.160	163	.041
Are you happy with your weight?	-.487	163	<.001
Are you happy with your body?	-.446	159	<.001
Can you do a pullup?	-.418	105	<.001
Do you feel healthy?	-.401	154	<.001
Can you run 1 mile or further?	-.316	106	.001
Do you frequently listen to audiobooks or podcasts?	-.284	84	.009
Do you always take the stairs?	-.268	109	.005
Did you grow up in a family that embraced an active lifestyle?	-.258	155	.001
Do you plan active outdoor activities (such as going for a hike or going skiing) for fun?	-.251	145	.002
Can you do 10 pushups?	-.234	117	.014
Do you eat cereal for breakfast?	-.215	153	.008
Do you enjoy talking about food and fitness topics?	-.203	113	.031

Do you participate in an organized sports league?	-.184	179	.017
Do you participate in outdoor sports in the winter?	-.180	143	.032
Do you like to exercise when you are on vacation?	-.164	160	.038
<b><i>Numerical</i></b>			
How many servings of dairy products do you typically consume on an average day?	.375	156	<.001
How many diet sodas do you drink each day?	.263	158	.001
How many siblings do you have?	.228	151	.005
How many hours a week do you watch video games?	.227	154	.005
How many times a year do you eat at a buffet restaurant?	.212	153	.009
Approximately how many books do you read monthly?	.167	153	.039
How often a week do you eat a leafy green vegetable?	.166	148	.043
How many times a week do you eat ice cream/frozen yogurt/gelato?	-.190	139	.025

\* Seed questions submitted by the study team

Chapter 2 – Table 2: Crowdsourced Questions Answered by Category and Statistical Significance

Category	Significant	Not Significant
<b>EATING HABITS</b>		
	(+) How many servings of dairy products do you typically consume on an average day?	Do you drink milk?
	(-) Do you eat cereal for breakfast?	Do you always eat breakfast?
	(+) How many times a year do you eat at a buffet restaurant?	How many times a week do you eat out?
	(-) I always choose the healthy snack when given a choice.	Do you eat snacks while watching television?
	(+) How many diet sodas do you drink each day?	Do you follow a vegetarian diet?
<b>PERSONAL APPEARANCE/ PERCEPTION</b>		
	(+) Do you think your BMI is above average?	Do you think how you look is important?
	(-) Are you happy with your body?	How concerned are you with your appearance?*
	(-) Are you happy with your weight?	I read magazines with pictures of men that look healthy.
	(-) I am comfortable in a swim suit.	How many times a day do you think about your weight?
	(-) Do you feel healthy?	
<b>BUILT ENVIRONMENT</b>		
	(+) Do you own a car?	Do you live in an urban area?
		Do you live in a rural area?
<b>PHYSICAL ACTIVITY</b>		
	(-) Do you participate in an organized	Do you prefer to be with

sports league?*	someone when exercising?
(-) Do you plan active outdoor activities (such as going for a hike or going skiing) for fun?	I seek out exercise because it makes me both feel and look better.
(-) Do you like to exercise when you are on vacation?	I don't seek out exercise because I don't have the time or energy.
(-) Do you participate in outdoor sports in the winter?	You are more likely to exercise in a group setting.
(-) Do you always take the stairs?	Do you use a standing desk?
<b>CHILDHOOD/ FAMILY</b>	
(+) How many siblings do you have?	My mother believes that exercise is important.
(+) Is anyone in your immediate family overweight?	
(-) Did you grow up in a family that embraced an active lifestyle?	
<b>MEDICAL ISSUES</b>	
(+) Have you ever been diagnosed with high blood pressure?*	Have you ever suffered from depression or symptoms of depression?
	Is there any history of heart disease in your family?
	Do you see a doctor for an annual physical?
<b>NON- EATING/DRIN KING ROUTINES</b>	
(-) Do you enjoy talking about food and fitness topics?	How many hours a night do you sleep?
(+) I enjoy watching home improvement shows.	Do you regularly set goals for yourself?
(+) Approximately how many books do you read monthly?	How many times per week do you weigh yourself?
(+) How many hours a week do you watch video games?	How many hours of sports do you watch a week?
(+) Do you own a cat?	Do you take vitamins or

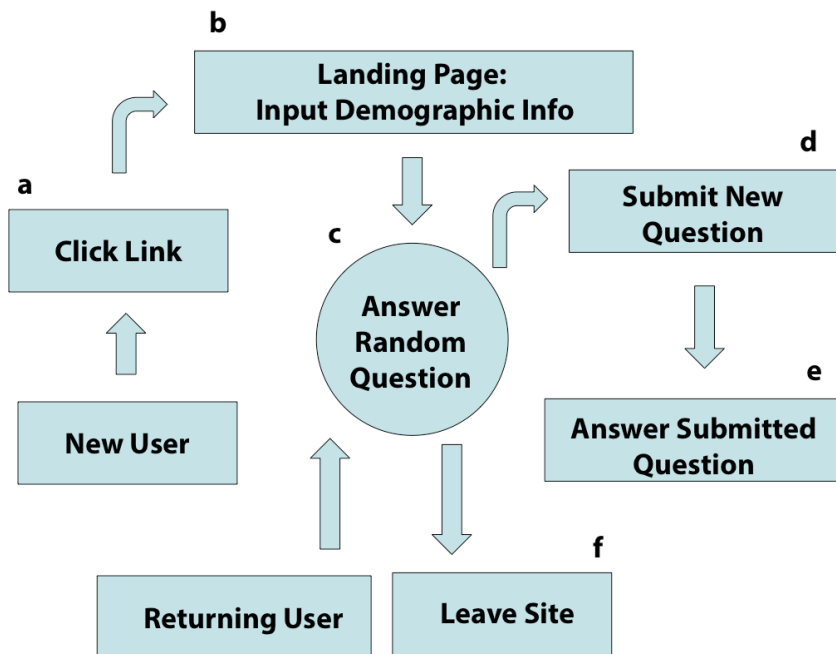
	supplements on a daily basis?
	(-) Do you frequently listen to audiobooks or podcasts?
<b>RELATIONSHI PS/ SEX</b>	
	Are you married?*
	Does your partner share the same diet goals as you?
	How many times a week do you have sex?
	How many hours of porn are you watching a week?

Note: (+) indicates positive correlation with BMI, (-) indicates negative correlation with BMI

- Seed questions submitted by the study team

## Figures

Chapter 2 – Figure 1: Crowdsourcing Survey Flow Chart



### **CHAPTER 3: Enrollment Challenges: Recruiting Men to Weight Loss Interventions**

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## **Introduction**

The number of overweight and obese men has steadily climbed in recent years, presenting a substantial public health problem (Centers for Disease Control, 2016). Current prevalence estimates indicate that 33.7% of men and 36.5% of women in the United States are obese, resulting in over \$190 billion in medical costs, annually (Ogden, Carroll, Kit, & Flegal, 2014). Men are currently underrepresented in the weight loss treatment literature. However, men have nearly the same prevalence of overweight and obesity as women and suffer the same degree of morbidity and mortality because of it (Must et al., 1999). Excess body weight in general increases the risk of many chronic diseases, including heart disease, diabetes, and cancer. Obese men are at an even greater risk of developing these conditions, as men typically accumulate fat in the abdominal region, elevating the health risks related to visceral fat deposits (Jakicic, 2012; Westerterp, Meijer, Janssen, & Saris, 1992).

Research suggests that women enroll in weight loss interventions nearly four times as often as men do, both commercially and in research settings (Franz et al., 2007). Globally only 27% of weight loss trial participants are men, with even fewer men participating in the United States (22% of weight loss subjects) (Franz et al., 2007; Pagoto et al., 2012). Men and women face different societal pressures related to weight, and women typically engage in more dieting behaviors (Pagoto et al., 2012). Men are also far less likely to identify themselves as overweight in the first place (Dorsey, Eberhardt, & Ogden, 2012). While men have less accurate self-perception of body weight than women,

previous research indicates that men are more likely to pursue weight loss as a result of an illness or health issue(Hankey, Leslie, & Lean, 2002; Klem, Wing, McGuire, Seagle, & Hill, 1997; Pagoto et al., 2012).

One widespread hypothesis is that men are not being appropriately targeted during the recruitment process, leaving them unengaged and uninterested. The public image of the weight loss industry is primarily female, with the majority of weight loss participants being Caucasian women. Consequently, when men join a weight loss intervention, they are often depending on approaches that have been designed for women(Lovejoy & Sainsbury, 2009). In order to moderate increased obesity and lessen the negative health consequences associated with excess weight in men, more efforts are necessary to accommodate the needs and preferences of men, in order to increase male enrollment in weight loss interventions (Aguiar et al., 2017; Hunt et al., 2014; Morgan et al., 2012; Morgan, Lubans, et al., 2011; Morgan, Lubans, Collins, Warren, & Callister, 2009; Morgan, Warren, Lubans, Collins, & Callister, 2011; Pagoto et al., 2012).

Research study recruitment can be a momentous challenge. Poor recruitment can result in an underpowered study, producing inadequate data and may also lead to a trial extension or termination, increasing costs. Some estimates suggest that less than half of clinical trials globally achieve their recruitment targets (AB & JPA, 2001; Charlson & Horwitz, 1984; R et al., 2003; Sully, Julious, & Nicholl, 2013). An increasing number of studies have suggested that the strategy for recruitment, instead of a lack of suitable and interested participants, is the largest hurdle for enrolling participants in research studies (Elizabeth F Sutton; Shaun Treweek, 2013; Sood et al., 2009). Fortunately, men tend to have high retention rates in weight loss trials, indicating that while they may be more

difficult to recruit, once they enroll, they are likely to continue with the study (Robertson et al., 2017).

There is a significant need to identify effective recruitment techniques to entice overweight and obese men to join weight loss interventions in order to initiate necessary weight loss and sustain successful long-term weight loss maintenance. Therefore, the purpose of this evaluation was to describe the methods that were, and were not productive, in recruiting men to an intervention designed specifically for males.

## **Methods**

### *Intervention*

With this in mind, a targeted recruitment strategy was developed to enroll 107 men to the Gutbusters weight loss intervention, conducted at the University of Vermont. Upon initial project design, the study was modeled after a previously successful intervention, Rethinking Eating and FITness (REFIT), completed at the University of North Carolina (UNC) (Crane, Lutes, Ward, Bowling, & Tate, 2015). The REFIT curriculum was used as a template for the Gutbusters trial. REFIT was a six-month randomized controlled trial that compared an active intervention to a waitlist control group (Crane et al., 2015).

The plan with Gutbusters was to use the template intervention in a slightly different population of men with the addition of incentives for successful weight loss. The REFIT intervention targeted all men aged 18-65 years with a BMI between 25-40 kg/m<sup>2</sup>. In contrast, for the Gutbusters study, recruitment efforts were originally aimed at men with two years or less of college education. The original intention was to conduct all in-person research activities at each participant's place of business in an attempt to

make the intervention convenient for participants, as men have reported a desire for programs that provide little disruption to their daily routines (Egger & Mowbray, 1993; Wolfe & Smith, 2002). By implementing these changes to the eligibility criteria, the goal was to recruit a unique population of men that are not often enrolled in behavioral weight loss interventions, as the REFIT program primarily followed college-educated men (83.2%) who were employed full-time (88.8%) (Crane et al., 2015).

### *Gutbusters*

Gutbusters was a randomized controlled trial comparing two arms: intervention plus incentives for successful weight loss (defined as losing one pound per week) and intervention alone. The goal of the Gutbusters intervention was to reduce daily caloric intake by making six 100-calorie adjustments to their typical daily diet (for a total of 600 calories per day, or 4200 calories per week). In order to guide participants in how to make these 100-calorie adjustments, a Gutbusters website was developed with thirteen separate lessons focusing on different eating behaviors and activities, such as portion size, caloric beverages, eating in restaurants, etc. The majority of the lessons focused on behavioral changes related to diet, and one lesson provided information on walking as a way to create a calorie deficit (walking one mile burns approximately 100 calories). Participants were given the option each week to select two to three behaviors/lessons to focus on in order to meet their calorie-adjustment goals.

The Gutbusters program included three assessment time points (baseline, 12 weeks and 24 weeks), as well as a weekly in-person weight collection and online check-in for the first twelve weeks. Weights were collected in person each week for twelve weeks on campus at the University of Vermont. The online check-in was completed using

the Gutbusters website and an online survey platform, LimeSurvey. Participants were asked each week to report the number of daily diet changes from the previous week, as well as select the two to three Gutbusters lessons they wanted to focus on for the subsequent week, in order to meet their calorie reduction goals.

Participants repeated assessment measurements at 12 and 24 weeks. Between the 12 week and 24 week assessments, participants had access to the Gutbusters website with the thirteen lessons. An email check-in was sent at week 18 to all participants in an attempt to maintain contact and encourage subject retention.

All study procedures were reviewed and approved by the University of Vermont Institutional Review Board for human research in the behavioral and social sciences.

### **Recruitment**

Burlington, Vermont has a population of 42,417, with approximately 20,619 men and a median household income of \$46,754 (Bureau, 2017). According to the Vermont Department of Health, 60% of adults in Vermont are currently overweight or obese (12,371 men), which provides a substantial subject pool for a weight loss intervention.

### *Worksites*

Seventeen medium to large-sized companies were approached with our target demographic in the greater Burlington, Vermont area over the course of three months. Companies were targeted from a list of Vermont's largest employers that had 150 to 6,500 employees and also had a large proportion of men employed. For each business, an email was sent to a member of Human Resources or to a Human Resources representative through an employee familiar with the study and/or a member of our research team. A maximum of two follow up emails were sent if we received no response after our initial

communication. Out of the seventeen companies, seven responded (41.2%) and of the seven, four (23.5%) were willing to meet to further discuss the Gutbusters study. Two companies decided not to participate after the meeting, and of the final two, one was a governmental organization that learned they could not allow the study at the worksite; the other allowed us to present the study to their employees during a regularly scheduled team meeting. After three months of minimal interest and few potential participants, we opened our eligibility to reflect that of the initial REFIT study, which meant including men from all educational backgrounds. Additionally, more “traditional” recruitment methods were employed including word of mouth, an email newsletter distributed to the University faculty and staff and 75 printed recruitment posters. The study was advertised on the University Clinical Trials website, as well as distributed to both the University graduate student and first year medical students email Listserv. Recruitment posters were hung around the University campus, in local restaurants, bars and shops, several local gyms and three separate physician’s offices.

Recruitment materials directed potential participants to a study website which contained a brief study description and screening questionnaire. As recommended in previous research, all recruitment materials were designed using entertaining language and graphics and focused on the benefits of participation(Morgan, Warren, et al., 2011). The brief questionnaire took approximately five minutes to complete and collected basic demographic information, self-reported height and weight, major exclusion criteria based on health history, and contact information. After completion of the screening questionnaire, all eligible participants were contacted via telephone for final screening and to schedule an in-person study orientation and consent form review. Sixteen

Gutbusters participants reported learning about the program through these printed recruitment posters.

### *Social Media and Newspaper*

In an attempt to recruit individuals who regularly use technology, we posted a Facebook advertisement for one month beginning in September 2017. The ad was shown to 4,642 unique, targeted Facebook visitors (male, aged 18-65 in Burlington, Vermont) and resulted in only 43 clicks (0.92%) to the screening website. In total, after seven months of recruitment, only 35 men were consented and enrolled into the Gutbusters program. After little community buy-in, few interested participants, and minimal success advertising online, a newspaper advertisement campaign was launched for one week in two local newspapers (one free and one delivered to paid subscribers). After the one week advertisement period, a total of 432 visits to the screening website were recorded, and 251(58.1%) men completed the initial screening questionnaire. Sixty-nine men (16.0%) were scheduled for orientation and 67 (15.5%) men consented and joined the Gutbusters program, for a total of 102 subjects.

### **Discussion**

In summary, while we knew recruiting men to a weight loss intervention could pose some challenges, it was far more difficult than initially envisioned. Based on previous recruitment literature, a more “active” recruitment technique was originally attempted with men at worksites in an attempt to minimize barriers to participation(Elizabeth F Sutton; Morgan et al., 2012). However, with such minimal worksite buy-in, we hit a roadblock to active recruitment that was not anticipated and instead, a more passive recruitment technique was ultimately most effective. Further,

attempts to reach a population of men with two years of college education or less was surprisingly unsuccessful. In the end, of 102 enrolled subjects, only 20 (19.6%) had not completed two years of college. This presents an area for future research, as men with less education are at increased risk for obesity and associated comorbidities related to excess weight (Paeratakul, Lovejoy, Ryan, & Bray, 2002). Using recruitment posters and email newsletters, Crane and colleagues were able to engage 277 men in online screening with 107 (38.6%) enrolling in the REFIT intervention over a period of eight months. It's important to note that the vast majority of the enrolled subjects had completed a college education, were employed full-time and were married or living with their partner.

Despite the documented low efficacy of newspaper advertising for recruitment into a clinical trial (Hapca et al., 2014), it was our most successful recruitment technique. Interestingly, the average age of participants enrolled from the newspaper was higher than the average age of participants recruited through other means (51 versus 39), suggesting newspaper recruitment may be more effective in a slightly older population, who are possibly more likely to read the newspaper. Throughout the course of the study, our retention rate remained fairly high (75 of the original 102 participants, 73.5%, completed the full 24 weeks of the intervention). In comparison, some weight loss trials report dropout rates of one-third to one-half of participants in one year (Delahanty et al., 2016) and similarly long male weight loss studies have reported retention rates of 81.0-90.3% (Crane et al., 2015; Morgan, Collins, et al., 2011; Morgan, Lubans, et al., 2011; Morgan et al., 2009) supporting the notion that once enrolled, men frequently remain active participants (Robertson et al., 2017).



While implementing a weight loss intervention solely for men positively contributes to the current literature, there are limitations to our recruitment strategy that could be addressed in future studies. To begin, newspaper advertisements qualify as a passive recruitment strategy and were the most successful Gutbusters recruitment technique. However, there are a variety of other active recruitment strategies (besides the workplace recruitment model used) that have the potential to be highly effective. Because we know that men are often motivated to lose weight after a poor health diagnosis or other illness, recruiting through a primary care physician's office could be advantageous. Additionally, offering a recruitment referral "incentive" has been effective in other populations and could be a way to entice men to encourage and refer other men to participate in upcoming interventions. Finally, the examination of the role of spouses/partners in male weight loss could be a promising future direction. When advertisements for weight loss programs are placed in environments accessible to both men and women, such as the newspaper (versus a bulletin board at work), who is initiating participation in these programs: the overweight man, or their romantic partner?

Our recent experience further validates the belief that the recruitment strategy, rather than male interest in weight loss itself, may be the foremost challenge when it comes to enrolling men in a weight loss clinical trial.

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## Tables

Chapter 3 – Table 1: Recruitment Methods and Totals

<b>Worksites</b>	<b>Email Newsletter/UVM Clinical Trials</b>	<b>Recruitment Posters</b>	<b>Facebook</b>	<b>Newspaper</b>
17 businesses contacted	3 email newsletters, 1 online link	75 posters displayed	4,632 unique ads shown	432 screening website visits
7 business responses (41.2%)	8 men enrolled	16 men enrolled	43 ad clicks (0.92%)	251 completed screening questionnaire (58.1%)
4 meetings (23.5%)			3 men enrolled	69 scheduled for orientation (16.0%)
1 business participated (5.8%)				69 men enrolled
6 men enrolled				

## Figures

Chapter 3 – Figure 1: Original Gutbusters Recruitment Posters



**ATTENTION MEN!**

**READY TO CONQUER THAT BURGER BODY?**

Gutbusters is a weight-loss research study based at the University of Vermont designed to help men lose weight through improving eating and exercise.

We are looking specifically for men with two years of college or less. This program is being offered at no cost to you, plus you have the opportunity to earn compensation for participating. This 12-week program will be held at your work site and will include help given both in-person and online to fit your busy schedule.

The University of Vermont

INTERESTED IN PARTICIPATING?  
[go.uvm.edu/gutbusters](http://go.uvm.edu/gutbusters)



**ATTENTION MEN:**

**FEELING A LITTLE INFLATED?**

Gutbusters is a weight-loss research study based at the University of Vermont designed to help men lose weight through improving eating and exercise.

We are looking specifically for men with two years of college or less. This program is being offered at no cost to you, plus you have the opportunity to earn compensation for participating. This 12-week program will be held at your work site and will include help given both in-person and online to fit your busy schedule.

The University of Vermont

Interested in participating?  
[go.uvm.edu/gutbusters](http://go.uvm.edu/gutbusters)

## **CHAPTER 4: The Impact of Incentives on Weight Loss Control in Men: A Randomized Controlled Trial**

### **Introduction**

Approximately 300,000 adult deaths are attributable to obesity each year in the United States (Allison, Fontaine, Manson, Stevens, & VanItallie, 1999). Men and women have similar overall rates of obesity, but the combined prevalence of overweight/obesity is much higher among men (Flegal, Carroll, Kit, & Ogden, 2012). Overweight and obese men experience significant years of life lost (YLL), with overall reductions in life span of 22 percent (Fontaine, Redden, Wang, Westfall, & Allison, 2003). Men who are overweight are a high-risk group for many obesity-related chronic diseases, as they are more likely to carry excess weight in the abdomen, which is generally more harmful than weight stored in the lower body (Wardle et al., 2004). Unfortunately, men are less likely than women to perceive themselves as overweight (men don't sense that they are overweight until they reach a substantially higher BMI threshold than women), and thus are less likely to initiate weight loss through organized weight loss programs (Andersson & Rössner, 1997; Brown et al., 2015; Collins, Morgan, Warren, & Lubans, 2011; French, Jeffery, & Wing, 1994; Morgan, Lubans, Collins, Warren, & Callister, 2011).

It has been reported that men may perceive too many barriers to weight loss and that current weight management programs do not appeal to them. Men have conveyed that they desire programs that are convenient, include other relatable participants and offer individualized feedback (Sabinsky, Toft, Raben, & Holm, 2007). They have also stated a preference to avoid strict meal plans and would like the autonomy to customize their diet based on preferences (Gough, 2007; Sabinsky et al., 2007; Wolfe & Smith,

2002). Constructing weight loss interventions that explicitly accommodate their reported needs and preferences may help improve male recruitment as well as commitment and satisfaction (Hunt et al., 2014; Robertson et al., 2017).

A recent review of weight loss trials found that, on average, less than 23% of participants were men (Pagoto et al., 2012). However, it does not appear as if failure to lose weight is the reason men steer clear of organized weight loss programs. In fact, contemporary research has demonstrated that men often lose as much weight, if not more, than women in the same programs (R. L. Williams, Wood, Collins, & Callister, 2014).

Despite these few known preferences, the weight loss literature specific to programs primarily for men is quite limited. The literature is relatively new and current available studies represent huge variations in treatment approach. Most study designs have relied on intervention comparison to no treatment controls rather than comparative effectiveness trials and most did not have adequate retention or use intent-to-treat data analysis methods (Young, Morgan, Plotnikoff, Callister, & Collins, 2012). This suggests that there is ample room for interventions that utilize more scientific rigor while also implementing innovation to improve outcomes for men. The goal of this study was to correct some of the previously stated methodological weaknesses while introducing the innovation of financial incentives to a male-focused weight loss intervention.

*Incentives in Weight Management.* Incentives are an effective tool to motivate behavior change. There is ample evidence to support the use of incentives as beneficial in encouraging many health-promoting behaviors, such as weight loss, physical activity, and smoking cessation (Butsch et al., 2007; Cawley & Price, 2009; E. A. Finkelstein, Brown, Brown, & Buchner, 2008; E. A. Finkelstein, Linnan, Tate, & Birken, 2007; Jeffery,



Forster, et al., 1993; Jeffery, Wing, et al., 1993; Kullgren et al., 2013; Roll, Higgins, & Badger, 1996).

Incentives work based on two theoretical ideas: operant conditioning and behavioral economics. Based on operant learning theory, incentives can be used as a type of behavioral reinforcement. They can be positive (receipt of an incentive for a positive behavior) or negative (removal of an incentive for a negative behavior). The positive reinforcement encourages repeated behavior and negative reinforcement discourages the ‘punished’ behavior (Skinner, 1953). Behavioral economics theorizes that people like to behave in ways to maximize benefits and minimize costs. Therefore, increasing the benefits associated with behaviors like weight loss may outweigh the cost of making better health decisions.

Incentives take many forms including deposit contracts, lottery systems and direct payments and can be used to reward process measures (such as attendance at a health class) or outcome measures (meeting a weight loss goal) (Hall, 2008; Schmidt, Asch, & Halpern, 2012). Monetary incentives undoubtedly work in improving weight outcomes on a short-term basis (E. A. Finkelstein et al., 2007; Eric A. Finkelstein, Tham, Haaland, & Sahasranaman, 2017; Jeffery, 2012; Jeffery, Wing, et al., 1993; John et al., 2011). It was hypothesized that men randomized to the incentive arm (Gutbusters+Incentive) would have greater weight losses at 12 and 24 weeks compared to the non-payment group (Gutbusters alone). Additionally, it was hypothesized that men in the incentive arm would have greater reductions in total body fat as well as waist circumference.

## Methods

All study procedures were reviewed and approved by the University of Vermont Institutional Review Board for human research in the behavioral and social sciences.

*Participants.* Participants were recruited through email, printed recruitment posters, online advertisements, Facebook, and two local newspaper ads between March and December 2017. To be eligible, men had to be between the ages of 18-65 years with a body mass index (BMI) between 25-40 kg/m<sup>2</sup>. Participants were required to have regular internet access and have no known medical condition that would put them at risk when losing weight, changing their diets, or participating in physical activity. Men were excluded if they had weight loss greater than 10 pounds in the previous six months, were currently participating in another weight loss program, had plans to leave Vermont in the six months following recruitment, had a significant mental illness diagnosis or hospitalization, were currently being treated for cancer, or reported heavy alcohol or drug use.

Recruitment materials directed potential participants to a study website which contained a brief study description and screening questionnaire. The questionnaire collected basic demographic information, self-reported height and weight, major exclusion criteria based on health history, and contact information. Two hundred fifty-one men completed the initial screening questionnaire and were contacted for final screening and in-person orientation scheduling. At orientation, participants gave informed consent and were briefed on all study procedures. Participants were randomized to the Gutbusters+Incentive condition or Gutbusters alone group after orientation using a random online number generator with a 1:1 ratio.

All study procedures were reviewed and approved by the University of Vermont Institutional Review Board for human research in the behavioral and social sciences.

### *Weight Loss Treatment*

*Gutbusters Program Description.* Both study conditions received the identical online intervention. Only the presence of incentives differed. The Gutbusters intervention was designed using a modified version of the REFIT program developed by Crane and colleagues (Crane, Lutes, Ward, Bowling, & Tate, 2015). The program was designed for men to have autonomy on the eating and exercise behaviors they would like to adjust, within a structured program, with the goal of long term adherence. The REFIT program was designed to utilize social cognitive theory (Bandura, 1991) and self-determination theory (Ryan & Deci, 2000) constructs, which have been used previously in successful weight loss interventions (Burke, Wang, & Sevick, 2012; Clark, Abrams, Niaura, Eaton, & Rossi, 1991; Sallis, Pinski, Grossman, Patterson, & Nader, 1988; Teixeira et al., 2006; Webber, Tate, Ward, & Bowling, 2010; G. C. Williams, Grow, Freedman, Ryan, & Deci, 1996).

The goal of the Gutbusters intervention, similar to the REFIT program, was to reduce daily caloric intake by making six 100-calorie adjustments to their typical daily diet (for a total of 600 calories per day, or 4200 calories per week). In order to guide participants in how to make these 100-calorie adjustments, a Gutbusters website was created with thirteen separate lessons focusing on different eating behaviors and activities. These lessons included information on portion sizes, caloric beverages, modifying eating in fast food and restaurant environments, increasing fruit and vegetable consumption, snacking, eating while watching television, walking for weight

management, reducing fat, including healthy breakfast options, limiting sweets, managing meat consumption and eating in social situations. Many of these same lessons were used in the REFIT program and utilized traditional weight loss behaviors that have been implemented in other successful weight loss interventions (Group, 2002) The majority of the lessons focused on behavioral changes related to diet, and one lesson provided information on walking as a way to create a calorie deficit (the message was that walking one mile burns approximately 100 calories).

Participants were asked each week to report the number of daily diet changes from the previous week, as well as select the two to three Gutbusters lessons they wanted to focus on for the subsequent week, in order to meet their calorie reduction goals. Participants were given the option each week to select two to three behaviors/lessons to focus on, with the understanding that not all of the selected behaviors needed to be completed each day. If the participant had not completed the online check-in by mid-week, an email reminder was sent. If it was not completed by the following week's weight collection, they were encouraged in person, while attending their weekly weigh-in, to complete the online check-ins.

Between the 12 week and 24 week assessments, participants had access to the Gutbusters website with the thirteen lessons but had no contact with study staff.

*Incentive structure.* The Gutbusters+Incentive group was eligible to earn a weekly monetary incentive for successful weight loss (defined as a loss of at least one pound from the previous week), and the Gutbusters alone condition was not paid for any weight loss.

During the Gutbusters intervention, the Gutbusters+Incentive group could earn a weekly incentive. This incentive schedule involved escalating rewards each week with a reset contingency. At the Week 1 weight collection, participants received \$4.00 if they had lost one pound since their baseline assessment the previous week. Each week the incentive increased by \$4.00, and participants were only paid if they lost an additional pound each week.

The reset contingency meant that if the participant did not meet the weekly weight loss goal, they earned \$0.00 at that weekly visit and the amount of money earned at the subsequent visit returned to the initial \$4.00. They then had to work their way back to the normal pay scale after two weeks of successful weight loss. This schedule was designed to prevent participants from taking a “holiday” for any weeks during the intervention with the thought that they will only be losing minimal rewards for any brief noncompliance (Roll et al., 1996). This schedule has been effectively utilized in a smoking cessation trial as well as a weight management intervention (Pope & Harvey-Berino, 2013; Roll et al., 1996).

### *Outcome Measures*

The Gutbusters program included three assessment time points (baseline, 12 weeks and 24 weeks), as well as a weekly in-person weight collection and online check-in for the first twelve weeks. All participants were paid \$25 to complete each of the three assessments, for a total of \$75. Weights were collected in person each week for the first twelve weeks on campus at the University of Vermont. Individualized feedback was emailed to each participant following his weight collection, including baseline assessment weight for reference. The online check-in was completed using the Gutbusters

website and an online survey platform, LimeSurvey. Participants were emailed a check-in link weekly. Once participants accessed the online check-in platform, they were prompted to select the lesson(s) they would focus on for the week ahead and enter how many 100-calorie changes they made for each of the subsequent seven days.

The primary outcome was weight change at 12 and 24 weeks. Secondary outcomes were changes in waist circumference and percent body fat. All measures were collected at baseline, 12 and 24 weeks unless otherwise noted.

Demographic Information. Demographic information including age and years of education was collected at baseline.

Anthropometrics. Weight was measured to the nearest 0.1lb on a calibrated digital scale (Tanita BF-684W), which was also used to measure body fat percentage. Height was measured to the nearest 0.25” using a wall-mounted stadiometer. Waist circumference (inches) was measured with a cloth tape measure at the umbilicus, due to difficulties locating the midpoint between the bottom rib and iliac crest.

Questionnaires.

*Weight Efficacy Lifestyle Questionnaire (WEL)* is a measure of self-efficacy for controlling eating in a variety of situations. The five subscales are negative emotions, availability, social pressure, physical discomfort and positive activities (Clark et al., 1991). This questionnaire demonstrated high internal consistency when given to men in a behavioral weight loss program (Linde et al., 2004).

*Godin Leisure-Time Exercise Questionnaire (GLTEQ)* is self-report measure used to quantify overall mild, moderate and strenuous physical activity in a seven-day period. The GLTEQ is widely used in a variety of populations and has been determined to be an

appropriate measurement tool based on test-retest validation compared to other physical activity questionnaires and CALTRAC accelerometer data (Jacobs, Ainsworth, Hartman, & Leon, 1993). Activity scores of 24 units and more classify an individual as active, 14-23 units qualify as moderately active, and scores of 13 units and less qualify as inactive (Godin, 2011).

*Treatment Self-Regulation Questionnaire (TSRQ)* is designed to assess different forms of motivation within self-determination theory. There are three separate subscales: autonomous motivation, externally controlled motivation, and amotivation. This questionnaire has exhibited high levels of internal consistency and is a common tool for measuring motivation for weight loss (Webber et al., 2010).

#### *Process Measures*

Program utilization (number of weekly online check-ins and selection of Gutbusters lessons through the LimeSurvey platform) was calculated from participants' saved weekly online check-in responses. Additionally, program utilization was measured based on in-person weekly weigh-ins.

*Statistical Analysis.* The effect size for the Gutbusters intervention was determined based on the results from the previous REFIT intervention. In order to have sufficient power to detect a statistically significant 4.0 kg difference between the two groups at 12 and 24 weeks with a standard deviation of 6.6 kg within each group, 44 participants were required in each group. Our initial aim was to recruit 20% more participants to account for reasonable attrition, giving us a total of 106 participants. Due to time constraints, recruitment concluded at 102 participants, which gave us 15% more participants than needed.

Data were analyzed using IBM SPSS Statistics Version 23. All variables were checked for accuracy and normality criteria. An intention to treat analysis was performed using last observation carried forward and participants were analyzed with their randomization group, whether or not they participated in study procedures. A completers' analysis was also conducted and included participants who attended all assessments (n=58). Descriptive statistics were used to describe the demographic data and assess differences in baseline characteristics between the two groups. Chi-squared and t-tests were used to examine group differences at baseline, 12 weeks and 24 weeks. Linear mixed models were used to assess all questionnaire data.

## **Results**

Figure 1 illustrates the flow of participants through the study. A total of 432 men visited the recruitment website and 251 filled out the screening questionnaire. In total, 129 were eligible for the study, however 27 were excluded prior to randomization. In total, 102 men attended orientation and completed baseline assessments.

Baseline demographics are shown in Table 1. There was no statistical difference between the treatment groups at baseline. Overall, subjects were  $47.0 \pm 12.3$  years of age with an average weight of  $220.9 \pm 40.3$  lbs and mean BMI of  $32.5 \text{ kg/m}^2$ . The majority of participants had at least two years of college (80.4%).

*Weight Loss and Secondary Outcomes.* ITT Analysis: Weight loss was significantly greater in the Gutbusters+Incentive group compared to the Gutbusters alone group at both 12 and 24 weeks ( $p = .009$ ). The Gutbusters+Incentive group lost an average of 8.5 pounds at 12 weeks (95% CI: 6.1, 10.8) and 7.5 pounds at 24 weeks (95%



CI: 5.0, 10.0). The Gutbusters alone group lost an average of 2.3 pounds at 12 weeks (95% CI: 0.5, 4.1) and an average of 2.2 pounds at 24 weeks (95% CI: -1.1, 5.4).

Completers Analysis: Table 2 shows change over time for weight, percent weight loss, total body fat and waist circumference from the completers analysis. The Gutbusters+Incentive group lost an average of 9.9 pounds at 12 weeks (95% CI: 7.4, 12.5) and 9.9 pounds at 24 weeks (95% CI: 6.6, 13.2). The Gutbusters alone group lost an average of 3.8 pounds at 12 weeks (95% CI: .83, 6.7) and an average of 3.4 pounds at 24 weeks (95% CI: -3.0, 9.9). There were also greater reductions in the Gutbusters+Incentive group for waist circumference and percent body fat at 12 and 24 weeks.

Weight loss as a percentage of baseline weight was calculated at 12 and 24 weeks. Mean percent weight loss in the Gutbusters+Incentive group was 4.5% at 12 weeks and 4.3% at 24 weeks. Mean percent weight loss in the Gutbusters alone group was 1.4% at 12 weeks and 0.8% at 24 weeks. There was a significant difference in percent weight loss between the two groups at both 12 weeks ( $p=.001$ ) and 24 weeks ( $p=.007$ ). At 12 weeks, significantly more Gutbusters+Incentive participants (50.0%) had lost at least 5 percent of their baseline weight compared to the control group (20.6%) ( $\chi^2 =6.44$ ,  $df=1$ ,  $p=.010$ ). At 24 weeks, more participants in the Gutbusters+Incentive group (44.1%) had lost at least 5 percent of their baseline weight, compared to the Gutbusters alone group (16.7%) ( $\chi^2 =5.99$ ,  $df=1$ ,  $p=.014$ ).

*Program Utilization.* All participants attended the in-person orientation session. Gutbusters+Incentive participants attended a mean 9.3 ( $\pm 1.6$ ) of the 12 in-person weekly weight collections. The participants in the Gutbusters alone group attended an average of

6.4 ( $\pm 3.5$ ) in-person weight collections. There was a significant positive association between frequency of in-person weight collection and weight loss ( $r = .242$ ,  $p = .036$ ). Participants completed an average of 6.9 ( $\pm 3.5$ ) of the twelve weekly online check-ins. Participants reported making an average of 29.2 ( $\pm 11.1$ ) of the 42 suggested 100-calorie behavior changes per week during the first 12 weeks. Table 3 illustrates the completion rates of each of the weekly check-ins. Table 4 shows participant selection of Gutbusters lessons.

*Questionnaires.* There was no significant effect of condition group on the GLTEQ scores ( $F[1, 99.73] = .123$ ;  $p = .727$ ), nor was there a significant group by time interaction effect ( $F[2, 150.26] = .766$ ;  $p = .766$ ). There was, however, a significant effect of time between baseline and 12 weeks for participants overall ( $F[1, 150.26] = 4.62$ ;  $p = .011$ ). Analysis using estimated marginal means showed an increase of 15.00 on scores for the GLTEQ between baseline and 12 weeks (Table 5). There was no statistically significant difference in total TSRQ scores between the groups or over time. There was also no effect by group or time for any of the three subscales (Table 5). There was no statistically significant difference between groups or over time for overall WEL scores. For four of the five WEL subscales, there was no significant difference in scores by group or over time. For the availability subscale, there was a significant effect of time ( $F[2, 138.75] = 5.61$ ;  $p = .005$ ). A pairwise comparison was conducted and there was an overall mean difference of  $-.497$  ( $SE = .166$ ;  $p = .010$ ) between baseline and 12 weeks as well as an overall mean difference of  $-.659$  ( $SE = .226$ ;  $p = .012$ ) between baseline and 24 weeks (data not shown for 24 weeks).

## **Discussion**

The Gutbusters program was a behavioral weight loss intervention, which added incentives to a previously successful weight loss intervention for overweight and obese men. Similar to the aforementioned REFIT intervention, weight loss in the incentive condition was significantly greater than the treatment only group. Percent weight loss was close to five percent in the incentive group, an amount that has widely been associated with improvements in many obesity-related biomarkers (Douketis, Macie, Thabane, & Williamson, 2005; Hamman et al., 2006; Wing et al., 2011). There were also greater reductions in waist circumference as well as total body fat in the incentive group, as compared to the intervention only group.

Unlike the REFIT program, we asked participants to attend an in-person weight collection weekly (versus weekly self-report) as well as completing the online check-in. Previous research has shown that the internet-based programs are an appropriate substitute to in-person behavioral weight control programs (Harvey-Berino et al., 2010; Tate, Wing, & Winnett, 2001), but because financial incentives were implemented for weight loss in the Gutbusters program, the in-person weight collection was added for validity. Compared to REFIT (Crane et al., 2015), our program utilization (measured by number of online check-ins) was lower ( $6.9 \pm 3.5$  in Gutbusters vs.  $11.2 \pm 2.7$  in REFIT) but participants attended two thirds or more of the in-person weight collections, on average. Overall, we found the participants interaction with the program components to be encouraging.

Data from the questionnaires was interesting, but not remarkable. Increases in physical activity over time in Gutbusters participants were measured by the GLTEQ,

despite the fact that increasing physical activity was not a particular goal of this study. One of the Gutbusters lessons did focus on walking one mile as a way to satisfy a 100-calorie change, so it is possible that the slight increase in GLTEQ score between baseline and 12 weeks was due to this. Of note, walking was also one of the most regularly selected behaviors. There were no significant changes in measures of motivation over the course of the Gutbusters program, as measured by the TSRQ. Utilizing a cash financial incentive was designed to increase external motivation, but didn't appear to make a difference in this population. In a recent study by West and colleagues, average weight loss of -5.5% was maintained for 18 months after a behavioral weight loss program focused on increasing participant motivation (West et al., 2011). In the future, a stronger focus on motivational factors of weight loss in the intervention components may improve long-term outcomes. There were also no substantial changes in measures of self-efficacy by the WEL throughout the intervention, except for a small increase in self-efficacy on the food availability subscale.

Overall retention was moderate, but we regrettably did experience some attrition. High levels of attrition have been seen in Internet-based health behavior change programs and it is unclear which participant attributes are needed for both dynamic engagement with online program content and participation in later follow-ups (Eysenbach, 2005; Glasgow, Boles, McKay, & Jr., 2003). At 12 weeks, 85.2 percent of participants in the incentive group and 60.4 percent of participants in the intervention only group were still actively participating. At 24 weeks, 73.9 percent of the incentive group and 50.0 percent of the control group returned for their final assessment. In the REFIT program, 94.3 percent of REFIT participants remained at 12 weeks versus 94.4 percent of the waitlist

control group. Similarly, 90.6 percent of REFIT participants completed the six-month assessment compared to 90.7 percent of the waitlist control participants (Crane et al., 2015). One reason for this could be that the majority of the study for participants was during the winter in Vermont. Many of our subjects were coming from far away and driving to the University for weight-collection was challenging during some weeks. In addition, greater drop out in the non-payment group could be attributable to disappointment or frustration that other participants were being paid for the same level of study effort. One potential explanation for the additional dropout between weeks 12 and 24 is due to lack of weight maintenance. Anecdotally, several men expressed they were embarrassed to return for their final weigh-in because they had been successful during the first 12 weeks, and then gained most or all of the weight back.

Incentives were another deviation from the original REFIT program and demonstrated value, in terms of weight lost, in the group that received them. Similar to the studies by Pope and Higgins (Pope & Harvey, 2013; Roll & Higgins, 2000), the escalating payment scheme with a ‘reset’ for two weeks if a participant didn’t reach his weight loss goal was effective overall. While the amounts of money started small (only \$4), by the end participants were eager to continue to lose weight so as not to return to baseline and miss out on the larger sums of money. An interesting difference between REFIT and Gutbusters is the REFIT team was able to achieve clinically significant weight loss of at least 5% in the majority of their participants, even the waitlist control. This success was not replicated in the present study. Instead, the men randomized to the non-payment control group achieved much lower rates of weight loss than the incentive

group. This could be interpreted as more evidence supporting the value of incentives for weight loss, but again, when the incentive was discontinued, some weight was regained.

The simplified 100-calorie changes intervention provided a novel approach to weight management efforts. Interestingly, participants in both REFIT and Gutbusters selected the lesson on portion control as one of their top choices (for REFIT it was the most selected lesson and for Gutbusters it was only second to “Walking for Weight Management” which was a lesson unique to Gutbusters). This is a surprising finding, as the idea of eating less than usual has been expressed as a major barrier to weight loss participation for men (Egger & Mowbray, 1993; Sabinsky et al., 2007). Providing information on specific, tangible behaviors and foods while allowing for autonomy in which behaviors they wanted to focus on, the program allowed men to make adjustments where they wanted and choose not to cut out things they were unwilling to give up. This was in line with what men previously stated they wanted from a weight loss program and also supports the self-determination theory concept that personal autonomy is essential for long-term behavior change.

This study adds to the literature of behavioral weight programs that are designed for men. Unlike the majority of previous male weight loss interventions, which were designed with an intervention comparison to a no treatment or waitlist control, Gutbusters was implemented as a comparative effectiveness trial, which will help bolster the evidence base for real-world application and potentially reduce future costs (Basu, Jena, & Philipson, 2011). Additional strengths of this study include a moderate retention rate and ITT analysis, as well as higher rates of weight loss in men who received a modest financial incentive. As previously stated, men have declared that they want convenient

programs that offer tailored feedback and have participants they can relate to. The overall time commitment of this program was fairly minimal. The weekly weigh-ins were done in an easily accessible location and we offered several different days and time slots to accommodate busy schedules. The online component only took several minutes (if it was completed). The program as a whole was streamlined so the amount of communication between research team and participant could be as much or as little as the participant wanted. While the majority of the men did not overlap with others during their weigh-ins, occasionally there was more than one man getting weighed at a time. This appeared to be valuable, and while they waited to be weighed many men chatted with one another and were congratulatory if others shared they had met their weight loss goal. Finally, the men received individualized feedback each week via email regarding their weight loss progress and lesson selection. Compared to other successful interventions with significant personal investment and interaction from researchers and participants (Hunter et al., 2008; Tate, Wing, & Winett, 2001), the Gutbusters program utilized the less demanding online approach of some more recent interventions with success (Crane et al., 2015; Morgan, Collins, et al., 2011; Morgan, Lubans, Collins, Warren, & Callister, 2009). While we don't believe we have conquered male weight loss, this minimally cost- and time-intensive model appears to work.

*Limitations and Future Research.* This study had several limitations. One limitation is that we were unable to reach our intended sample size of 106 participants within our intended time frame. Difficulty in recruitment was a major hurdle for us, and we were surprised that our most effective recruitment technique was a newspaper advertisement, instead of a more technological savvy approach (Facebook ad, website

postings, etc.). Similar to the REFIT program, the majority of our participants were college-educated, White men, which is generally representative of the population in Burlington, Vermont but is not generalizable to the American population as a whole. Initial efforts were made to recruit men outside of these characteristics, but unfortunately we were not successful in doing so. Finally, like many other weight loss interventions, we were unable to obtain true weight loss maintenance. Obtaining final assessment weights twelve weeks after the end of the intervention is not a proper maintenance measurement, but the effects of the program had already begun to diminish at that time.

Despite these limitations, we were able to replicate the encouraging results of Crane and colleagues (Crane et al., 2015) and this simplified approach to calorie reduction with minimal in-person interaction as a general program design looks to be an effective technique to help overweight and obese men lose weight.

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## Tables

Chapter 4 – Table 1: Participant Baseline Characteristics

*(Mean ±SD)*

	Gutbusters+Incentive	Gutbusters alone	p-value (between groups)
N	54	48	
Age (yrs)	49.0 ± 11.8	44.7 ± 12.6	.344
Weight (lb)	223.8 ± 41.6	217.4 ± 38.9	.802
BMI	32.3 ± 5.1	32.6 ± 5.7	.295
Body Fat (%)	29.6 ± 7.5	26.8 ± 7.7	.551
Waist Circumference (in)	44.5 ± 6.0	43.2 ± 5.9	.783
Education; n(%)			
< 1 year of college	5 (4.9)	7 (6.9)	
1-2 years of college	6 (5.9)	2 (2.0)	
> 2 years of college	43 (42.2)	48 (47.1)	

Chapter 4 – Table 2: Change in Weight, Waist Circumference and Percent Body Fat

	Gutbusters + Incentive	p-value (between BL and assessment)	Gutbusters	p-value (between BL and assessment)
<b>Weight (lbs)</b>				
12 Weeks	9.93 (7.38, 12.48)	<.001	3.76 (.83, 6.68)	.014
24 Weeks	9.89 (6.58, 13.20)	<.001	3.43 (-3.04, 9.91)	.284
<b>Waist Circumference (in)</b>				
12 Weeks	1.87 (1.31, 2.43)	<.001	1.09 (.34, 1.85)	.006
24 Weeks	1.74 (.47, 3.00)	.009	1.32 (.22, 2.42)	.021
<b>Body Fat (%)</b>				
12 Weeks	2.00 (.13, 1.50)	.036	1.02 (-1.05, 3.08)	.320
24 Weeks	3.12 (1.50, 4.74)	<.001	-0.63 (-4.14, 2.88)	.712



Chapter 4 – Table 3: Online Check-in Completion Rates

*Table 3. Online Check-in Completion Rates*

<b>Program Week</b>	<b>Gutbusters+Incentive n (%)</b>	<b>Gutbusters n (%)</b>
1	50 (92.6)	35 (73.0)
2	48 (88.9)	31 (64.6)
3	42 (77.8)	23 (48.0)
4	36 (66.7)	21 (43.8)
5	35 (64.8)	23 (48.0)
6	36 (66.7)	21 (43.8)
7	32 (59.6)	19 (39.6)
8	35 (64.8)	19 (39.6)
9	32 (59.6)	21 (43.8)
10	29 (53.7)	17 (35.4)
11	30 (59.3)	16 (33.3)
12	26 (48.1)	18 (37.5)

Note: Percentages indicate percentage of subjects in each group who completed weekly check-in

Chapter 4 – Table 4: Participant Selection of Targeted Behaviors

<b>Target Behavior</b>	<b>Gutbusters+Incentive (n=54)</b>	<b>Gutbusters (n=48)</b>	<b>Total (n=102)</b>
Walking for Weight Management	235	151	386
Portion Distortion	191	114	305
Start with Breakfast	164	121	285
Balance Your Beverages	121	102	223
Preventing Snack Attack	137	79	216
Reducing in Restaurants	70	59	129
Eating in Social Situations	75	43	118
Swap out Sweets	63	49	112
Cutting the Fat	78	21	99
Tune out TV	66	32	98
Increase to Decrease	72	18	90
Manage Meats	51	38	89
Format Fast Food	32	17	49

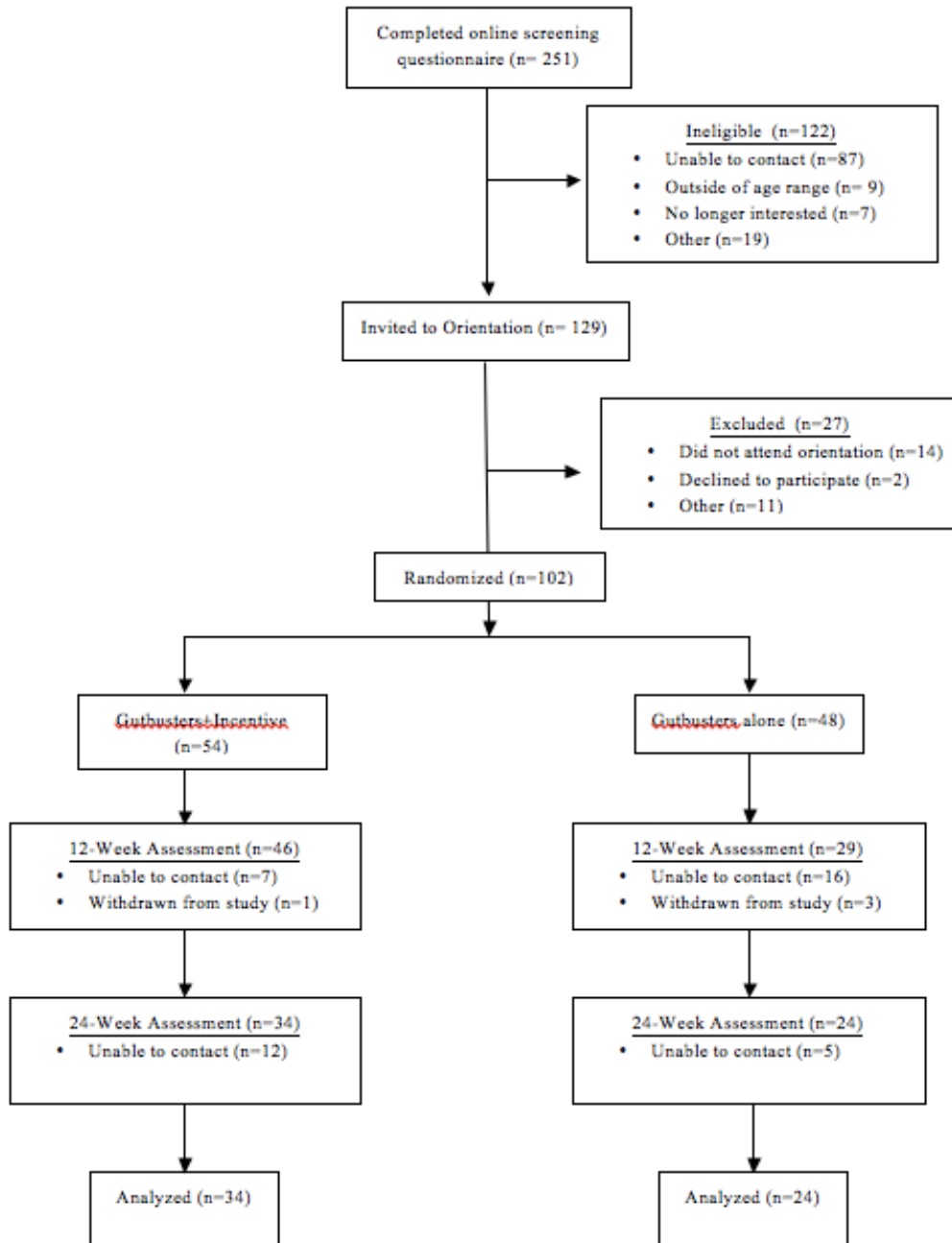
Chapter 4 – Table 5: Linear Mixed Model Analysis Assessing Questionnaire Outcomes from Baseline through 12 Weeks

	Assessment Period		Time 12 Week vs. BL	p-value Group	Group x Time 12 Week
	Baseline	12 Week			
<b>GLTEQ</b>					
Gutbusters+Incentive	40.1 (28.9, 51.3)	52.7 (40.7, 64.7)	.011	.727	.766
Gutbusters	42.5 (29.9, 55.1)	59.9 (44.5, 75.3)			
<b>TSRQ – Autonomous Motivation</b>					
Gutbusters+Incentive	5.4 (5.2, 5.6)	5.4 (5.1, 5.6)	.935	.064	.756
Gutbusters	5.1 (4.9, 5.5)	5.2 (4.9, 5.5)			
<b>TSRQ – Externally Controlled Motivation</b>					
Gutbusters+Incentive	4.6 (4.4, 4.9)	4.6 (4.3, 4.9)	.659	.105	.818
Gutbusters	4.4 (4.2, 4.7)	4.3 (4.0, 4.6)			
<b>TSRQ - Amotivation</b>					
Gutbusters+Incentive	4.7 (4.4, 5.0)	4.6 (4.3, 5.0)	.424	.417	.906
Gutbusters	4.5 (4.2, 4.8)	4.6 (4.2, 5.0)			
<b>WEL - Total</b>					
Gutbusters+Incentive	5.8 (5.4, 6.2)	6.1 (5.4, 6.2)	.645	.728	.179
Gutbusters	6.0 (5.6, 6.5)	5.9 (5.4, 6.3)			
<b>WEL – Negative Emotions</b>					
Gutbusters+Incentive	5.5 (5.0, 6.0)	5.9 (5.4, 6.4)	.547	.636	.403
Gutbusters	5.8 (5.3, 6.4)	5.8 (5.2, 6.4)			
<b>WEL - Availability</b>					
Gutbusters+Incentive	4.4 (4.0, 4.9)	5.1 (4.6, 5.5)	.005	.840	.392
Gutbusters	4.5 (4.0, 5.0)	4.9 (4.3, 5.4)			
<b>WEL – Social Pressure</b>					
Gutbusters+Incentive	5.7 (5.2, 6.2)	6.2 (5.7, 6.7)	.159	.422	.125

Gutbusters	5.5 (5.0, 6.0)	5.5 (5.0, 6.1)			
<hr/>					
WEL – Physical Distress					
Gutbusters+Incentive	6.8 (6.2, 7.4)	7.0 (6.3, 7.6)			
Gutbusters	6.7 (6.0, 7.3)	6.3 (5.5, 7.1)	.955	.520	.533
<hr/>					
WEL – Positive Activities					
Gutbusters+Incentive	6.4 (5.7, 7.2)	6.8 (6.0, 7.5)			
Gutbusters	7.1 (6.3, 8.0)	6.5 (5.6, 7.5)	.791	.647	.483

## Figures

Chapter 4 – Figure 1: Gutbusters CONSORT Flow Diagram



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## **APPENDICES**

# Balance Your Beverages

## GUTBUSTERS LESSON

### Problem:

Liquid calories are often overlooked. The calories in soda, juice, alcohol and coffee drinks can really add up without contributing any real nutritional benefit. This is problematic when trying to lose weight.

### Solution:

Become aware of the beverages that you are drinking and how many calories they contain. You can work towards the Gutbusters goal of making six changes to your diet each day by targeting calories from drinks. The calories from drinks add to your total intake without filling you up, so this can be a good place to make changes to your diet without feeling hungry.

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### What do I need to watch for in my drinks?

- **Sugar** is a main source of calories in drinks. Soda is often the focus when talking about sugary drinks but juices, coffee drinks and energy drinks all contain high levels of sugar as well. Did you know that juice contains almost the same amount of sugar and calories as soda? That means “healthy” juice drinks aren’t going to help you lose weight if you drink them too often!
- **Alcohol** is another source of calories in drinks. By the gram, alcohol contains more calories than carbohydrates or protein but provides no nutritional value. Add mixers for liquor and multiple servings and you can see why alcohol is problematic.
- **Dairy.** Full-fat dairy products contain high levels of fat, which increases the amount of total calories. In addition, many dairy



based beverages are mixed with sugary flavorings, increasing their calories.

## **BALANCE YOUR BEVERAGES**

### **Replace caloric beverages with lower calorie or no-calorie options**

One option for cutting calories from drinks is to switch to a lower calorie alternative. These alternatives include:

- Diet soda
- Un-sweetened tea
- Light beer
- WATER**

Estimate the difference between your regular drink and your replacement to estimate the number of 100-calorie changes you are making. *The average can of soda contains 140 to 200 calories.* Replacing a 20 oz. bottle of regular soda with diet soda will be 2 changes.

If you add sugar to drinks, you may want to try a sugar-alternative such as Sweet-n-Low or Splenda.

If you haven't tried some of the new diet sodas, give them a shot! Many people find they don't like Diet Coke, but enjoy Coke Zero (they have different sweeteners).

If you don't like the taste of water, try adding slices of fruit or a small splash of juice to enhance the flavor. Sparkling water is also a good alternative to soda because it has the carbonation without the calories.

### **Remove extra servings to reduce your calories**

If you are not ready to switch your beverages completely, another way to reduce your calories is to remove extra servings of drink you have per day. Aim for drinking only 1-2 drinks per day that contain calories.

Here's some math to consider: suppose you drink 3 Budweiser beers per day. With 145 calories each, you are drinking 435 extra calories. That's more than a McDonald's Quarter Pounder! Cutting back to 1 will save you almost 300 calories per day and could be 2 of your daily changes this week.

Reducing your servings is especially important with alcohol. As you drink more alcohol, your willpower is reduced and you may end up eating more along with the extra calories from your drinks.

### **Reduce the size of each serving**

Another way to cut calories is to reduce your serving size. Switching from a large soda to a small at a typical fast food restaurant will cut approximately 160 calories.

Consider using the following tips:

- Choose the smallest size drink available. You get the flavor with less calories. If you are still thirsty, refill your cup with water.
- At home, drink juice and soda from smaller glasses. Reducing from one cup of juice to a half cup would save you 50 calories.
- Read the nutrition labels closely. Many bottled drinks have two to three servings per bottle.
- Dilute fruit juices with water, sparkling water or seltzer.
- Use smaller wine glasses. The larger the glass, the more you will pour!

**Home**

- Balance Your Beverages
- Format Fast Food
- Portion Distortion
- Preventing Snack Attack
- Tune Out TV
- Walking For Weight Management
- Reducing in Restaurants
- Cutting the Fat
- Eating in Social Situations
- Swap Out Sweets
- Start with Breakfast
- Manage Meats
- Increase to Decrease



**GUTBUSTERS**  
Weight Loss Research Study

### GUTBUSTERS: A Weight Loss Research Study for Men

Gutbusters is a weight loss research study for men based at the University of Vermont designed to help men lose weight through improving eating and exercise.

This program is being offered at no cost to you, plus you have the opportunity to earn compensation for participating. This 12-week program will include help given both in-person and online to fit your busy schedule.

If you have any questions, please feel free to contact the study team at [gutbusters@uvm.edu](mailto:gutbusters@uvm.edu).



The University of Vermont

[Resume later](#)   [Exit and clear survey](#)

#### Week 3 - Gutbusters

✦ Please select the lessons you will be focusing on this week. You can select up to three. Keep in mind you don't have to do all three each day. For example, if you decide you want to drink Diet Coke instead of your normal three 20-oz. Cokes, you have made your six 100-calorie changes for that day.

Check all that apply  
 Please select at most 3 answers

- Walking for Weight Management
- Reducing in Restaurants
- Eating in Social Situations
- Start with Breakfast
- Manage Meats
- Increase to Decrease

Submit