Smart Phones and Dietary Tracking: A Feasibility Study

by

Barbara Cunningham

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Christopher Warton, Chair
Carol Johnston
Richard Hall

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ABSTRACT

Dietary self-monitoring has been shown to be a predictor of weight loss success and is a prevalent part of behavioral weight control programs. As more weight loss applications have become available on smartphones, this feasibility study investigated whether the use of a smartphone application, or a smartphone memo feature would improve dietary self-monitoring over the traditional paper-and-pencil method. The study also looked at whether the difference in methods would affect weight loss. Forty-seven adults (BMI 25 to 40 kg/m^2) completed an 8-week study focused on tracking the difference in adherence to a self-monitoring protocol and subsequent weight loss. Participants owning iPhones (n=17) used the 'Lose It' application (AP) for diet and exercise tracking and were compared to smartphone participants who recorded dietary intake using a memo (ME) feature (n=15) on their phone and participants using the traditional paper-and-pencil (PA) method (n=15). There was no significant difference in completion rates between groups with an overall completion rate of 85.5%. The overall mean adherence to self-monitoring for the 8-week period was better in the AP group than the PA group ($p = .024$). No significant difference was found between the AP group and ME group ($p = .148$), or the ME group and the PA group ($p = .457$). Weight loss for the 8 week study was significant for all groups ($p = .028$). There was no significant difference in weight loss between groups. Number of days recorded regardless of group assignment showed a weak correlation to weight loss success ($p = .068$). Smartphone owners seeking to lose weight should be encouraged by

the potential success associated with dietary tracking using a smartphone app as opposed to the traditional paper-and-pencil method.

DEDICATION

This paper is dedicated to my wonderfully supportive husband Tom, who gave me the go-ahead to pursue a long-standing goal of becoming a Registered Dietitian 28 years after completing my undergraduate degree in Foods and Nutrition. Without Tom's support and tolerance of many absent nights and high gas bills, I would not have been able to accomplish this task. This paper is also dedicated to my children, Julie, John and Jana who never wavered in their encouragement to pursue my goal. Special thanks to Julie for being the chief editor of all my papers; to Jana who quizzed me on many occasions, and who did not seem to mind going to college with her mom. Thanks to Sheila Whittington, my unofficial life coach, who called me "her hero" for going back to school when I had the chance. That thought kept me going when I started to question my sanity. Lastly, huge thanks to my parents, Paul and Connie Christofanelli, who have always supported me tremendously in my educational pursuits (and life in general), no matter what my age or degree choice.

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INTRODUCTION

Obesity is considered epidemic in the United States (CDC Vital Signs, 2010), with 68% of Americans categorized as overweight or obese (Flegal, Carroll, Ogden, & Curtain, 2010). According to the information collected by the National Health and Nutrition Examination Survey (NHANES) the proportion of adults who are classified as obese in the United States has grown from 15 percent in 1980 to 34.3 percent in 2006. NHANES data also showed that the obesity rate among children between the ages of 2 and 19 has more than tripled since 1980 (Prevalence of overweight, cdc.gov, 2008). The U.S. government estimates that 280,000 deaths per year are related to obesity; as such, it has placed a high priority on combating the problem (Allison, Fontaine, Stevens, & VanItallie, 1999).

Those who suffer from obesity are often at higher risk for type-2-diabetes, heart disease and stroke (Brown, Fujioka, Wilson, & Woodworth, 2009). Obesity is also related to certain cancers, osteoarthritis, liver disease, urinary incontinence, sleep apnea, depression and other medical conditions that result in significant disabilities (Overweight and Obesity: Health Consequences, cdc.gov). In response to these issues, the U.S. Department of Health and Human Services has developed a set of goals for promoting health and preventing disease. Two of the objectives of the program are: 1) to increase the proportion of adults who are of

healthy weight and 2) to reduce the proportion of adults who are obese (Nutrition and Weight Status, healthypeople.gov).

Obesity is the result of chronic energy imbalance. People who are overweight or obese consume more calories on a daily basis than they expend through daily activities and exercise. Caloric imbalance results from a complex set of factors, including access to, and consumption of more processed and convenience foods of larger portion sizes; higher amounts of, saturated fats and sugars in the diet; and chronic physical inactivity (Jeffrey, 2003; Rolls, 2006; Rundle, 2009).

Many programs have been initiated to educate consumers on healthier food choices and increasing daily physical activity. The U.S. Department of Health and Human Services and the U.S. Department of Agriculture jointly publish the Dietary Guidelines every five years. The overall message to consumers is to eat smaller portions, increase consumption of fruits and vegetables, choose low fat or fat free dairy products, lower sodium intake and increase physical activity. The guidelines are concise, easy to understand and doable for most Americans (dietaryguidelines.gov). The U.S. Department of Agriculture also has MyPyramid.gov which is an interactive website designed to give consumers nutrition information and recommendations (mypyramid.gov).

A problem that further complicates the obesity epidemic is the high rate of relapse following weight loss (Wadden, Crerand, & Brock, 2002). The National Weight Control Registry (NWCR) monitors the habits of people

successful in weight loss maintenance (nwcr.ws). The NWCR has defined successful weight loss maintainers as people who have intentionally lost greater than or equal to 10% of their initial body weight and maintained that weight loss for at least one year (Wing and Hill, 2001). Studies using data from the NWCR have identified several characteristics associated with successful weight loss and successful weight loss maintenance among the approximately 5000 members it is currently monitoring.

Among the characteristics studied in this population, self-monitoring of weight on a regular basis, eating a diet low in calories and fat, recording dietary intake, and including exercise on a daily basis were most often associated with success in weight loss and weight maintenance (Wing & Phelan, 2005). These characteristics have proved successful in other studies as well (Corbalan, 2009; Tate, 2001). Tate and colleagues (2001) used a randomized control trial to assess whether overweight individuals participating in a behavioral therapy weight loss program with Internet follow-up and feedback were more successful than people who were simply given diet education and access to a website with education on diet strategies (Tate, Wing & Winett, 2001). The behavior therapy Internet participants were asked to record dietary intake and exercise and send a weekly report via the Internet. Of the participants who completed the program, the behavior therapy group lost more weight than the education only group ($p=.005$) (Tate et al., 2001). Similar results were noted in a study by Corbalan and colleagues (2009), which showed that people who always recorded their food

intake (including calories and fat grams) lost twice as much weight as those who sometimes recorded their food intake. Participants in this study also monitored their weight on a daily basis. Authors noted that keeping a record of everything that is consumed was valuable for a number of reasons: it made participants more aware of their actual caloric intake, it reinforced positive choices and gave participants more control over what they were eating, and it also aided the health care practitioner in counseling a participants on appropriate dietary modifications to enhance success (Brown, 2009; Tate, 2001; Wing, 2005).

Dietary assessment traditionally has been handled by methods such as the 24-hour recall, food record and the food frequency questionnaire (Gersovitz, Madden, & Smiciklas-Wright, 1978). The food record is a record of foods and beverages and the amounts of each consumed over one or more days and is most accurate if the food is written down at the time of consumption (Brown et al., 2009). A limitation of the food record is that it has traditionally been done with paper and pencil and requires a high amount of literacy, motivation, and time. The demands of frequent recording may discourage respondents from participating, and research has shown dramatic dropout rates after three consecutive days of paper and pencil recording (Gersovitz et al, 1978).

Technology has dramatically improved the ease of recording dietary intake, and programs now exist on the market that simplify the dietary recording process (McCabe-Sellers, 2010). Technology has also provided easier access to nutrition education (Long and Stevens, 2004). However, little research has been

done to test the efficacy of using different forms of technology to improve weight loss success. Svetkey et al. (2008) compared the long-term weight regain between a group using an interactive website to monitor caloric intake and energy expenditure, a group who was self-directed, receiving minimal contact and group attending monthly personal contact. Researchers found that at 18 and 24 months post-weight loss, the technology group had lower weight regain ($p = .003$). However at 30 months there was no significant difference between groups (Svetkey et al., 2008). Other research has shown that digital data communication using mobile phone technology or digital cameras might be a preferred method of recording dietary data by children compared to oral interviews (Boushey et al., 2009). Adolescents and diabetics have also been shown to benefit from the use of interactive web-based technology (Long et al., 2004).

Writing down daily intake has been shown to have a significant effect on the success of a weight loss diet and continued weight loss maintenance (Klem, 1997; Tate, 2001; Wing, 2005). Making the process of recording food consumption and energy expenditure easier may encourage more people to develop this habit and maintain it for a greater length of time. Some research already points to this possibility. Arsand et al. (2008) studied the viability of using mobile phone technology to enhance accountability with diabetics and found that one of the key factors to success and sustainability was the mobility of the recording device (Arsand, Tufano, Ralston, & Hjortdahl, 2008).

Smartphones have revolutionized the way American's send and receive information. In particular, the advent of smartphone applications ('apps') has opened a floodgate of possibilities for entertainment, communication, and data collection. Apps are web- and non-web based programs that operate remotely on mobile and other devices, or interact with databases through web browsers over a network such as the Internet.

A leading brand of smart phone is the iPhone with over 800,000,000 users worldwide (apple.com). The average iPhone user downloads 11 apps per month for their iPhone (iPhone.com), and many of the more popular apps are health-oriented. One such app generated for the iPhone is called "Lose It" (loseit.com). This app allows the user to set weight loss goals and establish a daily calorie budget based on the Mifflin-St. Jeor equation (Estimating Percent Calorie Restriction, scientificpsychic.com). The user enters the food consumed and the "Lose It" program subtracts the caloric amount of the food from the total calories allowed per day. The allowable caloric recommendation can be altered by entering exercise activities and durations, which are also tracked and can add calories to the overall caloric budget. Diet and exercise data are entered using a searchable database (loseit.com). Weight may be entered on a daily basis and feedback regarding macronutrient percentages and calories burned through exercise is given via a daily report. These features encourage three of the habits identified by the NWCR associated with successful weight loss maintenance: self-

monitoring of dietary intake, weighing at least one day per week and exercise an average of one hour per day (NWCR Facts, nwcr.hs).

To the best of our knowledge, no research has been published on the use of mobile phone apps in tracking dietary intake for weight loss. Because many individuals now use mobile phones for multiple functions, these devices are often carried by their owners throughout the day. As such, there is potential for these devices and their associated apps to offer a simpler and quicker system for dietary tracking that can be applied as easily in a research setting, as in real life. The purpose of this study is to compare the efficacy of using a smart phone to track dietary intake and exercise for weight loss with traditional paper and pencil methodology. Additionally, this study will also compare the use of a smart phone diet tracking app to the process of keeping daily diet records using text-based smart phone 'note' functions. We hypothesize that use of the smartphone and a diet tracking app will lead to increased compliance in tracking caloric consumption, diet composition and energy expenditure, compared to either note taking on a mobile device or traditional paper-and-pencil diet-tracking methodology. We further hypothesize that the smart phone group will demonstrate lower rates of attrition compared to the paper and pencil group. Finally, we hypothesize that participants using smart phones with diet tracking apps will lose more weight than participants using either note-taking functions on their smart phone or traditional paper-and-pencil diet-tracking methodology.

Chapter 2

LITERATURE REVIEW

Obesity Global Epidemic

Obesity is a global epidemic. In 2005, 23.2% of the world's adult population was overweight, 9.8% fell into the obese category (Kelly, Yang, Chen, Reynolds & He, 2008). Obesity and Type 2 Diabetes are major causes of death in the United States (Ford, Williamson, Liu, 1997). 300,000 people die each year from obesity related deaths and diabetes is the sixth leading cause of death in the United States (Allison et al., 1999). Enormous costs to the health care system in the U.S. are attributed to obesity and diabetes. The Behavioral Risk Factor Surveillance System (BRFSS) is a cross-sectional telephone survey conducted by the CDC in 2001(Mokdad et al., 2003). The survey was conducted by a random digital call system and was designed to assess how many risk factors individual's possessed. The results indicated that obesity had risen from 19.8% in 2000 to 20.9% in 2001. Hence in 2001, 44.3 million Americans were obese. Other results from the survey indicated a high correlation between overweight obesity and type-2-diabetes, high blood pressure, high cholesterol, asthma and arthritis. Theoretically overweight and obesity are preventable along with the risk factors inherent with them. Every effort should be made to develop programs and policies that encourage a healthy weight for all Americans (Mokdad et al., 2003).

Commercial Weight Loss Programs

Rena R. Wing PhD, in an article entitled, "Do Commercial Weight Loss Programs Have a Role?" wrote a commentary on how weight loss diet programs fit into the national weight loss picture. Dr. Wing specifically reported on a study conducted by Rock et al. where 442 overweight or obese women entered into a two year weight loss program with a two year follow up period. The cohort was randomized into three groups: a control group who met with a dietitian only at baseline and six months, plus a monthly follow-up by e-mail and two intervention groups. One of the intervention groups was center-based and one was telephone-based. All components of the weight loss diet were provided free of charge. The diet recommendation was to eat 20-30% calories from fat and participate in thirty minutes of exercise on at least five days in a week. The subjects were provided pre-packaged meals to help them achieve their dietary goals. After two years, the center-based group lost 7.4 kg, the telephone group lost 6.2 kg and the control group lost 2.0 kg. Two years after the study ended, the subjects were followed up with and 62% of the center based program, 56% of the telephone participants and 29% of the control group had maintained a weight loss of 5% of their starting weight. These results are atypical and the author theorizes that perhaps it is because the food was provided for free. She goes on to suggest that this might be a cost effective alternative to gastric bypass surgery. She also expressed the need to conduct cost effective analysis of available commercial programs (Wing, 2010).

There are many popular diets on the market today many of which depart substantially from mainstream medical advice. The various diets generally fall into four categories: overall kilocalorie restriction (Weight Watchers), restriction of fat (Ornish), restriction of carbohydrates without restriction of fat (Atkins) or modulation of macronutrient balance and glycemic load (The Zone). Dansinger, Gleason, Griffith, Selker and Schaefer (2005) conducted a 1-year randomized trial of Weight Watchers, Atkins, Ornish and The Zone to compare the effectiveness of each in terms of weight loss and cardiovascular health. The study was conducted in the Boston area with 160 participants randomized into one of four groups. The authors included adults of any age with a BMI between 26 and 42 with one or more cardiovascular risk factor. The groups were monitored closely for the first two months and were followed up with at 6 and 12 months. The outcome measures were assessed at baseline, two, six and twelve months. All groups experienced modest statistically significant weight loss at one year with no significant difference between diets. All diets showed modest statistically significant improvement in cardiac risk factors at one year. The authors further noted that the most successful people in the study showed the greatest adherence to the diet, regardless of the diet parameters and encouraged the development of practical techniques to increase dietary adherence rates. The bottom line is that adherence to any diet can work, so if adherence is increased, then weight loss can be achieved and sustained (Dansinger et al., 2005).

The Exercise Component

In 1995, the Institute of Medicine stated that most individuals regain their weight in the year following their weight loss, and if they do not gain it all back in that first year, they will have by 5 years (Sterns et al., 1995). It is clear however that some people do keep their weight off. Befort et al. (2008) compared successful and unsuccessful weight maintainers following a weight loss program encompassing both weight loss and weight maintenance strategies. The subjects of this study had participated in a weight loss program that incorporated calorie reduction and physical activity as the primary weight loss strategies. Other components of the treatment protocol included nutrition education and strategies for increasing physical activity. Behavioral strategies included goal setting, consuming five or more fruits and vegetables and 150-300 minutes of physical activity per week. Another behavioral strategy included self-monitoring of food intake and calories expended on exercise. Participants were mailed a follow-up survey that assessed current weight and ongoing use of weight control behaviors. 179 people responded out of 417 possible people. 76.5% had maintained a weight loss of 5% below their baseline weight and 55.9% had maintained 100% of their weight loss. Among the behaviors studied, exercise was the strongest predictor of weight maintenance (Befort et al., 2008).

Kruger, Blanck & Gillespie (2006) studied diet strategies of people who were successful at losing weight, with strategies that included a physical activity component. The authors examined data from Styles 2004, specifically looking at

responses from 4,345 households. Respondents indicated whether or not they were successful at losing weight and keeping it off. They were divided into two groups, "successful weight losers" and "unsuccessful weight losers". A significantly higher proportion of successful weight losers reported exercising 30 or minutes daily other significant characteristics of successful weight loss participants were tracking calories and fat, measuring food on plate and weighing themselves' daily. The results also indicate that people who were more successful at weight loss baked for fun and lifted weights (Krueger et al., 2006).

Successful Weight Loss Maintenance

There are people who are successful at maintaining their weight loss and research has gained insight into successful weight maintenance strategies from these people. Jordan, Canavan & Steer (1987) conducted a study that followed up with 154 people who had lost at least 15 pounds and kept it off for one to five years using cognitive behavioral therapy. The researchers' looked at how these same people were doing six to ten years later. The focus of the study was to assess the habits people had developed to maintain their weight loss over a long period of time and to determine if cognitive behavior therapy worked. They compared habits from people who had lost weight and kept it off, to people who had regained the weight they lost. A survey was sent to154 people from the previous study, 115 returned the completed questionnaire. 67% of the people had regained approximately 7.15 lbs and 36% had maintained the weight loss. The authors found three areas that were different between weight maintainers and

people who had regained the weight. Weight maintainers planned snacks in advance and choose low calorie snacks. They also found activities other than eating to occupy their time when free time presented itself. Pre-planning of meals and snacks, and increased activity proved to be successful habits of the weight maintainer group. Walking was the preferred activity (Jordan et al., 1987).

The National Weight Control Registry (NWCR) was developed by Dr. James Hill and Dr. Rena Wing to provide information about people who are successful and weight loss and weight maintenance (Hill, Wyatt, Phelan, &Wing, 2005). To participate in the NWCR individuals must have maintained a 30-pound weight loss for at least one year. It was started in 1993 and continues to add participants on a voluntary basis every year. The NWCR reports that people lose weight using many different methods, but increased physical activity is included in most cases. A predominant number of individuals registered with the NWCR lost weight and kept it off by incorporating both diet and exercise into their weight loss strategy. Registry participants are contacted every year to update their records. The result of long-term follow up shows that the "weight loss maintainers" report better adherence to physical activity, a low-calorie/low fat diet and greater dietary restraint. The NWCR is not a random sample of the population and uses self-reported information, however, many of the weight loss and weight maintenance strategies found to be prevalent in NWCR members have been shown to be prevalent in other research (Hill et al., 2005). Self-monitoring

of food intake has also been shown to be characteristic of NWCR members (Klem, Wing, McGuire, 1997).

Treatment for Obesity, Self-monitoring

The current recommendation for American's who are classified as overweight (BMI between 25 and 30 kg/m^2) or obese (BMI between 30 and $35kg/m^2$) and who have two or more health risk factors, is to lose 5 - 10% of their current body weight by reducing their caloric intake and increasing exercise 30 minutes per day at least five days per week (Van Dorsten & Lindley, 2008). Weight loss techniques have improved over the last thirty years, but the problem with weight maintenance still exists. Programs that use behavioral therapy techniques have the basic belief that the habits a person attains that ultimately make them overweight can be replaced by new healthy habits to get them on a path to a healthy weight for life. Setting goals is a critical piece of the weight loss puzzle and self-monitoring has been suggested to be the single-most important component of staying focused on the weight loss goal (Cobain and Foreyt, 2005). Self- monitoring can compose tracking caloric intake, fat grams, steps walked on a pedometer or exercise minutes (Van Dorsten & Lindley, 2008).

Behavior therapy is a great strategy used by many programs to encourage weight loss. Sbrocco, Nedegaard, Stone, & Lewis (1999) compared behavioral choice treatment (BCT), a type of cognitive behavioral therapy, with a traditional behavioral weight management treatment methodology (BWM). The authors believed that obese women could benefit from learning strategies of decision

making on how to eat and exercise in moderation. They also desired to teach the subjects how to separate eating from self-evaluation. The BCT group was expected to have more success than the BWM group. Both groups were placed on a low calorie diet. The participants were recruited via newspaper advertising. They had to be otherwise healthy overweight women between the ages of 18 and 55, had to fill out a two week food diary and pay $150.00 to be involved in the study. The $150.00 was returned to participants who completed the study. Twenty-four women met the inclusion criteria. All participants received a two week diet plan and a recipe booklet that only differed in the amount of food they were allowed. After two weeks, the diets were analyzed and feedback was given on the number of calories and grams of fat consumed. The food was listed from highest to lowest fat content and suggestions were given for lower fat food options. The program lasted for twelve months. The BCT group also received training using cognitive restructuring and behavioral therapy on making good food choices. The BCT group lost and maintained a greater amount of weight over 12 months than the BWM group. The authors concluded that self-monitoring was a key factor in the success of the BCT group (Sbrocco et al., 1999).

A study was conducted on the effectiveness of adding cognitive behavioral therapy (CBT) to instructions for a low fat diet and a low carbohydrate diet (Rodriguez-Hernandez et al., 2005). Obese women from the same neighborhood with similar socio-economic status participated in the study that compared two

diet protocols (low fat and low carbohydrate) with the addition of cognitive therapy including self-monitoring of diet. 105 obese women with an average age of 45.4 years and an average BMI of 36 kg/m^2 were randomized in a two stage process. In stage one, 55 women were placed in a CBT group and 50 women were placed in a control group. In stage two, each woman was randomly assigned to either a low fat or a low carbohydrate diet. The study lasted six months and each woman had psychological support every week. The CBT group also received one hour per week of additional training in diet and exercise using cognitive behavior therapy techniques. Diaries of diet and exercise were compiled and reviewed at each visit. Adding CBT to both the low fat and the low carbohydrate diets, produced significantly more weight loss in the short term, than the control group experienced (Rodriguez-Hernandez et al., 2005).

Children who are overweight face many difficulties, some of which include quality of life, self-concept and poor peer relationships. Jelalian et al. (2010) studied 118 overweight adolescents and one primary caregiver to evaluate the effectiveness of a peer intervention called "adventure therapy." Previous studies had shown the effectiveness of weight control interventions with adolescents that included a dietary component, physical activity, cognitive behavior therapy (CBT) and peer involvement. This study compared two randomized groups of overweight 13 to 16 year olds, one with CBT and peer enhanced adventure therapy, to CBT with traditional types of exercise. Adherence to the diet protocol was also studied. Both groups had a calorie

restriction of 1400 to 1600 kilocalories per day, 16 one-hour weekly sessions along with their primary caregiver, four biweekly maintenance sessions and progressive exercise up to sixty minutes on most days of the week. Participants were also asked to maintain weekly records of daily food intake and exercise expenditure. Self-monitoring included notes on food consumed, portion size, how food was prepared, time of day, and an estimate of calories and fat grams. Both groups showed a significant reduction ($p < .01$) in BMI with adherence to self-monitoring being the only predictor of success. The authors concluded that self-monitoring of diet and physical activity is predictive of weight control outcomes and suggested that future studies should focus on innovative ways to increase adherence to self-monitoring (Jelalian et al., 2010).

In conjunction with the Jelalian et al. (2010), Sato et al., (2010) studied the association between parental attitudes toward weight loss and the success of the adolescents involved in the aforementioned weight loss study. The targeted parental variables were parent weight change, self-monitoring, feeding practices and general attitudes toward food. The participants were the same as described in the previous study. Each adolescent had to have a participating parent. The parents attended weekly behavioral therapy sessions separate from their children. The parents were not put on a diet but were taught the same behavior modification strategies that the adolescents were taught. Parents were asked to complete dietary and physical activity records for the first three weeks of the study. The results of the study found that parental behaviors and attitudes had a significant

impact on their teen's weight loss success. A change in parental BMI was the only independent predictor of adolescent BMI. Adolescents whose parents lost more than 2.2 pounds during the intervention were three times more likely to lose eight pounds over the adolescent whose parents either maintained or gained weight during the intervention. The authors also found that for each additional diet record the parent kept during the first month of the study, the child was 2.7 times as likely to lose eight pounds. The impact of self-monitoring in this study might have several plausible explanations. It could be attributable to the impact of parental modeling or the increased parental awareness of food choices leading to more healthy food purchases. It also may have been an indicator of a motivated parent which was in turn beneficial to the weight loss of the adolescent (Sato et al., 2010).

Treatment programs almost always include self-monitoring, but consistency of self-monitoring is usually not addressed. Consistency is characterized as the frequency with which a person completes the self-monitoring protocol and the quality of the record (Boutelle, Kirschenbaum, Baker, & Mitchell, 1999). Methods for improving both the quality and the quantity of self-monitoring could be very valuable in achieving the goal of slowing down and reversing the obesity epidemic. The holidays are a problem for many people so a study was conducted that looked at how increasing contact with a therapist who emphasized self-monitoring would impact weight maintenance during the holiday season post-Thanksgiving though the New Year. Fifty-seven people participated

in the study and were given 4 x 6 notebooks to record caloric intake and exercise output. They monitored for eight weeks, three weeks prior to the holidays, two weeks during the holiday season (Christmas to New Years) and three weeks after. During the eight weeks, all subjects participated in weekly cognitive behavior therapy sessions with trained therapists, they were weighed, and strongly encouraged to adhere to the self-monitoring protocol. The intervention group received additional daily mailings encouraging them to self-monitor, they also received one to two extra phone calls per week. The study found that the group receiving the extra mailings and phone calls lost more weight and monitored more days than the group that did not receive the intervention (Boutelle et al., 1999).

Technology and Self-monitoring

Mossavar-rahmani et al. (2004) reported in the Journal of the American Dietetic Association on the impact of different self-monitoring tools used in the Women's Health Initiative. The Women's Health Initiative (WHI) is a long term clinical trial that assesses the effect of specific food choices on the impact of breast and colorectal cancers, and heart disease. Each participant monitored fruit and vegetable intake, fat intake, and grain intake. The study sample consists of 19,542 WHI participants. These are post-menopausal women between 50 and 79 years of age who are followed up on average 8.5 years. The group started in 1994. Self-monitoring was a significant piece of the study. Each person was asked to record three days per month or nine days per quarter. The self-monitoring tools available when the study began were paper and pencil

notebooks. Self-monitoring declined 6 – 7 % in the first three years and 3 – 4% in the years that followed. In March 1996, additional tools were introduced to increase self-monitoring. Quick scan and Picture tracker were introduced in 1998. The original paper and pencil method was used alongside of a reference guide with fat gram amounts. Quick scan was another reference guide that could be customized based on usual food intake. A computerized version was also available. Picture tracker allowed participants to circle fruit/vegetable and grain icons based on amount consumed but did not include fat grams. Participants using additional tools to the paper and pencil food diary recorded 2.2 more days than the food diary group per quarter. The number of days recorded was only significantly higher when comparing the best performing clinics. The authors found that once the group stopped self-monitoring, they didn't return to it. In conclusion, the need for innovative self-monitoring tools to keep people from becoming bored could help people the adherence to a self-monitoring protocol (Mossavar-rahmani et al., 2004).

Self-monitoring increases diet success because it raises the awareness of what people are consuming (Wadden, Crerand, & Brock, 2002). The most often used method for self-monitoring up until recently has been the paper-and-pencil method. Burke et al. (2011) studied the use of a PDA, and compared the use of a PDA plus diet feedback to a PDA that simply recorded calorie intake and exercise output. The trial lasted 24 months and used a three group design that tested adherence and the effect of adherence on success. The study looked at whether

self-monitoring of physical activity and eating using a PDA with or without tailored feedback (PDA + FB) was better than keeping a paper and pencil record (PR). All three groups received the same dietary intervention strategies which included daily calorie and exercise goals, daily self-monitoring of eating and exercise, and group sessions. There was no significant difference between attrition rates between the groups at 6 months. At 6 months, there was significant weight loss for all groups ($p < 0.01$), however, the PDA + FB group had a higher proportion of participants that achieved $\geq 5\%$ weight loss ($p=0.04$). The overall adherence was better for the PDA groups than the PR group ($p < 0.01$). The study concluded that regardless of the method of self-monitoring, the participants lost weight. The group that was given tailored feedback regarding their eating and exercise habits lost more weight than the other two groups. This suggested that daily tailored feedback promoted greater success. The results are encouraging given the number of people with access to similar programs now available on cell phones (Burke et al., 2011).

A study conducted by Acharya, Okan, Sereika, Styn & Burke (2011) compared dietary changes between a PDA group and a paper-and-pencil record group participating in a weight loss intervention. The authors hypothesized that self-monitoring with a PDA would improve diet quality over the traditional paper-and-pencil methodology. Analysis from this study compared the changes in dietary intake between a PDA group and a paper-and-pencil group. At six months, both groups had reduced calorie consumption ($p < .001$), percent calories from fat

and saturated fat ($p < .001$) and had lost a significant amount of weight ($p < .001$) with no differences between groups. The PDA group had significantly increased consumption of fruits ($p = .02$) and vegetables ($p = .04$) and decreased consumption of refined grains ($p=.02$) when compared to the paper group. Another interesting finding of this study suggested that adherence to self-monitoring was less important to the PDA group than the paper group because was there was less of a correlation between days recorded and outcome measures. The authors noted that the study added further evidence to suggest that using a PDA might be a beneficial tool for raising awareness of nutrient intake and promoting healthy lifestyle changes (Acharya et al., 2011).

The frequency of self-monitoring is an important predictor of diet success (Yon, Johnson, Harvey-Berino, Gold, & Howard, 2007). Technology has the potential to make this process easier, with the goal of enhancing success. Yon et al. (2007) studied sixty-one overweight and obese adults with an average BMI greater than 25 kg/m^2 and less than 39 kg/m^2. The group was given a personal digital assistant (PDA) with weight loss software to use for 24 weeks and placed on a plan to lose one to two pounds per week eating 1000 kcal less per day. The control group had participated in a previous study using paper and pencil. They were also instructed to reduce their caloric intake by 1000 kcals per day and given a calorie counting book. Both groups were encouraged to exercise the equivalent of walking 10 miles per week. Participants in the technology group and the control group had weekly meetings and were encouraged via e-mails by group

leaders. Some people dropped out because they found the technology to be too cumbersome. There was no significant difference in weight loss between the groups and no significant difference in self-monitoring. The people who self-monitored using both methods lost more weight than the people who did nothing, regardless of the group. However, PDA users lost three times more weight than the people who did nothing. Self-monitoring using the PDA did not improve weight loss over the other two groups. However, the adherence was higher in the PDA groups over the paper and pencil group (Yon et al., 2007).

Boushey et al. (2009) also studied the use of technology in children's dietary assessment using 31 Chinese boys and girls enrolled in a camp that took place on a college campus. For one day, the campus converted to a metabolic lab and all the food, snacks and activities were monitored. The participants tested six different methods of keeping a food record. The six methods were: 24 hour recall, keeping a food record using paper and pencil, PDA with a hierarchal menu, PDA with search menu and PDA with camera. There was 100% agreement for the dislike of the paper and pencil food record and a high adherence for the PDA with camera record keeping method (Boushey et al., 2009).

Automated Feedback and Weight Loss Success

One possible strategy to increase weight loss success is to involve the community. Wing, Crane, Thomas, Kumar & Weinberg (2010) conducted a study aimed at determining whether adding behavioral weight loss techniques could improve the outcome of a community intervention. The study was conducted in

conjunction with the Shape-Up Rhode Island program which was designed to help Rhode Islanders lose weight. The program was conducted in 2008 and 2009 and was a 12-week, statewide, Internet-based programmed that encouraged competition among communities. The study design had two interventions. Study one determined whether having weekly education sessions, teaching behavior strategies for successful weight loss, would improve weight loss results. Study two looked at the effects of combining multimedia educational sessions plus self-monitoring and automated computer feedback regarding behavior changes. Both groups were set up to lose one to two pounds per week with a calorie intake of 1200-1500 calories per day for those weighing less than 200 pounds and 1500 to 1800 calories per day for those weighing more than 200 pounds. There was also a physical activity component which started at 100 minutes per week of exercise and increased gradually to 200 minutes per week. At the conclusion of the study the investigators found that adding multimedia lessons, self-monitoring and automated feedback significantly increased the average weight loss of the study participants. The multimedia/self-monitoring/feedback group also had more participants lose 5% of their starting weight, leading the authors to conclude that community-based programs can be effective in promoting weight loss (Wing et al., 2010).

Technology for a Healthy Lifestyle

Technology has the ability to promote a healthy lifestyle and enhance public health initiatives (Guillen, Sanna, Ngo, Meneu, del Hoyo, & Demeester

M., 2009). The focus of some health care organizations is to enhance how the information is delivered, how it can be personalized and how mobile it is. Internet communication treatment can make support available 24/7 and provide immediate feedback. "Activity coach" is a program that creates a custom diet and exercise program based on a person's profile of information. Healthy cooking and shopping tips are provided as people interact with the software. Text messages and phone conversation are also a way to keep in contact with the person using the service (Guillen et al., 2009).

Long and Stephens (2004) conducted a study using computers to promote self-efficacy for healthy eating in adolescents using a pre-test, post-test quasi-experimental design. Students in two schools volunteered to participate and were randomized based on convenience. The intervention students' had access to computers while the controls in many cases did not. The intervention group also had five hours of web based nutrition education and ten hours of classroom curriculum given over the period of one month. The control group simply had nutrition information imbedded into their current daily curriculum. The study tested for two variables, self-efficacy for healthy eating particularly associated with consumption of fat and consumption of fruits and vegetables. There was no significant difference between groups for fruit and vegetable consumption but the intervention group had higher self-efficacy for healthy eating, diet knowledge and healthier usual food choice scores. Adolescence is a critical time for developing

food habits so improving self-efficacy for healthy eating could have long-term positive personal benefits (Long and Stephens, 2004).

Internet Weight Loss Programs

. In the past, the most successful weight loss programs have been those involving individuals participating in face-to-face meetings either with individual counselors or with groups (Gold et al., 2007). Internet weight loss programs are becoming more prevalent but have not been shown to be as effective as face-to-face contact with group members. Gold et al. (2007) conducted a 12 month study that compared an internet-based weight loss program to a program that included both the internet component and a monthly in-person meeting. The program used behavior modification techniques and focused on changing eating and exercise habits. Participants met weekly in an online chat room in groups of fifteen to twenty. They were asked to review their weekly lesson and submit previously assigned homework to the facilitator before the meeting started. The goal for all participants was a weight loss of one to two pounds per week. Participants were also encouraged to exercise beginning at 250 calories per week and increase to 1000 calories per week. The second group had the same protocol but met in person once per month in place of an internet chat. Monthly in-person meetings did not improve weight loss over the internet chat group. Although this was not what the authors hypothesized, they were encouraged that an internet only weight loss intervention was as successful as in-person meetings. This could potentially involve greater numbers of people interested in losing weight (Gold et al., 2007).

Tate, Jackvony & Wing (2006) conducted a study to examine the difference in short term weight loss between groups of people using a self-directed internet weight loss program compared with the same program augmented with e-mails from "live" counselors. 192 people participated in the study, 162 female and 30 male. The participants had a mean age of 49.2 and a BMI of 32.7 kg/m^2. The subjects were divided into three groups: no counseling computer automated feedback and computer automated feedback plus e-mail feedback from a personal diet counselor. The participants all used the Slim-fast interactive website promoting weight loss. The computer automated group and the live feedback group were also granted access to a personal diary application on the website. All participants were placed on a 1200-1500 kcal diet plan. The study retention across all groups was good with 82% attending a three month follow-up appointment and 80% attending a six month follow-up appointment. At three months, both the auto-feedback group and the human contact group lost more weight than the control group. There was no significant difference between the auto-feedback group and human contact group in weight loss at three months. At the six month follow-up, visit the percentage of participants who lost 5% of their body weight was 27% in the control group, 34% in the auto-feedback group and 52% in the human contact group. The researchers were also able to track how many times each participant logged in to the Slim-fast website and found that the control group and the human contact group logged in more frequently than the auto-feedback group. There was also a significantly greater weight loss between

people who logged in more frequently than the people who rarely logged in to the website. Finding population based methods for providing behavior weight loss techniques is potentially beneficial (Tate et al., 2006).

Hurling et al. (2007) conducted a study the purpose of which was to assess the impact of internet and mobile phone feedback on the success of an exercise program. The author hypothesized that a group with an internet/mobile-phone based physical activity program would adhere to the protocol better than a group with just the physical activity program with no access to the internet component or the mobile-phone encouragement. Both groups wore a physical activity monitoring device. After screening, 77 subjects aged 30 – 55 with a BMI between nineteen and thirty participated in the study. Thirty people were randomized into the control group with no internet or mobile-phone component and forty-seven people were in the internet/mobile-phone group (IMP). The IMP group got a series of internet sessions where they were asked about their weekly physical activity and were provided feedback. The mobile phone was used as a reminder tool. A text-based automated dialogue helped the subjects identify barriers they had to exercise and encouraged them to complete some sort of daily physical activity. The IMP group also had a group forum with which they could share with other participants about their physical activity goals and progress. The authors reported that people in the IMP group had on average two hours and eighteen minutes more activity per week than the control group. The participants

really liked the charts and graphs that printed out as a result of the accelerometer data (Hurling et al., 2007).

Development of New Technology

Wang, Kogashiwa & Kira (2006) studied the development of a PDA with a camera and a mobile phone attachment for keeping a diet record. The study evaluated the Wellnavi PDA and looked for practicality and ease of time constraints involved in record keeping as previously noted by people who use a paper and pencil method of self-monitoring. Adherence was studied as well as preference for use. Twenty-four hour recall and weighed food records for twenty-eight female students majoring in Foods and Nutrition from a University in Japan were analyzed. The students were asked to keep a one day weighed food record and also take pictures of all recorded food. The pictures were sent to dietitians participating on the research team. The following day, an unannounced diet recall was conducted. The students were then asked to complete a questionnaire that compared use of the Wellnavi to the weighed food record and 24 hour recall. 89% of the participants regarded the Wellnavi as the best method for keeping a diet record. They also thought it would most accurately represent their usual diet intake and all but one said they would be willing to participate in a follow-up study using the software (Wang et al., 2006).

Six et al. (2010) studied the development of a mobile phone food record specifically designed for adolescents. Diet assessment using a mobile phone would be beneficial to both the person and to a health professional if the expertise

was required. The study looked at whether improvements were made in keeping a diet record using a mobile phone versus a more traditional paper and pencil format. Proficiency with the mobile phone was established during training sessions and was tested based on how well the students' could capture an image of what they were eating. The authors also looked at self-reported ease of use. The subject were adolescent girls ages 11-18 participating in a summer camp. The girls were given the phones and trained on how to take pictures of their food. Some of the feedback provided was they wanted a automatic confirmation that they had taken an adequate picture of the food and they did not like orally entering a submission on the phone as a diet record. They felt as though the oral diet submission would be embarrassing to do in front of others but taking pictures of their food would not be that awkward (Six et al., 2010).

Guillen et al. (2009) wrote a paper featuring several new interactive internet technologies to promote a healthy lifestyle. Activity Coach (AC) is a product designed by the MyHeart project (Guillen et al., 2009). AC is a personal-health system designed to help people reach their fitness goals. The user first put information into the system and an algorithm designed to make suggestions based on the person's current physical fitness and relevant health issues, comes up with a plan that includes incremental increase in the level of exercise. This process get a person set up and then a "coaching" algorithm takes over. Each person using this medium is provided with a garment which has sensors built in that transmit information to the Activity Coach where heart rate and respiration are monitored

and evaluated to see if the person is exercising at a level that will promote increased fitness. Suggestions are made accordingly. The second program Guillen et al. looked at is the PIPS project, specifically "Move it, Lose it, and Win." The strategy is to take otherwise healthy overweight individuals (BMI 26 – 30) and allow them to qualify for prizes based on their participation in changing their eating and activity habits. The participants are screened and given a course of action, pedometer, and access to the internet portal associated with the program. The platform provides: 1) interactive profiling of the participants habits based on questionnaires, 2) a personalized course of action to develop a healthier diet, 3) support for healthy cooking a shopping, 4) mobile support of body weight and steps walked via text message, 5) motivation and reminder messages by phone call, 6) automatic adaptation of the person's diet and exercise habits to improve the outcome, 7) web-based information on nutritional matters. The goal of the program is to take standard information that is available to the public about building a healthier lifestyle and individualizing it. The authors were very encouraged by the programs and encourage specific studies to evaluate their effectiveness (Guillen et al., 2009).

Joo and Kim (2007) conducted a community based anti-obesity intervention program using text messages. 927 subjects came to a health clinic and enrolled in a twelve week weight loss program. They were given information on dieting and exercise and asked to follow it. Every week participants received a text message with behavior modification strategies and encouragement on diet

and exercise. Participants also received printed materials through the mail. After twelve weeks, 433 subjects had completed the program (47%). This appears to be a rather low number, but when taken by itself has fairly high impact for effort. There were mean reductions in BMI ($p<.001$), weight (weight loss of 1.6 kg, $p<.001$), and waist circumference 4.3 cm ($p<.001$). A majority of participants were satisfied with the protocol and the authors concluded that using text messaging that focuses on behavior modification techniques, along with print media, might be an effective way to impact the health of a community when promoted by a community health organization (Joo and Kim, 2007).

Technology is a way of life for most people in the United States. Using technology to improve self-monitoring of diet intake is a natural fit for success and has been shown to improve adherence to self-monitoring. This should be encouraging to people looking to make better health-related lifestyle choices.

Chapter 3

METHODS

Purpose

Previous research has demonstrated that those who log their daily dietary intake more completely are more successful at weight loss (Kruger, 2006; Wing 2001; Butryn, 2007). With the advent of smart phone technology, potentially new avenues for diet tracking are opening up, yet little research exists exploring the best ways of employing these technologies (Bouchey, 2009; Tate, 2006; Yon, 2007). The purpose of this study was to assess the feasibility of using a smart phone to keep records of caloric intake and exercise compared to traditional paper and pencil methodology. Additionally, the study compared participants who either recorded their dietary intake and exercise on the notes feature of the iPhone or memo feature of a Blackberry, or recorded dietary intake using the "Lose It" application on the iPhone. A comparison was also made between groups for weight loss.

Participants

Fifty-seven healthy individuals with no unresolved medical conditions were recruited for the study, and were between 18 and 65 years of age, with a BMI (kg/m^2) between 25 and 40, had been weight stable (+/- 5 lbs) for the past six months, and who desired to lose weight. Participants currently owned a smart phone and had not used a weight-loss application on the phone within the last six months. Participants were recruited using a list serve sent to all Arizona State

University (ASU) campuses (Tempe, West, Downtown and Polytechnic). The recruitment message indicated that the study focused on weight loss involving smart phones. The message also indicated that participants must be willing to record food intake for an eight-week period on their smart phone or on paper and travel to one of the ASU campuses for evaluation and follow-up across four time points. Exclusion criteria included planned vacations during the study period of more than one week, use of a weight related phone app in the past six months, and use of any medications that would affect weight status in the past six months. This study was submitted and approved by the Arizona State University Institutional Review Board, Human Participants Committee for approval.

Study Protocol

This study was a controlled experimental study lasting eight weeks. Participants with smartphones were recruited and semi-randomized into three groups: group 1 (n=19) included participants who owned an iPhone and were trained to use the diet/exercise tracking "Lose It" app (AP), group 2 (n=18) included smartphone owners who were trained to track dietary intake through use of the "notes" or "memo" function on their phones (ME), and group 3 (n=20) included non-iPhone smartphone owners who were trained to record dietary intake using traditional paper-and-pencil methods (PA). Of the 59 people who were randomized into one of the three groups, 47 completed the study (12 men, 35 women, mean age 44.0 ±14.6, 17 AP, 17 ME and 13 PA). Data for two ME group participants was dismissed for not following ME group protocol

Measures

At the beginning of the study, researchers asked participants to complete a health history questionnaire (Appendix A), took participants' weight on a calibrated Tanita scale, and measured height and waist circumference. The weight-loss goal for all participants was one pound per week. Each participant was given a calorie allotment based on the Mifflin St. Jeor equation with an activity value of 1.375, lightly active. The definition of lightly active is, light exercise/sports 1-3 days/week, approximately 590 calorie/day (Estimating Percent Calorie Restriction, scientificpsychic.com). At the outset of the study all groups were given five general weight loss strategies which included part of the U.S. Dietary Guidelines and habits proven to be successful for NWCR participants. The five general guidelines included: eating five servings of fruits and vegetables daily, consuming a diet low in fat, exercising 30 minutes per day three to five days per week, keeping a food record, and weighing themselves frequently during the study (Appendix J). All groups were encouraged to weigh and measure food consumed to get the most accurate calorie count.

As part of the study protocol the AP group recorded dietary intake using the "Lose It" app which was programmed to send daily food log reports to researchers. The AP group was given no additional instruction on diet. Groups 2 and 3 (ME, PA) were placed on an exchange diet (www.mayoclinic.com) and given instructions at the first meeting (Appendix B). Group 2 (ME) recorded dietary intake and exercise using the notes or memo application on their smart

phones and sent these records via email to researchers on a daily basis. Group 3 (PA) recorded dietary intake and exercise using a notebook provided by the researchers and were asked to turn in completed notebooks at weeks four and eight. Researchers instructed each group to record their diet and exercise on a daily basis and instructed participants not to fill in days that they missed. Daily diet records were considered 'complete' when the participant recorded ≥ 800 calories of food in a 24-hour period. In our study, an 800 kilocalorie diet record was considered a "complete day" to account for 2/3 of the minimum required kilocalories needed by a participant to meet daily macronutrient needs as established in several recent weight loss studies (The Look AHEAD research group, 2010; Sacks, 2009). Daily diet records were considered 'partial' days when total daily calories were > 0 but < 800. Finally, daily diet records were considered a 'no-record' day if calories = 0 on a particular day. The groups were instructed not to go back and complete records for days that had not previously been recorded.

To encourage participation, weekly e-mails were sent to all groups thanking them for their participation and encouraging them to continue with the study. The ME and PA groups also received a variety of messages encouraging them to eat a combination of five fruits and vegetables daily and to find ways to incorporate exercise into their daily activity. These messages were taken from various internet sources. An alternating weekly emphasis was placed on exercise and encouraging consumption of fruits and vegetables. The messages can be

found in Appendix C. The ME and PA groups received “enhanced” weekly encouragement to compensate for the immediate feedback the AP group was getting from the weight loss app. To encourage all participants to attend follow-up meetings at weeks four and eight, researchers provided gift cards to Target in the amount of $5.00 at week four and $10.00 at week eight.

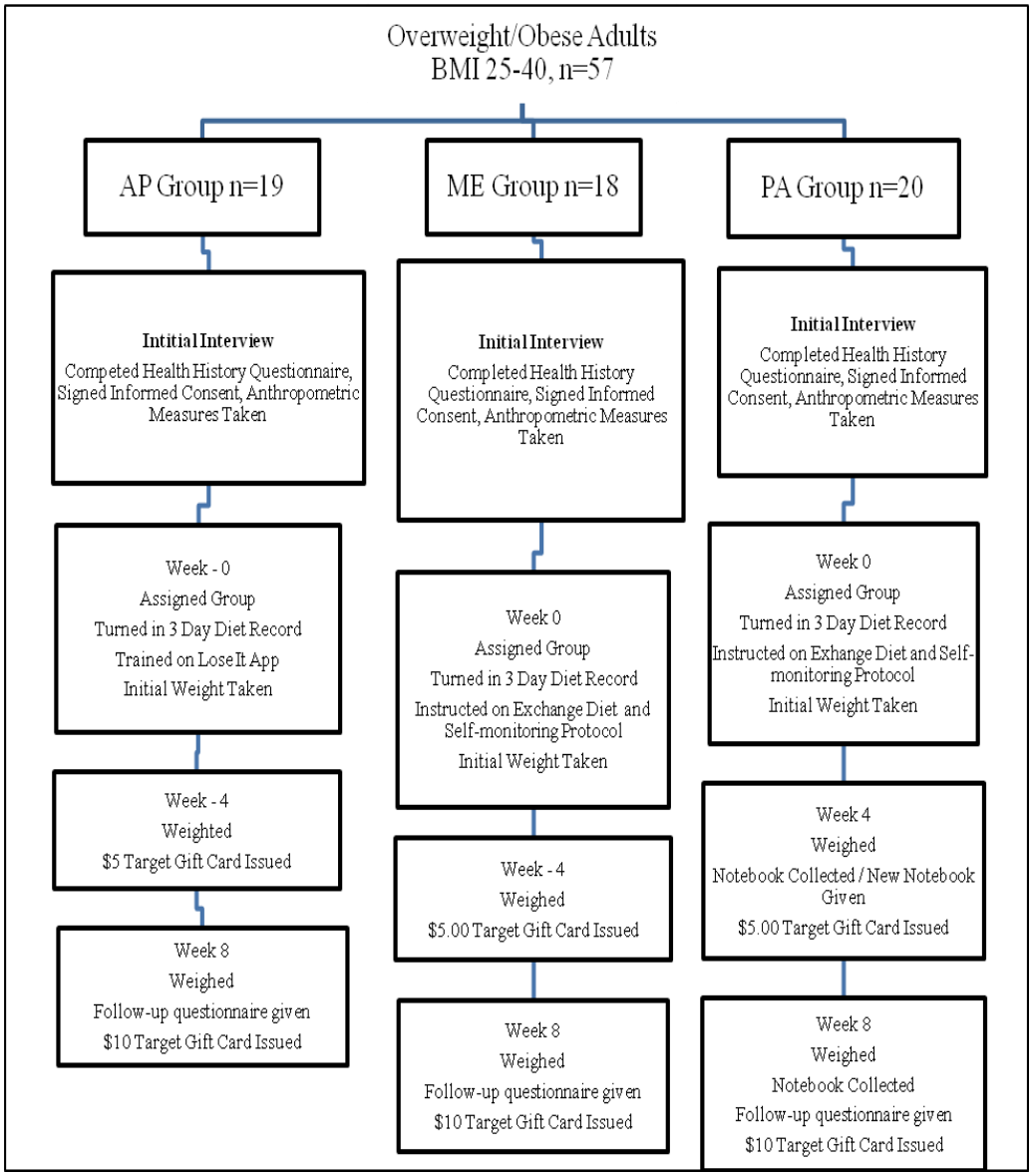

Figure 1. Study Protocol

Timeline

At the outset of the study, participants attended an initial meeting at which time they signed a consent form and completed a health history questionnaire. Researchers then weighed participants and measured their height and waist circumference. Finally, participants were instructed to complete a three-day diet

record over the course of the next week including two weekdays and one weekend day, which they turned in at week 0. Subjects were stratified by gender, age, BMI, body weight and waist circumference on a weekly basis, and randomly assigned to a group (AP, ME, PA).

At week 0, participants turned in their three-day diet record and began the study protocol associated with their group assignment. Participants in the AP group received training on the "Lose It" app for the iPhone (Appendix F). Researchers customized the app's settings for each participant so that daily caloric intake was limited to an amount that would result in one pound of weight loss per week. Participants using the app were instructed to record their daily dietary intake using the app, which subtracted the calories consumed with each food or beverage from the calories allotted. The AP group was also encouraged to record exercise, which then gave calorie credits based on the type and duration of exercise. The ME and PA groups were educated on an exchange diet (Diabetes Diet, mayoclinic.com) and assigned exchanges based on the number or calories allotted to lose one pound per week. The ME and PA groups were also encouraged to record exercise and given a scale to calculate various calorie credits based on the type and duration of exercise. The exercise scale given to the ME `and PA groups was developed from the calorie credits assigned to specific exercises on the Lose It app to be consistent with the AP group. Notebooks were distributed to the PA group.

At week 4, all participants returned to an ASU campus to be weighed. The PA group turned in their initial notebooks for assessment and received a new notebook. All groups were encouraged to continue and any questions or problems were addressed. There were no additional diet or exercise materials given. A $5.00 Target gift card was given to all participants (n=45) who attended the week 4 weight in.

At week 8, participants were weighed on the same calibrated Tanita scale. The PA group turned in their second set of notebooks for assessment. All participants were asked to complete a non-validated post-study questionnaire developed to assess perceptions of the diet recording method used, self-efficacy, weight loss and study satisfaction (Appendix H). A $10.00 Target gift card was given at the completion of the study.

Chapter 4

RESULTS

Descriptive characteristics

Fifty-seven participants with smartphones were recruited for this study to determine if adherence to the recording of food intake would be increased for those who used a phone application (AP), as compared to those using a memo or note feature (ME), or the traditional paper and pencil (PA) method; if there would be more weight loss for the AP group as compared to the ME or PA group, and if there would be less attrition for the AP group as compared to the ME or PA groups. All subjects were recruited through advertisement at the four campuses of Arizona State University. After completing a screening questionnaire the participants were placed in one of three groups. All iPhone (n=19) users were placed in the AP group because the "Lose it" application was only available on the iPhone at the time the study was conducted. The remaining participants were randomly placed in either the ME (n=18) group or the PA group (n=20). 85% (n=47) completed the 8 week assessment. Data collected for two participants assigned to the ME group who completed the study were dismissed because they were using an app on their respective phones to record food intake. Data analysis was conducted on 45 participants who completed the study according to their group assignments with no differences in anthropometric characteristics (Table 1) or demographic characteristics (Table 2).

Table 1

Baseline Anthropometric Characteristics of Subjects by Treatment Group

	AP (n=17)	**ME (n=13)**	**PA (n=15)**	***P***
Baseline Weight (lbs)	185.9±31.4	189.9±41.7	181.4±38.7	.830
Height (inches)	66.2±4.2	65.7±3.3	66.2±4.0	.918
Waist Circumference (cm)	90.6±10.4	92.4±12.3	91.3±11.7	.915
Baseline BMI (kg/m^2)	29.8±4.2	30.9±6.0	28.9±4.0	.534

P values obtained from one-way ANOVA

Table 2

Group Demographic Information

	AP N=17	ME N=13	PA N=15	*P**
Age	44±14.6	41.5±14.5	40.8±14.6	.808
Gender				
Male	5	2	4	.655
Female	12	11	11	
Education				
High school only	0	0	1	.477
Some college	3	5	4	
College graduate	13	8	10	
Ethnicity				
Hispanic or Latino	2	1	2	.889
Not Hispanic or Latino	15	12	13	
Race				
American Indian/Alaskan Native	0	0	0	.081
African American	1	3	0	
White	14	10	10	
Native Hawaiian/Pac. Islander	0	0	2	
Asian	2	0	3	
Smoker				
Yes	1	1	0	.576
No	16	12	15	
Medications				
Yes	10	8	7	.690
No	7	5	8	
Supplements				
Yes	11	10	11	.745
No	6	3	4	
Activity Level				
Not active	1	2	1	.855
Somewhat active	12	9	11	
Active	3	2	3	
Very active	1	0	0	
Alcohol				
Yes	9	3	7	.237
No	8	10	8	

**P Pearson's Chi Square*

Attrition Rates

There was no significant difference in attrition rates between groups. 89.5% of the AP group, 83.3% of the memo group and 75% of the paper group completed the eight week study. There was on overall completion rate of 85.5 %.

Adherence to Self-monitoring

An analysis of covariance was performed to see if a difference in adherence to keeping a diet record existed between the three groups after controlling for the degree of weight change over time. The correlation between weight change during the trial and number of days recorded was -.270 which indicated a weak correlation between variables. There was a significant difference between recording methods and amount of complete days after controlling for weight change over time ($F=3.48$, $p = .040$) (Table 4). The overall mean adherence to self-monitoring for the 8 week period was better in the AP group than the PA group ($p = .024$). However, there was no significant difference between the AP group and ME group ($p = .148$), or the ME group and the PA group ($p = .457$) when controlling for the degree of weight change during the trial. A day was considered 'complete' if the participant consumed > 800 kilocalories for the day. The AP group had a 40% higher recording rate as compared to the PA group and 23% higher recording rate as compared to the ME group; however, these differences did not reach significance (Table 3). The AP group had a 50% lower 'none complete' recording rate as compared to the PA and ME groups;

however, these differences also did not reach significance (Table 3). The recording rates over time are displayed in Figure 1.

Table 3

Adherence to Self-Monitoring Between Groups[1]

	AP N=17	**ME N=13**	**PA N=15**	***P***
Completed days	42.7±11.4	34.8±12.5	30.73±17.6	.070[2]
None completed days	10.4±9.7	21.3±12.1	21.0±19.1	.063[3]

[1] *Data are mean values* [2]*P value one-way ANOVA* [3]*K P value Kruskal-Wallis*

Table 4

Completed days when controlling for weight change

Between groups	AP vs ME	AP vs PA	ME vs PA
P = .040	P = .028	P = .148	P = .457

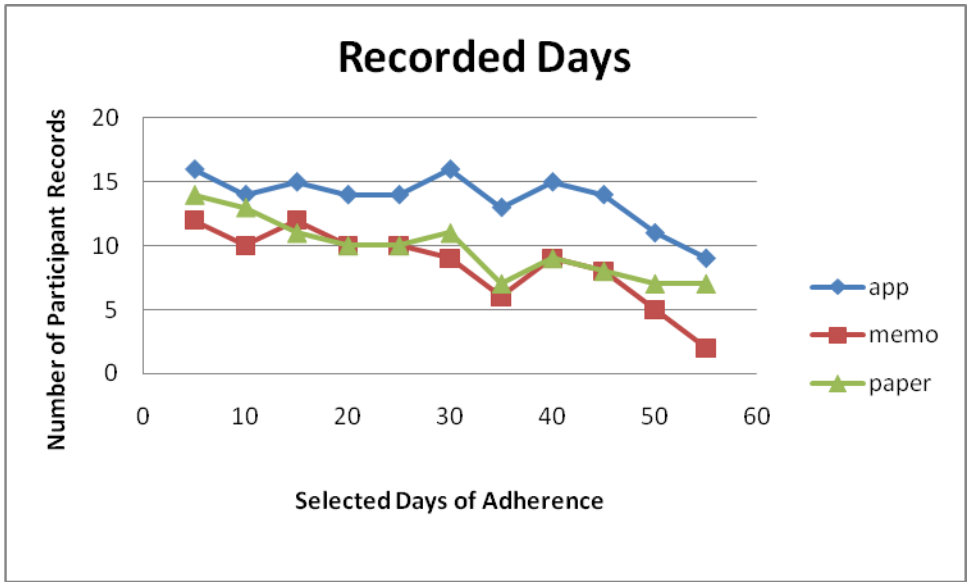

Figure 2. Comparison of self-monitoring on specific days. Data includes both complete and partially completed days. An incremental sampling of five days, starting on day five.

Weight Loss

At 8 weeks (57 days) the percent mean weight loss was statistically significant ($p < 0.01$) for all treatment groups with no significant difference between the groups. There appears to be a weak correlation between completed days and weight loss ($r = -.278$, $p = .068$) and between weight gain and days not recorded ($r = .266$, $p = .081$). The total weight loss for the AP group was 3.34 ± 1.1 lbs, the total weight loss for the ME group was 6.55 ± 1.3 lbs. and the total weight loss for the PA group was 4.4 ± 1.3 lbs (Table). Weight change over the study is depicted in Figure 2.

Table 5

Weight Loss (lbs)

	AP	**ME**	**PA**
Weight baseline	185.4±32.2	189.5±41.6	181.1±38.8
Weight week 4	182.2±31.5	185.1±40.8	177.8±38.1
Weight week 8	182.0±31.6	183.0±39.5	174.0±36.4
Total weight loss	**-3.34 ± 1.1**	**-6.55±1.3**	**-4.4±1.3**

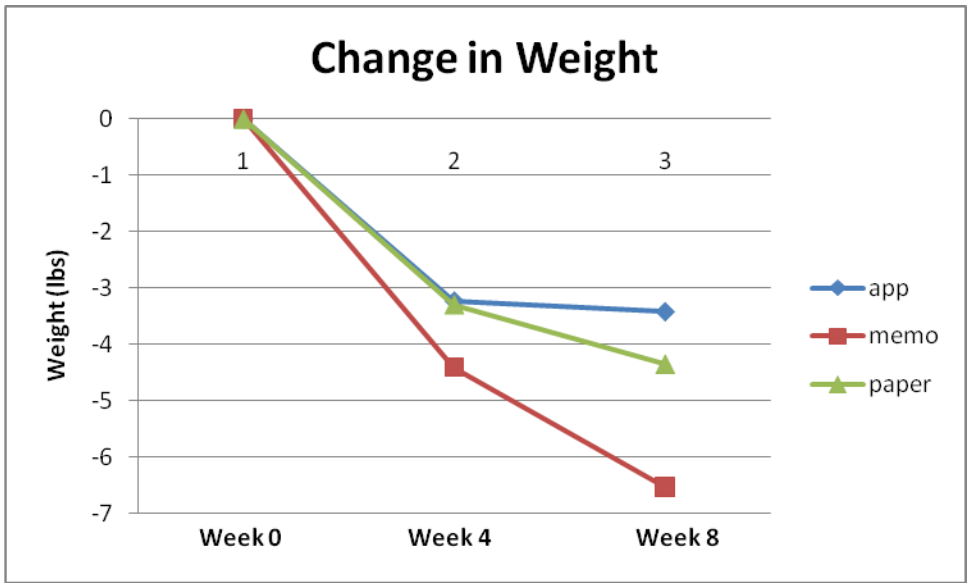

Figure 3. Mean weight loss. App group wt. change 4 weeks - 3.24 ± 3.31, 8 weeks - 3.42 ± 4.51. Memo group wt. change 4 weeks – 4.41 ± 2.67, 8 weeks – 6.55 ± 4.94. Paper group wt. change 4 weeks – 3.30 ± 2.42, 8 weeks - 4.36 ± 4.65.

Follow-up Questionnaire

The results of a follow-up questionnaire (Table 6) indicated there was strong agreement on several questions. There was agreement to the statements that focused on the benefits of keeping a food record and incorporating exercise into a program for weight loss regardless of group assignment. A significant difference (P = .009) was shown when asked the question regarding the time commitment to a particular method of keeping the food record. The AP group disagreed with the notion that using the phone application was too time consuming (Figure 4).

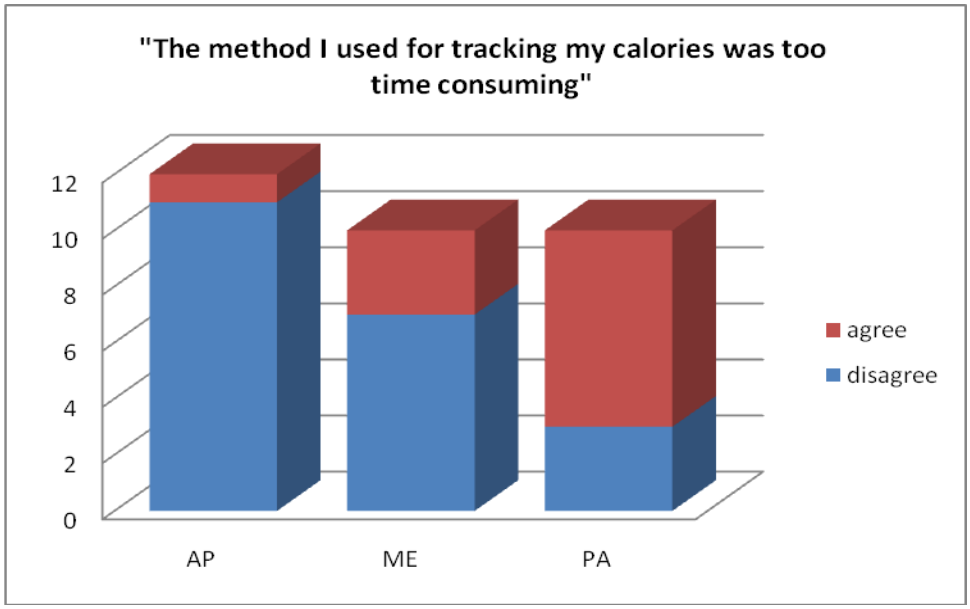

Figure 4

Table 6

Follow-up questionnaire

		AP	ME	PA	P
Recording my daily intake was helpful in keeping me on track toward my weight loss goal.	agree disagree	12 0	10 0	10 0	
The method I used for tracking my calories was too time consuming	agree disagree	1 11	3 7	7 3	.009
I was more aware of my eating habits because I was keeping a record.	agree disagree	12 0	10 0	10 0	
I am more confident in my ability to lose weight.	agree disagree	12 0	10 0	10 0	
I will continue to record my food intake.	agree disagree	11 1	9 1	9 1	.988
I will continue to exercise	agree disagree	12 0	10 0	10 0	
I met my weight loss goal	agree disagree	6 6	8 2	5 5	.277

Chapter 5

DISCUSSION

Strategies that promote weight loss success are widely sought after by the general public and healthcare professionals alike. Research has consistently shown that adherence to self-monitoring of food intake increases success in both weight loss and weight maintenance because self-monitoring increases awareness of food intake and the behavior associated with weight gain (Jelalian, 2010; Dorsten, 2008). Self-monitoring has also been shown to improve adherence to an exercise program (Hurling et al., 2007) and to adhering to a low-sodium, low-fat diet (Achary et al., 2011). A recent study conducted by Burke et al. (2007) compared self-monitoring using a personal digital assistant (PDA) to the traditional paper-and-pencil method and discovered that the group using the PDA had significantly better adherence to keeping a diet record than the paper-and-pencil group ($P < 0.01$).

Smartphones have recently become commonplace; over 28% of Americans own one ("Health app downloads soar, but do they work?"). Smartphones allow their owners constant access to the Internet via a digital network; it is analogous to having a handheld computer at all times. Popular features of smartphones are the applications that can help with shopping, banking, travel, games, social networking and much more. There are a plethora of apps promoting a healthy lifestyle, including many targeting weight loss. Despite their popularity, there is very little research on whether apps make a measurable

difference in achieving the healthier lifestyle that they promote ("Heath app downloads soar, but do they work?").

The purpose of this study was to compare the efficacy of using a smartphone to track dietary intake and exercise for weight loss with traditional paper-and-pencil methodology and to compare the use of a smartphone diet tracking app to the process of keeping daily diet records using text-based smartphone 'note' functions. We hypothesized that use of the smartphone and a diet tracking app would lead to increased compliance in tracking caloric consumption, diet composition and energy expenditure, compared to either note taking on a mobile device or traditional paper-and-pencil diet-tracking methodology. We further hypothesized that the smart phone group would demonstrate lower rates of attrition compared to the paper-and-pencil group and that participants using smart phones with diet tracking apps would lose more weight than participants using either note-taking functions on their smart phone or traditional paper-and-pencil diet-tracking methodology.

All study participants had a desire to lose weight and had a BMI of 25 - 40 kg/m^2. After being assigned to a group, (AP, ME, PA) subjects were given instruction on self-monitoring dietary intake and physical activity recommendations, but there was no significant difference in anthropometric or demographic measures among groups. All subjects were allocated a number of kilocalories based on the goal of achieving a one pound weight loss per week. No further diet instruction was given to the AP group to test the viability of the

weight loss app when used independently of the study atmosphere. The ME group and the PA group were placed on an exchange diet, and were encouraged to eat at least five servings of fruit and vegetables per day, while lowering their fat intake. All groups were encouraged to exercise for a calorie deficit of 800 kilocalories per week. Both the ME and PA groups were sent weekly e-mails which included strategies to incorporate more fruits and vegetables into their diet and ways to incorporate exercise daily. The AP group was sent weekly e-mails, but the e-mails did not include recommendations on fruits and vegetables or exercise.

Adherence to self-monitoring for the AP group was assessed through automatic e-mails sent to researchers without any action by the AP group participant. The ME group was instructed to e-mail their records daily to researchers. Notebooks from the PA group were collected at four and eight weeks. All participants were instructed not to record a previous day's intake if they missed recording on a particular day. In this study, the app group recorded the most days (42.7±11.4) with a trend toward significance ($p = 0.070$). The overall mean adherence to self-monitoring for the 8-week period was better in the AP group than the PA group ($p = .024$). However, there was no significant difference between the AP group and ME group ($p = .148$), or the ME group and the PA group ($p = .457$). One factor that could have contributed to the lack of significance was there was no way of tracking the paper people who did not complete the study. The AP participant data was automatically sent, giving 100% accountability. In future studies, it may be advantageous to collect diet records

from the PA group at shorter intervals to improve retention and data collection. The ME group had to manually send their daily records which also introduced another limitation to the study. When no record was sent for the participants in the memo group, a missed day was recorded, this gave researchers a better record of ME group adherence when compared to the PA group.

For all groups, weight loss was significant ($P < 0.01$), but there was not a marked difference in the amount of weight reduction between groups. There was a significant correlation between number of days recorded and weight change at four and eight weeks ($P = .038$), regardless of which method of self-monitoring was used. This finding is consistent with previous studies (Burke, 2007; Yon, 2007) and should provide encouragement to individuals looking for strategies to increase weight loss success. It is interesting to note that the AP group recorded the highest number of days, but as a group, lost the least amount of weight. This finding may indicate the influence of the extra coaching provided to the ME and PA groups. Burke et al. (2007) found that when using a PDA to self-monitor food intake with dietary feedback as compared to a PDA only or keeping a paper-and-pencil record there was no significant difference between groups, but the PDA with feedback had a higher proportion of individual achieving ≥ 5% of weight loss in comparison to the paper group ($P = 0.04$) and the PDA without feedback group ($P = 0.09$) (Burke et al., 2011). Wing et al (2010) also found a key component to diet success is feedback. Gullen et al. (2009) found that using an

internet tool to provide diet feedback was an effective way to promote a healthy lifestyle.

This study did have a higher attrition rate from the PA group (25%) but the attrition rate was not significant between groups (AP 10%, ME 17%) which confirms data from a previous study comparing a PDA to paper-and-pencil methodology (Burke et al., 2011) The PA group had the least amount of accountability which could have contributed to the higher attrition rate.

Given the significant problem of childhood obesity, smartphone technology could play an increased role in promoting healthier eating among children. Bouchey et al. (2009) and Long et al. (2004) both found that children responded positively to the use of technology when completing diet records and reported higher self-efficacy for healthy eating.

Cost effective treatments for weight loss could be beneficial in curbing the obesity epidemic (Wing, 2010). Weight loss apps are either free or moderately priced and can provide a very cost effective way to encourage adherence to a weight loss plan. Dansinger et al. (2010) found that when comparing popular weight loss diets, it was adherence to the diet that determined success, not the diet itself and encouraged strategies to improve diet adherence.

The use of a healthy lifestyle app in conjunction with feedback from a nutrition professional has the potential to promote success in a number of areas. Apps like Lose It, can be programmed to automatically send a report to whomever the app owner chooses. This could ease the process of providing tailored

feedback and increase accountability between the nutrition professional and client. Tailored feedback has been shown to improve success in improving diet quality, weight loss and increasing weekly minutes of exercise (Achyra, 2010; Hurling, 2007).

There were several limitations to this study. Three different smart phones were included in the study with different costs and features associated with each. The ME group was asked to type everything into a memo or note feature on their smartphone and e-mail their record to researchers on a daily basis. Typing on a cell phone can be tedious and frustrating so consequently this could have negatively influenced adherence to recording daily food intake by the ME group. At eight weeks, the study was somewhat short. The participants were all recruited from a University list serve, which created some homogeny that would not necessarily happen had participants been recruited from a larger sampling of the general public. There was a different level of accountability between all three groups. The PA group had the least accountability and the AP group had the most accountability because their records were automatically sent to researchers on a daily basis. All participants self-reported their dietary intake and energy expenditure, which could create discrepancies in the data depending on the accuracy of the subjects' recording.

Chapter 6

CONCLUSION

Our study used three different methods of self-monitoring diet and exercise. Two groups used their smartphone and one group used the traditional paper-and-pencil methodology. The purposes of the study were to assess adherence to dietary self-monitoring, to determine weight loss differences, and to measure attrition between groups. The AP group recorded more days than the PA group, but there were no differences between the AP and ME groups or between the ME and PA groups. Each group lost a significant amount of weight, but no group lost significantly more weight than the other. There was however, a weak correlation between the number of days recorded and the amount of weight loss across all groups. Attrition rates were not significantly different between groups. Our study confirmed evidence from previous studies that self-monitoring of diet and exercise, regardless of the method, can lead to weight loss success. The number of completed diet records by the AP group approached significance, and without the ME group which also used the smartphone, was significantly higher than the PA group. Easing the burden of self-monitoring could have the potential to make an impact on success for people trying to improve their health. Further studies exploring the effectiveness of smartphones as a weight loss tool are definitely warranted.

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APPENDIX A

HEALTH HISTORY QUESTIONNAIRE

HEALTH /HISTORY QUESTIONNAIRE

ID#_____

1. Gender: M F Age: _ _ (To be completed → by study personnel) Weight ___ Height ___ Waist ___

2. Have you lost or gained *more than* 5 lbs in the last 3 months?
   Yes No

   If yes, how many pounds lost or gained? _____
   How long ago? _____

   Do you desire to lose weight? Yes No
   How many pounds? _____

3. Are you willing to adhere to a diet plan and record food consumed on a daily basis for 8 weeks?

   Yes No

4. Education (please circle) High school Some college College graduate

5. Ethnicity: (please circle) Hispanic or Latino Not Hispanic or Latino

6. Race: (please circle) American Indian/Alaska Native African-American White Native Hawaiian/Other Pacific Islander Asian Other

7. Do you smoke? No, never _____ Yes _____
   # Cigarettes per day = _____
   I used to, but I quit _____ months/years (circle) ago

8. Do you take any medications regularly? Yes No

If yes, list type and frequency:

Medication	Dosage	Frequency

9. Do you currently take supplements (vitamins, minerals, herbs, etc.) ?
Yes No

If yes, list type and frequency:

Supplement Dosage Frequency

_____

_____

_____

10. Please ANSWER (YES/NO) if **you currently have** or if **you have ever** been diagnosed with any of the following diseases or symptoms:

	YES	NO		YES	NO
Coronary Heart Disease			Chest Pain		
High Blood Pressure			Shortness of Breath		
Heart Murmur			Heart Palpitations		
Rheumatic Fever			Any Heart Problems		
Irregular Heart Beat			Coughing of Blood		
Varicose Veins			Feeling Faint or Dizzy		
Stroke			Lung Disease		
Diabetes			Liver Disease		
Low Blood Sugar			Kidney Disease		
Bronchial Asthma			Thyroid Disease		
Hay Fever			Anemia		
Leg or Ankle Swelling			Hormone Imbalances		
Eating Disorders			Emotional Problems		

Please elaborate on any condition listed above

_____

_____

_____

_____

11. How would you rate your lifestyle? (please check)

Not active _____ Active _____

Somewhat active _____ Very Active _____

12. Please circle the total time you spend <u>in each category</u> for an average **week.**

Light activities such as:
Slow walking, golf, slow cycling, doubles tennis, easy swimming, gardening
Hours per week: 0 1 2 3 4 5 6 7 8 9 10+

Moderate activities such as:
Mod. Walking, mod. cycling, singles tennis, mod. swimming, mod. weight lifting
Hours per week: 0 1 2 3 4 5 6 7 8 9 10+

Vigorous activities such as:
Fast walking/jogging, fast cycling, court sports, fast swimming, heavy/intense
weight lifting
Hours per week: 0 1 2 3 4 5 6 7 8 9 10+

13. How much alcohol do you drink? (average drinks per day)

_____

14. Do you have any food allergies? Yes No *If yes, please explain*:

_____

15. Do you follow a special diet? (weight gain/loss, vegetarian, low-fat, etc.) Yes No

If yes, please explain:

_____

_____

_____

_____

_

APPENDIX B

EXCHANGE DIET INSTRUCTION

Your Personal Diet Plan

Starch – 1 serving = 1 slice bread, ½ c cooked cereal, rice or pasta, 1 oz ready-eat-cereal, ½ bun, bagel or English muffin, 1 small roll, biscuit or muffin, 3-4 small or 2 large crackers.
Vegetables – 1 serving = ½ cooked or raw vegetables, 1 c leafy raw vegetables, ½ c cooked legumes, ¾ c vegetable juice.
Fruit - 1 serving = 1 medium whole fruit, ½ grapefruit, 1 melon wedge, ¾ cup juice, ½ c berries, ½ c diced cooked or canned fruit, ¼ c dried fruit.
Milk - 1 serving = 1 c low fat milk or yogurt, 2 oz process cheese food 1 ½ oz cheese
Fat - margarine, salad dressing oils, lard, mayonnaise, sour cream, cream cheese, butter gravy, sauces, potato chips, chocolate bars. (equivalent amount to 50 kcal)
Meat – 1 serving 2 to 3 oz lean cooked meat, poultry or fish, 1 egg, ½ c cooked legumes, 4 oz tofu, 1/3 c nuts or seeds.
Sweets – You may include one sweet serving per day – ½ cup ice cream, 1 snack size candy bar, 1 cookie.

	kcal	
fruit	60	
Milk (low-fat)	120	
Vegetables	25	
Meat (low-fat)	75	
fat	45	
starches	80	

Example Diet plan: _____ kcals (plus one 'sweet serving' per day maximum)	
breakfast	
snack	
lunch	
snack	
dinner	
snack	
sweet	

APPENDIX C

E-MAIL MESSAGES

Week 1

Hello "memo" group,
One week down, three to go before our first weigh in. You all are doing a great job keeping a record and sending it to us. If you have access to a scale, we would encourage you to check your progress. Save the date: Aug. 16th for downtown weigh in, and Aug. 17th for West campus weigh in.

Here are a couple of housekeeping items:

- Please include your number on your daily food diary.
- Please include any exercise you have completed.
- Please indicate whether it is a complete day.

Remember we are encouraging you to eat 5 servings of fruits and vegetables every day and to "burn" 800 - 1000 kcals per week in exercise.
Here is a website with ideas for including more fruits and vegetables in your daily diet,
http://nutrition.about.com/od/fruitsandvegetables/qt/5to9.htm

Keep up the good work, Danielle and I really appreciate it!
Barb

Week 2

Hello,
This week we are encouraging exercise! Try incorporating a 15-20 minute walk on your lunch break. How about taking the stairs? Don't forget to stay hydrated and drink water before, during and after exercise. Also, fruits and vegetables have a high % of water.

Don't worry if you miss a day, just keep going! Research shows the more self monitoring, the more pounds lost. As always, email us with any questions or comments. Have a great week. Thanks again. We appreciate you!

Barb and Danielle

Week 3

Hello!
This week we are encouraging fruits! August is the best month for **peaches**.

- One peach has 3 g of fiber, vitamins A, C and potassium
- Use in a salad, with whole grain cereal or low fat yogurt

If you are not keen on peaches, how about **watermelon**!

- Watermelons contain vitamins A&C, lycopene, fiber and potassium
- Carve out a bowl and fill with a fruit salad

Keep up the food recording. Email if you have questions. Hope you are having a good week. We appreciate you! Thanks again.
Barb and Danielle

Week 4

Hello,
Thanks again for participating in our study. We are very appreciative. We hope you are learning something and are motivated to keep up the good work. Our focus this week is on portions vs. serving size. Serving size is the recommendation on the food product and the amount that the nutrition information is based on. Portion size is what you choose to eat. This may or may not be the same as serving size. Here are some ideas to help you out that we got from the American Dietetic Association website.

Here are some everyday comparisons to help you figure out your serving sizes:

- A teaspoon of margarine is the size of one dice.
- Three ounces of meat is the size of a deck of cards.
- One cup of pasta is the size of a baseball.
- An ounce and a half of cheese is the size of four stacked dice.
- One-half cup of fresh fruit is also the size of a baseball.

Keep in mind, if your portion is bigger than one food group serving, it counts as more that one serving.
To overcome portion distortion and to downsize your helpings, try these tips:

- Eat from a plate, not a package, so you know how much you eat.
- Use smaller dishes, such as a lunch plate for your dinner, so less looks like more on your plate.

Have a great week!
Barb and Danielle

Week 5 10 Tips for eating out

1. Think ahead and plan where you will eat. Consider what meal options are available. Look for restaurants or carry-out with a wide variety of menu items.
2. Read restaurant menu's carefully for clues to fat and calorie content. Menu terms that can mean **less** fat and calories: baked, braised, broiled, grilled, poached, roasted and steamed.
3. Menu terms meaning **more** fat and calories: batter-fried, pan-fried, buttered, creamed, crispy or breaded. Choose these foods only occasionally and in small portions.
4. Think about your food choices for the entire day. If you are planning a special restaurant meal in the evening, have a light breakfast and lunch.
5. Split your order. Share an extra large sandwich or main course with a friend or take half home for another meal.
6. Eat your lower calorie food first. Soup or salad is a good choice. Follow up with a light main course.
7. In place of fries or chips, choose a side salad, fruit or baked potato. Or, share a regular order of fries with a friend.
8. A baked potato offers more fiber, fewer calories and less fat than fries if you skip the sour cream and butter. Top your potato with broccoli and a sprinkle of cheese and salsa.
9. Be size wise about muffins, bagels, croissants and biscuits. A jumbo muffin has more than twice the fat and calories of the regular size.
10. Pass up all-you-can-eat specials, buffets and unlimited salad bars if you tend to eat too much.

Source: ADA website (eatright.org), Finding Your Way to a Healthier You (DHHS, USDA)

Week 6

20 Ways to Eat Your Vegetables

Vegetables are nature's gifts of health to us. They are low in calories and high in both fiber and phytochemicals to protect us from diseases and manage our weight. It is recommended that we eat 2 to 2 ½ cups of a variety of colorful vegetables daily. Here are some ideas to help you incorporate more vegetables into your daily diet.

1. Make your own "to go" packs. Fill small plastic bags with single servings of grape tomatoes, carrot and celery sticks, sliced peppers and snap peas.
2. Pile sliced cucumber, zucchini, mushrooms, tomato, carrot strips, pepper rings, shredded cabbage, and spinach leaves on your sandwich or your wrap.
3. Load your omelet with broccoli, mushrooms, peppers, onions, tomatoes and herbs.
4. Double the vegetables and reduce the noodles or rice in pastas or casseroles.
5. Serve spaghetti squash instead of pasta, topped with your favorite marinara sauce.
6. Whip up homemade soups from pureed cooked vegetables and herbs with broth, or add a handful of frozen vegetables to a prepared low sodium soup.
7. Top your favorite baked potato with salsa, peppers, corn and broccoli.
8. Order a salad or steamed vegetables for your "side" instead of fries.
9. Toss carrots and some "greens" like spinach or kale into your smoothie.
10. Juice vegetable for a refreshing beverage.
11. Create your own veggie pizza.
12. Roast or grill vegetables in batches (in advance) to use for future meals. Roasted or grilled asparagus, onions, peppers and Brussels sprouts go from sides to salads, pasta and wraps.
13. Prepare a quick dinner stir fry.
14. Grate zucchini, carrots and spinach into meat loaf, lasagna, mashed potatoes, pasta sauce, brown rice dishes and even muffin batter.
15. Use a dark green salad as a vehicle to eat all kinds of colorful vegetables.
16. Fix a spice vegetarian chili with red, green or orange peppers, onions.
17. A crock-pot stew with tomatoes, carrots, celery and peas.
18. Experiment with vegetables you haven't used before.
19. Snack on celery stuffed with hummus, cucumber slices with Greek yogurt or fat-free cottage cheese mixed with tomatoes.
20. Chop once eat lots. Take time to chop vegetables in advance and add to dishes throughout the week.

Thanks to *Virginia G. Piper Cancer Center* Nutrition Services for these ideas

Week 7

Hello,
Hope everyone is doing fine. Here are some tips from the website familydoctormag.com on eating more fruits and vegetables.
Keep up the good work.
Barb and Danielle

BREAKFAST

- A small glass of 100-percent fruit juice is the perfect start to an energizing breakfast.
- Add sautéed mushrooms, onion, red and yellow bell peppers, or tomatoes to scrambled eggs or omelets.
- Slice peaches, bananas, strawberries or other fresh fruit onto cereal.
- Mix dried cranberries or raisins into oatmeal.
- Make a quick breakfast smoothie of frozen fruit, low-fat yogurt, and nutmeg or sweetener to taste.

LUNCH AND DINNER

- Skewer up some pineapple, nectarines, zucchini, mushrooms and cherry tomatoes to go with grilled chicken or steak.
- Double your vegetable servings.
- Create your own salad bar, or build your own pizza. Try red, green, orange and yellow bell peppers; mushrooms; broccoli; spinach; zucchini; and pineapple cubes.
- For dessert, blend frozen berries, juice, sweetener and vanilla extract in a food processor. Enjoy it like you would a sorbet.

SNACKS

- Keep small plastic bags filled with single servings of cherries or grapes in your refrigerator to make fruit as easy to grab as a bag of chips.
- Munch on cut-up raw vegetables and a low-fat dip.
- Spread hummus on whole-grain crackers.

Party with fruits and vegetables!

- Pick up a bouquet of fruit as a hostess gift.
- Instead of arriving with a box of chocolates, bring a pretty tin of homemade chocolate-dipped strawberries or dried apricots.
- Have a fondue party with cut apples, pears, pineapple, bananas and strawberries.

WHEN EATING OUT

- Start your meal with a broth-based, vegetable-loaded soup or a colorful mixed salad.
- Ask for extra vegetables on sandwiches.
  Trade French fries for a side salad or steamed vegetables.

Week 8

Three Is the Key to Getting Your Whole Grains

September is Whole Grains Month, and when it comes to getting your whole grains, three is the magic number: *3 one-ounce servings per day*.

What is a serving equivalent to?

- A slice of 100-percent whole-wheat bread
- ½ cup of brown or wild rice
- ½ cup of oatmeal
- Five whole-grain crackers

Whole grains provide fiber, antioxidants, vitamins, minerals and nutrients, so it's worth making sure you are getting your share.

Keep in mind that products labeled "bran" or "multigrain" actually might not be whole-grain products. Look for 100-percent whole-wheat breads, whole-grain pastas, brown or wild rice, or whole-grain oatmeal. Popcorn also makes an excellent whole-grain snack when prepared without added fat or salt.

Studies show that eating a diet rich in whole-grains may lower your risk of heart attack and stroke, aid digestive health and help maintain a healthy weight.

Produced by ADA's Public Relations Team

APPENDIX D

INFORMED CONSENT

ASU NUTRITION: SMART PHONE TRIAL

INTRODUCTON

The purposes of this form are (1) to provide you with information that may affect your decision as to whether or not to participate in this research study, and (2) to record your consent if you choose to be involved in this study.

RESEARCHERS

Drs. Christopher Wharton and Carol Johnston, professors in the ASU Nutrition Program, and Barbara Cunningham, Danielle Sterner, and Kevin Cowen, ASU nutrition masters students, have requested your participation in a research study.

STUDY PURPOSE

The purpose of this research study is to evaluate the usefulness of smart phones as a tool to help individuals adhere to weight loss diets. Weight loss diet quality will also be assessed.

DESCRIPTION OF RESEARCH STUDY

You have indicated to us that you are healthy and that you desire to lose weight. You have also indicated that you are willing to follow the study diet which has been designed specifically for you to help you lose about 1 pound per week during the study. You will be asked to record all food intake on a daily basis, a strategy that has been shown in previous research to facilitate weight loss. Initially you will come to the test site to complete a brief health history questionnaire to demonstrate the absence of medical conditions or situations that may impact the study. At this visit you will be instructed to complete a 3-day diet record prior to the initiation of the study. Your weight and height will be measured, and we will measure your waist circumference. The scale that determines your body weight will also provide information regarding your body composition by sending a weak electrical current through your body that cannot be felt. This first meeting will take 30-45 minutes. At this visit you will be scheduled for three more study visits at the test site which will take about 30 minutes each. At these visits we will repeat measurements of your weight, waist circumference, and body composition. You will be receiving follow-up phone calls, or emails if preferred, by researchers so any questions can be answered. This study will last 8 weeks.

At the start of the study you will be randomly assigned to one of three study groups; that is, you will not be able to choose which group you are in. You will be prescribed a weight loss diet specific for you, and you will be counseled on how to follow the diet. You will be asked to record

all food consumed daily during the 8-week study. Two groups will utilize their smart phones in this process, and one group will not be using their smart phone for the study. During the 8-week trial, you will be asked to exercise each day to burn about 150 calories. You will be provided a chart on activities with the associated calorie use. If you begin taking new medications during the study, you are to notify the study investigators. About 60 people will participate in this study. This study will take place at an ASU campus (ASU West or the Downtown campus) and is funded by research monies at the ASU Foundation.

RISKS

There are no foreseeable risks associated with this study. Individuals may become bored or frustrated with the diet protocol. Individuals will be carefully screened to include individuals with a strong desire to follow a diet plan and to lose weight.

BENEFITS

This study will provide information regarding the usefulness of smart phone technology for improving diet adherence and possibly weight loss. You will receive free diet counseling, and you may lose weight, if you participate in this study.

NEW INFORMATION

If the researchers find new information during the study that would reasonably change your decision about participating, then they will provide this information to you.

CONFIDENTIALITY

All information obtained in this study is strictly confidential unless law requires the disclosure. The results of this research study may be used in reports, presentations, and publications, but your name or identity will not be revealed. In order to maintain confidentiality of your records, Drs. Wharton and Johnston will use subject codes on all data collected, maintain a master list separate and secure from all data collected, and limit access to all confidential information to the study investigators.

WITHDRAWAL PRIVILEGE

You may withdraw from the study at any time for any reason without penalty or prejudice toward you. Your decision to withdraw would not affect you in any manner.

COSTS AND PAYMENTS

You will receive up to $15.00 in gift certificates to Target if you participate in this study. The first gift card will be received at week 4 ($5) and the second ($10) will be given at the time of trial completion.

COMPENSATION FOR ILLNESS AND INJURY

If you agree to participate in the study, then your consent does not waive any of your legal rights. However, in the event of harm, injury, or illness arising from this study, neither Arizona State University nor the researchers are able to give you any money, insurance coverage, free medical care, or any compensation for such injury. Major injury is not likely but if necessary, a call to 911 will be placed.

VOLUNTARY CONSENT

Any questions you have concerning the research study or your participation in the study, before or after your consent, can be answered by Drs. Christopher Wharton (480-727-1821) or Carol Johnston (480-727-1713).

If you have questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at 480-965 6788.

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

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

_____

Subject's Signature

Printed Name

_____

Date

_____

Contact phone number

_____

Email (print clearly)

INVESTIGATOR'S STATEMENT

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

Signature of Investigator_____

Date_____

APPENDIX E

EXERCISE REFERENCE VALUES

Exercise	30 min.	40 min.	50 min.	60 min.
Walking moderate pace 3 mph	73 kcal	97 kcal	121 kcal	146 kcal
walking brisk pace 3.5 mph	89 kcal	118 kcal	148 kcal	177 kcal
walking very brisk 4 mph	127 kcal	169 kcal	211 kcal	253 kcal
bicycling < 10 mph leisure	95 kcal	127 kcal	158 kcal	190 kcal
bicycling 10-11.9 mph slow	158 kcal	211 kcal	264 kcal	317 kcal
bicycling 12-13.9 mph moderate	222 kcal	296 kcal	370 kcal	443 kcal
hiking general	153 kcal	211 kcal	264 kcal	317 kcal
Pilates	63 kcal	84 kcal	106 kcal	127 kcal
Running 5 mph (12 min. mile)	222 kcal	296 kcal	370 kcal	443 kcal
Stationary Bicycle light	143 kcal	190 kcal	238 kcal	285 kcal
Stationary Bicycle moderate	190 kcal	253 kcal	317 kcal	380 kcal
Swimming freestyle moderate	190 kcal	253 kcal	317 kcal	380 kcal
Tennis singles	222 kcal	296 kcal	370 kcal	443 kcal
Vacuuming	79 kcal	106 kcal	132 kcal	158 kcal
Yoga	48 kcal	63 kcal	79 kcal	95 kcal

LOSE IT APPLICATION
(www.loseit.com)

APPENDIX F

LOSE IT INSTRUCTIONS

Getting the Lose it application

1. Access the *"App"* store on iPhone.
2. Using the search feature, search *Lose it.*
3. Choose *Fit Now, Lose it (*This should be the first app on the list).
4. Tap on the *Free* button located at the top right corner of the screen. The *Free* button will change to *Install*, tap again.
5. You will be prompted to enter your iTunes password.

Creating a Loseit.com account

1. Open Lose it on your iPhone.
2. Select the *More* tab at the bottom right of the screen.
3. Select *configure loseit.com.*
4. Select *Create Account.*
5. Select *Account Info*, enter e-mail and create a password – select finish.
6. Select *Edit Profile Details*, enter name hit save at the top right.
7. Select *More* on the top left to proceed to the next step.

Select Nutrient Preferences

1. Select *On* for all items listed under nutrient preferences. When finished select *More* at the top left of the screen.

Setting weight loss goal

1. Choose *Goals* at the bottom of the screen.
2. Select *Modify Program.* Hit *next* at the top right of the screen between each entry.
3. Enter starting weight, goal weight (subtract 8 lbs from you starting weight), gender, height, birthday.
4. Under *my plan* choose 1 lb per week.
5. To proceed to the next step select *goals* at the top left of the screen.

Entering food

1. Select *My Day* located at the bottom left of the screen.
2. Select *Add Food.*
3. Choose the meal you are recording for.
4. *Search Food* allows you to search through a data base to find specific food items. Enter food item and hit *Search* located on the bottom right of the screen. Select your specific food, choose the amount and select *Add* located at the top right of the screen.
5. To choose additional foods for a specific meal tap on the "+" located at the top right of the screen, choose the meal and repeat the previous steps.
6. *My Foods* will bring up any food that you previously have entered.
7. *Previous Meals* will bring up previous meals that you have entered.
8. *Brand Name Foods* allows you to search for brand name foods purchased at the grocery store or by Restaurant.

Entering Exercise

1. Select *My Day.*

2. Select *Add Exercise.*
3. Select *Browse Exercise.*
4. Select number of minutes and tap *Add* located at the top right of the screen.

Creating a Recipe

1. Select *More* located at the bottom right of the screen.
2. Select *Edit Foods and Exercises.*
3. Select *Recipes,* tap the "+" at the top right.
4. Name your Recipe and Save.
5. Add the foods that are part of your Recipe.
6. Select *Done* when finished.
7. To locate a Recipe you've added be sure to search in your Recipe menu rather than the Search Food menu.

Creating a Custom Food or Custom Exercise

You can make a Custom Food or Custom Exercise two ways

1. At the bottom of any meal or exercise screen select *Create Custom Food* or *Create Custom Exercise.* Enter all of the information about the food or exercise that you know and select *Add* at the top right of the screen
2. In the *More* tab select *Edit Foods and Exercises.* Select *Custom Foods* or *Custom Exercises* and in the top right corner select the "+" icon. Enter the information and select *Add.*
3. When searching for a food/exercise you've created make sure you are looking in *My Foods* or *My Exercises.*

For more information on how to use the Lose It application go to www.loseit.com

APPENDIX G

VERBAL SCRIPT

Can your SMART PHONE *help you lose weight?*

iPhone Blackberry Droid

HELP US FIND OUT

INVESTIGATORS FROM THE *NUTRITION PROGRAM AT ARIZONA STATE UNIVERSITY*
ARE RECRUITING VOLUNTEERS (18-65 y of age) FOR A WEIGHT LOSS TRIAL

IF YOU CURRENTLY OWN A SMART PHONE AND ARE OVERWEIGHT AND DESIRE TO LOSE WEIGHT,
YOU MAY QUALIFY FOR THIS TRIAL

THIS STUDY WILL EVALUATE THE USEFULNESS OF SMART PHONES AS A TOOL TO HELP INDIVIDUALS ADHERE TO WEIGHT LOSS DIETS

Participation will include:

- Following an individualized weight loss diet plan and recording food intake for 8 weeks
- Exercising most days of the week
- Meeting with trial investigators on four occasions at ASU West, DTC, or Tempe

You will receive diet instruction & $15 in gift certificates to Target if you participate in this trial ***INTERESTED?*** Email ASU nutrition study investigators at:
ASUsmartphonetrial@yahoo.com

APPENDIX H

IRB APPROVAL

ASU Knowledge Enterprise Development

Office of Research Integrity and Assurance

To:	Carol Johnston HSC
From:	Carol Johnston, Chair Biosci IRB
Date:	06/16/2010
Committee Action:	**Expedited Approval**
Approval Date:	06/16/2010
Review Type:	Expedited F4 F7
IRB Protocol #:	1006005238
Study Title:	Smart phones and dietary tracking: a feasibility study
Expiration Date:	06/15/2011

The above-referenced protocol was approved following expedited review by the Institutional Review Board.

It is the Principal Investigator's responsibility to obtain review and continued approval before the expiration date. You may not continue any research activity beyond the expiration date without approval by the Institutional Review Board.

Adverse Reactions: If any untoward incidents or severe reactions should develop as a result of this study, you are required to notify the Biosci IRB immediately. If necessary a member of the IRB will be assigned to look into the matter. If the problem is serious, approval may be withdrawn pending IRB review.

Amendments: If you wish to change any aspect of this study, such as the procedures, the consent forms, or the investigators, please communicate your requested changes to the Biosci IRB. The new procedure is not to be initiated until the IRB approval has been given.

Please retain a copy of this letter with your approved protocol.

APPENDIX I

FOLLOW-UP QUESTIONNAIRE

Please answer the following questions regarding your participation in the research study on successful weight loss strategies. Circle the answer that best fits your opinion.

1. Recording my daily food intake was helpful in keeping me on track toward my weight loss goal?

strongly disagree disagree no opinion agree strongly agree

2. The method I used for recording my daily food intake was too time consuming to be practical.

strongly disagree disagree no opinion agree strongly agree

3. I was more aware of my eating habits because I was recording my food intake.

strongly disagree disagree no opinion agree strongly agree

4. I enjoyed the exercise component of the diet plan.

strongly disagree disagree no opinion agree strongly agree

5. I am more confident in my ability to lose weight after participating in this study.

strongly disagree disagree no opinion agree strongly agree

6. I will continue to record my food intake after the study is over.

strongly disagree disagree no opinion agree strongly agree

7. I will continue to exercise after the study is over.

strongly disagree disagree no opinion agree strongly agree

8. I achieved my 8 week weight loss goal.

strongly disagree disagree no opinion agree strongly agree

APPENDIX J
GENERAL DIET INSTRUCTION

Five "F's" For Fat Fall

- Eat "Five" or more servings of fruits and vegetables

Fruits and vegetables are lower in calories, fat and cholesterol and high in vitamins, minerals and fiber. The American Medical Association recommends 5 servings of fruits and vegetables daily for optimal health.

- Move your "Feet"

Exercise is very beneficial in helping to create a calorie deficit. In order to lose weight and maintain that weight loss people need to expend more calories than they consume. Exercise provides just the right opportunity to make that happen plus providing many other health benefits.

- Record your "Food" intake

Recording food intake increases awareness of food consumption, enhances control over eating, helps identify main sources of calories and allows for adjustments.

- Weigh your "Flesh" frequently

Research on the largest group of Americans who have lost weight and kept it off (The National Weight Loss Registry) shows that people who weigh themselves daily lose more weight and keep the weight off.

- Lower your "Fat" intake

Elevated fat is directly responsible for elevated cholesterol, triglycerides, high blood pressure, diabetes and excess weight. Lowering fat intake can help to reverse the health risks associated with a high fat diet.