

The Feasibility of Peer Group and Text Message-Based Weight Loss and Management  
Intervention for African American Women

A DISSERTATION  
SUBMITTED TO THE FACULTY OF THE  
UNIVERSITY OF MINNESOTA  
BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF  
DOCTOR OF PHILOSOPHY

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June, 2017

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## **Acknowledgements**

The completion of my dissertation and my PhD program would not have been possible without the assistance, support, and guidance of a few very special people in my life.

I would like to express the deepest appreciation to my academic advisor, Dr. Ruth Lindquist who has helped me grow as a nursing researcher. She became my advisor, mentor, and role model since I met her at the MNRS conference in 2009. I am really grateful for her support, help, care, concern, understanding, encouragement, and trust in me over 8 years. Without her strong support and thoughtful advising to my PhD program, my dissertation could not have done possible. Thank you so much for sharing your wisdom, experience, and knowledge, Dr. Ruth Lindquist. I can't express how much I appreciate that I was your student. I would also like to thank my co-advisor, Dr. Erica Schorr. I really appreciate her support, guidance and encouragement to help writing abstracts, developing posters and manuscripts. Thank you so much for your time, expertise and encouragement, Dr. Schorr. I will never forget!

Dr. Diane Treat-Jacobson, my committee chair, has been another great role model throughout my PhD program. Dr. Chih-Lin Chi served as my very valuable committee member and reviewer. Dr. Jayne Fulkerson, the Director of Graduate Studies, supported me in many ways. Michelle A. Mathiason provided statistical advice, expertise throughout the dissertation project. I appreciate their careful support, precious time, and thoughtful encouragement for my dissertation project.

I would like to thank my family for their unconditional love and support. To my mom and step-dad, Young-Suk and Chan-Seong, and my parents in law, Byung-Ok, and Sang-Hun, for their great support and help. To my husband, Dr. Taiho Yeom for his love, trust, and support since we were boyfriend and girlfriend. He always encourages me to be a strong woman and good mother. To my beautiful boys, David Jihoon and Ryan Jio for helping me survive all the stress and not letting me give up. They are my hope, energy, and the greatest joy. To my baby sister and little brother, So-Hyeon, and Jong-Ong, for reminding me I am not alone. They will never know how much I love them. Also, I would like to thank my friends and their family for their laughs and humor that I could enjoy my life in Minnesota – especially, Kyung-Mi, Hee-Young, Hye-Mi and You-Sil (“84 friends”).

I cannot say thanks enough to everyone and how much I appreciate each person that I got to know throughout my PhD program at the University of Minnesota. Thank you, everyone, for every moment.

## **Dedication**

This dissertation is dedicated to my dad, Beom-Soo Lee. My dad passed away when I was fourteen. He left his will to donate his body to the medical school for future research and student education. I believe he tried to send the clear and strong message to me even though he is not with me all the time in my life. With his message, I decided to become a nurse to help people for their healthier and better lives. Now, I am really proud to be a nursing researcher to develop innovative, in-expensive, non-invasive, and patient-oriented programs to prevent diseases and improve people's quality of life.

## **Abstract**

Obesity is a significant risk factor for many chronic diseases, including cardiovascular disease. Over 80% of adult African American (AA) women are overweight or obese, the highest of all ethnic groups. For many decades, healthcare providers and researchers have developed weight-loss interventions to help people achieve weight loss and management. Unfortunately, it is typical for people to lose weight quickly during the intervention period but then slowly regain weight until they return to their approximate baseline.

Technology-based interventions are the newest approaches to achieve long-term weight loss and management. Several advantages make technology helpful for maintaining weight loss. A systematic search through electronic databases and a manual citation search were conducted to review the existing literature of technology-based weight loss maintenance interventions (WLMIs) to further explore the use of technology for disease management and prevention. Limited numbers of randomized controlled trials published since 2000 that included randomization and technology-based WLMIs were identified. The characteristics of the eight studies were diverse. The average score of study design quality was moderate. The results of the effectiveness of technology-based WLMIs were mixed. Technology-based WLMIs are more likely to be effective than usual care but not more effective than personal contact. Based on the review, guidelines were established for the selection and potential success of technology-based WLMIs. The effectiveness of technology-based interventions for weight loss varied, and potential

strategies and approaches are discussed to improve their effectiveness. Further studies are needed to better evaluate and refine the efficacy of technology-based WLMIs.

For the dissertation research project, text messages and support groups were designed to operationalize Bandura's Social Cognitive Theory components and theory-driven strategies, such as self-efficacy, outcome expectancy, self-monitoring, role modeling, motivation, and goal-setting. A quasi-experimental, one-group pretest-posttest design tested a newly developed 16-week experimental intervention protocol that combined bi-weekly group education sessions and peer support with daily text messages. More than 110 text messages were created from reliable sources and delivered using Short Message Service format and a client-based software application. One-hour support group sessions were held at a church and community center.

Twenty-two AA women enrolled, and 17 women completed the intervention. Statistically significant changes were detected in weight and body mass index from baseline to 16 weeks (-3.7 lbs.,  $t = 4.42, p < 0.001$ ; -0.6,  $t = 4.30, p = 0.001$ , respectively). No statistically significant changes were found in blood pressure or waist circumference. At baseline, 36% of participants were in action and maintenance stages in stages of change for weight loss and management; this percent increased to 82% at 16 weeks.

The focus group interview identified perceived benefits and challenges of a combination intervention. Participants agreed that daily text messaging was helpful to keep them motivated, apply content to their daily lives, fill the gap between face-to-face group sessions, and reinforce information and knowledge gained through the program. However, participants debated potential challenges of the text message protocol, such as

message delivery time, frequency and quality, and technical difficulty. Participants agreed that biweekly support groups were beneficial to share difficulties encountered and successful strategies, provide encouragement, and learn from other peers. Participants also reported feeling a strong sense of belonging because they had common goals and problems. However, they did not come to consensus regarding the optimal frequency and timing of support group sessions. Overall, most participants agreed the combined program was great because it gave them a good balance between face-to-face meetings and personal text messages. Lastly, women reported noticing small changes and an increased awareness of healthy lifestyle behaviors.

Findings of this feasibility study provide preliminary evidence that combining text messaging (an inexpensive delivery tool) and in-person peer support (human interaction) could address the need for human interaction and lead to successful behavior change. This new hybrid approach is synergistic, whereas technology-alone or traditional in-person meeting-only approaches report mixed findings for promotion of weight management. Preliminary findings of this study indicate that a combined approach is an effective vehicle to deliver a weight management program for AA women.

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## **Chapter 1: Introduction**

### **Background**

#### **Prevalence of Obesity**

The current obesity epidemic is problematic in the United States. As of 2012, more than two-third of adults were reported to be obese or overweight (body mass index [BMI]  $\geq 25 \text{ kg/m}^2$ ), more than one-third of adults were obese, and about 6.4% were extremely obese (BMI  $\geq 40 \text{ kg/m}^2$ ; Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016). This fact is particularly important for those in the African American community, where the prevalence of overweight or obesity for adult women is over 80%, the highest of all ethnic groups (Ogden, Carroll, Kit, & Flegal, 2014).

The reason overweight and obesity should be treated is that these are strongly related to increased morbidity and mortality (Jensen et al., 2013; National Institutes of Health [NIH], 1998). Overweight and obese individuals tend to have a higher risk for chronic diseases, such as hypertension, type II diabetes, coronary heart disease, stroke, and certain types of cancer (Khaylis, Yiaslas, Bergstrom, & Gore-Felton, 2010). Obese individuals may also suffer from psychosocial problems, such as depression, anxiety, low self-esteem, low quality of life, social stigmatization, and discrimination (Khaylis et al., 2010; NIH, 1998). In addition, these negative physical and psychosocial outcomes give rise to higher healthcare costs. Recent findings show that costs increase curvilinearly with rising body mass index (Lehnert, Sonntag, Konnopka, Riedel-Heller, & Konig, 2013). Consequently, obesity should be monitored by healthcare providers, due to adverse physical, psychosocial, and financial associations.

## **Weight Loss and Weight Loss Maintenance Interventions**

Many types of weight loss programs have been developed over the last few decades that have evaluated obesity management interventions, such as dietary therapy, behavioral therapy, pharmacotherapy, and surgery (NIH, 1998). Although overweight and obese individuals have lost weight successfully through these kinds of weight loss programs, it is common for individuals to easily regain the weight lost after completing the interventions (Turk et al., 2009). It confirms the fact that weight loss maintenance is extremely challenging for participants who lose weight through short-term interventions. Therefore, there is a need to develop effective weight loss maintenance programs targeting the prevention of weight re-gain for long-term success, and/or for continuing weight loss trajectory if desired. According to a National Institutes of Health guideline, weight loss and management goals include: (1) prevent weight regain, (2) reduce body weight, and (3) maintain lower body weight over the long term (NIH, 1998). Therefore, the term “weight loss and management” is used to include weight loss and weight loss maintenance.

## **Technology-Based Interventions (e-Health Interventions)**

Technology-based interventions (e-Health interventions) are becoming popular because they are less expensive and largely usable. Eysenbach (2001) broadly defined e-Health as follows: “e-Health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of mind, a way

of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology” (p. e20). e-Health interventions deliver health information and communication using technology. Many types of healthcare interventions exist using technology, such as the Internet, wireless communications, mobile phone, interactive TV, voice response systems, kiosks, personal digital assistances, CD-ROMs, DVD-ROMs, and remote monitoring (Baker, Gustafson, & Shah, 2014). In this dissertation, the term “technology-based intervention” is used to encompass e-Health and m-Health.

### **Text Message-Based Interventions**

Among the technology-based interventions, text message-based interventions delivered via mobile phone can be one of the most cost-effective and powerful approaches (Cole-Lewis & Kershaw, 2010; Shaw & Bosworth, 2012). According to Pew Research Center Internet Project Survey, about 90% of American adults have a mobile phone as of January 2014. Traditional, ordinary mobile phones allow people to call, text, take pictures or videos, and record voice at any time, from anywhere. Recently developed smartphones can be used to play games, share pictures and video, and interact with peers using many types of applications. Texting, also called short message service (SMS) and one of the easiest functions of traditional phones and smartphones, is simple, easy, and widely used, and less expensive than Internet access (Shaw & Bosworth, 2012). Many researchers have conducted clinical trials using text messages for health-related issues, such as smoking cessation, weight loss, mental health, prenatal support, reminders, etc. (Vodopivec-Jamsek, de Jongh, Gurol-Urganci, Atun, & Car, 2012). Recent review papers

evaluating behavior change interventions delivered via text messaging suggest that text message-based interventions show beneficial effects and positive behavioral findings (Stephens & Allen, 2013; Fjeldsoe, Marshall, & Miller, 2009).

Text messaging may provide an opportunity to improve healthy behaviors that can be helpful for weight loss (Patrick et al., 2009) and weight loss maintenance. For example, a randomized controlled trial (RCT) consisting of a 16-week text message-based intervention was conducted to determine the efficacy of the text messaging program with daily text messages. The study concluded that text messages were a supportive approach to help individuals self-monitor weight and promote positive weight-related outcomes (Patrick et al., 2009). Moreover, a recent study conducted with a larger sample found a positive association between text message-based intervention adherence and long-term weight loss (Shapiro et al., 2012). In addition, the research suggested that text messaging can be one component of a multi-strategy for weight loss that consists of telephone counseling, group sessions, medication, or other approaches (Shapiro et al., 2012).

### **Social Support**

Even though technology-based interventions are easy and simple vehicles for weight loss and management, many review studies found that technology-based interventions have several limitations. A recent review paper examining the efficacy of e-Health interventions for behavioral change reported mixed findings (Norman et al., 2007), and some studies reported that e-Health interventions were less effective in delivering social support than in-person modalities. In addition, Internet usability and

acceptability is different among, wealthy and poor communities, rural and urban areas, different regions and ethnic communities, as well as younger and older adults (Eysenbach, 2001).

Recent studies have identified social support as one of the key components of effective behavioral weight-loss maintenance interventions, and group support was found to boost commonality, motivation, and encouragement (Khaylis et al., 2010). In particular, Krukowski, Harvey-Berino, Ashikaga, Thomas, and Micco (2008) found that social support was the best predictor of weight loss maintenance. Social support can be defined as interpersonal communications, such as emotional concern, appraisal, and information (House, 1981; Hwang et al., 2011). Adding a social support component to a maintenance intervention has the potential to create more effective strategies (Elfhag & Rossner, 2005), and could augment successful maintenance in long-term follow-up (Wing & Jeffery, 1999).

### **Statement of Purpose**

The purpose of this dissertation project was to develop and test a novel weight loss and management intervention program for African American women. The long-term goal of this project is to find scientific evidence for accessible and effective weight management program to prevent cardiovascular disease, especially for underserved populations.

## **Specific Aims**

### **Specific Aim 1**

The first aim of this dissertation was to review the randomized controlled trials of technology-based weight loss maintenance interventions for adults.

The research questions for Specific Aim 1:

1. What are the characteristics of the primary studies of technology-based weight loss maintenance interventions?
2. What is the quality of study designs of the primary studies?
3. Are the technology-based maintenance interventions effective in maintaining weight loss?

### **Specific Aim 2**

The second aim of this dissertation was to describe the development and implementation of a weight management program comprised of text messaging and peer support group for African American women.

### **Specific Aim 3**

The third aim of this dissertation was to examine the feasibility, acceptability, and potential efficacy of a combined intervention comprising text messaging and peer group support to foster weight loss and management for African American women.

The research questions for Specific Aim 3:

1. Is text messaging and peer group intervention feasible and acceptable for African American women's weight management?

2. Is text messaging and peer group intervention effective in weight loss and weight loss management?
3. After text messaging and peer group intervention, did participants change their level of the stage of change?
4. After the program, which program component was preferred or was judged to be more satisfying by participants?

### **Significance**

The significance of this dissertation project was three-fold. First, it was significant because this project was targeting African American women. Over 80% of African American women are overweight and obese in the United States. African Americans are sensitive to salt, which can contribute to higher risks of hypertension and heart disease. There is a strong need to change their health-related behaviors (e.g., eating and physical activity). Second, this project was a combined approach that refers to a “hybrid” of two concepts for weight management: technology and social support. These two concepts synergistically complemented each other to facilitate the participants’ efforts to change behaviors and to lose weight. The program evaluation supported that this flexible combined approach was feasible and acceptable for women. Third, in this work, women were viewed within the context of their family and communities. Implementation was to a great extent shifted to the church community to facilitate and eventual ongoing self-help group program model. A church (faith)-based health promotion program is a low-cost approach with the potential to reach and change lifestyle behavior of the entire population.

## **Organization of Dissertation**

This dissertation consists of five chapters. Chapter 1 is an introductory chapter for an overview of the dissertation and its purpose and aims. Chapter 2 presents a previously published manuscript that comprises a literature review of technology-based weight loss maintenance interventions. In Chapter 3, the manuscript describes the development of the text messaging and peer group intervention for African American women. Chapter 4 is a previously published manuscript of text messaging and peer group intervention presenting primary outcomes and program evaluation. The final chapter (Chapter 5) reviews the major findings from the dissertation, discusses implications, and proposes directions for research to address weight management in future programs for underserved populations.

## **Chapter 2: Manuscript One**

This chapter explores Aim 1 of the dissertation. The purpose of Aim 1 was to review the randomized controlled trials of technology-based weight loss maintenance interventions for adults. This manuscript was published in the *Telemedicine and eHealth* in 2015. The research questions for Specific Aim 1 are as follows.

1. What are the characteristics of the primary studies of technology-based weight loss maintenance interventions?
2. What is the quality of study designs of the primary studies?
3. Are the technology-based maintenance interventions effective in maintaining weight loss?

To address these research questions, a systematic search was conducted through the electronic database. A systematic review of the existing literature examined the efficacy of technology-based weight loss maintenance interventions for the purpose of exploring the use of technology for disease management and prevention.

## **A Review of Technology-Based Interventions to Maintain Weight Loss**

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### **To cite this article:**

Lee Sohye and Lindquist Ruth. *Telemedicine and e-Health*. March 2015, 21(3): 217-232.

doi:10.1089/tmj.2014.0052.

Published in Volume: 21 Issue 3: March 13, 2015

Online Ahead of Print: February 18, 2015

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Received: March 11, 2014

Revised: June 24, 2014

Accepted: June 26, 2014

## **Abstract**

**Background:** For many decades, healthcare providers and researchers have developed weight-loss interventions to help people achieve weight loss. Unfortunately, it is typical for people to lose weight quickly during the intervention period but then slowly regain weight until they return to their approximate baseline. Technology-based maintenance interventions are among the newest approaches to long-term weight loss. Several advantages make technology helpful for maintaining weight loss. The purpose of this article was to review and critique the randomized controlled trials of technology-based weight-loss maintenance interventions (WLMIs) for adults.

**Materials and Methods:** A systematic search through electronic databases and a manual citation search were conducted. Limited numbers of controlled trials published since 2000 that included randomization, and technology-based WLMIs were identified.

**Results:** The characteristics of the eight studies were diverse. The average score of study design quality was moderate. The results of the effectiveness of technology-based WLMIs were mixed. Technology-based WLMIs are more likely to be effective than usual care but not more effective than personal contact.

**Conclusions:** Based on the review, guidelines were established for the selection and potential success of technology-based WLMIs. The effectiveness of technology-based maintenance interventions for weight loss varied, and potential strategies and approaches are discussed to improve their effectiveness. Further studies are needed to better evaluate and refine the efficacy of technology-based WLMIs.

**Key words:** obesity, weight loss and weight-loss maintenance, technology-based intervention

## **Introduction**

Obesity is problematic in American society and worldwide. In 2011 and 2012, more than two-thirds of adults were reported to be obese or overweight, more than one-third of adults were obese, and about 6.4% were extremely obese.<sup>1</sup> The World Health Organization reported that being overweight or obese is the fifth leading risk factor for global death and leads to at least 2.8 million adult deaths every year.<sup>2,3</sup> Overweight and obese individuals have a higher risk for diseases such as coronary heart disease, stroke, hypertension, type 2 diabetes, and certain types of cancer.<sup>4</sup> Obese individuals may also suffer from psychosocial problems such as depression, anxiety, low self-esteem, low quality of life, social stigmatization, and discrimination.<sup>3,4</sup> In addition, these negative outcomes result in higher healthcare costs. Recent reports estimate that weight-related healthcare costs total almost \$147 billion in out-of-pocket, private, and insurance expenses.<sup>4,5</sup> Clearly, obesity is a significant problem in American society, one with adverse physical, social, psychological, and financial consequences. An important fact is that obesity is largely preventable<sup>2</sup> and remediable.<sup>5</sup> For decades, healthcare providers and researchers have developed and studied the effects of weight-loss interventions (WLIs). They have found that WLIs reduced blood pressure, serum triglycerides, blood glucose, and serum cholesterol levels and increased high density lipoprotein levels.<sup>3</sup> Indeed, weight loss can make individuals healthier and reduce their risk factors for chronic diseases.

Although overweight and obese individuals do lose weight successfully through these kinds of WLIs, previous studies have reported that participants quickly regain the weight after completing the interventions.<sup>6</sup> A recent report asserted that most participants regained about one third of the weight lost during the year following the completion of an intervention program and tended to return to their baseline weight within 3-5 years.<sup>7</sup> This confirms that weight loss maintenance is extremely challenging for participants who lose weight through short term interventions. Researchers have developed and examined several strategies to maintain weight loss, such as ongoing therapist contact, training in relapse prevention, problem-solving therapy, providing prepackaged foods, and incorporating peer support.<sup>6</sup>

Another weight-loss maintenance strategy, technology-based interventions, is one of the newest approaches and has several advantages. First, technology makes the information easier and quicker to access.<sup>8</sup> People can easily access Internet or mobile phone-based programs to provide reminders to maintain their healthier lifestyles despite their other commitments. Second, technology-based interventions are less expensive than in-person interventions over the long term. Many individuals can access technology-based programs anytime and anywhere. Computers, tablet PCs, smartphones, smart TVs, and wireless Internet access have quickly grown in popularity. Companies are developing new fitness devices to monitor individuals' physical activities. The availability of such technology means there is great potential to augment or improve interventions and to offer participants powerful tools. In addition, technology-based interventions can provide a private, varied, and rapid contact using computers, tablet PCs, or smartphones that can

access WLIs through the Internet or downloadable applications.<sup>9</sup> Secure, personalized access can be used to provide enhanced cultural and personal sensitivity.<sup>8</sup> Therefore, particular programs can be personalized for specific users.

A previous meta-analysis revealed significant evidence that the use of Web-based interventions improved behavioral change results and increased exercise time, knowledge of nutritional status, and knowledge of healthcare, among other concerns.<sup>10</sup> Also, several reviews have recently examined the effectiveness of technology-based interventions.<sup>4,11,12</sup> However, there are relatively few weight-loss maintenance interventions (WLMIs), and few studies have discussed technology-based WLMIs.

The purpose of this article is to review the randomized controlled trials of technology-based WLMIs for adults published since 2000. The following research questions were the focus of this review:

- Q1: What are the characteristics of the primary studies of technology-based WLMIs?
- Q2: What is the quality of study designs of the primary studies?
- Q3: Are the technology-based maintenance interventions effective in maintaining weight loss?

## **Materials and Methods**

### **Article Identification Search Strategy**

A systematic literature review of scientific journal articles published since 2000 was conducted using the following five electronic databases: OVID Medline, CINAHL, PsycINFO, Compendex, and PubMed. Key words were selected in accordance with the

review purpose to include three main concepts of interest: purpose and length of intervention, outcomes, and technologies used. Therefore, key words were “long term\*,” “maintain\*,” “sustain\*,” “weight loss,” “weight gain,” “body weight change,” “telecommunication,” “telephone,” “cellular phone,” “Internet,” “telemedicine,” “technology,” and “wireless technology.” The search was limited to journal articles published in English since 2000. In addition, a manual citation search was performed of the reference lists of the selected articles.

### **Selection Criteria**

Table 2.1 shows inclusion and exclusion criteria. The criteria were developed to narrow the results and to focus on the rigorous research studies conducted on technology-based WLMIs. Selection criteria were established according to population, study design, intervention, publication type, and outcome. Only journal articles published after 2000 were included because technology-based interventions are a relatively recent development. Articles were included when they were published in a scientific journal, reported quantitative body weight changes, and conducted a technology-based intervention for maintenance of weight loss that performed random assignment.

Articles that targeted specific illnesses were excluded, except for those that focused on cardiovascular disease risk factors, such as hypertension, diabetes, and dyslipidemia. Because many studies’ long-term goals were to prevent cardiovascular diseases or other chronic diseases, cardiovascular disease prevention studies were also considered relevant to the present review. Eating disorder groups and post-gastric bypass surgery groups were excluded because the specific nature of their disease or surgery

serves as a guide to different intervention strategies. Secondary analysis studies, such as cost effective analyses and review articles, were excluded. Those articles that reported only WLI and did not report WLMI were also excluded (see Appendix 2.1).

Table 2.1

*Search Criteria*

Inclusion	Exclusion
Adult population (aged 18 years older)	Targeted specific illnesses
Published after year 2000	Participating in eating disorder groups or post-gastric bypass surgery groups
Published in scientific journal	Secondary analysis
Reported quantitative body weight change	Review articles
Conducted technology-based intervention for maintenance of weight loss	Performed short-term weight-loss intervention only
Performed random assignment	Not in English language

**Data Synthesis**

To examine the characteristics of primary studies, data were extracted from the original studies. The study quality was measured according to the nine methodological characteristics tool developed by Norman et al.<sup>8</sup> (see Appendix 2.2). Originally, Norman et al.<sup>8</sup> established the study quality coding criteria to rate methodological characteristics for e-Health interventions. In this article, the study quality coding criteria were adapted for this review to assess the quality of the studies identified. The score given to each study was calculated as a percentage of the maximum score. In addition, each study was categorized by the level of effectiveness of the technology-based WLMI to facilitate the

maintenance of weight loss. Meta-analysis was not conducted because of the heterogeneity of the studies and the lack of data.

## Results

### Study Selection

Eight original studies were identified. Figure 2.1 shows the flow diagram of study selection that was used for identifying the studies. The 166 records were identified through the electronic search data-bases OVID Medline, CINAHL, PsycINFO, Compendex, and PubMed. An additional eight records were identified through a manual search of article reference citations. After duplicates were removed, 82 studies remained. Then, 41 articles were excluded after articles were screened by title and abstract. Twenty articles that did not meet the inclusion criteria were excluded, and 21 WLI studies using technology were identified.<sup>7,9,13–31</sup>

Many technology-based WLIs have been conducted over the last decade using the telephone,<sup>13–16</sup> the Internet,<sup>7,9,14,17–21</sup> remote support,<sup>22</sup> computer,<sup>23</sup> e-mail,<sup>24</sup> Web sites,<sup>13,25–27</sup> mobile phones,<sup>28</sup> text messaging,<sup>29</sup> a tailored expert system,<sup>30</sup> or interactive technology.<sup>31</sup> This article focused on technology-based WLMIs. This focus led to 13 studies being excluded because they examined only WLIs (during primary program implementation), not maintenance interventions. *Appendix 1* provides a summary of the 13 studies and the reasons they were excluded. Finally, eight studies were identified that used randomized controlled trials and conducted technology-based WLMIs; these were subjected to description and evaluation. As an exception, the study of Wing et al.<sup>7</sup> added

value because it focused on the maintenance intervention for participants who lost weight over long periods.

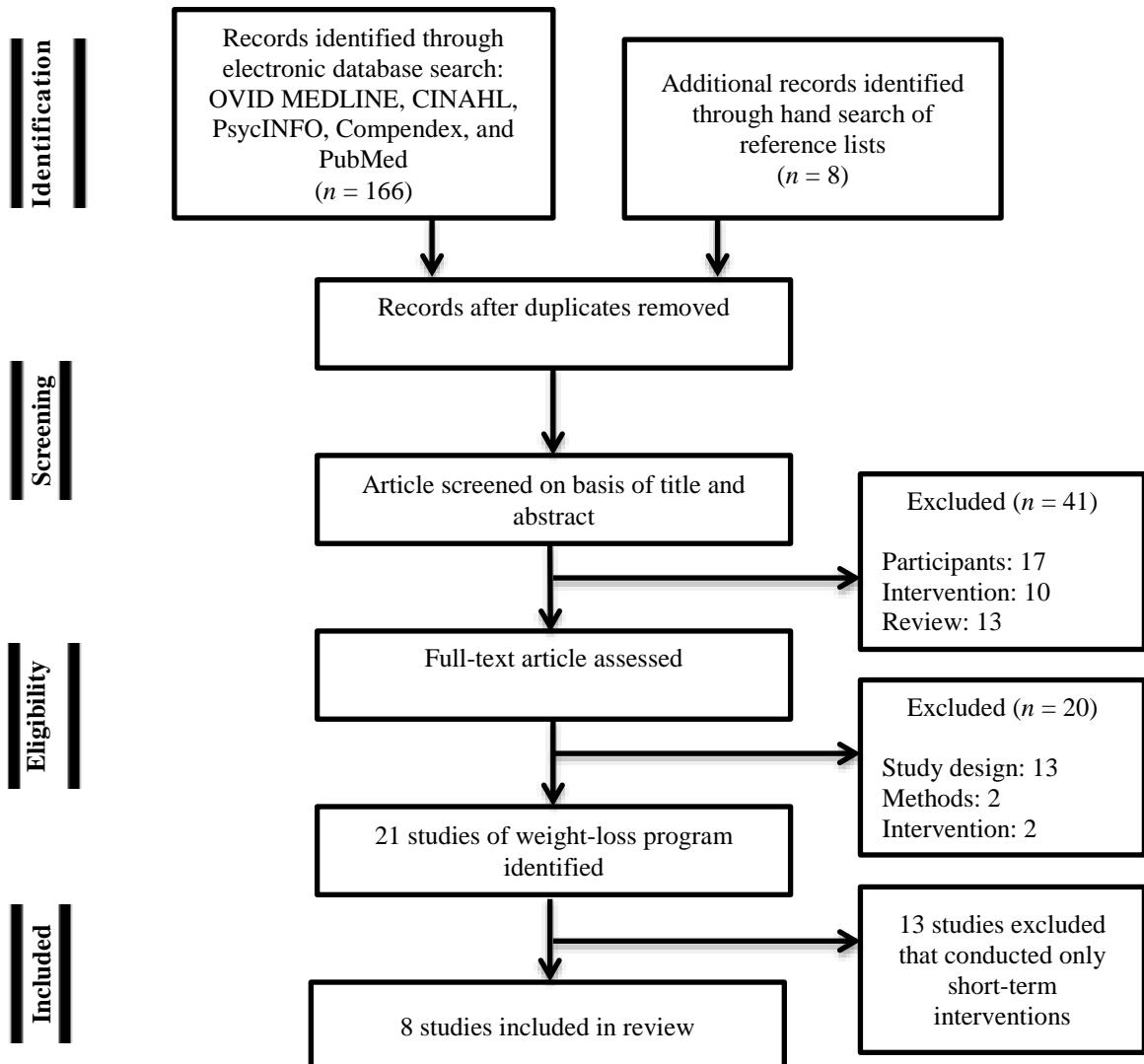


Figure 2.1 Flow Diagram of Study Selection

### Characteristics of Included Studies

All eight studies conducted two-arm<sup>9,17</sup> or three-arm<sup>7,15,19,20,21,31</sup> randomized controlled trials. Table 2.2 shows the summary of these eight primary studies according

to population, intervention, comparison, outcomes, setting, and publication year (time). The most recent study was published in 2012.<sup>17</sup> In each of these studies, more women were recruited than men. The majority of the studies' participants were in their forties<sup>9,17,19,20,21</sup> and fifties.<sup>7,15,31</sup> The participants were either overweight or obese (mean body mass index range, 27.5–37.1 kg/m<sup>2</sup>). Their health characteristics were diverse. Participants were generally healthy adults (employed),<sup>17</sup> perimenopausal women,<sup>9</sup> obese women in rural areas,<sup>15</sup> women with hypertension, dyslipidemia, or both,<sup>31</sup> or healthy, overweight, and obese adults.<sup>19–21</sup>

The studies focused on the changes in the participants' weight, body mass index (BMI), blood chemistry, cardiovascular disease risk factors, physical activity, and dietary intake. Additionally, one study measured the participants' self-reported overall health as "excellent, very good, good, fair, or poor."<sup>17</sup> Another study analyzed the Spearman correlation coefficients of the Internet log entries with changes in weight, exercise energy expenditures, and energy intake during the maintenance period.<sup>9</sup> Several investigators analyzed the adherence<sup>15,19–21</sup> to and cost-effectiveness<sup>15</sup> of weight-loss programs. The studies included maintenance interventions immediately following the same short-term interventions and randomization. The WLIs were 10 weeks–6 months long, and the WLMIs were 22 weeks–30 months long. Svetkey et al.<sup>31</sup> performed the longest intervention, which lasted 30 months.

Table 2.2

*Summary of Characteristics of the Primary Studies*

REFERENCE (YEAR)	BASELINE CHARACTERISTICS OF PARTICIPANTS					OUTCOMES	INTERVENTIONS	MEASURE TIME	STUDY DESIGN; AMERICAN STATE
	N <sup>a</sup>	MEN:WOMEN RATIO	AGE (YEARS)	BMI (KG/M <sup>2</sup> )	PARTICIPANTS				
Thorndike et al. <sup>17</sup> (2012)	330	158:172 <sup>b</sup>	EG: 44.2 (11.8) CG: 41.6 (13.6) <sup>c</sup>	EG: 28.0 (5.8) CG: 27.5 (5.9)	Employees	Weight, height, WC, BP, FL, FSG, PA, NB, overall health	10-week WLI: nutrition and physical activity program (n = 506) 9-month WLMI: EG: Internet and personal contact (n = 174, 157 analyzed); CG, usual care (n = 156, 145 analyzed)	Baseline, 10 weeks, 12 months	RCT; MA
Cussler et al. <sup>9</sup> (2008)	135	0:135	EG: 48.0 (4.6) CG: 48.4 (4.3)	EG: 31.0 (3.9) CG: 30.4 (3.3)	Perimenopausal women	Weight, height, PA (EEE), DI (EI), characteristics of Internet use	4-month WLI: cognitive-behavioral therapy-based program (n = 161) 12-month WLMI: EG, Internet (n = 66); CG, self-directed (n = 69)	Baseline, 4 months, 16 months	RCT; AZ
Perri et al. <sup>15</sup> (2008)	234	0:234	EG1: 59.8 (6.2) EG2: 59.2 (6.2) CG: 58.6 (6.0)	EG1: 36.9 (5.7) EG2: 37.1 (4.5) CG: 36.2 (4.3)	Obese women in rural area	Weight, height, BP, FL, FSG, adherence, cost	6-month WLI: lifestyle modification program (n = 298) 12-month WLMI: EG1, telephone counseling (n = 72); EG2, face-to-face counseling (n = 83); CG, education (n = 79)	Baseline, 6 months, 18 months	RCT; FL
Svetkey et al. <sup>31</sup> (2008)	1,032	378:654	EG1: 55.7 (8.5) EG2: 55.4 (9.1) CG: 55.8 (8.5)	EG1: 34.2 (4.9) EG2: 34.2 (4.8) CG: 34.0 (4.8)	Overweight or obese and had risk factors	Weight, PA, CI	6-month WLI: group-based behavioral intervention (n = 1,685) 30-month WLMI: EG1, interactive technology (n = 348, 347 analyzed); EG2, personal contact (n = 342, 341 analyzed); CG, self-directed (n = 342, 341 analyzed)	Baseline, 6, 12, 18, 24, 30, and 36 months	RCT; NC

Table 2.2 (continued.)

REFERENCE (YEAR)	BASELINE CHARACTERISTICS OF PARTICIPANTS					OUTCOMES	INTERVENTIONS	MEASURE TIME	STUDY DESIGN; AMERICAN STATE
	N <sup>a</sup>	MEN:WOMEN RATIO	AGE (YEARS)	BMI (KG/M2)	PARTICIPANTS				
Wing et al. <sup>7</sup> (2006)	314	59:255 <sup>b</sup>	EG1: 50.9 (9.3)  EG2: 51.0 (10.3)  CG: 52.0 (10.8)	EG1: 28.1 (4.6)  EG2: 28.7 (4.7)  CG: 29.1 (5.0)	Those who had lost at least 10% of their body weight during the prior 2 years	Weight, PA, EI	Orientation (n = 521)  18-month WLMI: EG1, Internet intervention (n = 104); EG2, face-to-face intervention (n = 105); CG, control (n = 105)	Baseline and 6, 12, and 18 months	RCT; RI
Harvey-Berino et al. <sup>19</sup> (2004)	255	46:209	EG1: 46.5 (9.8)  EG2: 45.2 (8.9)  EG3: 46.5 (7.7)	EG1: 29.3 (5.2)  EG2: 28.9 (3.8)  EG3: 29.0 (4.3)	Healthy overweight and obese adults	Weight, PA (EEE), DI, adherence, attendance, acceptability, peer support	6-month WLI: interactive television weight-loss program (n = 255)  12-month WLMI: EG1, Internet support (n = 77); EG2, frequent in-person contact (n = 77); EG3, minimal in-person contact (n = 78)	Baseline and 6, 12, and 18 months	RCT; across the United States
Harvey-Berino et al. <sup>20</sup> (2002)	122	18:104	EG1: 46.3 (11.1)  EG2: 49.8 (8.4)  EG3: 49.1 (9.1)	EG1: 32.2 (4.0)  EG2: 31.5 (4.8)  EG3: 32.8(4.6)	Healthy overweight and obese adults	Weight, PA (EEE), DI, adherence, attendance, acceptability, peer support	6-month WLI: in-person behavioral obesity treatment (n = 122)  12-month WLMI: EG1, Internet support (n = 40); EG2, frequent in-person support (n = 41); EG3, minimal in-person support (n = 41)	Baseline and 6, 12, and 18 months	RCT; VT
Harvey-Berino et al. <sup>21</sup> (2002)	46	9:37	46.3 (7.4) <sup>d</sup>	33.7 (4.6) <sup>d</sup>	Healthy overweight and obese adults	Weight, PA (EEE), DI, adherence, attendance, acceptability, peer support	15-week WLI: behavioral weight control program (n = 46)  22-week WLMI: EG1, Internet (n = 15); EG2, in-person, therapist-led (n = 14); CG, no treatment (n = 15)	Baseline, 15 weeks, 37 weeks	RCT; VT

Data for age and body mass index (BMI) are mean (standard deviation) values.

<sup>a</sup>Total number in study (at randomization).<sup>b</sup>Recalculated from the original data.<sup>c</sup>p < 0.05, for differences between groups.<sup>d</sup>Not reported by groups.

BP, blood pressure; CG, control group; CI, caloric intake; DI, dietary intake; EEE, exercise energy expenditure; EG, experimental group; EI, energy intake; FL, fasting lipids; FSG, fasting serum glucose; NB, nutrition behavior; PA, physical activity; RCT, randomized controlled trial; WC, waist circumference; WLI, weight-loss intervention; WLMI, weight-loss maintenance intervention.

Table 2.3 summarizes the primary studies' measurements and results. In terms of retention rates, the rates for Experimental Group 1 (technology-based WLMIs) were lower than those of the control group or Experimental Group 2 or 3 (non-technology-based WLMIs). During the WLI period, participants lost significant amounts of weight (-2.7 to -9.4 kg) except in the study of Wing et al.<sup>7</sup> Among the studies reviewed, the participants in the study of Perri et al.<sup>15</sup> lost the largest proportion of body weight. However, all participants regained the weight during the maintenance period (0.4–5.5 kg) except those in the study of Harvey-Berino et al. The longer WLMIs studies tended to report more weight regain.<sup>31</sup>

Most of the studies used reliable measures to assess outcomes. The majority used a calibrated weight scale with the participant wearing light clothes and no shoes. To measure physical activity and dietary intake, various questionnaires were used. Of the eight studies, four used the Paffenbarger Physical Activity Questionnaire<sup>32</sup> to measure physical activity, and three studies used the Block Food Frequency Questionnaire<sup>33,34</sup> to measure dietary intake. The majority of the studies stated their measurements clearly, using tools that had been tested for their validity and reliability through previous research studies. (For more specific details on this result, see Table 2.3)

### **Quality of Study Design**

The range of study design quality scores across the studies was from 55.6% to 100%. The average score was 80.9%, which is moderate. Table 2.4 shows the results of the study design quality assessment and characterized results of effectiveness in maintaining weight loss. All studies met the individual randomization, control group, and

Table 2.3

*Summary of Measurements and Results*

REFERENCE (YEAR)	RETENTION (%) <sup>a</sup>	SIGNIFICANT MAIN OUTCOMES			
		WEIGHT (KG) <sup>b</sup>	PA	DIETARY (ENERGY, CALORIC) INTAKE	OTHERS
Thorndike et al. <sup>17</sup> (2012)	506 406 (80) 330 (81) EG: 120 (76) CG: 118 (81)	0–10 weeks: EG, - 2.17c; CG, - 1.95c  0–12 months: EG, - 1.54 <sup>c</sup> ; CG, - 1.17 <sup>c</sup>  10 weeks–12 months: EG, + 0.63 <sup>c</sup> ; CG, + 0.78 <sup>c</sup> No group differences	At 12 months: time spent in moderate PA increased by $\pm$ 2 h/ week for 30%; climbing $\pm$ 5 flights of stairs/day increased from 42% to 49%	Baseline versus 12 months: eating fruits and vegetables $\pm$ 3 times/day, 38% versus 57%; never eating fatty foods and snacks, 51% versus 70%; never eating sugary foods and beverages, 26% versus 42% <sup>e</sup>	BMI, WC, and total and low-density lipoprotein cholesterol were lower at 10 weeks and 1 year (but no group differences) Overall health <sup>e</sup> : baseline versus 12 months as “excellent,” 13% versus 25%
Measurement conditions		With clothes and shoes off, using Salter lithium electronic scale model 9037	By asking participants to estimate (1) time spent per week during the past 3 months in exercise, (2) average flights of stairs climbed daily, and (3) normal walking pace	Estimating the number of time a day over the last month that a participant had eaten the following categories of food: fruits and vegetables, fatty goods and snacks, and sugary foods and drinks	
Cussler et al. <sup>9</sup> (2008)	300 161 (54) 135 (84) EG 52 (79) CG 59 (86)	0–4 months: EG, - 5.3 (3.6); CG, - 5.2 (3.8)  0–16 months: EG, - 4.9 <sup>c</sup> ; CG, - 4.6c  4–16 months: EG, + 0.4 (5.0); CG, + 0.6 (4.0) No group differences	EEE (kcal/day): for 0–4 months, EG of 151 (196), CG of 144 (151);  for 4–16 months, EG of 55 (301), CG of 62 (279)	EI (kcal/day): for 0–4 months, EG of - 442 (545), CG of - 370 (471);  for 4–16 months, EG of 123 (390), CG of 171 (399)	Correlation coefficients with 4–16-month change in (Internet use): weight, diet log <sup>d</sup> , negatively; EEE, diet log <sup>e</sup> ; weekly weight log <sup>e</sup> ; PA log <sup>e</sup> ; participants contacted <sup>d</sup> ; nonparticipants contacted <sup>d</sup> ; articles posted <sup>d</sup>
Measurement conditions		With light clothes and without shoes; using electronic scale (model 770; SECA, Hamburg, Germany)	The Seven-Day Physical Activity Recall interview	Nine randomly assigned days of diet records	

Table 2.3 (continued.)

REFERENCE (YEAR)	RETENTION (%) <sup>a</sup>	SIGNIFICANT MAIN OUTCOMES			
		WEIGHT (KG) <sup>b</sup>	PA	DIETARY (ENERGY, CALORIC) INTAKE	OTHERS
Perri et al. <sup>15</sup> (2008)	559 298 (53) 234 (79) EG1 70 (97) EG2 75 (90) CG 75 (94)	0–6 months: EG1, - 9.4 (0.6); EG2, - 10.1 (0.6); CG, - 10.5 (0.6)  0–18 months: EG1, - 8.2 <sup>c</sup> ; EG2, - 8.9 <sup>c</sup> ; CG, - 6.8 <sup>c</sup>  6–18 months: EG1, + 1.2 (0.7); EG2, + 1.2 (0.6); CG, + 3.7 (0.7) EG1 <sup>d</sup> , EG2 <sup>d</sup> < CG			Adherence: self-monitoring, EG1 <sup>d</sup> , EG2 <sup>d</sup> > CG; less adherence, more weight gain <sup>e</sup>  Cost: telephone, \$2,125; FTF, \$2,555; education control, \$1,824
Measurement conditions		Using certified scale			
Svetkey et al. <sup>31</sup> (2008)	3,178 1,685 (53) 1,032 (61) EG1 323 (93) EG2 321 (94) CG 320 (94)	0–6 months: EG1, - 8.6 (4.5); EG2, - 8.3 (4.2); CG: - 8.5 (4.0)  0–36 months: EG1, - 3.3 (0.4); EG2, - 4.2 (0.4); CG, - 2.9 (0.4)  6–36 months: EG1, + 5.2 (0.3); EG2, + 4.0 (0.3); CG, + 5.5 (0.3)  Until 30 months: EG1 < CG <sup>d</sup> , EG2 < CG <sup>d</sup> At 30 and 36 months: EG1 < EG2 <sup>d</sup> , EG2 < CG <sup>d</sup>	Minutes of MVPA/week: 0–6 months, all - 48; 6–36 months, EG1 of 35, EG2 of 33, CG of 32	EI (kcal/day): for 0–6 months, all - 325; for 6–36 months, EG1 of 16, EG2 of 55, CG of 88; for 0–36 months, EG1 of - 326, EG2 of - 272, CG of - 231	

Table 2.3 (continued.)

REFERENCE (YEAR)	RETENTION (%) <sup>a</sup>	SIGNIFICANT MAIN OUTCOMES			
		WEIGHT (KG) <sup>b</sup>	PA	DIETARY (ENERGY, CALORIC) INTAKE	OTHERS
Measurement conditions					
		Wearing light in-door clothes without shoes; using high-quality, calibrated digital scale; values measured on 2 separate days were averaged	Measured by accelerometry (calibrated, triaxial accelerometer [RT3; Stay healthy Inc., Monrovia, CA])	Block Food Frequency Questionnaire	
Wing et al. <sup>7</sup> (2006)	648 521 (80) 314 (60) EG1 92 (88) EG2 101 (96) CG 98 (93)	0–18 months: EG1, + 4.7 (8.6); EG2, + 2.5 (6.7); CG, + 4.9 (6.5)  EG2 <sup>d</sup> < CG	PA: no group differences	Caloric intake: no group differences	Adherence: attendance at the FTF and chat room decreased over time <sup>e</sup> but better in the FTF group than in the Internet group <sup>d</sup> Self-weighing: daily self-weighing associated with a decreased risk of regaining <sup>e</sup>
Measurement conditions		Wearing light street clothes; using calibrated scale	Paffenbarger Physical Activity Questionnaire	Block Food Frequency Questionnaire	
Harvey-Berino et al. <sup>19</sup> (2004)	255 232 (91) 232 EG1 52(68) EG2 61(79) EG3 63(81)	0–6 months: EG1, - 8.4(6.1); EG2, - 7.6 (5.0); EG3, - 7.6 (4.9)  0–18 months: EG1, - 7.6 (7.3); EG2, - 5.1 (6.5); EG3, - 5.5 (8.9)  6–18 months: EG1, + 0.8 <sup>f</sup> ; EG2, + 2.5 <sup>f</sup> ; EG3, + 2.1 <sup>f</sup> No group differences	All groups: significantly increased reported PA in time effect <sup>e</sup> , no group effect (during the treatment)	All groups: significantly decreased reported EI in time effect <sup>e</sup> , no group effect	Adherence: attendance, EG2 of 10 (5.1) versus EG1 of 7.7 (5.3) <sup>d</sup> ; self-monitoring, EG2 of 18.6 (13.2) versus EG1 of 11.6 (13.2) <sup>e</sup> ; peer support contact, EG2 of 4.9 (17.4) versus EG1 of 27.1 (58.2) <sup>e</sup>
Measurement conditions		Wearing street clothes and without shoes, using beam-balance scale	Paffenbarger Physical Activity Questionnaire	Block Food Frequency Questionnaire	

Table 2.3 (continued.)

REFERENCE (YEAR)	RETENTION (%) <sup>a</sup>	SIGNIFICANT MAIN OUTCOMES			
		WEIGHT (KG) <sup>b</sup>	PA	DIETARY (ENERGY, CALORIC) INTAKE	OTHERS
Harvey-Berino et al. <sup>21</sup> (2002)	94 51 (54) 44 (86) EG1 (87) <sup>f</sup> EG2 (100) <sup>f</sup> CG (93) <sup>f</sup>	0–15 weeks: all - 6.4 (5.6), no group difference  0–37 weeks: EG1, - 7.0 (10.6) <sup>c</sup> ; EG2, - 8.9 (7.8) <sup>c</sup> ; CG, - 7.8 (6.9) <sup>c</sup>  15–37 weeks: all - 1.6, no group differences	15–37 weeks: increased calories expended in exercise by 419/week	15–37 weeks: decreased calorie and fat intake by 20 calories and 0.33 fat g/day	Attendance: EG2 of 58% versus EG1 of 33% <sup>d</sup>
Measurement conditions		Wearing street clothes and without shoes; using beam-balance scale	Paffenbarger Physical Activity Questionnaire	Complete 3-day food records and analyzed using the Food Intake Analysis System version 2.1	

<sup>a</sup>Data are numbers for the recruitment, enrollment, allocation, and completion stages (by groups), respectively. The percentage of retention rate is calculated from the original participant numbers.

<sup>b</sup>Weight is given as mean or mean (standard deviation) value.

<sup>c</sup>Recalculated from the original data.

<sup>d</sup>p < 0.05, <sup>e</sup>p < 0.001, for differences between groups.

<sup>f</sup>Not reported by groups.

BMI, body mass index; CG, control group; EEE, exercise energy expenditure; EG, experimental group; EI, energy intake; FTF, face-to-face; MVPA, moderate to vigorous physical activity; PA, physical activity; WC, waist circumference.

Table 2.4

*Quality of Study Design Scores and Effectiveness of Maintaining Weight Loss*

REFERENCE (YEAR)	INDIVIDUAL RANDOMIZATION	CONTROL GROUP	ISOLATE TECHNOLOGY	PRE-POSTTEST DESIGN	RETENTION $\geq 80\%$	BASELINE GROUPS EQUIVALENT	MISSING DATA	SAMPLE SIZE CALCULATION	VALIDITY OF MEASURES	SCORE (% OF MAXIMUM) <sup>a</sup>	EFFECTIVENESS OF MAINTAINING <sup>b</sup>
Thorndike et al. <sup>17</sup> (2012)	Y	Y	N	Y	N	N	Y	Y	UK	55.6%	—
Cussler et al. <sup>9</sup> (2008)	Y	Y	Y	Y	Y	N	Y	Y	Y	88.9%	—
Perri et al. <sup>15</sup> (2008)	Y	Y	Y	Y	Y	N	Y	Y	Y	88.9%	++ / -
Svetkey et al. <sup>31</sup> (2008)	Y	Y	Y	Y	Y	Y	Y	Y	Y	100%	++ / -
Wing et al. <sup>7</sup> (2006)	Y	Y	Y	Y	Y	Y	N	Y	Y	88.9%	++ / -
Harvey-Berino et al. <sup>19</sup> (2004)	Y	Y	Y	Y	N	Y	Y	Y	Y	88.9%	++ / +
Harvey-Berino et al. <sup>20</sup> (2002)	Y	Y	Y	Y	N	Y	Y	N	Y	77.8%	—
Harvey-Berino et al. <sup>21</sup> (2002)	Y	Y	Y	Y	Y	UK	N	N	Y	66.7%	- / -

The quality of study design scoring was adapted from that of Norman et al.<sup>8</sup>

<sup>a</sup>Mean score of total percentage, 81.96%.

<sup>b</sup>Direction of the effectiveness of maintain was coded as follows: “++” = technology-based intervention resulted in significant maintenance in weight loss compared with pure control group; “—” = technology-based intervention resulted in no significant maintenance in weight loss compared with pure control group; “+” = technology-based intervention resulted in significant maintenance in weight loss compared with non-technology comparison group; “-” = technology-based intervention resulted in no significant maintenance in weight loss compared with non-technology comparison group.

N, no; UK, unclear/unknown; Y, yes.

pre- and posttest design standards. Three studies reported that they conducted paired, blocked, or stratified randomization,<sup>7,17,31</sup> whereas other studies mentioned randomization briefly. Six studies had a non-technological comparison group, such as face-to-face counseling,<sup>7,15</sup> personal contact,<sup>21,31</sup> frequent in-person contact,<sup>19,20</sup> and minimal in-person contact.<sup>19,20</sup> All studies tested the effectiveness of designed technology-based interventions except the study of Thorndike et al.<sup>17</sup>; its maintenance intervention consisted of two components: Internet and personal contact. The average retention rate for all of the studies was 84.7%, but three studies' retention rates did not exceed 80%.<sup>17,19,20</sup> Three studies reported significant differences among groups at baseline on some variables,<sup>9,15,17</sup> and one study did not mention any group differences at baseline.<sup>21</sup> A majority of the studies conducted analyses with consideration of missing data that maintained the fidelity of the randomization such as the baseline-observation-carried-forward method,<sup>9,17</sup> intent-to-treat analysis,<sup>19,20</sup> missing-at-random assumption,<sup>15</sup> or imputation.<sup>31</sup> All studies mentioned their measurement validity information, except the study by Thorndike et al.<sup>17</sup>; these investigators mentioned their measurement methods but did not fully describe their validity or make references about nutrition behavior and overall health.

### **Effectiveness in Maintaining Weight loss**

There were various results in terms of effectiveness in maintaining weight loss. The researchers in three recent studies concluded that technology-based maintenance interventions did not improve outcomes<sup>17</sup> or work better than self-direction in sustaining weight loss.<sup>9,21</sup> However, several studies reported that technology-based maintenance

interventions allowed for sustained weight loss better than that of the control group<sup>7,15,19,31</sup> but not better than non-technology-based maintenance interventions.<sup>7,15,31</sup> Therefore, the results of the effectiveness of technology-based WLMIs were mixed in the primary research studies.

## **Discussion**

In a search of the literature, eight studies were identified. Those selected for review were randomized controlled trials to evaluate the effectiveness of technology-based WLMIs in sustaining weight loss. Neve et al.<sup>11</sup> also conducted a systematic review with meta-analysis to evaluate the effectiveness of Web-based interventions, published in 2010. They concluded that Web-based interventions have the potential to achieve outcomes to change other lifestyle behaviors; however, they also questioned the effectiveness of Web-based interventions for weight loss and weight-loss maintenance.<sup>11</sup>

Khaylis et al.<sup>4</sup> also qualitatively reviewed the efficacy of technology-based WLIs and identified the five components necessary to succeed in enabling a successful weight-loss program: “self-monitoring, counselor feedback and communication, social support, use of a structured program, and use of an individually tailored program.” They concluded that long-term results are varied, although the short-term goals of technology-based intervention programs have been accomplished.

This review article supports previous review studies that report that long-term WLCI studies using technology have mixed findings. The article adds to the literature beyond previous reviews of long-term outcomes of WLI with its specific focus on the use/testing of technology-based interventions that were implemented during the

maintenance phase (not just follow-up after a technology-based intervention). From this review, it is evident that there is a strong need to find an effective way to improve study interventions and protocols that will affect the weight related outcome.

### **Suggested Guidelines for Technology-Based Maintenance Interventions**

From the above review of eight studies, six guidelines have been derived that suggest ways to use technology-based WLMI methods effectively:

- Tailor the technology-based maintenance intervention for specific subjects.<sup>17,31</sup>
- To improve retention rates, develop additional sessions for special concerns.<sup>15</sup>
- Encourage participants to utilize the technology.<sup>9-17</sup>
- Consider having participants keep weekly self-weighing and diet logs.<sup>7,9,15</sup>
- Check participants' technical abilities.<sup>21</sup>
- Consider an occasional personal contact component to complement the technology-based maintenance intervention.<sup>20,31</sup>

Svetkey et al.<sup>31</sup> elaborated that it is very important to provide more tailored interventions to achieve greater benefits because different individuals may prefer different types of interventions. They also reported that social support, reengagement, and motivation may need to be strengthened for long-term success. Thorndike et al.<sup>17</sup> conducted a wellness program to modify employees' diet and exercise behaviors. The researchers focused on a specific population (employees) in a specific environment (a workplace). They reported that the employees became less motivated to participate in the less intensive 9-month maintenance intervention and that utilization of the Web site was relatively low in comparison with the 10-week intervention. These results showed that

long-term maintenance interventions may need more specific intervention strategies focused on the workplace and on the employees. Therefore, more tailored interventions are needed on long-term aspects<sup>31</sup> for specific subjects and environments.<sup>17</sup> Generally, 20–25% attrition rates were observed in behavioral weight-loss programs.<sup>34</sup> The retention rates of the eight primary studies were in this range, but investigators could improve their retention rates by using additional sessions to satisfy participants. Perri et al.<sup>15</sup> designed additional sessions for women in rural areas, such as low-calorie cooking techniques and performance for a healthy eating plan while away from home, to cope with the lack of family or friend support while losing weight. It is interesting that these researchers reported the highest retention rate among eight studies. Therefore, it is possible to conclude that the special additions make participants more likely to stay in the study.

Cussler et al.<sup>9</sup> stated that there was considerable variation in weight changes during the 12-month weight maintenance period within the Internet group. The weight change range was 12.2–20.9 kg, so the authors assumed that the amount of weight change might reflect differences in the degree of Internet usage during the maintenance period. In addition, Harvey-Berino et al.<sup>19</sup> tested participants' computer experience and comfort, attendance, and adherence. It was surprising that the attendance rate was better for the in-person group than for the Internet group. Moreover, the technology group's retention rate was relatively low in the majority of studies. These results indicate that investigators should simplify the interface, make it more convenient to use, and encourage participants to use technology more frequently.

Cussler et al.<sup>9</sup> also reported that the diet log was correlated with a change in weight ( $p < 0.05$ ). The authors mentioned that the logs helped participants feel at ease and might have encouraged more mindful eating habits. Perri et al.<sup>15</sup> also mentioned that completing the food logs mediated between extended-care counseling and long-term weight-loss success had a direct effect on the self-regulation theory (self-monitoring). Wing et al.<sup>7</sup> also reported that daily self-weighing was associated with effective weight maintenance.

Harvey-Berino et al.<sup>19-21</sup> tested the acceptability for participants of their group assignment. In early studies they found that some participants did not have a computer equipped with technology such as a sound card and speakers.<sup>21</sup> Use of the Internet and mobile phones became more popular with middle aged or elderly people. However, there can still be barriers to the effective use of these technologies. Investigators should check the participants' abilities and their devices to make sure participants can use the technology properly.

Svetkey et al.<sup>31</sup> concluded that personal contact interventions were effective across all subgroups. Although the intervention contact was only a 10 -15 min telephone conversation, it still increased the effectiveness of weight-loss maintenance. Researchers suggested that occasional personal contact may be needed to augment technology-based interventions. Other studies reported that face-to-face contact produced the best outcomes.<sup>7</sup> Therefore, personal contact can be added to technology-based interventions to increase the likelihood of weight loss maintenance.

## **Limitations**

There are several limitations in this article. First, publication bias should be considered. Only electronic databases were searched. At RCT.org, many studies are listed as currently being implemented throughout the United States. Because of time-consuming data collection and publication processes, it takes significant time to prepare articles for publication. In addition, some studies are not published, including those with nonsignificant results or negative results. Second, only English-language journal articles were included. Issues related to being overweight and obese exist all over the world. More evidence might be published in languages other than English. Third, only a few studies were included. Previous studies included large ranges of intervention periods for weight-loss programs that were implemented. In this article, the focus was on long-term, technology-based WLMIs. It was difficult to find articles that satisfied both criteria (i.e., use of technology and application over the long term). In a few years, more studies will be published that will meet the inclusion requirements. Fourth, there was a lack of weight change data in the original studies. One study did not report body weight changes in each group, making it difficult to compare its results with those of other studies.<sup>21</sup> In addition, some studies provided either a standard deviation or a confidence interval for weight change, but other studies provided only weight change. If there were more data, a meta-analysis could have been conducted. Fifth, there is considerable risk of bias in individual studies and across studies. To enhance the validity of study review, pairs of reviewers or peer reviewers can work independently. In this article, no assessment of risk of bias was performed.

## **Conclusions**

The current obesity epidemic is problematic in the United States and worldwide as well. Overall, investigators of most of the studies agreed that technology could be a more effective tool in preventing weight gain than self-directed maintenance alone. However, some questions remain about the efficacy of technology-based WLMIs. In this review, results of the effectiveness of technology-based WLMIs were mixed. Therefore, this article has discussed potential strategies and approaches to improve the effectiveness of technology-based WLMIs.

This review provides important information to both patients and healthcare providers. Healthcare providers can suggest technology-based WLMIs to their patients and can include information about the strengths and weaknesses of each of the interventions. Moreover, suggested guidelines in this article can aid in planning further research design and implementation.

Further studies are needed to better evaluate the efficacy of technology-based WLMIs. Even longer maintenance intervention periods are needed to better evaluate the effectiveness of technology-based maintenance interventions. Moreover, this review included only eight studies; more primary studies are needed to evaluate reliable results. Meta-analysis also can be useful to examine actual body weight changes during the long-term period.

## References

1. Ogden CL, Carroll MD, Kit BK, Flegal KM. Prevalence of childhood and adult obesity in the United States, 2011–2012. *JAMA* 2014;311:806–814.
2. World Health Organization. Obesity and overweight. Available at [www.who.int/mediacentre/factsheets/fs311/en/](http://www.who.int/mediacentre/factsheets/fs311/en/) (last accessed February 26, 2014).
3. National Institute of Health, National Heart, Lung, and Blood Institute. Clinical guidelines on the identification, evaluation and treatment of overweight and obesity in adults; the evidence report. *Obes Res* 1998;6(Suppl 2):51S–209S.
4. Khaylis A, Yiaslas T, Bergstrom J, Gore-Felton C. A review of efficacious technology-based weight-loss interventions: Five key components. *Telemed JE Health* 2010;16:931–938.
5. Weinstein PK. A review of weight loss programs delivered via the Internet. *J Cardiovasc Nurs* 2006;21:251–258.
6. Turk MW, Yang K, Hravnak M, Sereika SM, Ewing LJ, Burke LE. Randomized clinical trials of weight loss maintenance: A review. *J Cardiovasc Nurs* 2009;24:58–80.
7. Wing RR, Tate DF, Gorin AA, Raynor HA, Fava JL. A self-regulation program for maintenance of weight loss. *N Engl J Med* 2006;355:1563–1571.
8. Norman GJ, Zabinski MF, Adams MA, Rosenberg DE, Yaroch AL, Atienza AA. A review of eHealth interventions for physical activity and dietary behavior change. *Am J Prev Med* 2007;33:336–345.

9. Cussler EC, Teixeira PJ, Going SB, et al. Maintenance of weight loss in overweight middle-aged women through the Internet. *Obesity (Silver Spring)* 2008;16:1052–1060.
10. Wantland DJ, Portillo CJ, Holzemer WL, Slaughter R, McGhee EM. The effectiveness of web-based vs. non web-based interventions: A meta-analysis of behavioral change outcomes. *J Med Internet Res* 2004;6:e40.
11. Neve M, Morgan PJ, Jones PR, Collins CE. Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: A systematic review with meta-analysis. *Obes Rev* 2010;11:306–321.
12. LaPlante C, Peng W. A systematic review of e-Health Interventions for physical activity: An analysis of study design, intervention characteristics, and outcomes. *Telemed J E-Health* 2011;27:509–523.
13. Cadmus-Bertram L, Wang JB, Patterson RE, Newman VA, Parker BA, Pierce JP. Web-based self-monitoring for weight loss among overweight/obese women at increased risk for breast cancer: The HELP pilot study. *Psychooncology* 2012;22:1821–1828.
14. Van Wier MF, Dekkers JC, Hendriksen IJM, et al. Effectiveness of phone and e-mail lifestyle counseling for long term weight control among overweight employees. *J Occup Environ Med* 2011;53:680–686.
15. Perri MG, Limacher MC, Durning PE, et al. Extended-care programs for weight management in rural communities: The Treatment of Obesity in Underserved Rural Settings (TOURS) randomized trial. *Arch Intern Med* 2008;168:2347–2354.

16. Sherwood NE, Jeffery RW, Pronk NP, et al. Mail and phone interventions for weight loss in a managed-care setting: Weight-to-be 2-year outcomes. *Int J Obesity* 2006;30:1565–1573.
17. Thorndike AN, Sonnenberg L, Healey E, Myint-U K, Kvedar JC, Regan S. Prevention of weight gain following a worksite nutrition and exercise program: A randomized controlled trial. *Am J Prev Med* 2012;43:27–33.
18. Morgan PJ, Lubans DR, Collins CE, Warren JM, Callister R. 12-month outcomes and process evaluation of the SHED-IT RCT: An Internet-based weight loss program targeting men. *Obesity (Silver Spring)* 2011;19:142–151.
19. Harvey-Berino J, Pintauro S, Buzzell P, Gold EC. Effect of Internet support on the long-term maintenance of weight loss. *Obes Res* 2004;12:320–329.
20. Harvey-Berino J, Pintauro S, Bussell P, DiGiulio M, Gold BC, Moldovan C, Ramirez E. Does using the Internet facilitate the maintenance of weight loss? *Int J Obes* 2002;26:1254–1260.
21. Harvey-Berino J, Pintauro SJ, Gold EC. The feasibility of using Internet support for the maintenance of weight loss. *Behav Modif* 2002;26:103–116.
22. Appel LJ, Clark JM, Yeh HC, et al. Comparative effectiveness of weight-loss interventions in clinical practice. *N Engl J Med* 2011;365:1959–1968.
23. Van Geungten L, Van Empelen P, Boon B, Borsboom G, Visscher T, Oenema A. Results from an online computer-tailored weight management intervention for overweight adults: Randomized controlled trial. *J Med Internet Res* 2012;14:e44.

24. Thomas D, Vydelingum V, Lawrence J. E-mail contact as an effective strategy in the maintenance of weight loss in adults. *J Hum Nutr Diet* 2011;24:32–38.
25. Bennett GG, Herring SJ, Puleo E, Stein EK, Emmons KM, Gillman MW. Web-based weight loss in primary care: A randomized controlled trial. *Obesity* 2010;18:308–313.
26. Womble LG, Wadden TA, McGuckin BG, Sargent SL, Rothman RA, Krauthamer-Ewing ES. A randomized controlled trial of a commercial Internet weight loss program. *Obes Res* 2004;12:1011–1018.
27. Gold BC, Burk S, Pintauro S, Buzzell P, Harvey-Berino J. Weight loss on the web: A pilot study comparing a structured behavioral intervention to a commercial program. *Obesity (Silver Spring)* 2007;15:155–164.
28. Haapala I, Barengo NC, Biggs S, Surakka L, Manninen P. Weight loss by mobile phone: A 1-year effectiveness study. *Public Health Nutr* 2009;12:2382–2391.
29. Patrick K, Raab F, Adams MA, et al. A text message-based intervention for weight loss: Randomized controlled trial. *J Med Internet Res* 2009;11:e1.
30. Rothert K, Strecher VJ, Doyle LA, et al. Web-based weight management programs in an integrated health care setting: A randomized, controlled trial. *Obesity (Silver Spring)* 2006;14:266–272.
31. Svetkey LP, Stevens VJ, Brantley PJ, et al. Comparison of strategies for sustaining weight loss: The weight loss maintenance randomized controlled trial. *JAMA* 2008;299:1139–1148.

32. Paffenbarger RS Jr, Wing AL, Hyde RT. Physical activity as an index of heart attack risk in college alumni. *Am J Epidemiol* 1978;108:161–175.
33. Harlan LC, Block G. Use of adjustment factors with a brief food frequency questionnaire to obtain nutrient values. *Epidemiology* 1990;1:224–231.
34. Block G, Hartman AM, Dresser CM, Carroll MD, Gannon J, Gardner L. A database approach to diet questionnaire design and testing. *Am J Epidemiol* 1986;124:453–469

## Appendix 2.1

### *Summary of Weight-Loss and Weight-Loss Intervention Studies and Study Selection*

REFERENCE (YEAR)	BASELINE CHARACTERISTICS OF PARTICIPANTS					PRIMARY OUTCOMES	STUDY FLOW	STUDY DESIGN; LOCATION	INTERVENTIONS (NUMBER ALLOCATED)	STUDY SELECTION <sup>b</sup>
	N <sup>a</sup>	MEN:WOMEN RATIO	BMI (KG/M <sup>2</sup> )	AGE (YEARS)	PARTICIPANTS					
Cadmus-Bertram et al. <sup>13</sup> (2013)	50	0:50	EG: 33.4 (3.8) CG: 31.5 (3.3)	EG: 61.2 (5.6) CG: 60.2 (5.9)	Women at increased breast cancer risk	Anthropometrics, physical activity	Randomization; 12-week WLI; 2-year follow-up	RCT; San Diego, CA	12-week WLI: EG, telephone and Web-based intervention (n = 33); CG, dietary information but no training (n = 17)	Excluded, WLI only
Thorndike et al. <sup>17</sup> (2012)	330	158:172	EG: 28.0 (5.8) CG: 27.5 (5.9)	EG: 44.2 (11.8) CG: 41.6 (13.6)	Employees	Weight	10-week WLI; randomization; 9-month WLMI	RCT; Massachusetts, 2008	10-week WLI: nutrition and physical activity intervention  9-month WLMI: EG, Internet and personal contact (n = 174); CG, self-directed (n = 156)	Included
Van Genugten et al. <sup>23</sup> (2012)	539	164:375	EG: 28.17 (2.02) CG: 27.91(1.85)	47.8 (9.4)	General population	Anthropometrics, energy balance-related behaviors	Randomization; 6-month WLI	RCT; Rotterdam, The Netherlands, 2009	6-month WLI: EG, computer-tailored intervention (n = 270); CG, general information (n = 270)	Excluded, WLI only
Appel et al. <sup>22</sup> (2011)	415	151:264	EG1: 36.0 (4.7) EG2: 36.8 (5.2) CG: 36.8 (5.14)	EG1: 55.8 (9.7) EG2: 53.3(10.5) CG: 52.9 (10.1)	Obese adults	Weight	Randomization; 24-month WLI	RCT; Baltimore, MD, 2008–2009	24-month WLI: EG1, remote support only (n = 139); EG2, in-person only (n = 138); CG, self-directed (n = 138)	Excluded, WLI only

REFERENCE (YEAR)	BASELINE CHARACTERISTICS OF PARTICIPANTS					PRIMARY OUTCOMES	STUDY FLOW	STUDY DESIGN; LOCATION	INTERVENTIONS (NUMBER ALLOCATED)	STUDY SELECTION <sup>b</sup>
	N <sup>a</sup>	MEN:WOMEN RATIO	BMI (KG/M <sup>2</sup> )	AGE (YEARS)	PARTICIPANTS					
Morgan et al. <sup>18</sup> (2011)	65	65:0	EG: 30.6 (2.7) CG: 30.5 (3.0)	EG: 37.5 (10.4) CG: 34.0 (11.6)	Overweight or obese male staff and students	Weight	Randomization; 3-month WLI; 12-month follow-up	RCT; Callaghan, Australia, 2007	3-month WLI: EG, SHED-IT Internet group (n = 34); CG, information group (n = 31)	Excluded, WLI only
Van Wier et al. <sup>14</sup> (2011)	1386	929:457	EG1: 29.5 (3.5) EG2: 29.6 (3.4) CG: 29.6 (3.7)	EG1: 43 (8.8) EG2: 43 (8.4) CG: 43 (8.7)	Employees	Weight	Randomization; 6-month WLI, 2-year follow-up	RCT; The Netherlands, 2004	6-month WLI: EG1, phone (n = 462); EG2, Internet (n = 464); CG, self-directed (n = 460)	Excluded, WLI only
Bennett et al. <sup>25</sup> (2010)	101	53:48	EG: 35.0 (3.5) CG: 34.6 (3.2)	EG: 54.4 (7.4) CG: 54.5 (8.9)	Obese, hypertensive patients	Weight	Randomization; 12-week WLI	RCT; Massachusetts, 2005–2006	12-week WLI: EG, Web-based intervention (n = 51); CG, usual care (n = 50)	Excluded, WLI only
Thomas et al. <sup>24</sup> (2011)	55	Unclear	EG: 33.1 CG: 32.7	EG: 43.2 (15.23) CG: 46.2 (12.0)	Those who had lost ‡ 5% of their body weight	Weight	Randomization; 6-month WLI	RCT; United Kingdom	6-month WLI: EG, e-mail group (n = 28); CG (n = 27)	Excluded, WLI only
Haapala et al. <sup>28</sup> (2009)	125	29:96	EG: 30.6 (2.7) CG: 30.4 (2.8)	EG: 38.1 (4.7) CG: 38.0 (4.7)	Volunteer	Weight, height, and waist circumference	Randomization; 12-month WLI	RCT; Finland, 2001–2002	12 month WLI: EG, mobile phone-operated intervention (n = 62); CG (n = 63)	Excluded, WLI only
Patrick et al. <sup>29</sup> (2009)	78	13:52	EG: 33.5 (4.5) CG: 32.8 (4.4)	EG: 42.4 (7.5) CG: 47.4 (7.1)	Overweight adults	Weight	Randomization; 4-month WLI	RCT; California, 2007	4-month WLI: EG, text message-based intervention (n = 39); CG, usual care (n = 39)	Excluded, WLI only
Cussler et al. <sup>9</sup> (2008)	135	0:135	EG: 31.0 (3.9) CG: 30.4 (3.3)	EG: 48.0 (4.6) CG: 48.4 (4.3)	Women	Anthropometrics, physical activity, dietary assessment	4-month WLI; randomization, 12-month WLMI	RCT; Arizona	4-month WLI, 12-month WLMI: EG, weight maintenance Internet intervention (n = 66); CG, self-directed (n = 69)	Included

REFERENCE (YEAR)	BASELINE CHARACTERISTICS OF PARTICIPANTS					PRIMARY OUTCOMES	STUDY FLOW	STUDY DESIGN; LOCATION	INTERVENTIONS (NUMBER ALLOCATED)	STUDY SELECTION <sup>b</sup>
	N <sup>a</sup>	MEN:WOMEN RATIO	BMI (KG/M <sup>2</sup> )	AGE (YEARS)	PARTICIPANTS					
Perri et al. <sup>15</sup> (2008)	234	0:234	EG1: 36.9 (5.7) EG2: 37.1 (4.5) CG: 36.2 (4.3)	EG1: 59.8 (6.2) EG2: 59.2 (6.2) CG: 58.6 (6.0)	Women, rural area	Weight, BMI	6-month WLI; randomization, 26-week WLMI	RCT; Florida, 2003–2007	6-month WLI, 26-week WLMI: EG1, telephone counseling (n = 72); EG2, face-to-face counseling group (n = 83); CG, education control (n = 79)	Included
Svetkey et al. <sup>31</sup> (2008)	1,032	378:654	EG1: 34.2 (4.9) EG2: 34.2 (4.8) CG: 34.0 (4.8)	EG1: 55.7 (8.5) EG2: 55.4 (9.1) CG: 55.8 (8.5)	Taking medication for hypertension, dyslipidemia; no active CVD	Weight	6-month WLI; randomization; 30-month WLMI, 36-month follow-up	RCT; North Carolina, 2003–2007	6-month WLI (n = 1,685), 30-month WLMI: EG1, interactive technology (n = 348); EG2, personal- contact (n = 342); CG, self-directed (n = 342)	Included
Gold et al. <sup>27</sup> (2007)	124	23:101	EG1: 32.3 (3.9) EG2: 32.5 (4.2)	EG1: 46.5(10.7) EG2: 48.9 (9.9)	Overweight and obese adults	Weight	Randomization; 12-month WLI	RCT; online, 2003–2005	12-month WLI: EG1, 12-month VTrim (n = 62); EG2, eDiets.com (n = 62)	Excluded, WLI only
Rothen et al. <sup>30</sup> (2006)	2862	492:2,370 <sup>c</sup>	EG1: 33.0 (3.8) EG2: 31.3 (3.9)	EG1: 45.6 (12.1) EG2: 45.2 (12.0)	Current members of Kaiser Permanente	Weight	Randomization; 6-month WLI	RCT; four regions, 2002-2003	6-month WLI: EG1, tailored expert system (n = 1,475); EG2, information only (n = 1,387)	Excluded, WLI only
Sherwood et al. <sup>16</sup> (2006)	1801	508:1,298 <sup>c</sup>	EG1: 34.1 (0.2) EG2: 33.5 (0.2) CG: 34.0 (0.2)	EG1: 50.6 (0.5) EG1: 50.7 (0.5) CG: 50.8 (0.5)	Clinic members	Weight	Randomization; 10-lesson WLI, 18-month follow- up, 24-month follow-up	RCT; Minnesota, 1999–2002	10-lesson WLI: EG1, mail (n = 600); EG2, phone (n = 601); CG, usual care (n = 600)	Excluded, WLI only

REFERENCE (YEAR)	BASELINE CHARACTERISTICS OF PARTICIPANTS					PRIMARY OUTCOMES	STUDY FLOW	STUDY DESIGN; LOCATION	INTERVENTIONS (NUMBER ALLOCATED)	STUDY SELECTION <sup>b</sup>
	N <sup>a</sup>	MEN:WOMEN RATIO	BMI (KG/M <sup>2</sup> )	AGE (YEARS)	PARTICIPANTS					
Wing et al. <sup>7</sup> (2006)	314	59:255 <sup>c</sup>	EG1: 50.9 (9.3) EG2: 51.0 (10.3) CG: 52.0 (10.8)	EG1: 28.1 (4.6) EG2: 28.7 (4.7) CG: 29.1 (5.0)	Those who had lost at least 10% of their body weight during the prior 2 years	Weight	Randomization; 18-month WLMI	RCT	Orientation (n = 521) of those who had lost 10% of weight; 18-month WLMI: EG1, Internet intervention (n = 104); EG2, face-to-face intervention (n = 105); CG, control (n = 105)	Included
Harvey-Berino et al. <sup>19</sup> (2004)	255	46:209	EG1: 29.3 (5.2) EG2: 28.9 (3.8) EG3: 29.0 (4.3)	EG1: 46.5 (9.8) EG2: 45.2 (8.9) EG3: 46.5 (7.7)	Healthy overweight and obese adults	Weight, energy intake, physical activity	6-month WLI; randomization; 12-month WLMI, 18-month follow-up	RCT; Vermont, 2000–2002	6-month interactive television WLI (n = 255); 12-month WLMI (n = 232): EG1, Internet support (n = 77); EG2, frequent in-person contact (n = 77); EG3, minimal in-person contact (n = 78)	Included
Womble et al. <sup>26</sup> (2004)	47	0:47	EG1: 33.9 (3.2) EG3: 33.0 (3.0)	EG1: 44.2 (9.3) EG3: 43.3 (11.1)	Women	Weight	Randomization; 4-month WLI, 12-month follow-up	RCT; Philadelphia, PA, 2001–2002	12-month WLI: EG1, eDiet.com (n = 23); EG2, weight-loss manual (n = 24)	Excluded, WLI only
Harvey-Berino et al. <sup>20</sup> (2002)	122	18:104	EG1: 32.2 (4.0) EG2: 31.5 (4.8) EG3: 32.8 (4.6)	EG1: 46.4 (11.1) EG2: 49.8 (8.4) EG3: 49.1 (9.1)	Healthy overweight adults	Weight	6-month WLI; randomization; 12-month WLMI	RCT; Vermont	6-month WLI; 12-month WLMI: EG1, Internet support (n = 40); EG2, in-person support (n = 41); EG3, minimal in-person support (n = 41)	Included

REFERENCE (YEAR)	BASELINE CHARACTERISTICS OF PARTICIPANTS					PRIMARY OUTCOMES	STUDY FLOW	STUDY DESIGN; LOCATION	INTERVENTIONS (NUMBER ALLOCATED)	STUDY SELECTION <sup>b</sup>
	N <sup>a</sup>	MEN:WOMEN RATIO	BMI (KG/M <sup>2</sup> )	AGE (YEARS)	PARTICIPANTS					
Harvey-Berino et al. <sup>21</sup> (2002)	46	9:37	33.7 (4.6) <sup>d</sup>	46.3 (7.4) <sup>d</sup>	Obese adults	Weight	15-week WLI; randomization; 22-week WLMI	RCT; Vermont	15-week WLI (n = 46); 22-week WLMI (n = 44); EG1, in-person, therapist-led (n = 14); EG2, Internet (n = 15); CG, no treatment (n = 15)	Included

Age and body mass index (BMI) are given as mean (standard deviation) values.

<sup>a</sup>Total number in study.

<sup>b</sup>Reasons the studies were excluded.

<sup>c</sup>Recalculated from original data.

<sup>d</sup>Not reported by groups.

CG, control group; CVD, cardiovascular disease; EG, experimental group; RCT, randomized controlled trial; WLI, weight-loss intervention; WLMI, weight-loss maintenance intervention.

## Appendix 2.2

### *Study Quality Coding Criteria*

TABLE HEADING	SCORING CRITERIA
Individual randomization	Were participants randomized to study conditions? If so, was randomization at the individual level? Stratified and blocked randomization is acceptable. Studies that used individual randomization combined with a small proportion of randomized matched pairs are considered Y. Appropriately designed and powered group randomization would also be acceptable if the group was also the unit of analysis. Individual randomization is N when the authors fail to mention randomization, specify that another method of assigning group status was used, or randomize at the group level and analyze at the individual level.
Control group	Did the study include a comparison group? The comparison group could be a no treatment as usual or an alternate treatment group.
Isolate technology	Did the study design allow for test of effectiveness of the technology (e.g., Web-based delivery versus no treatment)? To isolate the technology, the authors had to test the technology alone and compare with a group with no technology (Y). Packaged interventions where the technological components can't be parsed out are coded as not isolating the technology (N).
Pre-/posttest design	Was assessment of behavior completed preintervention and postintervention?
Retention	Was study retention at least 80% of the subjects who initially agreed to participate the study? Retention is calculated for the entire sample and not by group. For studies that did not report retention or dropout rates, retention can be calculated using the sample size used for analyses (e.g., 300 were randomized, but only 250 were included in analyses = 83.3% retention).
Baseline group equivalent	Were tests conducted to determine if groups were equivalent at baseline in important variables (e.g., gender, age, weight)? If no tests mentioned, then UK. If subset of test indicated any group differences at baseline, then N.
Missing data	Were analyses conducted with consideration of missing data that maintain the fidelity of the randomization (e.g., intent-to-treat, imputation)? Listwise case deletion (completer analysis) = N if this was the only analysis conducted. If 100% retention, then completer analysis is appropriate = Y. If authors compared the “dropped subgroup” with the selected or randomized sample, but did not consider the impact of the dropped subgroup on randomization (e.g., intent-to-treat or imputation), then code as N.
Sample size calculation	Was power analysis reported to determine study sample size?

Validity of measures	Did description of measures include reliability and validity information? If reference or coefficients, then Y. If a well-established measure that is known to be validated was used, then Y. For objective measures without validity evidence, if the objective measure is used as a proxy (e.g., food receipt for nutrition intake), then N. If the objective measure is used as a direct measure of behavior (e.g., food receipts for food purchase), then Y. If validity not reported and measure unknown, then UK.
Total	Percentage of Y values (%)

The study quality coding criteria were adapted from those of Norman et al.<sup>8</sup>

N, no; UK, unclear/unknown; Y, yes.

### **Chapter 3: Manuscript Two**

This chapter explores Aim 2 of the dissertation. The purpose of Aim 2 was to describe the development and implementation of the weight management program comprised of text messaging and peer support for African American women. This manuscript will be submitted to the *Western Journal of Nursing Research*.

## **Development of Text-Messaging and Peer-Support Intervention for Weight Management among African-American Women**

*(Manuscript is prepared to be submitted to Western Journal of Nursing Research)*

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### **Introduction**

Mobile phones are one of the most popular communication devices in modern society. Mobile phones have many functions, including voice message or video calling, text messaging, cameras, video or voice recording, note taking, and Internet access. Text messaging is one of the easiest and most powerful communication functions of mobile phones (Cole-Lewis, & Kershaw, 2010). Mobile text messaging via mobile phones is also a relatively cheap and a highly accessible communication tool to connect with diverse populations. Further, text messages can be seen and stored for viewing anytime and anywhere. Text messaging has been used for health-care related purposes including providing health information and medical appointment reminders. According to a recent report from the American Heart Association, text messaging is a great medium to deliver health information and medical reminders (Piette, List, Rana, Townsend, Striplin, & Heisler, 2015).

According to Pew Research Center, the mean number of text messages sent and received per day for African Americans (non-Hispanic Black) was much higher than White or Hispanic populations (Pew Research Center, 2014). In the past year, 67% of African Americans used their phone to look for information about a health condition. Thus, text messaging via mobile phones has been demonstrated to be an acceptable and favorable tool for acquiring and delivering health information among African Americans.

Peer support is a major element that provides strong social relationships and social support. Peer group support interventions have been conducted for health behavioral changes (Webel, Okonsky, Trompetta, & Holzemer, 2010). A recent study reported that team-based interventions provided strong networks that influence health behavior change for weight loss (Leahy, Kumar, Weinberg, & Wing, 2012). A recent systematic review that was conducted to assess the impact and effectiveness of peer support for diabetes individuals found that peer support improved glycemic control, blood pressure, cholesterol, weight, physical activity, self-efficacy, and depression (Dale, Williams, & Bowyer, 2012). With these positive findings, peer support group can augment a text messaging intervention.

The purpose of this paper is to describe how a novel combined text message and peer support group program was developed to enhance weight management skills among African American women. To minimize the limitations of traditional face-to-face group meetings, text messages were created to provide daily health behavior information. Bi-weekly group meetings were designed to be less costly than weekly intensive meetings, but still provide the engagement and benefits of group membership.

## **Methods**

### **Conceptual Framework**

The conceptual framework of this study was developed from Bandura's Social Cognitive Theory (SCT) to promote healthy behavior for weight loss and weight management. SCT indicated that a triadic interplay of personal, behavior and environmental factors impact participants' behavioral change (Bandura, 2011). Bandura (2011) stated "personal factors, in the form of cognitive, affective and biological processes, the way in which one behaves, and environmental events all operate as interacting determinants that influence each other directionally" (p. 34).

The study's conceptual framework and operational model based on Bandura's SCT were developed to enhance the research design and protocol, to support the study rationale, and to strengthen the theoretical base of this work (Figure 3.1). From the model, it is posited that socioeconomic status (SES) factors, which are static and unchangeable, will influence a person's environmental, behavioral, and personal factors.

The intervention that was designed to be applied in context of this model targeted personal, behavioral, and environmental factors that organically affect each other. From the model, it was further posited that all factors ultimately contribute to behavioral changes, such as diet and physical activity. Weight loss and management are the primary outcomes of the program to be achieved by behavioral changes. There are several theory-oriented strategic targets that can be derived from this theory that can be used to encourage participants and boost their engagement, including self-efficacy, outcome-expectancy, self-regulation, role-modeling, motivation, and goal-setting (Bandura, 2001).

[Figure 3.1 here]

Self-efficacy is an individual's judgment or belief about abilities to perform certain behaviors (Bandura, 1997; Warziski, Sereika, Styn, Music & Burke, 2008). The recent study by Byrne, Barry and Petry (2012) examined the effects of pre-treatment self-efficacy for diet and exercise, and the researchers concluded that self-efficacy can be a weight loss predictor that enhances participants' success. For example, if participants are more confident about performing the exercise, they will increase physical activity, and then they are more likely lose weight (Byrne et al., 2012; Warziski, 2008).

An outcome-expectancy is defined as "a person's estimate that a given behavior will lead to certain outcomes" (Bandura, 1977, p.193). Finch et al. (2005) examined whether more favorable outcome expectations resulted in more weight loss and improved weight loss maintenance. They found that positive outcome expectations were associated with weight loss. Especially optimistic outcome expectations that emphasized positive perspectives of weight loss, such as wearing smaller sized clothes, improved physical health, attractiveness to others, ability to complete activity, etc. (Finch et al., 2005)

Self-regulation theory is explained as "self-monitoring that precedes self-evaluation of progress made toward one's goal and self-reinforcement for the progress made; thus the process of changing habits requires well-developed self-regulatory skills" (Burke, Wang, & Sevick, 2011, p.92). A systematic review of self-monitoring for weight loss found that self-monitoring can be a positive strategy to increase a person's attention of targeted behaviors, such as diet, exercise, or self-weighing (Burke et al., 2011). Wing, Tate, Gorin, Raynor, and Fava (2006) also supported daily self-weighing based on a self-

regulation program that was associated with long-term weight loss maintenance, especially in context of a face-to-face format.

Role-modeling is another theory-driven strategy to promote physical activity. Cardinal and Cardinal argued physical activity's paradox: "do as I say, not as I do" (Cardinal, & Cardinal, 2001). The authors mentioned that role modeling was a powerful teaching tool to minimize the physical activity paradox. Researchers or group members can make role models, or can be role models themselves to increase physical activity and decrease the physical activity paradox.

Motivation is derived from the health-belief model that is applied in many healthcare settings. Williams, Grow, Freedman, Ryan, and Deci (1996) concluded that the individual's autonomous motivation is positively associated to their attendance in a weight loss program. Another recent study by West and colleagues (2011) supported that a weight loss maintenance program could be used as motivation to achieve a weight loss goal. In their study, motivation was used as one of the strategies for weight loss maintenance; in this study, participants focused on maintaining motivation to keep using diet, physical activity, and behavioral skills from the previous short-term program as they moved into the phase of weight loss maintenance.

Goal-setting has been found to be effective in promoting behavior change for weight loss maintenance. Cullen, Baranowski, and Smith (2001) reviewed dietary behavior change interventions, and they discussed the 4-step goal setting process: recognizing the need for change, establishing a goal, monitoring goal-related activity, and self-rewarding for goal attainment (Cullen et al., 2001). The Specific, Measurable,

Achievable, Realistic, Timely (SMART) rule can be used to set effective goals for behavioral change and objective goals (Bastable, 2008). A realistic goal-setting strategy can be applicable to interventions designed to change subjects' diet and exercise behaviors.

As presented in Table 3.1, strategies that were derived from SCT were used to design the intervention in the present study to help participants change behaviors related to weight loss and management and to incorporate them into their daily lives. Connections amongst strategy concepts were drawn from SCT and literature (strategy factors), built into program objectives to be achieved through the intervention, and delivered in the intervention program as a series of related weekly intervention topics #1 through #16 as presented in the curriculum outlined in Table 3.2; the weekly topics were coupled with content-related text messages focused on the weekly, specific, targeted health behaviors (Table 3.1).

[Table 3.1 here]

### **Program Curriculum**

The intervention program curriculum plan was developed prior to study initiation (Table 3.2). Weekly text messaging topics were designed to cover all aspects of the program objectives. Bi-weekly support group topics were set as part of a plan for the program structure comprising a series of topical guest speaker and peer group activities. The program curriculum and schedule were established and embedded into the study protocol, including time frame, screening schedule, weekly topics, date and place of

sessions, and possible guest speakers. The planned curriculum, prepared in advance, provided a strong foundation from which to implement the intervention program.

[Table 3.2 here]

### **Study Implementation**

The 16-week text messaging and peer support group intervention was implemented from September 2014 to March 2015 in Saint Paul, MN. The primary outcomes of the study have been reported previously (Lee, Schorr, Chi, Treat-Jacobson, Mathiason, & Lindquist, 2017).

### **Application of Text Messaging**

More than 110 text messages were developed related to behavior changes in diet and physical activity before the program started. The messages were retrieved and adapted from the National Institutes of Health, and American Heart Association websites. The Short Message Service (SMS), which consists of 160 characters, was selected as the service to deliver health behavior messages daily from October 2014 to February 2015.

A total 2,089 messages were sent to 20 participants using an online text messaging application. A total 22 participants enrolled, however, one participant provided the wrong mobile phone number and one participants' phone was not able to receive text messages. Therefore, 20 participants received daily text messages for 16 weeks. Even though participants didn't have to respond to text messages, a total 66 messages were received from 16 participants. Among the 66 response messages, participants sent a few short text messages directly to the researcher to show their

gratitude and appreciation for this program, such as “thank you”, “I love the program”, “sounds real good”, and “thanks for the info.”

A total 112 kinds of messages were sent daily for 16 weeks. Eighteen messages (16%) were program-related announcement messages to remind participants of the support group sessions and the measurement sessions. Sixty-three messages (56%) were related to healthy behavioral skills for healthy eating and physical activity. Thirty-one messages (28%) were related to motivational messages, including goal setting, knowledge, outcome-expectancy, and self-monitoring.

Participants provided anecdotal comments after completing the 16-week program on a post-questionnaire. Participants stated that text messaging was satisfying, citing reasons including, “time and the content of messages,” “it reminds you throughout the day,” “encouragement,” “consistency,” and “getting new ideas.” Participants mentioned that the text messages were not as satisfying when delivered late --- after they had “done their own thing” (i.e., behaved contrary to principals of salutary health behaviors). Overall, the first reaction when text messages were delivered was positive; described, for example, as a “good surprise” or as “great reminders.” The top three memorable text messages were behavioral skills that the program emphasized, such as “walking more,” “portion control,” and “limit unhealthy foods.”

### **Peer Group Support**

A total of eight support group sessions were held in the participant’s community center or church biweekly for approximately one hour. A researcher reminded the group session time and place via text messages. Healthy light snacks were provided to

participants. Three guest speakers were invited including a nurse practitioner, physical activity instructor, and yoga instructor. After program completion, participants stated that peer group sessions were satisfying because “coming together and bring support of one another;” the group sessions were times during which, “everyone could share their struggles and tips for doing better in the battle of maintaining or losing weight.”

## **Discussion**

This brief research report presents the theoretical basis and response to the delivery of an intervention protocol and program curriculum comprising peer support and text messaging; this report focuses on the text messaging component. The theoretical basis of the intervention protocol and program curriculum provided an innovative foundation for study development and implementation. The intervention protocol was developed and pilot tested to examine how mobile technology (text messaging) and the more intimate interpersonal support of peer groups could be effectively coupled. From the conduct of the study and the responses of participants, this approach was both feasible and acceptable as a strategic approach for future investigational programs of weight maintenance interventions with African American women.

Participants preferred early morning text messages. Most of them agreed that the behavioral messages helped their daily healthy diets and physical activity. The early morning messages would help to remind and promote participants’ health behaviors. Some woman didn’t want be reminded of goals and tips later in the day, especially after lunch time, because they had already spent the day “their own way” (i.e., not making healthy choices or applying health behaviors that they had learned). These early morning

messages delivered theory-driven strategies, such as motivation, self-efficacy, and outcome-expectancy to change behaviors daily.

Support group attendance was moderate. The support group offered the participants an opportunity to “weigh-in,” with a weight scale present so that the participants could monitor their weight. Most women didn’t have a scale at home. Therefore, the peer group sessions provided important self-monitoring opportunities. The support group also provided peer-to-peer role-modeling in the form of participants’ discussion of strategies and tips they used to overcome challenging situations. Researchers and peers could both serve as key role models in this context.

The researchers provided inexpensive healthy snacks for each session to model/practice healthy eating and to familiarize participant with potentially new healthy food choices, and to expand their thinking about food. Women expressed satisfaction with the healthy snacks that were provided during peer group sessions. The healthy snack options were available at the American Heart Association website. The healthy snack information could be replaced with text messaging; however experience and trial of tasting healthy snacks could not have been provided through text messaging. Therefore, the text messaging and support groups worked well when coupled together to enhance dietary behavior changes.

The scientific theories, built into the program objectives, provided a strong foundation for developing the intervention protocol. Bandura’s SCT was the fundamental basis of the research protocol. The SCT provided the three factors to set the boundary and research scope. The theory-driven strategies provided the sound direction for program

content and activities. The program objectives provided tangible goals to achieve via research implementation. The text messaging content and support group materials were developed within the frame of the SCT.

The theory-based program curriculum served as an effective blueprint realistic for the researcher and effectively engaged the participants in their process of behavior change. The curriculum provided firm guidance for the implementation of the 16-week program. Having a theory base grounded the program and provided a broad structure that was flexible and permitted changes required during program delivery such as unavailable guest speakers and study material changes that were responsive to the real-world needs of participants. The flexible and adaptable theory-based curriculum is important so that community program planners or investigators can adjust to situations where they encountered unplanned situations, events, or circumstances.

### **Summary and Conclusions**

In summary, Bandura's SCT provided a strong foundation for the development of the intervention protocol and curriculum. Text messaging and support group content were developed within the theory concepts, and expressed in the program objectives. The flexible and adaptive curriculum was implemented and determined to be feasible and potentially effective, however its broader use warrants further research.

## References

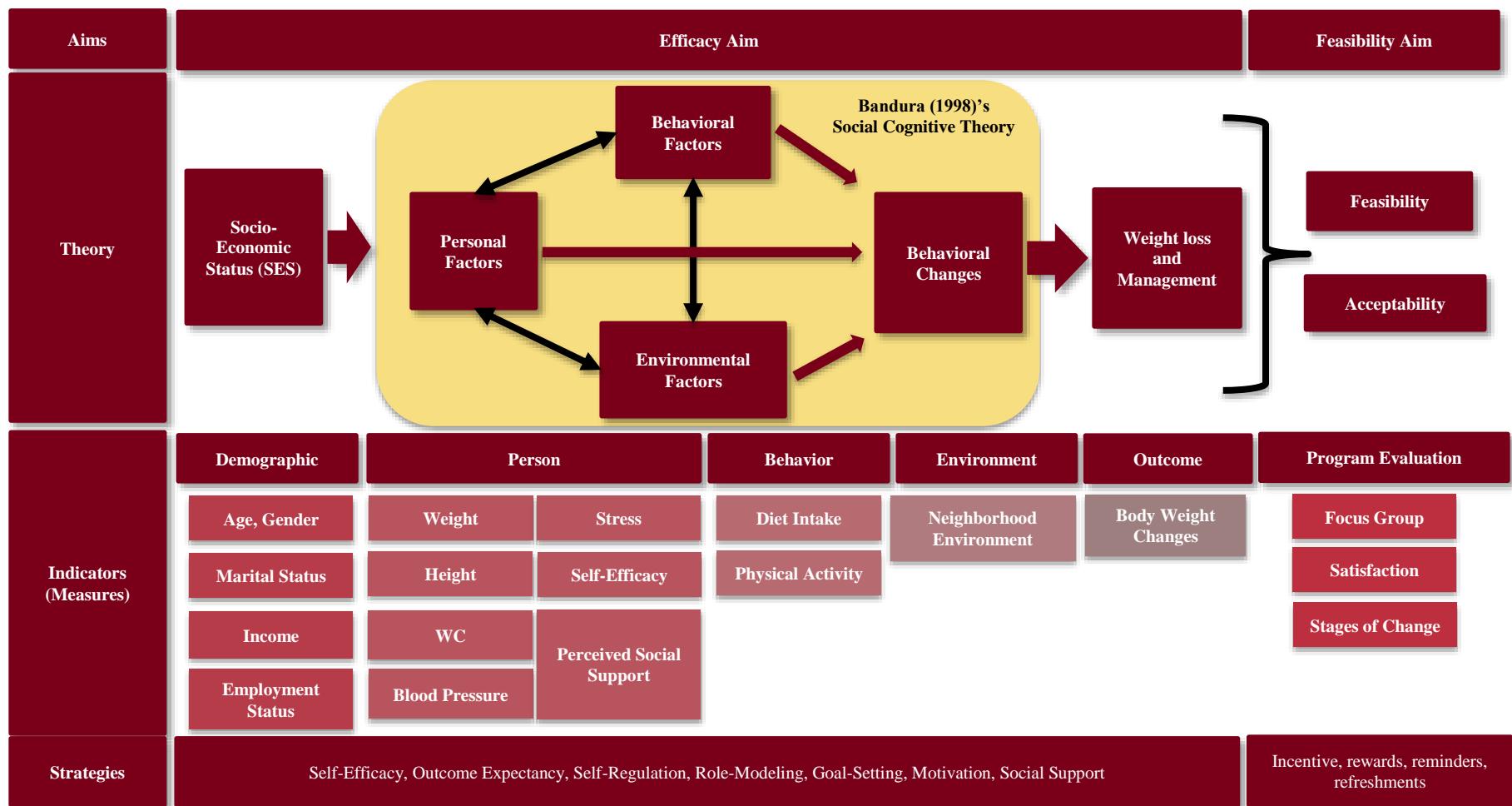
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191. doi:10.1037/0033-295X.84.2.191
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52(1), 1-26. doi:0066-4308/01/0201-0001
- Bandura, A. (2011). Social cognitive theory. In A. W. Kruglanski, E. T. Higgins, & P. A. M. Van Lange (Eds.), *Handbook of Theories of Social Psychology: Volume One* (p. 349). London: SAGE.
- Bastable, S. B. (Ed.). (2003). *Nurse as educator: Principles of teaching and learning for nursing practice*. Sudbury, MA: Jones & Bartlett Learning
- Burke, L. E., Wang, J., & Sevick, M. A. (2011). Self-monitoring in weight loss: A systematic review of the literature. *Journal of the American Dietetic Association*, 111(1), 92-102. doi:10.1016/j.jada.2010.10.008
- Byrne, S., Barry, D., & Petry, N. M. (2012). Predictors of weight loss success. Exercise vs. dietary self-efficacy and treatment attendance. *Appetite*, 58(2), 695-698. doi:10.1016/j.appet.2012.01.005 Byrne et al., 2012;
- Cardinal, B. J., & Cardinal, M. K. (2001). Role modeling in HPERD: Do attitudes match behavior?. *Journal of Physical Education, Recreation & Dance*, 72(4), 34-39. doi:10.1080/07303084.2001.10605737

- Cole-Lewis, H., & Kershaw, T. (2010). Text messaging as a tool for behavior change in disease prevention and management. *Epidemiologic Reviews*, 32(1), 56-69. doi:10.1093/epirev/mxq004
- Cullen, K. W., Baranowski, T., & Smith, S. P. (2001). Using goal setting as a strategy for dietary behavior change. *Journal of the American Dietetic Association*, 101(5), 562-566. doi:10.1016/S0002-8223(01)00140-7
- Dale, J. R., Williams, S. M., & Bowyer, V. (2012). What is the effect of peer support on diabetes outcomes in adults? A systematic review. *Diabetic Medicine*, 29(11), 1361-1377. doi: 10.1111/j.1464-5491.2012.03749.x
- Finch, E. A., Linde, J. A., Jeffery, R. W., Rothman, A. J., King, C. M., & Levy, R. L. (2005). The effects of outcome expectations and satisfaction on weight loss and maintenance: Correlational and experimental analyses-a randomized trial. *Health Psychology*, 24(6), 608. doi:10.1037/0278-6133.24.6.608
- Fitzgibbon, M. L., Tussing-Humphreys, L. M., Porter, J. S., Martin, I. K., Odoms-Young, A., & Sharp, L. K. (2012). Weight loss and African-American women: A systematic review of the behavioural weight loss intervention literature. *Obesity Reviews*, 13(3), 193-213. doi:10.1111/j.1467-789X.2011.00945.x
- Kim, B. H., & Glanz, K. (2013). Text messaging to motivate walking in older African Americans: a randomized controlled trial. *American Journal of Preventive Medicine*, 44(1), 71-75. doi: 10.1016/j.amepre.2012.09.050

- Leahy, T. M., Kumar, R., Weinberg, B. M., & Wing, R. R. (2012). Teammates and social influence affect weight loss outcomes in a team-based weight loss competition. *Obesity*, 20(7), 1413-1418. doi: 10.1038/oby.2012.18
- Lee, S., Schorr, E., Chi, C-L., Treat-Jacobson, D., Mathiason, M. A., & Lindquist, R. (2017). Peer group and text message-based weight-loss and management intervention for African-American women. *Western Journal of Nursing Research*. Retrieved from  
<http://journals.sagepub.com/eprint/VwHxAbsRzpJkpajMmY6Z/full>
- Loescher, L. J., Rains, S. A., Kramer, S. S., Akers, C., & Moussa, R. (2016). A Systematic review of interventions to enhance healthy lifestyle behaviors in adolescents delivered via mobile phone text messaging. *American Journal of Health Promotion*, 1-15. doi: 10.1177/0890117116675785
- Lytle, L. A., & Perry, C. L. (2001). Applying research and theory in program planning: An example from a nutrition education intervention. *Health Promotion Practice*, 2(1), 68-80. doi:10.1177/152483990100200111
- Naserian, N., Ansari, S., & Abedi, P. (2017). Comparison of training via short messages and group training on level of knowledge and practice of middle-aged women about breast cancer screening tests. *Journal of Cancer Education*, 1-7. doi: 10.1007/s13187-017-1203-x
- Pew Research Center. (2014). *Mobile technology fact sheet*. Retrieved from  
<http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/>

- Piette, J. D., List, J., Rana, G. K., Townsend, W., Striplin, D., & Heisler, M. (2015). Mobile health devices as tools for worldwide cardiovascular risk reduction and disease management. *Circulation*, 132(21), 2012-2027.
- Warziski, M. T., Sereika, S. M., Styn, M. A., Music, E., & Burke, L. E. (2008). Changes in self-efficacy and dietary adherence: The impact on weight loss in the PREFER study. *Journal of Behavioral Medicine*, 31(1), 81-92. doi:10.1007/s10865-007-9135-2
- Webel, A. R., Okonsky, J., Trompetta, J., & Holzemer, W. L. (2010). A systematic review of the effectiveness of peer-based interventions on health-related behaviors in adults. *American Journal of Public Health*, 100(2), 247-253. doi: 10.2105/AJPH.2008.149419
- West, D. S., Gorin, A. A., Subak, L. L., Foster, G., Bragg, C., Hecht, J., . . . Wing, R. R. (2011). A motivation-focused weight loss maintenance program is an effective alternative to a skill-based approach. *International Journal of Obesity*, 35(2), 259-269. doi:10.1038/ijo.2010.138
- Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*, 70(1), 115. doi:10.1037/0022-3514.70.1.115
- Winett, R. A., Tate, D. F., Anderson, E. S., Wojcik, J. R., & Winett, S. G. (2005). Long-term weight gain prevention: A theoretically based Internet approach. *Preventive Medicine*, 41(2), 629-641. doi:10.1016/j.ypmed.2004.12.005

Wing, R. R., Tate, D. F., Gorin, A. A., Raynor, H. A., & Fava, J. L. (2006). A self-regulation program for maintenance of weight loss. *New England Journal of Medicine*, 355(15), 1563-1571. doi:10.1056/NEJMoa061883



*Figure 3.1. Conceptual Framework and Operational Model*

Table 3.1

*Theory Concepts, Program Objectives, Related Topics and Text Messages*

<b>Strategy Factors</b>	<b>Program Objective</b>	<b>Topic/ Activities</b>	<b>Examples of Text Messages</b>
<b>Personal factors</b>			
Knowledge	Provide background knowledge of weight loss benefits	Topic #1	Research supports the idea that being mindful of what we eat and how we move makes a difference in how much we weigh.
Self-efficacy	Provide strategies on how to overcome low motivation or willingness in certain situations	Topic #6	It is not always easy to change your eating and physical activity habits. You may have setbacks along the way. But keep trying- You can do it!
Goal-setting	Teach how to set SMART goals for weight loss and management	Topic #11, #16	Set your goal for next week (easy & simple goal for your healthy weight). You can do it! Don't give up!
Motivation	Provide positive mind-body connection	Topic #12, 13, 14	Have you told yourself today? I am STRONG! I am HEALTHY! I am WORTHY! I am BEAUTIFUL! I am PERFECT! Yes, you are, indeed!
Perceived social support	Encourage verbalizing feelings of support from others (friends and family)	Support groups	Tell your friends your goal weight and send them weekly updates of how you are doing.
Outcome expectations	Provide optimistic outcome for losing weight or maintaining weight loss	Topic #2	The benefits of maintaining a healthy weight go far beyond improved energy and smaller clothing sizes!
Biological status	No change in body weight or loss of body weight	Outcome measures	You lost 2.8 lbs.! I hope you keep eating & exercising healthy! Thanks! You are a STAR!
<b>Behavioral factors</b>			
Knowledge	Provide knowledge about meal planning and physical activity	Topic #3, #5. #7, #8	Understand correct portion sizes. A serving of meat (like chicken breast or roast beef) should about 3 oz. (about the size of a deck of cards).
Self-regulation	Teach how to self-monitor behavior and weight	Information session, Diary log, measurements Topic # 14	Monitor your step/day using pedometer. Prepare your pedometer tonight and don't forget to wear your pedometer tomorrow. You can do it!
Incentive-Reward	Give rewards to participants when they perform healthy behavior such as reducing dietary intake or increasing physical activity	Entire program	Reward yourself as you reach your goals. Keep up the good work. Remember that physical activity and eating are key to getting on track to a healthier you!
Behavioral skills	Acquire behavioral strategies to overcome challenges	Topic #4	Eat slowly because it takes 20 minutes after your stomach is full for the brain to recognize that and stop the hunger signals! You can do it!

Table 3.1 (continued.)

<b>Strategy Factors</b>	<b>Program Objective</b>	<b>Topic/ Activities</b>	<b>Examples of Text Messaging</b>
<b>Environmental factors</b>			
Incentive & Role-modeling	Encourage finding a role model from group members or research staff	Support groups	It is rewarding and inspiring to see your friends around you lost weight; and you are role modeling for them too. You can do it!
Social support	Enhance social support with researchers and group members Find strategies when the family and friends are not supportive for weight loss and management	Support groups	TRACK BARRIERS that keep you and your family and friends from moving more and eating better. When you meet or talk, discuss the barriers each person faced and what everyone did to overcome them!
Physical activity environment	Awareness of neighborhood environment for physical activity (e.g., strengths and/or limitations)	Topic #9, #10	Let's walk around the inside of mall/office/hallway in bad weather! You can do it!

*Note.* Adapted from Lytle & Perry (2001)

Table 3.2

*Sample Program Curriculum*

Time	Text Messaging Weekly Topic	Date	Support group Topic	Activities	Measurements
<b>Information Session<sup>a</sup></b>	Intervention purpose, process, measurements	<b>9/6</b>		In-person Presentation	
<b>Recruitment Session<sup>b</sup></b>	Possible benefits and harms, and precaution, Consent form, Human subjects rights, Intervention outlines, First measurement, how to write diet and PA log	<b>10/4</b>		Consent form In-person Presentation Health Assessment Survey	weight, height, BP, WC, BMI, pre-questionnaire (demographic variables, psychosocial variables, behavioral variables, & environmental variable)
<b>Week 1 (General)</b>	#1. Understanding adult overweight and obesity, benefits of weight loss, why chose to lose weight, keys to success ( <b>10/13-10/19</b> )	<b>10/11</b>	#1. Understanding your numbers, find a support person <b>Guest Speaker</b>	Text messaging Guest Presentation Support group session	
<b>Week 2 (General)</b>	#2. Expected outcomes, tips of weight loss, behavioral strategies, goal setting, motivation, support ( <b>10/20-10/26</b> )			Text messaging	
<b>Week 3 (Diet)</b>	#3. How to calculate, count, calories, serving size, good nutrition, food choices, plan healthy snacks and meal ( <b>10/27-11/2</b> )	<b>11/1</b>	#2. Review and analyze diet using diet log. Share experiences, idea, thoughts, and feelings <b>Guest Speaker</b>	Text messaging Guest Presentation Support group session	
<b>Week 4 (Diet)</b>	#4. Overcoming challenges diet plan, making small changes exchanging foods, mindfulness eating, sneaky snacks ( <b>11/3- 11/9</b> )			Text messaging	

Table 3.2 (continued)

Time	Text Messaging Weekly Topic	Date	Support group Topic	Activities	Measurements
<b>Week 5 (PA)</b>	#5. Physical activity recommendation, level of activity, pedometer monitor, walking safety, how to increase physical activity ( <b>11/10-11/16</b> )	<b>11/8</b>	# 3. Review and analyzing their physical activity level using PA log. Share experiences, idea, thoughts, and feelings <b>Guest Speaker</b>	Text messaging Guest Presentation Support group session	
<b>Week 6 (PA)</b>	#6. Overcoming challenges physical activity, stretching, balance exercise ( <b>11/17-11/23</b> )			Text messaging	
<b>Week 7 (Diet)</b>	#7. Healthy eating, healthy food, targeting problem food ( <b>11/24-11/30</b> )	<b>11/22</b>	#4. Understanding your numbers, Share diet strategies. (Dietician will be invited) <b>Guest Speaker</b>	Text messaging Guest Presentation Support group session	
<b>Week 8 (Diet)</b>	#8. Nutrition: fats, salt, sugar. Supplements ( <b>12/1-12/7</b> )			Text messaging	
<b>Week 9 (PA)</b>	#9. Find exercise options such as bicycles, dancing, basketball, and tennis ( <b>12/8-12/14</b> )	<b>12/6</b>	<b>#5. Health Fair<sup>c</sup></b> <b>(No support group session)</b>	Text messaging Guest Presentation Support group session	weight, height, BP, WC, BMI,
<b>Week 10 (PA)</b>	#10. Trying/adding new activity, walking, strategies for physical activity ( <b>12/15-12/21</b> )			Text messaging	
<b>Week 11 (Mind-Body)</b>	#11. Mindfulness activity options ( <b>12/22-12/28</b> )	<b>12/20</b>	#6. Share exercise strategies. <b>Guest Speaker</b>	Text messaging	
<b>Week 12 (Mind-Body)</b>	#12. Body image, self-esteem ( <b>12/29-1/4</b> )			Text messaging	

Table 3.2 (continued)

Time	Text Messaging Weekly Topic	Date	Support group Topic	Activities	Measurements
<b>Week 13 (Mind-Body, PA)</b>	#13. Walking and stretching (1/5-1/11)	<b>1/10</b>	#7. Stretching (yoga) instruction will be invited. <b>Guest Speaker</b>	Text messaging Guest Presentation Support group session	
<b>Week 14 (Mind-Body, Diet)</b>	#14. Mindfulness eating (1/12-1/18)			Text messaging	
<b>Week 15 (General)</b>	#15. Relapse, recovery and steps of beginning again, sustain progress (1/19-1/25)	<b>1/24</b>	#8. Understanding your numbers, Understanding your numbers, find a support person <b>Guest Speaker</b>	Text messaging Guest Presentation Support group session	
<b>Week 16 (General)</b>	#16. Setting new goal, how to become a successful maintainer (1/26-2/1)			Text messaging	
<b>Wrap-up session<sup>d</sup></b>	Wrap-up session Announcement: STAR of the program, Super-STaR of the program	<b>1/31</b>		In-person Presentation Health assessment	weight, height, BP, WC, BMI, post-questionnaires (program evaluation)

<sup>a</sup> Information session was planned to provide study information.

<sup>b</sup> Recruitment session was planned to enroll participants, obtain participants' consenting, and screen eligibility.

<sup>c</sup> Health Fair is an annual community congregational health promotion event.

<sup>d</sup> Wrap-up session was planned to debrief the program. The participants were awarded based on their achievement.

## **Chapter 4: Manuscript Three**

This chapter explores Aim 3 of the dissertation. The purpose of Aim 3 was to examine the feasibility, acceptability, and potential efficacy of a combined intervention comprising text messaging and peer group support to foster weight loss and management for African American women. The research questions for Specific Aim 3:

1. Is text messaging and peer group intervention feasible and acceptable for African American women's weight management?
2. Is text messaging and peer group intervention effective in weight loss and weight loss management?
3. After text messaging and peer group intervention, did participants change their level of the stage of change?
4. After the program, which program component was preferred or judged more satisfying by participants?

To address these research questions, pre/post questionnaires and focus group interview were conducted. The outcomes of dissertation were discussed in this chapter. This manuscript was published by the *Western Journal of Nursing Research* via online first.

**Peer Group and Text Message-Based Weight-Loss and Management Intervention  
for African American Women**

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First Published March 23, 2017

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**Abstract**

About 80% of African American (AA) women are overweight or obese.

Accessible and effective weight management programs targeting weight loss, weight maintenance and the prevention of weight regain are needed to improve health of AA women. A feasibility study was conducted to examine the feasibility, acceptability, and potential efficacy of a 16-week intervention protocol for weight loss and management that combined daily text messages and biweekly peer group sessions. Modest but statistically significant reductions were detected in weight and body mass index from baseline to 16 weeks. At baseline, 36% of participants were in action and maintenance stages in measures of the stages of change for weight loss and management; this percent

increased to 82% at 16 weeks. Findings of this feasibility study provide preliminary evidence of an educational intervention that could motivate women and lead to successful behavior change, and successful weight loss and management for AA women.

*Keywords:* African American, women, text messaging, peer group support, weight loss and management

## **Background**

Obesity is an epidemic in the United States and closely associated with increased risks for chronic diseases including heart disease and stroke (Hakkak & Bell, 2016; Lavie, Milani, & Ventura, 2009). The current obesity epidemic is particularly serious in the African American (AA) community, where about 80% of AA women are overweight or obese and over 57.2% of adult women are obese, the highest rate of all ethnic groups (Flegal, Kruszon-Moran, Carroll, Fryar, & Ogden, 2016; Ogden, Carroll, Kit, & Flegal, 2014). The reason why overweight and obesity should be monitored is that these are significant societal health threats that are strongly related to increased morbidity and mortality, and which have adverse physical, functional, psychosocial, and financial consequences (Jensen et al., 2014).

A variety of weight loss and management interventions have been developed over the last few decades to study overweight and obesity management, such as dietary therapy, physical activity interventions, behavioral therapy, pharmacotherapy, and surgery (National Institutes of Health, National Heart, Lung, and Blood Institute, 2017). Although these weight loss interventions often show initial success, intervention participants tend to experience gradual weight regain and return slowly to their original

weight (Turk et al., 2009). Therefore, accessible and effective weight loss and management interventions targeting weight loss, healthy body weight maintenance, and the prevention of weight regain are needed to prevent negative health outcomes.

### **m-Health Intervention for Behavior Change**

m-Health intervention is one of the categories of e-Health and is defined by Free and colleagues as “the use of mobile computing and communication technologies in health care and public health” (Free et al., 2010, “Background” section, para. 1). Popularity of m-Health interventions focusing on the use of mobile technology is growing quickly along with the development of mobile technology. Among m-Health interventions, text message-based interventions using mobile technology are one of the easiest, most cost-effective, and potentially most powerful approaches for behavioral change because they are less expensive, widely accessible, eliminate geographical barriers, and potentially interactive (Hall, Cole-Lewis, & Bernhardt, 2015; Shaw et al., 2013). The Pew Research Center Internet Project Survey found that 90% of AA adults possessed a mobile phone as of January 2014 and 81% of mobile phone owners use their mobile phone to send or receive text messages (Pew Research Center, 2014).

Many researchers have conducted clinical trials using text messages to promote behavior changes, such as smoking cessation (Free et al., 2011), weight loss (Shapiro et al., 2012), mental health management (Luxton, McCann, Bush, Mishkind, & Reger, 2011), prenatal support (Gazmararian, Elon, Yang, Graham, & Parker, 2014), medication adherence (Foreman et al., 2012), appointment reminders (Perron et al., 2013), and HIV/STD prevention (Juzang, Fortune, Black, Wright, & Bull, 2011). Recent review

papers evaluating behavior change interventions delivered via text messaging confirm their beneficial effects on outcomes and positive behavioral changes (Shaw & Bosworth, 2012; Stephens & Allen, 2013).

Text messaging can be used to promote healthy behaviors that are applicable for weight loss and management. A recent study found a positive association between text message-based interventions and long-term weight loss (Shapiro et al., 2012). Patrick and colleagues (2009) conducted a 16-week text message-based intervention to determine its efficacy and found that text messages were a supportive approach that helped individuals' self-monitoring of their weight, promoting positive weight-related outcomes. In addition, Lin and colleagues (2015) conducted a randomized controlled trial using mobile phone text messaging for AA adults for weight management. The tailored text messaging was helpful to participants in weight loss compared to standard care without messaging. However, investigators reported program challenges, such as a high attrition rate, and substantial missing follow-up data.

Text message-based interventions are easy and simple vehicles to deliver health information; however, they do have limitations. A review paper examining the efficacy of technology-based interventions to promote behavior change for long-term weight management reported mixed results of effectiveness in selected studies and implementation challenges, including low retention rate, less engagement due to lack of human interaction, and a wide range of ability to use technology (Lee & Lindquist, 2015). In addition, differences in technology usability and acceptability exist between wealthy and poor communities, rural and urban areas, younger and older generations, and

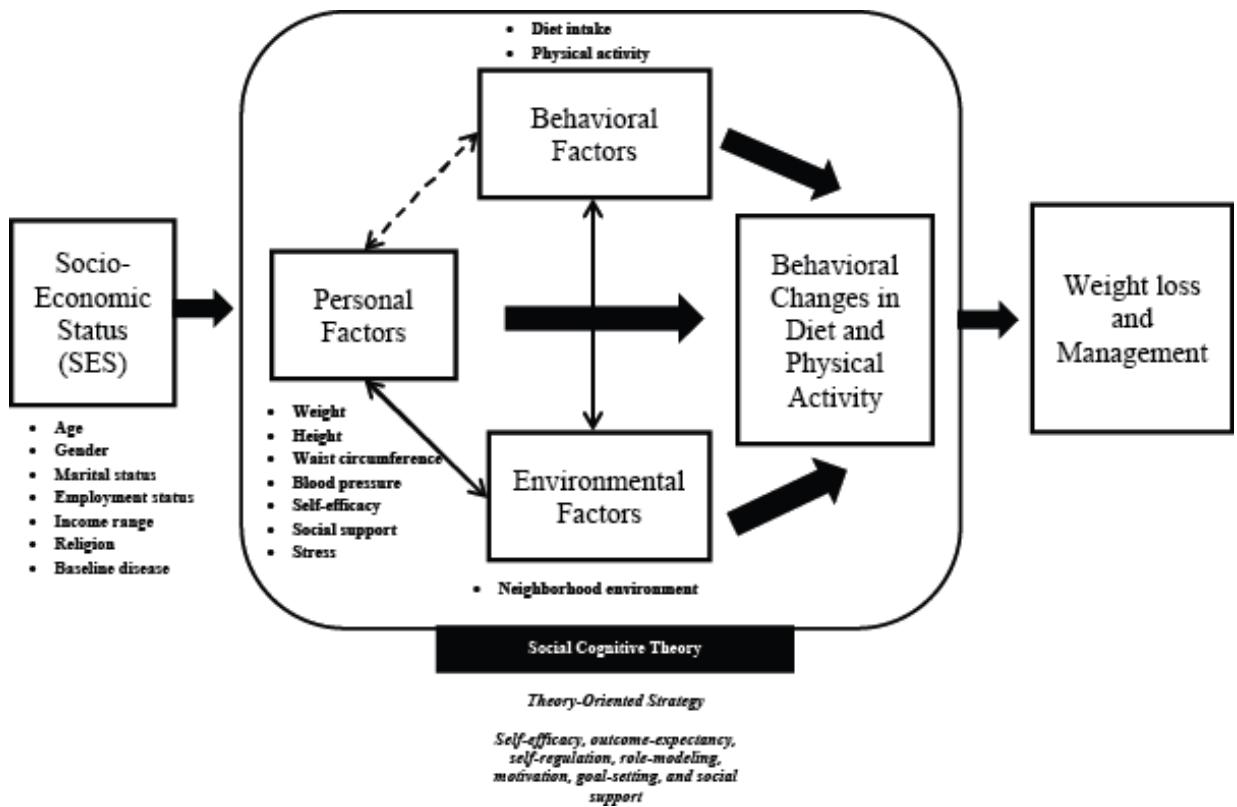
different geographic regions, ethnic communities, employment status, and education level. There is a need to address these challenges to reduce this discrepancy and enhance intervention efficacy.

Recent studies have identified social support as one of the key components of effective behavioral weight management, and peer group support is one type of social support that has been found to boost commonality, motivation, and encouragement (Khaylis, Yiaslas, Bergstrom, & Gore-Felton, 2010). Social support can be received from interpersonal communications, such as emotional concern, appraisal, and information (Hwang et al., 2011). It is expected that adding a social support component (e.g., incorporating peer group support into behavior change interventions) has the potential to create more effective interventions that could augment successful long-term weight management (Elfhag & Rössner, 2005). In this present work, the peer group support format provided emotional and appraisal social support, and supportive text messages were used to provide informational and instrumental social support.

## Theoretical Framework

Bandura's (1986) Social Cognitive Theory (SCT) served as the foundation for the study design, protocol, and measures. In SCT, Bandura asserts that a triadic interplay of personal, environmental, and behavioral factors impact participants' behavioral changes (McAlister, Perry, & Parcel, 2008); SCT has been used as a basis of numerous health-focused behavioral interventions, including weight loss and weight loss maintenance programs (Bandura, 1998; Winett, Tate, Anderson, Wojcik, & Winett, 2005). Authors of a recent systematic review of weight loss interventions for AA women asserted that there

is a need to expand this behavior change approach to further elaborate and strategically consider biological, social, cultural, and environmental factors (Fitzgibbon et al., 2012). The present study design incorporated this multi-factorial approach supported by SCT. Theory-oriented components were developed and implemented that operationalized self-efficacy, outcome-expectancy, self-regulation, role-modeling, motivation, goal-setting, and social support. Figure 4.1 illustrates the study's theoretical framework founded on SCT.



*Figure 4.1. Conceptual Framework of Intervention Protocol*

*Source.* Adapted from Bandura's (1986) Social Cognitive Theory.

*Note.* SES = socioeconomic status.

## **Purpose**

This Supportive Text-messaging Against Regain (STAR) project was a community-based, combined peer group and text message-based intervention study that utilized mobile technology and in-person group meetings to deliver health information, encouragement, and support to achieve goals of weight loss and management. The goals of this weight loss and management intervention included preventing weight regain, reducing body weight, and maintaining body weight over time.

The purpose of this study was to explore feasibility, acceptability, and potential efficacy of a combined intervention comprising text messaging and peer group support to foster weight loss and management for AA women.

## **Method**

### **Participants**

AA adult women who were able to read and write in English language, who possessed their own mobile phone, who were able to receive and send text messages, and who were willing to attend biweekly support group sessions were included in the study. AA women were excluded if they were pregnant, had delivered in the past 6 months, or planned to become pregnant during the intervention. Women who were currently on weight loss medication or had received a notice to avoid exercise from their primary physicians were excluded. Convenience sampling was used to recruit AA women from a two-campus church community.

## **Intervention Procedure**

An information session was held at one church site before the intervention was initiated. During the information session, potential participants were provided with brief study information, such as the intervention purpose, process, measurement, possible benefits and harm, and precautions (i.e., do not text while driving or walking). The interest form that included name, contact information, and short survey about mobile phone use was given to potential participants. Participants were provided time to consider study enrollment. After the information session, a follow-up recruitment session was held for study enrollment. In this session, participants were assessed for their eligibility, and potential participants reviewed the consent form with research staff. When participants agreed to enroll the intervention, a pre-intervention questionnaire and health screening were administered. Split before and after the intervention, a total of US\$40 was given to participants for text messaging data fee compensation. During the support group sessions, small gifts were provided through a lottery. After pre and post questionnaires and health screening completion, US\$5 incentives were provided.

The 16-week intervention comprised two main components: daily text messaging and biweekly peer support group meeting.

### ***Text messaging***

Text messages were developed to follow the 16-week topics and to provide feedback and support. Short Message Service (SMS), which allows up to 160 characters, was used to deliver daily text messages to participants. Over 110 text messages were created by the principal investigator, and the contents were derived from websites of the

American Heart Association and the National Institutes of Health. Table 4.1 provides examples of text messages related to target behaviors using target-oriented strategies. SMS texts were sent using a client-based software application for text messaging services. Twilio.com is a widely used commercial communication application service, which provides secure SMS text delivery. The investigator created a study phone number and sent text messages to the participants using this application system.

Table 4.1

*Example of Text Messages*

Text Message	Topic	Strategy
What is your goal size? Set SMART goal. Remember your own desire to succeed is more important than any other one thing!	General	Goal-setting
Guzzling sugary drinks is a sneaky way to pack on the pounds. No more than 450 calories (36 ounces) a week. Stay well-hydrated with water!	Healthy eating	Knowledge
Don't shop when you're hungry and use a shopping list. When you start having a craving, drink a tall glass of water!	Healthy eating	Behavioral skills
Take the stairs instead of the elevator or escalator at work or at the mall. Do not give up, get moving, and believe you can do it!	Physical activity	Behavioral skills
You can become more active if you set a daily goal to do so. Have you told yourself "I CAN" today!	Physical activity	Goal-setting
Monitor your steps per day using a pedometer. Prepare your pedometer tonight and don't forget to wear your pedometer tomorrow. You can do it!	Physical activity	Self-monitoring
It is rewarding and inspiring to see your friends around you losing weight; and you are role-modeling for them too. You can do it!	Weight loss	Incentive
Maintaining a healthy weight provides many health benefits. If you are overweight, losing as little 5-10 pounds may help lower your blood pressure	Weight loss	Outcome-expectancy
No group session today! Next session: 11/22/2014 (SAT) 12PM/Guest Speaker: [Name]/Topic: Physical Activity!/Light lunches will be served!	Sample Session announcement	

*Note.* Messages were adapted from websites of the American Heart Association and the National Institute of Health.

### ***Support group***

Support group sessions comprised lecture presentations and peer group discussion. Several guest speakers were invited to give lectures. The guest speakers included a dietitian, exercise specialist, yoga instructor, and nurse practitioner. The peer group discussions were held for 45 min to motivate group members, enhance accountability, support the use of weight management strategies, and promote healthy behaviors. The principal investigator served as a moderator to facilitate the conversation in the group and to intervene as needed to engage participants and ensure each participant had the opportunity to talk. There were planned biweekly topics throughout the curriculum to focus peer discussions. All participants had an equal opportunity to discuss challenging habits and share their experience and strategies with group members.

### **Study Design**

A one-group pretest–posttest design was used for this study. Assessments were conducted at baseline and 16 weeks. The study was approved by the Institutional Review Board (IRB) at the University of Minnesota. The intervention was conducted between October 13, 2014, and February 1, 2015.

### **Data Collection**

Biological variables including height, weight, waist circumference, and blood pressure were measured at baseline and 16 weeks. Research staff and volunteers assessed biological variables using the PhenX Toolkit ([www.phenxtoolkit.org](http://www.phenxtoolkit.org)). The PhenX toolkit provided standard protocols for measures in weight, height, waist circumference, and blood pressure (Hamilton et al., 2011). Weight was measured using a digital floor scale

and recorded in pounds. Participants were asked to remove heavy outwear and shoes when obtaining weight. The scales were calibrated before use. Self-reported height was used and recorded in inches. Body mass index was calculated weight in kilograms divided by height in meters squared ( $\text{kg}/\text{m}^2$ ).

The psychosocial variables were measured using pre and post intervention questionnaires. Self-efficacy scales by Bandura (2006) were used to assess self-efficacy related to diet and exercise. The self-efficacy scales to regulate eating habits and exercise (SE-eating, SE-exercise) were used to assess participants' degree of confidence and strength of their beliefs on a healthy diet and exercise routine regularly. The SE scales have a 100-point, which has 10-unit intervals from 0 (cannot do at all) to 100 (highly certain can do). The 20-item Perceived Social Support from friend (PSS-Fr) scale was used to assess social support (Procidano & Heller, 1983). The 14-item Perceived Stress Scale (PSS) was used to assess participants' stress levels (Cohen, Kamarck, & Mermelstein, 1983). The PSS is a simple measure of one's appraisal of stress level.

The short version of self-reported Stages of Change was used to measure weight loss intention and current activities using four simple questions. The Stages of Change Weight Control questions are 4-items of a transtheoretical model-based measure (Cancer Prevention Research Center, 1991). Participants were classified into one of the stages categories including precontemplation (no intention of managing weight), contemplation (not actively trying to manage weight), action (actively trying to managing weight), and maintenance stage (successfully maintained their weight loss).

The program was evaluated after the 16-week intervention using a post questionnaire and a focus group session. Attendance at each support group meeting was recorded, and rates of attendance were calculated. After the intervention period, one focus group was held with five participants in the church community center to explore the participants' views of the feasibility, acceptability, and potential efficacy of the combined text messaging and support group intervention. The focus group session was tape-recorded and transcribed verbatim.

Finally, the effect sizes (Cohen's d) that express the difference in the means using standard deviation units were calculated for all variables.

### **Statistical Analysis**

Data were analyzed using the Statistical Package for the Social Sciences (SPSS), Version 22.0. The mean difference of weight, body mass index, waist circumference, systolic blood pressure, and diastolic blood pressure before and after the intervention were compared using paired t tests. Pre and post changes in self-efficacy, perceived social support, and perceived stress were also analyzed using paired t tests. Descriptive analyses were used for demographics, stages of change, and support group attendance rate. For the focus group data, the transcript was reviewed several times and summarized in sentences.

### **Results**

A total of 22 women were enrolled in the intervention; three participants withdrew before the intervention was initiated. Nineteen women started the program and

17 participants completed and were included in the final analyses (N = 17). Two participants were lost to follow-up.

Table 4.2

*Baseline Characteristics of Participant*

Characteristics	n	%
Marital status		
Married	8	50
Divorced or widowed	3	19
Separated	1	6
Single	4	25
Employment status		
Full-time	12	75
Part-time	2	13
Not employed	2	13
Annual household income (US\$)		
Low (less than 29,999)	4	25
Medium (30,000-59,999)	10	63
High (more than 60,000)	2	13
Other health issues <sup>a</sup>		
None	6	38
Hypertension	7	44
Diabetes	4	25
Heart disease	2	13
Others	2	13
Weight trajectory within the past year		
Lost	5	33
No change	5	33
Gain	5	33

<sup>a</sup>Participants were allowed to select multiple answers.

Participant baseline characteristics are described in Table 4.2. The mean age was 50.9 (SD = 13.7) years, and the mean body mass index was 33.1 (SD = 4.8) kg/m<sup>2</sup>. Half of the participants were married (n = 8), and 25% were single (n = 4). A majority of participants were working full-time (75%, n = 12) or part-time (13%, n = 2). Among the 17 participants, the majority of participants reported at least one other health issues (e.g.,

hypertension, diabetes, or heart disease). Among participants who reported pre-program weight trajectories over the past year, 33% ( $n = 5$ ) reported that they lost weight, 33% reported no change, and 33% had gained weight. Two subjects' weight trajectory data were missing.

Table 4.3 shows paired mean change of biological and psychosocial variables from baseline to 16 weeks, paired t-test results, and Cohen's d. There were no statistically significant differences in systolic and diastolic blood pressure, and waist circumference. However, there were statistically significant decreases in weight ( $p = .000$ ) and body mass index ( $p = .001$ ). Scores for self-efficacy of exercise, perceived social support, and perceived stress did not differ pre and post intervention. However, there were statistically significant increases in scores for self-efficacy of eating ( $p = .004$ ).

Table 4.3

*Biological and Psychosocial Variables at Baseline and at 16 weeks*

Variable	<i>n</i>	Baseline		16 Weeks		Differences		<i>t</i>	<i>p</i> Value	Cohen's <i>d</i>
		<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
Weight (lb)	17	203.0	30.5	199.3	29.5	-3.7	3.5	-4.42	<.001	-1.07
BMI ( $\text{kg}/\text{m}^2$ )	17	33.1	4.8	32.5	4.7	-0.6	0.6	-4.30	.001	-1.04
WC (inches)	15	40.7	3.8	40.2	4.5	-0.5	2.7	-0.68	.509	-0.17
SBP (mmHg)	17	132.4	8.3	135.9	11.7	3.5	10.6	1.37	.190	0.33
DBP (mmHg)	17	82.4	9.5	78.9	9.0	-3.5	12.4	-1.16	.265	-0.28
SE-eating	9	1262.2	431.6	1701.1	384.6	438.9	331.7	3.97	.004	0.32
SE-exercise	11	726.4	310.5	903.6	277.4	177.4	417.4	1.41	.189	0.42
PSS-Fr	9	12.8	2.1	12.7	2.7	-0.1	2.6	-0.13	.900	-0.04
PSS	10	35.1	9.8	35.3	6.6	0.2	9.6	0.07	.949	0.02

*Note.* BMI = body mass index; WC = waist circumference; SBP = systolic blood pressure; DBP = diastolic blood pressure; SE-eating = Self-Efficacy to regulate eating habits; SE-exercise = Self-Efficacy to regulate exercise; PSS-Fr = Perceived Social Support–Friends; PSS = Perceived Stress Scale

Participants ( $n = 11$ ) moved through stages of change between baseline and 16 weeks. The percent of subjects in maintenance and action stages were increased, and the percent in contemplation and precontemplation stages were decreased. At baseline, 36% of participants were in action and maintenance stages; increasing to 82% at 16 weeks. Specifically, one participant moved from the precontemplation to contemplation stage, and one moved from precontemplation to maintenance after the 16-week intervention. Four participants moved from contemplation to action; one moved from contemplation to precontemplation. Finally, one participant moved from the action to maintenance stage. Therefore, seven participants changed positively, two changed negatively, and two remained the same.

The focus group interview identified perceived benefits and challenges of the combination intervention. The majority of participants reported that text messages were effective and they were satisfied with the use of text messages. Participants agreed that daily text messages were helpful to keep them motivated, apply content to their daily lives, to fill the gap between face-to-face group sessions, and to reinforce information and knowledge gained throughout the intervention. However, participants debated the specific details of the text message protocol and did not fully agree on all of the aspects, such as text message delivery time, frequency, length, and quality.

The mean support group attendance was six out of eight sessions. Most women agreed that the support group sessions were very effective and they were satisfied with the content and guest speakers. Participants agreed that biweekly support groups were beneficial to share difficulties encountered and successful strategies used, to provide

encouragement, and to learn from their peers. Participants also reported feeling a strong sense of belonging because they had common goals and problems. However, they did not come to consensus regarding the optimal frequency and timing of support group sessions. Finally, women reported noticing small behavioral changes and had an increased awareness of healthy lifestyle behaviors that could be adopted for use in their daily lives. Overall, most participants agreed that the combined program was highly satisfactory because there was a good balance between face-to-face meetings and personal text messages.

### **Discussion**

In this study of the feasibility, acceptability, and potential efficacy of a 16-week weight loss and management intervention for AA women, there were modest but significant decreases in weight and body mass index from baseline to 16 weeks; however, changes in systolic blood pressure, diastolic blood pressure, and waist circumference were non-significant (data reported elsewhere). To explore the feasibility and acceptability of the combined intervention, behavioral and psychosocial variables were examined. Despite the difficulty in detecting significant changes in exercise or dietary habits in a small sample, participant efficacy increased and, overall, stages of change advanced. These data provide preliminary evidence of the efficacy of the combined intervention, and data that support that this combined intervention is feasible and acceptable for AA women.

There are several limitations to this study. First, the study findings cannot be generalized to all AA women because of the small sample size, sample selection, and low

statistical power. However, this small sample is acceptable since this was a feasibility study. A larger study is needed to more rigorously determine intervention efficacy and the generalizability of the results; a randomized controlled trial comparing the intervention efficacy with usual care or as compared with another intervention would add strength. Second, there was a significant amount of missing data in pre and post questionnaires. Questionnaires should be easily readable, comprehensible, and brief. The participants may need some help completing the questionnaires to minimize missing data. In addition, research staff could review forms with participants to verify whether questions were “missed” by intention or by mistake. Third, several challenges in the implementation of this combined approach were identified. For the text messaging component, there were technical difficulties encountered in sending and receiving text messages. The application used for this study did not allow investigators to set the delivery date and time in advance. In future research, with larger sample sizes, investigators may desire to find an application with better functions (e.g., setting the time for delivery, selecting participants, and tailoring messages). In addition, the participants’ individual mobile phone information (e.g., type of phone—smart phone or flip phone, data plan—unlimited plan or not, monthly price—unlimited text and call or not, ability to use phone—unskilled or skillful) should be obtained before initiating the intervention. Because such information provides a better understanding of participants’ ability to send and receive text messages, this step could identify individuals who could benefit from an additional education session explaining how to send and receive text messages.

Text messaging was a useful tool to foster participant engagement and provide behavioral information related to diet and exercise. The peer support group sessions provided social interaction with peers and the study investigators that could not be fulfilled with text messaging alone. These were expected findings of a combination intervention designed for women to manage their weight and change behavior throughout mobile technology and social support. Advantages of the text message-based intervention were identified, including decreased burden for participants compared to intensive weekly face-to-face interventions, relatively low cost to investigators and participants, the provision of self-monitoring tools, and ease of access since information could be received and stored in their mobile phones (Fitzgibbon et al., 2012; Patrick et al., 2009; Shaw & Bosworth, 2012; Steinberg, Levine, Askew, Foley, & Bennett, 2013).

It is important to consider the long-term goals when interventions are initially designed by investigators. It is well known that participants experience difficulty in maintaining their health behaviors for long-term periods. In past research, AA participants have demonstrated smaller weight loss and difficulty with weight loss maintenance relative to other ethnic groups (Turk et al., 2009). In this study, the intervention was developed with a focus on inexpensive and acceptable interventions to help participants maintain lifestyle changes and promote health behaviors. In-person support group sessions are suitable for fostering interaction and developing rapport between investigators and peers, and for initiating intensive interventions. Text messaging was viewed as an essential tool to continually provide participants with

information related to healthy diet and exercise habits, and encouragement to apply the information in their daily lives.

Some challenges and barriers of the combined approach were discussed throughout the “Results” section in the presentation of the focus group findings. The focus group interview provided qualitative information about participants’ perspectives on text messaging and participation in the peer support group. Participants reported varied opinions about text message delivery time, frequency, length, and quality. Participants mentioned that each individual may prefer a different time and frequency for support group sessions. It is understandable that everyone has a different schedule and ability to use a mobile phone. Therefore, in planning intervention studies, it is important to assess the target populations’ ability and willingness to use technology. In the development stage, a needs assessment of the community would be beneficial for the overall study design, as well as specific details of the intervention. Finally, for the support group meetings, investigators need to contact community leaders or pastors to identify church or community events in advance and plan intervention sessions accordingly.

Text messaging didn’t deliver peer-to-peer communications in this study; however, text messaging could be added the function that deliver peer group support and social support for future studies. A mobile phone “buddy system” was investigated to evaluate a mobile phone–based intervention for self-management of diabetes (Rotheram-Borus et al., 2012). It is possible that research emphasizing a peer support system via text messages among the participants would be novel and fruitful for further study. In this

study, participants wanted text message exchange with peers and researchers. If possible, text messaging with peers can be added to the intervention protocol to enhance their social connection and relationship.

To increase attendance rates, future investigators should find additional ways to increase attendance including, perhaps, larger incentives, an accountability system, or options to attend remotely. There were several factors that could account for this, such as scheduling conflicts with church events, family events, or holidays. The research protocol built in strategies to increase attendance using small gifts, incentives, and text message reminders. In addition, investigators might consider other ways to engage participants when they are unable to participate in in-person meetings. Online conferencing systems could be an alternative option for individuals who are unable to attend peer support group meetings.

This feasibility study demonstrated that the combined approach was a feasible strategy for delivery of a weight loss and management program for AA women. Findings of this feasibility study provide preliminary evidence of an educational intervention program that could motivate women and lead to successful behavior change, weight loss and management for AA women.

## References

- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology and Health*, 13, 623-649. doi:10.1080/08870449808407422
- Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 307-337). Greenwich, CT: Information Age.
- Cancer Prevention Research Center. (1991). *Weight control: Stages of change (short form)*. Retrieved from <http://web.uri.edu/cprc/weight-control-stages-of-change-short-form/>
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385-396. Retrieved from <http://www.jstor.org/stable/2136404>
- Elfhag, K., & Rössner, S. (2005). Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity Reviews*, 6, 67-85. doi:10.1111/j.1467-789X.2005.00170.x
- Fitzgibbon, M. L., Tussing-Humphreys, L. M., Porter, J. S., Martin, I. K., Odoms-Young, A., & Sharp, L. K. (2012). Weight loss and African-American women: A systematic review of the behavioural weight loss intervention literature. *Obesity Reviews*, 13, 193-213. doi:10.1111/j.1467-789X.2011.00945.x
- Flegal, K. M., Kruszon-Moran, D., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2016). Trends in obesity among adults in the United States, 2005 to 2014. *Journal of the*

- American Medical Association, 315*, 2284-2291. doi:10.1001/jama.2016.6458
- Foreman, K. F., Stockl, K. M., Le, L. B., Fisk, E., Shah, S. M., Lew, H. C., . . . Curtis, B. S. (2012). Impact of a text messaging pilot program on patient medication adherence. *Clinical Therapeutics, 34*, 1084-1091. doi:10.1016/j.clinthera.2012.04.007
- Free, C., Knight, R., Robertson, S., Whittaker, R., Edwards, P., Zhou, W., . . . Roberts, I. (2011). Smoking cessation support delivered via mobile phone text messaging (txt2stop): A single-blind, randomised trial. *The Lancet, 378*(9785), 49-55. doi:10.1016/S0140-6736(11)60701-0
- Free, C., Phillips, G., Felix, L., Galli, L., Patel, V., & Edwards, P. (2010). The effectiveness of m-Health technologies for improving health and health services: A systematic review protocol. *BioMed Central Research Notes, 3*(1), 250. doi:10.1186/1756-0500-3-250
- Gazmararian, J. A., Elon, L., Yang, B., Graham, M., & Parker, R. (2014). Text4baby program: An opportunity to reach underserved pregnant and postpartum women? *Maternal and Child Health Journal, 18*, 223-232. doi:10.1007/s10995-013-1258-1
- Hakkak, R., & Bell, A. (2016). Obesity and the link to chronic disease development. *Journal of Obesity and Chronic Diseases, 1*(1), 1-3. doi:10.17756/jocd.2016-001
- Hall, A. K., Cole-Lewis, H., & Bernhardt, J. M. (2015). Mobile text messaging for health: A systematic review of reviews. *Annual Review of Public Health, 36*, 393-415. doi:10.1146/annurev-publhealth-031914-122855

- Hamilton, C. M., Strader, L. C., Pratt, J. G., Maiese, D., Hendershot, T., Kwok, R. K., . . . Nettles, D. S. (2011). The PhenX toolkit: Get the most from your measures. *American Journal of Epidemiology*, 174, 253-260. doi:10.1093/aje/kwr193
- Hwang, K. O., Ottenbacher, A. J., Lucke, J. F., Etchegaray, J. M., Graham, A. L., Thomas, E. J., & Bernstam, E. V. (2011). Measuring social support for weight loss in an internet weight loss community. *Journal of Health Communication*, 16, 198-211. doi:10.1080/10810730.2010.535106
- Jensen, M. D., Ryan, D. H., Apovian, C. M., Ard, J. D., Comuzzie, A. G., Donato, K. A., . . . Yanovski, S. Z. (2014). 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. *Obesity*, 22(Suppl. 2), S41-S410. doi:10.1002/oby.20660
- Juzang, I., Fortune, T., Black, S., Wright, E., & Bull, S. (2011). A pilot programme using mobile phones for HIV prevention. *Journal of Telemedicine and Telecare*, 17, 150-153. doi:10.1258/jtt.2010.091107
- Khaylis, A., Yiaslas, T., Bergstrom, J., & Gore-Felton, C. (2010). A review of efficacious technology-based weight-loss interventions: Five key components. *Telemedicine and e-Health*, 16, 931-938. doi:10.1089/tmj.2010.0065
- Lavie, C. J., Milani, R. V., & Ventura, H. O. (2009). Obesity and cardiovascular disease: Risk factor, paradox, and impact of weight loss. *Journal of the American College of Cardiology*, 53, 1925-1932. doi:10.1016/j.jacc.2008.12.068

- Lee, S., & Lindquist, R. (2015). A review of technology-based interventions to maintain weight loss. *Telemedicine and e-Health*, 21, 217-232. doi:10.1089/tmj.2014.0052
- Lin, M., Mahmooth, Z., Dedhia, N., Fruthey, R., Mercado, C. E., Epstein, D. H., . . . Cheskin, L. J. (2015). Tailored, interactive text messages for enhancing weight loss among African American adults: The TRIMM randomized controlled trial. *The American Journal of Medicine*, 128, 896-904. doi:10.1016/j.amjmed.2015.03.013
- Luxton, D. D., McCann, R. A., Bush, N. E., Mishkind, M. C., & Rege, G. M. (2011). mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice*, 42, 505-512. doi:10.1037/a0024485
- McAlister, A. L., Perry, C. L., & Parcel, G. S. (2008). How individuals, environments, and health behaviors interact. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research and practice* (4th ed., pp. 169-188). San Francisco, CA: John Wiley.
- National Institutes of Health, National Heart, Lung, and Blood Institute. (2017). Treatment. Retrieved March 9, 2017, from <https://www.nhlbi.nih.gov/health/health-topics/topics/obe/treatment>
- Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *The Journal of American Medical Association*, 311, 806-814. doi:10.1001/jama.2014.732
- Patrick, K., Raab, F., Adams, M., Dillon, L., Zabinski, M., Rock, C., . . . Norman, G. (2009). A text message-based intervention for weight loss: Randomized

- controlled trial. *Journal of Medical Internet Research*, 11(1), e1.  
doi:10.2196/jmir.1100
- Perron, N. J., Dao, M. D., Righini, N. C., Humair, J. P., Broers, B., Narring, F., . . .  
Gaspoz, J. M. (2013). Text-messaging versus telephone reminders to reduce missed appointments in an academic primary care clinic: A randomized controlled trial. *BioMed Central Health Services Research*, 13(1), Article 125.  
doi:10.1186/1472-6963-13-125.
- Pew Research Center. (2014). *Mobile technology fact sheet*. Retrieved from  
<http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/>
- Procidano, M. E., & Heller, K. (1983). Measures of perceived social support from friends and from family: Three validation studies. *American Journal of Community Psychology*, 11, 1-24. doi:10.1007/BF00898416
- Rotheram-Borus, M. J., Tomlinson, M., Gwegwe, M., Comulada, W. S., Kaufman, N., & Keim, M. (2012). Diabetes buddies peer support through a mobile phone buddy system. *The Diabetes Educator*, 38, 357-365. doi:10.1177/0145721712444617
- Shapiro, J. R., Koro, T., Doran, N., Thompson, S., Sallis, J. F., Calfas, K., & Patrick, K. (2012). Text4Diet: A randomized controlled study using text messaging for weight loss behaviors. *Preventive Medicine*, 55, 412-417.  
doi:10.1016/j.ypmed.2012.08.011
- Shaw, R. J., & Bosworth, H. (2012). Short message service (SMS) text messaging as an intervention medium for weight loss: A literature review. *Health Informatics Journal*, 18, 235-250. doi:10.1177/1460458212442422

- Shaw, R. J., Bosworth, H. B., Silva, S. S., Lipkus, I. M., Davis, L. L., Ronald, S. S., & Johnson, C. M. (2013). Mobile health messages help sustain recent weight loss. *The American Journal of Medicine*, 126, 1002-1009. doi:10.1016/j.amjmed.2013.07.001
- Steinberg, D. M., Levine, E. L., Askew, S., Foley, P., & Bennett, G. G. (2013). Daily text messaging for weight control among racial and ethnic minority women: Randomized controlled pilot study. *Journal of Medical Internet Research*, 15(11), e244. doi:10.2196/jmir.2844.
- Stephens, J., & Allen, J. (2013). Mobile phone interventions to increase physical activity and reduce weight: A systematic review. *The Journal of Cardiovascular Nursing*, 28, 320-329. doi:10.1097/JCN.0b013e318250a3e7
- Turk, M. W., Yang, K., Hravnak, M., Sereika, S. M., Ewing, L. J., & Burke, L. E. (2009). Randomized clinical trials of weight-loss maintenance: A review. *The Journal of Cardiovascular Nursing*, 24(1), 58-80. doi:10.1097/01.JCN.0000317471.58048.32
- Winett, R. A., Tate, D. F., Anderson, E. S., Wojcik, J. R., & Winett, S. G. (2005). Long-term weight gain prevention: A theoretically based Internet approach. *Preventive Medicine*, 41, 629-641. doi:10.1016/j.ypmed.2004.12.005

## **Chapter 5: Discussion**

### **Summary and Synthesis of Results**

In Chapter 2, the manuscript presenting the literature review supported previous reviews that report that long-term weight loss maintenance intervention studies using technology have mixed findings. The manuscript adds to the literature beyond previous reviews of long-term outcomes of weight loss intervention with a specific focus on the use/testing of technology-based interventions that were implemented during the maintenance phase (not just a follow-up after a technology-based intervention). From this review, it is evident that there is a strong need to find an effective way to improve study interventions and protocols that will affect weight-related outcomes.

In Chapter 3, the intervention development was discussed. The brief research report presented a theoretical basis of the intervention protocol and program curriculum which provided an innovative foundation for study development and implementation. The intervention protocol that was developed employed mobile technology and more intimate interpersonal support of the group. It is concluded that this approach could be effectively coupled and further tested in future research with African American women for weight management.

In Chapter 4, the main dissertation research project was discussed. In this study of the feasibility, acceptability, and potential efficacy of a 16-week weight loss and management intervention for AA women, there were modest but significant decreases in weight and body mass index from baseline to 16 weeks. However, changes in systolic blood pressure, diastolic blood pressure, and waist circumference were non-significant.

To explore the feasibility and acceptability of the combined intervention, behavioral and psychosocial variables were examined. Despite the difficulty in detecting significant changes in exercise or dietary habits in a small sample, participant efficacy increased and, overall, stage of change advanced. These data provide preliminary evidence of the efficacy of the combined intervention, and data that support that this combined intervention is feasible and acceptable for AA women. This approach warrants further study.

### **Conclusions**

The current obesity epidemic is problematic not only in the United States, but worldwide. Overall, investigators of most of the studies agreed that technology could be a more effective tool in preventing weight gain than self-directed maintenance alone. In this review, results of the effectiveness of technology-based weight loss maintenance interventions (WLMIs) were mixed. Therefore, Chapter 2 discussed potential strategies and approaches to improve the effectiveness of technology-based WLMIs. This review provides important information to both patients and healthcare providers. Healthcare providers can suggest technology-based WLMIs to their patients and can include information about the strengths and weaknesses of each of the interventions. Moreover, suggested guidelines in this article can aid in planning further research design and implementation. In Chapter 4, this feasibility study demonstrated that the combined approach was a feasible strategy for delivery of a weight loss and management program for AA women. Findings of this feasibility study provide preliminary evidence of an

educational intervention program that could motivate women and lead to successful behavior change, weight loss, and management for AA women.

### **Recommendations of Future Research**

A combined approach that comprised mobile technology and peer group support was feasible and acceptable for African American women. Mobile technology (text messaging) and peer group support (social support) complemented each other. The mobile technology eliminates the limitations of traditional peer group format and peer support group enhances human interaction and relationship. Based on the dissertation findings, several recommendations are made for future research. First, culturally-tailored and language-concordant text messages can be developed to test the potential efficacy of weight loss and management program for various ethnic populations. According to American Community Survey Report, 21% of the population spoke a language other than English at home in the United States (Ryan, 2013). Also, there are “limited-English-proficient” populations. These populations are often medically underserved and reported poorer health. Therefore, finding evidence of the effectiveness of culturally-tailored and language-concordant text messages for weight management among diverse ethnic groups can be the next step for future research. Second, a randomized controlled trial with a larger sample (sufficiently powered to test hypotheses) can be developed and implemented to test the efficacy of three groups (text messaging, peer group support, and combine group). This feasibility study was conducted with a small sample. If supported by a larger grant, a randomized controlled trial could be conducted to more definitively test the efficacy of this combined approach. Third, in future studies, investigators may

also focus on other cardiovascular risk factors (such as blood pressure or cholesterol-lowering) as primary outcomes. In this dissertation, the primary outcome was weight loss and management. Future research can aim to improve CVD risk factors using this combined approach.

## References

- Appel, L. J., Clark, J. M., Yeh, H. C., Wang, N. Y., Coughlin, J. W., Daumit, G., . . . Noronha, G. (2011). Comparative effectiveness of weight-loss interventions in clinical practice. *New England Journal of Medicine*, 365(21), 1959-1968. doi: 10.1056/NEJMoa1108660
- Baker, T. B., Gustafson, D. H., & Shah, D. (2014). How can research keep up with eHealth? Ten strategies for increasing the timeliness and usefulness of eHealth research. *Journal of Medical Internet Research*, 16(2), e36. doi:10.2196/jmir2925
- Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, 84(2), 191. doi:10.1037/0033-295X.84.2.191
- Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: Freeman.
- Bandura, A. (1998). Health promotion from the perspective of social cognitive theory. *Psychology and Health*, 13, 623-649. doi:10.1080/08870449808407422
- Bandura, A. (2001). Social cognitive theory: An agentic perspective. *Annual Review of Psychology*, 52(1), 1-26. doi:0066-4308/01/0201-0001
- Bandura, A. (2006). Guide for constructing self-efficacy scales. In F. Pajares & T. Urdan (Eds.), *Self-efficacy beliefs of adolescents* (pp. 307-337). Greenwich, CT: Information Age.

- Bandura, A. (2011). Social cognitive theory. In A. W. Kruglanski, E. T. Higgins, & P. A. M. Van Lange (Eds.), *Handbook of theories of social psychology: Volume One* (p. 349). London: SAGE.
- Bastable, S. B. (Ed.). (2003). *Nurse as educator: Principles of teaching and learning for nursing practice*. Sudbury, MA: Jones & Bartlett Learning
- Bennett, G. G., Herring, S. J., Puleo, E., Stein, E. K., Emmons, K. M., & Gillman, M. W. (2010). Web-based weight loss in primary care: A randomized controlled trial. *Obesity, 18*(2), 308-313. doi: 10.1038/oby.2009.242
- Block, G., Hartman, A. M., Dresser, C. M., Carroll, M. D., Gannon, J., & Gardner, L. (1986). A data-based approach to diet questionnaire design and testing. *American Journal of Epidemiology, 124*(3), 453-469.  
doi:10.1093/oxfordjournals.aje.a114416
- Burke, L. E., Wang, J., & Sevick, M. A. (2011). Self-monitoring in weight loss: A systematic review of the literature. *Journal of the American Dietetic Association, 111*(1), 92-102. doi:10.1016/j.jada.2010.10.008
- Byrne, S., Barry, D., & Petry, N. M. (2012). Predictors of weight loss success. Exercise vs. dietary self-efficacy and treatment attendance. *Appetite, 58*(2), 695-698.  
doi:10.1016/j.appet.2012.01.005
- Cadmus-Bertram, L., Wang, J. B., Patterson, R. E., Newman, V. A., Parker, B. A., & Pierce, J. P. (2012). Web-based self-monitoring for weight loss among overweight/obese women at increased risk for breast cancer: The HELP pilot study. *Psycho-Oncology, 22*(8), 1821-1828. doi: 10.1002/pon.3219

- Cancer Prevention Research Center. (1991). *Weight control: Stages of change (short form)*. Retrieved from <http://web.uri.edu/cprc/weight-control-stages-of-change-short-form/>
- Cardinal, B. J., & Cardinal, M. K. (2001). Role modeling in HPERD: Do attitudes match behavior?. *Journal of Physical Education, Recreation & Dance*, 72(4), 34-39.  
doi:10.1080/07303084.2001.10605737
- Cohen, S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *Journal of Health and Social Behavior*, 24, 385-396. Retrieved from <http://www.jstor.org/stable/2136404>
- Cole-Lewis, H., & Kershaw, T. (2010). Text messaging as a tool for behavior change in disease prevention and management. *Epidemiologic Reviews*, 32(1), 56-69.  
doi:10.1093/epirev/mxq004 Elfhang & Rossner, 2005
- Cullen, K. W., Baranowski, T., & Smith, S. P. (2001). Using goal setting as a strategy for dietary behavior change. *Journal of the American Dietetic Association*, 101(5), 562-566. doi:10.1016/S0002-8223(01)00140-7
- Cussler, E. C., Teixeira, P. J., Going, S. B., Houtkooper, L. B., Metcalfe, L. L., Blew, R. M., . . . Lohman, T. G. (2008). Maintenance of weight loss in overweight middle-aged women through the Internet. *Obesity*, 16(5), 1052-1060. doi:10.1038/oby.2008.19
- Dale, J. R., Williams, S. M., & Bowyer, V. (2012). What is the effect of peer support on diabetes outcomes in adults? A systematic review. *Diabetic Medicine*, 29(11), 1361-1377. doi: 10.1111/j.1464-5491.2012.03749.x

- Elfhag, K., & Rössner, S. (2005). Who succeeds in maintaining weight loss? A conceptual review of factors associated with weight loss maintenance and weight regain. *Obesity Reviews*, 6, 67-85. doi:10.1111/j.1467-789X.2005.00170.x
- Eysenbach, G. (2001). What is e-health? *Journal of Medical Internet Research*, 3(2), e20. doi:10.2196/jmir.3.2.e20
- Finch, E. A., Linde, J. A., Jeffery, R. W., Rothman, A. J., King, C. M., & Levy, R. L. (2005). The effects of outcome expectations and satisfaction on weight loss and maintenance: Correlational and experimental analyses-a randomized trial. *Health Psychology*, 24(6), 608. doi:10.1037/0278-6133.24.6.608
- Fitzgibbon, M. L., Tussing-Humphreys, L. M., Porter, J. S., Martin, I. K., Odoms-Young, A., & Sharp, L. K. (2012). Weight loss and African-American women: A systematic review of the behavioural weight loss intervention literature. *Obesity Reviews*, 13, 193-213. doi:10.1111/j.1467-789X.2011.00945.x
- Fjeldsoe, B. S., Marshall, A. L., & Miller, Y. D. (2009). Behavior change interventions delivered by mobile telephone short-message service. *American Journal of Preventive Medicine*, 36(2), 165-173. doi:10.1016/j.amepre.2008.09.040
- Flegal, K. M., Kruszon-Moran, D., Carroll, M. D., Fryar, C. D., & Ogden, C. L. (2016). Trends in obesity among adults in the United States, 2005 to 2014. *Journal of the American Medical Association*, 315, 2284-2291. doi:10.1001/jama.2016.6458

- Foreman, K. F., Stockl, K. M., Le, L. B., Fisk, E., Shah, S. M., Lew, H. C., . . . Curtis, B. S. (2012). Impact of a text messaging pilot program on patient medication adherence. *Clinical Therapeutics*, 34, 1084-1091. doi:10.1016/j.clinthera.2012.04.007
- Free, C., Knight, R., Robertson, S., Whittaker, R., Edwards, P., Zhou, W., . . . Roberts, I. (2011). Smoking cessation support delivered via mobile phone text messaging (txt2stop): A single-blind, randomised trial. *The Lancet*, 378(9785), 49-55. doi:10.1016/S0140-6736(11)60701-0
- Free, C., Phillips, G., Felix, L., Galli, L., Patel, V., & Edwards, P. (2010). The effectiveness of m-Health technologies for improving health and health services: A systematic review protocol. *BioMed Central Research Notes*, 3(1), 250. doi:10.1186/1756-0500-3-250
- Gazmararian, J. A., Elon, L., Yang, B., Graham, M., & Parker, R. (2014). Text4baby program: An opportunity to reach underserved pregnant and postpartum women? *Maternal and Child Health Journal*, 18, 223-232. doi:10.1007/s10995-013-1258-1
- Gold, B. C., Burke, S., Pintauro, S., Buzzell, P., & Harvey-Berino, J. (2007). Weight loss on the web: A pilot study comparing a structured behavioral intervention to a commercial program. *Obesity*, 15(1), 155-155. doi: 10.1038/oby.2007.520
- Haapala, I., Barengo, N. C., Biggs, S., Surakka, L., & Manninen, P. (2009). Weight loss by mobile phone: A 1-year effectiveness study. *Public Health Nutrition*, 12(12), 2382-2391. doi:10.1017/S1368980009005230

- Hakkak, R., & Bell, A. (2016). Obesity and the link to chronic disease development. *Journal of Obesity and Chronic Diseases*, 1(1), 1-3. doi:10.17756/jocd.2016-001
- Hall, A. K., Cole-Lewis, H., & Bernhardt, J. M. (2015). Mobile text messaging for health: A systematic review of reviews. *Annual Review of Public Health*, 36, 393-415. doi:10.1146/annurev-publhealth-031914-122855
- Hamilton, C. M., Strader, L. C., Pratt, J. G., Maiese, D., Hendershot, T., Kwok, R. K., . . . Nettles, D. S. (2011). The PhenX toolkit: Get the most from your measures. *American Journal of Epidemiology*, 174, 253-260. doi:10.1093/aje/kwr193
- Harlan, L. C., & Block, G. (1990). Use of adjustment factors with a brief food frequency questionnaire to obtain nutrient values. *Epidemiology*, 1(3), 224-231.
- Harvey-Berino, J., Pintauro, S. J., & Gold, E. C. (2002). The feasibility of using Internet support for the maintenance of weight loss. *Behavior Modification*, 26(1), 103-116. doi:10.1177/0145445502026001006
- Harvey-Berino, J., Pintauro, S., Buzzell, P., & Gold, E. C. (2004). Effect of Internet support on the long-term maintenance of weight loss. *Obesity Research*, 12(2), 320-329. doi: 10.1038/oby.2004.40
- Harvey-Berino, J., Pintauro, S., Buzzell, P., DiGiulio, M., Gold, B. C., Moldovan, C., & Ramirez, E. (2002). Does using the Internet facilitate the maintenance of weight loss?. *International Journal of Obesity*, 26(9), 1254. doi:10.1038/sj.ijo.0802051
- House, J. S. (1981). *Work stress and social support*. Reading, MA: Addison-Wesley
- Hwang, K. O., Ottenbacher, A. J., Lucke, J. F., Etchegaray, J. M., Graham, A. L., Thomas, E. J., & Bernstam, E. V. (2011). Measuring social support for weight

- loss in an internet weight loss community. *Journal of Health Communication*, 16, 198-211. doi:10.1080/10810730.2010.535106
- Jensen, M. D., Ryan, D. H., Apovian, C. M., Ard, J. D., Comuzzie, A. G., Donato, K. A., . . . Yanovski, S. Z. (2014). 2013 AHA/ACC/TOS guideline for the management of overweight and obesity in adults: A report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and The Obesity Society. *Obesity*, 22(Suppl. 2), S41-S410. doi:10.1002/oby.20660
- Juzang, I., Fortune, T., Black, S., Wright, E., & Bull, S. (2011). A pilot programme using mobile phones for HIV prevention. *Journal of Telemedicine and Telecare*, 17, 150-153. doi:10.1258/jtt.2010.091107
- Khaylis, A., Yiaslas, T., Bergstrom, J., & Gore-Felton, C. (2010). A review of efficacious technology-based weight-loss interventions: Five key components. *Telemedicine and e-Health*, 16, 931-938. doi:10.1089/tmj.2010.0065
- Kim, B. H., & Glanz, K. (2013). Text messaging to motivate walking in older African Americans: a randomized controlled trial. *American Journal of Preventive Medicine*, 44(1), 71-75. doi: 10.1016/j.amepre.2012.09.050
- Krukowski, R. A., Harvey-Berino, J., Ashikaga, T., Thomas, C. S., & Micco, N. (2008). Internet-based weight control: The relationship between web features and weight loss. *Telemedicine and e-Health*, 14(8), 775-782. doi:10.1089/tmj.2007.0132
- LaPlante, C., & Peng, W. (2011). A systematic review of e-health interventions for physical activity: an analysis of study design, intervention characteristics, and

- outcomes. *Telemedicine and e-Health*, 17(7), 509-523. doi: 10.1089/tmj.2011.0013
- Lavie, C. J., Milani, R. V., & Ventura, H. O. (2009). Obesity and cardiovascular disease: Risk factor, paradox, and impact of weight loss. *Journal of the American College of Cardiology*, 53, 1925-1932. doi:10.1016/j.jacc.2008.12.068
- Leahey, T. M., Kumar, R., Weinberg, B. M., & Wing, R. R. (2012). Teammates and social influence affect weight loss outcomes in a team-based weight loss competition. *Obesity*, 20(7), 1413-1418. doi: 10.1038/oby.2012.18
- Lee, S., & Lindquist, R. (2015). A review of technology-based interventions to maintain weight loss. *Telemedicine and e-Health*, 21, 217-232. doi:10.1089/tmj.2014.0052
- Lee, S., Schorr, E., Chi, C-L., Treat-Jacobson, D., Mathiason, M. A., & Lindquist, R. (2017). Peer Group and Text Message-Based Weight-Loss and Management Intervention for African-American Women. *Western Journal of Nursing Research*. Retrieved from <http://journals.sagepub.com/eprint/VwHxAbsRzpJkpajMmY6Z/full>
- Lehnert, T., Sonntag, D., Konnopka, A., Riedel-Heller, S., & König, H. H. (2013). Economic costs of overweight and obesity. *Best Practice & Research Clinical Endocrinology & Metabolism*, 27(2), 105-115. doi:10.1016/j.beem.2013.01.002
- Lin, M., Mahmooth, Z., Dedhia, N., Fruthey, R., Mercado, C. E., Epstein, D. H., . . . Cheskin, L. J. (2015). Tailored, interactive text messages for enhancing weight loss among African American adults: The TRIMM randomized controlled trial. *The American Journal of Medicine*, 128, 896-904. doi:10.1016/j.amjmed.2015.03.013

- Loescher, L. J., Rains, S. A., Kramer, S. S., Akers, C., & Moussa, R. (2016). A Systematic review of interventions to enhance healthy lifestyle behaviors in adolescents delivered via mobile phone text messaging. *American Journal of Health Promotion*, 1-15. doi: 10.1177/0890117116675785
- Luxton, D. D., McCann, R. A., Bush, N. E., Mishkind, M. C., & Reger, G. M. (2011). mHealth for mental health: Integrating smartphone technology in behavioral healthcare. *Professional Psychology: Research and Practice*, 42, 505-512. doi:10.1037/a0024485
- Lytle, L. A., & Perry, C. L. (2001). Applying research and theory in program planning: An example from a nutrition education intervention. *Health Promotion Practice*, 2(1), 68-80. doi:10.1177/152483990100200111
- McAlister, A. L., Perry, C. L., & Parcel, G. S. (2008). How individuals, environments, and health behaviors interact. In K. Glanz, B. K. Rimer, & K. Viswanath (Eds.), *Health behavior and health education: Theory, research and practice* (4th ed., pp. 169-188). San Francisco, CA: John Wiley.
- Morgan, P. J., Lubans, D. R., Collins, C. E., Warren, J. M., & Callister, R. (2011). 12-month outcomes and process evaluation of the SHED-IT RCT: An Internet-based weight loss program targeting men. *Obesity*, 19(1), 142-151. doi: 10.1038/oby.2010.119
- Naserian, N., Ansari, S., & Abedi, P. (2017). Comparison of training via short messages and group training on level of knowledge and practice of middle-aged women

about breast cancer screening tests. *Journal of Cancer Education*, 1-7. doi: 10.1007/s13187-017-1203-x

National Institutes of Health, National Heart, Lung, and Blood Institute. (2017). Treatment. Retrieved from <https://www.nhlbi.nih.gov/health/health-topics/topics/obe/treatment>

National Institutes of Health. (1998). Clinical guidelines on the identification, evaluation, and treatment of overweight and obesity in adults. *Obesity Research*, 6(2), 51S-209S. Retrieved from

<http://www.ncbi.nlm.nih.gov.ezp1.lib.umn.edu/books/NBK2003/>

Neve, M., Morgan, P. J., Jones, P. R., & Collins, C. E. (2010). Effectiveness of web-based interventions in achieving weight loss and weight loss maintenance in overweight and obese adults: a systematic review with meta-analysis. *Obesity reviews*, 11(4), 306-321. doi: 10.1111/j.1467-789X.2009.00646.x

Norman, G. J., Zabinski, M. F., Adams, M. A., Rosenberg, D. E., Yaroch, A. L., & Atienza, A. A. (2007). A review of eHealth interventions for physical activity and dietary behavior change. *American Journal of Preventive Medicine*, 33(4), 336-345. e16. doi:10.1016/j.amepre.2007.05.007

Ogden, C. L., Carroll, M. D., Kit, B. K., & Flegal, K. M. (2014). Prevalence of childhood and adult obesity in the United States, 2011-2012. *The Journal of American Medical Association*, 311, 806-814. doi:10.1001/jama.2014.732

- Paffenbarger, R. S., Wing, A. L., & Hyde, R. T. (1978). Physical activity as an index of heart attack risk in college alumni. *American Journal of Epidemiology*, 108(3), 161-175. doi: 10.1093/oxfordjournals.aje.a112608
- Patrick, K., Raab, F., Adams, M., Dillon, L., Zabinski, M., Rock, C., . . . Norman, G. (2009). A text message-based intervention for weight loss: Randomized controlled trial. *Journal of Medical Internet Research*, 11(1), e1. doi:10.2196/jmir.1100
- Perri, M. G., Limacher, M. C., Durning, P. E., Janicke, D. M., Lutes, L. D., Bobroff, L. B., . . . Martin, A. D. (2008). Extended-care programs for weight management in rural communities: The treatment of obesity in underserved rural settings (TOURS) randomized trial. *Archives of Internal Medicine*, 168(21), 2347-2354. doi: 10.1001/archinte.168.21.2347
- Perron, N. J., Dao, M. D., Righini, N. C., Humair, J. P., Broers, B., Narring, F., . . . Gaspoz, J. M. (2013). Text-messaging versus telephone reminders to reduce missed appointments in an academic primary care clinic: A randomized controlled trial. *BioMed Central Health Services Research*, 13(1), 125. doi:10.1186/1472-6963-13-125.
- Pew Research Center. (2014). *Mobile technology fact sheet*. Retrieved from <http://www.pewinternet.org/fact-sheets/mobile-technology-fact-sheet/>
- Piette, J. D., List, J., Rana, G. K., Townsend, W., Striplin, D., & Heisler, M. (2015). Mobile health devices as tools for worldwide cardiovascular risk reduction and disease management. *Circulation*, 132(21), 2012-2027.

- Procidano, M. E., & Heller, K. (1983). Measures of perceived social support from friends and from family: Three validation studies. *American Journal of Community Psychology*, 11, 1-24. doi:10.1007/BF00898416
- Rotheram-Borus, M. J., Tomlinson, M., Gwegwe, M., Comulada, W. S., Kaufman, N., & Keim, M. (2012). Diabetes buddies peer support through a mobile phone buddy system. *The Diabetes Educator*, 38, 357-365. doi:10.1177/0145721712444617
- Rothert, K., Strecher, V. J., Doyle, L. A., Caplan, W. M., Joyce, J. S., Jimison, H. B., ... & Roth, M. A. (2006). Web-based weight management programs in an integrated health care setting: a randomized, controlled trial. *Obesity*, 14(2), 266-272. doi: 10.1038/oby.2006.34
- Ryan, C. (2013). Language use in the United States: 2011. *American community survey reports*, 22, 1-16. Retrieved from <https://census.g>
- Samaha, M., & Hawi, N. S. (2016). Relationships among smartphone addiction, stress, academic performance, and satisfaction with life. *Computers in Human Behavior*, 57, 321-325. doi: 10.1016/j.chb.2015.12.045
- Shapiro, J. R., Koro, T., Doran, N., Thompson, S., Sallis, J. F., Calfas, K., & Patrick, K. (2012). Text4Diet: A randomized controlled study using text messaging for weight loss behaviors. *Preventive Medicine*, 55, 412-417. doi:10.1016/j.ypmed.2012.08.011
- Shaw, R. J., & Bosworth, H. (2012). Short message service (SMS) text messaging as an intervention medium for weight loss: A literature review. *Health Informatics Journal*, 18, 235-250. doi:10.1177/1460458212442422

- Shaw, R. J., Bosworth, H. B., Silva, S. S., Lipkus, I. M., Davis, L. L., Ronald, S. S., & Johnson, C. M. (2013). Mobile health messages help sustain recent weight loss. *The American Journal of Medicine*, 126, 1002-1009. doi:10.1016/j.amjmed.2013.07.001
- Sherwood, N. E., Jeffery, R. W., Pronk, N. P., Boucher, J. L., Hanson, A., Boyle, R., ... & Chen, V. (2006). Mail and phone interventions for weight loss in a managed-care setting: weigh-to-be 2-year outcomes. *International Journal of Obesity*, 30(10), 1565-1573. doi: 10.1038/sj.ijo.0803295
- Steinberg, D. M., Levine, E. L., Askew, S., Foley, P., & Bennett, G. G. (2013). Daily text messaging for weight control among racial and ethnic minority women: Randomized controlled pilot study. *Journal of Medical Internet Research*, 15(11), e244. doi:10.2196/jmir.2844.
- Stephens, J., & Allen, J. (2013). Mobile phone interventions to increase physical activity and reduce weight: A systematic review. *The Journal of Cardiovascular Nursing*, 28, 320-329. doi:10.1097/JCN.0b013e318250a3e7
- Svetkey, L. P., Stevens, V. J., Brantley, P. J., Appel, L. J., Hollis, J. F., Loria, C. M., ... Samuel-Hodge, C. (2008). Comparison of strategies for sustaining weight loss: the weight loss maintenance randomized controlled trial. *JAMA*, 299(10), 1139-1148. doi: 10.1001/jama.299.10.1139
- Thomas, D., Vydelingum, V., & Lawrence, J. (2011). E-mail contact as an effective strategy in the maintenance of weight loss in adults. *Journal of Human Nutrition and Dietetics*, 24(1), 32-38. doi: 10.1111/j.1365-277X.2010.01123.x

- Thorndike, A. N., Sonnenberg, L., Healey, E., Myint-U, K., Kvedar, J. C., & Regan, S. (2012). Prevention of weight gain following a worksite nutrition and exercise program: a randomized controlled trial. *American Journal of Preventive Medicine*, 43(1), 27-33. doi: 10.1016/j.amepre.2012.02.029
- Turk, M. W., Yang, K., Hravnak, M., Sereika, S. M., Ewing, L. J., & Burke, L. E. (2009). Randomized clinical trials of weight-loss maintenance: A review. *The Journal of Cardiovascular Nursing*, 24(1), 58-80. doi:10.1097/01.JCN.0000317471.58048.32
- Van Genugten, L., van Empelen, P., Boon, B., Borsboom, G., Visscher, T., & Oenema, A. (2012). Results from an online computer-tailored weight management intervention for overweight adults: randomized controlled trial. *Journal of Medical Internet Research*, 14(2), e44. doi:10.2196/jmir.1901
- Van Wier, M. F., Dekkers, J. C., Hendriksen, I. J., Heymans, M. W., Ariëns, G. A., Pronk, N. P., . . . van Mechelen, W. (2011). Effectiveness of phone and e-mail lifestyle counseling for long term weight control among overweight employees. *Journal of Occupational and Environmental Medicine*, 53(6), 680-686. doi: 10.1097/JOM.0b013e31821f2bbb
- Vodopivec-Jamsek, V., de Jongh, T., Gurol-Urganci, I., Atun, R., & Car, J. (2012). Mobile phone messaging for preventive health care. *Cochrane Database of Systematic Reviews*, 12. doi:10.1002/14651858.CD007457.pub2.
- Wantland, D. J., Portillo, C. J., Holzemer, W. L., Slaughter, R., & McGhee, E. M. (2004). The effectiveness of Web-based vs. non-Web-based interventions: a meta-

- analysis of behavioral change outcomes. *Journal of Medical Internet Research*, 6(4), e40. doi: doi:10.2196/jmir.6.4.e40
- Warziski, M. T., Sereika, S. M., Styn, M. A., Music, E., & Burke, L. E. (2008). Changes in self-efficacy and dietary adherence: The impact on weight loss in the PREFER study. *Journal of Behavioral Medicine*, 31(1), 81-92. doi:10.1007/s10865-007-9135-2
- Webel, A. R., Okonsky, J., Trompeta, J., & Holzemer, W. L. (2010). A systematic review of the effectiveness of peer-based interventions on health-related behaviors in adults. *American Journal of Public Health*, 100(2), 247-253. doi: 10.2105/AJPH.2008.149419
- Weinstein, P. K. (2006). A review of weight loss programs delivered via the Internet. *Journal of Cardiovascular Nursing*, 21(4), 251-258. doi: 10.1097/00005082-200607000-00003
- West, D. S., Gorin, A. A., Subak, L. L., Foster, G., Bragg, C., Hecht, J., . . . Wing, R. R. (2011). A motivation-focused weight loss maintenance program is an effective alternative to a skill-based approach. *International Journal of Obesity*, 35(2), 259-269. doi:10.1038/ijo.2010.138
- Williams, G. C., Grow, V. M., Freedman, Z. R., Ryan, R. M., & Deci, E. L. (1996). Motivational predictors of weight loss and weight-loss maintenance. *Journal of Personality and Social Psychology*, 70(1), 115. doi:10.1037/0022-3514.70.1.115

- Winett, R. A., Tate, D. F., Anderson, E. S., Wojcik, J. R., & Winett, S. G. (2005). Long-term weight gain prevention: A theoretically based Internet approach. *Preventive Medicine*, 41, 629-641. doi:10.1016/j.ypmed.2004.12.005
- Wing, R. R., & Jeffery, R. W. (1999). Benefits of recruiting participants with friends and increasing social support for weight loss and maintenance. *Journal of Consulting and Clinical Psychology*, 67(1), 132. doi:10.1037/0022-006X.67.1.132
- Wing, R. R., Tate, D. F., Gorin, A. A., Raynor, H. A., & Fava, J. L. (2006). A self-regulation program for maintenance of weight loss. *New England Journal of Medicine*, 355(15), 1563-1571. doi: 10.1056/NEJMoa061883
- Womble, L. G., Wadden, T. A., McGuckin, B. G., Sargent, S. L., Rothman, R. A., & Krauthamer-Ewing, E. S. (2004). A randomized controlled trial of a commercial Internet weight loss program. *Obesity Research*, 12(6), 1011-1018. doi: 10.1038/oby.2004.124
- World Health Organization. *Obesity and overweight*. Retrieved from [www.who.int/mediacentre/factsheets/fs311/en/ov/content/dam/Census/library/publications/2013/acs/acs-22.pdf](http://www.who.int/mediacentre/factsheets/fs311/en/ov/content/dam/Census/library/publications/2013/acs/acs-22.pdf)

## Appendix A

### IRB Approval Letter

#### UNIVERSITY OF MINNESOTA

Twin Cities Campus

Human Research Protection Program

Office of the Vice President for Research

D528 Mayo Memorial Building

420 Delaware Street S.E.

MMC 820

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Office: 612-626-3654

Fax: 612-626-6061

E-mail: [irb@umn.edu](mailto:irb@umn.edu) or [ibc@umn.edu](mailto:ibc@umn.edu)

Website: <http://research.umn.edu/subjects/>

September 23, 2014

Sohye Lee

RE: "The Feasibility of Text Message-Based, Combined Weight-Loss and Weight-Loss Maintenance Intervention for African American Women; Supportive Text messages Against Regain (STAR) project"  
IRB Code Number: **1408P53127**

Dear Sohye Lee

The Institutional Review Board (IRB) received your response to its stipulations. Since this information satisfies the federal criteria for approval at 45CFR46.111 and the requirements set by the IRB, final approval for the project is noted in our files. Upon receipt of this letter, you may begin your research.

IRB approval of this study includes the consent form and flyer received September 16, 2014 and recruitment materials received August 19, 2014.

The IRB would like to stress that subjects who go through the consent process are considered enrolled participants and are counted toward the total number of subjects, even if they have no further participation in the study. Please keep this in mind when calculating the number of subjects you request. This study is currently approved for 30 subjects. If you desire an increase in the number of approved subjects, you will need to make a formal request to the IRB.

For your records and for grant certification purposes, the approval date for the referenced project is September 5, 2014 and the Assurance of Compliance number is FWA00000312 (Fairview Health Systems Research FWA00000325, Gillette Children's Specialty Healthcare FWA00004003). Research projects are subject to continuing review and renewal; approval will expire one year from that date. You will receive a report form two months before the expiration date. If you would like us to send certification of approval to a funding agency, please tell us the name and address of your contact person at the agency.

As Principal Investigator of this project, you are required by federal regulations to:

\*Inform the IRB of any proposed changes in your research that will affect human subjects, changes should not be initiated until written IRB approval is received.

\*Report to the IRB subject complaints and unanticipated problems involving risks to subjects or others as they occur.

\*Inform the IRB immediately of results of inspections by any external regulatory agency (i.e. FDA).

\*Respond to notices for continuing review prior to the study's expiration date.

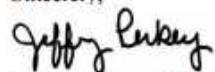
\*Cooperate with post-approval monitoring activities.

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Information on the IRB process is available in the form of a guide for researchers entitled, What Every Researcher Needs to Know, found at <http://www.research.umn.edu/irb/WERNK/index.cfm>

The IRB wishes you success with this research. If you have questions, please call the IRB office at 612-626-5654.

Sincerely,



Jeffery Perkey, MLS, CIP  
Research Compliance Supervisor  
JP/bw

CC: Ruth Lindquist

## **Appendix B**

### **Supportive Text messages Against Regain (STAR) project**

#### **CONSENT FORM**

You are invited to be in a research study of weight loss management and maintenance program. You were selected as a possible participant because you have completed short-term interventions in the past year or you have kept your weight stable over the past year. We ask that you read this form and ask any questions you may have before agreeing to be in the study.

This study is being conducted by Sohye Lee and Ruth Lindquist (Adviser), School of Nursing, University of Minnesota.

#### **Background Information**

The purpose of this study is to examine the feasibility and acceptability of text message-based, combined intervention to maintain weight loss or increase weight loss for African American women.

#### **Procedures:**

If you agree to be in this study, we would ask you to do the following things: The STAR project is a community-based, text message based, and combined intervention study that utilizes technology (text messages) and in-person (social support) group meetings. The intervention will be conducted for 16 weeks. The program consists of two components: daily text messaging and bi-weekly support group. Text messages will be delivered at their preferred time during the day, and if you want, more messages can be delivered based on your request. Support group sessions will be held in the participants' community church or center biweekly. Support group sessions will be composed of lecture presentation and group discussion sessions. The sessions will begin with a 60-minute lecture presentation led by guest speakers, such as dieticians, exercise physiologists, nurses, psychologists, yoga (mind-body) instructors, or medical doctors. The group sessions will be held for 30 minutes to motivate group members, keep them accountable, and support their maintenance of healthy behaviors that aid in weight management.

- Participants will be asked to provide demographic data, such as age, gender, race, marital status, employment status, income range, religion, and baseline diseases using the pre-intervention questionnaire before the intervention.
- Weight, height, waist circumference, and blood pressure will be measured at baseline, 8 weeks, and 16 weeks.

- The psychosocial variables (social support, stress, and self-efficacy) will be measured using pre- and post-intervention questionnaires at before and after the intervention.
- Diet and exercise will be assessed using diary log books. The participants will receive diary log books bi-weekly and be encouraged to monitor their diet and exercise habits at least twice a week. A total step count per day using a pedometer will be recorded to assess participants' physical activity. In addition, questionnaires will be obtained to assess diet intake and physical activity before and after the intervention.
- The environmental variable will assess neighborhood environmental attributes that are closely associated with physical activity before and after the intervention.
- The program evaluation will be measured after a 16-week intervention using a post-questionnaire.

### **Risks and Benefits of being in the Study**

The research involves possible risks or harms to the subjects, such as embarrassment or stigma, possible breach of confidentiality, personal information disclosure, change in diet and exercise, etc. However, the degree of the risks or harms will be minimal. There are precautions that will be taken to minimize each of the risks. In addition, there are anticipated benefits of this research for who participate which includes the health benefits of weight loss and/or maintenance.

### **Compensation:**

You will receive modest payment: Before and after the intervention, a total of \$40 (\$10 per month) will be provided for text messaging fee compensation. During the support group session, several gifts will be provided through a lottery.

### **Confidentiality:**

The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records. Study data will be encrypted according to current University policy for protection of confidentiality.

### **Voluntary Nature of the Study:**

Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota. If you decide

to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

### **Contacts and Questions:**

The researchers conducting this study are: Sohye Lee and Ruth Lindquist. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact them at School of nursing, University of Minnesota, [leex6022@umn.edu](mailto:leex6022@umn.edu) or [lindq002@umn.edu](mailto:lindq002@umn.edu).

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher(s), **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.

*You will be given a copy of this information to keep for your records.*

### **Statement of Consent:**

I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Signature of parent or guardian: \_\_\_\_\_ Date: \_\_\_\_\_  
*(If minors are involved)*

Signature of Investigator: \_\_\_\_\_ Date: \_\_\_\_\_

## **Appendix C**

### **Focus Group Questions**

**Study Title:** The Feasibility of Text Message-Based, Combined Weight-Loss and Weight-Loss Maintenance Intervention for African American Women: Supportive Text messages Against Regain (STAR) project

**IRB Code Number: 1408P53127**

There will be 3 sets of questions asked during the focus group sessions: One set relating to the text messaging, one set relating to the support group and one comprising general questions about the overall weight maintenance program.

#### **I. Text Messaging**

- 1) Were you satisfied with the text messages?
- 2) Were you satisfied with the phrases used in the text messages?
- 3) Were you satisfied with the time, frequency and duration of the text messaging?
- 4) Do you think the text messages were helpful for weight management?
- 5) Anything that made you like the text messaging?
- 6) Anything that made you dislike the text messaging?
- 7) What was your first reaction when the text messages were delivered in your phone?
- 8) Tell me what you liked or what was useful to you in your participation using a mobile phone.
- 9) Anything else about the text messages or messaging process that you think we should know?

#### **II. Support Group**

- 1) Were you satisfied with the support group?
- 2) Were you satisfied with the content of the support groups?
- 3) Were you satisfied with the environment and setting for the groups and the way that they were run?
- 4) Were you satisfied with time, duration, and frequency of the support group
- 5) Do you think the support groups were helpful for weight management? If so why? If not, why not?
- 6) What did you like about the support group?
- 7) What did you dislike about the support group?
- 8) Tell us what was useful to you and not useful to you in your participation in the support groups.
- 9) Anything else that we should know about the support groups?

#### **III. STAR project**

- 1) Would you recommend this program to your friend or family?
- 2) How could this program be improved?
- 3) Do you think this program was helpful to achieve your goal or to manage your weight?
- 4) If this program were repeated in the future, what changes or improvements should be made?
- 5) Anything else that you would like to tell us or that we should know about the program?