1-1-2016

Do Smartphone Applications Aid in Weight Loss? A Study on the Efficacy of Apps as a Supplemental Weight-Loss Aid

Elizabeth C. Fitzsimmons

Eastern Illinois University

This research is a product of the graduate program in Nutrition and Dietetics at Eastern Illinois University. Find out more about the program.

Recommended Citation

http://thekeep.eiu.edu/theses/2524

This Thesis is brought to you for free and open access by the Student Theses & Publications at The Keep. It has been accepted for inclusion in Masters Theses by an authorized administrator of The Keep. For more information, please contact tabruns@eiu.edu.
Preserving, reproducing, and distributing thesis research is an important part of Booth Library's responsibility to provide access to scholarship. In order to further this goal, Booth Library makes all graduate theses completed as part of a degree program at Eastern Illinois University available for personal study, research, and other not-for-profit educational purposes. Under 17 U.S.C. § 108, the library may reproduce and distribute a copy without infringing on copyright; however, professional courtesy dictates that permission be requested from the author before doing so.

Your signatures affirm the following:

- The graduate candidate is the author of this thesis.
- The graduate candidate retains the copyright and intellectual property rights associated with the original research, creative activity, and intellectual or artistic content of the thesis.
- The graduate candidate certifies her/his compliance with federal copyright law (Title 17 of the U.S. Code) and her/his right to authorize reproduction and distribution of all copyrighted materials included in this thesis.
- The graduate candidate in consultation with the faculty advisor grants Booth Library the non-exclusive, perpetual right to make copies of the thesis freely and publicly available without restriction, by means of any current or successive technology, including by not limited to photocopying, microfilm, digitization, or internet.
- The graduate candidate acknowledges that by depositing her/his thesis with Booth Library, her/his work is available for viewing by the public and may be borrowed through the library's circulation and interlibrary loan departments, or accessed electronically.
- The graduate candidate waives the confidentiality provisions of the Family Educational Rights and Privacy Act (FERPA) (20 U.S. C. § 1232g; 34 CFR Part 99) with respect to the contents of the thesis and with respect to information concerning authorship of the thesis, including name and status as a student at Eastern Illinois University.

I have conferred with my graduate faculty advisor. My signature below indicates that I have read and agree with the above statements, and hereby give my permission to allow Booth Library to reproduce and distribute my thesis. My adviser's signature indicates concurrence to reproduce and distribute the thesis.

Graduate Candidate Signature

Faculty Adviser Signature

Please submit in duplicate.
Do Smartphone Applications Aid in Weight Loss: A Study on

The Efficacy of Apps as a Supplemental Weight-loss Aid

(TITLE)

BY

Elizabeth C Fitzsimmons

THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

Master of Science in Nutrition and Dietetics

IN THE GRADUATE SCHOOL, EASTERN ILLINOIS UNIVERSITY
CHARLESTON, ILLINOIS

2016

YEAR

I HEREBY RECOMMEND THAT THIS THESIS BE ACCEPTED AS FULFILLING THIS PART OF THE GRADUATE DEGREE CITED ABOVE

9/1/16

THEESIS COMMITTEE CHAIR DATE

FAMILY AND CONSUMER SCIENCES CHAIRPERSON DATE

THEESIS COMMITTEE MEMBER DATE

THEESIS COMMITTEE MEMBER DATE

THEESIS COMMITTEE MEMBER DATE
Do Smartphone Applications Aid in Weight Loss? A Study on the Efficacy of Apps as a Supplemental Weight-Loss Aid

by
Elizabeth C. Fitzsimmons

Submitted in partial fulfillment of the requirement for the degree of Masters of Science in Nutrition & Dietetics

Eastern Illinois University
School of Family & Consumer Sciences
September 2016
Acknowledgements

I would like to thank my parents, Jay and Laurie Fitzsimmons, for all their support throughout this process and beyond. Their endless love and encouragement has given me the confidence to pursue this task and many others. Since day one, they have taught me how to work hard and push myself and for that I will always be grateful. Mom and dad, thank you for being amazing parents, friends, and role models.

I would also like to thank my wonderful thesis committee: Dr. Hugo, Dr. Burns, and Dr. Shaw. They provided the most valuable insight throughout this process and their guidance was more than helpful every step of the way. I am truly thankful to have had the expertise of such passionate professors.

Dr. Hugo, thank you for taking me under your wing during this process. Your patience, guidance, and input were beyond appreciated and helped me grow both professionally and personally.

Dr. Burns, thank you for giving me the opportunity to be here in the first place. Your kind and optimistic nature provided encouragement when I needed it most.

Dr. Shaw, I never dreamed of writing a thesis until I encountered your enthusiasm and optimism in Research Methods – FCS 5900. Thank you for bringing excitement to research and writing.
# Table of Contents

Abstract.................................................................................................................iv

1. Introduction.........................................................................................................1
   1.1 Need for Study.................................................................................................2
   1.2 Purpose of the Study......................................................................................4
   1.3 Research Questions......................................................................................4
   1.4 Assumptions....................................................................................................4
   1.5 Definition of Key Terms..............................................................................5

2. Review of Literature.............................................................................................7
   2.1 Smartphone Applications and Weight Loss.................................................7
   2.2 Nutritional Messages and Behavior Change.............................................9
       Efficacy of nutritional messaging in childhood and adolescence............10
       Efficacy of nutritional messaging in adulthood.......................................11
       Theory base..................................................................................................15
   2.3 Continual Nutrition Counseling.................................................................18
   2.4 High Motivation Levels..............................................................................20
   2.5 Summary.......................................................................................................21

3. Methodology.........................................................................................................23
   3.1 Design of the Study......................................................................................23
       Intervention group.........................................................................................24
       Control group...............................................................................................25
       Midwestern weight-loss clinic.....................................................................26
   3.2 Sample...........................................................................................................27
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Recruitment of sample.................................................................28

3.3 Instrumentation/Measurement Description...........................................29

Demographic survey.................................................................29

Smartphone application pre-survey.................................................29

Smartphone application post-survey...............................................30

Control group post-survey...........................................................32

Nutritional messages.................................................................32

MyFitnessPal app.................................................................33

3.4 Procedure for Data Collection..................................................34

Qualitative data.................................................................34

Quantitative data.................................................................36

3.5 Data Analysis.................................................................36

Qualitative data.................................................................36

Quantitative data.................................................................37

4. Results.................................................................39

4.1 Participant Characteristics..................................................41

4.2 Weight Loss.................................................................41

4.3 Attitudes.................................................................44

Smartphone application..................................................44

Nutritional messages.................................................................47

4.4 Intervention Use..........................................................49

Smartphone application..................................................49

Nutritional messages.................................................................52
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

5. Discussion........................................................................55

5.1 Weight Loss..................................................................55

5.2 Attitudes.......................................................................57

Smartphone application......................................................57

Nutritional messages............................................................58

5.3 Intervention Use..........................................................60

Smartphone application......................................................60

Nutritional messages............................................................62

5.4 Theory Base...................................................................62

6. Conclusions....................................................................64

6.1 Implications...................................................................64

6.2 Limitations....................................................................67

Sample..................................................................................67

Duration.................................................................................68

Data collection.....................................................................68

Control group contamination.............................................69

References............................................................................70

Appendices..........................................................................77

A. Institutional Review Board Approval...............................77

B. Control Group Email......................................................78

C. Preexisting MyFitnessPal Account Intervention Group Email..............................79

D. Non-Account Intervention Group Email.............................80

E. Demographic Survey........................................................81
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

List of Figures and Tables

Table 1 – Characteristics of All Participants ................................................... .40
Table 2 – Individual Weight Loss ........................................................................... 41
Figure 1 – Weight Loss Comparison between Groups .............................................. .44
Figure 2 – Comparison of Pre- and Post-Intervention Positivity towards App .......... .46
Table 3 – Intervention Group Attitudes towards App .............................................. .47
Table 4 – Likert Scale Values of Attitudes towards Messages ................................. .48
Table 5 – Intervention Group Attitudes towards Messages ..................................... .49
Figure 3 – Weekly App Use within Intervention Group .......................................... .51
Figure 4 – Comparison of Weekly App Use between Groups ................................... .52
Figure 5 – Weekly Message Use within Intervention Group .................................... .53
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Abstract

Over the past decade, mobile technology has been developed in the hopes of improving health outcomes, especially related to weight loss. The purpose of this study was to evaluate the effectiveness of a smartphone application as a supplementary weight loss tool among highly motivated individuals. Twenty-five individuals over the age of 18 were included in the study based on BMI and participation in a Midwest weight-loss clinic. Intervention group participants (n = 13) were instructed to use the MyFitnessPal app to monitor food intake and receive SMS-style nutritional messages. The control group (n = 12) received no mobile-based intervention, but was not limited on their own use of the technology. All participants attended weekly nutrition counseling sessions at the clinic. Qualitative and quantitative measures were used to evaluate the effectiveness of the intervention. At the end of the four-week study, the amount of weight lost compared between groups was minimal. App use decreased among intervention group participants; however, more than half of the control group (n = 7) reported app use throughout the study. The nutritional messages were well-received by the intervention group and a positive correlation was found between message use and weight loss.

Although varied outcomes were determined, mobile technology should not be disregarded as an effective weight loss tool. Many participants reported positive feedback in regards to the app and more notably the nutritional messages, suggesting that mobile-based weight-loss interventions should consider the motivation levels and preferences of the individuals who are using them.

Keywords: weight loss, smartphone application, app, nutritional messages, SMS
Chapter 1

Introduction

In recent years, smartphone technology has begun to receive attention as a means for providing healthcare. The amount of smartphone applications (apps) available to consumers has reached six digits and continues to climb (Hibbard, Greene, & Overton, 2013). Healthcare providers have taken it upon themselves to use this technology to their advantage. Studies have shown that patients who are less involved in their healthcare have higher costs due to increased incidences of disease and other health issues (Hibbard, Greene, & Overton, 2013). Many members of the healthcare community now view apps as a way to communicate with and involve patients in their healthcare. Smartphone applications are often thought of as an “opportunity,” especially among registered dietitians, to provide healthcare interventions and nutrition education. Nutrition apps offer a range of services to their users, including access to nutrition information and providing a medium for dietary monitoring (Boyce, 2014).

According to the United States Department of Health and Human Services (2015), over two-thirds of adults in the United States are overweight, nearly 35% of which fall into the obese category. These rates are the highest of any developed nation (Mahan, Escott-Stump, & Raymond, 2011), which has contributed to Americans spending about $147 billion dollars on obesity-related medical costs each year. This is equal to an increased medical cost of nearly $1,500 per obese person per year (Finkelstein, Trogdon, Cohen, & Dietz, 2009). However, other countries are not immune from the epidemic that is now referred to as “globesity.” Obesity incidences have increased worldwide and are continuing to grow. This trend is due to a number of factors, including sedentary
lifestyles, increased portion sizes, and obesogens, which refer to chemicals that contribute to increased body fat by disturbing the body's normal metabolic behaviors. Among the most prevalent obesogens are those used in food packaging, such as bisphenol A and phthalates, which can infiltrate foods that come into contact with them (Mahan et al., 2011).

**Need for Study**

Research on the usefulness of smartphone application-based multidirectional approaches for overweight and obese patients is limited. In this case, a multidirectional approach for weight loss refers to combining a smartphone application, nutritional messages, and continual nutrition counseling. One study primarily investigated the effects of a nutrition smartphone application called “Lose It!” (Wharton, Johnston, Cunningham, & Sterner, 2014), while another study conducted by Laing, Mangione, Tseng, Leng, Vaisberg, Mahida, Bholat, Glazier, Morisky, & Bell (2014) examined the effectiveness of MyFitnessPal, an app used for dietary monitoring. The study also required participants to continue receiving usual primary care.

However, neither study evaluated the effect of nutrition messages on weight loss in addition to the app. Studies that have investigated nutrition messages, mostly in the form of short message service (SMS), include those by Hingle, et al. (2013), Fassnacht, et al. (2015), Shapiro, et al. (2008), Shapiro, et al. (2012), Haapala, et al. (2009), Gerber, et al. (2009), Hurling, et al. (2007), Fjeldsoe, et al. (2010), Kornman, et al. (2010) and Hebden, et al. (2014). While a few of these studies looked primarily at one-way text messaging in which researchers developed nutrition messages to send to participants (Hingle et al., 2013; Gerber et al., 2009; & Hurling et al., 2007), two of them went a step
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Further in order to evaluate more interactive, text-based approaches in which participants were encouraged to send researchers information and responses via text (Shapiro et al., 2012 & Haapala et al., 2009). Another study by Carter, Burley, Nykjaer, and Cade (2013) combined aspects of each of these studies by researching the weight loss effects of an approach that incorporated an app in addition to nutrition messages via text messaging.

Furthermore, none of these studies looked into the impact of continual nutrition counseling coupled with text or app-based weight-loss interventions. As stated earlier, the study by Laing et al. (2014) asked participants to continue receiving primary care, which could be viewed as a means of nutrition counseling. Patrick, Raab, Adams, Dillon, Zabinski, Rock, Griswold, and Norman (2009) investigated an interactive text-based nutrition program in which participants received phone calls from a health care provider once per month for counseling purposes. One study by Hebden, Cook, van der Ploeg, King, Bauman, & Allman-Farinelli (2014) did encompass all three aspects that were incorporated into this study. The weight-loss program incorporated a nutrition app and nutrition messages sent through SMS in addition to asking participants to meet one time with a registered dietitian. While a nutrition education session with a dietitian served as a valuable means of dietary counseling, it only occurred one time with each participant during the study. This study specifically sought out participants who had access to continual group nutrition counseling sessions on a weekly basis in order to create a more persistent weight-loss intervention.

Part of the appeal of smartphone applications and text message-based interventions for health care is that they can “stand alone.” This references the fact that they are viewed as convenient and personalized, thus making other interventions
unnecessary or excessive (Carter et al., 2013). However, studies that have only used these interventions led to indifferent outcomes. This study aimed to contribute to the smartphone application research database by investigating the effectiveness of apps in addition to nutrition messages on weight loss in highly motivated individuals who attended regular nutrition counseling sessions.

**Purpose of the Study**

The purpose of this study was to evaluate the effectiveness of a smartphone application as a supplementary weight-loss tool among highly motivated individuals. Additionally, the study assessed participants' feelings and attitudes toward smartphone application use as an aid for weight loss.

**Research Questions**

1. To what extent did the use of a smartphone application, in addition to regular nutrition counseling, impact the amount of weight lost by the participants?

2. What were the participants' attitudes toward the use of a weight loss smartphone application?

3. What were the participants' attitudes toward receiving nutritional messages through the smartphone application?

4. How often did participants use the smartphone application, including the nutritional messages, in order for it to have an impact?

**Assumptions**

For the purpose of this study, assumptions were made regarding the participants' integrity and intentions. Assumptions for the purpose of this study included the following:
1. Participants were committed to completing the duration of the study and met all of the expectations of the intervention (i.e. attended all counseling sessions and used the app and nutritional messages to the best of their ability).

2. Participants did not lose motivation during the study to complete their intervention tasks, thus minimizing the potential for decreased intervention adherence.

3. Participants answered the provided surveys and questionnaires honestly and to the best of their ability, creating unbiased and authentic results.

Definitions of Key Terms

Terms used throughout this study include:

1. Body mass index (BMI) – a value used to categorize an individual’s body mass based on the formula weight/height$^2$, which is measured in units of kg/m$^2$ (Mahan, Escott-Stump, & Raymond, 2011).

2. Obese – “condition of excessive fatness, either generalized or localized” that refers to individuals with a body mass index greater than or equal to 30 kg/m$^2$ (Mahan, Escott-Stump, & Raymond, 2011, p. 469).

3. Overweight – condition in which an individual’s weight exceeds the recommended amount based on standards predetermined by their height; individuals with a body mass index between 25 and 29.9 kg/m$^2$ (Mahan, Escott-Stump, & Raymond, 2011).

4. Motivation – influences, including thoughts, emotions, and actions, that are focused on achieving an objective; “striving for a goal” (Weiner, 2000, p. 316).

For the purposes of this study, a motivated individual refers to one who is
following a very-low-calorie diet and regularly attending weekly nutrition counseling.

5. Very-low-calorie diet (VLCD) – a diet used to treat obesity, as well as other medical conditions, in which 400-800 calories are consumed on a daily basis. VLC diets are considered to be safe under medical supervision and when sufficient protein, carbohydrates, vitamins, and minerals are provided either through the diet or supplementation (Anderson, 2008).
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Chapter 2

Review of Literature

Weight loss is a difficult journey that requires patience and dedication. Due to the increase in number and potential of nutrition-based smartphone applications, many registered dietitians have turned to technology for patient support (Boyce, 2014). Smartphone applications offer a variety of services to engage their users; however, these interventions are not always enough to help patients reach their goals. In many cases, patients have low involvement in weight-loss programs, which can lead to setbacks such as program cessation or weight regain. Therefore, weight-loss programs must be adapted to encourage higher levels of participant interest and commitment (Shapiro, Koro, Doran, Thompson, Sallis, Calfas, & Patrick, 2012).

Smartphone Applications and Weight Loss

Due to the growth of smartphone applications, dietary monitoring can now be completed through cell phone devices. This technology has decreased the inconvenience that is often associated with diet tracking (Wharton et al., 2014), but do apps serve as an effective dietary aid? One study conducted an eight-week weight loss trial on 47 men and women during which researchers compared monitoring via smartphone to the traditional method of dietary logging, the “pencil-and-paper” method (Wharton, Johnston, Cunningham, & Sterner, 2014). The researchers examined two different forms of smartphone dietary monitoring; one group used an app called “Lose It!” and another group used a memo feature. Between the three groups (control group and app and memo feature intervention groups), both smartphone groups recorded the highest numbers of completed food record days. Additionally, the “Lose It!” app group had the lowest
number of missing days, which in this case refers to a day when no food intake was recorded at all. After the eight-week trial, each of the three groups lost weight; however, there was no significant difference in the amount of weight lost among them. Interestingly, the dietary quality of the app group fell by about 6%, while there was little to no difference seen in the other two groups.

Similar findings were observed in the study conducted by Laing, et al. (2014) in which usual primary care without dietary monitoring was compared to primary care in addition to the “MyFitnessPal” app. At the end of the six-month study, the app group lost only about half a pound more than the control group, making the amount of weight lost between the two groups insignificant. Additionally, the consistency of MyFitnessPal use decreased dramatically by the end of the study.

Similarly, Carter and researchers (2013) compared the effectiveness of a diet-tracking smartphone application, website, and pencil-and-paper method on weight loss over a six-month period. Researchers found that the smartphone application was associated with more positive outcomes overall. The app group averaged a total of 92 completed food log days. This was approximately three times higher than both the website and pencil-and-paper groups (35 and 29 days, respectively). Additionally, the app group had the highest satisfaction rates out of the three groups and was found to be the most convenient method of dietary monitoring. Changes in BMI and body fat percentage were seen in all three groups; however, the greatest differences occurred among app group participants with a decrease in BMI of 1.6 kg/m² and a decrease in body fat of 1.3%. Still, these changes were relatively minor in relation to the other two groups, in which BMI decreased by 0.5 kg/m² in the website group and 1 kg/m² in the pencil-and-
paper group. The results of this study indicated that while apps are typically received well by participants overall, they did not necessarily impact weight loss at a significant level.

In 2014, Hebden et al. (2014) studied behavior change as a result of a mobile phone health intervention including multiple features, such as apps, text messaging, and online forums. While the body mass index and weight changes in the mobile intervention group were comparable to the above studies, some significant differences were seen in overall behavior changes in both groups. Vegetable consumption increased by about one serving per day, while sugary beverage consumption and dining out decreased in both groups by the end of the study. The amount of change between these groups was negligible; however, a significant amount of behavior change was seen in the mobile intervention group in regards to daily physical activity. Intervention group participants performed nearly 25 minutes more of activity than the control group, who did not receive the mobile phone intervention. While the reviewed findings suggest that nutrition applications have minimal impact on weight loss, there is still potential for apps to be useful in this area. Other features of smartphone applications, such as messaging portals, can be used as a vehicle for nutritional messages to be sent to users, thus creating more potential for positive weight loss outcomes.

**Nutritional Messages and Behavior Change**

Nutritional messages sent via smartphone technology is another health intervention that has received recent attention as a possible vehicle for patient involvement, especially related to weight loss (Shaw & Bosworth, 2012). Often delivered through text messaging, nutrition messages can be educational and/or motivational in order to promote behavior change and improvements in health outcomes. One reason text
messaging seems to work well as a health care aid is because of its basis on “push” technology, referring to its ability to serve more as a reminder than a burden. Additionally, text messages can be tailored to fit individual needs and wants in a way that is convenient. Other technology-based mediums for health care often require users to search through excessive amounts of additional information in order to find what they want, rather than having it readily and easily available to them (Gerber, Stolley, Thompson, Sharp, & Fitzgibbon, 2009).

**Efficacy of nutritional messaging in childhood and adolescence.** An important factor to consider with text messaging interventions is the target audience. Younger generations have been investigated as recipients of this type of intervention, which has proven to be effective in promoting behavior change (Shapiro, Bauer, Hamer, Kordy, Ward, & Bulik, 2008). The average daily fruit and vegetable consumption both increased by nearly one serving after an eight-week text message intervention in children ages eight to ten (Fassnacht, Ali, Silva, Gonçalves, & Machado, 2015). A different eight-week study, during which children monitored and recorded behaviors, including sugar-sweetened beverage consumption and physical activity via text message, found that 43% of the participants used the intervention daily. While no significant differences were seen between the intervention and control groups concerning sugary beverage consumption and physical activity, the text message program was still preferred by the children and had a high acceptance rate (Shapiro et al., 2008).

The Loozit Study conducted by Kornman et al. (2010) studied the effects of a text and email-based intervention during which partially personalized nutrition messages containing educational and encouraging content were sent to overweight and obese
adolescents between the ages of 13 and 16. The text messages and emails were sent monthly, except during school holidays (during which messages were sent every two weeks), for 10 months. Participant (n = 49) engagement with the intervention was measured by replies to the nutrition messages. Nearly one-quarter (22%) of the messages received responses and a minimum of one response was received throughout the intervention by nearly 88% of the participants. Researchers also investigated participant satisfaction with the messages, which resulted in indifferent outcomes. Slightly more than half of the participants (n = 27) regarded the text messages as some degree of helpful, while seven (14%) of the participants viewed the messages as unhelpful. This outcome was slightly different than the ones for the messages sent via email, in which 29 participants (59%) regarded the messages as either “very helpful” or “somewhat helpful” and only four participants (8%) thought the messages were not helpful. Nonetheless, the text-based nutrition messages were received more quickly by researchers than the ones sent via email. While behavior change and health outcomes were not considered during the Loozit Study, the program was considered to be somewhat acceptable based on participants’ engagement. However, participants’ message responses suggested that some progress on dietary and other lifestyle behaviors was being made.

Efficacy of nutritional messaging in adulthood. While text-messaging interventions have somewhat positive results with children and adolescents, the adult population has had more inconsistent experiences with text message-based nutrition interventions. Haapala, Barengo, Biggs, Surakka, and Manninen (2009) found that individually tailored nutrition text messages sent three to eight times weekly for one year resulted in an initial weight loss of nearly 10 pounds in the text message intervention
group compared to a total loss of about only 2.5 pounds in the control group who received no text messages. The amount of weight lost by the intervention group was the highest during the first six months of the study; however, partial weight regain eventually occurred during the last half of the study. Patrick and researchers (2009) found that text messages containing nutrition tips and positive reinforcement sent three to five times daily resulted in a loss of less than 4.5 pounds after four months, which was considered insignificant. Although it should be noted that the text messaging intervention was received well by the participants as indicated by the high levels of compliance.

A study by Shapiro et al. (2012) produced similar findings. The program used in this study, called Text4Diet, was developed by researchers to aid in behavior modification among adults ages 21 to 65. Topics targeted by the intervention included overall dietary habits, sugary beverage consumption, physical activity, and daily step count. Information, tips, and motivation in regards to these subjects were provided to participants via text messaging and MMS (multimedia messaging services), which included pictures and other graphics. Overall, the amount of weight lost by both groups was minimal at the end of the one-year intervention, although the text messaging group lost slightly more weight than the control group. However, the number of steps taken per day by the intervention group participants dramatically increased by the end of the study. Participants receiving the text messages increased their step count by an average of 3,000 steps per day. Also of note is the correlation that was found between the number of text message responses and the amount of weight lost. Participants who responded to the text messages more frequently each day were found to lose more weight than the participants who responded to fewer texts.
The amount of physical activity also increased as a result of a text message-based intervention completed by Hurling, Catt, De Boni, Fairley, Hurst, Murray, Richardson, and Sodhi (2007). The intervention consisted of a combination approach utilizing text messaging, email, and an online message board to encourage increased physical activity levels among participants between the ages of 30 and 55. The individualized nutrition messaging system allowed participants to choose certain characteristics of the intervention. Participants identified areas needing improvement and received tailored motivational messages based on their personal barriers to physical activity. At the end of the nine-week study, participants in the intervention group were found to have an increase in weekly physical activity of two hours and 18 minutes, which was significantly higher than the control group. Positive responses regarding the intervention method were also found by researchers on the message board, indicating program satisfaction.

In a similar study, Fjeldsoe, Miller, and Marshall (2010) also researched physical activity behavior changes as a result of a text-based intervention. The 12-week study consisted of 88 post-natal women, half of which (n = 45) were exposed to a text message intervention called MobileMums. The frequency of the individually tailored messages received each week ranged from five and three text messages, while the message content targeted the participant’s various physical activity goals, forms of social support, and perceived benefits of physical activity. Researchers found that a large majority of the intervention group participants (84%) met their predetermined physical activity goals at the end of the study. This number was found to have a positive correlation with “goal check” responses, meaning those who responded to the check-up text messages more frequently also reported meeting their physical activity goals more often than those who
did not respond to the text messages. Additionally, the intervention group was found to have an increase in daily physical activity (defined as at least 30 minutes of exercise in a day) by 1.82 days/week. This can be compared to an increase in physical activity of only 0.24 days per week seen in the control group. Intervention acceptability among the intervention group was considered to be useful to some degree by 93% of the participants. However, participant intervention use did decrease throughout the course of the study.

The Obesity Reduction Black Intervention Trial (ORBIT) by Gerber et al. (2009) utilized a highly personalized nutrition message intervention in which participants were prompted to choose message content, timing, and frequency. In addition to the personal messages containing reminders or motivation, participants also received non-personalized nutrition and physical activity messages created by the researchers. An average of three messages were sent via text message to the participants each week. Researchers found that the text messages were highly accepted among the participants as evidenced by the high rates of self-reported dedication to reading the messages. Additionally, many participants reported that the messages had a positive influence on their dietary behaviors.

The study conducted by Hingle, Nichter, Medeiros, and Grace (2013) did not research behavior change as a result of text message interventions, but rather investigated the reactions to the communication style of nutrition and physical activity-related messages. More specifically, researchers determined preferences among adolescents (n = 177) in regards to message style and language through focus groups and classroom discussions. Researchers found that the adolescents had an overall interest in receiving
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

nutrition-related text messages; however, shorter message lengths were favored. Message content relevant to the age group included in the study was better received by the adolescents and created greater relatability to the messages. Additionally, the message tone was found to have influence over the acceptability of the text messages. An authoritative language style was not preferred by the adolescents, which used a more demanding tone. Instead, participants desired a more passive tone be used in the messages, which used words such as “try” in place of words like “always.” Based on the outcomes of each of these studies, text-message based nutrition interventions seem to be positively regarded overall by those that receive them. Additionally, these studies suggest that nutrition messages via text messaging services have the capability to promote weight loss and/or behavior change. Given that it is a newer method of weight-loss intervention, more research is required for enhanced use and outcomes (Shaw & Bosworth, 2012).

Theory base. Nutrition education programs, including sending nutritional messages through text messaging, often lead to more positive outcomes for the audience when they are constructed using proven educational theories, such as the transtheoretical model (TTM). The TTM suggests that the process of behavior change occurs in five stages, each derived from an individual’s psychological and behavioral tendencies (Contento, 2016).

The first of these stages, precontemplation, occurs when an individual does not recognize that a behavior change may be necessary. This stage can occur for various reasons, including unawareness, disinterest, and neglect. The next stage, contemplation, refers to the time when an individual begins to consider the possibility of behavior change due to the benefits changing can provide them. However, the decision to make the
behavior change is not absolute during this stage and individuals often struggle with the reality that changing the behavior will be a difficult task. The third stage, preparation, represents the intention for an individual to change. During this stage, individuals have decided that they will commit to a behavior change and have begun the first steps to making that happen. The action stage signifies the time when an individual actually practices the new behavior change and figures out what works best for them in order to make that behavior change long-term. An individual enters the final stage of the TTM, the maintenance stage, when they have adopted the behavior change for longer than six months. At this point in the TTM the behavior change has been made long-term; however, self-discipline is still necessary in order to integrate the change into their lifestyle (Contento, 2016).

One major benefit of the transtheoretical model regarding nutrition education is that it allows for tailored interventions, meaning once an individual’s stage of change is identified the intervention can be adapted to that phase. Using the TTM in such a way better supports the movement an individual through the rest of the stages of change. Johnson & Evers (2015) state that the TTM can be successfully implemented through text message-based interventions when an individual’s stage of change has been identified. However, the intervention must be different depending on the recognized stage in order to fully engage the individual’s readiness to change. Therefore, the frequency of the text messages and the content contained in each message should vary as progress is made through the subsequent stages of change.

A study conducted by Park, Nitzke, Kritsch, Kattelmann, White, Boeckner, Lohse, Hoerr, Greene, and Zhumin (2008) compared a TTM-based Internet intervention
to a non-TTM nutrition education intervention. Researchers found a 17.6% increase in
the number of participants in the TTM-based intervention group (n = 58) who moved
from pre-action stages (precontemplation, contemplation, and preparation) to the
action/maintenance stage regarding vegetable consumption, while the control group (n =
53) saw a 10.4% increase in positive movement through the stages of change. Based on
these percentages, the number of intervention group participants who moved to the
action/maintenance stage was significantly different compared to those in the control
group. However, similar trends were not seen regarding the participants’ fruit
consumption. When the two groups were compared, the difference in the number of
participants who moved through the stages of change was not significant, although both
groups saw positive increases in fruit consumption (24.4% in the control group and
21.8% in the intervention group). Also of note was the finding that the majority of
intervention group participants reported an increase in their confidence and motivation
regarding their vegetable intake. While not all behaviors underwent significant changes
as a result of the TTM-based intervention, the program influenced overall positive
outcomes related to the participants’ movement through the stages of change and led to
an increase in positive dietary behaviors, including fruit and vegetable consumption.

A different study by Lana, Faya-Ornia, and López (2014) tested the effects of a
nutrition education website on cancer risk behaviors in adolescents. The website was
based on the TTM, as well as one other educational theory, and applied to two
intervention groups. One intervention group received only the website, while the other
intervention group received access to the website along with nutritional text messages.
After the 9-month study was completed, the website and text message group (n = 244)
saw the largest decrease in insufficient fruit intake (-71.5%) and excessive fat intake (-9.6%). This group also saw the only decrease in overweight/obesity during the study with a decrease of 19.6%, while both the control (n = 316) and website-only intervention (n = 177) groups increased in overweight/obesity prevalence. However, not all cancer risk behaviors were positively influenced by the TTM-based website and text messages. Sedentary behavior increased by 3.7% in this group and insufficient vegetable intake increased by 5.4%. Nonetheless, the intervention groups both encountered significant decreases in TCBR (total cancer behavioral risk) scores. The website-only intervention group decreased their TCBR score by 3.5 points, while the website and text message group decreased TCBR scores by 5.3 points, which was higher than any other group. While not all outcomes from the two previous studies led to entirely clear findings, they still produced meaningful results and positive implications for TTM-based web and text nutrition education interventions.

Continual Nutrition Counseling

Insufficient research has been conducted on the efficacy of a multifaceted weight-loss intervention pairing weight loss smartphone applications with continual nutrition counseling. Of the studies previously discussed, none incorporated a combined weight loss approach utilizing a smartphone intervention and multiple face-to-face counseling sessions. The study conducted by Hebden et al. (2014) required participants to meet with a registered dietitian one time prior to the study. During the meeting, participants were provided with a 10-page nutrition booklet, which contained information such as energy requirements, the recommended number of daily servings of the food groups for men and women, and the macronutrient distribution ranges. In the study by Christian et al. (2008),
the intervention group participants met with a physician one time during the 12-month period. The physicians were made aware of individual participant’s goals in order to better counsel each patient and provide motivation. The study conducted by Laing et al. (2014) combined a weight loss app with usual primary care for the intervention. However, neither a one-time meeting with a dietitian or physician nor primary care are as rigorous as regular nutrition education and counseling sessions. The study conducted by Patrick et al. (2009) included once monthly phone counseling sessions in addition to the text message intervention. The phone sessions lasted approximately five to 15 minutes and covered topics related to the app’s functions as well as participant’s concerns regarding the app, their current dietary habits, and their personal progress towards their goals.

In a meta-analysis conducted by Dansinger, Tatsioni, Wong, Chung, and Balk (2007), the effectiveness of dietary counseling was compared to the effect of usual care on weight loss. The analysis included 46 dietary counseling programs ranging from 2.5 months to two years. Researchers determined that the dietary counseling programs resulted in a nearly two-unit decrease in overall body mass index during the greatest points of efficacy. When compared to usual care outcomes, dietary counseling yielded increased weight loss results.

Furthermore, Christian, Bessesen, Byers, Christian, Goldstein, and Bock (2008) demonstrated the significance face-to-face counseling has on weight loss in patients with type 2 diabetes mellitus. Prior to the counseling sessions, 273 overweight and/or obese participants completed questionnaires identifying personal obstacles relating to their health goals in order to better tailor each individual’s counseling sessions. Throughout
the one-year study, intervention group participants ($n = 141$) met with a counselor every three months, while the control group ($n = 132$) only received usual primary care. As a result of the counseling sessions, intervention group participants achieved positive outcomes related to their physical activity levels with number of participants reaching the recommended 150 minutes of physical activity each week doubling by the end of the study. While significant differences between the amount of weight lost were not seen between the two groups, twice as many intervention group participants were able to maintain the weight loss recommendation of 5% total body weight compared to the control group. Additionally, total cholesterol and low-density lipoprotein levels were significantly decreased in the intervention group at the end of the study. The moderate findings from Dansinger’s meta-analysis along with the overall positive results from the study by Christian et al. suggest that dietary counseling tends to have a greater impact on weight loss than usual care.

**High Motivation Levels**

There is also a lack of research surrounding the use of smartphone applications for weight loss in highly motivated individuals. None of the aforementioned studies targeted samples with high motivation levels. Rather, they focused mainly on collecting participants based on overweight and obese BMI classifications. The study by Christian et al. (2008) comments on the importance of the role of motivation during times of health behavior change. The study revealed that participants valued health care provider support more than any other aspect of the intervention.

Implications from the study conducted by Laing et al. (2014) suggest that readiness to change in addition to commitment to calorie-counting play an important role
in determining whether or not an individual should be recommended an app for weight loss aid. While overall use of the weight loss app decreased substantially by the end of the study, one participant stood out from the rest. This participant recorded the highest individual numbers for total MyFitnessPal logins in addition to losing 29 pounds, which was drastically higher than the app group as a whole. A similar situation was also seen in the study conducted by Carter et al. (2013). One participant placed in the pencil-and-paper dietary monitoring group acknowledged the use of a weight loss smartphone application throughout the study. The participant lost a total of 70 pounds during the six-month period, which was significantly higher than the entirety of each of the three groups. These instances seem to insinuate a correlation between high motivation levels and increased weight loss app effectiveness.

Summary

The increase in available smartphone programs has led many registered dietitians to smartphone technology for patient support (Boyce, 2014). Technology, such as nutrition messages sent through text messaging and dietary monitoring via apps, has become particularly useful for individuals who are trying to lose weight (Shaw & Bosworth, 2012). Although findings related to these weight-loss interventions are inconsistent, occasional positive outcomes have warranted further investigation to reap their potential benefits (Stephens & Allen, 2013). This study attempted to use a targeted intervention approach including weekly nutrition counseling, a diet-tracking smartphone application, and tri-weekly motivational and educational nutrition messages. The focus of this study was to determine the effectiveness of a smartphone application that functioned as one part of a weight-loss intervention, rather than the app serving as the entire
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

intervention, with the intent of leading to more desirable weight-loss outcomes for the overweight and/or obese patient.
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Chapter 3

Methodology

The purpose of this study was to evaluate the effectiveness of a smartphone application as a supplementary weight-loss tool among highly motivated individuals. This study focused on determining if a combination weight-loss approach including a smartphone app, nutritional messages, and weekly nutrition counseling had a positive impact on the amount of weight lost by the participants. This study also assessed feelings and attitudes toward the app and nutritional message intervention and determined if there was a connection between the amount each of these components were used and how much weight was lost by the participants. Based on these outcomes, this study assessed whether or not a smartphone application was a useful addition to a preexisting weight-loss intervention.

Design of the Study

Approval to conduct research was granted by the Eastern Illinois University Institutional Review Board (#16-029) via email (Appendix A). The study was a randomized, controlled design, similar to the studies conducted by Brown et al. (2014), Carter et al. (2013), Fassnacht et al. (2015), Fjeldsoe et al. (2010), Hebden et al. (2014), Laing et al. (2014), Shapiro et al. (2012), and Wharton et al. (2014). A majority of current research in this area utilized a mixed methodology in order to assess quantifiable changes in anthropometric measurements and subjective outcomes related to intervention satisfaction (Hebden et al., 2014; Carter et al., 2013; Laing et al., 2014; Hurling et al., 2007; Shapiro et al., 2012; Shapiro et al., 2008; & Fassnacht et al., 2015). Therefore, a similar approach was used to collect data through quantitative surveys with open-ended
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

questions and anthropometric measurements. The study consisted of a control and intervention group in order to compare weight loss outcomes as a result of using the smartphone applications, which was an approach taken by previous researchers to compare anthropometric measurement and behavior changes in intervention versus control groups (Patrick et al., 2009; Haapala et al., 2009; Christian et al., 2008; Fassnacht et al., 2015; Shapiro et al., 2012; Shapiro et al., 2008; Hurling et al., 2007; Laing et al., 2014; Wharton et al., 2014; Carter et al., 2013; & Hebden et al., 2014).

**Intervention group.** The intervention group received a three-part weight-loss intervention consisting of 1) a smartphone application, 2) nutritional messages, and 3) weekly nutrition counseling. This intervention was adapted from the program used by Hebden et al. (2014). The smartphone application used in this study was a preexisting app called MyFitnessPal, which was based on the study conducted by Laing et al. (2014) in which the same app was also used as a part of the intervention. This app was chosen due to its high interest levels among focus group participants and satisfactory levels among participants at the end of the study. The purpose of MyFitnessPal for this study was to serve as a means of daily dietary monitoring. Each of the intervention group participants were “friended” on MyFitnessPal upon account setup in order to track individual app use and to serve as a vehicle for the nutritional messages.

The nutritional messages used in this study were sent to the intervention group participants via the MyFitnessPal app messaging portal. The studies conducted by Carter et al. (2013) and Hebden et al. (2014) used a similar method of combining an app and nutritional messages. For this study, the messaging approach was based primarily on the model used by Hebden et al. (2014) in which messages aimed to inform and promote
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

behavior change. This system was found to have a high satisfaction and usage rate among participants. The tone of the messages used in this study took into consideration the findings from Hingle and researchers (2013). Consequently, the nutritional messages created by the researcher were brief and tailored to the participants’ age group, which were preferable characteristics among the participants of a previous study (Hingle, et al., 2013). Additionally, the messaging portal that was used through MyFitnessPal allowed for two-way communication between the researcher and participants. Therefore, intervention group participants were able to ask questions and receive more information if they wished on any topics covered in the messages. This type of researcher-participant communication showed potential for increased participant engagement in the intervention according to Hingle et al. (2013).

Additionally, the intervention group participants attended weekly nutrition counseling and educational sessions. The meetings occurred in a face-to-face group setting and were conducted by trained staff members at the Midwestern weight-loss clinic. Participants attended the meetings one time each week, which lasted approximately one hour. This component of the intervention was lacking in previous studies that incorporated counseling aspects into smartphone interventions (Laing et al., 2014; Patrick et al., 2009; & Hebden et al., 2014). Therefore, this study aimed to increase the research available on persistent nutrition counseling as a part of a smartphone-based weight-loss intervention.

**Control group.** Participants in the control group attended the same weekly nutrition counseling sessions as the intervention group participants. The control group did not receive any smartphone interventions implemented by the researcher, including the
MyFitnessPal app and nutritional messages. However, the control group participants were not restricted from using smartphone technology for weight loss purposes on their own. Previous studies, including those by Laing et al. (2014) and Carter et al. (2013), did not prohibit individuals in the control group from using nutrition applications as a part of their own weight loss aid. As a result, significant outcomes regarding the weight loss of two control group participants in relation to smartphone apps were found. For that reason, this study also did not place restrictions on the control group participants concerning app use.

**Midwestern weight-loss clinic.** A particular local weight-loss clinic was chosen for inclusion in this study due to their reputable and safe program, including weekly counseling/education sessions and specialized staff members. The weight-loss clinic used for this study has been in business since 2008 and has been awarded the Outstanding Achievement Award by the Robard Corporation for 2013, 2014, and 2015. The program was developed by medical professionals and has a panel of four physicians who specialize in either endocrinology or internal medicine, which demonstrates the reliability of the programs offered through the clinic. Furthermore, the staff members brought on by the clinic to educate, counsel, and encourage clients include individuals who have a minimum of a bachelor’s degree in areas relating to nutrition, exercise science, and/or psychology.

The programs offered at the weight-loss clinic include very low calorie diets (VLCD), low calorie diets (LCD), or hybrid programs, which combine aspects of both VLCD and LCD. VLCD and LCD involve reduced calorie diets. Maintenance of the various diet programs is achieved through meal replacement plans utilizing nutritionally
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS? 27

complete shakes, bars, and snacks, which were created by a team of registered dietitians and scientists. Once goal weights have been reached or are within five to 10 pounds of an individual’s goal, clients are then advanced to the “adapting” or “sustaining” phases of the program. The former requires increasing calories and re-introducing solid foods, while the latter involves weight maintenance for long-term success. Due to the program’s intensity, close medical supervision is required throughout the program by professionals.

In addition to the weight-loss programs, clients are also required to attend weekly nutrition education sessions, which are conducted in a group setting by trained staff members. The classes cover a range of topics related to nutrition and behavior including general nutrition information (e.g. recommended daily intake and portion sizes) and relapse prevention. Clients can also attend individual counseling sessions throughout their weight loss program if they wish (S. Janvrin, personal communication, March 31, 2016).

Sample

The sample included adult men and women who were currently enrolled in the weight-loss clinic discussed previously. Initial inclusion criteria for this study required participants to be overweight or obese based on their BMI measurements and to have been a patient at the weight-loss clinic for at least one month in order to maintain consistency with the intervention assumptions and expectations. However, due to the low number of participants during recruitment, exceptions were made for individuals who were maintaining their weight, but not necessarily considered overweight or obese, and for individuals who had been in the program for less than one month. Therefore, inclusion criteria for this study was 1) a BMI considered overweight and/or obese or 2) a
BMI of normal, but still monitoring weight status and following special weight-loss clinic diet plans. Additionally, participants were maintaining VLCD, LCD, hybrid, or sustaining diets through the clinic and had been enrolled at the clinic for any length of time.

Recruitment of the sample. A purposive sample was used for this study due to the need for participants who were actively involved in nutrition education and/or counseling sessions with a trained professional and cleared for safe, monitored weight loss. Participants were recruited from a local Midwestern weight-loss clinic through word-of-mouth and email. One clinic staff member was prompted to read a script promoting participation in the study at the beginning of each counseling session for one month prior to the study.

After individuals gave consent to participate in the study, they were randomly placed into the control or intervention group, which was determined by the researcher drawing patient numbers (i.e. numbers assigned by the weight-loss clinic) from a hat, a method that was deemed effective by Leedy and Ormrod (2013). Once the participants were separated into groups, they received emails from the researcher with instructions on how to complete the study, which corresponded with group placements. Furthermore, participants in the intervention group received one of two emails based on their response to the smartphone application pre-survey indicating preexisting MyFitnessPal accounts. If participants already had a MyFitnessPal account, as indicated on the pre-survey, they were sent friend requests by the researcher through the app. If participants did not have a MyFitnessPal account, they were sent an email asking them to download the app and
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

create an account. Various emails sent to participants in both groups can be found in Appendices B, C, and D.

Instrumentation/Measurement Description

**Demographic survey.** The survey (see Appendix E) consisted of five questions regarding participants' gender, age, race, education level, and income level. The purpose of the survey was to determine the heterogeneity of the sample. Questions and answer choices were adapted from the U.S. Census in order to determine appropriate terminology as well as ranges for age and income level. This survey was given to all participants prior to the study. Additionally, a sixth question was added to the survey that asked for the email addresses of the participants. This information was used to communicate with the participants throughout the study regarding instructions for participation as well as to carry out the recruitment process.

**Smartphone application pre-survey.** The pre-survey (see Appendix F) consisted of a total of six questions, which evaluated the participants' attitudes toward smartphone applications as a weight loss tool prior to the beginning of the study. Questions inquired participants' previous experience with weight loss/nutrition apps as well as information about the frequency of use and feelings toward the app. This survey’s first question about previous app use was in a yes/no format. Following the first question, an additional question was added specifically for individuals who had a preexisting MyFitnessPal account in which they were asked to provide their account username or email to the researcher. The purpose of this was to allow the researcher to send friend requests to the participants in order to increase the simplicity of the intervention and thus increase the likelihood of participation. The remaining three questions regarding frequency of use and
feelings toward the app used Likert scales. Both the 4- and 5- point Likert scales found in these questions were the same as those used in the other surveys, which is discussed in the following subheadings. This part of the survey was developed through the literature review (Shapiro et al., 2008; Hebden et al., 2014).

The final two questions assessed the participants’ stages of change according to the transtheoretical model. The purpose of these questions was to determine the majority of the participants’ readiness to change in order to tailor the content and tone of the weekly nutritional messages to the appropriate stage. One question used a multiple choice format, while the other utilized a 4-point Likert scale. The multiple choice question assessed the length of patient enrollment at the weight-loss clinic, ranging from just starting the program to being in the program longer than six months. In regards to the Likert scale question, an answer of one indicated that the participant was “not confident” that the weight-loss clinic would help them achieve their weight loss goals and four signified that the participant was “very confident.” These two questions were adapted through the literature review (Park et al., 2008). However, a five-point scale was not used like in the study conducted by Park and researchers (2008) due to the implications from Leedy and Ormrod (2013), which warn about the disadvantages of offering an option for a neutral response.

Smartphone application post-survey. The post-survey (Appendix G) included 10 questions. The first two questions assessed the participants’ frequency of use of both the app and the nutritional messages. The remaining four questions located in Part 1 of the survey inquired participants’ feelings about the role of the app and nutritional messages regarding their weight loss and whether or not they found them to be effective.
This part of the questionnaire was assessed through a Likert scale, numbered one through four, with the exceptions of the first and second questions. One indicated an answer of “not at all,” while four indicated an answer of “definitely.” Numbers two and three signified feelings somewhere in between the former (i.e. “no” and “yes”). A number corresponding with a “neutral” response to the questions was excluded from the survey based on implications from Leedy & Ormrod (2013), which suggest that allowing for impartial responses may dampen conclusions. The first question found in Part 1 of the survey, assessing participants’ weekly use of the app and nutritional messages, used a 5-point Likert scale. An answer of one indicated that participants “never” used the app, while five corresponded with “every day” use of the app. Numbers two through four will designate responses that fall in between the two former numbers, including specific answers of “1-2 days,” “3-4 days,” and “5-6 days.” The second question, inquiring participants’ weekly use of the nutritional messages, used a 4-point scale that indicated that participants read “every” message each week or “never” read any of the nutritional messages. Responses that fall in between these numbers corresponded with reading “1 message” or “2 messages” out of the three messages sent to the participants each week.

The four questions found in Part 2 of the survey assessed the participants’ likes and/or dislikes about the app and nutritional messages through open-ended questions. Participants were provided with space following each question to describe their thoughts and feelings. However, if an individual felt they did not have an opinion or comments related to a question, “N/A” was provided in the blank. This served as a control for unfinished surveys; if participants wrote “N/A” in the space following a question it signified they answered the question, rather than possibly unintentionally missing the
question and leaving it blank. This survey was developed through the literature review (Laing et al., 2014; Fassnacht et al., 2015; Shapiro et al., 2008; Hebden et al., 2014).

**Control group post-survey.** This survey (Appendix H) was made up of four questions total in order to assess if any participants in the control group used a nutrition-related app during the study. The purpose of this survey was to control for any variables that may affect the weight loss outcome for the control group. The first question was to determine which app, if any, was used during the study. The remaining three questions used a Likert scale to determine participants’ feelings toward the app and whether or not they believed it led to any additional weight loss. The 4- and 5-point Likert scales incorporated in this survey were the same as those used in the previous surveys discussed. This survey was based on the literature reviewed (Laing et al., 2013 & Carter et al., 2013).

**Nutritional messages.** The nutritional messages (Appendix I) were sent to the intervention group participants three times per week over the course of the four-week study through the MyFitnessPal app messaging portal. Twelve nutrition messages were developed in total by the researcher. The topics of the messages were targeted to adults and adapted from the 2015-2020 Edition of the *Dietary Guidelines for Americans*. This entity was chosen as the basis for the nutrition messages due to its recommendations, which are supported by scientific evidence and reflect the current needs of Americans (Executive Summary, 2016). The content included facts, tips, and motivation concerning information on the recommended serving sizes of each of the five food groups as well as recommendations on what types of foods from each food group are healthiest. Additionally, the messages offered information on physical activity recommendations
and tips for healthier eating. The tone of the messages took into account the findings from the study conducted by Hingle et al., (2013) in which it was found that participants preferred messages that were short, straightforward, and directly related to their age group. Additionally, messages that used words such as “try” instead of “never” or “always” were received better by the participants. Therefore, these findings were applied to the nutritional messages that were developed for use in this study.

The nutritional messages were targeted to the majority of the intervention group participants’ stage of change according to TTM criteria. As mentioned earlier, the final two questions of the smartphone application pre-survey assessed the participants’ length of time enrolled at the weight-loss clinic as well as their confidence levels regarding the weight loss program’s efficacy. Based on the responses, a majority of the participants were placed in the action phase of TTM, which requires actual practice of the behaviors necessary to promote change as well as feelings of self-efficacy toward those behaviors. As a result, the nutritional messages were “stage-matched” to individuals included in this study, which has been shown to be successful in previous nutrition education interventions (Contento, 2016).

**MyFitnessPal app.** The MyFitnessPal smartphone application was created by software engineers as well as dietitians to act as a food record and calorie counter (Laing et al., 2014). Through the free app, users can record their daily intake and physical activity as well as receive feedback on calories, macronutrient distribution, and overall nutrient intake. The food database included in the app contains over one million foods for users to choose from in addition to giving users the option to add their own foods and recipes. MyFitnessPal encourages users to personalize the app by prompting them to
enter their weight loss goals, which then allows the app to tailor daily calorie intake objectives to help users reach that goal. Additional app features include community discussion forums and friending. The community feature allows users to search for nutrition, weight loss, and physical activity-related articles and read success stories and tips from other MyFitnessPal users. The friend feature permits users to add friends through the app, which gives users a sense of support and motivation (MyFitnessPal, Inc., 2016). Permission to use the app in this study was granted via email by MyFitnessPal Support, which can be found in Appendix J.

**Procedure for Data Collection**

Data collection for this study occurred for four weeks. Anthropometric measurements, specifically weight, were collected one time at the beginning and one time at the end of the study during nutrition counseling sessions at the weight-loss clinic. The smartphone application pre- and post-surveys assessing attitudes and beliefs were both given only to participants in the intervention group in order to assess any changes in thoughts toward the smartphone application. The pre-survey was administered at baseline, while the post-survey was given at the end of the four weeks. The demographic survey was given to all participants at baseline. Additionally, the post-survey for the control group was given to those participants at the end of the study. The program’s staff distributed all surveys at the beginning of nutrition counseling sessions.

**Qualitative data.** The qualitative data, including intervention group participants’ feelings, attitudes, likes, dislikes, and suggestions for improvement regarding the smartphone app and nutritional messages intervention, were collected through pre- and post-surveys. The pre-survey was given only to the intervention group at the beginning of
the study in order to determine initial feelings toward using an app as part of a weight loss program. This survey was supported through the literature review (Shapiro et al., 2008; Hebden et al., 2014).

Two post-surveys were also created using concepts from previous studies. The smartphone application post-survey was developed through studies conducted by Laing et al. (2014), Fassnacht et al. (2015), Shapiro et al. (2008), and Hebden et al. (2014). The purpose of this post-survey was to assess any changes in participants’ feelings and attitudes toward the smartphone application. Additionally, the survey determined whether or not participants felt that the app and/or nutritional messages played a role in any additional weight loss. The survey was given only to the intervention group participants at the end of the study in order to allow for comparison between preliminary and concluding thoughts and opinions.

A different post-survey was developed according to studies by Laing et al. (2013) and Carter et al. (2013) for use among control group participants upon completion of the study. The goal of this survey was to determine if any control group participants used some variation of a smartphone application throughout the study, since they were not be restricted from doing so. Similar to the intervention group post-survey, this survey also evaluated any possible effects of the app on the amount of weight lost by control group participants by requesting their thoughts toward the program. Each of the surveys were administered by a weight-loss clinic staff member prior to the final counseling sessions included in this study. All surveys and nutritional messages used in this study were created by the researcher based on the ideas of previous studies. These instruments were tested for face validity and general understanding of the questions and expectations.
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Quantitative data. The anthropometric measurements used for this study specifically included weight. These measurements were collected at baseline and at the end of the study using a scale provided by the Midwestern weight-loss clinic. Similar methods showed to be an effective means of monitoring differences in weight loss in the studies conducted by Patrick et al. (2009), Haapala et al. (2009), Hebden et al. (2014), Carter et al. (2013), Laing et al. (2014), Wharton et al. (2014), Shapiro et al. (2012), and Christian et al. (2008).

The smartphone application pre- and post-surveys in addition to the control group post-survey each contained questions that used a Likert scale to assess participants’ thoughts regarding the smartphone application and nutritional messages. Questions included in the surveys assessed if participants felt either component of the intervention led to any weight loss, if the app was easy to use, and if the content of the nutrition messages was deemed to be motivational and/or informing. This method of data collection will be adapted from similar methods used by Shapiro et al. (2012), Shapiro et al. (2008), and Fassnacht et al. (2015).

Data Analysis

Qualitative data. Content analysis was used to evaluate the qualitative pre- and post-survey data. Questions from each of these surveys that asked participants to write in answers were transcribed in order to identify themes. The various themes were then coded by the researcher using different colored highlighters to indicate each group or subgroup (Patten, 2014). This was done in order to determine common themes among participants’ answers as well as any abnormalities regarding feelings/attitudes toward the smartphone application and nutrition messages that are related to the research questions.
Quantitative data. Appropriate measures of central tendency were used when analyzing the data provided by the anthropometric measurements and Likert scale values. The mean was used when analyzing the anthropometric measurements of the participants, including weight and BMI. This value was determined for both the intervention and control group participants’ weight and indicated the average number of pounds that was lost by each group. These numbers were then used to determine the difference in the amount of weight lost when comparing the two groups. The quantities for each of the mean values were identified through the formula provided by Leedy & Ormrod (2013).

\[
M = \frac{X_1 + X_2 + X_3 + \ldots + X_n}{N}
\]

Where \(X_1, 2, 3, \ldots\) = weight or BMI of each participant per group

\(N = \) the total number of participants per group

The mean and mode of the Likert scale values provided as answers to the pre- and post-surveys was determined in order to establish trends among participants’ feelings and beliefs about the weight-loss intervention. These values were figured for each question. The Likert scale used in each of the surveys incorporated an interval scale, therefore a mean can be effectively determined (Leedy & Ormrod, 2013). The mean was used to summarize the overall feelings of the participants relating to the various questions. The mode, referring to the value that is corresponded with most frequently, was used to determine what the majority of participants’ felt towards each question (Leedy & Ormrod, 2013).
Additionally, frequencies, descriptive statistics, and correlations were determined between various outcomes using the Statistical Package for the Social Sciences (SPSS) version 10. A Pearson correlation p-value of less than 0.05 was considered to be significant when assessing relationships between intervention use, weight loss, and perceptions about effectiveness. A similar evaluation method was used in the studies conducted by Shapiro et al. (2008), Fassnacht et al. (2015), Christian et al. (2008), Wharton et al. (2014), Shapiro et al. (2012), Laing et al. (2014), and Hebden et al. (2014).
Chapter 4

Results

Initially, 35 individuals agreed to participate in this study. Seven participants failed to take either demographic or intervention group pre-surveys prior to the four-week study, while three individuals did not take control or intervention group post-surveys at the end of the study. Therefore, a dropout rate of approximately 29% was observed and a total of 25 participants were eligible for inclusion during data analysis.

Participant Characteristics

Of the 25 participants included in this sample, 13 were placed in the intervention group and 12 in the control group. A majority were female, white, and had some level of college education. Over three-fourths of the participants were female, while 100% of the study population identified as white. Slightly less than half of the participants were between the ages of 21 and 44, while the second highest age range placed participants between 45 and 65 years old (42.8%). Only two of the participants were older than 65. All but two of the participants had some background in college education, with 23 participants total having at least some college credit. Furthermore, 16 of the 25 participants had a college degree ranging from an associate’s degree to a master’s degree or higher. The income levels of the participants possessed the most diversity in regards to the various demographic characteristics questioned. Approximately 44% of the participants reported an annual household income between $75,000 and $100,000 (or above), while the remaining participants reported earnings between $25,000 and $74,000. Three of the participants chose not to share their annual household income. A demographic comparison between control and intervention groups can be seen in Table 1.
Table 1

**Characteristics of All Participants**

<table>
<thead>
<tr>
<th>Demographic</th>
<th>Intervention</th>
<th>Control</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>12</td>
<td>92</td>
<td>8</td>
</tr>
<tr>
<td>Male</td>
<td>1</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-44</td>
<td>9</td>
<td>69</td>
<td>8</td>
</tr>
<tr>
<td>45-64</td>
<td>4</td>
<td>31</td>
<td>2</td>
</tr>
<tr>
<td>65+</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>13</td>
<td>100</td>
<td>12</td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HS grad</td>
<td>2</td>
<td>15</td>
<td>0</td>
</tr>
<tr>
<td>Some college</td>
<td>3</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>Associate's</td>
<td>2</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Bachelor's</td>
<td>4</td>
<td>31</td>
<td>4</td>
</tr>
<tr>
<td>Master's+</td>
<td>2</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>Income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25,000-49,000</td>
<td>3</td>
<td>23</td>
<td>4</td>
</tr>
<tr>
<td>50,000-74,000</td>
<td>2</td>
<td>15</td>
<td>2</td>
</tr>
<tr>
<td>75,000-99,000</td>
<td>2</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>100,000+</td>
<td>5</td>
<td>39</td>
<td>1</td>
</tr>
<tr>
<td>Did not specify</td>
<td>1</td>
<td>8</td>
<td>2</td>
</tr>
</tbody>
</table>

Additionally, the intervention group participants were assessed according to the TTM in order to tailor the nutritional messages. Of the 13 intervention group participants, 12 reported that they had been enrolled in the weight loss program for at least one month, while 10 participants felt “very confident” that the weight-loss clinic could help the achieve their weight loss goals. Thus, prior commitment to the program and high feelings of self-efficacy placed the majority of the intervention group in the action phase of the TTM.

Furthermore, intervention group participants were also questioned on their previous experience with apps for nutrition and/or weight loss purposes. All but two of
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

the participants reported prior app use for health reasons, eight of which specifically used MyFitnessPal. Other apps used previously by the participants included Weight Watchers Mobile, Fitbit, and My Diet Coach. Five intervention group participants had no prior experience with the MyFitnessPal app.

**Weight Loss**

Weight status was monitored for both control and intervention groups throughout the 4-week study, one time at the beginning and one time at the end of the study. The intervention group lost a total of 21.6 pounds during the study, which was an average of 1.7 pounds lost per participant. The intervention group participant who lost the most weight equaled a weight loss of 7.0 pounds, followed by two participants who lost 6.0 and 5.2 pounds respectively. It is important to note that each of these individuals did not report using the app every day. The individual who lost the most weight claimed to use the app 3-4 days per week, while the other two highest weight loss participants both reported app use averaging only 1-2 days per week. Only one intervention group participant gained weight during the study. This individual gained a total of 5.8 pounds and reported "never" using the app.

The control group lost a total of 27.7 pounds during the four-week study, which averaged out to a weight loss of 2.3 pounds per participant. One individual in the control group lost significantly more weight than the rest of the participants. This individual lost a total of 11.0 pounds, which was more than the next two highest weight losses combined. The latter two participants lost 5.2 pounds and 3.8 pounds, respectively. Eight of the participants lost less than 1.0 pound per week, while four control group participants
gained weight during the study, the highest of which was 2.6 pounds. Further breakdown of the total weight lost or gained by each individual can be found in Table 2.

Table 2

<table>
<thead>
<tr>
<th>Individual Weight Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>2</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>4</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>6</td>
</tr>
<tr>
<td>7</td>
</tr>
<tr>
<td>8</td>
</tr>
<tr>
<td>9</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>11</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>13</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

*Note.* The ranking column represents the participants’ ranking within their own group.

As discussed in more detail later, a contamination rate of 58% was found among control group participants, meaning over half of the participants in the control group used some kind of smartphone application for weight loss purposes. Of the participants who reported app use throughout the study (n = 7), three of these individuals gained weight. Conversely, the control group participant with the largest amount of weight loss did not use an app for weight loss aid. The two participants with the second and third largest weight loss totals reported using an app every day during the study, one of which was the same app as the one used by the intervention group. However, it is important to note that no correlations were found between app use and weight loss. A p-value of 0.171 was determined between the two outcomes, making their relationship insignificant.
Interestingly, the control group was found to have lost 6.1 more pounds than the intervention group by the end of the study. More specifically, the intervention group lost 77% of that of the control group. On average, the control group lost approximately 1.5 more pounds each week compared to the intervention group. When divided between each control group participant, an average of 0.125 pounds more were lost by each individual on a weekly basis. However, the substantial weight loss of the control group participant who lost the most weight (11.0 pounds) should be noted due to the impact it had on the weight loss of the group as a whole. The participant made up approximately 40% of the control group’s total weight loss, thus also markedly raising the average individual weight loss of the control group. If the individual had lost some number of pounds closer to the average weight lost by the control group (2.3 pounds) or closer to the next highest weight loss in the group (5.2 pounds), then the total weight lost by the group would have been virtually equal to or lesser than that of the intervention group. Therefore, the impact of the mobile intervention on weight loss would yield more optimistic outcomes from this study. A comparison of the total weight loss between groups, including both beginning and end weights, can be seen in Figure 1.
Figure 1. Weight loss comparison between groups. This figure compares the total number of pounds within each group at the beginning of the study versus the end of the study.

Attitudes

Intervention group participants' attitudes were assessed toward both the smartphone application and the nutritional messages through qualitative and quantitative questions. The attitudes of the control group participants who reported app use at any point throughout the study were assessed only through questions utilizing a Likert scale.

Smartphone application. Despite minimal changes in weight loss within the intervention group, overall feelings toward the app intervention were generally positive. Prior to the study, 85% of the intervention group participants felt that smartphone applications were an effective means of dietary tracking to some degree, while 77% felt that dietary apps impacted weight loss to some degree. At the end of the study, the percentage of intervention group participants who felt that the app was useful for dietary tracking purposes remained the same. However, three individuals' views on this subject
decreased upon completion of the study. While one participant only slightly decreased in opinion, from "definitely" to "yes," two individuals changed fully in opinion relating to apps for dietary tracking purposes. Prior to the study, both participants felt that apps were useful for food logging, while at the end of the study they did not. Additionally, three individuals' opinions increased in regards to dietary intake monitoring and apps. Similar to the decreased opinions previously described, two of the three individuals reported complete changes in opinion. These individuals reported negative feelings toward apps for food logging before the intervention, but viewed apps as useful for this purpose after the intervention.

As stated earlier, 77% of intervention group participants felt that apps used for dietary purposes had a positive effect on weight loss. At the end of the study, this percentage decreased by over 20%. While slightly more than half of the intervention group participants had feelings of positivity toward the impact of the app on weight loss, six individuals did not. Five of the individuals' opinions on the subject remained unchanged as a result of the study. Figure 2 shows a comparison between beginning and ending feelings of some degree of positivity toward smartphone applications in regards to effectiveness as both dietary tracking and weight loss aids within the intervention group.
Attitudes toward the smartphone application intervention were also assessed through qualitative questioning, which more specifically interpreted participants' likes and dislikes about using MyFitnessPal for dietary monitoring. Intervention group participants' attitudes toward the app were inconclusive, with a mix of both positive and negative feelings. Positive aspects about the app included ease of use, convenience, and specific app features, such as the large food database, the barcode scanner to identify foods, and the macronutrient distribution charts. Intervention group participants commented on "how easy it was" to use and that it was "easy to look up foods."

Additionally, one participant commented on the app's ability to count calories, stating "it helps me know where I am at with my calories." Conversely, a number of participants did not think the app was user friendly, stating that the app was "hard to figure out" and "sometimes felt like a burden." Other participants commented on the repetitiveness of the app, which led to boredom and forgetfulness. Table 3 highlights the numbers and

Figure 2. Comparison of pre- and post-intervention positivity towards app.
percentages of intervention group participants who reported the various positive and/or negative aspects about the app through qualitative questioning. It should be noted that some participants felt that certain questions were not applicable to their thoughts about the app. Therefore, not all participants gave positive and/or negative responses.

Table 3

<table>
<thead>
<tr>
<th>Intervention Group Attitudes towards App</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Positive</td>
<td></td>
</tr>
<tr>
<td>Ease of use</td>
<td>3</td>
</tr>
<tr>
<td>Convenience</td>
<td>2</td>
</tr>
<tr>
<td>App features</td>
<td>6</td>
</tr>
<tr>
<td>Negative</td>
<td></td>
</tr>
<tr>
<td>Not user friendly</td>
<td>2</td>
</tr>
<tr>
<td>Repetitiveness</td>
<td>1</td>
</tr>
<tr>
<td>Inconvenience</td>
<td>5</td>
</tr>
<tr>
<td>App features</td>
<td>1</td>
</tr>
</tbody>
</table>

Nutritional messages. While feelings in regards to nutritional messages were not assessed at the beginning of the study, they were questioned at the end of the study through the intervention group post-survey. Feelings in relation to the content of the nutritional messages as well as their effects on weight loss and/or dietary quality were assessed through four-point Likert scales, as described previously. A majority of the intervention group participants' attitudes toward the nutritional messages were positive. Over 90% of the intervention group reported feelings that the messages contained useful nutrition information. One participant commented on the messages' “nice facts” and “short format,” while another reported that the messages “make you think and be aware of what you are eating.” Another participant noted the incorporation of the up-to-date dietary guidelines and stated, “I like getting the messages because it helps to keep me current with the latest information on health and weight loss.” Two participants also
viewed the messages as a sort of support-system by reporting that the messages were a “good motivator” and “offered some encouragement.” Despite these findings, attitudes toward the impact of the nutritional messages on weight loss and dietary quality were not as strong. Seven of the 13 intervention group participants reported feelings that the messages did not have an effect on weight loss or dietary quality. Furthermore, participants noted that reading the messages was “just another thing I had to do” and that there was “not always enough time to read them.” Table 4 breaks down the number of intervention group participants who reported certain Likert scale values corresponding with positive or negative attitudes toward the nutrition messages in regards to content and weight loss.

Table 4

*Likert Scale Values of Attitudes towards Messages*

<table>
<thead>
<tr>
<th>Likert Scale Value</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td>Usefulness of content</td>
<td></td>
</tr>
<tr>
<td>1; not at all</td>
<td>0</td>
</tr>
<tr>
<td>2; no</td>
<td>1</td>
</tr>
<tr>
<td>3; yes</td>
<td>6</td>
</tr>
<tr>
<td>4; definitely</td>
<td>6</td>
</tr>
<tr>
<td>Aid in weight loss</td>
<td></td>
</tr>
<tr>
<td>1; not at all</td>
<td>0</td>
</tr>
<tr>
<td>2; no</td>
<td>7</td>
</tr>
<tr>
<td>3; yes</td>
<td>6</td>
</tr>
<tr>
<td>4; definitely</td>
<td>0</td>
</tr>
</tbody>
</table>

Furthermore, likes and dislikes in regards to the nutritional messages were assessed through open-ended questions. Intervention group participants' thoughts were generally positive, with comments containing more positive information than negative. Common themes among the positive aspects of the nutritional messages focused on the content. Many of the individuals reported that they learned new information from the
messages and felt encouraged and/or motivated as a result of receiving the messages each week. In addition to this, some participants felt that the information, which was based on the most recent Dietary Guidelines for Americans, kept them up-to-date with current intake recommendations. Other aspects users found enjoyable about the nutritional messages were that they felt a sense of accountability when reading the messages each week and that the messages were interactive. Certain messages encouraged the participants to ask further questions or to respond to receive recipes related the message content for the day. Seven responses were received throughout the course of the study from the participants either commenting on the message content itself or asking for more information and recipes. Table 5 further analyzes the qualitative reports from intervention group participants regarding positive and negative aspects about the nutrition messages. Once again, it should be noted that not all participants felt that certain questions accurately reflected their specific feelings toward the messages, thus some participants did not respond to each question. Additionally, some participants chose to give multiple reasons with each response, which caused some quantities to be greater than the total number of intervention group participants.

Table 5

<table>
<thead>
<tr>
<th>Message Feedback</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
</tr>
<tr>
<td><strong>Positive</strong></td>
<td></td>
</tr>
<tr>
<td>Informative</td>
<td>7</td>
</tr>
<tr>
<td>Accountability</td>
<td>3</td>
</tr>
<tr>
<td>Motivational</td>
<td>3</td>
</tr>
<tr>
<td>Interactivity</td>
<td>2</td>
</tr>
<tr>
<td><strong>Negative</strong></td>
<td></td>
</tr>
<tr>
<td>Inconvenience</td>
<td>2</td>
</tr>
<tr>
<td>Not new information</td>
<td>2</td>
</tr>
</tbody>
</table>
**Intervention Use**

Intervention use regarding MyFitnessPal for both groups was assessed using a 5-point Likert scale, with "1" indicating "never" and "5" indicating "every day."

Additionally, the individuals in the intervention group were asked about the frequency with which they read the nutritional messages based on a 4-point Likert scale. An answer of "1" corresponded with never reading the messages, while "5" indicating that every nutritional message was read during the study.

**Smartphone application.** Prior to the study, an average Likert-scale value of 3.92 was reported by intervention group participants in regards to using some form of weight loss-related smartphone application, which most closely corresponds with app usage of 5-6 days per week. A majority of intervention group participants (61%) indicated using an app for weight loss or dietary monitoring purposes every day each week. At the end of the study, app use decreased by a value of 0.77 on the 5-point Likert scale. An average value of 3.15 was reported by intervention group participants, which is most consistent with using the app 3-4 days per week. Therefore, a decrease in app use of about 1-3 days was seen as a result of this study. A comparison between the number of intervention group participants reporting a various number of days of app use weekly at the beginning and end of the study can be found in Figure 3. Three individuals self-reported increased app use, while three more reported decreased app use. Of the former participants, the largest increase seen by one individual went from "never" using an app to using MyFitnessPal 3-4 days per week. Of the latter intervention group participants, the largest decrease in app use reported by an individual dropped from "every day" app use to "never" using MyFitnessPal. It should be noted that the
individuals who reported decreased app use indicated within the open-ended question portion of the post-survey that they could not properly operate the app or used different weight loss-centered apps throughout the study.

![Weekly app use within intervention group.](image)

Figure 3. Weekly app use within intervention group.

Of the 12 control group participants, more than half \((n = 7)\) reported using a smartphone application for weight loss purposes. Furthermore, four control group participants used MyFitnessPal, equating to one-third of the control group using the same app as the intervention group. The remaining three participants self-reported use of the FitBit app throughout the study. Of the MyFitnessPal users, 75% \((n = 3)\) indicated using the app every day each week, while the majority of FitBit users \((n = 2)\) also reported every day app use. Overall, approximately 71% of control group participants self-reported daily app use. An average Likert scale value of 3.08 was calculated for the control group in regards to app use, while an average value of 3.15 was seen for the
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

intervention group. Therefore, app use between groups was very similar, despite no app intervention being used in the control group. However, when the averages of only the participants who reported some extent of weekly app use are compared, the outcome is different. On average, control group participants who reported app use recorded Likert scale values equal to 4.57. When compared to the average Likert scale value of the individuals within the intervention group who reported app use (3.8), a difference of 0.77 was seen in favor of the control group. This indicates that the control group participants were using some weight loss-based smartphone application approximately 20% more often each week than intervention group participants. Figure 4 compares the weekly app use between both groups at the end of the study.

![Graph](image)

*Figure 4. Comparison of weekly app use between groups.*

**Nutritional messages.** Three nutritional messages were sent to the intervention group participants each week during the study, equating to a total of 12 nutritional messages throughout the study. Previous experience with nutritional messages was not
assessed, therefore message use was only questioned on the post-survey via a 4-point Likert scale. Approximately 77% of intervention group participants reported reading every nutritional message that was sent by the researcher, which corresponded with a Likert scale value of 4. Two of the 13 intervention group participants stated that they read an average of 2 messages each week, while one participant reported reading about one nutritional message on a weekly basis. No participants claimed to have never read any of the messages. Thus, an overwhelming majority of the intervention group read every nutritional message or most of the messages that were sent each week. Further analysis of the average number of nutrition messages read weekly by the intervention group participants can be seen in Figure 5.

![Figure 5. Weekly message use within intervention group.](image)

Despite this finding, only 20% of the participants that reported reading every message also used the app every day. However, 40% of these individuals reported app use averaging 5-6 days per week, while 20% claimed to use the app at least a few days
each week. Two of the 10 individuals that reported reading every nutritional message claimed that they never used the app for dietary logging purposes. Nevertheless, a positive correlation was found between nutrition message use and weight loss. A P-value of 0.000 indicated that increased nutrition message use was associated with increased weight loss.
Based on the conclusions from the various studies analyzed in the literature review portion of this study, predictions were made that the intervention group would lose significantly more weight than the control group. While this was not necessarily the outcome of the aforementioned studies, the findings suggested that potential for positive weight loss outcomes was possible as a result of mobile phone-based interventions, such as apps and nutritional messages. The purpose of this study was to evaluate the effects of a multifaceted weight-loss intervention, including an app, nutritional messages, and continual nutrition counseling. These intervention characteristics were chosen because they targeted individuals with high motivation levels in addition to holding participants accountable on multiple levels. Therefore, the intervention group was expected to lose a greater amount of weight than the control group while also having overall positive feelings toward the app and nutritional message aspects of the intervention. However, the results demonstrated that the predicted outcomes did not match the actual outcomes.

**Weight Loss**

Although the intervention group lost weight, the control group lost approximately 6.1 more pounds than the intervention group by the end of this study. Previous studies did not include weight-loss interventions as rigorous as the one used in this study; however, weight loss outcomes were comparable. App-based interventions conducted by Wharton et al. (2014), Laing et al. (2014), Carter et al. (2013), and Hebden et al. (2014) each resulted in weight loss among both control and intervention groups. Nonetheless, when compared between groups, the weight loss was insignificant in each case. Additionally,
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

nutritional message-based interventions also produced minimal differences in weight loss outcomes when compared to control groups (Haapala et al., 2009; Patrick et al., 2009; Shapiro et al., 2012).

Previous studies seem to suggest that smartphone applications alone may not heavily influence weight loss outcomes, although a more intensive intervention still produced similar findings. Therefore, the impact of the multifaceted intervention on weight loss was negligible. In the study conducted by Hebden et al. (2014), researchers concluded that nutrition counseling as a primary intervention may be sufficient for weight loss. Since both control and intervention groups in this study were exposed to weekly nutrition counseling sessions, that explanation may be plausible. Christian and researchers (2008) comment on the importance and impact that in-person nutrition counseling can have on health outcomes due to the personalization and engagement of such programs. The outcomes of this study support that idea grounded on the fact that the participants in this study were required to meet weekly for nutrition education and counseling purposes.

Another explanation as to why the weight-loss intervention used in this study was not more successful is that smartphone apps may not be preferable for some individuals. Weight loss is largely based on personal interest and motivation. therefore, weight-loss interventions should match those factors. The participants in this study may have had other preferences as to how to achieve weight loss, which could have resulted in low motivation to use the app and adhere to dietary monitoring practices.
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Attitudes

Smartphone application. Intervention group participants' feelings toward the app were mixed during this study. Those who felt the app was useful for dietary monitoring remained unchanged at 85%, while those who thought the app aided in weight loss decreased significantly by over 20%. However, participants reported mostly positive feedback about the app during qualitative questioning. Participants enjoyed specific app features as well as the user-friendly design and convenience of the app. Conversely, some participants felt that the app was burdening and repetitive.

This mixed outcome was inconsistent with previous studies that also investigated attitudes toward smartphone applications. Carter et al. (2013) and Hebden et al. (2014) found high satisfaction rates among intervention group participants in regards to weight loss-based apps. While this study did produce positive app feedback, it was not enough to claim generally positive attitudes among intervention group participants.

As mentioned earlier, it is likely that a number of participants simply did not like the app or preferred another method of weight loss aid. This imbalance in participants' attitudes toward the app could have played a role in the overall impact of the app on weight loss. Ideally, the more participants liked the app, the more they would use it for food logging and other weight loss factors. Thus, the amount of weight lost would be increased compared to those who did not use the app. However, this was proven not to be the case and suggests that attitudes have a strong influence of app use and effectiveness.

Laing and researchers (2014) found that participant app use significantly decreased throughout the study, which according to participant interviews was due to reasons such as inconvenience and boredom. This strongly correlates with the negative
feedback that was received from the participants in this study. Therefore, it seems to suggest that app use decreased largely because of diminishing enthusiasm due to the monotonous and inconvenient nature of the app, which could also explain the 23% drop in the belief that the app impacted weight loss.

**Nutritional messages.** Unlike the attitudes toward the smartphone application portion of the intervention, participants were much more positive in regards to the tri-weekly nutrition messages. A majority of the intervention group felt that the messages contained useful information. Additionally, some participants commented on how the messages made them feel a sense of motivation and accountability, while others enjoyed the interactivity of the messages. The negative feedback toward the messages was limited; however, dislikes included that the messages were inconvenient and/or did not provide the participants with new information. Despite the largely positive feedback, slightly over half of the participants did not feel that the messages impacted their weight loss.

Most studies to date focusing on nutritional messages investigated participants' behavior changes as a result of receiving the messages; however, some researchers studied participants' thoughts on receiving the messages to some degree. Similar to this study, a majority of the feedback was positive and satisfaction rates with the various interventions were high (Kornman et al., 2010; Patrick et al., 2009; Gerber et al., 2009; Fjeldsoe et al., 2010). Intervention group participants in these studies regarded the messages as helpful and reported high compliance levels in terms of reading the messages (Kornman et al., 2010; Patrick et al., 2009; Gerber et al., 2009),
Based on the similarities between this study and previous studies, nutritional messages may be a more feasible method to incorporate into future weight-loss interventions than smartphone apps. Participants reported more satisfactory feedback towards the messages than the app, especially when specifically asked for negative feedback. The most notable difference between the two intervention features was related to convenience. Five participants found the app to be inconvenient, while only two reported feeling that the messages were inconvenient. As mentioned earlier, other negative feedback on the app included repetitiveness and difficulty understanding how to operate the intervention. Participants did not report these oppositions towards the nutritional messages. Therefore, the satisfactions rates of the messages was higher than that of the app.

One possible explanation as to why the messages were received better than the app could be related to the amount of time is takes to use each invention. When using the app for food logging purposes, it is expected for participants to use the app every day, multiple times per day. However, the messages were only sent to participants three times per week and were very brief. Therefore, the significant difference in time consumption between the two interventions could have potentially played a role in the feedback related to convenience.

Another explanation for the nutritional message preferences among intervention group participants could be related to the personalization of the messages. The messages were created keeping the participants' age, needs, and stage of change within the TTM in mind. Additionally, the messages were meant to be interesting and easy to understand by giving the participants information they did not already know in a quick and relatable
manner. Meanwhile, the app was repetitive and difficult to use for some of the participants. Additionally, the app used in this study (MyFitnessPal) was created for use by the masses. There are a number of features within the app that may not be applicable to many users, therefore creating an intervention that is daunting and inconvenient. The messages seemed to serve as a reminder as well as a sense of accountability for the participants, whereas the app was viewed more as a burden. This seems to suggest that participants lean more towards quick, targeted interventions rather than consumer-based ones for weight-loss purposes.

**Intervention Use**

**Smartphone application.** Intervention group participants' use of the app decreased between the baseline and the end of the study by approximately 1-3 days. The research also indicated that decreased use was associated with difficulty using the app or preference for another weight loss-based app. High rates of control group contamination were found during this study, resulting in app use among the control group similar to that of the intervention group. However, when app use among only those who reported some extent of weekly app use was investigated, the control group used an app for weight loss significantly more than the intervention group. Despite increased app use as well as increased weight loss among the control group, no correlation was found between app use and weight loss.

The decreased app use that was observed among the intervention group in this study was consistent with previous studies that also investigated app use. The study conducted by Laing and researchers (2014) found that app use significantly decreased throughout the study, dropping from an initial 94 participants to only 34 at the end of the
study. Additionally, the study conducted by Hebden and researchers (2014), in which a multifaceted weight-loss intervention was also used, found that the app feature of the intervention was used significantly less than other aspects, including text message and email.

When the intervention group participants' attitudes toward the app are factored into the decreased app use, a relationship can be observed between the two. Nine responses giving negative feedback were received from the intervention group participants, which commented on repetitiveness, inconvenience, and difficulty of use. Additionally, some intervention group participants stated preferences for other weight loss-based apps, When these attitudes are factored into app use, it suggests that perceptions greatly influence compliance. Therefore, if users feel negatively towards an app, they are less likely to use it.

**Nutritional messages.** The nutritional messages were used more widely among the intervention group participants when compared to the smartphone application. All 13 of the intervention group participants self-reported reading the messages to some extent, although the average number of messages read each week varied. A majority read each nutritional message that was sent, which equated to a total of 12 messages. The remaining participants read between one and two messages weekly. Additionally, a positive correlation was found between nutrition message use and weight loss.

When the findings of this study are compared to previous studies focusing on nutrition messages as a weight loss aid, the results are similar. As mentioned earlier, the intervention group lost a total of 21.6 pounds, averaging 1.7 pounds lost per participant during the 4-week study. The studies conducted by Haapala et al. (2009), Patrick et al.
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

(2009), and Shapiro et al. (2012) all resulted in minimal weight loss after a nutritional message-based intervention when compared to control groups. However, it should be noted that positive outcomes resulted from each of the studies. Haapala and researchers (2009) found high initial weight loss among intervention group participants who received the nutritional messages, although weight loss declined by the end of the study. Furthermore, the studies conducted by Patrick et al. (2009) and Shapiro et al. (2012) found a correlation between increased message use and increased weight loss, a result which was similar to this study.

Based on this study as well as some previous studies, the results suggest that nutritional messages may have a more powerful impact on weight loss outcomes, especially when compared to the other intervention aspects that were investigated in this study. The nutritional messages were used more often and also regarded with more positive attitudes by the intervention group participants in this study when compared to the smartphone application. Additionally, increased message use correlated with increased weight loss, unlike the app used in this study. Hebden and researchers (2014) concluded that the effectiveness of nutritional messages, when sent in a brief, SMS-style, may be a larger factor among weight-loss interventions because they are more engaging, personalized, and serve as a form of two-way communication. Therefore, nutritional messages may be more useful to individuals who prefer mobile-based weight-loss interventions as long as they are willing to commit to intervention compliance.

Theory Base

As discussed previously, this study's methodology was based on the transtheoretical model (TTM), which is an educational theory suggesting that behavior
change is a 5-step process based on an individual's psychological and behavioral trends. One major benefit of using the TTM is that it allows for tailored interventions, often relating to a person's stage within the TTM, which corresponds with their readiness to change and motivation. This aspect of the theory ideally increases the effectiveness of an intervention.

Previous studies conducted by Laing et al. (2014) and Hebden et al. (2014) concluded that mobile-based interventions may be more useful when applied to participants with higher motivation levels. Therefore, based on this theory and previous suggestions it was hypothesized that the intervention group participants targeted for inclusion in this study would have higher intervention compliance and increased weight loss when compared to the control group. However, these findings were not the case in this study. Instead, differences in weight loss between the two groups were minimal and smartphone application use was inconsistent within the intervention group. Conversely, the TTM supports the outcomes in regards to the nutritional messages, that is, higher compliance and increased weight loss.

One explanation as to why choosing more highly motivated individuals for inclusion in this study did not impact the results more widely is that all of the participants in this study were placed at higher stages within the TTM. Since both intervention and control groups consisted of motivated individuals, the two cannot be compared in terms of how much of a role the TTM had in the results of this study. However, the finding that a large number of control group participants were also using some kind of weight loss app to a certain degree, despite not being asked to, suggests that the TTM potentially impacted the results of this study to some extent in relation to intervention use.
Chapter 6

Conclusions

Mobile phone-based interventions, including apps and nutritional messages, have become increasingly popular for weight loss in recent years. However, no definitive answers have been provided as to whether or not they serve as effective weight loss aids. The purpose of this study was to determine the impact of a multifaceted weight-loss intervention, including an app, nutritional messages, and regular counseling, as well as attitudes toward the various features of the intervention.

Based on the results of this study, no decisive conclusions can be made regarding the usefulness of mobile-based weight-loss interventions. Despite having little impact on weight loss itself, positive feedback towards both the app and nutritional messages suggest that both intervention features may have some purpose as weight loss aids among individuals who are motivated to use them. Therefore, future research is warranted on apps and nutritional messages in order to determine their effectiveness as well as how to enhance their impact on weight loss.

Implications

Based solely on the outcomes of this study, a number of implications can be drawn in regards to the usefulness of mobile-based weight-loss interventions as well as the preferences of those who use such interventions. At first look, the app and message interventions may seem as though they did not influence weight loss based on the minimal weight loss of both groups in this study. However, positive feelings toward both interventions from the participants in this study suggests that further investigation into their usefulness may be warranted.
This study found that participants had stronger positive feelings toward the nutritional messages and higher compliance rates when compared to the smartphone application. Additionally, the nutritional messages were found to correlate with increased weight loss. These findings suggest that nutritional messages may be more useful and have a larger effect on weight loss outcomes than smartphone applications. The intervention group participants commented on the impact of the messages, which included education, motivation, and accountability, as well as the interactivity of the messages, which allowed participants to engage with the intervention. Therefore, nutritional messages may be a more attractive option for individuals who prefer mobile-based interventions for weight loss.

Despite receiving more negative feedback from participants and not correlating with increased weight loss, smartphone applications still may have a place among mobile-based interventions. A number of intervention group participants reported using different weight loss-based apps throughout the study rather than the one specifically recommended for this study. Additionally, many of the control group participants used some type of app without being instructed to do so and used the app more on average than the intervention group. These findings suggest that apps may be effective weight-loss intervention tools based on the preferences of individuals. As discussed earlier, previous studies recommended targeting highly motivated individuals in order to increase intervention efficacy (Laing et al., 2014; Hebden et al., 2014); however, this study suggests that apps may be more useful for individuals who are motivated to specifically use an app for weight loss, not an individuals who is motivated solely based on the TTM.
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

There are also a number of implications applicable to this study based on previous research. Studies have shown that patients who are less involved in their healthcare have higher medical costs due to increased incidences of disease and other health issues (Hibbard et al., 2013). Over 80% of the American population owns a cell phone, of which 35% are considered to be smartphones that have access to Internet, apps, and other smart technology (Smith, 2011; Boulos, Wheeler, Tavares, & Jones, 2011). The current prevalence and projected growth of this technology solidify its communication abilities and capacity for health care assistance (Free et al., 2010; Fiordelli, Diviani, & Schulz, 2013). Thus, apps and nutritional messages sent via mobile technology may be one way to increase patient involvement in health care plans.

There are a number of perceived advantages that come as a result of utilizing health care aids available via mobile technology (Free et al., 2013). At the forefront of these benefits are convenience, personalization, and minimal cost, if any (Carter et al., 2013; Mehregany & Saldivar, 2012). These factors contribute to the idea that mHealth can serve as a “stand-alone” health care intervention (Simons & Hampe, 2010).

According to Labrique, Vasudevan, Kochi, Fabricant, and Mehl (2013), this should not be the case. Instead, apps and other mobile health care interventions should be used as a supplemental form of health care in which patient-practitioner relationships continue to be maintained. Additionally, caution is important to practice when recommending these types of programs for patient care purposes (Shah, 2014). Due to the rapid growth of this technology, the reliability of certain programs may be lacking (Probst, Nguyen, Rollo, & Li, 2015). Furthermore, many current mobile health programs
do not adequately involve or interest their users, thus decreasing program commitment and the potential impact on health outcomes (McCurdie et al., 2012).

When recommending these interventions to patients, practitioners should be mindful that the technology has been found to be less effective when used as a primary means of health care (Sherry & Ratzan, 2012). However, current research suggests that possible benefits can result from the use of mobile technology to promote dietary and physical activity behavior changes. Therefore, these programs may be a feasible addition to health care plans for certain patients in need of improved nutrition-related behaviors.

Limitations

A number of limitations can be seen in this study that could have impacted the outcomes. These limitations a largely related to the methodology and include 1) a small, homogenous sample, 2) a short study duration, 3) self-reported data, and 4) control group contamination.

Sample. As stated earlier, over two-thirds of the adult population is considered overweight and over one-third is considered obese in the United States according to the United States Department of Health and Human Services (2015). The obesity population alone is equal to nearly 79 million individuals. Due to the massive size of the population that is overweight and obese in the United States, a sufficient sample size for this study would be about 400 participants according to Leedy and Ormrod (2013). Therefore, the sample size of this study (n = 28) was inadequate for this population.

Additionally, a majority of the participants were white females between the ages of 21 and 64 with some form of college education. Thus, the demographics of the participants included in this study were not representative of the overweight/obese
population in the United States. For these reasons, future researchers should consider a larger, more diverse sample size when studying the effects of apps and other mobile technology on weight loss outcomes in order to ensure increased applicability to the overweight/obese population overall.

**Duration.** The intervention in this study was implemented for four weeks; however, four weeks was not long enough to provide complete nutrition education and truly evaluate the impact of apps and nutritional messages on weight loss. A more adequate study duration may have been six months or longer, which was determined to be an adequate length of time in previous studies of a similar nature (Laing et al., 2014; Shapiro et al., 2012). Additionally, the TTM states that individuals often incorporate certain behaviors into their lifestyle more permanently when those behaviors have been adopted for longer than six months (Contento, 2016). Five participants in the intervention group no previous exposure to MyFitnessPal, thus app use during this one month intervention most likely was not a routine behavior practiced by some of the participants. Therefore, the full potential of apps as a weight loss aid was not uncovered as a result of this study. Future studies should employ longer intervention durations so that the efficacy of apps and other mobile health care technology can be assessed more precisely.

**Data collection.** Data collection for this study relied solely on self-reported data from the participants through the various surveys given throughout the study. This created an increased potential for error within the results due to the possibility that 1) participants' memories of what actually happened throughout the study may have been altered, 2) participants may have reported answers that they believed the researcher wanted them to report, and 3) participants were put on the spot and may not have
articulated thoughts and feelings clearly and accurately. Each of these factors held the potential to create bias within the results, thus decreasing the reliability and validity of the outcomes (Contento, 2016). With this being said, future researchers should implement data collection methods that are more reliable and have better controls for accuracy.

**Control group contamination.** A final limitation of this study came as a result of control group contamination. As mentioned earlier, this study did not prohibit the control group participants from using weight loss aids, including smartphone applications. This tactic was based on previous studies conducted by Laing et al. (2014) and Carter et al. (2013) in which control group participants were allowed to use any and all apps for weight loss purposes. Based on the survey responses in this study, 7 control group participants used some form of smartphone application for weight loss purposes. Of these apps, 57% were the same app that was used by the intervention group (MyFitnessPal). This methodological characteristic had the potential to influence the amount of weight lost by the control group, thus altering the weight loss comparison between the two groups. Therefore, it may be beneficial for future researchers to limit control group participants on the types of weight-loss interventions that can be used throughout smartphone application-based studies.
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

References


DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

http://web.a.ebscohost.com/ehost/pdfviewer/pdfviewer?sid=4e4017f6-5746-479c-a58a-d9481e8adc20%40sessionmgr4005&vid=22&hid=4207


DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?


DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?


adolescents: Results from a randomized controlled trial. Preventive Medicine, 59, 54-59. doi: http://dx.doi.org/10.1016/j-ypmed.2013.11.015


DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Randomized controlled trial. *Journal of Medical Internet Research*, 11(1). doi: 10.2196/jmir.1100


DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?


Appendix A

Institutional Review Board Approval

From: EIU IRB
Sent: Monday, February 22, 2016 2:45 PM
To: Beth C Fitzsimmons
Cc: Nichole Hugo
Subject: IRB Study Approval - Fitzsimmons, #16-029

February 22, 2016

Elizabeth Fitzsimmons
Family & Consumer Sciences

Thank you for submitting the research protocol titled, “Do Smartphone Applications Aid in Weight Loss? A Study on the Efficacy of Apps as a Supplemental Weight-Loss Aid” for review by the Eastern Illinois University Institutional Review Board (IRB). The IRB has approved this research protocol following an expedited review procedure. IRB review has determined that the protocol involves no more than minimal risk to subjects and satisfies all of the criteria for approval of research.

This protocol has been given the IRB number 16-029. You may proceed with this study from 2/22/2016 to 2/23/2017. You must submit Form E, Continuation Request, to the IRB by 1/23/2017 if you wish to continue the project beyond the approval expiration date. Upon completion of your research project, please submit Form G, Completion of Research Activities, to the IRB, c/o the Office of Research and Sponsored Programs.

This approval is valid only for the research activities, timeline, and subjects described in the above named protocol. IRB policy requires that any changes to this protocol be reported to, and approved by, the IRB before being implemented. You are also required to inform the IRB immediately of any problems encountered that could adversely affect the health or welfare of the subjects in this study. Please contact me, or the Compliance Coordinator at 581-8576, in the event of an emergency. All correspondence should be sent to:

Institutional Review Board
c/o Office of Research and Sponsored Programs
Telephone: 581-8576
Fax: 217-581-7181
Email: eiuirb@www.eiu.edu

Thank you for your assistance, and the best of success with your research.

Richard Cavanaugh, Chairperson
Institutional Review Board
Telephone: 581-6205
Email: recavanaugh@eiu.edu
Appendix B

Control Group Email

Hello,

My name is Elizabeth Fitzsimmons and I am a graduate student at Eastern Illinois University. First of all, I would like to thank you for volunteering for this study! Your participation is greatly appreciated.

Second, I would like to provide you with instructions for your participation. For this study, I am asking you to fill out 2 different surveys (you have already taken 1) throughout the 4-week study period. These surveys will be given to you at your weekly Physician’s Choice Wellness meeting (when necessary) by your PCW educator. The surveys are short (between 4 and 6 questions) and should take no more than 5 minutes to complete.

Once again, thank you for your participation in this study! I look forward to working with you.

Sincerely,
Elizabeth Fitzsimmons
Appendix C

Preexisting MyFitnessPal Account Intervention Group Email

Hello,

My name is Elizabeth Fitzsimmons and I am a graduate student at Eastern Illinois University. First of all, I would like to thank you for volunteering for this study! Your participation is greatly appreciated.

Second, I would like to provide you with instructions for your participation. For this study, I am asking you to download the MyFitnessPal smartphone application (it’s free!) on your mobile phone or other smart device, whichever is easiest and most convenient for you. MyFitnessPal is a calorie counting app that is available on both Apple and Android devices. If you already have a MyFitnessPal account, you may continue to use this one for the study or you can create a new one, if you wish. After you have created a MyFitnessPal account, please reply to this email with your MyFitnessPal username or account email. From there, I will send you a friend request through the app. My username is elizfitz17, so please be on the lookout for my friend request shortly after your response to this email. Just as a reminder, your identity will remain completely confidential throughout this study. I will not share anything you do on MyFitnessPal with anybody. If you do not have a smartphone or smart device, please respond to this email and let me know so that I can verify that you received this email.

Once I have added you on the app, use the app as much or as little as you want to for the next 4 weeks. I will be sending you 3 nutrition-related messages each week (1 every Monday, Wednesday, and Friday). The content of these messages ranges from nutrition facts all the way to how to add more veggies to your diet. All you need to do is read the messages (or not); nothing else. If you would like to get more information related to a message or have any questions, please feel free to reply back to me. I am more than happy to help!

In addition to using MyFitnessPal, I am asking you to take 3 different surveys throughout this 4-week study. You have already completed 2 of the surveys, leaving you to take only 1 more. These surveys will be given to you at your weekly Physician’s Choice Wellness meeting (when necessary) by your PCW educator. The surveys are short (between 6 and 10 questions) and should take no more than 10 minutes to complete.

Once again, thank you for your participation in this study! I look forward to working with you.

Sincerely,
Elizabeth Fitzsimmons
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Appendix D

Non-Account Intervention Group Email

Hello,

My name is Elizabeth Fitzsimmons and I am a graduate student at Eastern Illinois University. First of all, I would like to thank you for volunteering for this study! Your participation is greatly appreciated.

Second, I would like to provide you with instructions for your participation. For this study, I am asking you to use the MyFitnessPal smartphone application on your mobile phone or other smart device, whichever is easiest and most convenient for you. Based on your survey response, you indicated that you already have a MyFitnessPal account, therefore you may continue to use this one for the study. Since you have provided me with your MyFitnessPal username, I will be sending you a friend request on the app shortly. My username is elizfitz17, so please be on the lookout for my friend request. By accepting my friend request, you are granting me permission to send you weekly messages through the app, which I will explain next. Just as a reminder, your identity will remain completely confidential throughout this study. I will not share anything you do on MyFitnessPal with anybody.

Once you have accepted me as a friend on MyFitnessPal, use the app as much or as little as you want to for the next 4 weeks. I will be sending you 3 nutrition-related messages each week (1 every Monday, Wednesday, and Friday). The content of these messages ranges from nutrition facts all the way to how to add more veggies to your diet. All you need to do is read the messages (or not); nothing else. If you would like to get more information related to a message or have any questions about a topic, please feel free to reply back to me. I am happy to give you more information!

In addition to using MyFitnessPal, I am asking you to take 3 different surveys (you have already taken 2) throughout this 4-week study. These surveys will be given to you at your weekly Physician’s Choice Wellness meeting (when necessary) by your PCW educator. The surveys are short (between 6 and 10 questions) and should take no more than 10 minutes to complete.

Once again, thank you for your participation in this study! I look forward to working with you.

Sincerely,

Elizabeth Fitzsimmons
Appendix E

Demographic Survey

This survey contains 6 questions regarding demographic and background information. For each question, circle the answer that is the most appropriate. Please answer each one to the best of your ability.

1. What gender do you most identify with?
   -  male
   -  female

2. What is your age?
   -  18 – 20
   -  21 – 44
   -  45 – 64
   -  65+

3. What race do you identify with?
   -  White
   -  Black or African American
   -  American Indian or Alaska Native
   -  Asian
   -  Native Hawaiian or Other Pacific Islander
   -  Hispanic or Latino

4. What is the highest level of education you have completed?
   -  some high school
   -  high school graduate
   -  some college, no degree
   -  Associate’s degree
   -  Bachelor’s degree
   -  Master’s degree or higher
   -  I don’t want to give out this information

5. What is your annual household income?
   -  under $25,000
   -  $25,000 - $49,000
   -  $50,000 - $74,000
   -  $75,000 - $99,000
   -  $100,000+
   -  I don’t want to give out this information

6. Please provide your email address in the space provided. This will be used by the researcher (Elizabeth Fitzsimmons) to contact you regarding study information and instructions.

   Email: _________________________________
Appendix F

Smartphone Application Pre-Survey

The following survey contains six questions. For each question, please circle the answer or number that accurately represents your feelings and beliefs toward each question. A table containing the meanings of each number is provided following each question.

1. Do you have any previous experience with using smartphone applications for weight loss and/or dietary monitoring?

YES  NO

If you circled yes, what app did you use?

If you have a MyFitnessPal account, what is your username or account email? This information may be used by the researcher, Beth Fitzsimmons, to send you a friend request on the app.

2. On average, how often did you use the app each week?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Never</td>
<td>1-2 days</td>
<td>3-4 days</td>
<td>5-6 days</td>
<td>Every day</td>
</tr>
</tbody>
</table>

3. Do you feel the smartphone application was an effective means of dietary tracking?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>

4. Do you feel the smartphone application led to any additional weight loss?

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>

5. How long have you been a part of the Physician’s Choice Wellness program?
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

☐ I just started the program
☐ 1-3 months
☐ 4-6 months
☐ Greater than 6 months

6. How confident do you feel that you can reach your weight loss goals at Physician’s Choice Wellness?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not confident</td>
<td>Slightly confident</td>
<td>Confident</td>
<td>Very Confident</td>
</tr>
</tbody>
</table>
Appendix G

Smartphone Application Post-Survey

The following survey contains two parts. For **Part 1**, please circle the number that accurately represents your feelings and attitudes towards the smartphone application and nutrition messages received over the past several weeks. A table containing the meanings of each number is provided with each question. For **Part 2**, please write your thoughts, feelings, or reactions to the questions in the space provided. If you do not have any comments, please write N/A following the question.

**Part 1**

1. On average, how often did you use the app each week to record your diet?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Never</td>
<td>1-2 days</td>
<td>3-4 days</td>
<td>5-6 days</td>
<td>Every day</td>
</tr>
</tbody>
</table>

2. On average, how often did you read the nutritional messages each week?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>I never read any of the messages.</td>
<td>I read 1 message each week.</td>
<td>I read 2 messages each week.</td>
<td>I read every message each week.</td>
</tr>
</tbody>
</table>

3. Do you feel the app was an effective means of dietary tracking?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>

4. Do you feel the app led to any additional weight loss?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>
5. Do you feel the nutritional messages provided helpful nutritional insight?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>

6. Do you feel the nutritional messages made a difference in overall weight loss and/or dietary quality?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>

Part 2

1. What did you like about using the app?

2. What did you dislike about using the app?

3. What did you like about receiving the nutritional messages?

4. What did you dislike about receiving the nutritional messages?
Appendix H

Control Group Post-Survey

The following survey contains four questions. For the appropriate questions, please circle the answer or number that accurately represents your feelings and beliefs towards each question. A table containing the meanings of each number is provided following each question.

1. Did you use any weight loss/dietary monitoring smartphone applications during this study?

   YES
   NO

If you circled yes, what app did you use?

If you answered NO to the first question, please disregard all of the following questions.

2. On average, how often did you use the app each week?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Never</td>
<td>1-2 days</td>
<td>3-4 days</td>
<td>5-6 days</td>
<td>Every day</td>
</tr>
</tbody>
</table>

3. Do you feel the smartphone application was an effective means of dietary tracking?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>

4. Do you feel the smartphone application led to any additional weight loss?

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Not at all</td>
<td>No</td>
<td>Yes</td>
<td>Definitely</td>
</tr>
</tbody>
</table>
DO SMARTPHONE APPLICATIONS AID IN WEIGHT LOSS?

Appendix I

Nutritional Messages

1. Did you know adults ages 18-64 should do at least 2 and a half hours of moderate-intensity aerobic physical activity each week? This includes brisk walking, light bicycling, tennis, dancing, and swimming. Find an activity you love and get moving!

2. If you are looking for more of a challenge, do 75 minutes of vigorous-intensity physical activity per week instead of 2 and a half hours of moderate-intensity exercise. Jogging, tennis, hiking, and basketball are great alternatives that get your heart pumping!

3. One serving of fruits and vegetables is equal to 1 cup. Did you know 1-cup equivalents vary depending on how fruits and vegetables are prepared? One serving is equal to 1 cup of raw or cooked fruits and vegetables, 1 cup of juice, 2 cups of leafy greens, and a ½ cup of dried fruits and vegetables.

4. One serving of grains is equivalent to 1 ounce. 1 medium slice of bread, a ½ cup of cooked rice, pasta, or cereal; and 1 cup of flaked cereal are all equal to 1 ounce.

5. Like grains, a serving of protein is also equal to 1 ounce. Did you know 1 ounce of lean meat, poultry, or seafood is the size of a matchbox? 1 egg, ¼ cup of cooked beans, 1 tablespoon of peanut butter, and a ½ ounce of nuts are also equal to one serving of protein.

6. One serving of dairy is equal to 1 cup. This is equivalent to 1 cup of milk or yogurt, 1 and a half ounces of natural cheese, and 2 ounces of processed cheese. Picture this, 1 ounce of cheese is similar in size to 4 dice.

7. One goal of the 2015-2020 Dietary Guidelines is to increase Americans' vegetable consumption. One great way to do this is to add more vegetables to mixed dishes. Also try choosing a salad or other vegetables as side dishes. Some tasty options include garlic green beans, oven-roasted asparagus, and glazed carrots!

8. Just like vegetables, fruit intake also needs to be increased for a more balanced diet. Try incorporating fruit into snacks, side dishes, and desserts. Adding fruit to yogurt, cereal, salads, and cottage cheese are all delicious ways to work more fruit into the diet!

9. Did you know half of the grains you eat each day should be whole grain? Make this happen by eating more oatmeal, brown rice, as well as whole grain bread, crackers, and cereal.

10. Fat-free and low-fat dairy products provide many great health benefits! These forms of dairy products also contain less calories, sodium, and saturated fat than regular versions. Try replacing your regular dairy products with low-fat milk, yogurt, and cheese.

11. Most Americans consume close to the recommendations when it comes to protein, but the same isn’t true for seafood. Seafood can do great things for your health, making it an important part of balanced eating! Consuming more nuts, seeds, beans, and seafood in place of meat is a great option to create more variety in your protein intake.
12. Did you know added sugars make up nearly 13% of calories in a typical U.S. diet? Much of these calories come from sugar-sweetened beverages, including soda, energy drinks, and sweetened coffee and tea. Added sugar can also be found in snack foods such as cookies and pastries. To lower your added sugar intake each day, try replacing these snacks and drinks with healthier options!
Appendix J
MyFitnessPal Permission

Re: Graduate Research Opportunity
To: elizfitz@live.com; marketing@myfitnesspal.com

If your email program allows, please type your reply at the top of the email to expedite our response. (Some systems do not permit a reply at the top of the email, never fear, we'll find your response and get back to you!)

Natalie wrote:
DEC 29, 2015 11:32 AM PST

Hi Elizabeth,

Thank you for being a member of MyFitnessPal. We are honored you are now interested in conducting a study involving MyFitnessPal. It should not be a problem for you to use our program as part of the study.

We do request that anyone conducting research adhere to our community guidelines and terms of use. You are welcome to create a group or blog post looking for participants for your research. Please do not send unsolicited messages or use the main forum for research purposes.

http://www.myfitnesspal.com/account/terms_and_privacy?
http://www.myfitnesspal.com/welcome/guidelines

I hope this information is helpful and we wish you the very best of luck with your research.

Warm Regards,
Natalie

How satisfied were you with our reply?

New to MyFitnessPal? You can quickly find answers to Frequently Asked Questions by clicking here.

Using one of our mobile apps? Frequently Asked Questions -- and in some cases Tutorial Videos! -- are found on the "Help" page of the Android and iPhone apps and the "More" page of our other apps.

Find us on Facebook
www.facebook.com/myfitnesspal

Follow us on Twitter:
@myfitnesspal for news and announcements
@MFP_Ops for updates on website or app issues and their resolution.