

WEB-BASED APPLICATIONS FOR WEIGHT LOSS AND MANAGEMENT:

AN INTEGRATIVE REVIEW

A Scholarly Project

Submitted to the

Faculty of Liberty University

In partial fulfillment of

The requirements for the degree

Of Doctor of Nursing Practice

By

Linda L. Smith

Liberty University

Lynchburg, VA

July 2021

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Scholarly Project Chair Approval:

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ABSTRACT

Obesity is associated with the leading causes of death in the United States and the world. Internationally, 39% of the world's population was overweight or obese, in 2014, with 9% having diabetes. These causes include diabetes, stroke, certain types of cancer and heart disease. Obesity can lead to poorer mental health outcomes and cause a decrease in the quality of life. This integrative review is to determine if health and dietary smart-phone apps are effective tools to help overweight and obese people lose weight and maintain that loss.

Keywords: Obesity, weight management, behavioral changes, self-management, smartphone, sustainability, positive health outcomes, and mHealth.

Dedication

This body of work is dedicated to the memory of my grandfather, the Reverend Asbury Lawton, who viewed education as the tool to best serve God, provide for family, and develop personal satisfaction. He sold our only mule to support furthering the education of his children. Thank you for your sacrifices.

Acknowledgements

I would like to thank my cousin, Vincent James, for his encouragement. I also thank my good friends, Ms. Eileen and John, for their support, and wisdom. Also, a big thank you to the Liberty University nursing instructors for their professional and expert guidance as I work toward my goals. Finally, thank you to my three biggest cheerleaders, my beloved daughter Ms. April L. Ferguson, my cherished mother, Ms. Edna J. Lawton, and especially, thank you, to our heavenly Father.

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List of Abbreviations/Acronyms

Application-App

Body Mass Index–BMI

Collaborative Institutional Training Initiative–CITI

Doctor of Nursing Practice–DNP

National Institute of Health–NIH

Mobile Health–mHealth

Health Information National Trends Survey-HINTS

Integrative Review–IR

electronic Dietary Intake Assessment-eDIA

SECTION ONE: FORMULATING THE REVIEW QUESTION

It is undisputed that healthful behaviors are likely to result in the healthy weight of individuals. These behaviors include regular physical activity and healthy eating. Dietary behaviors play a pivotal role in preventing overweight individuals. The Physical Activity Guidelines for Americans give the following recommendations concerning exercise; 150 minutes of moderate-intensity activity or 75 minutes of vigorous-intensity activity with 2 days of strength training each week. The Department of Health and Human Services further encourages eating whole grains, fruit, vegetables, lean protein, low-fat and fat-free dairy products, and drinking adequate water (Department of Health and Human Services, 2019). Our behaviors may be based on several factors, including community environment, genetics, family history, diseases, and certain drugs, to name a few.

Several physical consequences of obesity exist. Examples of these consequences include, hypertension, hyperlipidemia, type 2 diabetes, coronary heart disease, stroke, gallbladder disease, osteoarthritis, sleep apnea, cancer, low quality of life, difficulty functioning due to body pain, and stiffness (Center for Disease Control and Prevention [CDC], 2020).

A new complication of being obese is an increase in hospitalization of individuals diagnosed with COVID-19. A recent study showed, of 5,700 patients in New York City hospitalized with COVID-19, 41.7% were obese. All studies reviewed showed obese patients diagnosed with COVID-19 were most likely to be admitted to the intensive care unit. Furthermore, the majority of the studies conducted indicated obese patients had a higher rate of death among patients diagnosed with COVID-19. Thirty-five pooled studies show obese individuals diagnosed with COVID-19 had a greater chance of experiencing unfavorable outcomes, resulting in 48% more deaths (Popkin et al., 2020).

Despite the best efforts, such as healthcare providers giving dietary education to patients, the government creating programs and policies, and the education system implementing health education and sports programs, Americans have not been able to win the battle against obesity. In fact, the rate of obesity is the highest it has ever been, with 42.4% of American adults and 18.5% of our children considered obese between 2017-2018 (CDC, 2020).

As healthcare providers, we are in the ideal position to teach and encourage patients about weight loss and management. The role of the healthcare provider has not changed concerning patient teaching, but we now have an overwhelming number of technological tools to help us with patient care, including teaching. It is critical to find good balance and opportunities for using technology in our profession. We must continually ask ourselves how we can incorporate this valuable asset to help improve patient outcomes. Presently, technology has become an integral part of our lives and a critical component of teaching and learning. We do not need to be a master of technology to successfully integrate it into our teaching, but we must be unafraid and embrace the technologies that may help patients achieve healthy outcomes. The concept of this integrative review (IR) is simply to examine studies that show evidence of a decrease in weight due to using mobile applications designed for this. The studies delve into which methods of mobile app use are most effective and why. The studies examined are the foundation to determining whether mobile app use is effective in weight loss and where this information can lead.

Defining Concepts and Variables

The concept of this IR is finding whether mobile app programs are effective in assisting individuals in losing weight. The conceptual definition of weight loss is a loss is 5% of an

individual's overall weight maintained preferably for 6 months or more past the study period (Toronto & Remington, 2020).

Rationale for Conducting the Review

Healthcare costs associated with obesity accounted for more than 21% of all annual healthcare spending in the United States in 2015. The cost of obesity is as high as \$209.7 billion. Much of this cost is associated with treating comorbidities, such as cardiovascular disease and type two diabetes (Spieker & Pyzocha, 2016).

Weight reduction and management could produce a savings of \$610 billion in the next 20 years with medical savings greater than \$17 billion. Obesity is continually rising, and without corrective action, the cost of the healthcare burden can only rise with it (Spieker & Pyzocha, 2016). It is time to examine all possible solutions and research effectiveness and sustainability. Therefore, there are a number of reasons to conduct this IR. This IR has the purpose of reviewing available literature and learning if it supports the concept that Internet-based tools are effective for improving diet and weight. This review is a method that can summarize theoretical literature to provide a deeper understanding of the topic. It opens the opportunity to build nursing science, deepen research, and initiate policy changes (Whittemore & Knafl, 2005).

Purpose and/or Review Question

The purpose of this project was to analyze current studies regarding electronic mobile health applications (apps) and their effectiveness in making dietary changes, resulting in weight loss and maintenance. The review summarizes and critiques interventions within the studies that support improved health habits that result in weight loss and weight management. The studies in

consideration examine various application methods from mindfulness, exercise, dietary diaries, meal planning, increase of plant-based foods, and lifestyle changes.

This IR focuses on an attempt to answer the following question: Is there evidence in the literature suggesting that using a mobile health app may improve patients' weight loss and management efforts, resulting in better patient outcomes?

The essentials of the Doctor of Nursing Practice (DNP) education stress the importance of using science-based concepts to evaluate and improve health care delivery and improve patient outcomes. This is the first DNP Essential, and the analyses of current research for this IR are supported. As noted earlier, past and current weight loss methods and their management have had little to no success on the obesity rate in this country (American Academy of Colleges of Nurses [AACN], 2006).

DNP Essential II asserts that to contribute to nursing science, research must be evaluated, translated, and disseminated to successfully assimilate into practice. This IR's goal is to evaluate the effectiveness of using mobile-based apps to improve patient weight, health and overall health outcomes. It is hoped to reveal successes and possible gaps in the use of technology for this purpose. It assists nurse leaders in encouraging discussion regarding changing technologies and their benefits (AACN, 2006).

According to DNP Essential III, the advanced practice nurse must be accountable for the quality of care and the patient's safety, which may lead to changes in healthcare delivery. This IR supports shaping possible initiatives within the healthcare arena (AACN, 2006).

DNP Essential IV addresses systems and patient care technology for healthcare improvement. This IR is examining the current trend of the sweeping mobile technology

popularity, which is being used successfully in several health care applications. Understanding technology helps the DNP stay current and take advantage on behalf of the patients (AACN, 2006).

Identification of gaps in healthcare policy and taking an active role in legislative policy is a responsibility of nurses in general, and it is pertinent that the DNP identify problems and advocate for social justice as stated in the DNP Essential V. This IR is critically analyzing current practices with weight loss and management and weighing a possible solution (AACN, 2006).

Reviewing and analyzing current research, often expanding is a collaborative effort of the DNP, as shown in Essential VI. Whether a scholarly project or an IR, the information will be disseminated and hopefully change practice models or even practice standards. Dissemination requires effective collaboration, which may occur during the presentation of this information or if this IR is helpful for others studying the effectiveness of mobile apps (AACN, 2006).

DNP Essential VII contends the DNP must examine epidemiological, biostatistical occupations and environmental information to help improve outcomes for people and their communities. This IR will further assist in incorporating the psychosocial and cultural impacts related to the use of mobile apps in weight loss efforts (AACN, 2006).

This IRs goal is to improve patient health outcomes by demonstrating clinic judgment, systems thinking, and delivery of evidence-based care. DNP Essential VIII focuses on leading a comprehensive needs assessment and possibly introducing and guiding patients through new methods of healthcare delivery (AACN, 2006).

Formulate Inclusion and Exclusion

The characteristics of the articles reviewed, include, articles written clearly and unambiguously, also primarily written in English, studies that focused on adults ≥ 18 years and ≤ 65 years, who were overweight or obese, studies that were peer-reviewed and conducted between 2015 and 2021, studies that used qualitative methods for capturing data, and studies that were primarily conducted in the United States (Whittemore & Knafl, 2005). Only non-domestic references for IR content were used. Studies involving the guided use of Internet-based applications were preferred to help narrow search efforts. Some exclusions were studies that utilized adolescents, pre-adolescents, and children, studies conducted outside of this country and opinion pieces. Unpublished theses, and non-peer-reviewed journals were also avoided (see Table 1).

Table 1 –

Inclusion and Exclusion Table of Criteria

Inclusion	Exclusion
Studies within the United States and/or other first-world countries	Studies from second or third world countries
Reviews in the United States and other first-world countries	Reviews from second or third world countries
Studies using adults 18 years to 64 years old	Studies using participants less than 18 years or over 64 years of age
Participants who were overweight or obese	Participants within normal weights or morbidly obese
Full-text articles	Abstracts
Publications no earlier than 2014, primarily between 2016-2020	Publication earlier than 2014

Conceptual Framework

An IR can potentially allow diverse research methods to become a part of evidence-based practice initiatives (Whittemore & Knafl, 2005). Although theory-based behavioral modification strategies could prove effective to promote the behavioral changes needed to lose and maintain weight, a conceptual framework will be applied, reviewing health education, mobile technologies, and supporting interventions. This framework was used to examine, review, critique, synthesize, and present the listed literature (Whittemore & Knafl, 2005). The IR starts with a literature search, analyses, and evaluation of usable data and considers other data, including the supporting interventions' effectiveness to the weight loss goal. This should allow the topic to be synthesized into a systematic knowledge base that will lead to nursing or other healthcare practice (Whittemore & Knafl, 2005).

SECTION TWO: COMPREHENSIVE AND SYSTEMATIC SEARCH

The developer of this project is the exclusive collector of the data and has completed the CITI modules as required. This review was conducted as a comprehensive literature search in the following search engines: Medline, PubMed, Cumulative Index of Nursing and Allied Health Literature (CINAHL), Liberty University Library, Ovid, and primarily ProQuest. Keywords and phrases included: obesity rate in the United States, methods of dietary counseling, diseases of obesity, the impact of obesity, dietary intervention in obesity, dietary resources for obesity, electronic mobile use of weight management, behavior changes in obesity, mobile app efficacy on health, and nutritional education through smart phone apps, weight loss apps, and current uses for healthful mobile apps. data explored data that were fewer than seven years to find the most updated information as advancements in smart phone technologies have improved quickly each

year. Studies prior to the mid-2000s are unlikely useful. I excluded information about children, and countries of different socio-economic levels, primarily targeting the United States. The search was further limited to adults within the 18-64 age range using the English language. Purging of the resources found resulted in the use of 17 sources. Case studies and surveys were the preferable resources in this search. Some studies were discovered using the reference lists of relevant articles.

The appraisal of data was managed using Melnyk's levels of evidence and the hierarchy of evidence (Melnyk & Fineout-Overholt, 2015), which measures the quality of each study or as a tool of validity and inserting the data into a matrix table found later in this IR. The use of this tool assisted in ensuring appropriate articles are used. Several types of studies were utilized to include statistical analysis, qualitative studies, randomized studies, descriptive statistical study, quasi-experimental design study, and meta-analysis quantitative reviews. The levels of evidence ranged from I to VI with careful effort to focus on the highest levels of evidence, listed in the attached matrix. This matrix places research articles in an easy to reference table, prioritizing the articles' relevance and strength of validity.

Search Organization and Reporting Strategies

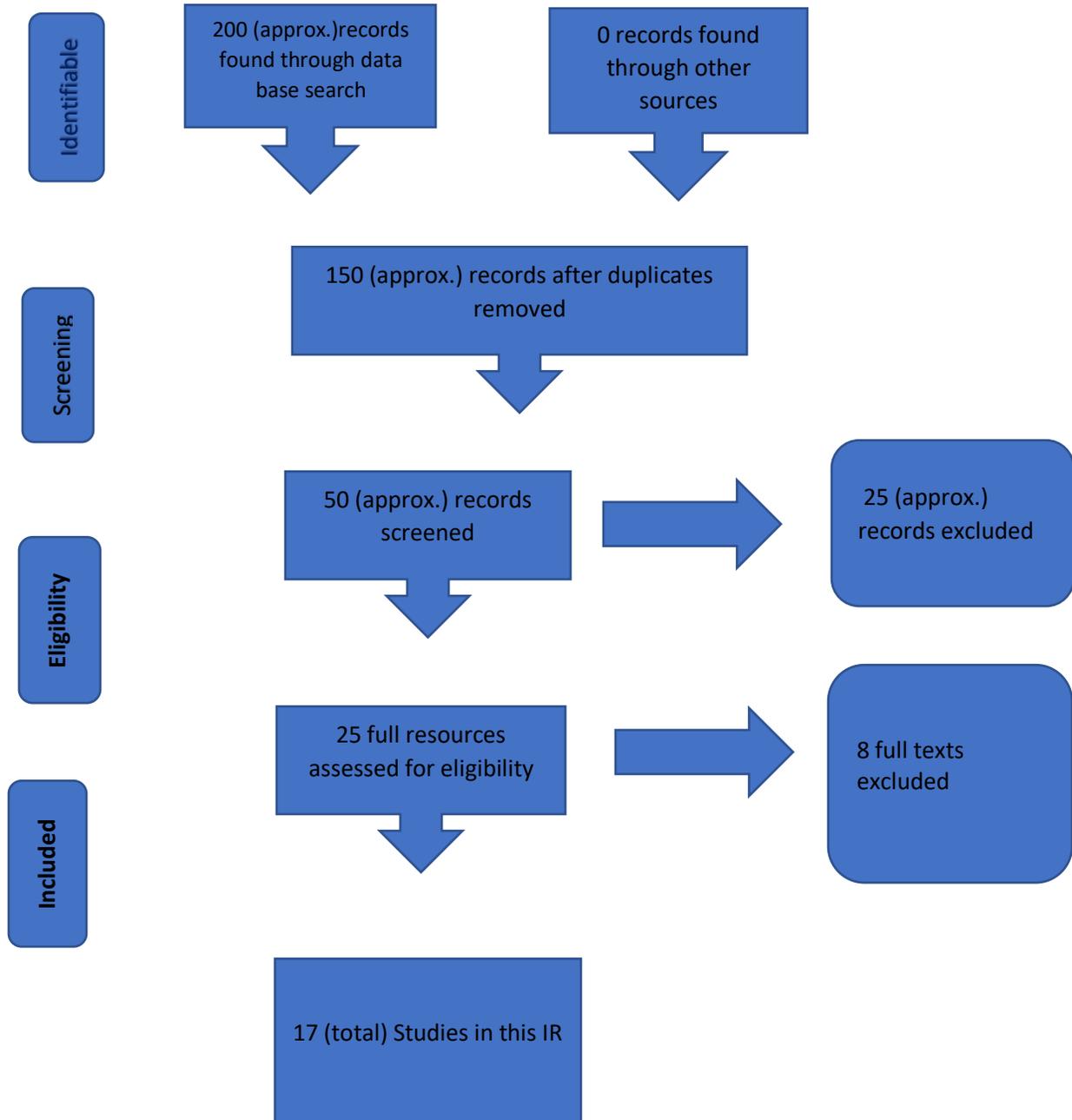
PubMed and CINAHL databases contained the most relevant information on the IR topic. Medical, nursing and technology databases were the foci. Most of the search items from these databases were also located in the Jerry Falwell Library for quicker access. Additional search terms included *mobile phone apps in healthcare, food tracker apps for weight management, mobile phone apps and technology, phone apps impact on healthcare, and mobile phone apps and the healthcare industry*. Initially, this search produced several articles that were too numerous and broad. The time frame from 2010 to the present also limited adequate studies.

Technology has improved quickly; it was determined to decrease the period for more relevant and current information. The time frame was reduced to 2015-2020. Several of the articles spanned the globe, from various countries with various of social and economic levels. The use of articles strictly from the United States only helped narrow the number of articles, the social and economic disparities, and focus on issues that may be more concerning to the target audience. Also, focusing on articles that pertained to adults 18-64 helped narrow the list of usable studies.

The initial search produced more approximately 200 articles, narrowing the search to the United States, and narrowing the age of participants greatly decreased the number of usable articles. It was also helpful to incorporate the term “*smartphone*” *application*, which resulted in more pertinent articles. Controlled use of terms produced fewer articles with greater relevance. Limiting the use of studies in first world countries may have decreased the chance of bias. It was difficult to divide by the gender used in the studies; most studies had a higher rate of female participants versus males. Utilizing full-text articles versus abstracts also provided more robust and pertinent information. This narrowed the limiting factors to: articles from 2015 to the present, full-text articles, an adult population, and studies conducted in first-world countries. This strategy allowed for the comprehensiveness of the search. Creating a flow chart allows for the ability to replicate the search (Toronto & Remington, 2018). For the PRISM flow chart (see Figure 1).

Figure 1

Preferred Reporting Items for Systemic Review and Meta-Analyses (PRISMA) Flow Diagram of the Literature Review Process for Studies Regarding the Use of Mobile Phone Apps and Their Effectiveness for Weight Loss



From: Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ* 2021;372:n71. doi: 10.1136/bmj.n71

Terminology

Terminology within the database systems includes: the type of text, abstract, full text, and free full text. Associated data is a method to pull resources closely related to the searched topic. Article types vary from books and documents, to clinical trials, meta-analyses, randomized controlled trials, reviews, and systemic reviews. The publication date allow the research to specify a time frame of information desired. These terms are a controlled and hierarchical vocabulary used for indexing, cataloging, and search for information. Other available health-related databases include, MEDLINE, OVID, MeSH and Healthstar. These databases are a comprehensive collection of related data organized for easy access. Within the database, a search module is located where to being a topic search:

- Behavioral interventions—strategies designed to affect the actions that individuals take concerning to their health; these strategies include interventions for weight management and lifestyle changes that require self-monitoring (Zaidan & Roehrer, 2016).
- Improved health outcomes—the positive effects of care on the health of patients or populations. Indicators of quality of the end results or a positive response for the patient (Ayanian & Markle, 2016).
- mHealth technologies—the use of mobile technologies to capture, store, and communicate health information, which is now touted as having the potential to transform health care (Malvey & Slovensky, 2014).

- Self-monitoring—observing and recording the person’s eating pattern, followed by feedback of those behaviors, increases self-awareness regarding a targeted behavior and outcomes relative to food intake and weight loss. Combined with health weight guidelines, this provides a possible solution to weight management (Zaidan & Roehrer, 2016).
- Wellness apps—mobile phone applications using technologies to monitor users’ health and help them maintain healthy lifestyle efforts. They provide real-time feedback and employ persuasive technology among individuals. Examples include; MyFitnessPal, iTrakbites, and SparkPeople, but hundreds more exist (Zaidan & Roehrer, 2016).

SECTION THREE: MANAGING THE COLLECTED DATA

After a comprehensive search of the data, all citations were noted and labeled. The search relied heavily on topic relevancy using the earlier identified criteria list. A PRISMA flow chart was created to help monitor the creation and flow of the data (Toronto & Remington, 2020). In addition to the reliance on PubMed, CINAHL, and the LU library, the National Library of Medicine/National Institute of Health (NLM/NIH) were also explored using the same search terms. With a search focused on “mobile devices for weight loss, efficacy,” this data-base yielded 407 results. This database also listed recent PubMed articles on this topic. Further screening within the database, narrowed articles meeting the criteria of 2015-2020 (which resulted in 26 articles), those within the United States, and those that were specifically peer-reviewed (resulting in 10 articles). Several of the resulting articles were from the Library of the Surgeon General’s office and included other factors, such as cancer patients, liver disorders, and autism. Per Toronto and Remington’s recommendation to screen via removal of duplicates and

removal of irrelevant articles, it was determined the use of this database presented difficulty managing criteria and was excluded from the search.

SECTION FOUR: QUALITY APPRAISAL

Utilizing the inclusion criteria was critical in maintaining relevancy in the search and creating a manageable number of articles. It assisted in identifying inferior studies and was a tool for continually guiding relevancy and making selection less stringent (Toronto & Remington, 2020).

Sources of Bias

Bias is possible at all stages of the review, and the assessment must be transparent and reproducible. The believability (bias) of findings is called the internal validity. The following are the most common types of bias.

Selection

Some identified areas of selection bias include, utilizing only students from one university to conduct surveys. The participants were all college-level educated, a small window of an age group that may be healthier and more active (due to the age bracket) than the majority of the population the study is hoping to impact. Some studies included predominantly females, who may be more or less interested in improving health behaviors. One study selected participants from the Facebook media site. This may lead to the exclusion of older adults who may not access Facebook regularly or at all. This is targeting a population who also has more experience using smart phone applications and may not truly reflect barriers that may occur in the general population. To prevent this type of bias, it is best to randomize or conceal allocation from data collectors.

Measurement

One study noted there should have been more training for the data collectors, that a way to measure mindfulness had not been considered. Also, the use of nutritional biomarkers to facilitate objective comparisons would have better validated a study on the intake of food groups. Training the research personnel properly will help to minimize this type of bias.

Attrition

Many of the studies involving school-age and college-age participants had an issue with drop outs, lack of completion of the final survey, and missing sessions or turning in occasional surveys. One study addressed this probability by offering an Apple minicomputer for full participation. Choosing participants, who may be interested in the topic randomly, may warrant offering group-appropriate incentives.

Performance

This may occur when one group receives more attention than another group. This can and should be avoided by using standard protocol for all groups.

Utilizing the Melnyk level of evidence, as within the matrix, prevented bias, as much as possible and assisted in identifying the strengths and weaknesses of selected studies (Toronto & Remington, 2020).

In one study regarding changing sedentary habits, there was no report on how the random sequence was generated. Also, participants were aware of each intention's goals and purpose, possible influencing behavior or reporting. Most studies were found to have a high risk of bias (Shrestha et al., 2019).

Internal Validity

The studies identified as having a number of biases compromise the validity of these studies. However, these studies can still be used to continue the study topic. Compromised validity in a study could lead to the strengthening of studies to follow (Toronto & Remington, 2020). At least three studies presented bias, and the researchers acknowledged the weaknesses found and determined further study was warranted.

Appraisal Tool

The appraisal tool utilized for this IR, is the literature matrix (see Appendix A). Umesh et al., (2016) states that utilizing a strong appraisal tool is “the process of carefully and systematically examining research to judge its trustworthiness, and its value and relevance in a particular context” (p.1). Furthermore, a strong appraisal tool helps to reduce information overload by eliminating irrelevant studies, identifies the best and most relevant papers, assesses the validity of the study, helps recognize the potential for bias, and helps determine the usefulness and applicability of the study to clinical use (Toronto & Remington, 2020).

Using the Melnyk pyramid appraisal tool helped ensure all studies of this IR were examined for authenticity, quality, and relevancy. Each article was graded on Melnyk’s hierarchy of evidence scale levels, from I to VII (see Table 2). Level I studies include systematic reviews and meta-analysis of randomized controlled trials (RCT) and provided the strongest evidence for an IR. Level II study includes well-designed RCT trials. Level III includes well-designed nonrandomized controlled trials. Level IV evidence produces case-control and cohort studies. Level V includes systemic reviews or qualitative studies. Level VI covers single or descriptive

qualitative studies, and Level VII evidence is from authoritative opinions, reports, and guidelines (Melnik & Fineout-Overholt, 2015).

Shresthma et al., (2019), examined 19 studies; 12 were RCTs, 2 were cross over, and 5 were cluster RCTs. The reviews' purpose was to consider if reducing non-occupational sedentary behaviors could result in weight loss. The findings indicated that interventions such as sit-to stand desks, television lockouts, and smartphone reminders may reduce sedentary leisure time in the medium term and television viewing time in the short to medium term. No evidence for long term-efficacy was determined (Shrestha et al., 2019).

Applicability of Results

The use of mHealth apps shows promising effectiveness to improve diet leading to weight loss and management. The most promising apps include the intervention of increased physical activity. The most effective apps incorporated diet, increased physical exercise, and health care provider interventions. The use of all three interventions was substantially more effective than the self-paced stand-alone apps that offer little guidance or accountability. It would be prudent that this comparison is explored more in-depth via controlled trials. Such intervention studies should gather additional app usage statistics to help pin point factors that will encourage user engagement and measure retention to improve maintenance. Overall, the foundation for effective weight loss stems from behavioral changes at the root. Apps that incorporate cognitive understanding seem to be highly effective with lasting retention.

Reporting Guidelines

Using the combination of the Melnyk matrix and the PRISMA flow chart for the IR helped assure transparency with the PRISMA as recommended by Toronto and Remington

(2020), and ensuring authenticity, quality, and relevancy as noted by Melnyk and Fineout-Overholt (2015). The Melnyk method classified research into a hierarchy of strength of evidence. The articles within the matrix (listing the levels of evidence) are those used for the IR. These include four randomized studies, three statistical studies, two or fewer qualitative and survey studies, and supporting reviews. It also reports only the articles considered for the IR, while the PRISMA chart showed articles that were used and eliminated at some point in the process. This decision prevented information overload, made studies more manageable, and further excluded the weakest studies (Toronto & Remington, 2020).

SECTION FIVE: DATA ANALYSIS AND SYNTHESIS

This stage of the IR process has been deemed difficult because it has been underdeveloped and only superficially described (Whittemore & Knafl, 2005). At best, the goal is to better understand the researched topic, hence creating new meaning and knowledge. (Toronto & Remington, 2020). This IR has incorporated the results of 18 studies to support the clinical question.

Data Analysis Method

The purpose of this project is to determine if electronic mobile health applications (apps), are effective in making dietary changes, which result in proper weight and maintenance.

Is there evidence in the literature that suggests that using a mobile health app may improve patients' weight loss and management efforts, resulting in better patient outcomes? There were several methods of dietary instruction and/or tools created in cooperation with the internet, social media, applications, and telehealth, in an attempt to update methods of teaching. Advancements in mobile technology have resulted in an onslaught of weight loss and fitness app

availability on smartphones. These are used clinically and personally to facilitate dietary behavioral changes. Weight loss apps vary in effectiveness, complexity, size of food and activity data bases, and availability on specific operating systems (Android versus Apple). It is important to evaluate the quality of the various apps to ensure the likelihood of sustainability of positive health outcomes. Reviewing the studies within this IR, while assessing the effectiveness of mobile technology's impact on weight loss, four patterns of interventions trended, from adding exercise and meditation to specific dietary changes. Listed are the top four interventions that impacted weight loss more than just using the mobile device alone.

Effort to Increase Fruit and Vegetable Intake

A high intake of fruits and vegetables is linked with a lower risk of chronic diseases (Duthie et al., 2018). There are various reasons study participants gave for low fruit and vegetable intake. For some, it may have been an issue of cost and accessibility. In the United States, access to a healthy food store was associated with increased fruit and vegetable consumption. "At home" food preparation also impacted the likelihood of eating more fresh produce than those eating commercially prepared food and relying heavily on processed, easily accessible foods. As the health industry has identified low-income communities as at-risk for increased health issues and a leading group in the growing burden of illness, governments have targeted these communities for health promotion via mass media and social marketing techniques. These techniques have proven successful in other high-income countries. Thirty years of social marketing efforts geared toward increasing fruit and vegetable intake have resulted in disappointing results among all age groups. These efforts incorporated advertising, public relations, and community-based campaigns.

In contrast, the New Zealand study, using educated young adults who reported a low consumption of fruits and vegetables, compared a group using mobile app interventions, which sent two daily prompts, to remind participants to eat at least five servings of fruits and vegetables per day. This resulted in the increased consumption of one or more servings of fruits and vegetables each day by group participants resulting in moderate weight loss and metabolic improvements (Duthie et al., 2018). This study discovered as participants increased fruit and vegetable consumption, they also tended to prepare food at home versus eating prepackaged or fast food (Noy et al., 2018). The mobile app prompts used were based on target group research and the behavior change theory as seen in apps such as NOOM.

Reduce Sedentary Behaviors

Self-reported data from studies of more than 25 western countries show that approximately 18% of adults spend greater than 7.5 hours sitting in a normal day. Surveys have shown a large decline in physical activity and an increase in sedentary behaviors around the world. These behaviors are associated with increased mortality related to cardiovascular diseases, type 2 diabetes, and various cancers. It is estimated that globally, sedentary behavior is responsible for 9% of all deaths. The self-reported data of a U.S. Labor survey indicated the watching television was the preferred leisure time activity, at roughly 2.5 hours each day, in 2015. Older adults use the greatest amount of time watching television at 3.3 hours each day. In addition, as adults travel longer distances to and from work, there is a considerable amount of time sitting during transportation (Shrestha et al., 2019). Recent studies have proven the obesity rate increased with the increased use of cars over the past decades. Efforts have been initiated at the community level toward reducing non- work-related sedentary behaviors. Individually, the health care providers have relied on counseling and feedback, and patients using self-monitoring

behaviors and personalized feedback. Other efforts used include sit-to-stand desks, walking, biking-friendly parks, public use bicycles, and scooters. Even a small decrease in television viewing time may result in increased public health among adults. Two interventions in this study were utilized to decrease television viewing time. A mobile device connected to a smart television would restrict leisurely television access and allow health education access. There is little data about how new technologies such as mobile apps contribute to the sedentary lifestyle, but strategies such as standing during commercial breaks may need to be examined in the future. Currently, the mobile app's ability to track steps and the recent 10,000 step per day campaign has greatly improved the activity rate among young adults, providing an attainable and effective goal in making the public more active.

Mindfulness Incorporated with Mobile App Usage

There has been an explosion of mindfulness smart-phone apps to affect a broad range of outcomes. It has been proven effective with pain management, smoking cessation, diet and/or other consummatory behaviors, depression, anxiety, and addiction, to name a few (Creswell, 2017). Mindfulness-based interventions (MBI) were created to target dietary behaviors and have become popular recently. These MBIs have been used in combating emotional eating, binge eating, and external dietary intake, which have led to obesity in some. Emotional eating is described as eating in response to emotional arousal. Binge eating is described as a maladaptive coping mechanism that results in eating large amounts of food and loss of control in eating. Of those who binge eat, 70% are obese. External is related to eating in response to external cues such as sight, smell, or even an advertisement. MBIs have been used to treat chronic pain, cancer, depression, anxiety and stress disorders, speech disorders, and substance abuse disorders in recent years and proven somewhat effective. Studies are now being conducted concerning as

to whether MBIs are an effective tool in changing obesity-related behaviors. MBIs facilitate present moment awareness, self-awareness and attention to the environment minus pre-judgments. It may encourage better self-regulation which is needed for successful weight management. These MBIs interventions lead to increased satiety in adults, have helped decrease blood pressure in adolescents, and helped increase body image thoughts in pre-adolescents, further reducing the incidence of eating disorders. MBI techniques may include meditation, guided imagery, body scans, yoga, martial arts, muscle relaxation and mindful eating. In this interventional study, participants gave self-reports on age, height, weight, gender, race, and any previous back-ground on any type of mindfulness (Creswell, 2017). They were asked to download mindful apps on their telephones and access them daily to view one video each day. The apps sent prompts as reminders to watch the video for that day. Participants between 14 and 18 found the mindfulness apps useful and acceptable for this group and they verbalized a preference for virtual health promotion programs related to mindfulness interventions. Participants view the app to improve eating behaviors, guide physical activity, help with sleep, and improve well-being (Turner, 2017).

Meal Planning

Over the past decade, time devoted to cooking has decreased from 1-2 hours per day to 58 minutes per day in the United States. As foods prepared at home have decreased, foods prepared outside of the home have increased. Studies show food prepared away from home is associated with a lower quality in diet and a high body mass index. Foods prepared at home are associated with a higher intake of fruits and vegetables, more fiber, lower fat intake, and better adherence to dietary objectives in young people. This was the only study showing the association between meal planning and diet quality (Ducrot et al., 2017).

The studies indicate smart phone apps can promote improved eating habits to assist with weight loss. The potential to improve lifelong dietary habits should be explored further to improve outcomes. The most effective apps focused on using a combination of dietary and physical activity interventions, instead of dietary interventions alone. One of the studies indicated apps may be more effective when social interaction is implemented, such as with the guidance of a dietician.

Additional studies measured the impact of mobile technology and food diary-type strategies, where the premise is to pre-plan what you will eat per day or week ahead of time, have proven to be extremely popular and effective.

Validity of Technological Interventions to Impact Eating Behaviors

Although mobile telephone technology use combined with dietary assessment has become popular and even preferred, it was necessary to test usability and validity for use in dietary studies. The electronic Dietary Intake Assessment (e-DIA) is a telephone app created to record all food and drink consumption. The study targeted college students between the ages of 19-24 in the second, third, and fourth year of school. The introduction included a 30-minute group session with instructions, expectations and needed tools. A text message was sent as a reminder each day to input data for a period, documenting their regular diets. The comparison was which group used and benefited from mobile technology in improving dietary intake. The first group relied on 24-hour recall data, and the second group relied on real-time data entered into their mobile device once prompted. The intake data were divided into food groups. The result was there was not a significant difference, as each group (recall method and e-DIA method) had similar mean and median intakes. At the time of the study (Rangan et al., 2016), it showed support of the potential of the e-DIA as an alternative to the recall method to assess

dietary behavior and intake. It is highly recommended that future studies include participants other than college students and recommend using nutritional biomarkers to help build objective comparisons.

Assess Nutritional Knowledge

Participants were divided into three groups; face-to-face, mobile app, and the control group. Categories were further divided by age, BMI, and gender with similar levels of experience concerning diet and technology. Face-to-face sessions included discussion, exercises, and food diaries, while the mobile app group had similar sessions via mobile phone apps. The control group experienced all of the same measurements but without the interventions (Creswell, 2017).

Descriptive Results

Twenty-one studies included using the mobile app supported with increased physical activity, of which 14 showed significant weight loss. Thirteen studies focused on dietary changes alone; of these, seven showed significant improvement. More studies of those reporting significant improvements detected between-group improvements in weight loss or related health outcomes, while fewer studies reported significant improvements with a healthcare provider engagement. A larger proportion of multi-component interventions, such as increased physical activity (8 of 13; 62%), showed significant improvements (with guidance from a healthcare provider) compared to participants using dietary-focused app interventions alone (5 of 14; 36%). Eleven studies reported app usage statistics, and three of them demonstrated that higher app usage was associated with improved weight loss.

Synthesis

The characteristics of the articles reviewed included written clearly and unambiguously, also primarily written in English, studies that focused on adults over age 18 and below 65, studies which were conducted 5 years or less, studies that used qualitative methods to capture data, studies which were primarily conducted in the United States, and studies involving guided use of Internet-based applications. Some exclusions were studies that utilized adolescents, pre-adolescents and children, studies conducted outside of this country, books, and opinion pieces. Unpublished theses, literature reviews, and non-peer-reviewed journals were avoided.

Ethical Considerations

The Liberty University Institutional Review Board (IRB) approved the project and deemed that it was not classified as human subjects research. Furthermore, there was no collection of private information in this IR paper. The approval letter was signed by a member of the Research Ethics Office (see Appendix A). The CITI training regarding social and behavioral research, was successfully completed on 26 January 2020 and is in effect until 2023 (see Appendix B).

SECTION SIX: DISCUSSION

The literature review supports there may be a beneficial use of mobile apps to assist in weight loss and management. Findings further suggest the best use of the mobile apps is most effective when supported with other modalities, such as, mindfulness, exercise, premeal preparation, a targeted effort to increase plant-based food intake (fruits and vegetables), and a targeted effort to decrease sedentary lifestyle behaviors. There is an additional implication that dietary mobile apps used in conjunction with health coaching were even more effective.

Implications for Practice/ Future Work

The findings of this integrative reviews, suggest a positive influence of mobile technology on improving and assisting with weight loss. The implication is that mobile health technologies associated with improvement in accessing information, efficiency, and evidence-based decision making, especially when linked with other supportive modalities, such as, mindfulness, meal planning, exercise, and increasing fruits and vegetables.

A majority of the studies implied there is plenty of opportunity for future research with several foci. The smartphone and a wide variety of health applications are relatively new but are continually growing. Several of the intervention descriptions were brief and lacked detail. Studies should show the full intervention protocols used so that they may be properly reproduced by future researchers. It would be helpful if the terminology used was clear in meaning concerning the intervention. Most of the studies were short-term, with limited diversity of demographics. Both should be expanded to gain a clearer picture of the effectiveness of the interventions.

Future studies should also include possible roles to include the healthcare team and the capacity they can support weight loss and management efforts. Many of the interventions in these studies are within the scope of practice of a registered nurse. Under the guides of a registered nurse, a trained healthcare delivery team could easily offer education and support to participants during a weight loss journey.

Dissemination

The final step of this IR is to identify possible methods of dissemination. A poster presentation is thought to be the best method of dissemination for this IR content, with the hopes

of approval for display by the research department of the preceptor's facility. Several of the poster displays are in hospital and clinical staff allowing areas, allowing for patient accessibility as well. There may also be an opportunity to display a poster at the Liberty University annual Research Week. As mobile technology continues to be explored, it is the hopes that the information displayed will inspire further research. Improved patient outcome is the overall goal with use by healthcare workers during patient support and education.

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Appendix A

Table A1*Strengths of Evidence Table (Matrix)*

Article, Author, Title, Year	Study Purpose	Sample	Method	Results	Level of Evidence	Limitations	Evidence to support change? Rational?
Trends in Obesity and Severe Obesity Prevalence in US Youth and Adults by Sex and Age, 2007-2008 to 2015-2016 Hales et al.	Study was conducted to analyze trends in obesity prevalence among youth and adults to determine any recent changes.		Statistical Analysis / RCT	Over the recent decade increases in obesity and severe obesity persisted among adults but showed no significant trends among youth.	Level II – Retrospective Design	Additional data will allow continued monitoring of trends in obesity and severe obesity in the US.	No, further studies are needed to fully support change.
Food Culture Practices and Nutritional Education. Guarita, H. 2017.	Comparisons of the various dietary types: cafeteria diets, Fat or sugar diets, meal feeding binge feeding, impact of maternal diet on offspring. Understanding		Qualitative study.	Consideration should be taken of reading and mathematical skills and when implementing strategies involving food labeling or other	Level IV – Comparative Design	Efforts of health authority’s actions and increased access to nutritional information should result in conscious food choices, food prioritization, and regaining the	Yes. This evidence supports a change.

	the brains involvement in dietary choices.			nutritional education tools.		habit of cooking at home.	
Comparison of two approaches to nutrition education in the management of diabetic patients. Zeghari, et al. 2018	The purpose is to study the impact of two different nutritional education (personalized versus collective) on the glycemic control of diabetes.		Randomized Study.	Both types of nutritional education were effective in improving the glycemic profile in patients with type-2 diabetes.	Level II – Comparative Design	Personalized education proved to be the most efficient approach and is recommended for critical and advanced cases.	Does not apply.
Dietary behavior changes to improve nutritional quality and health outcomes. Tapsell, L.C. 2017	Addresses the changes needed in dietary behaviors to assist with the current global burden of disease.		Narrative Review	When creating dietary behavior changes the relationship between dietary factors and health outcomes and an understanding of food sources of nutrients must be considered.	Level V – Narrative Review	Interdisciplinary approaches must be taken to support individuals in making appropriate changes in their complex life circumstances.	Requires additional study.

<p>Process Evaluation of a Multifaceted Health Program Aiming to Improve Physical Activity Levels and Dietary Patterns Among Construction Workers. Viester et al. 2014</p>	<p>To evaluate the process of a health promotion program that aims to improve dietary and physical activity levels in construction workers.</p>		<p>Randomized Control Study. Descriptive Statistics.</p>	<p>The program tailored my motivational stage and helped to determine readiness. Tools for self-monitoring were also implemented as well as individual coaching.</p>	<p>Level V - Retrospective</p>	<p>Program proved to be feasible and potentially effective but still requires additional adjustments before widespread implementation.</p>	<p>Further study is needed.</p>
<p>Supporting Engagement, Adherence, and Behavior Change in Online Dietary Interventions. Claire et al. 2019</p>	<p>Study purpose is to examine online interventions that create flexibility and accessibility incorporating smartphones and their use in daily activities such as shopping and eating.</p>		<p>Literature review.</p>	<p>Improvement in dietary behavior was seen in 14 of the 19 interventions reviewed. The review supports the potential of online and smartphone dietary interventions to effectively change dietary behaviors in adults.</p>	<p>Level IV – IR</p>		<p>Yes. This evidence supports a change.</p>

Mindfulness Intervention. Creswell, J.D. 2017	This is an evaluation of the growing evidence of mindfulness interventions by reviewing and discussing the effects of interventions on health.		Literature review.	Cognitive therapies show promising evidence that mindful interventions can lead to improved mental and physical health and outcomes.	Level IV – Integrative Review	There were some risks in participation as some report, agitation, anxiety, and discomfort, to name a few, especially those with a history of trauma or other psychiatric diagnosis.	Yes. This evidence supports a change but further study is needed.
Assessing the Efficacy of a Group Mediated Nutritional Knowledge Intervention for individuals with Obesity. Baukje et al. 2016	This study looks at the effect of a group-based nutrition intervention program on nutritional knowledge and eating habits of people who are obese.		Quasi-experimental design	Nutritional intake knowledge and behavior improved. Participants report they increased their consumption of healthy food and that knowledge of these healthy foods increased their chance of choosing these foods for weight control in the future.	Level III – Group Design	Despite the high dropout rate, 40% of participants remained in the study and retained the new knowledge, which was significantly improved.	Yes. This evidence supports a change.

<p>Trends in cause-specific mortality among adults with and without diagnosed diabetes in the USA: an epidemiological analysis of linked national survey and vital statistics data. Gregg et al. 2018.</p>		<p>Cross-Sectional Survey Design</p>	<p>Described at the first nationally representative study of trends in the causes of death for adults diagnosed with diabetes and compares them with those with undiagnosed diabetes.</p>	<p>The estimates confirm a large risk of death due to diabetes across diverse causes.</p>	<p>Between 2010 and 2018, the number of people with diabetes in the USA more than tripled. There was a decreased proportion of women of non-Hispanic whites, an increase in the proportion of people with a high school education who developed diabetes. Those with undiagnosed diabetes tended to be older, non-white, and had lower levels of education.</p>	<p>Level I – Survey</p>	<p>n/a</p>
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Note. Clinical question: Is there evidence in the literature that suggests that use of a mobile health app may improve patients' weight loss and management efforts, resulting in better patient outcomes?

Article, Author, Title, Year	Study Purpose	Sample	Methods	Results	Level of Evidence	Limitations	Evidence to support change? Rational?
Telehealth methods to deliver multifactorial dietary interventions in adults with chronic disease: a systematic review protocol. Kelly et al. 2015.	To review whether telehealth interventions effectively promote change in dietary intake and improve diet quality in people with chronic disease.	Adults >18y/o, diet related chronic disease (obesity >30kg/m2).	(RCT), cluster RCTs, and quasi-RCTs. Provides diet education in an intervention longer than 4 weeks and at least half of the intervention contact must be delivered by telehealth.	Results included states that if telehealth is found effective, this may inform a change in current clinical and public health practice by restructuring funding.	Level II – Group Study	To be further discussed in context of the quality of the evidence.	Yes. If found effective, it would support change.
Effect of increasing fruit and vegetable intake by dietary intervention on nutritional biomarkers and attitudes to dietary change: a randomized	To investigate whether increasing daily intake of fruits, vegetables and juices from low to high intakes impacts	19 men, 26 women, 39-58 y/o with low intake of fruits, juice, and vegetables, randomized to consume either their regular diet	RCT	Findings support claims that providing fruits, vegetables and juices significantly increases intake and circulating	Level II – Group Design	Data do not support the idea that improving dietary nutrients' status significantly benefits on circulating antioxidants	Yes. This evidence supports a change.

trial. Duthie et al., 2018	nutritional and clinical biomarkers.	or a diet supplemented with 480 gm of additional fruits and vegetables, for 12 weeks.		levels of nutrients positively associated with human health.		in healthy people.	
Effectiveness of interventions for reducing non-occupational sedentary behavior in adults and older adults: A systematic review and meta-analysis. Shrestha et al., 2019.	To consider that there are more opportunities for a sedentary lifestyle outside of work (TV, computers, driving)	Randomized control trial and cluster RCT among adults re: the effectiveness of interventions to reduce non-occupational sedentary behavior in adults and older adults. Search of eight data bases performed.	Meta-analysis, Quantitative Review.	Review demonstrates interventions may reduce sedentary leisure time in medium term and TV viewing in the short to medium-term. No evidence of long-term efficacy for any of the interventions used.	Level I – Comparative Study	Need higher quality research with larger samples.	Yes, interventions may be effective in reducing non-occupational sedentary behavior in short to medium term in adults. No significant effect was found on longer-term outcomes.
Meal planning is associated with food variety, diet quality and body weight status	Reviewing the possibility that meal planning resolve time scarcity and	Internet using volunteers >18 y/o. Baseline self-administered questionnaire, which was re-	Meta-analysis.	People planning meals are more likely to have better dietary quality,	Level I – Group Study	The cross-sectional design prevented inference of causality. Participants	Yes, as data suggests promoting meal planning to improve dietary

in a large sample of French adults. Ducrot et al., 2017.	encourages home meal preparation, which is linked to improved diet quality.	administered each year for 10 years. 40,554 participants used in the observational Nutri-net Study.		including a higher adherence to nutritional guidelines and increased food variety.		being volunteers may have higher awareness and interest in nutritional issues.	quality and prevent obesity is effective.
Electronic Dietary Intake Assessment (e-DIA): relative validity of a mobile phone application to measure intake of food groups. Rangan et al., 2016	To assess the validity of the e-DIA as a dietary assessment tool, using the 24-h recall as a comparison method, to measure intakes of food groups in a sample of university students	80 university students, 63% female, mean age of 21, BMI 23, 16% overweight.	Statistical Analysis	The study supports e-DIA as an effective alternative to 24- hour recall of dietary intake.	Level III - Survey	Small target group. Future studies to use nutritional biomarkers to facilitate objective comparisons. A need for training before use, burden of recording foods, and searching through large food data bases.	Yes. There is strong potential this study can be used for change. Future research measuring validity is needed.
New frontiers in community initiatives to increase vegetable	Gives a broad view of health promotion interventions.	n/a	Literature Review	Reviews indicate local food initiatives are currently	Level VI – Integrative Review	They hold promises of new possibilities for promoting	Somewhat. The evidence supports a change or

consumption. Noy et al., 2018.	To show the value of using food system models and move beyond traditional health promotion approaches.			small-scale compared to mainstream food systems; however, their numbers and reach are growing, as the reviews show.		healthy eating that align with broader global sustainability. The challenge includes bringing the benefits of these new initiatives to all facets of the community.	further research.
Evaluation of a Mindfulness-Based Mobile App Aimed at Promoting Awareness of Weight-Related Behaviors in Adolescents: A Pilot Study. Turner et al., 2017.	Purpose of this study was to evaluate the acceptability, feasibility, and utility of a mindfulness-based intervention delivered through mobile apps in teens between 14	20 of 66 met criteria. 15 completed baseline surveys and 9 completed post-study surveys. High proportion was Hispanic. 20% were overweight, and 1/3 had heard of mindfulness.	Single-arm pilot study. Statistical analysis	The mindfulness app was given a rating of “acceptable” and useful by participants. Ratings support the app as a potential way to improve eating behaviors, encourage physical	Level I – Group Study	The method of measuring mindfulness was not validated for this study.	Yes. This evidence supports a change or further research.

	to 18 years old.			activity, facilitate sleep initiation, and improve overall well-being.			
The effects of acceptance and commitment therapy on eating behavior and diet delivered through face-to-face contact and a mobile app: a randomized controlled trial. Elina et al., 2015.	Study investigated whether general acceptance and commitment therapy (ACT) affects eating behavior and diet quality.	254 participants, 85% females, mean BMI was 31, mean age was 49 y/o.	Randomized controlled trial	ACT-based interventions, delivered in the group sessions or by mobile app, did show beneficial effects on eating behaviors.	Level IV – Group Study and Comparison Design	Generalized study due to majority female, people with chronic illness were excluded.	Yes. This evidence supports a change or further research.

Appendix B

IRB Approval Documentation

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

March 5, 2021

Linda Smith
Cynthia Goodrich

Re: IRB Application - IRB-FY20-21-694 WEB BASED APPLICATIONS FOR WEIGHT LOSS AND MANAGEMENT: AN INTEGRATIVE REVIEW (Mar 2021)

Dear Linda Smith and Cynthia Goodrich,

The Liberty University Institutional Review Board (IRB) has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study does not classify as human subjects research. This means you may begin your research with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study is not considered human subjects research for the following reason:

(1) It will not involve the collection of identifiable, private information.

Please note that this decision only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued non-human subjects research status. You may report these changes by completing a modification submission through your Cayuse IRB account.

Also, although you are welcome to use our recruitment and consent templates, you are not required to do so. If you choose to use our documents, please replace the word *research* with the word *project* throughout both documents.

If you have any questions about this determination or need assistance in determining whether possible modifications to your protocol would change your application's status, please email us at irb@liberty.edu.

Sincerely,

G. Michele Baker, MA, CIP

Administrative Chair of Institutional Research

Research Ethics Office

Appendix C

CITI Certificate



Appendix D

Table D1*Guided Timetable*

<u>Process</u>	<u>Goal Date</u>
Final proposal defense submission	20 April 2021
IRB approval request	5 March 2021
Continued searches/semester break	March-May 2021
Update framework, discussion, and dissemination	20 June 2021
Updated tables and contents	22 June 2021
Recommendations of updates	14-25 June 2021
Final review of IR	25 June 2021
Send to editor	27 July 2021
<u>Presentation of IR</u>	<u>16 Jul 2021</u>