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A DNP PROJECT

IMPROVING DIABETIC PATIENTS' MOTIVATION TO EXERCISE USING A MOBILE APPLICATION

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Abstract

Purpose of Project: The goal of this project is to investigate how the use of a mobile application and social support improve diabetic patients' motivation to start and maintain an exercise program. Other aims of the study are to promote awareness regarding the benefits of exercise among diabetic patients and to use mobile applications to encourage activity and social support among diabetic patients.

Methodology: The study employed a descriptive pre-test/post-test design with a baseline data collection on all study participants. This was followed by a period of intervention during which the smartphone application was introduced to the participants. The total length of the project was four weeks. The end line data collection phase, using the same instruments used at baseline.

Results: Data was gathered using a smartphone application called MapMyFitness. A total of 6 diabetic patients were asked to use the fitness app during their exercise routine for a total of four weeks. They were also partner up with a buddy, and they were asked to keep in contact with each other via the app daily. The results showed that patients who used the application spent more time exercising and were more compliant with their fitness. Patients who did the workout with a partner or who received some form of motivation from a partner were more motivated to exercise. The study demonstrated that the use of the fitness app helped diabetic patients to increase their motivation to exercise.

Implications for practice: Based on these findings, healthcare providers in primary settings should take time to discuss physical activities with their patients. The use of mobile apps and a partnership with a friend either personally or virtually should be discussed or encouraged with diabetic patients.

Improving Diabetic Patients' Motivation to Exercise Using a Mobile Application

Introduction

According to the World Health Organization (WHO, 2018), Diabetes Mellitus (DM) is a complicated chronic disease affecting 422 million adults around the world, with a total of 1.6 million deaths each year. In the United States, 30.3 million people are living with DM. In 2015 it caused the deaths of 252,806 people in the United States, making it the seventh leading cause of death in the country (American Diabetes Association [ADA], 2018). The main objective of the *WHO Diabetes Programme* is to minimize the complications of the disease while maximizing the quality of life for all diabetic patients (WHO, 2019 a). Physical activity is essential in the care of DM. People with type 2 diabetes can lower their blood glucose, control insulin resistance, and prevent diabetic-related complications by exercising. It can also decrease the levels of A1c independent of body weight (Tate, Lyons, & Valle, 2015).

The ADA (2018) recommends at least 150 minutes a week of moderate to vigorous exercise, such as walking, swimming, or biking, for adults with diabetes. It advises dividing the 150 minutes into at least 30 minutes of daily activities without skipping two consecutive days in order to maximize the benefits of exercise on insulin sensitivity (Tate et al., 2015). One way to obtain the exercise goals recommended by the ADA is to have an accountability partner or companion. Samendinger, Pfeiffer, and Feltz (2018) claim that there is substantial evidence proving that exercising with a companion boosts one's level of exercise and physical activity. According to studies, human companions increase motivation and social support for physical activity. Samendinger et al. (2018) also acknowledged some barriers related to exercising with a partner, such as coordinating exercise time, establishing common goals, and social physique

anxiety. Despite these concerns, the benefits of exercising with a partner outweigh the disadvantages.

In addition to exercising with a companion, recent technologies are also helping motivate people to exercise. One current and very popular innovation for exercise is fitness and health smartphone applications, or apps. These applications are equipped with tools that help users maintain their exercise routines, such as with schedulers, and tools for tracking duration of exercise, levels of activity, calories burned, and diet. Health and fitness apps are also equipped with psychosocial intervention tools that can help increase physical activity motivation (Samendinger et al., 2018). Therefore, encouraging social support groups while using smartphone applications may increase diabetic patients' motivation to start and continue an exercise program.

Background and Significance

Diabetes Mellitus

Diabetes mellitus (DM) is described by the ADA (2018) as a condition that elevates the blood glucose levels in one's body. The three different types of diabetes are gestational diabetes, type 1 diabetes mellitus (T1DM), and type 2 diabetes mellitus (T2DM); T2DM is the most common type. T1DM affects approximately 20% of the population, while T2DM accounts for nearly 80% of cases.

As described by the WHO (2016), DM affects 422 million adults causing a total of 1.6 million deaths each year around the world. In the United States, 30.3 million people were living with DM in 2015, but only about 21 million were diagnosed. In 2015 diabetes was the cause of death of 252,806 people in the United States, making it the seventh leading cause of death in the country (ADA, 2018). The ADA (2018 a) estimates that eleven million Americans age 65 and

older have either diagnosed or undiagnosed diabetes. Additionally, 86 million people in the United States were prediabetic in 2012 (Reush, Regensteiner, Stewart, & Veves, 2018). In New Jersey, 12% of the population has diabetes and about 39,000 people are diagnosed every year.

DM is one of the biggest health concerns of our time. It not only affects the person diagnosed with the disease but society in general (Jenkins & Jenks, 2017). The number of diabetes diagnoses has tripled in six decades, going from 1.58 million new cases in 1958 to 7.21 million in 1991. For at least three decades the epidemic of DM was overlooked, but in the mid-1990s the disease became more prominent, gaining the attention of the government and the healthcare professionals (Reush et al., 2018). By 2040 the number of people with DM is expected to increase to 642 million worldwide (Reush et al., 2018).

DM affects subgroups at different levels, and it is more prominent among African-Americans, Hispanic/Latin Americans, American Indians, Alaska Natives, and Pacific Islanders. American Indians and Alaskan Natives had the highest prevalence of diagnosed cases in 2015 with a total of 15.1%. They are followed by non-Hispanic Blacks at 12.7%, Hispanic people at 12.1%, Asians at 8 % and non-Hispanic Whites at 7.4% (ADA, 2017). The disease prevalence is widely affected by education level, which is often linked to socioeconomic status. In the United States, twelve percent of adults diagnosed with DM had less than a high school education, while 9.5% had a high school education and 7.2% had an education level higher than high school (ADA, 2017).

Several diagnostic tests can diagnose DM. The hemoglobin A1C is a test used to measure the average blood glucose for the past two to three months. A diagnosis of diabetes is made when hemoglobin A1c is 6.5 or higher. Fasting blood glucose is another diagnostic test used to test for diabetes. As the name indicates, the test is done after fasting for eight hours or more. Diabetes is

diagnosed if the fasting blood glucose is greater than 126mg/dl. The oral glucose tolerance test is a two-hour diagnostic test that assesses how one's body processes glucose. This test evaluates the glucose level after drinking a sweet drink with 8 grams of glucose. A diagnosis of diabetes is made when the oral glucose tolerance test is greater than 200mg/dl. (ADA, 2019).

According to the ADA (2018 d), diabetes healthcare costs increased from $245 billion in 2012 to $347 billion in 2017, a total increase of 26% in only five years. Of this $327 billion, $237 billion is directly related to medical costs and $90 billion is from reduced productivity. Most of the medical cost related to diabetes is linked to hospitalizations and medical management of symptoms, each at 30% of the total medical cost. Diabetes supplies and physician visits are 15% and 13% of the total cost, respectively. A person with diabetes has an average medical cost of $9,601 per year. The medical expenses for those diagnosed with diabetes are 2.3 times higher than for those without diabetes (ADA, 2018 d). California has the largest cost of diabetes, spending a total of $39.47 billion (ADA, 2018 d). Government insurance programs cover most of the total cost of diabetes in the United States. Through Medicare, Medicaid, and the military, the government pays out about 67.3% of the total cost of diabetes in the country (ADA, 2018).

Type 1 diabetes (T1DM) is classified as an autoimmune disease, characterized by autoimmune beta cell destruction. People with T1DM produce no insulin, which makes them completely dependent on insulin. It affects about 1.25 million Americans and about 5% of the diabetic population (ADA, 2019 a). A prevailing misconception about T1DM is that it is a childhood disease, but according to the ADA (2019 a) it can affect people at every age, race, shape, and size. The main aim of treatment of this condition is to decrease the symptoms and avoid further complications by controlling blood glucose levels (WHO, 2018).

Type 2 diabetes is the most common form of diabetes, affecting 90% to 95% of the population with DM and mostly adults ages 45 and older. With T2DM, the body becomes resistant to insulin. At first, the pancreas produces extra insulin to maintain an average glucose level, but as the disease progresses, the pancreas becomes unable to keep up with the demand. The primary goal of treatment for T2DM is to control blood glucose levels through lifestyle changes such as a healthy diet, exercise, oral medications, and insulin (ADA, 2018). Exercise is considered the foundation for the prevention and treatment of T2DM (Revdal, Hollekin-Strand, & Ingul, 2016).

Gestational diabetes (GD) is diagnosed during pregnancy in non-diabetic women. It is usually diagnosed between 24 and 28 weeks of pregnancy. About 2% to 10% of pregnancies are affected by GD yearly (CDC, 2018). GD can be controlled with a healthy diet and physical activity, but in some cases insulin and oral medications are necessary (CDC, 2018). GD is associated with several problems such as macrosomia, cesarean sections, high blood pressure or preeclampsia, and hypoglycemia. Because GD might lead to T2DM, it is recommended that women get tested for diabetes six to twelve weeks post-partum (CDC, 2018).

Prediabetes is classified as a condition wherein the blood glucose level is higher than normal but still not high enough to meet the criteria to be diagnosed with T2DM. The symptoms of prediabetes are very subtle, making it harder to be diagnosed. Risk factors include obesity, age, family history of diabetes, sedentary lifestyle, gestational diabetes, and polycystic ovary syndrome. About 84.1 million Americans have prediabetes, but only 10% of them have been diagnosed (CDC, 2018). The primary goal of treatment of prediabetes is to prevent a later diagnosis of T2DM; early treatment of prediabetes can return blood sugar levels to normal

(ADA, 2018). The risk of developing T2DM can be reduced by 58% by losing 7% of body weight and engaging in moderate physical activity (ADA, 2018).

Living with Diabetes

DM has a significant effect on the health and well-being of those living with the disease. Complications of T2DM are linked to higher mortality and morbidity rates, decreased quality of life, economic burden, and reduced life expectancy (Brinkhues et al., 2018). Therefore, the main focuses in managing the disease are prevention and management of its complications. Prevention of diabetes complications is as significant as treatment of the disease itself.

Moreover, DM is associated with microvascular complications such as neuropathy which can lead to impotence, amputations, nephropathy, and retinopathy. Retinopathy is directly linked to adult blindness. Macrovascular complications of DM involve cardiovascular diseases, especially heart attacks, strokes, peripheral vascular disease, and arterial disease (WHO, 2018). According to the CDC (2018), people with diabetes are twice as likely to have heart disease when compared with those without diabetes. As evidenced by several studies, tight blood glucose control can help to prevent the advancement of these complications (WHO, 2018).

Self-Management of Diabetes

Due to the complexity of DM and its management, those living with the disease, encounter many obstacles that can negatively impact their quality of life (Vigen et al., 2018). According to Vigen et al. (2018), the quality of life of diabetic patients can be influenced by the time necessary for the self-management of certain activities, interruption of daily activities, disease management goals, and coping mechanisms. Diabetes Self-Management Education and Support is a tool that can be used to help improve the quality of life of diabetic patients. This tool is described by the CDC (2018) as an evidence-based intervention created to help manage and

decrease diabetes complications by empowering patients and providing them with knowledge and skills to self-manage the condition and associated complications. This program is a continuous process that allows people to develop skills and knowledge that enable them to learn and understand diabetes, its treatments, healthy eating, physical activities, medication management, and coping mechanisms for stress and depression. Lifestyle changes involving healthy eating habits and an increase in physical activity showed a decrease of 58% in diabetes prevalence among individuals previously diagnosed with diabetes (Brown et al., 2018).

Diabetes and Exercise

Revdal et al. (2016) state that exercise is the foundation for treatment and prevention of T2DM, but despite all the recommendations, two out of three individuals with T2DM do not exercise, and only a low number of them follow current exercise recommendations. The overall benefits of exercising are far more extensive than just lowering glucose levels; it also helps decrease the overall mortality rate and cardiovascular risks. Moderate physical activities have been shown to increase insulin sensitivity, improve glycemic control, decrease abdominal fat, help with the uptake of insulin into the peripheral tissues, and increase the number of insulin receptors (Revdal et al., 2016).

Exercise is a cornerstone in diabetes maintenance, prevention, and care. A minimal weight loss of 5% to 7% of total body mass by healthy eating and increased physical activity decreased the incidence of diabetes by 58% (ADA, 2018 d). In people age 60 and older, the decrease in diabetes incidence from improved diet and increased exercise was 71%. Patients who maintained these lifestyle changes for more than ten years had a 34% lower incidence of T2DM. Besides all the benefits that exercise provides to patients, getting motivated to initiate or continue an exercise routine, such as brisk walking, bicycling, dancing, or strength training, remains a

challenge to many Americans (ADA, 2018 d). To get people moving, the ADA recommends that inactive people start with moderate activities for five to ten minutes a day and gradually increase their exercise a few minutes each week (ADA, 2018 d).

Exercise and Mobile Applications

As previously discussed, many patients with diabetes are not as active as they should be, according to recommended guidelines. Therefore, tools that use technology to encourage the maintenance of physical activity can be very useful to help patients stay on track and motivated (Tate et al., 2015).

Eysenbach et al. (2015) conducted a study with a total of 84 patients using an interactive diet and activity tracker called iDAT. In this study, they concluded that patients with higher exercise motivation used the mobile app more often than those with lower motivation. They also found that the more motivated patients are, more likely to better manage their diabetes by making better lifestyle choices.

A cross-sectional study assessed the eating behavior, physical activity, and health-related lifestyle choices and mobile health app usage in 401 university students. In this study Sarconaa, Kovacsb, Wright, and William (2017) determined that mobile app usage is very beneficial in health promotion programs due to the extensive use of smartphones among the young population specifically and society in general. The majority of participants in this study reported that mobile health app usage made them feel healthier and motivated (Sarconaa et al., 2017). In another study involving 61 participants considered overweight and at risk of developing T2DM, Fukuoka, Gay, Joiner, and Vittinghoff (2015) concluded that in-person therapy sessions combined with a mobile app and pedometer lead to an increase in physical activity and reduction

in fat intake. These changes led to statistically significant weight loss and lowering of blood pressure over five months.

Exercise and Social Support

In a study conducted by Heiss and Petosa (2016), participants who received higher levels of social support from family and friends were found to be more likely to spend more time practicing moderate intensity exercise per week than those that exercise alone, which correlates with previous literature. Adults with T2DM who engaged in physical activities reported having more support from family and friends when compared with those not exercising regularly (Heiss & Petosa, 2016). According to another study, a diabetic patient who felt empowered by social support demonstrated a higher glycemic control level and exhibited better self-care behaviors (Arda Sürücü, Büyükkaya Besen, & Erbil, 2018). When planning new measures to develop self-care behaviors in patients with T2DM, it is important to integrate social support into these plans. (Arda Sürücü et al., 2018)

Needs Assessment

Global and National Setting

Due to the limited time that most practitioners have to spend with patients during office visits, many of them struggle to provide appropriate motivation tools regarding exercise (Higgins, 2018). Therefore, many are relying on Internet-based tools such as mobile applications to increase compliance with physical activities (Higgins, 2018). Results from a study conducted in Australia involving 134 participants who identified barriers to exercise showed that lack of motivation negatively influenced self-efficacy for exercising over 12 months (Alharbi et al., 2017). A qualitative study by Lidegaard, Schwennesen, Willaing, and Færch (2016) explored the barriers and motivators for physical activity among people with T2DM in Denmark. This study

concluded that social interaction might help a person maintain higher levels of activity, which can thereby motivate providers to incorporate social support and the use of mobile applications in their practice for encouraging and motivating patients to exercise. Research is necessary to comprehend fully what helps motivate people with and at risk for T2DM to make lifestyle changes (Korkiakangas et al., 2011).

State and Local Setting

The New Jersey Diabetes Prevention and Control Program promotes diabetes self-management education programs and lifestyle interventions for New Jerseyans diagnosed with diabetes by making grants available through the Diabetes Resource Coordination Centers. This program cooperates with providers to promote patient participation in diabetes self-management and prevention programs (New Jersey Health, 2019). Although the state of New Jersey supports self-management as the key to preventing diabetes complications, a lack of data prevents providers from understanding what encourages lifestyle changes in people with T2DM.

A well-established practice that provides care to a very diverse population is the ideal location for implementing a project that can promote practice change. This practice currently cares for adults of all ages with diverse healthcare problems, especially diabetes. The physician at the site has expressed the need to encourage patients with chronic diseases to start exercising. He also reports that while many of his patients can begin an exercise regime, they have problems staying motivated [redacted] MD February 22, 2019).

Problem Statement

Diabetes is one of the biggest health concerns of our era, with many related complications making its management complicated and costly to patients and healthcare systems. Exercise delivers physical and psychological benefits for those diagnosed with diabetes, and as

per evidence presented here, many people living with or at risk of developing diabetes lack the appropriate motivation or social support to start and maintain an exercise regimen. Technology-assisted interventions may be beneficial in delivering lifestyle interventions that can help patients achieve and increase their willingness to adhere to exercise programs.

Clinical Question

Does social support while using a smartphone application help to keep diabetic patients motivated to start and continue an exercise program?

Aims and Objectives

The goal of this project is to investigate how the use of a mobile application and social support improve diabetic patients' motivation to start and maintain an exercise program.

Objectives

- To promote awareness regarding the benefits of exercise among diabetic patients.
- To use social support to promote exercise and motivation for exercise among diabetic patients.
- To use mobile applications to promote exercise and social support among diabetic patients.

Literature Review

The review of the literature was done using the Cumulative Index of Nursing and Allied Health Literature (CINAHL), and PubMed. The search was tailored to peer-reviewed articles with a full text available within the Rutgers library. From CINAHL, a total of 14 articles were found on the subject, and a total of 41 articles were retrieved from PubMed. Only 18 from the 55 articles were used because the content was more suitable for this DNP project. Search terms used

were *smartphone, diabetes, exercise, social support, and motivation.* Please refer to Appendix A for the Table of Evidence.

Exercise and Diabetes

Exercise is one of the most critical aspects of glucose control in individuals with diabetes and one of the best interventions to prevent the progression of the disease in prediabetics (Colberg et al., 2016). Although there are well-established recommendations on an exercise regimen for those with diabetes and other chronic diseases, these recommendations are usually generalized and not tailored to fit individuals' needs. In a meta-analysis, Pedersen and Saltin (2015) determined that in certain situations, exercise can be as effective or superior to any other medical treatment. Additionally, in another meta-analysis Macleod, Terada, Chahal, and Boulé (2013) concluded that exercise had a significant effect in lowering the average glucose concentration and daily time in hyperglycemia but had a minor impact in controlling fasting glucose concentration.

In a ten-year study involving 572,437 Brazilian adults, it was concluded that although diabetic patients had better dietary habits, their level of physical activity was relatively lower when compared with their non-diabetic peers. Diabetic patients had less leisure-time physical activity (PRa, 0.92 [$P < .001$]) and less transport-related physical activity (PRa, 0.84 [$P <.001$]) than non-diabetic patients. These results reinforce the idea that it is imperative for health care providers to stress the importance of incorporating physical activity and other lifestyle modifications in the management of diabetes (de Oliveira, Maia, Silva, Martins, & Claro, 2018). A nine-month controlled exercise program featuring individuals who practiced aerobic, flexibility, and resistance/balance exercises three times a week revealed that high-intensity

exercises are associated with higher glycemic control and better HbA1c management. (Mendes, Sousa, Reis, & Themudo-Barata, 2017).

Thornton et al. (2016) found that healthcare providers have an essential role in making exercise an essential element in the management of the chronic disease and that a physical activity assessment should be included in a patient's routine care. Training and education regarding the importance of exercise should also be routine in every practice. Patients are more likely to adopt an exercise routine if it is directly recommended by a physician (Thornton et al., 2016).

Exercise, Mobile Applications, and Diabetes

As previously discussed, lifestyle changes and physical activity play an essential role in the management and tight control of glucose and A1C monitoring, and the use of technology is becoming a necessary part of this process (Block et al., 2015). A 2-arm pilot randomized control trial that evaluated a group of 45 Filipino Americans with type 2 diabetes, Block et al. (2015) showed that the use of mobile phone-based lifestyle intervention applications were successful in tracking health behaviors such as weight loss interventions and increased the number of steps taken over time by participants. They also concluded that older adults are capable of learning and becoming proficient in the use of mobile technology, contrary of the misconception that older adult cannot learn new technology (Bender, Copper, Park, Padash, & Arai, 2017). Understanding about older adult leaning capacity is important to consider while designing and implementing this DNP project. An SMS based diabetes self-management support programme was found to be effective in helping to achieve moderate glycemic index control, but the study failed to show any difference in encouragement or motivation to exercise (Block et al., 2019).

Fukuoka (2015) concluded that individuals at risk for diabetes who used a pedometer to track their physical activity had a better rate of adherence to the physical activity than other studies have shown. Participants in this study had a mean weight loss of 6.8% throughout five months by increasing their activity level. Hou, Carter, Hewitt, Francisa, and Mayor (2016) found that mobile apps can be a helpful component in the management of HbA1c and can be used as an add-on intervention to the normal self-management routine in patients with type 2 diabetes. All these studies are a good steppingstone for further studies on the use of apps for motivating diabetic patients to exercise.

In a randomized control trial, Laing et al. (2014) evaluated weight loss, systolic blood pressure changes, frequency in app use, and app use satisfaction six months after a group of 221 primary care patients were introduced to a smartphone app for weight loss. It was concluded that after six months weight loss was minimal with no difference between groups (mean between-group difference, −0.30 kg [95% CI, −1.50 to 0.95 kg]; $P = 0.63$). Specifically, after a month, participants' logins to the smartphone app decreased significantly. These results led to the conclusion that it is crucial to assess the patient's readiness to start an exercise program before introducing them to a fitness smartphone app. For those who are ready and committed, however, the app could serve as a helpful tool (Laing et al., 2014).

Several physical activity applications could be used during this project. The most common podia for these apps are IOS and Android. Standard features of these applications are goal setting, progress tracking, target cross-training with set intervals, instructional videos, and voice coaching (Wong, Meng, Loprinzi, & Hongu, 2014). Laing et al. (2014) reported MyFitnessPal as one of the most popular applications available, while Pagoto, Schneider, Jojic, Debiasse, and Mann (2013) found MyNetDiary and MyNetDiary Pro to have the most significant

number of evidence-based strategies, including a library containing a lot of information on various topic, such as nutrition, exercise plans. For this project, an app such as MapMyFitness will be used. It can be downloaded from Android or IOS, and it logs more than 600 different fitness activities, syncs with smartwatches and includes a report of a user's performance. Furthermore, users can save data on their exercise pace, calories burned, and distance, and they can join the community for social support motivation.

Social Support and Motivation to Exercise

The use of cell phone and other mobile applications have been demonstrated to be reliable in providing peer support (Rotheram-Borus et al., 2012). In a qualitative study, Fukuoka, Kamitani, Bonnet, and Lindgren (2014) determined that mobile phone-based lifestyle programs may be helpful to increase the motivation of participants to start exercising, increase their physical activity level and improve their diet. Connelly, Kirk, Masthoff, and Macrury (2013) concluded that personal coaching could be more beneficial than peer-to-peer support but found that peer-to-peer support is still very beneficial. They suggested that peer-to-peer support can help individuals adhere more easily to lifestyle and behavior modifications than when doing it alone.

Mladenovic, Wozniak, Plotnikof, Johnson, and Johnson (2014) conducted a qualitative study of participants in a program called Healthy Eating and Active Living for Diabetes in primary care networks (HEALD). Participants reported self-efficacy and motivation to implement physical activity during the program and attributed their increase in motivation to feeling supported by the exercise specialists who led the program and peers participating in the program.

The review of the literature provides extensive evidence for the private investigator (PI) of this project to implement a program to help diabetic patients increase their motivation to exercise while using both a smartphone application and an accountability partner. The research provided substantial evidence that social support and smartphone fitness applications could increase diabetic patients' accountability to exercise and help them maintain their personalized exercise goals.

Theoretical Framework

The social cognitive theory (SCT) was created by Bandura and is known as the cognitive formulation of social learning theory. The theory is considered a versatile model that explains the continuous interaction of personal factors, environmental influences, and behavior. It is a model widely used in principles of behavior modification because of its dynamic and its relevance to observational learning, reinforcement, self-efficacy, and self-control (Glanz, 2001).

SCT evaluates how an individual attains and maintains behavior. The theory also assesses the social environment in which an action is performed. The social cognitive approaches associated with this theory encourage optimal self-management of health habits, allows people to maintain these habits through a lifetime (Bandura, 2004).

Bandura determines three core determinants that can influence health practices. The knowledge of health risks and benefits, self-efficacy in managing one's health habits, and outcome expectations. One of the central tenets of this theory is self-efficacy, the belief in one's capability to work towards one's goal. Self-efficacy is often known as the cornerstone in behavioral initiation and maintenance. Longer-term behavior changes are greatly influenced by self-efficacy (Fanning et al., 2017). Taylor et al. (2016) found a strong correlation between self-

efficacy and physical activity, concluding that SCT seems to be a valuable model in understanding physical activities in diabetic patients.

For the purpose of this project, self-efficacy is reflected in the individual's beliefs and capacity to perform an early preventive behavior such as the initiation of an exercise program. Environmental influences are the basis that allows individuals to reinforce their behaviors by observing and receiving the encouragement of others. In this project, self-efficacy would be demonstrated with the use of the smartphone fitness app and peer-to-peer support. Behavioral factors are shown on the individuals' outcomes and accomplishments, specifically, the number of steps per day per individual and participants' ability to continue the program for the four weeks of the program. Please refer to Appendix B.

Design of Project

Study Design

The study employed a descriptive pre-test/post-test design with a baseline data collection on all study participants. This was followed by a period of intervention during which the smartphone application was introduced to the participants. The total length of the project was four weeks. The end line data collection phase, using the same instruments used at baseline. The pre-test/post-test design is a non-experimental design that allows the principal investigator (PI) to investigate changes over time by using the earlier measurement observation and bypassing the use of a control group (Fisher & Foreit, 2002).

Study Setting

The study took place in a physician practice in Middlesex County in central New Jersey. The practice is a well-established medical office with an average of 1200 patients yearly. About 40%, or 480, of the patients, are identified as diabetic. About 40 of these diabetic patients are

seen monthly. The patients from the practice are primarily from African descendants and non-Hispanic Whites.

Population Sample

Using the sample size calculator on the Raosoft website, a sample size of 45 participants was calculated. This number was obtained using a 5% margin of error and a 95% confidence interval. The inclusion criteria will be English speaking diabetic patients ages 30 to 70 years who have a smartphone and are comfortable with sending and receiving text messages, comfortable using a fitness application, and healthy enough to walk at least 30 minutes daily. The exclusion criteria will be non-diabetic patients, patients 70 years old and older, diabetic patients unable to practice any physical exercise, patients who do not own or are not comfortable using a smartphone and patients who admit having any positive item on the Physical Activity Readiness (PAR-Q) (Appendix E).

Recruitment

To recruit participants for the study, recruitment flyers (Appendix C) were placed in the office lounge, examination rooms, and bathrooms of the site of this study. In-person recruitment was also done by the PI in the facility. The PI informed patients at the facility of the study and assess their willingness to participate in it. During the visit intake, a flyer was provided by the PI to all incoming patients. All the Recruitment was done during scheduled appointments. Potential participants were identified by a list of patients with diabetes provided by the office manager. All participants were provided with the PI's contact information and were able to contact the PI through text messages or phone calls.

Risks, Ethics, and Consent Procedure

The study presented minimal risk to the participants, although there is a small risk that disclosed information such as phone numbers, fitness application data, and personal health information could be shared unintentionally. No names were collected. Instead, each participant was given a code such as P1, P2. Because the project involves walking, there are certain risks such as joint pain, falling, and shortness of breath. Another risk to considered was the stress related to the use of technology. These risks were be fully disclosed on the written informed consent as per Rutgers University IRB requirements.

The informed consent, found in Appendix H, was adapted from the Rutgers IRB template, and it was modified to reflect the participants' needs and the objective of the project. The participants were informed that they are free to participate in the program and that their decision to participate would not influence the routine care provided. Any new findings in the study that might affect the participants' decision to remain in the study was reported to them. They were also informed of the implications, risks, and benefits of the project during the first scheduled meeting. They were able to opt out at any point in the four weeks with no questions asked, as long as they inform the PI. There were no penalties to any the participants that decided to opt out. Then they will also have the opportunity to ask questions, which will be answered by the PI. The informed consent forms will be maintained confidentially and in a secure place.

Subject Cost and Compensation

To help ensure and encourage participation, refreshments and healthy snacks were offered at every scheduled meeting. Each participating member was presented with a $10 gift card from Starbucks during the last scheduled session, and an armband smartphone carrier was be provided during the first meeting. There was no cost to the individuals who participated in this project.

Study Intervention and Resources

The focus of the study is to analyze the benefits of using a smartphone application and an accountability partner to increase patients' motivation to exercise. The duration of the study will be a total of four weeks with two in-person meetings. During the first meeting with the PI, participants were asked to sign the written informed consent form, take the initial background survey (Appendix D), and complete the Physical Activity Readiness Questionnaire (PAR-Q) (Appendix E) to assess their physical activity readiness (Samendinger et al., 2018).

All the participants were assessed at baseline with a pre-test questionnaire on motivation to exercise. The survey used is called Motives for Physical Activity Measure-Revised (MPAM-R) (Appendix F). This tool contains 30 questions used to evaluate five different factors about fitness, including appearance, competence/challenge, social and enjoyment motives. This scale has been used in the prediction of several behavioral outcomes, such as attendance, persistence, and maintained participation in a physical activity routine (Self Determination Theory, 2019). As indicated by Hancock and Bergman (2013), the MPAM-R tool has been shown to demonstrate appropriate internal consistency, with evidence of validity and feasibility.

During the first in person meeting, the PI conducted a discussion session about diabetes, exercise, and the utilization of the fitness application and accountability partner to increase motivation to exercise. Brochures containing this information (Appendix K-O) were distributed to all participants. The participants were allowed to ask questions and any necessary clarifications was made. Then the PI helped the participants download the fitness application MapMyFitness into their smartphone and assisted them with the registration process and the use of the of features such pace, timing, and performance in the app. The PI was able to follow each participant through the app, and all the participants were likewise able to follow each other's

progress and activities. They could communicate and encourage each other through the application. The initial ideas were to assign or give the participants a choice to self-select a partner, but the sample size was too small for such. Therefore, they were all accountable for each other. All the participants exchanged contact numbers, and they were instructed to check on each other at least once a day.

The PI contacted each participant at the end of weeks two and three over the phone to check-in, deal with any possible issues, and answer any questions. At the beginning of the program, the PI's phone contact information was provided to all participants and the particpants was reassured that they could call the PI anytime during the four weeks with questions or concerns. During the last in person meeting, each participant was asked to complete the post-test (Appendix G) and an evaluation form.

Study Timeline and Budget

The timeline of the study includes the PI presenting the proposal to the DNP team members. After approval from all the team members, the proposal was submitted to the Rutgers IRB. Once the study was approved by the IRB, the project was implemented. Appendix J provides a detailed timeline of the project. The project was entirely funded by the PI. The clinical site did not provide any funding for the project.

Evaluation Plan, Data Analysis Plan, Data Maintenance / Security

Data Collection and Evaluation

Motivation to exercise was measured using the motivation questionnaire MPAM-R (Social Determination Theory, 2019). The MPAM-R has 30 items measured on a seven-point Likert scale, and it is used to assess motivation to partake in an exercise activity. This scale was used as a pre-test/post-test to analyze participants' level of motivation to exercise. The level of

awareness of exercise as a prevention tool was collected and analyzed. All data from the smartphone application was collected at the end of the four weeks. To measure the usefulness of a partner in increasing motivation was done using the MPAM-R. Participants had the opportunity to evaluate the project using an evaluation questionnaire (Appendix I) at the last meeting.

Data Analysis, Maintenance, and Security

Descriptive statistics were used to present demographic data that was presented as frequencies/percentages. Analytical non-parametric Wilcoxon signed ranked test was used to compare mean MPAM-R scores pre and post-intervention. Data obtained from questions about motivation using mobile apps were displayed using descriptive statistics.

All participant names were de-identified, and every participant was given a designated code such as "patient one" or "P1." The PI used this code for any data collection. This measure helped to ensure confidentiality and prevent any unintentional disclosure of protected information. All informed consent and collected data were maintained in a secure office at Rutgers University, Stanley S. Bergen Building, in room 1115 at 65 Bergen St., Newark, N.J. 07101. After completion of the project and closure of IRB, all the collected data, surveys, and informed consents were destroyed as recommended by Rutgers University.

Results

A total of six diabetic patients participated. The first in-person meeting with the first set of data collection took place on February 5, 2020, and the last in-person meeting happened on March 7, 2020. The intervention period was four weeks. One of the participants was not available for the final in-person meeting.

After the data collection, descriptive statistics were used to present demographic data that was presented as frequencies/ percentages. Analytical non-parametric Wilcoxon signed ranked

test was used to compare mean MPAM-R scores pre and post-intervention. Data obtained from questions about motivation using the mobile app were displayed using descriptive statistics. Microsoft Excel statistical package was used for data analysis.

Characteristics of the sample population.

Descriptive statistics were used to present the demographic data, as demonstrated by Table 1. All participants (n=6) identified themselves as females. The age of the participants varied from 30 to 50 years old. All participants (n=6) were diagnosed with diabetes in the past two to fifteen years. All the participants, 66.7%, had used a smartphone app while exercising, and 33.3% never used a mobile application. From those that had used a mobile application, only 33.3 % believed it increased their motivation to exercise. Only 16.7 % of the population had exercised with a partner in the past.

MPAMP-R scores pre-intervention and post-intervention

Analytical non-parametric Wilcoxon signed ranked test was used to compare mean MPAM-R scores pre and post-intervention as described in Table 2. The mean motivation score pre-intervention was 108. The mean motivation score post-intervention was 142. The Wilcoxon signed ranked test was done and showed no significant difference in mean scores from pre to posttest, $p=0.69$. Despite a numerical increase in mean motivation score post-intervention, this increase was not statistically significant, meaning that there is no certainty that the intervention improved the motivation of participants to exercise. Table 3 reports the results of the MPAM-r scores. Several correlations were analyzed with the MPAM-r questionnaires. The first categories were interest/enjoyment with a mean absolute value of 25.2 for the pretest and 29.5 for the posttest. The second category was competence. The mean absolute value for pretest was 26.5, and the posttest was 33.3. The third category was appearance with a mean absolute value of 29.2

pretest and 29 posttest. The fitness category showed a mean absolute value of 30 pretest 31.4 posttest. The social category had a mean absolute value of 11.6 pretest and 17.2 posttests.

Motivation to exercise using an app or a partner

About 60% of the sample size reported an increase in motivation while using the mobile application, and 100% of the population said that the group activity and following their colleagues through the app motivated them to keep their fitness plans. During the evaluation of the program, 83.3 % of the population stated that the favorite aspect of the program was the motivation they received from others. 100% of the participants agreed that the length of the program was short

Discussion

The goal of this project was to investigate how the use of a mobile application and social support improve diabetic patients' motivation to start and maintain an exercise program. The objectives were to promote awareness regarding the benefits of exercise among diabetic patients, use social support to encourage exercise and motivation for exercise among diabetic patients and to use mobile applications to promote activity and social support among diabetic patients.
The study showed that despite a numerical increase in motivation, there was no statistically significant difference in motivation score post-intervention. A lack of statistical significance may be explained by the small sample size of the project that affected statistical power to detect differences. On the other hand, it is possible to assume that the use of an application or a partner alone, without other supporting measures, may not be sufficient to improve motivation to exercise.

The numerical increase in the patient's motivation to exercise observed in this study, agrees with the current literature that demonstrated that the use of mobile phone-based lifestyle

intervention applications was successful in tracking health behaviors such as weight loss interventions and increased the number of steps taken over time by the participants (Block et al., 2015).

Although, this study didn't evaluate the HBA1c directly, the increase in exercise, further help with the management of diabetes which is consistent with an investigation by Hou, Carter, Hewitt, Francisa, and Mayor (2016) in which they describe the benefits of mobile apps in the management of HbA1c.

The findings of this study also favor the current literature that supports that peer-to-peer support can help individuals adhere more easily to lifestyle and behavior modifications than when doing it alone (Connelly, Kirk, Masthoff, and Macrury, 2013). The fitness app and the workout partner proved to increase the participants' accountability, which increased their motivation to exercise and eventually will help with controlling their diabetes.

There is a lot of question remain unanswered, particularly regarding the effect of apps on long-term adherence to exercise amongst diabetic patients. Also, the effect of apps and motivation to exercise on the long-term outcomes of diabetes (cardiovascular events) remain unclear. Future scholars should conduct a well-designed study with adequate sample size, prolonged follow-up, and objective measures of data collection to answer these questions.

Limitations and Barriers

The study had several limitations and barriers that need to be acknowledged. The most significant barrier was the recruitment process. Several patients that had agreed to take part in the study didn't make it for the first in-person meeting, which affected the sample size. The small sample size might have affected the results of the project since it reduced statistical power to detect differences in pre and post-intervention.

The length of the period for the intervention was four weeks, which didn't allow enough time for participants to develop and maintain an exercise habit. Another observed barrier was the season in which the study took place. As reported by the participants, they were less motivated to go for a walk during the winter days. Because the intervention required the use of a smartphone, this presented as a limitation for those patients that are not technologically proficient. All the participants were required to have a smartphone. Therefore the results of this study can not be extended to the non-smartphone users.

Although they all reported that they were able to use a smartphone without any restrictions, the follow-up calls were spent trying to help participants navigate through the application. The number of in-person meetings wasn't sufficient and didn't provide patients with the adequate support necessary to keep the study fluent. All these limitations might affect the project findings, resulting in non-significant differences in pre and post-intervention.

Implications for Clinical Practice

The findings of this project can be used to guide clinical practice and education. The particular findings of this project showed that the use of a partner and a mobile application could help diabetic patients increase their motivation to exercise (numeric but not statistical increase). Based on these findings, healthcare providers in primary settings should take time to discuss physical activities with their patients. The use of mobile apps and a partnership with a friend either personally or virtually should be discussed or encouraged with diabetic patients. This study could provide healthcare providers with a tool that can help them provide unbiased exercise education to all their patients.

Conclusions

Diabetes has a significant effect on the health and well-being of those living with the disease. Exercise is considered the cornerstone of the fight against diabetes, but due to limited time, many providers struggle to provide adequate education to patients in outpatient settings. Technology-assisted interventions may be beneficial in delivering lifestyle interventions that can help patients achieve and increase their willingness to adhere to exercise programs.

The study showed that despite a numerical increase in motivation, there was no statistically significant difference in motivation score post-intervention. Future studies should be conducted to determine whether mobile applications and other innovative approaches increase motivation and adherence to exercise and, hopefully, improve long-term clinical outcomes among patients with diabetes.

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Appendices

Appendix A: Table of evidence

Increase Motivation to Exercise in Diabetic Patients Using a Mobile Application

Article Number	Author and Date	Evidence Type	Sample size Setting	Study Findings Relevant to the DNP Project	Limitations to the study	Evidence Level and Quality
1	Arda Sürücü et al. 2018	Descriptive cross-sectional and relational research	A total of 220 individuals with type 2 diabetes, who hospitalized in the endocrine service in a hospital in Turkey	A diabetic patient who felt empowered by social support demonstrated a higher glycemic control level and exhibited better self-care behaviors.	A diabetic specific scale to evaluate social support was not used. The study was held in the low-income area in Turkey the study cannot be generalized to the entire Turkey population	Level I A
2	Block et al. 2015	RCT	The trial randomly assigned 339 persons to the Alive-PD intervention (n=163) or a 6-month wait-list usual-care control group (n=176). Eligible participants were prediabetic,	The study was found to be effective, in helping to achieve moderate glycemic index control, but the study failed to show any difference in exercise's encouragement or motivation	The authors defended that the fact that the study was fully automated was a limitation and a strength. The population was well educated	Level II A
3	Eysenbach et al., 2015	Qualitative	A total of 84 patients with type 2	Patients with higher exercise motivation	The analysis was limited by the fact that the app	Level I A

			diabetes mellitus from a primary care clinic in Singapore.	used the mobile app more often than those with lower motivation. According to them, these patients are more likely to better manage their diabetes, by making better lifestyle choices.	database could only provide information on app usage every week.	
4	Heiss & Petosa, 2016	Cross-sectional survey study	A total of 181 adults with type 2 diabetes participated in the study. The study was conducted in the [redacted]	Participants who received higher levels of social support from family and friends were more likely to spend more minutes practicing moderate exercise per week.	The sample was drafted from ResearchMatch.org these individuals might have more interest to participate in research than other members of the T2DM population. It is hard to generalize the sample because the sample was random. They used the self-report for the variables.	Level II A
5	Laing et al. (2014),	RCT	Two hundred twelve primary care patients with a body mass index of 25 kg/m^2 or greater in a two academic	After six months, weight change was minimal, with no difference between groups (mean between-group difference, −0.30 kg [95% CI, −1.50 to	Although the study was blinded to the name of the app, 14 control group participants (13%) used MyFitnessPal. Also, 32% of intervention group participants and 19% of control group participants	Level I A

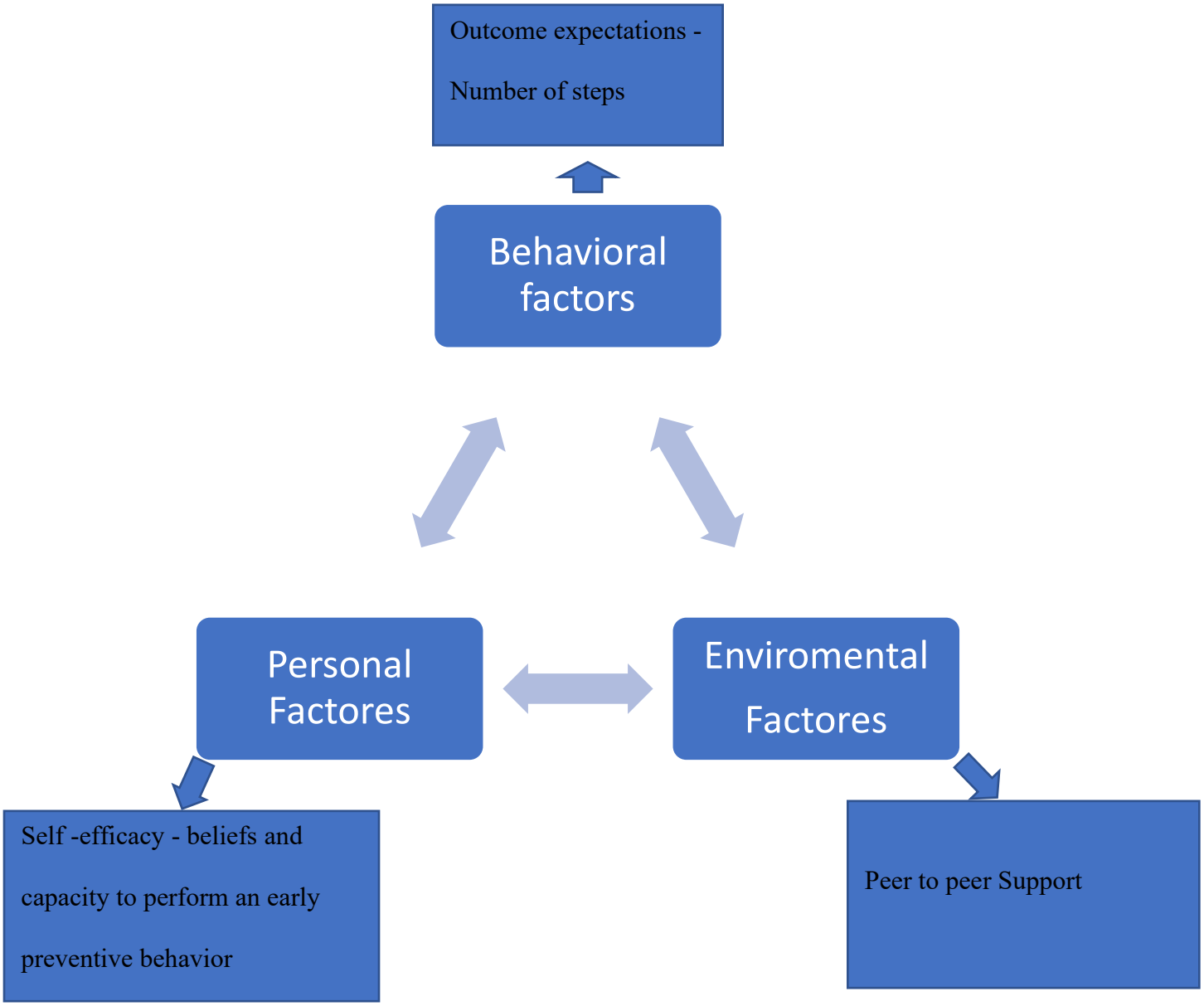
			primary clinic.	0.95 kg]; *P* = 0.63) Smartphone apps for weight loss can be helpful for persons who are ready to self-monitor, but it is not helpful if the patient is not ready	didn't follow-up at six months. Research assistants gave the app to patients instead of physicians.	
6	Lidegaard, Schwennese, Willing & Færch, 2016	Qualitative	The researchers conducted focus groups with 28 patients with Type 2 Diabetes mellitus. The study was conducted in an outpatient clinic in Denmark.	The study concluded that social interaction might help to maintain higher levels of activity, once an individual has established a routine.	The study focused on diabetic patients with dysregulated diabetes complications, and many can argue that the results of the study are specific to that population. The population was recruited from a clinic with only diabetic patients, and all patients had good experiences with physical activities except four of the participants. The authors perceived all these as barriers that prevent them from generalizing the study.	Level I B
7	Mendes, Sousa, Reis, & Themudo-Barata. (2017	Non-randomized controlled study - quantitative	Participants aged 55 to 75 years recruited at the local hospital. One hundred seventy	They found that a long-term community-based combined exercise program	The researchers described the lack of complete randomization as their major limitation of the study. This was mostly due to the	Level I A

			patients meet criteria such as being diagnosed with diabetes type 2 for at least a year. A1c less than 10% and with no complication of diabetes like diabetic foot and nephropathy. A total of 68 patients applied, but only 60 were randomly selected.	developed with low-cost exercise strategies was effective in demonstrating benefits on glycemic control, lipid profile, blood pressure, anthropometric profile, and the 10-year risk of coronary artery disease in middle-aged and older patients with type 2 diabetes. They were able to demonstrate the importance of exercises in diabetes	small sample size. The extensive number of dropout and withdrawals due to poor adherence to exercise sections.	
8	Mladenovic et al. (2014)	Qualitative	A 24-week primary care-based walking programme for people with type 2 diabetes, proven effective in increasing physical activity. Interviews were held with 13 participants 6 months after they	The findings are consistent with Social Cognitive Theory, and Participants' described self-efficacy and motivation to start a physical activity during the programme were linked to feeling supported by the exercise specialists who led the programme and peers	Because, they used self-reported data and did not appraise changes in social support, self-efficacy or motivation, which can be considered a weakness. Participants in other lifestyle programmes may have perspectives different from those reported in this study.	Level I A

			finished the programme.	participating in the programme.		
9	Pagoto, Schneider, Jojic, Debiasse, & Mann (2013	Qualitative	Thirty weight-loss mobile apps, available on iPhone and Android platforms, were accessed and researched to whether they had 20 behavioral strategies derived from an evidence-based weight-loss program the collection of data happened in January 2012 and it was analyzed in June 2012.	The apps included on average 18.83% (SD=13.24; range=0%–65%) of the 20 strategies. Behavioral strategies that help improve motivation, reduce stress, and assist with problem-solving were absent across apps.	The additional features associated with the apps did not access in this study. The apps that did not have dietary and weight self-monitoring features were not included because these two behavioral approaches are the basis of evidence-based behavioral weight-loss programs and are the most common behavioral strategy included in weight-loss apps. The apps used were limited to those in the top 100 for Android systems and the iPhone,	Level II B
10	Rotheram-Borus, et al. (2012),	Quantitative	A total of 22 women with diabetes in Cape Town, South Africa, participated in a 12-week program that provided knowledge of health routines to manage diabetes.	By three months, women improved their sleep and conveyed a higher level of positive action and social coping, but blood glucose increased by 3.3 points. From 3 to 6 months, spiritual hope	The problems with pilot programs are the lack of opportunities to sustain investments for new programs over time; the authors also found that the frequency of texting did not impact the changes in individuals' symptoms of diabetes.	Level I

			They were linked with a buddy via a mobile phone for support and were questioned daily about a health behavior via text message. Women were assessed at recruitment, t 3 months and six months	decreased, and diastolic blood pressure increased. After one year all the 22 women continue to attend meetings.		

Appendix B:Theoritical Framework



Adapted from Alona Dalusung-Angosta, Reimund Serafica, & Sheniz Moonie. (2015). Measuring enjoyment of ballroom dancing in Filipino Americans using the physical activity enjoyment scale. Asian/Pacific Island Nursing Journal, 2(2), 1–9. https://doi.org/10.1177/2373665815585320

Appendix C : The Recruitment Flyer

Come Join US and Increase your Motivation to Exercise

IMPROVING DIABETIC PATIENTS' MOTIVATION TO EXERCISE USING A MOBILE APPLICATION.

The goal of this project is to analyze how the use of a mobile application and social support, improve diabetic patients' motivation to start and maintain an exercise **program.**

Participants must be

- *-30 to 70 years old*
- *Diagnosed with diabetes*
- *Own a smartphone*
- *Capable of walking at least 30 minutes.*

Refreshements and snacks will be served. An armband smartphone carrier will be provided.

For more information contact
Carina Santos
At [redacted]
Or [redacted]

The Study will take place at [redacted]

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Version 01

Appendix D : Initial Survey

Initial Survey

Initials: _____Date _____.

Please answer each question below.

1) What is your age?

2) Gender
   a) Male
   b) Female
   c) Transgender
   d) Prefer not to answer

3) Are you diabetic?
   a) Yes
   b) No

4) Do you exercise?
   a) Yes
   b) No

5) If yes, how often?
   a) Once to three times a week
   b) Three to five times a week
   c) Daily

6) How motivated are you to exercise?
   a) It is hard for me to get motivated
   b) I'm motivated
   c) I'm very motivated

7) Do you work with a partner?
    a) Yes
    b) No
8) If yes, did it increase your motivation to exercise?
    a) It did not help
    b) It did help
    c) it helped a lot
9) Are you able to use a smartphone?
    a) Yes
    b) No
    c) With difficulty
10) Did you ever use a smartphone fitness application?
    a) Yes
    b) No
11) If yes, did it increase your motivation to exercise?
    a) It did
    b) It did not
    c) Somehow
12) Are you able and willing to walk while using a smartphone fitness application?
    a) Yes
    b) No
13) Are you willing to exercise with a partner, either personal or remotely?
    a) Yes
    b) No

Appendix E : Physical Activity Readiness Questionnaire (PAR-Q) and You

Physical Activity Readiness Questionnaire (PAR-Q) and You

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their doctor before they start becoming much more physically active.

If you are planning to become much more physically active than you are now, start by answering the seven questions in the box below. If you are between the ages of 15 and 69, the PAR-Q will tell you if you should check with your doctor before you start. If you are over 69 years of age, and you are not used to being very active, check with your doctor.

Common sense is your best guide when you answer these questions. Please read the questions carefully and answer each one honestly:

YES	NO		
☐	☐	1.	Has your doctor ever said that you have a heart condition and that you should only do physical activity recommended by a doctor?
☐	☐	2.	Do you feel pain in your chest when you do physical activity?
☐	☐	3.	In the past month, have you had chest pain when you were not doing physical activity?
☐	☐	4.	Do you lose your balance because of dizziness or do you ever lose consciousness?
☐	☐	5.	Do you have a bone or joint problem that could be made worse by a change in your physical activity?
☐	☐	6.	Is your doctor currently prescribing drugs (for example, water pills) for your blood pressure or heart condition?
☐	☐	7.	Do you know of any other reason why you should not do physical activity?

If you answered:

YES to one or more questions

Talk to your doctor by phone or in person BEFORE you start becoming much more physically active or BEFORE you have a fitness appraisal. Tell your doctor about the PAR-Q and which questions you answered YES.

- You may be able to do any activity you want – as long as you start slowly and build up gradually. Or, you may need to restrict your activities to those which are safe for you. Talk with your doctor about the kinds of activities you wish to participate in and follow his/her advice.
- Find out which community programs are safe and helpful for you.

NO to all questions

If you answered NO honestly to all PAR-Q questions, you can be reasonably sure that you can:

- Start becoming much more physically active – begin slowly and build up gradually. This is the safest and easiest way to go.
- Take part in a fitness appraisal – this is an excellent way to determine your basic fitness so that you can plan the best way for you to live actively.

Delay becoming much more active:

- If you are not feeling well because of a temporary illness such as a cold or a fever – wait until you feel better; or
- If you are or may be pregnant – talk to your doctor before you start becoming more active.

Please note: If your health changes so that you then answer YES to any of the above questions, tell your fitness or health professional. Ask whether you should change your physical activity plan.

Informed use of the PAR-Q: Reprinted from ACSM's Health/Fitness Facility Standards and Guidelines, 1997 by American College of Sports Medicine

Appendix F : Pre- Evaluation Questionnaire

Pre evaluation test

Motives for Physical Activities Measure – Revised (MPAM-R)

The following is a list of reasons why people engage in physical activities, sports, and exercise. Keeping in mind your
primary physical activity/sport, respond to each question (using the scale given), because of how true that response is
for you.
1 2 3 4 5 6 7
not at all very
true for me true
for me

___ 1. Because I want to be physically fit.
___ 2. Because it's fun.
___ 3. Because I like engaging in activities which physically challenge me.
___ 4. Because I want to obtain new skills.
___ 5. Because I want to look or maintain weight, so I look better.
___ 6. Because I want to be with my friends.
___ 7. Because I like to do this activity.
___ 8. Because I want to improve my existing skills.
___ 9. Because I like the challenge.
___ 10. Because I want to define my muscles, so I look better.
___ 11. Because it makes me happy.
___ 12. Because I want to keep up my current skill level.
___ 13. Because I want to have more energy
___ 14. Because I like activities which are physically challenging.
___ 15. Because I like to be with others who are interested in this activity.
___ 16. Because I want to improve my cardiovascular fitness.
___ 17. Because I want to improve my appearance.
___ 18. Because I think it's interesting.
___ 19. Because I want to maintain my physical strength to live a healthy life.
___ 20. Because I want to be attractive to others.
___ 21. Because I want to meet new people.
___ 22. Because I enjoy this activity.
___ 23. Because I want to maintain my physical health and well-being.
___ 24. Because I want to improve my body shape.
___ 25. Because I want to get better at my activity.
___ 26. Because I find this activity stimulating.
___ 27. Because I will feel physically unattractive if I don't.
___ 28. Because my friends want me to.
___ 29. Because I like the excitement of participation.
___ 30. Because I enjoy spending time with others doing this activity.

Scoring Information

Interest/Enjoyment: 2, 7, 11, 18, 22, 26, 29
Competence: 3, 4, 8, 9, 12, 14, 25
Appearance: 5, 10, 17, 20, 24, 27
Fitness: 1, 13, 16, 19, 23
Social: 6, 15, 21, 28, 30

Adapted from Self Determination Theory retrieved from

https://selfdeterminationtheory.org/motives-for-physical-activity-measure/

Appendix G : Post Evaluation Questionnaire

Post Evaluation Questionnaire

Motives for Physical Activities Measure-Revised (MPAM-R)
The following is a list of reasons why people engage in physical activities, sports, and exercise. Keeping in mind your
primary physical activity/sport, respond to each question (using the scale given), based on how true that response is
for you.
1 2 3 4 5 6 7
not at all very
true for me true
for me

___ 1. Because I want to be physically fit.
___ 2. Because it's fun.
___ 3. Because I like engaging in activities which physically challenge me.
___ 4. Because I want to obtain new skills.
___ 5. Because I want to look or maintain weight, so I look better.
___ 6. Because I want to be with my friends.
___ 7. Because I like to do this activity.
___ 8. Because I want to improve existing skills.
___ 9. Because I like the challenge.
___ 10. Because I want to define my muscles, so I look better.
___ 11. Because it makes me happy.
___ 12. Because I want to keep up my current skill level.
___ 13. Because I want to have more energy
___ 14. Because I like activities which are physically challenging.
___ 15. Because I like to be with others who are interested in this activity.
___ 16. Because I want to improve my cardiovascular fitness.
___ 17. Because I want to improve my appearance.
___ 18. Because I think it's interesting.
___ 19. Because I want to maintain my physical strength to live a healthy life.
___ 20. Because I want to be attractive to others.
___ 21. Because I want to meet new people.
___ 22. Because I enjoy this activity.
___ 23. Because I want to maintain my physical health and well-being.
___ 24. Because I want to improve my body shape.
___ 25. Because I want to get better at my activity.
___ 26. Because I find this activity stimulating.
___ 27. Because I will feel physically unattractive if I don't.
___ 28. Because my friends want me to.
___ 29. Because I like the excitement of participation.
___ 30. Because I enjoy spending time with others doing this activity.

Scoring Information

Interest/Enjoyment: 2, 7, 11, 18, 22, 26, 29
Competence: 3, 4, 8, 9, 12, 14, 25

Appearance: 5, 10, 17, 20, 24, 27
Fitness: 1, 13, 16, 19, 23
Social: 6, 15, 21, 28, 30

Did your motivation to walk increase in the past four weeks?

Having the fitness application motivate you to walk?

Having an accountability partner increase your motivation to walk?

Adapted from Self Determination Theory retrieved from

https://selfdeterminationtheory.org/motives-for-physical-activity-measure/

Appendix H : Informed Consent

CONSENT TO TAKE PART IN A RESEARCH STUDY

TITLE OF STUDY: Improving Diabetic Patients' Motivation to Exercise Using a Mobile Application.

Principal Investigator: Carina Santos

STUDY SUMMARY: This consent form is part of an informed consent process for a research study and it will provide information that will help you decide whether you want to take part in this study. It is your choice to take part or not. The purpose of the research is to: The goal of this project is to analyze how the use of a mobile application and social support, improve diabetic patients' motivation to start and maintain an exercise program.

If you take part in the research, you will be asked to walk daily for at least 30 minutes and use a smartphone app to register your physical activity. Your time in the study will take 3o minutes daily for four weeks and two in-person meeting for two hours. Possible harms or burdens of taking part in the study may be fall, and joint pain from walking and possible benefits of taking part may decrease blood sugar and develop a habit of walking.

The information in this consent form will provide more details about the research study and what will be asked of you if you choose to take part in it. If you have any questions now or during the study, if you choose to take part, you should feel free to ask them and should expect to be given answers you completely understand. After all of your questions have been answered, and you wish to take part in the research study, you will be asked to sign this consent form. You are not giving up any of your legal rights by agreeing to take part in this research or by signing this consent form.

Who is conducting this research study?
Carina Santos is the Principal Investigator of this research study. A Principal Investigator has the overall responsibility for the conduct of the research. However, there are often other individuals who are part of the research team.

Carina Santos may be reached at [redacted] or email at [redacted]

The Principal investigator or another member of the study team will also be asked to sign this informed consent. You will be given a copy of the signed consent form to keep.
.

Why is this study being done?
. The goal of this project is to analyze how the use of a mobile application and social support, improve diabetic patients' motivation to start and maintain an exercise program.

Who may take part in this study and who may not?
Diabetic patients ages 30 to 70 years with a smartphone, being comfortable with sending and receiving text messages, comfortable using a fitness application and healthy enough to walk at least 30 minutes daily.

Why have I been asked to take part in this study?
Because you are diabetic.

How long will the study take and how many subjects will take part?
The study will take four weeks.

What will I be asked to do if I take part in this study?
To have a smartphone download a fitness application called MapMyFitness, partner with a buddy to encourage each other to exercise and walk at least 30 minutes daily.

What are the risks and discomforts I might experience if I take part in this study?
His study?
You will be asked to share personal information such as name, race, and date of birth, and there is a small risk that this information can be shared. There might be a risk of joint pain and fall while walking, but these risks are minimal and if you don't feel strong enough to walk you shouldn't't participate in this project

How will I know if new information is learned that may affect whether I am willing to stay in the study?
During the study, you will be updated about any new information that may affect whether you are willing to continue taking part in the study. If new information is learned that may affect you after the study or your follow-up is completed, you will be contacted.

Will I receive the results of the research?
Yes.

Will there be any cost to me to take part in this study?
There will be no cost to you to participate in this study.

How will information about me be kept private or confidential?
All efforts will be made to keep your personal information in your research record confidential, but total confidentiality cannot be guaranteed.

What will happen to my information collected for this research after the study is over?

Collected for this research may be used by or distributed to investigators for other research without obtaining additional informed consent from you

What will happen if I do not wish to take part in the study or if I later decide not to stay in the study?
It is your choice whether to take part in the research. You may choose to take part, not to take part or you may change your mind and withdraw from the study at any time.

If you do not want to enter the study or decide to stop taking part, your relationship with the study staff will not change, and you may do so without penalty and without loss of benefits to which you are otherwise entitled.

You may also withdraw your consent for the use of data already collected about you, but you must do this in writing to Carina Santos at [redacted] or [redacted]

Will I be able to review my research record while the research is ongoing?
No. We are not able to share information in the research records with you until the study is over. To ask for this information, please contact the Principal Investigator, the person in charge of this research study.

Do I have to give my permission?
No. You do not have to permit the use of your information, but if you do not give permission, you cannot take part in this research study if you decide to participate or not will not affect your medical care and other benefits at the doctor office.

If I say yes now, can I change my mind and take away my permission later?
Yes. You may change your mind and not allow the continued use of your information (and to stop taking part in the study) at any time. If you take away permission, your information will no longer be used or shared in the study, but we will not be able to take back information that has already been used or shared with others. If you say yes now but change your mind later for the use of your information in the research, you must write to the researcher and tell him or her of your decision:

How long will my permission last?
Your permission for the use and sharing of your health information will last until the end of the research study.

Who can I call if I have questions?
If you have questions about taking part in this study or if you feel you may have suffered a research-related injury, you can call Carina Santos at [redacted]

If you have questions about your rights as a research subject, you can call the IRB Director at: Newark Healthscope (973)-972-3608;

AGREEMENT TO PARTICIPATE

1. Subject consent:

I have read this entire consent form, or it has been read to me, and I believe that I understand what has been discussed. All of my questions about this form and this study have been answered. I agree to take part in this study.

Subject Name:_____

Subject Signature:_____ Date:_____

2. Signature of Investigator/Individual Obtaining Consent

To the best of my ability, I have explained and discussed all the important details about the study including all of the information contained in this consent form.

Investigator/Person Obtaining Consent (printed name):_____

Signature:_____ Date: _____

Appendix I : Program Evaluation

Program Evaluation

1. How would you rate this project?
    a. Excellent
    b. Good
    c. Average
    d. Below average
    e. Poor
2. What was your favorite thing about the program?
3. How would you rate the in-person meetings?
4. What was your least favorite about the project?
    a. Too long
    b. Average
    c. Too short
5. What would you change about the program?

Appendix J : DNP Timeline

DNP Project Timeline

Date	Pre-implementation		Evaluation
March 2019	Letter of support from the Site		
April 2019	Obtain all team members signature and DNP chair member Finalize Proposal		
May- July 2019	Attempt to Present DNP to team members Submit TO IRB, following the approval from all DNP team Members		
August -September 2019	Possible Approval from IRB	Start recruitment process after discussing the last details with the office staff	
October 2019		Study implementation	
November 2019-April 2020			Writing results Poster and PowerPoint Presentation

Version 01

Appendix K : Education Pamphlet

Sports, Cardiovascular, and Wellness Nutrition
a dietetic practice group of the Academy of Nutrition and Dietetics

Diabetes Care and Education
a dietetic practice group of the Academy of Nutrition and Dietetics

Exercise and Type 2 Diabetes

Did you know that aerobic activity, strength training, and stretching all have unique benefits? One of the greatest benefits of exercise is that it can help prevent diabetes or it can help you manage diabetes if you have it. You can start by being more active every day. Get up and move as often as possible. Mix it up! Try walking, swimming, dancing, cycling, boxing, weight-lifting, or any variety of activities to find the ones you enjoy.

Benefits of Exercise:

- Helps prevent or delay the onset of type 2 diabetes.
- If you have diabetes, exercise helps with:
  - Weight loss and maintenance
  - Stronger, healthier heart
  - Improved sleep
  - Improved mood, decreased stress, increased energy
  - Improved blood pressure, cholesterol, triglycerides, and blood glucose levels
  - Increased lean muscle mass and strength
  - Injury prevention

Exercise and Blood Glucose:

- Exercise helps lower blood glucose by increasing the muscle's ability to take up and use glucose.
- Exercise can help lower the amount of medication needed to keep blood glucose levels within your goal range.
- Monitor blood glucose before and after you exercise to learn how your glucose level changes with activity.
  - If you take a glucose lowering medication that contributes to hypoglycemia, such as insulin, sulfonylureas (SFUs) or glinides, you may need extra carbohydrate for exercise. If your glucose is less than 100 mg/dL before you start an activity, consume 15 grams of carbohydrate to keep your glucose from going too low.
  - After exercise, if your glucose is less than 100 mg/dL, follow your meal plan. If it is not time for your next meal you may need to add a snack.
- Stop exercising and test your blood glucose if you feel symptoms of hypoglycemia, including excessive sweating, anxiousness, shakiness, confusion, and/or low energy.
- A change of heart rate is normal when exercising.

Guidelines:

- Talk with your doctor before starting a new exercise routine, especially if it is more vigorous than your comfortable walking pace.
- Challenge yourself by gradually increasing effort and exercise time as you become more fit.
- Wear comfortable, well-fitting shoes and socks to prevent sores or blisters on your feet. Check your feet regularly!
- Carry a treatment for hypoglycemia, such as glucose tablets, gels, juice, or a piece of fruit.
- Work toward exercising at least 150 minutes per week at a moderate intensity (i.e., brisk walking, water aerobics). Try 30 minutes a day for 5 days a week.
- If you exercise at a vigorous intensity (i.e., jogging, running, swimming laps), aim for at least 75 minutes per week. Try 25 minutes, 3 days a week.
- You can also "mix and match" your activity by combining moderate- and vigorous-intensity activities within a week or even accumulate your time over multiple short sessions in a day (i.e., 10 minutes of brisk walking 3 times a day).

Resources

1. American Diabetes Association. Blood Glucose Control and Exercise. http://www.diabetes.org/food-and-fitness/fitness/get-started-safely/blood-glucose-control-and-exercise.html.
2. Rosenbloom C, Coleman, E. Sports Nutrition: Practice Manual for Professionals. 5th ed. Academy of Nutrition and Dietetics.
3. U.S. Department of Health and Human Services. National Diabetes Education Program: Diabetes Health Sense. http://ndep.nih.gov/resources/diabetes-healthsense/.
4. U.S. Department of Health and Human Services. Physical Activity Guidelines for Americans. http://www.health.gov/paguidelines/.

Contact SCAN or DCE

www.scandpg.org or www.dce.org
800.249.2875

Written by SCAN and DCE registered dietitians (RDs) to provide nutrition guidance. The key to optimal meal planning is individualization. Contact a SCAN or DCE RD for personalized nutrition plans. Access "Find a SCAN RD" at www.scandpg.org or by phone at 800.249.2875. Find a DCE RD at www.dce.org

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Contributed by: Lisa Brown, RD, LD, CDE, Charlotte Hayes, MMSc, MS, RD, LD, CDE, ACSM CES and Jeanne Reilly, MS, RDN

(DCE, 2019)

Appendix L : Education Pamphlet

ENGLISH

Diabetes: What Is It?

Diabetes is a disease that affects how the body uses food for energy. Because the body's cells cannot use food properly, the blood glucose (sugar) becomes high. The blood sugar becomes high either because the body lacks insulin or because it cannot use the insulin it makes. Insulin is a hormone that helps glucose get into the cells for energy. Diabetes is diagnosed when the fasting blood sugar is above 126 mg/dl when tested at least twice. There are three types of diabetes:

Type 1

Type 1 diabetes usually occurs in children and young adults. It's always treated with insulin. A healthy diet that controls starches and sugars (carbohydrates) is important. Regular exercise can reduce risk for heart disease and other complications.

Symptoms include sudden weight loss, excessive thirst and hunger, frequent urination, nausea, vomiting, poor growth, and lack of energy. If type 1 diabetes is not treated, a condition called ketosis occurs. Ketosis can cause coma and even death.

Type 2

Type 2 diabetes usually occurs in older adults. However, it is now becoming more common in children and teens. Those with type 2 diabetes are often overweight and unfit. They cannot make enough insulin to keep their blood sugar in control. A meal plan for weight control and regular exercise is often the first treatment tried. If diet and exercise are not enough, medicine may be required.

Various diabetes pills can be used. If diabetes pills don't work, insulin shots may be needed. The doctor decides what medicine works best.

Symptoms for type 2 diabetes usually are not obvious. In fact, people vary from merely feeling tired to having symptoms similar to type 1 diabetes. If you have diabetes in the family, have your blood sugar checked yearly by the doctor. Finding diabetes early is the best way to prevent serious problems later.

Gestational Diabetes

Gestational diabetes only occurs with pregnancy. It is usually controlled with a special meal plan and exercise. If medicine is needed, only insulin can be used. Diabetes pills are not safe for the baby. Screening will be done around the 26th week of the pregnancy, or earlier if the woman is at high risk.

Women at high risk include those with a history of large babies, a previous history of gestational diabetes, or a history of stillbirths or miscarriages and those who are overweight or who have a history of diabetes in the family. As a woman gets older, she is more likely to get gestational diabetes.

After delivery, the woman will be tested again for diabetes. Most women do not have diabetes then. However, having gestational diabetes greatly increases a woman's risk for type 2 diabetes later in life. Women who are overweight and inactive are most at risk.

NDEP National Diabetes Education Program
A program of the National Institutes of Health and the Centers for Disease Control and Prevention

Why Worry About Diabetes?

Diabetes is serious. No one has "a little bit of sugar," just as no one is a "little bit pregnant." High blood sugar causes serious health problems. Diabetes health care costs in the United States were $132 billion in 2002.

- Diabetes is the seventh leading cause of death in the United States.
- Heart disease and stroke are two to four times more common in those with diabetes.
- Diabetes is the leading cause of new cases of blindness in adults.
- Diabetes is the leading cause of end stage kidney disease.
- More than half the amputations of the feet and legs are due to diabetes.
- Gum disease occurs in 30 percent of those over age 19 who have diabetes.
- Sixty to seventy percent of those with diabetes have some nerve damage.

STUDIES HAVE SHOWN THAT CONTROLLING BLOOD SUGAR CAN PREVENT OR DELAY THESE PROBLEMS!

Good diabetes care requires permanent lifestyle changes. Diabetes cannot be cured. It can only be managed by a healthy meal plan, regular exercise, medicine, and frequent blood tests, using a blood sugar meter. Working with a medical team, including a doctor, dietitian, nurse, exercise specialist, pharmacist, eye doctor, podiatrist, and mental health professional can make it easier to make these changes.

National Diabetes Education Program
For more information call 1-800-CDC-INFO (800-232-4636)
TTY 1-(888) 232-6348 or visit www.cdc.gov/info.
To order resources, visit www.cdc.gov/diabetes/ndep

NIH National Institutes of Health

CDC

June 2017

(CDC, 2019 a)

Appendix M : Education Pamphlet

(CDC, 2019 b)

Appendix N : Diabètes and Activity

Tips for Being Active With Diabetes

How Much Activity?

- Start by doing what you can do, and then look for ways to do more until you reach 150 minutes a week of activity.
- Find the time that works best for you to add up to 150 minutes. For example:
  - 30 minutes at one time five times a week.
  - 15 minutes at a time 10 times a week.
  - 10 minutes at a time several times a day.

Do It Your Way

- Brisk walking is a great way to be active.
- Try dancing, gardening, following a video, or taking a class.
- Be active with a friend or family member.
- Start with 10 minutes a day and build up over time.

Be Safe

- Check your blood sugar before you are physically active.
- Carry a snack with you in case your blood sugar goes too low.
- Carry identification that says you have diabetes.
- Wear shoes that fit well and are made for the kind of activity you do.
- Check your feet every day. Call your doctor or nurse if a cut, sore, blister, or bruise on your feet or toes does not go away after 2 days.

Ask Your Doctor or Nurse:

1. What physical activities are safe for me?

2. Are there any special things I need to do to protect my feet?

3. Do I need to make any changes in my medicines before I raise my level of physical activity? Do I need to eat a snack before I'm active?

One thing I will do to be more active before my next appointment:

Other notes from the doctor or nurse:

National Center for Chronic Disease Prevention and Health Promotion
Division of Diabetes Translation

CDC

(CDC, 2019 c)

Appendix O : Education Pamphlet

Role of Individuals and Families: Incorporating Walking Into Your Life

Regular physical activity has substantial health benefits. People can get those benefits by walking or by adding brisk walking to other physical activities.

Here are some ways to add more walking to your daily life.

With family and friends:

- Take walks with a coworker at lunchtime.
- Make a standing walking date with a friend.
- Put a walk on the family schedule after dinner.
- Start or join a walking or hiking group.

For transportation:

- If you take a bus to work, get off a few stops early and walk.
- See whether you can do any of your errands by just walking or by walking and taking public transportation.
- If you drive, think about parking farther away from your destination.

Role of Individuals and Families: Making Your Community Walkable

You can make your community more walkable. You do not have to be the head of a large company or the Surgeon General to create walkable communities. Any person, regardless of age or experience, can be part of this movement.

Here are some things you can do:

- Become a walking champion in your community by starting a walking group or encouraging other people to join one.
- Join or help mobilize a neighborhood clean-up effort to make places where people walk safe and attractive.
- Participate in community activities (for example, neighborhood watch) to reduce crime and violence.
- Join advisory boards, nonprofits, and community planning processes to support safe and convenient places to walk.

7

(CDC, 2019 d

Tables

Table 1

Population Demographic

Characteristic	Frequency	Percent	Cumulative Percent
Age group			
30 – 39 years old	3	50.0	50
40-49 years old	2	33.3	83.3
50-59 years old	1	16.7	100
Total	6	100	
Gender			
Female	6	100.0	100
Use of mobile app for exercise in the past			
Yes	6	100.0	100
Frequency of exercise			
Never	2	33.3%	
1-3 times a week	2	33.3%	
3-5 times a week	2	33.3%	

Table 2

Motivation to exercise using an app or a partner

Variable	**Number of participants**	**% of Total (n=5)**
Fitness app motivate to walk		
Yes	3	60%

No	2	40%
Partner motivate to walk		
Yes	0	0%
No	6	100%

Table 3

MPAMP-R scores pre and post intervention

Measurements	Results/Output
Number of participants (Ranked)	5
Test statistics	Z= -0.41
Standard Error	
(Alpha = 0.05)	
Significance (2 sided)	p= 0.69