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Telehealth Coaching to Improve Exercise Self-Efficacy in Diabetics

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Abstract

Background and Review of Literature: Exercise is essential to the self-management of Type 2 Diabetes Mellitus (T2DM). The literature reveals that many patients with difficulty in the self-management of exercise improve with coaching. The literature also reveals that an adequate exercise routine results in improved blood glucose control and the prevention of complications.

Purpose: This DNP project aims to demonstrate the positive effect of low-cost telehealth coaching to improve self-efficacy in an exercise regimen for T2DM patients.

Methods: A one-group pretest-posttest design was used in this project. Telephone calls and text messaging were used to coach patients to improve exercise self-efficacy A self-efficacy scale was used to measure the pre- and post-intervention self-efficacy.

Implementation plan/Procedure: This project was implemented by recruiting participants from the community and administering three weeks of remote coaching via phone calls and text messaging.

Implication/Conclusion: Evidence from the literature supports the positive effect of telehealth coaching in improving self-efficacy in patients with T2DM. The project's outcome was a significant improvement in exercise self-efficacy in the participants which far exceeded 5% on the self-efficacy scale after three weeks of coaching. The results showed that telehealth coaching via phone calls and text messaging is an effective, low-cost means of helping T2DM patients improve self-efficacy in maintaining an exercise routine due to the behavior modification that occurred from the intervention.

Keywords: Type 2 diabetes, diabetes and exercise, remote health coaching, blood glucose control, telehealth, behavior change in chronic disease, exercise self-efficacy, telephone coaching.

Telehealth Coaching to Improve Exercise Self-Efficacy in Diabetics

Introduction

Many people in the United States of America (USA) suffer from chronic illnesses. Wang et al. (2014) reported that 81.5% of caregivers to the chronically ill also have at least one chronic disease themselves. Chronic illnesses require ongoing management, and it is crucial that patients learn self-management to maintain a good quality of life and avoid complications. Type 2 Diabetes Mellitus (T2DM) is a highly prevalent chronic condition, and its complications may cause other chronic diseases, including chronic kidney disease, neuropathy, diabetic retinopathy, hypertension, and coronary artery disease (Aliyari et al., 2020). The serious complications of poorly managed T2DM underscore the importance of good self-management. Exercise is of particular importance in the management of T2DM. This DNP Quality Improvement (QI) project aimed to identify the effect of three weeks of low-cost telehealth coaching on the self-efficacy of T2DM patients in the self-management of an exercise routine. Phone calls and text messaging were used as a low-cost telehealth method for this project.

Problem Statement

The problem addressed in this DNP project is the inability of many T2DM patients to maintain a regular exercise routine. Although the health benefits of exercise are well-known in the management of T2DM, many patients still do not make an exercise routine a part of their daily lives (Mori et al., 2011). Maclean et al. (2012) found that, although ongoing coaching has been found to be effective in the improvement of patient's self-efficacy in the self-management of chronic diseases, it is not adequately utilized because of the high cost involved in coaching individual patients. The use of low-cost telehealth coaching via phone calls and text messaging has been shown as an inexpensive alternative to improve self-efficacy in these patients (Maclean

et al., 2012). This DNP project will benefit patients by providing low-cost ongoing telehealth coaching to help them attain behavior modification that will foster the development and maintenance of an essential exercise routine. As per the literature, this will result in blood glucose control, improvement in the quality of life, and the prevention of complications.

Purpose of Project

The purpose of this DNP project is to use low-cost telehealth coaching to help patients who have difficulty maintaining a regular exercise regimen to improve their self-efficacy by behavior modification that will foster the habit of regular exercise. Coaching people to improve self-efficacy in exercise can be comparable to the use of a personal trainer. According to Lowe and ÓLaighin (2012), individuals are more successful at keeping a regular exercise regimen when they have a personal trainer compared to when they do not. Remote health coaching may provide a motivation that is comparable to having a personal trainer, with the eventual goal of getting the patients into a more self-efficacious routine (Lowe & ÓLaighin, 2012). This can be provided to the patients as a part of healthcare because exercise is particularly important in the control of T2DM and the prevention of complications.

Summary of Plan

The DNP student's plan was to translate into practice the research that identified coaching as an effective means of improving self-efficacy in the self-management of T2DM. The aspect of T2DM management addressed in this project was the maintenance of an exercise routine. The obstacle of cost, which works against the individualized coaching for these patients, was mitigated using phone calls and text messaging. The participants' self-efficacy levels were evaluated prior to the coaching and then after coaching. The difference between pre- and post-intervention self-efficacy levels was considered the participants' self-efficacy improvement.

Background

The self-management of diabetes is of economic and clinical importance because patients can be coached to problem-solve and develop the appropriate self-efficacy for the independent management of their conditions (Grady & Gough, 2014). Many patients have problems self-managing chronic illnesses, including T2DM, despite the available treatments. According to Houtum et al. (2015), the problems encountered by individuals with chronic illnesses can be basic or social and include income, work, shelter, affiliation (family, spouse, and others), sexuality, and leisure issues. Barriers to the adequate self-management of diabetes reported by Fukunaga et al. (2011) include inadequate social and psychological support, social prejudice against diabetes/diabetics, co-morbidities, and medication issues/side effects.

Many of the difficulties encountered in the self-management of T2DM, including the maintenance of an exercise routine, can be overcome by life coaching (Schneider et al., 2011). This approach helps patients practice proper self-management over time. The effective management of diabetes results in the patient's inculcation of proper self-management as a part of the patient's daily routine via behavior modification (Smoorenburg et al., 2019). Patients can be assisted to develop effective exercise management skills. Those in lower socio-economic classes are generally less educated, more likely to develop chronic illness, and less likely to manage them adequately (Willard-Grace et al., 2015). Many T2DM patients need ongoing coaching to develop self-efficacy for optimal exercise management. This type of intervention could help the patients develop self-efficacy for self-management (Smoorenburg et al., 2019).

Literature Review

The literature review focused on coaching patients with chronic diseases, challenges involved in coaching, and the outcome of such coaching, with specific attention to exercise in

T2DM. The University of Massachusetts, Amherst, library portal and Google Scholar were used to access CINAHL and PubMed to retrieve relevant peer-reviewed articles in scholarly journals. The keywords used to identify related articles were as follows: diabetes, type 2 diabetes, diabetes and exercise, health coaching, remote coaching, blood glucose control, chronic illness, telehealth coaching, behavior change techniques in chronic disease, hypertension, telehealth, telemedicine, and telephone coaching. The inclusion criteria were articles published in English that were published no earlier than 2009 and contained information on health coaching and chronic illnesses or their synonyms and those with the importance of exercise in T2DM management. Articles that were not related to the coaching in any chronic illness were excluded. In all, 40 articles were found. Of them, 17 met the inclusion criteria outlined above and are included in this literature review. The articles include randomized clinical trials, quantitative and qualitative studies, retrospective studies, and systematic reviews.

Many patients have difficulty managing chronic illnesses independently. Although much improvement has been made regarding medications and other interventions, many patients still fail to manage chronic diseases adequately. For instance, although there were many different types of blood pressure medications available to treat hypertension, two thirds of patients with hypertension failed to maintain adequate control (Bennet et al., 2009). This failure also happens in exercise management in T2DM patients. Fortunately, coaching may reverse it. Health coaching includes helping patients understand the disease process and make necessary lifestyle adjustments to control the disease (Sqalli & Al-Thani, 2019).

Exercise management is particularly problematic in the management of T2DM. Braber et al. (2019) identified nutrition and exercise as the two major components of diabetes management and found that coaching is effective in helping patients increase exercise.

According to Nadeau (2014), many Americans have difficulty maintaining adequate exercise regimens, and patients with T2DM have lower exercise rates than the general population. Difficulty in exercise management among patients with T2DM is reversed when the patients are motivated by coaching. Mobile applications (apps) are effective in helping this motivation (Nadeau, 2014). Oftedal et al. (2011) found that exercise management may be improved by stimulating intrinsic motivation or self-efficacy. Remote health coaching helps patients improve physical activity in addition to general diabetes, hypertension, and weight control (Huang et al., 2018).

Issues identified in the management of chronic disease include the patients' inability to manage chronic diseases, the non-availability of coaching, and the cost of coaching. Many patients are unable to manage their chronic illnesses for various reasons. These issues can be overcome using health coaching. Using a case study of 14,591 health plan members who were seeking a lifestyle change in Western Pennsylvania, Budzowski et al. (2019) observed that 77% of the participants achieved life stress reduction with health coaching. In a randomized controlled clinical trial over a period of 12 months, Willard-Grace et al. (2015) investigated coaching by medical assistants during office visits in 441 low-income patients from San Francisco Safety Net clinics. The participants included those with diabetes, hypertension, and hyperlipidemia. The attainment of the goal of effective self-management was significantly higher in the intervention group compared to the control group (46.4% as opposed to 34.3%). Systolic blood pressure difference was not statistically significant. The glycated hemoglobin (HbA1C) goal was achieved by 48.6% of patients in the intervention group and only 27.6% in the control group. The cholesterol goal was achieved by 41.8% of patients in the intervention

group compared to 25.4% in the control group. This coaching can be applied to the exercise regimen, which was one of the issues addressed in the study.

If chronic diseases are widespread in the general population in the USA, they are even more so among minorities and other underserved demographics. According to Willard-Grace et al. (2015), patients who belong to minority groups and low-income patients are more likely to develop chronic illnesses and less likely to manage them appropriately than patients in other segments of the population. Bearing this in mind, the populations that are most in need of health coaching in managing chronic illnesses are minorities, those with a lower educational level, and those with a lower socioeconomic status, particularly African Americans (Willard-Grace et al., 2015).

Some researchers have investigated the effect of health coaching on the quality of life of diabetes patients. Sherifali et al. (2019) investigated the effect of one year of health coaching on the improvement of self-care, HbA1C, and cost in patients with T2DM living in a community. They conducted a single-blind randomized controlled clinical trial where patients were randomized into two groups of diabetes education and diabetes education with diabetic health coaching. The participants were Canadian T2DM patients over 18 years of age (the mean age was 57.9 years) who had had diabetes for an average of eight years with an HbA1C of 7.5% or greater (mean HbA1C 8.98%) in the prior six months. The participants needed to be English language literate and have telephone access. Sherifali et al. (2019) found that diabetes health coaching, in addition to the usual diabetes education, improved self-care. In addition, it was expected to decrease stress and improve the quality of life in people who live with T2DM.

Using a randomized clinical trial, Bennet et al. (2009) evaluated how coaching combined with medication adjustment could improve blood pressure in low-income patients of

a teaching hospital whose hypertension was poorly controlled. Patients in the intervention group were provided with six months of health coaching and home monitoring of blood pressure while blood pressure medications were adjusted as necessary. These patients could answer phones, check their blood pressure, and send text messages to the coach. An active control group received blood pressure monitoring at home and health coaching, while a passive control group received the usual care. Change in systolic blood pressure was the primary outcome, while change in diastolic blood pressure was the secondary outcome. The patients in both the intervention group and the active control group improved blood pressure control above the usual care (Bennet et al., 2009).

Coaching may need to be combined with medication modification in some circumstances. Blackberry et al. (2013) sought to evaluate how goal-based coaching affects glycemic control in patients with T2DM. They used prospective randomized controlled clinical trials to study 437 patients randomized into the intervention group while additional 237 patients served as the control group. During the 18 months of the trial period, the patients received eight telephone coaching sessions and one face-to-face coaching session from a nurse. This study found no significant difference between patients in the intervention and control groups who were coached by nursing staff without the prescriptive rights to adjust the patients' medication when needed. The findings of this study indicate that, in some instances, coaching may need to be paired with the ability to change or introduce prescriptive medication and equipment, or done in collaboration with a prescribing clinician, to be effective. However, the improvement sought in the current project is in exercise self-efficacy, which does not require prescriptive services.

Data from abroad also affirm the efficacy of coaching. Kim (2019) studied coaching in individuals aged 65 and over with a diagnosis of hypertension in Seoul, South Korea, to find the

effect of long-message-service (LMS) phone coaching to improve blood pressure. The participants could answer phones, check their blood pressure, and send text messages to the coach. The single-blind randomized clinical trial involved 124 participants divided up with 30 participants receiving health coaching; 31 in the control group; 32 receiving LMS; and 31 receiving both LMS and coaching. The results of the study showed that blood pressure, self-efficacy, self-management, medication adherence, and health knowledge significantly improved as a factor of the help received (Kim, 2019). Health coaching with LMS had better outcomes than health coaching alone. Health coaching alone had better outcomes than LMS alone, which had a better outcome than the control group. This finding supports the need for coaching intervention because the outcome improved proportionately to the intervention.

Coaching is effective even for patients with multiple chronic illnesses. Panagioti et al. (2018) used trials within cohorts in randomly selected patients within a cohort and studied the effects of coaching in patients with multiple chronic illnesses. The intervention group received coaching and social support with periodic phone calls while the control group did not. The patients who received coaching needed significantly less emergency healthcare, used more services, and lived longer than the control group; but the intervention group incurred more monetary expenditure. The cost of the intervention was too high for the general healthcare population (Panagioti et al., 2018).

However, coaching provided via text messaging and phone calls can significantly reduce the cost. Mao et al. (2017) used a retrospective study with data that is already in the registries of commercial insurance companies to study the insured patients of a health insurance company to assess the effects of mobile phone health coaching in weight and blood pressure control in patients with hypertension. Participants were coached for four months using phone, text

messages, and videos and were provided with equipment that included a blood pressure cuff, a wireless scale, and a pedometer. The control group comprised of uncoached patients. The patients in the intervention group had a weight loss of 5% or greater, while those in the control group gained almost 2% of their total body weight. The improvement in the hypertension group was so significant that their entire hypertension staging improved by one point (Mao et al., 2017).

Oddone et al. (2017) studied veterans with modifiable health risk factors that included smoking, obesity, and physical inactivity to see if the addition of telephone coaching to health risk assessment would improve patient outcomes when compared to health risk assessment alone. Using a randomized controlled trial, the intervention group received coaching in addition to a health risk assessment, while the control group received health risk assessment alone. The participants in the intervention group showed significant improvement compared with those in the control group (Oddone et al., 2017).

Finally, in a systematic review on the effect of coaching on chronic illness management, Dennis et al. (2013) discovered that health behavior, self-efficacy, and the overall health status of patients with chronic illnesses would improve if they received ongoing telephone coaching. These three studies (Mao et al., 2017; Oddone et al., 2017; and Dennis et al., 2013) show that telephone coaching is an effective means of coaching patients for behavior modification.

The high cost of ongoing individual coaching by healthcare workers for each patient with chronic disease may make it unattainable. Fortunately, the institution of artificial intelligence (AI) apps, which can help patients with ongoing coaching, with only occasional intervention by healthcare workers, can reduce the cost of coaching. AI is explored by Sqalli and Al-Thani (2019), who sought to understand how it can be integrated into the coaching of

patients with chronic diseases. Using different processes that included media and social actor processes, AI was used for data collection and processing, educating, coaching, motivating, and providing feedback to patients (Sqalli & Al-Thani, 2019). The authors found that AI is a cost-effective complement to coaching by healthcare workers to improve healthy behavior and attain positive lifestyle changes in people with chronic illnesses.

Persell et al. (2018) is testing the effect of a smart phone app in patients with uncontrolled hypertension in the Hypertension Personal Control Program (HPCP). This study is a prospective randomized clinical trial consisting of a telephone app with AI that provides coaching and support to patients in the self-management of hypertension to promote good blood pressure control behaviors. Behavior change is vital to exercise management. In this ongoing and promising study, the intervention group is being coached using the AI app while the control group is receiving blood pressure monitoring alone at home.

In this current project, the DNP student compared the pre- and post-intervention self-efficacy ratings of participants with T2DM following a three-week period of exercise coaching via telephone calls and text messaging. The literature used in the review consisted of primary articles and systematic reviews of primary articles. All the evidence used dealt with chronic illnesses and their management focusing on coaching and exercise management in T2DM. This is important because exercise management in T2DM is particularly problematic (Nadeau, 2014). Several articles cited in this project support the effective use of remote coaching to improve the management of chronic illnesses and an exercise routine in patients with T2DM. Evidence in a randomized clinical trial by Rezvani et al. (2018) found that telephone coaching can help patients keep an exercise regimen better than uncoached patients. This project used telephone calls and text message coaching to help the participaants to improve self-efficacy in

managing and maintaining an exercise routine and to develop an intrinsic behavior modification that would persist even after the coaching stops.

Theoretical Framework

The theory that guided this project is Orem's Selfcare (Deficit) Theory (Orem et al., 2003), which deals with activities an individual will initiate and accomplish for his/her own self-maintenance (Gonzalo, 2019) (Appendix A). It recognizes the interrelationships between the patient and the overall environment, which impacts the actions of the patient. These interrelationships are affected by personal attributes, cultural and socio-economic factors, beliefs, and relationship with the healthcare provider. This project used coaching via text messaging and periodic phone calls to help the participants develop self-care skills for self-efficacy to manage their own chronic illnesses, such as the exercise regimen needed in T2DM.

Self-care demands are those actions that the patient undertakes to keep a regular exercise routine. Patients' personal attributes include their willingness and ability to learn from a coach (self-care agency). The ability of the DNP student to provide coaching and feedback constitutes the nursing agency. The receipt of information from the participants, coaching, and the feedback provided constitute the interrelationships between the coach and the participants. The space to exercise and cell phones used for calls and text messaging are parts of the environment. The result is the development of the desired self-efficacy that enabled the particpants to maintain the desired exercise routine, which will help them maintain good glucose control and a good quality of life and avoid complications of T2DM.

Methods

Goals, Objectives, and Outcomes

The goal of this project was to identify the effect of telehealth coaching on self-efficacy in exercise management by patients with T2DM. The objective was to improve self-efficacy in an exercise routine. The first phase was the development of cost-effective short-term coaching to help the patient in the development of self-management skills needed for the management of an exercise routine and its implementation. The second phase was to identify the effect of this low-cost telehealth coaching on T2DM patients' self-efficacy in exercise management after the intervention. The expected outcome was the improvement in the self-efficacy rating by minimum of 5% in a at least 75% of the participants.

Table 1

Goal, Objectives, and Outcomes

Goal	**Objectives**	**Outcomes**
The DNP student was to identify the effect of telehealth coaching on the improvement of self-efficacy in exercise management by patients with T2DM.	1. The participants would complete self-efficacy ratings pre- and post-intervention. 2. The participants would complete a minimum of 15 minutes of walking at normal pace daily for at least five days a week during the three weeks of intervention. 3. The DNP student would provide initial coaching and three weekly reviews, coaching, and give feedback to the participants via phone calls and text messaging.	There would be a minimum of 5% improvement in self-efficacy rating of at least 75% of participants.

This project used a pilot pre-post one group intervention design to identify the effect of cost-effective telehealth coaching on T2DM patients' self-efficacy after telehealth coaching on exercise self-management. This educational intervention involved coaching and encouraging participants to maintain a regular exercise routine.

The evidence-based intervention applied to this project was behavior modification through individual coaching of the participants. The coaching was provided by the DNP student who contacted the participants weekly by phone calls and text messaging to instruct them on exercise, resolve any issues that arose that could have a negative impact on the exercise regimen, answer their questions, and provide feedback. The participants expected and welcomed these telephone interactions. On a few occasions, some even initiated the coaching phone calls themselves. The behavior modified was self-efficacy in maintaining a regular exercise regimen. The participants walked at a comfortable pace and did not exert themselves because this DNP project was about self-efficacy in the maintenance of an exercise routine rather than the intensity of the exercise. The participants were instructed to abort this exercise at the first sign of exertion. The improvement in self-efficacy needed to be a minimum of 5% of the initial rating to be considered a positive improvement. All of the participants signed an informed consent document after the project was explained and their questions were satisfactorily answered. Five participants were recruited for this project and they all completed the project.

Measurement Instrument

A diabetes exercise self-efficacy scale (Appendix B), which is a modified LMC Skills, Confidence & Preparedness Index (SCPI) (Mbuagbaw et al., 2017) (Appendix C), was the tool adoped by the DNP student in this project. Some aspects of the self-efficacy scale was also adapted from the Participants' Skills and Self-Efficacy (Confidence) Ratings to Perform

Diabetes Self-Management (Adu et al., 2019) (Appendix D). The Participants' Skills and Self-Efficacy (Confidence) Ratings to Perform Diabetes Self-Management(Adu et al., 2019) is also a modificaction of the SCPI. The self-efficacy scale was used to assess the participants' self-efficacy ratings pre- and post-intervention. The original SCPI was used to measure their participants' skills and self-efficacy (confidence) to perform diabetes self management. The SCPI tool has construct validity, reliability, and readability for the age bracket, educational level, gender, ethnicity, and settings of the participant population in this project (Mbuagbaw et al., 2017). The SCPI is an Open Access tool, and as such, no special permission was sought for its use and adaptation. An initial attempt was made by the DNP student to seek permission from Adu et al. (2019), but the student was informed that the document is also Open Access and could be used for academic purposes with appropriate attribution.

The DNP student modified and adapted the scale, which is made up of the confidence domain which is self-efficacy. This self-efficacy scale contained ten Likert scale questions with five possible responses which values ranged from -2 to 2 as follows: Strongly Disagree (-2), Disagree (-1), Not Sure (0), Agree (1), and Strongly Agree (2). The self-efficacy scale contained only quantitative closed-ended responses and was used to collect pre- and post-intervention ratings. The ratings were then scored by adding up the participant's responses in all of the ten items on the scale, which provided the participant's rating on the self-efficacy scale at each point. The self-efficacy rating scale was chosen for this project because the variable measured was the participants' confidence, because it provided their self-efficacy ratings.

Data Collection Procedure

After approval from the University of Massachusetts, Amherst, Internal Review Board (UMass IRB), the DNP student carried out this project over a period of two months to allow each

participant to complete three consecutive weeks of coaching and exercise. The DNP student administered the self-efficacy scale questionnaire (Appendix B) by phone to collect the pre- and post-intervention self-efficacy ratings. The self-efficacy scale is numeric and collected quantitative data for analysis. The DNP student helped the participants to choose an appropriate time of the day and an alternative time to set aside for exercise, depending on their daily routines. The participants were required to undertake a daily 15-minute walk for five days each week. The phases of the intervention and data collection are detailed in the following sections.

Pre-Intervention

The participant recruitment strategy consisted of solicitation on Facebook and via flyers placed at physician's offices, gyms, churches, and community buildings. The DNP student distributed the flyers. Flyer distribution was problematic because of the pandemic. Many places refused to accept the flyer because of infection control, and some Facebook diabetes groups refused the flyers because they are tightly controlled to prevent people from using members as study subjects. The only Facebook page that accepted the flyer was that of the Type2Diabetes.com. After the flyer distribution, five prospective participants voluntarily contacted the DNP student for inclusion in the study. The participants entered for this project voluntarily if they could walk independently at their own pace for at least fifteen minutes at a time and if they met the other criteria listed on the Pre-screening Questionnaire (Appendix E).

The DNP student set up a time with each participant for the initial formal phone discussion. The Prescreening Questionnaire (Appendix E) was administered first. All of the five prospective participants were found to be eligible to participate in the project. The consent document was administered, and the DNP student answered the participants' questions and made any necessary clarifications.

Next, the DNP student made a second phone call appointment after the consent document had been signed and administered the self-efficacy questionnaire. The questionnaire was read by the DNP student and the possible responses were sent to the prospective participant by text messaging so that the participants could read the alternative answers to the questions on their phones. After the administration of the self-efficacy questionnaire, the DNP student reviewed time scheduling, places to exercise, and alternatives to time and place in addition to the specific needs of each participant. The time and place to exercise were agreed upon, and if the participant expressed possible issues with remembering, a cell phone recurring alarm was set as a reminder for the participant to exercise.

Intervention

The initial coaching was provided at the time of administration of the pre-intervention self-efficacy questionnaire and any potential participant's issues were discussed and resolved. The DNP student explained to each participant that the project was about helping them to form a habit and not about the intensity of the exercise. After this initial set-up, the DNP student and each participant agreed upon the time of follow-up phone calls and coaching. Participation in the project started with the participants' consent and commitment to undertake the daily exercise regimen. The DNP student educated the participants on the health benefits of exercise in T2DM, gave a detailed explanation of the project, and instructed the participants regarding the exercise regimen required, which was a 15-minute walk at the participant's comfortable pace.

The participants were given an opportunity to ask questions and clarify issues during the phone calls. Coaching information was provided during the phone calls and any communication that happened in-between the weekly phone calls was done by text messaging. The DNP student personalized the participants' education, which depended on each participant's prior knowledge,

the problems encountered, schedule, and available resources. Individualized education given to the participants included the effect of regular exercise on blood glucose control in T2DM, the need to walk at a regular pace, and the location and time to exercise. Although the participants could enter the intervention phase anytime within an eight-week period, their three weeks of participation were consecutive.

Initial coaching was provided regarding the need to take walks daily for a period of 15 minutes at a convenient time for the participant. The participants walked daily, Monday through Saturday, but were not required to walk on Sundays. In effect, if any of the participants missed one of the six days, they would still be adherent. The DNP student called each participant on set days every week to discuss progress, discuss any issues, answer questions, and provide feedback. The coaching provided was individualized, and the instructions focused on a participant's needs. The participants seemed to look forward to the calls, because they gave them the opportunity to receive feedback and gain encouragement. They were encouraged to keep a routine time for the exercise by setting an alarm and to reschedule the alarm to a different time for each day when exigencies disrupted the exercise time.

Post-Intervention

The DNP student made a final phone appointment with each participant at the end of the third week and administered the post-intervention self-efficacy scale rating. The tool used for this rating was the same scale that was used for the pre-intervention rating (Appendix B). The possible responses were sent to the participants by text message and the ten items on the scale were read out to each participant, who then provided the responses, which were recorded by the DNP student. The scores for the items were totaled to get the total score for that participant. The data collection was pre- and post-intervention self-efficacy ratings and by weekly confirmation

of the completion of the daily exercise by the participants. The weekly confirmation of participation was used for the validation of participation and the ratings on the self-efficacy scale was used for data analysis. Descriptive statistics were used to compute the individual and average improvement in self-efficacy rating and its statistical significance. The descriptive statistics data were obtained using Microsoft Excel.

Data Analysis

The data was collected using the self-efficacy scale pre- and post-intervention. After the post-intervention rating, the DNP student subtracted the total pre-intervention score of each participant from their final score. The difference was recorded as the self-efficacy improvement. This information is provided in Table 2 and was entered into SPSS software for analysis to obtain the Wilcoxon signed-rank test scores. Descriptive statistics were used to analyze this data. The total score of all the responses of each participant on the ten-item scale was subtracted from the post-intervention rating on the self-efficacy scale. This difference between the pre-intervention and the post-intervention ratings was noted as the rate of improvement in self-efficacy. This difference was divided by the pre-intervention rating and multiplied by 100 to obtain the percentage improvement in self-efficacy for each of the participants. The difference between the final and initial participant ratings constituted the participants' final score, and this data yielded the percentage rate of improvement (Table 2). The scores were analyzed using descriptive statistics. The Wilcoxon signed-rank test was used due to the small sample size (N=5). The Wilcoxon signed-rank test was the appropriate test for this project because it is uncomplicated, straightforward, and valid (Yeo, 2017). The measure used in this DNP project is of high quality because it involves self-rating by the participants. Descriptive statistics and the Wilcoxon signed-rank test served to answer the following research question: “In patients with

T2DM, does telehealth coaching via phone calls and text messaging improve the post-intervention self-efficacy compared to their pre-intervention self-efficacy?"

Ethical Considerations/Protection of Human Subjects

To comply with human subjects' protection, the DNP student sought and obtained approval from the UMass IRB before the DNP project's commencement. Numbers were assigned to the participants to ensure their confidentiality. The numbers assigned to the participants obviates their association with the data. The participants opted into the project voluntarily after abundant explanation and satisfaction with detailed answers to their questions. The DNP student planned to collect all data using phone and text messaging only. However, the IRB requested the use of DocuSign for the execution of the informed consent. DocuSign required that the participants provided their email addresses to send the document. The email addresses used for the consent were promptly and permanently deleted once the consent document was retrieved.

This project did not pose any significant risks to the participants because they carried out the same activities of walking at their own pace for fifteen minutes, with the only difference being to adhere to exercise routine towards improving self-efficacy under coaching. The participants who were unable to walk independently for fifteen minutes at a time could not participate in this DNP project.

This project's outcome is the participants' improvement in self-efficacy in exercise management with present and future benefits in the reduction in complications of T2DM and improvement in quality of life. This project is ethical and beneficial to participants: Without any significant risks, they developed a behavior modification that improved their overall wellbeing. This outcome is also beneficial as a source of knowledge that will benefit many patients who suffer from T2DM.

This DNP project's benefits included improvement in patients' self-efficacy, which is vital in maintaining an exercise routine, particularly in T2DM patients. Improved self-efficacy does result in improved regular exercise regimen and overall self-management which would result in improved HbA1C and reduction of complications of T2DM. Reduction in complications of T2DM has cost-saving benefits that could run in the hundreds of thousands of dollars per patient.

Results

The setting used for this project was the community of the participants and the DNP student carried out the project using low-cost telehealth coaching. The participants were drawn from adult population between 21 to 65 years of age who had had T2DM for at least one year. The DNP project took place over a two-month period, and each participant participated by engaging in an exercise regimen for three consecutive weeks within that period. The DNP student recruited five participants who were two females and three males aged between 28 to 58 years . Each participant participated by taking a 15-minute daily walk at a normal pace at least five times during each of the three weeks. The DNP student provided weekly coaching via phone calls and text messaging.

Pre- and post-intervention data was collected and tabulated (Table 2). This data showed an improvement in self-efficacy that ranged from 17.60% to 373.00%. The data resulted from computing the difference between each participant's pre- and post-intervention ratings on the self-efficacy scale. The percentage was computed as the product of the fractional improvement and 100. All of the participants showed a significant improvement in self-efficacy, and each expressed contentment with the outcome. All of the participants expressed satisfaction with the opportunity to participate and stated that they would try to continue the program on their own.

Table 2

Participants' Self-Efficacy Rating

Participant Number	Pre-Intervention Rating (AR)	Post-Intervention Rating (PR)	Self-Efficacy Improvement (PR-AR)	Self-Efficacy Improvement % {(PR-AR) X100}
1	17	20	3	17.60
2	6	19	13	217.00
3	4	19	15	373.00
4	6	19	13	217.00
5	11	17	6	54.55
Mean ($\bar{x}$)	8.80	18.80	10	176.23

Although the mean of self-efficacy in the pre-intervention was 8.8 (standard deviation was 5.26), , the mean of self-efficacy in the post intervention was 18.8 (standard deviation was 5.2). Table 2 shows the pre- and post- intervention self-efficacy ratings, individual self-efficacy improvement, percentage of individual self-efficacy improvement, and their means ($\bar{x}$). Participant 1 rated the highest pre-intervention self-efficacy (score =17). For this reason, this participant made a gain of only 3 points (maximum rating = 20). This participant was the only one out of the five participants to attain the maximum point of 20. Each of participants 2 and 4 started at 6 points pre-intervention and both ended with 19 points post-intervention. These two participants accounted for the mode and median of all the scores. Participant 3 had the lowest pre-intervention rating of 4 and made the highest improvement at the post-intervention rating of

19, which was an improvement of 15 points or 373.00%. Participant 5 started at the second highest pre-intervention self-efficacy rating and ended with a post-intervention self-efficacy rating of 17. The improvement was 6 points or 54.55%, which was lower than the others, considering that there were still 3 points the person could improve on, but the rate of improvement was still significantly higher than the minimum of 5% required.

Table 3

Sample Result and Statistics

Participant Number	Pre-Intervention Rating (AR)	Post-Intervention Rating (PR)	Difference (PR-AR)
Total	44	94	50
Mean ($\bar{x}$)	8.80	18.80	10
Mode	6	19	13
Median	6	19	13
Standard Deviation (S)	5.26	1.10	5.20

Table 3 shows the total improvement of the whole sample/cohort. The total pre-intervention rating for all the participants was 44. Post-intervention, the total rating was 94, which represented a gain of 50 points.

The mode and median self-efficacy were the same: 6 pre-intervention, 19 post intervention, and 13 for the improvement. The standard deviation varied: 5.26 pre-intervention, 1.10 post-intervention, and 5.20 improvement. The reason for these standard deviation values is because the participants who started with lower self-efficacy ratings made more improvement and closed the gap with those who started with a higher pre-interventiol self-efficacy rating. The

standard deviation post-intervention was the lowest. In addition, the participants who started with a higher self-efficacy rating could not gain more than 3 points, at the highest point of attainment.

The pre-intervention standard deviation showed the wide difference between the self-efficacy rating of the participants before they received coaching. After coaching, the standard deviation was only 1.10, which showed that the participants with a low self-efficacy rating pre-intervention closed most of the gap post-intervention. The standard deviation of the difference between the pre- and post-intervention ratings was 5.20: reflecting the gap in the gains made by each participant. The participants with low pre-intervention self-efficacy ratings exhibited more improvement than those whose self-efficacy ratings were higher pre-intervention.

Figure 1

Graph of Individual Participants' Changes in Self-Efficacy

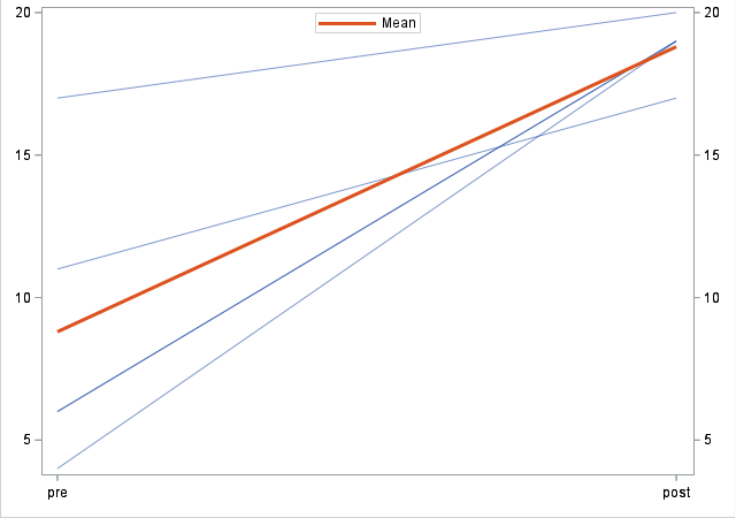

Figure 1 shows the results of the gains in self-efficacy made by the participants. The second blue line is darker because it represents the two participants who had the same scores:

Participants 2 and 4. The graph shows that all participants made significant gains. The mean is represented by the solid red line.

Figure 2

Bar Chart of the Results

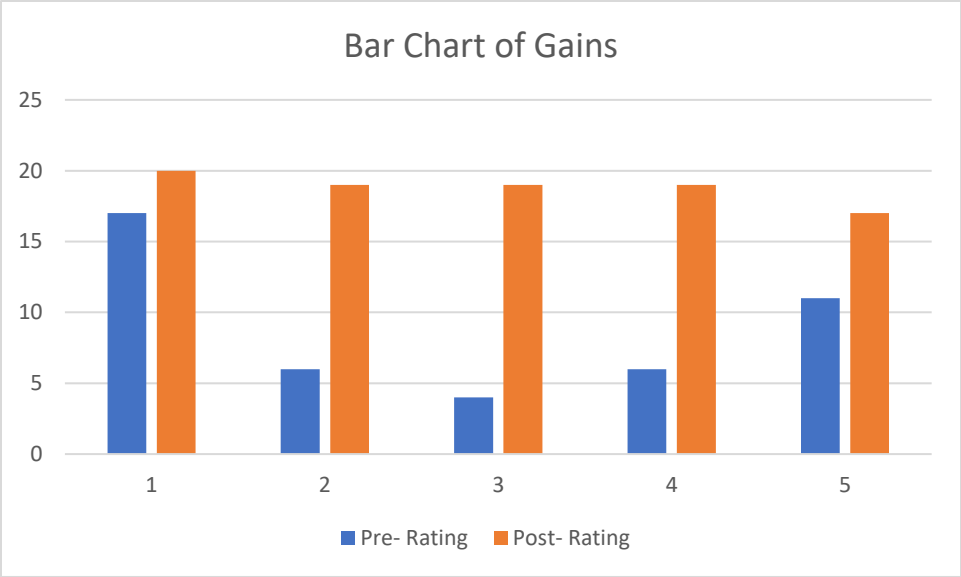

Figure 2 is a pictorial representation of the results of the project with a bar chart. The blue bars are the self-efficacy ratings prior to coaching while the orange bars represent the participants' post-intervention self-efficacy ratings. Using a low-cost telehealth coaching of patients with T2DM via phone calls and text messaging, there was a statistically significant improvement in self-efficacy ($z=-2.032$, $p=0.04$).

Discussion

The result of this pilot project on the use of low-cost coaching via phone calls and text messaging to improve self-efficacy in exercise management in patients with T2DM is significant and encouraging. The results show high gains in self-efficacy, especially in people whose self-efficacy ratings were initially low. Many articles from the literature reported improvement in self-efficacy when patients were coached to manage chronic diseases. Although

the findings reported in the literature were significant, they were not as high as the findings observed in this project.

In this project, the DNP student coached the participants regarding how to navigate through issues concerning setting up a daily exercise regimen, including flexibility of place and time and the use of cell phone alarms for reminders. The coaching provided by the DNP student was individualized to each patient's needs. This means that the issues that were dealt with during the coaching sessions were specific to each participant. The coaching by the DNP student taught the participants to concentrate on forming the exercise habit first and then build the exercise intensity as tolerated. Many of the participants gave poor weather as one of the reasons for skipping exercise, and so they were coached to exercise indoors in unfavorable weather, which eliminated this source of anxiety for the participants. Work issues were eased by planning to use a 15-minute break time to exercise on workdays or to exercise before or after work. For the issue of low motivation, working with the coach and looking forward to feedback seemed to improve motivation because of the confidence that the coach would guide them through any issues they encountered. The participants in this project were protected by keeping their personal information confidential; only assigned numbers were used for the participants' identification.

Orem's Selfcare (Deficit) Theory (Orem et al., 2003) was well suited for use in this project because the participants' self-care agency was activated by coaching. This led to improvement in the participants' self-efficacy and successfully supplied the self-care demand of regular exercise. The DNP student coach's nursing agency helped the participants navigate their environments and deal effectively with issues that worked against self-efficacy in the past.

The result of this DNP project supports the need for cost-effective coaching using cell phones for people with T2DM and other chronic illnesses. There was immense improvement in the self-efficacy of the participants from the coaching provided and the coach's weekly availability, which provided an ongoing resource for the participants. Ongoing resource availability could also prevent the participants from getting bored because of the anticipation of coaching sessions. If weekly coaching is used in actual patients, some patients could get to a point where a coach's weekly contact could become too often, as a patient progresses in self-efficacy. In this instance, a biweekly or monthly schedule could become an option depending on the patient and the stage of the coaching relationship. As patients improve in this behavior modification, they may be able to discontinue use of the coach as needed, with an option to restart in the case of future need.

This project is low-cost with high benefits. The total cost of this project was about three hundred dollars, excluding the cost of coaching personnel, because the DNP student provided the coaching. The benefit of improvement in patients' self-efficacy is significant. The observed improvement in self-efficacy ranged from 17.60% to 373.00%. The participants with the lowest pre-intervention self-efficacy rating gained the highest on the self-efficacy scale. Improved self-efficacy in routine exercise management will result in reduction in the complications of T2DM (Morrison et al., 2014). This has cost-saving benefits that can amount to hundreds of thousands of dollars per patient. This cost savings could come from the prevention of kidney disease and dialysis; the prevention of coronary artery disease, hypertension, and cerebrovascular accidents; and the prevention of the need for rehabilitation and on-going care. The patients can achieve improved energy, reduced complications, reduction in morbidity and mortality, and overall improvement in their quality of life, which could result in improved employment opportunities

and financial gain that cannot be quantified. Thus, it may be to the financial benefit of healthcare payers to provide low-cost telehealth exercise coaching to T2DM patients because it could result in lower complications and related costs.

The barriers to this project were patient recruitment, the initial attitude toward exercise, and anxieties about exercise. Many T2DM patients who do not exercise seemed to be dissuaded by the thought of a commitment to exercise. It was difficult to explain to the potential participants that this was something they could do. Possibly, the high initial rating of Participant 1 may have been affected by attempts to explain the program to the point of "I can do that", with the result that it may have affected the rating when administering the instrument. This potential problem prompted the DNP student to guard against unnecessary explanations in subsequent recruitments. The participant in this instance was the one who made the least gain because the person's initial self-efficacy rating was high. Another barrier was the current COVID-19 pandemic, which made it almost impossible to recruit participants via the distribution of flyers, as many doctors' offices and clinics were either closed for patient office visits or had removed flyer platforms as infectious control measures. Nevertheless, this project's result is robust, and all the participants were pleased to have participated. Each participant acknowledged the beneficial effect of the project because they cultivated new habits and became aware of some previously latent resources like exercising indoors and using cell phone alarms for reminders.

An important observation is that none of the participants disagreed or strongly disagreed with any of the items on the self-efficacy scale. This could mean that the participants may have found themselves in positions where they did not exercise, but not in situations where they

thought that they could not be assisted. This supports the need to make ongoing low-cost exercise coaching available to T2DM patients.

Limitations of the Project

This DNP project showed the high effectiveness of low-cost telehealth coaching by cell phone calls and text messaging to improve self-efficacy in T2DM patients who have difficulty keeping an exercise regimen. Although the improvement shown in this project far exceeded the expectation, the DNP student recognizes the limitations of this project: A low number of participants, pandemic conditions, and a lack of participant diversity.

This project's total number of participants was only five due to the Covid-19 pandemic-induced restrictions. The sample size was too small to show enough participant diversity, which is evidenced by them being all English speakers who may not be culturally diverse. The participants' races and economic statuses were not specified, so the project could not determine whether these factors could have affected the percentage of improvement noted.

Recommendations for Further Study

The result of this project is encouraging and warrants further exploration to identify the effect of telehealth exercise coaching in patient care. The DNP student recommends this project's execution with many participants in the future. Another recommendation is for the participants in a further study to specify race, educational level and economic status to identify who is more likely to benefit from this coaching and to elucidate further information and benefits.

Conclusion

Many patients with chronic diseases, including T2DM, do not have adequate control over their disease because the usual chronic disease health education provided in primary care settings is neither sufficient nor ongoing. As such, patients do not always develop the needed

behavior modification for adequate self-management. Self-efficacy in maintaining exercise routines in patients with T2DM is particularly problematic. Ongoing coaching has been proven repeatedly to improve the self-management of chronic diseases, including self-efficacy in maintaining an exercise regimen. However, although effective, coaching may come with high costs that could be difficult to afford due to its labor intensity. In response, this DNP project utilized phone calls and text messaging to provide low-cost coaching to patients with T2DM. This medium was used to receive and review participant information, provide coaching, and give feedback. The result was an overwhelming improvement in self-efficacy as rated on the self-efficacy scale after only three weeks of coaching. Interestingly, the participants with the lowest pre-intervention self-efficacy ratings made the highest improvements. The results of the project point to a lack of individual patient coaching as contributory to the low adherence to an exercise routine among T2DM patients.

The DNP student's periodic coaching and feedback via phone calls and text message proved to be an economical and effective intervention. Although not used in this project, AI may serve as an adjunct to coaching by healthcare personnel and thus reduce the cost of this intervention further. In conclusion, this DNP project is an inexpensive and effective means of improving self-efficacy in exercise and the overall self-management of T2DM.

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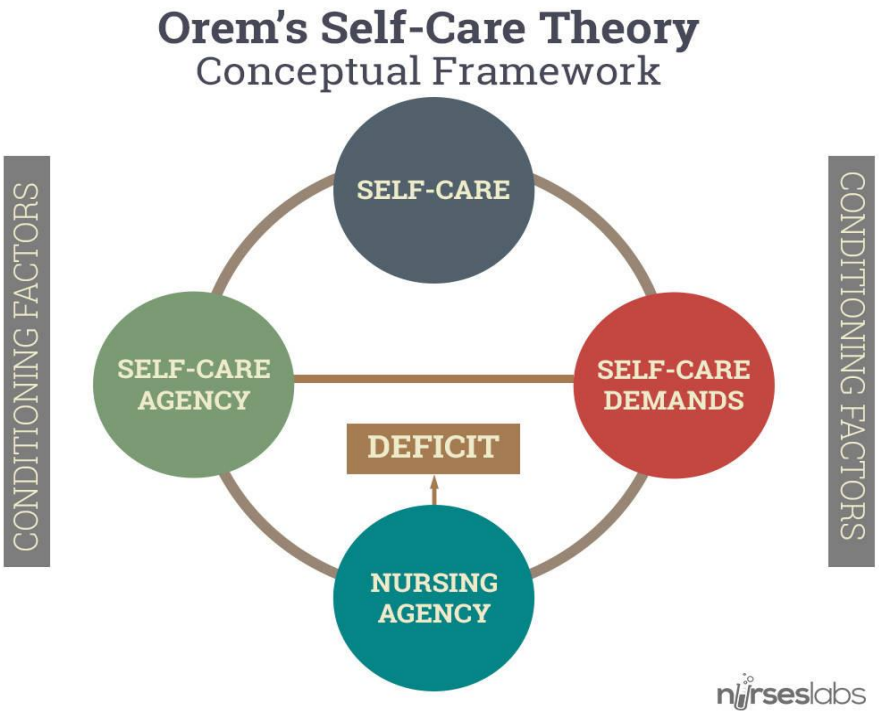
APPENDICES

Appendix A

Conceptual Framework

Figure 3

Orem's Self-Care Theory



Gonzalo (2019) https://nurseslabs.com/dorothea-orems-self-care-theory/

Appendix B

Self-Efficacy Scale

Table 4

Exercise Self-Efficacy Scale

Abilities	Strongly Disagree (-2)	Disagree (-1)	Not Sure (0)	Agree (1)	Strongly Agree (2)
I feel confident that regular exercise will improve my diabetes.					
I feel confident that I can set a realistic time for daily exercise.					
I feel confident that I can set a realistic alternate exercise time.					
I feel confident that I can exercise 5 times in a week.					
I feel confident that I can maintain 15 minutes of exercise daily at least 5 times a week.					
I feel confident that I can keep my exercise routine without excessive exertion.					
I feel confident that I can incorporate an exercise routine into my lifestyle and/or work schedule.					
I feel confident that I can make up exercise time when necessary.					
I feel confident that I can be flexible about where to exercise.					
Exercise time does not feel like “a chore”.					

Adapted from the LMC Skills, Confidence & Preparedness Index (SCPI) (Mbuagbaw et al., 2017; Adu et al., n. d.).

Appendix C

The LMC Skills, Confidence & Preparedness Index (SCPI)

Table 5

The LMC Skills, Confidence & Preparedness Index (SCPI)

Name of tool	Aspect of care assessed	Number of items
Problem areas in diabetes (PAID) [18]	Diabetes specific emotional distress	20
Diabetes Treatment Satisfaction Questionnaire (DTSQ) [6]	Treatment satisfaction	8
Audit of Diabetes-Dependent Quality of Life (ADDQoL) [7]	Impact of diabetes and its treatment on quality of life	13
Appraisal of Diabetes Scale (ADS) [8]	Individuals appraisal of diabetes and how it affects their life	7
Diabetes Care Profile (DCP) [10]	Social and psychological factors associated with Diabetes and it's treatment	234
Diabetes-39 Questionnaire (D-39) [5]	Quality of life in diabetic patients	39
Diabetes Health Profile (DHP) [17]	Eating, activity and psychological distress	32
Diabetes Impact Measurement Scales (DIMS) [14]	Symptoms, well-being, moral and social life	44
Diabetes Quality of Life Clinical Trial Questionnaire (DQLCTQ) [20]	Changes on quality of life for diabetic patients in clinical trials	142
Diabetes Quality of Life Measure (DQOL) [13]	Life satisfaction, diabetes impact, worries about diabetes and social concerns	46
Diabetes Specific Quality-of-Life Scale (DSQOLS) [4]	Treatment goals, burden of diabetes care and management	64
Questionnaire on Stress in Patients with Diabetes – Revised (QSD-R) [15]	Treatment goals, treatment success and burden of diabetes care and management	64
Well-being Enquiry for Diabetics (WED) [16]	Quality of life	50
Diabetes Empowerment Scale (DES) [3]	Psychosocial self-efficacy	37
Diabetes Knowledge Test (DKT) [9]	General Knowledge of Diabetes	23
Diabetes Self-Efficacy Scale [12]	Self-efficacy of diabetes self-care	12
Diabetes Self-Management Questionnaire (DSMQ) [19]	Diabetes-specific self-care activities associated with glycemic control	16
Diabetes Knowledge Questionnaire (DKQ) [11]	General Knowledge of Diabetes	24
Confidence in Diabetes Self-Care Scale (CIDS) [22]	Confidence in diabetes-specific self-care behaviours	20
Summary of Diabetes Self-Care Activities Measure (SDSCA) [21]	Activities associated with diabetes self-management	25

The LMC Skills, Confidence & Preparedness Index (SCPI) (Mbuagbaw et al., 2017).

https://hqlo.biomedcentral.com/articles/10.1186/s12955-017-0606-z/tables/1

Appendix D

Participants' Skills and Self-Efficacy (Confidence) Ratings

Table 6

Participants' Skills and Self-Efficacy (Confidence) Ratings to Perform Diabetes Self-Management.

Skills	Mean	SD
I am able to portion out and choose foods that have the minimal balance between carbohydrates, proteins and vegetables to keep my blood sugar on target	7.23	1.97
I know how my diabetes insulin and medication works in my body and at what time of the day I should check my blood sugar (BS) to make sure my dose is correct (*For T2D[a] not controlling with insulin and medication*: I know how my diet and physical activities impact my BS and at what time of the day to check my BS to make sure they are on target)	7.47	2.37
If I eat too much carbohydrate, or do not engage in my regular physical exercise, I know how my body will react and the steps to take to get it back on track	7.35	2.35
When I am planning to exercise, I know what changes I need to make to avoid low blood sugar before, during and after exercise	6.88	2.48
I know when to check my blood sugar if I wanted to see how my body reacted to a meal	7.81	2.33
When I am sick, I know what to do differently with my medications, fluids intake, food intake, blood sugar testing and when to go to the hospital	6.91	2.67
I know how to identify stress in my life and how it can impact my diabetes management and overall health	6.88	2.43
When I look at my blood sugar in my meter or in my log book in a given week, I could explain to my diabetes educator or doctor what my blood sugar pattern is	6.84	2.58
I know what the ABCs (HbA1c[b], Blood Pressure and Cholesterol) of diabetes are, what my targets are and how they impact my diabetes	7.00	2.54
Average score on skills	7.15	1.97
Self-Efficacy		
I feel confident that I can plan meals and snacks effectively in a way that it will not raise my blood sugar unnecessarily above my targets	7.22	2.06
I am confident that I can implement stress management techniques in my lifestyles	6.72	2.28
I am confident that at the next time I am eating out in my home, I will be able to plan and select the foods that best keep my blood sugar under control	7.06	2.34
I am confident that I can plan ahead for what to do and how to react either before, during or after exercise to avoid a low blood sugar	6.92	2.4
I am confident that I can choose a healthy physical activity for myself and include it in my schedule	7.16	2.26
I am confident that I can adjust my insulin or medication doses on my own, to reach the target blood sugar levels *(For T2D[a] not controlling with insulin and medication*: I am confident that I can adjust my meals and levels of physical activities on my own to reach the target blood sugar levels)	6.87	2.62
I am confident that I can commit to preventing and monitoring my diabetes complications such as seeing my eyes doctor at least once in a year and checking my feet on daily basis	8.08	1.85
I am confident that I can use my blood sugar results to make changes to my diet and/or insulin to help keep my blood sugar in target	7.00	2.54
Average score on confidence	7.17	1.81

[a]T2D: Type 2 diabetes mellitus

[b]HbAIC: Glycosylated hemoglobin

https://doi.org/10.1371/journal.pone.0217771.t001

Adu et al. (2019)

https://journals.plos.org/plosone/article/figure?id=10.1371/journal.pone.0217771.t001

Appendix E

Prescreening Questionnaire

(This pre-screening will be conducted over the phone with prospective participant)

Thank you for responding to our flyer for this research study. Before we enroll you, we will ask that you to take about 10 to 15 minutes and complete the screening questionnaire, which will help us to determine whether or not you are eligible to participate in this study. If you are not eligible, the information you provided in the questionnaire will be destroyed. If you are eligible and participate, your information will be kept safe and stored confidentially with all other study materials in a Umass IT box dedicated for that purpose at https://www.umass.edu/it/box where it will be protected from unauthorized access. Your information in the screening questionnaire will only be accessed by research personnel. If you are found to be eligible for this study, we will give you the informed consent document to read and consent. Please feel free to ask any questions, I will be glad to provide any answers or clarifications that you may need.

How old are you?

Are you able to make decisions for yourself?

Are you pregnant?

Are you incarcerated?

Do you have Type 2 Diabetes?

How long have you had Type 2 Diabetes?

How many times a week do you exercise?

What do you do for exercise?

How many minutes can you walk at a normal pace without getting exhausted, tired, or short of breath.

Do you think that you may need help to maintain a regular exercise regimen?

What are the problems that prevent you from maintaining a regular exercise regimen?