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Developing an innovative tablet-based walking program to improve arthritis fatigue

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Introduction and Background

Fatigue associated with arthritis is a persistent and highly prevalent symptom occurring in up to 80% of patients with arthritis (Hootman, Murphy, Boring, & Guglielmo, 2018). It also significantly impacts patients' quality of life and interferes with their participation in usual daily routines (Kirwan et al., 2007). Fatigue is a debilitating symptom defined as "lack of energy and inability to maintain a usual routine" (National Institutes of Health, 2015). Despite its high prevalence and significant impact on patients' health outcomes, effective methods for managing fatigue are limited. Medications targeting arthritis (e.g., inflammation medications) have little effect on fatigue (Katz, 2017). Instead, a number of physical activity/exercise interventions (e.g. pool-based therapy, dynamic strength training, yoga, low impact aerobics) have demonstrated a significant moderate effect on fatigue (Cramp et al., 2013). These exercise interventions, however, are resource intensive, requiring specially trained personnel, highly structured activities, and attendance at classes or a specified facility. Each of these requirements increases cost and barriers to wide implementation in healthcare settings. Most importantly, a critical weakness of these interventions is participants' lack of long-term engagement in and adherence to the program after the intervention is completed (Mayo et al., 2014). As a result, these interventions produce immediate benefits, but the benefits largely disappear at follow-up. Therefore, an urgent need exists for interventions that require minimal professional guidance and are convenient and easy to access.

To address this need, our team developed a simple walking program of physical activity, facilitated by tablet-based cognitive behavioral strategies. Becoming consistent with walking requires minimal professional guidance and equipment and has been shown to yield significant reductions in fatigue (Bravata et al., 2007). To ensure patient's long-term engagement and adherence to a walking activity, we developed the educational modules based on cognitive behavioral principles. The program was designed to promote long-term behavioral changes (e.g., long-term engagement and adherence to the intervention in this study). This was achieved through the application of basic learning principles (Skinner, 1953) as well as identification of unhelpful thoughts and behaviors that reinforce avoidance

of activity rather than engagement. Cognitive behavioral therapy (CBT) has been used broadly in the management of rheumatic disease (Dures & Hewlett, 2012). With CBT, patients improve core self-management skills of problem-solving and goal-setting and enhance a sense of control of their illness and confidence that they can do something to make a difference (Lorig & Holman, 2003), resulting in patients' long-term engagement in and adherence to a simple walking activity.

To effectively and efficiently deliver CBT education to older adults, we adopted a mini-tablet computer as a platform. A tablet computer can store sizable educational materials and is easy to carry and convenient for retrieving content, making educational materials readily available whenever and wherever needed. Technology is becoming easier to use and more cost effective for individual use. Technology adoption continues to increase among older adults, with one in four people over the age of 65 owning smart phones and half with broadband in their homes (Pew Research Center, 2017). Nursing is challenged to develop innovative and effective interventions using these technologies to improve fatigue symptoms. Our team has devised a pragmatic approach to apply off-the-shelf technology, cognitive behavioral focused education and a simple walking activity intervention to improve fatigue for those with arthritis. To the best of our knowledge, there is no fatigue management intervention that have both physical activity in a tablet platform and behavioral change approach as intervention components. Current physical activity only interventions produced a significant moderate effect on fatigue, but the effect did not last long and largely disappear after the intervention completion; the behavioral change only interventions yielded a long-term effect, but the effect sizes were smaller compared to the physical activity only interventions. Our Tab-CBI consists of two intervention components, CBT and tablet-based physical activity education to address the limitations of current interventions. This article describes the development of the tablet-based cognitive behavioral intervention ("Tab-CBI") application and the results of the first phase of our user-centered evaluation process.

Development of Tab-CBI

Nursing researchers, through collaboration with engineers, psychologists and nurse practitioners, have developed the Tab-CBI application. The Tab-CBI innovation is a tablet-based application that employs off-the-shelf technology and uses the principles of cognitive behavioral therapy to promote patients' engagement and adherence to a simple walking activity. Tab-CBI is composed of four key components: multimedia CBT education; videoconferencing communication with a provider; individualized goal setting; and electronic data submission.

Over the course of approximately ten (10) months researchers from nursing partnered with engineers to manage the off-the-shelf hardware and software customization and application. Clinical and content experts on cognitive behavior approaches worked with the research team to create specific educational modules for Tab-CBI. This section describes some of the major work to develop Tab-CBI.

Hardware

The research team selected the hardware for use in this study. Hardware selection was determined by the availability of off-the-shelf products easily accessible to the general population. The research team selected a mini-tablet computer (Samsung Galaxy Tab-A) as a platform for the Tab-CBI application (see Figure 1). A mini-tablet computer is a practical device for participant use; it can store sizable educational materials and yet is easy to carry. While compact in size for mobility, the tablet screen size is larger than a standard cell phone. This provides a larger screen space to accommodate a larger font size for viewing the Tab-CBI content. The research team also selected an accelerometer, Fitbit™ wristband, to count steps and wirelessly sync with a tablet computer. We chose Fitbit™ wristband because it has a simple visual display, is easy to operate, and has a relatively long battery life lasting up to 5-6 days without recharging. Most of all, it is accurate for tracking step counts of frail older adults with slow gait (Case, Burwick, Volpp, & Patel, 2015).

Key Components of Tab-CBI

Multimedia CBT educational modules.—The education modules consist of task management and written and video education. For the project, our team utilized a commercial software application, Microsoft To-Do™, loaded onto each tablet to manage weekly study tasks. The study participants were oriented to a checklist with the activities they were asked to do each week. These activities include taking self-assessment quizzes (to reinforce what they learn from the learning modules), using the educational materials for the week, or reviewing their weekly goal for walking. The team had access to the master account to be able to update or interact with the participants in real time. For example, at a weekly educational session, participant's walking goals were jointly set for the coming week (King, 1981). The investigator can update the tablet remotely to write the client's weekly walking goal in the task management section for the client to view immediately.

Educational information provided on Tab-CBI was created in two formats to appeal to the learning needs of the participants. For each of the topic areas covered in the study, a short video 3-5 minutes in length described the key points for each session. A script for the videos was drafted and reviewed by a research team to ensure that the CBT concepts were written using easy and simple terms for older adults. The videos were made using existing organizational cameras and equipment by the research team. After the prototype videos were created, they were uploaded to a private YouTube account so that only invited participants could view the recordings. The videos were organized into the weekly task list for viewing at the appropriate times. A written one-page "key points" summation was also provided to participants as an item in the task list. Both video and written material were available to participants at any time on the tablet (see Figure 1 for week 1 learning module).

Individualized goal setting.—An important feature of Tab-CBI is the goal setting component. Older adults maintain physical activity to a larger extent when goals are set (Katz, Margaretten, Gregorich, & Trupin, 2018). In line with the cognitive behavioral approach, one of the research team members works with participants to set SMART goals (Doran, 1981) which are specific, measurable, achievable, realistic, and time-based. The

participant sets a goal each week when meeting with the team member. This goal is then listed on the weekly to-do task list on the tablet (see Figure 2 for week 1 goal setting).

Communication with a provider using a videoconferencing tool.—A tablet with a videoconferencing tool is well suited to meet the needs of older adults with fatigue who often have difficulties traveling to places outside the home for education. It improves patients' access to the intervention, while closely resembling face-to-face interactions between a patient and a clinician, making it an effective alternative to the traditional in-person education approach (Moffet et al., 2015; Peel, Russell, & Gray, 2011). The tablets have been outfitted for safe, secure, and HIPPA compliant videoconferencing software for weekly education review and goal setting with the research member.

Electronic data collection and submission.—An accelerometer is a simple and inexpensive means of monitoring patients' step counts. For this study we had paired a unique accelerometer to its own dedicated tablet. Participants use the tablet to sync the accelerometer to it in their home. After syncing, they are able to see the step count on the larger tablet in real time and compare to the goal they have set. The accounts for the accelerometers are managed by the team and available for data collection.

Study metrics, such as fatigue, quality of life, and pain, are measured over the course of the study, at baseline and week 4, 6, 8 and 10. The surveys are created using a web-based survey tool, Qualtrics™ and populated into each tablet, as each study participant takes the surveys on the tablet. The results are stored on Qualtrics secure servers and can be accessed and managed by the team to analyze data and generate reports.

Cognitive Behavioral Education

The foundation of the education provided in Tab-CBI is based on cognitive behavioral principles. The key elements of this CBT approach invited participants to consider the function of their thoughts and behavior in relation to engaging in a simple walking program. The psychoeducation lessons focused on how avoidance behaviors are maintained and how avoidance is self-reinforcing (Bandura, 1969). Participants were also taught how to recognize unhelpful thoughts that also interfered with successful engagement in walking. Through the tablet-based program, participants were then taught simple strategies to overcome avoidance and increased motivation based on the basic principles of behavioral activation (Jacobson, Martell & Dimidjian, 2001) and cognitive reappraisal (Beck, 2011).

Over the course of three months, nurse researchers met weekly with a psychologist with expertise in CBT. The topics and content for the CBT-based educational modules were developed during these meetings. As the content began to be refined, the one-page weekly topic handouts and 3-4-minute videos were created for use in the study. The videos and one-page handouts were reviewed and refined for their appropriateness, accuracy, and relevance by three (3) outside experts. The final educational modules consist of four (4) weekly topics and one (1) booster session. The topical outline is listed in Table 1.

Evaluation of Tab-CBI

In order to move the innovation to the next level of research, the usability of Tab-CBI must be evaluated with a user-centered approach. This approach consists of a series of steps; expert review, quality assurance, testing of the innovation in focus groups and individually in the context of daily living with older adults with fatigue. The team completed the expert review and quality assurance of Tab-CBI of this evaluation, and these results are presented in this article. The remaining portions of the usability testing are currently in progress.

Expert Review

Once development of Tab-CBI was done, we obtained feedback on its content and the usability from three experts, a CBT expert (psychiatric nurse practitioner), a clinical education specialist, and a geriatric activity specialist and placed it in a spreadsheet for systematic review and decision making if feasible to change.

In general, the experts perceived that Tab-CBI was engaging and user friendly, i.e., easy to use and intuitive without lengthy comprehensive user training, and that it has potential to improve simple walking routines and alleviating fatigue. One expert said, "... (Tab-CBI) geared toward patients who want to be the "driver" of their care..." All three experts pointed out its remote accessibility as a key benefit. One of key features of Tab-CBI is the videoconferencing tool when communicating with patients for education and follow-ups. Patients don't need to leave home for communication, eliminating geographical constraints such as costs and time for transportation. Therefore, Tab-CBI can be more accessible to populations in remote areas and other populations who have physical and/or functional impairments that may limit their ability to participate in treatments such as arthritis patients in our study.

Experts also made a number of comments for further improvement. Several key comments are on icon education, minimizing the number of clicks, and user training. First, training of Tab-CBI would need to focus on education for the major icons of Tab-CBI. Second, the expert comments addressed the need to minimize the number of clicks to streamline progression through the software. Third, one expert said, "telecommunication may be harder for them using a tablet....May need additional support first 1-2 weeks of study period." Although Tab-CBI is perceived as intuitive and easy to use, older adults ages 75 and older may have challenges using the tablet. They may not be familiar with tablets and require more than one session for training. The experts' comments were integrated into a revision of Tab-CBI.

Quality Assurance

During the process of developing Tab-CBI there were several improvements and changes made. Once the final product was ready to begin testing, it was crucial that all of the tablets were systematically reviewed to ensure that the content was in correct format and that the components were working as intended. The researchers used a detailed spreadsheet to verify the tablets were all uniform.

Discussion

Developing an innovation to improve fatigue symptoms requires a team approach, a solid framework for organizing the innovation, and a systematic method of user-centered evaluation and revision. Tab-CBI development utilized a team of experts. Having a team approach, including the collaboration of engineers and psychologist, was valuable to maximize the use of the software and minimize extra steps when possible. It took approximately 10 months to assemble and test the application. Some strengths of this work are the pragmatic perspective of using off-the-shelf items in an innovative way. Also, the time, effort, and money for developing a sophisticated and complex software can be much reduced. A challenge of the innovation is that the off-the-shelf items, such as the software, were not configured exactly as researchers would have preferred. For example, reducing the number of clicks to start the videoconferencing would be helpful but is not a customizable feature of the software.

The Tab-CBI innovation is based on a cognitive behavioral approach. Cognitive Behavioral Therapy (CBT) principles guided what education content was provided and the formats for the weekly sessions. CBT is well regarded in promoting self-management of chronic conditions such as diabetes mellitus (Safren et al., 2014), depression (Ngai, Wong, Leung, Chau, & Chung, 2015), fibromyalgia (van Koulil et al., 2011) as well as cancer-related fatigue (Sandler et al., 2017), but it has rarely been used in arthritis fatigue management. The cognitive behavioral approach received positive comments in our expert review process. Our team collaborated with a psychology expert in CBT which was vital in this portion of the innovation.

The evaluation process of Tab-CBI took a significant portion of time to complete, but it is a necessary step in a technology development process. Ensuring the innovation is consistent (e.g., quality assurance) and provides value to participants is a good starting point. The expert feedback provided the team with an actionable list of changes. For example, based on the experts' comments, clearer and more detailed user instruction materials were developed. Also, the user training manual was revised paying special attention to educate major icons on Tab-CBI. The team worked to minimize clicks and simplify process of working through the screens. Attention was heightened to ensure participants 75 years of age and older were well represented in the next phase of usability testing. Through the expert feedback, our team was able to make changes to improve the product and the experience for participants.

In order to move the innovation to the next level of research, it is important to evaluate technology using a user-centered approach. The goal of user-centered usability test is to develop technologies that end users perceive as easy, effective, and enjoyable to use, and that fit seamlessly into their daily routines, thus promoting acceptance and use of the technologies (Preece, Rogers, & Sharp, 2015). This article describes the innovation of Tab-CBI and the first phase of evaluation which focuses on quality assurance and expert review. The second phase of usability testing involves the engagement of the end users, older adults with fatigue in focus groups in a laboratory setting and individually in the context of their daily living. The second phase of user-centered evaluation is currently underway. For a

future study, our team plans to conduct a pilot study to examine the long-term effect of Tab-CBI on step counts, fatigue, self-efficacy and quality of life.

This study has several nursing implications. Application of technology to health promoting activities of daily life will continue to grow. Many applications are readily available and are in use in the public. Nurse clinicians who care for older adults are seeking technology that has been determined to be appropriate and meaningful to this population. However, most technological applications have not been tailored to the older adults. Technological interventions focused on the older adults must be evaluated for use by older adults. This study adds to what is known regarding evaluation of a specific technological application, Tab-CBI, using a user-centered approach. Nurse educators, clinicians, and researchers may find the user-centered approach helpful in developing and evaluating technological applications in the future.

Conclusion

This article described the purpose and development process of an innovation, Tab-CBI, for older adults with arthritis fatigue. Development of the innovation required a team approach, a solid framework for organizing the innovation, and a systematic method of user-centered evaluation and revision. Our approach was team oriented, based on cognitive behavioral principles, and user centered evaluation of a technology. In this initial stage, Tab-CBI has been shown to be a usable innovation for fatigue management in older adults.

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Figure 1.
Learning module for week 1.

Figure 2.
Goal setting for week 1 learning module.

Table 1

Cognitive Behavioral Intervention Collaborative Psycho-educational Topics.

Title	Intervention Time Frame	Key Points	Strategies	Goal Setting
Session 1: Introduction: Taking steps to take steps	Week 1	Cognitive behavioral approach: how thoughts and feelings can change how we act.	Ways to change behavior; Setting SMART goals	Mutually set
Session 2: Tell me what you think	Week 2	Thoughts can change how we feel	Simple ways to change our thoughts from unhelpful to helpful	Mutually set
Session 3: Walk it out	Week 3	Emotions can change how we behave.	Ways to keep emotions from controlling behavior.	Mutually set
Session 4: Wrapping up and moving Forward	Week 4	How we think and feel affect our behavior.	How thoughts and emotions can be helpful/unhelpful; SMART goals are helpful. Motivational interviewing techniques.	Mutually set
Session 5: Moving forward: A Review	Week 6	How we think and feel affect our behavior.	Committing to action- reviewing the strategies of the previous weeks. Participant reflection of what is helpful/unhelpful.	Client driven