Development of Home-Based Exercise Mobile Application for Patients with Peripheral Artery Disease

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Abstract. This study aimed to develop a home-based exercise application to improve the exercising performance in patients with peripheral artery disease. This application is based on a theoretical framework and is paired with a wearable device, Fitbit Charge4. The application comprised five main categories with 30 screens: login, a record of exercise, goal achievement, information, and motivation. Using the application to nursing practice can manage and encourage patients to exercise without limitations of time and place.

Keywords. Exercise, mobile applications, peripheral arterial disease, telemedicine, wearable electronic devices

1. Introduction

Peripheral artery disease (PAD) is a chronic atherosclerotic obstructive disease with asymptomatic, intermittent claudication, and critical limb ischemia [1]. Patients with PAD experience ischemic pain during walking, which affects functional impairment and lower quality of life [2; 3]. Supervised exercise therapy (SET) performed in patients with PAD improves functional status and decreased leg symptoms [4]; however, it can be burdensome about accessibility and cost [5]. In this sense, home-based exercise therapy (HBET) may be a reasonable alternative to SET more accessible and accepted [4]. However, low adherence in HBET is challenging to achieve the effectiveness of exercise through behavioral changes [6]. Mobile health technology is an intervention strategy that can increase exercise adherence, collect behavioral health information such as daily physical activity, and provide individualized interventions regardless of time and place [6; 7]. The information-motivation-behavioral skills (IMB) model is a framework that describes the increase in health behavior by increasing health behavior skills through providing information and motivation [8]. Therefore, this study aimed to develop HBET mobile application based on the IMB model to improve the exercise performance in patients with PAD.

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2. Methods

We developed a mobile application based on the IMB model [8] to monitor activities and encourage exercise in conjunction with a wearable device, Fitbit Charge 4 (Fitbit, Inc., San Francisco, CA), to change the health-related behavior of patients with PAD. In addition, this study developed a mobile application to identify, design, develop, and prototype based on the Mobile Application Development Lifecycle Model [9].

3. Results

3.1. Identification

We investigated effective exercise methods with a high level of evidence in PAD patients through literature review and the 2016 AHA/ACC guideline for PAD [5]. As a result, the volume, intensity, frequency, and duration of the exercise were determined as targets. In addition, needs assessments related to patients' exercise were investigated through interviews (n = 9) and surveys (n = 138). According to an interview among nine PAD patients, it was found that they want to use an application expected to be a companion and supporter for exercise at home and an application with functions to monitor and feedback their exercise and emotional status. Participants with PAD had a high demand for exercise-related information. Additionally, they expected mobile applications to include education about exercise and function to check their status, and they expressed willingness to use mobile applications.

3.2. Design

We designed the structure and functions of the mobile application. The mobile application consisted of five categories: login, a record of exercise, goal achievement, information, and motivation. For motivation, daily and weekly exercise goals for time and number of steps were set. Furthermore, a text message algorithm was designed to deliver the message via in-application push, depending on whether the daily and weekly goals were achieved.

3.3. Development

After our research team designed a home-based exercise mobile application for patients with PAD, an application development team developed application and dashboard systems from January to March 2021. The mobile application was developed using Ionic Framework version 5 and Cordova version 9; the operating environment is Android version 5.0 or higher. The mobile application was comprised of five main categories with 30 screens. The five main categories and each content are as follows: (1) login - registration and login with ID and password; (2) a record of exercise - check the number of steps using Fitbit charge 4 and time using start/stop button in an application; (3) goal achievement - setting daily/weekly exercise goals and giving reward badges when achieving goals; (4) information - exercise and disease-related education video; and (5) motivation - sending in-application push regarding daily/weekly exercise goals according to text message algorithm.

3.4. Prototyping

It was implemented that mobile application for patients with PAD in a real mobile environment such as an android phone. First, researchers tested functionality, connectivity with Fitbit charge 4, overall layout, and design of mobile applications. Then, revision and modification were performed by requesting the programmer for errors and corrections found in the mobile application.

4. Conclusions

The present study develops a home-based exercise mobile application based on the IMB model for patients with PAD. Using the mobile application developed based on the theoretical framework in nursing practice can manage and encourage patients to exercise without limitations of time and place or the need for additional nursing personnel. In addition, the mobile application, which provides exercise and disease-related information and motivates them through text messages, may enhance patients' positive behavior changes such as exercise performance.

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