FitMi PD: an affordable home therapy device for individuals with Parkinson's disease

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Background

Parkinson's Disease (PD) is the second most common progressive neurodegenerative disorder affecting older adults in the United States and is predicted to increase in prevalence as the national population ages [1]–[3]. PD is characterized by cognitive deficits and debilitating motor impairment that includes bradykinesia, rigidity, tremor, postural instability, and gait disorders [1]–[5]. Current management of the disease has centered on pharmacological solutions [6], but even with optimal drug treatment, individuals still experience a deterioration in motor function, mobility, cognition, and daily activities [5], [7], [8]. This can lead to decreased independence, inactivity [9], social isolation [8], and reduced quality of life [8]. However, a growing body of research suggests that exercise therapy in conjunction with drug therapy can help slow down the degenerative process and even improve motor function [7], [10]–[24]. Unfortunately, access to intensive rehabilitation is limited, which often results in suboptimal dosages of exercise therapy [25]–[27]. In fact, one study by Hassan et al., [27] found that at 10 years post diagnosis, just 41% of individuals with PD were receiving physical therapy and only 16% were receiving occupational therapy. Long-term, frequent exercise therapy is necessary to maximize and maintain benefits [10], [13], [21], [28]–[32] and thus must become a routine part of everyday life for individuals with PD. Engaging home therapy options that encourage therapeutic exercise could increase the dosage and long-term duration of therapy individuals receive. However, most home-based exercise equipment (e.g., a treadmill) is not optimized to safely promote activity in older individuals with PD. Indeed, there remains a tremendous need for home exercise technology that is specifically tailored to address the problems faced by individuals with PD.

Recognizing this, we developed a computer-guided, in-home exercise system for promoting exercise in individuals with PD, called FitMi PD. The system consists of two wireless input devices ("Pucks") that measure movement (via inertial sensors), compression force, and touch events, and provide haptic feedback in the form of vibration. The Pucks communicate with exercise software on a computer or tablet to sense and direct exercises. The software analyzes the sensor inputs in real-time, detecting when an individual completes a repetition of a target exercise and providing motivating feedback to users.

Study Design

We evaluated the usability of FitMi PD in a three-week at-home study with 9 individuals with mild to moderate PD. All participants were provided with a FitMi PD system and were instructed to exercise for a total of 3 hours per week at the times and durations of their choosing for 3 weeks.

Methods

Inclusion criteria included a diagnosis of mild to moderate PD (Hoehn and Yahr stage I to III [33]), Mini-Mental State Examination [34] greater than 28, and age younger than 85 years old. All participants provided informed consent. After obtaining consent, participants were invited to use FitMi PD under supervision from a study administrator who provided initial instruction on how the system works and then guided the users through a practice session. Participants played through a few exercises in the software until they had demonstrated that they could use the system on their own. Following the supervised practice session, participants were invited to take home a FitMi PD system with tablet and exercise software pre-installed. They were instructed to exercise for a total of 3 hours/week at the times and durations of their choosing for 3 weeks. Appropriate exercise movements for each participant were selected in collaboration with each participant by a trained therapist.

After 3 weeks, participants returned for follow-up. At this point, the total number of hours of exercise therapy the users performed was extracted from the tablet. We will also solicited usability feedback from participants and their caregivers.

Results and Statistical Analysis

We recruited 9 individuals (4 Male, 5 Female) with a diagnosis of mild to moderate PD (Hoehn and Yahr stage I to III). The mean age of participants was 57 (range: 45 to 77 years) and mean time since diagnosis was 4 years (range: 1 to 10 years). Seven out of 9 participants successfully used FitMi PD to perform exercises at home, with the total number of exercise repetitions ranging from around 350 to 10,000. For the two participants who did not use the FitMi PD system: one did not feel comfortable exercising without their caregiver, who unexpectedly moved away shortly after enrollment; the other participant attempted a standing exercise even though their therapist had not recommended it and had difficulty maintaining their balance, which discouraged them from participating further. No safety concerns or adverse events were reported. No additional statistical analyses were performed due to the small sample size of the study

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