ARE SERIOUS GAMES PROMOTING MOBILITY AN ATTRACTIVE ALTERNATIVE TO CONVERNTIONAL SELF-TRAINING FOR ELDERLY PEOPLE?

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ABSTACT

Maintaining mobility of elderly persons has become a primary goal within European healthcare services because reduces institutional placement and mortality. Mobility exercises are conventionally instructed by physiotherapists using handouts, allowing self-exercising. However compliance to self-training is low, since exercises are considered tedious, thus prematurely stopped.

This clinical trial aims to determine whether elderly inpatients show higher adherence to self-training when using serious games than when performing conventional exercises. Secondly, we explore patients' mobility development accordingly. Results will provide insight into the effectiveness of serious games promoting mobility and contribute to understand the motivational potential of serious games in this population.

Keywords: elderly; self-training exercises; serious games; Kinect®; FitBit®; adherence; mobility

1. Introduction

The European population is getting older [1, 2]. Due to these demographic changes the need for adapted medical services for this specific age group has become critical. From the international literature several studies have proven the effectiveness of rehabilitation programs for geriatric patients [3, 4]. A recently published systematic literature review and meta-analysis demonstrated that specific inpatient rehabilitative programs increase physical abilities of elderlies and reduce institutional placement and mortality [5]. However, unsufficient data enabled to properly define all the features of a successful and efficient rehabilitation program.

In order to improve cardiorespiratory and muscular functions, and to reduce the risk of non-communicable diseases, depression and cognitive decline, the WHO recommends that adults aged over 65 practice aerobic physical activity for at least 150 minutes of moderate intensity or 75 minutes of high intensity per week [6].

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Moreover, elderly people should perform strengthening exercises minimum twice a week and balance exercises minimum thrice a week. In this manner, to increase therapy intensity and thus independence in activities of daily living, older patients admitted to rehabilitation are often instructed customized self-training exercises. These self-training programs, likewise therapist-assisted sessions, improve significantly physical capacities [7], and thus serve as a proven efficient and cost-effective mean for rehabilitation settings. However, the compliance of elderly people to execute self-exercise programs varies considerably. These programs are often considered as tedious and boring, hence prematurely stopped [8-11]. An alternative to increase patient's motivation for self-exercising is using serious games promoting mobility.

Nowadays computer games promoting mobility are commercially available in the leisure sector and for various video game consoles such as Nintendo Wii®, Xbox Kinect® or FitBit®. A feasibility study demonstrated that stroke patients were highly motivated to use Nintendo Wii® game console for training balance exercises [12]. However, some studies indicated constraints and difficulties during the manipulation of the commercial Nintendo Wii®: games are designed for the young and healthy audience and so older users need a lot of technical help [13-15], motions and interactions through a console make it more difficult to manipulate [16, 17], scores and progress measurements are too generic for rehabilitation use [16].

Although the use of serious games for exercising mobility and balance in rehabilitation settings has considerably expended in the past years, this research field is at an early stage and randomized controlled trials with sufficient subjects are still missing [18-21]. Furthermore, the law of attrition is a specific challenge in the evaluation of computer-based trials [22]. Therefore the primary objective of our clinical trial is to determine whether elderly people in rehabilitative settings show higher adherence to self-training when using serious learning games than when performing conventional exercises. Secondly it explores balance and mobility performances according to the mode of self-training. The purpose of this paper is to describe the study protocol and to present preliminary findings.

2. Methods

Study design The present study is part of the international GameUp project [23], focusing on game-based mobility training and motivation of senior citizen, and co-funded by the European research and development project "Ambient Assisted Living" (REF. AAL-2011-4-090). It consists of a double-site (Valens Rehabilitation Clinics and O'Berri Instituto Vasco de Innovacion Sanitaria), single blind, randomized controlled trial with two parallel-groups (conventional self-training exercises vs serious games exercises), two assessment periods (pre- and post-

intervention) by an examiner and daily data collection in a logbook by the patient himself. Participants are randomly allocated to the intervention group or to the control group, with an allocation ratio of 1:1. This study was modeled following a feasibility study carried out in Valens Rehabilitation Clinics in 2012 [5] and designed to complement the knowledge gained via multiple qualitative research methods used in GameUp (i.e. focus groups, semi-structures interviews).

Requirements As the Kinect® game console seems to display an easier navigational structure (no console is needed), and thus facilitates its handling, this game equipment is used for this clinical trial. Due to their lack of computer skills, serious games intended for elderly people should reproduce as much as possible activities of daily living [24] with little simultaneous information and few options but with enough time for assimilation [25]. These requirements are usually not met by standard commercial serious games. Based on these considerations and as part of the GameUp project, new serious games promoting mobility are developed on Kinect® for Windows and focus on the WHO physical requirements of elderly people. The patient performs exercises to enhance his mobility, strength, balance and endurance performances by means of the Kinect® game console and the Fitbit® pedometer.

Inclusion criteria Patients above 65 years old, able to walk independently over 20 meters and for whom self-training has been prescribed are included in this study. Patients with cognitive impairment (Mini Mental State Examination < 26) and other limiting disorders are excluded.

Study flow Once included, study participants are stratified in four groups according to their balance capacities (Berg Balance Score $\leq$ 44 or $\geq$ 45) and according to their computer skills (computer experience or no computer experience). This stratification reduces the risk of bias in relation to the training adherence: on one side, it avoids that more computer experienced participants are included in the Kinect group and on the other hand, participants with poor balanced capacities are equally distributed in both groups. Strata are then randomized in Microsoft Excel, so that participants are randomly assigned to one group. The examiner is not informed of the group allocation.

Intervention Participants are entitled to two time-slots à 30min per day, from Monday to Friday, dedicated to self-training in addition to the usual rehabilitation services, and this during the ten days of the intervention period. Self-training programs are instructed by a trained physiotherapist and appropriate balance exercises are selected according to the patient's balance capacities. The Berg Balance Scale (BBS) is used as a cutoff point. A BBS score < 45 indicates a risk of falling, and thus patients scoring less than 45 points perform the balance exercises in sitting

position only. Patients scoring between 45 and 56 points perform the balance exercises in static standing position, whereas patients reaching the maximum score of 56 points perform exercises in dynamic standing position. During the instruction, patients are told the following: "From Monday to Friday, you can use every available free time to carry out the self-training program. Perform the self-training exercises as intensively as possible, and as often as you want." Additionally patients are encouraged to walk and climb stairs instead of using the lift, in order to improve their endurance.

Outcome measures The primary outcome measure is the intensity of the performed self-training. It is based on the frequency (quantity) and duration (time in minutes) of individual self-training sessions. The patient records daily the data in a logbook during the whole intervention phase (10 working days). Secondary outcomes are mobility and self-perceived fall efficacy assessed with the German and Spanish version of the Fall Efficacy Scale-International version (FES-I) [26, 27]. Mobility is assessed with Berg Balance Scale (BBS) [28], a widely used clinical test of a person's static and dynamic balance abilities and a tri-axial accelerometer measuring Local Dynamic Stability [13]. LSD is a non-linear gait stability index quantified by calculating Lyapunov exponent. It has been advocated as an early indicator of risk for falls [29].

3. Conclusions

To our knowledge this study is the first to compare conventional self-training programs with serious games among elderly persons. Previous studies have been focusing on qualitative issues and in a lesser extend looking into clinical outcomes. Results will provide insight into the effectiveness of serious games promoting mobility and contribute to our understanding of the motivational potential of serious games in elderly people. One of the main characteristics of this study is its focus on the patient self-training. We foresee that game technology can be of high importance to tackle the low adherence to self-training, so increasing the effectiveness of rehabilitation.

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