ISSN: 2754-4745

Journal of Physical Medicine Rehabilitation Studies & Reports

SCIENTIFIC Research and Community

Review Article

Open Access

"Enhancing Rehabilitation Outcomes in Elderly Through Dance Intervention Delivered via an Inter-Communication Technology (ICT) Rollator: A Scoping Review, Pilot Study, and Proposed Future Longitudinal Study with ICT Rollator."

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ABSTRACT

A dance intervention and physical rehabilitation training programs delivered via an ICT Rollator are being investigated as potential ways to improve rehabilitation outcomes in elderly people in the current scoping review, pilot study, and anticipated future longitudinal study. The current study focuses to improve rehabilitation outcomes, psychological support through social inclusion platforms, guided movement training (e.g., gait, balance, strength), and fall prevention through ICT Rollator. However, there are Apps, digital technologies, web-based interventions, phone calls, virtual reality, augmented reality, wearable technology, and trackers are just a few of the innovations and methods that are revealed by a scoping review on home-based technology interventions for physical activity for elderly. Many studies, however, do not consider psychological variables or offer complete technological support. In the process after scoping review, six older (85+) participants took part in a pilot study that used customized prerecorded dance videos provided via a dance rollator. Pilot study preliminary results indicate improvements in balance, mobility, and gait, with high adherence rates and favourable qualitative evaluations. Sessions included monitoring of heart rate and blood pressure, which revealed patterns of heart rate intensity and variability. The pilot study demonstrates the possible advantages of dance training carried out using a dance rollator. The efficiency of rehabilitative training utilizing the ICT rollator in comparison to a control group using a conventional rollator will be further examined in proposed long-term longitudinal research. Pre-test and post-test questionnaires, an evaluation of training patterns utilizing the ICT-rollator in comparison to a standard rollator, and X-Sens sensors to analyse force distributions on body segments will be included in the study. As a unique rehabilitation aid for the aged, the Inter-Communication Technology (ICT) Rollator offers promising improvements in the elderly. A comprehensive approach to enhancing mobility, physical performance, and quality of life can be achieved by combining dance and physical rehabilitation training with technological support. The suggested longitudinal study intends to offer more information about the potential ICT-rollator.

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Received: August 19, 2023; **Accepted:** August 22, 2023; **Published:** August 31, 2023

Keywords: Rehabilitation, Dance Intervention, Inter-Communication Technology (Ict) Rollator, Technology-Based Interventions, Mobility, Psychological Support, Physical Rehabilitation and Longitudinal Study

Introduction

Physical rehabilitation is crucial for elderly because as the aging process increases the risk of developing chronic diseases rises, corresponding symptoms worsen, cardiovascular fitness declines, and physical mobility is limited [1]. Ensuring the well-being of elderly individuals requires prioritizing protection against chronic degenerative illnesses such as Parkinson's and Alzheimer's, which show distressing symptoms including tremors and cognitive decrease. By implementing comprehensive preventive measures and advancing a sound way of life, the hazard of these illnesses can be significantly diminished, subsequently improving the quality of life for the elderly population [2]. The inclusion of physical activity in their daily lives demonstrated improved rehabilitation results [3]. Furthermore, investigated the effects of physical movements on brain health, cognitive health, and motor abilities in elderly [4]. And concluded that Physical activity plays a key role in restoring and maintaining cognitive function as well as metabolic control, has several positive effects on brain health, including a reduction in the risk of dementia, depression, and stress. But the findings from prove that multimodal dance has positive effects on grey matter decline and prevention of neurodegenerative diseases in elderly [5]. At the same time in a study by, it was discovered that a six-month sport dance intervention in seniors aged 63 to 80 years had a positive impact on structural brain alterations, cognitive and motor performances, and the molecular mechanism of brain-derived neurotrophic factor (BDNF) [6]. According to the study, dance may be more advantageous than pure aerobic-physical interventions for healthy aging because it mixes physical activity with cognitive, coordination, and aerobic training in a social-emotional setting. At the same time the use of digital technology to encourage physical activity and a healthy lifestyle among the elderly population during pandemic related confinement was explored by [7]. The study discussed utilizing digital tools and interventions could decline the negative effects of isolation, active lifestyles, and support mental wellbeing in elderly adults during times of physical limitations and

social interaction. Also, in older people with cognitive impairment, dance has been shown to increase mobility and general fitness [7, 8]. The elderly may not all be able to engage in physical activity due to a variety of reasons, including a lack of facilities, mobility issues, living arrangements, levels of education, and financial circumstances, among others. Numerous studies also failed to consider the psychological status of the elderly during rehabilitation [9]. Additionally, there are no interventions that can support mobility while dancing, facilitating physical exercise, social engagement, and movement guidance so that these dance movements, physical activities can be performed at any time. To help the elderly perform at any time in rural areas at any location, including indoors, outdoors, and easily portable settings, we are aiming to provide physical rehabilitation, psychological support via social inclusion platforms, guided movement dance training along with gait training, balance training, strength training, and games combined with support through ICT- Rollator. We conducted a scoping review as part of this approach to learn about the different technology-based home physical activity programs and to examine how they considered other elements that are influencing the results and adherence of technology. To determine the impact of the interventional dancing videos on acute outcomes and adherence, pilot research was done. Accordingly, the long-term study was planned.

Home-Based Technologies for Physical Activity Interventions for Elderly - A Preliminary Scoping Review

At the same time, technology has already advanced to the point where sensor devices estimating and evaluating everything including from temperature to human behaviour are ubiquitous [10]. And the current studies investigate existing enabling technologies and focus on healthcare applications that help the elderly and disabled live longer and better lives at home [11]. Also, the evidence exists for literature reviews on physical activity interventions in older adults primarily focused on fall prevention, rehabilitation, and Individual health conditions [10]. However, no reviews have been conducted on exercise interventions using technology in home settings for the elderly.

The current Preliminary scoping review was conducted on randomized controlled trials, meta-analyses, longitudinal studies, and systematic reviews and reported based on PRISMA-ScR Guidelines. The objective is to know what technologies are available for the senior population for home-based exercise intervention. The interventions may consist of structured exercise, dance programs, walking, and movements in the body (yoga etc.). All the studies chosen were published in the last 22 years (2000-2022), implying that the use of innovations for exercise interventions in the home for the elderly has progressed at a moderate rate. Furthermore, only a few studies focus on home-based PA interventions using technologies in elderly for healthy aging. And ten articles were considered for the preliminary Scoping Review and 206 articles are considered for the ongoing Scoping Review. Among all following are the technologies used for home-based physical activity interventions in previous studies, supporting seniors for improvement in quality of life. The technologies available for home based physical activity technology interventions are Software – Jintronix, exergame technologies, apps – physitrack, vitamin app, digital technologies (smartphones, smartwatches), web-based interventions, telephone calls, virtual reality, augmented reality, wearable devices, and trackers.

In the current scoping review, only few studies focus on changing behavioural techniques to increase physical fitness in elderly at home with the help of digital technologies [12]. On the other hand, a study focused on giving intervention in the form of motivation through telephone calls for the older adults to walk [13]. And another study focused on motivational interviewing techniques in a stage-matched manner [14]. However, the remaining studies used direct physical activity interventions by using technology which indirectly related to changes in behaviour towards the physical activity in the older adults. Hence, this current scoping review results indicate psychological factors also play a significant role in PA interventions in home-based settings. So, the future interventions using technology at home must include the psychological outcomes as a measure for evaluating the effectiveness of the intervention. At the same time, more studies must focus on the interventions using technologies by combining exercises and the behavioural changing techniques at home-based PA interventions in the elderly. There are no advanced characteristics in the technologies for initial usage of technologies by the elderly. By this scoping review we are indulging social inclusion platform for our ICT-Rollator by giving importance to their psychological health. There are also no previous technologies for home based that can give assistance and support for mobility, guided training, fall detection sensors, and rehabilitation training that is coming with ICT-Rollator. During the scoping review we also noticed very less studies focused on education level of participants, technology experience, economic status, and living situations of participants and were considered in the current Pilot and future longitudinal studies.

A Pilot Study for Exploring the Efficacy of Personalized Dance Videos with Dance Rollator and Future ICT-Rollator Integration

Initially, the pilot study involved 6 patients aged 85 or older, 4 of them were female and 1 was male. One subject was later dropped out for personal reasons. Under supervision, all 5 subjects underwent pre-testing and screening for mobility using the timed up and go test, hand grip strength using the hand dynameter, balance using the Berg Balance Scale, quality of life assessment using the Barthel index, and functional mobility status assessment using the SF36 questionnaire before and after the interventions. After the five sessions of training with dance videos, tests are redone. Customized dancing videos with dance rollators are pre-recorded and exhibited during the sessions via projector, heart rate and blood pressure are monitored for all sessions at the beginning, during each break, and at the finish to prevent adverse events. Before each training session, the POLAR was installed to record the heart variables. Two breaks are taken during each hour-long session, which lasts one.

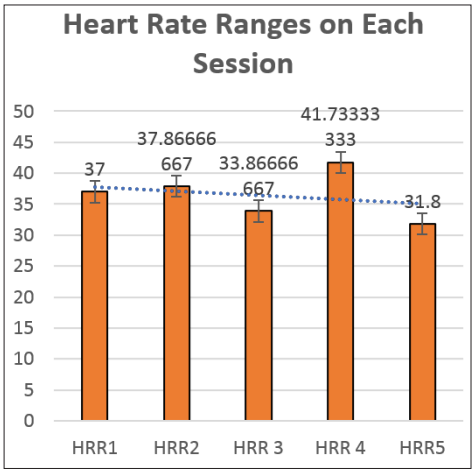

Figure 1: Comparison of Average of Heart Rate Ranges (HRR) for All Five Training Sessions

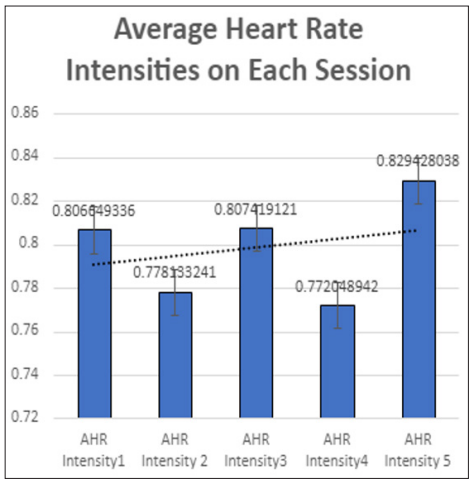

Figure 2: Comparison of Average Heart Rate Intensity (AHR) for All Five Training Sessions

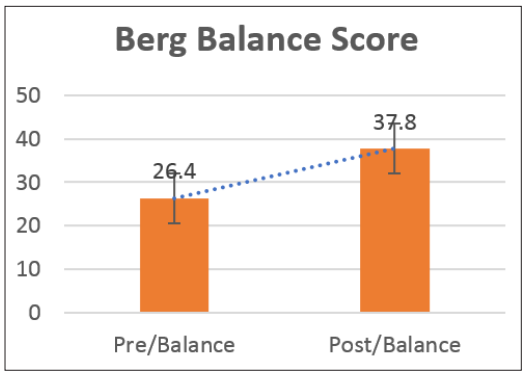

Figure 3: Comparison of Berg Balance Score from Pre-Testing to Post-Testing

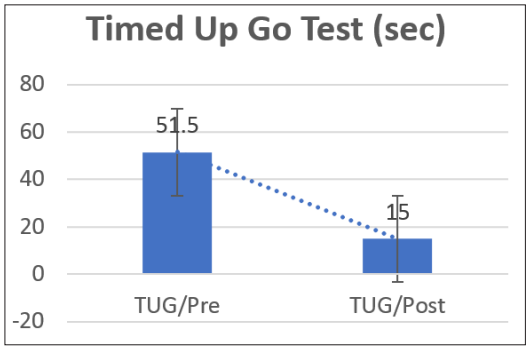

Figure 4: Comparison of Time taken to finish TUG (Timed Up and Go Test) from Pre to Post

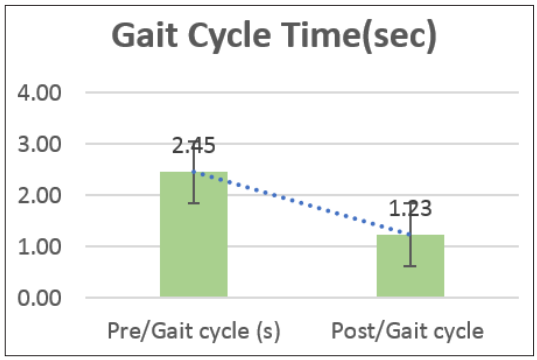

Figure 5: Comparison of Average Time taken for Gait Cycle from Pre to Post

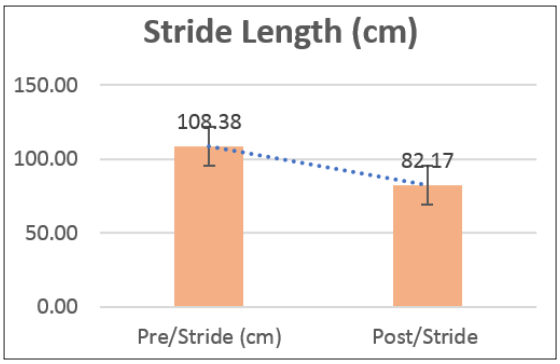

Figure 6: Comparison of Average Stride Length from Pre to Post-Testing

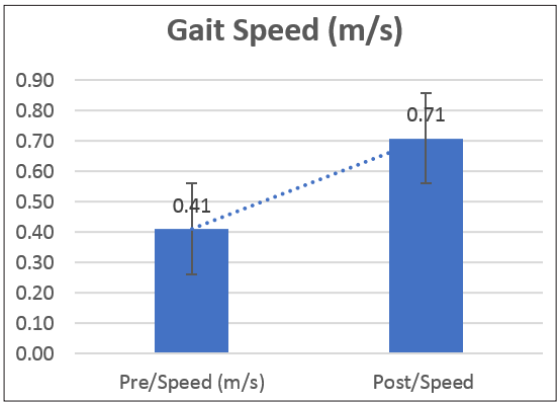

Figure 7: Comparison of Averages of Gait Speed from Pre to Post Testing using Optogait

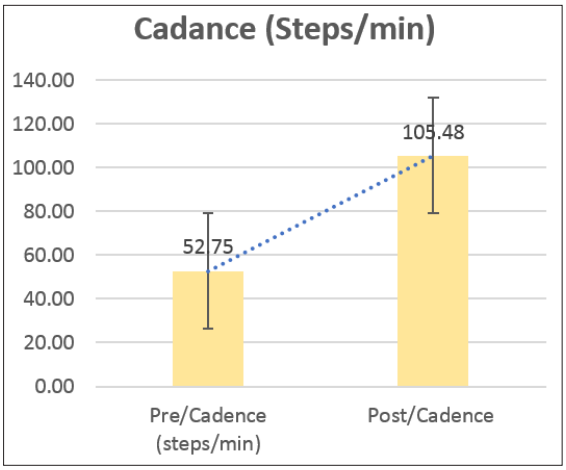

Figure 8: Comparison of Average Cadance Rate from Pre-Testing to post-Testing

Discussion of Pilot Study

The average duration from pretest to post-test reduced, which indicates greater mobility in the TUG (Timed up and go test)Figure 4. The qualitative survey that was conducted after the intervention found that respondents reported feeling more stable when performing domestic tasks, which is consistent with the improvement in the berg balance score from pre to post Figure 3. From pre to post, there are no differences in the hand grip strength or reaction speed. It can be because of the restricted upper body movements made during training. Although there is a decrease in stride length, this could also be the result of enhanced speed and better balance Figure 6. The gait variables speed and cadence rise from pre to post, and the gait cycle duration decreased Figure 7,Figure 8, and Figure

5 respectively. However, for the first, second, and third sessions, there is a gradually increased average heart rate intensity because participants are gradually pushing themselves harder Figure 2, and there is a decrease in heart rate range because of improved movement control Figure 1. Controversially, the second and fourth sessions' average heart rate intensity gradually reduced because the participants interspersed times of lower-intensity movement or rests between routines. Additionally, a wider range of heart rate responses during the second and fourth sessions may signify that individuals are engaging in more dynamic and diverse movements. This might be because several dance movements were introduced throughout these sessions. The fact that the participants' average heart rates either stay the same or slightly go down across all the sessions shows that they may be adapting to the dancing motions and increasing their cardiovascular efficiency. The current pattern can point to a well-planned dance intervention that includes recovery- or variety-oriented high-intensity and low-intensity portions. The body's general conditioning and cardiovascular fitness may both benefit from this method.

Limitations

Due to the smaller sample number, only descriptive statistics were used in the analysis. The polar values, which also considered the heart rate measurements taken during the intersession breaks might affect the results. It will be given attention throughout the upcoming longitudinal investigation.

Longitudinal Study Proposal-Evaluation of Physical rehabilitation training with Inter-Communication Technology Rollators on Health-Related Quality of Life and Mobility of Elderly

Dance and physical rehabilitation training during a three-month period utilizing an ICT rollator vs a control group using a standard rollator will be conducted for future longitudinal study. The force distributions on the various body segments used for all sessions for both groups are measured during training using X-Sens sensors. The same pre- and post-testing questionnaires used in the pilot study will be administered to both groups. The length of training will be recorded for the control group and for the intervention group uploaded to the ICT Rollator server. The social inclusion platform, guided dance movements, fall prevention sensors, feedback, and personalized adaptation utilizing POLAR data will be made available to the intervention group in the longitudinal study. Throughout the instruction, there were visible and audible clues. Then, using the data from the X-Sens sensors for all the sessions in both groups, simulations will be performed to examine how training patterns improve for the different body parts. This will improve the efficiency of the evaluation of the ICT Rollator.

Figure 9: Initial Digitalized Version of Dance Rollator

Figure 10: The Male using Dance Rollator, Playing with the Women using Initial Digitized Version of Dance Rollator

Study Design and Methodology

Elderly rollator users over the age of 70 who have functional mobility restrictions and other medical issues are included in the longitudinal study. The study's goal is to compare the use of an ICT-Rollator with a normal rollator to determine the effects of dance, strength, gait, and other training interventions on mobility, balance, cardiopulmonary function, force distribution on various body segments, gait, and quality of life outcomes. The subjects are divided into the intervention and control groups by randomisation. The ICT Rollator is used to deliver dance, strength, gait, and mobility training to the intervention group. The control group is given a regular rollator and is instructed to walk. SF-36 and the Barthel Index will be used for the initial screening of quality of life. General demographic information, surgical history, and pre- and post-testing for balance utilizing Balance Master will be installed, followed by optogait analysis for gait, X-sens sensors, and POLAR throughout the sessions are installed. After the intervention, individuals are evaluated for technology characteristics, including facilitators, barriers, enjoyment levels, and improvements. The ICT-Rollator itself keeps track of movement data and session length. The supervisor will also make a note of the control group for training duration. The improvement in movement quality, enhanced length, calories burned, and variations in heart rate for each session are used to compute adherence rates. The Figure 9 shows the initial digitalisation of dance rollator.

Conclusion

The ICT-Rollator is unique in that no other technology has been made for the elderly to use for rehabilitation through highly effective dance training combined with physical exercise and technology support in every living situation. It helps prevent falls using fall detection sensors, guides movement with visual and audible cues, and helps with mobility by maintaining an upright posture while moving around. The results of the pilot study show that the customized dance videos included with ICT Rollator are improving balance, mobility, and gait. Adherence rates are also good, with no adverse events or reported falls occurring during the pilot study sessions using dance rollator, refer Figure 10. The ICT Rollator's, including its fall detection sensors, visual and audio cues, guided dance movements, social inclusion platform, and training videos transmitted via tablet, will all be examined in the future longitudinal study [15-26].

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