# Physical training maintains or improves gait ability in long-term nursing home residents: A systematic review of randomized controlled trials

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## ARTICLE INFO

## ABSTRACT

Numerous studies have reported the benefits of physical exercise in older adults. However, studies performed in long-term nursing home (LTNH) residents are scarce. A literature search was conducted to identify physical exercise intervention studies that were randomized and controlled and that assessed gait ability in older LTNH residents using both walking speed and timed up-and-go (TUG) tests simultaneously. Together, these tests have been defined under the term "gait ability"; they are widely used to screen for impaired physical function, and can predict accelerated functional decline, difficulty with activities of daily living (ADL), falls, and disability in older adults. Multicomponent physical exercise programs are effective in improving or maintaining gait ability in older LTNH residents. The studies included in this review show substantial heterogeneity in terms of participant characteristics (age, baseline TUG performance, and walking speed), types of evaluated intervention (multi-component and gait retraining programs), duration of the intervention (ranging from four weeks to 12 months), duration of physical exercise sessions (ranging from 30 min to 1 h), and exercise intensity (from 40% to 60–70% RM). Due to this heterogeneity, no firm conclusions can be drawn regarding the impact of exercise programs on gait ability in LTNH residents. However, the results of this review should encourage the gathering of additional evidence to support the use of multicomponent exercise programs by older individuals.

## 1. Introduction

The World Health Organization (WHO) recently published an Action Plan for the Prevention and Control of Non-Communicable Diseases in the WHO European Region from 2016 to 2025 [1]. This action plan highlights the importance of encouraging musculoskeletal health programs for older individuals. Worldwide projections predict that the number of dependent older adults will increase from 350 million in 2010 to 488 million in 2030 [2]. The dependency on the activities of daily living (ADL) leads individuals to move to long-term nursing homes (LTNH), so this growth will directly influence the percentage of older adults residing in LTNHs in the coming years [3]. Because walking is possible for a certain proportion of LTNH residents, proactive prevention programs encompassing musculoskeletal health may be particularly relevant to preserve walking ability in those individuals.

Physical exercise programs are interventions meant to prevent or slow the functional decline of older adults living in LTNHs [4]. In community dwelling older adults, exercise has been found to reduce all-cause mortality as well as the risk of falls and fractures as a result of falling [5,6]. Nevertheless, substantial evidence supporting the efficacy and feasibility of these programs in LTNH settings is scarce. Further, people residing in LTNHs spend most of the day time taking part in sedentary activities. Bates-Jensen et al. [7] studied the amount of time that 451 residents of 15 LTNHs spent in bed and found that most of the residents spent at least 17 h a day in bed. Although the efficacy of physical exercise programs has been demonstrated for community dwelling older adults, few studies have analyzed the relevance of these programs in LTNHs.

Functional decline in older adults is driven mainly by impairments to gait ability. In particular, walking speed [8–11] and timed up-and-go (TUG) [12,13] are two bedside tests that screen for impaired functionality in older adults. In fact, the capacity for walking and for standing from a chair are key factors for identifying functional decline in older adults; thus, it seems particularly relevant to assess these capacities together. Indeed, walking speed and TUG tests together have been defined under the term "gait ability", and are found to predict accelerated functional decline, ADL difficulty, falls, and disability in older adults [14,15]. A usual walking speed of less than 1 m/s seems to identify people at risk of health-related outcomes in well-functioning

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older people [9]. However, older adults living in long-term care settings show slower performance in gait speed: a recent systematic review [16] found that usual pace gait speed in ambulant older people remained functional at 0.47 m/s. A recognized fall prevention guideline recommends the TUG test to screen for the presence of gait and balance disorders in older adults [17]. In fact, retrospective studies showed a significant positive association between the time taken to perform the TUG and a history of falls, where the cut-off time separating non-fallers and fallers varies from 10 to 32.6 s [18]. Unfortunately, the predictive ability of the TUG test for future falls remains limited [19].

Exercise interventions can be beneficial for frail older adults. However, there is no clear guidance regarding the most effective program indications for LTNH residents. Due to their sedentary behavior, this population stands to be positively affected by physical exercise. The objective of this study was to systematically review the impact of physical exercise interventions performed by residents of LTNHs in terms of gait ability parameters, interpreted as a result of assessing both TUG test and walking speed simultaneously. We have included the TUG test and walking speed as outcome measures because they are two of the most frequent parameters used to assess functional decline, and they have been previously analyzed together to measure the gait ability performance of older adults [20]. To the best of our knowledge, this is the first systematic review of randomized controlled trials (RCT) investigating the efficacy of exercise interventions and focused on gait ability in older adults who live in LTNHs.

## 2. Materials and methods

### 2.1. Literature search and study selection

This review was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement [21,22]. Relevant peer-reviewed literature was obtained by searching four electronic databases until 28 April 2017: MEDLINE (Medical Literature Analysis and Retrieval System on-line), PubMed, Cochrane, PEDro and Web of Science. The search strategy is shown in Table 1.

Articles fulfilling the following criteria were included: (1) randomized controlled trials (RCT); (2) peer-reviewed articles that were published in English, French, or Spanish; (3) interventions carried out in LTNH settings; (4) two or more physical exercise interventions were compared or one intervention was compared to a control group that continued usual care or low intensity Range Of Motion exercises (ROM); and (5) gait speed and TUG tests were assessed together as outcome variables. The "Get Up and Go" test [23] was also accepted as equivalent to the TUG test, as both involve performing the same procedure, standing from a chair, walking three meters, turning, going back, and sitting down on the same chair. The TUG test measures the performance by timing the task, while the "Get Up and Go" test scores

**Table 1**
Search strategy performed by the authors in *MEDLINE (Pubmed)*.

| |
|---|
| #1 "institutionalized" [All Fields] |
| #2 "nursing home" [Mesh] |
| #3 "long-term care" [Mesh] |
| #4 (#1 OR #2 OR #3) |
| #5 "exercis*" [All Fields] |
| #6 "physical performance" [All Fields] |
| #7 "training" [All Fields] |
| #8 (#5 OR #6 OR #7) |
| #9 "ability to walk" [All Fields] |
| #10 "ambulation" [All Fields] |
| #11 "walking" [Mesh] |
| #12 (#9 OR #10 OR #11) |
| #13 (#4 AND #8) |
| #14 (#4 AND #12) |
| #15 (#4 AND #8 AND #12) |

the result subjectively as a function of instability from 1 to 5 (1 = no instability; 5 = very abnormal). Both gait speed and TUG tests were selected as endpoint measurements of results based on their capacity to measure physical impairment in the studied population. No limits were applied concerning the type, duration, or frequency of the physical exercise interventions.

Articles were excluded if: (1) the physical exercise intervention was rehabilitation or treatment focused; (2) they were abstracts, dissertations, conference proceedings, pilot studies, reviews, or meta-analyses; (3) the study combined physical exercise intervention with nutritional supplementation.

Thereafter, a backward search was performed, reviewing reference lists of included articles in search of further relevant citations. After removal of duplicates, the titles and abstracts of all references obtained in the search were screened. The full text of those that were eligible was assessed against the inclusion and exclusion criteria by two authors (H.A., C.R.). Disagreements were resolved by consensus with a third author (A.R-L.).

### 2.2. Risk of bias assessment and data analysis

The Cochrane Handbook for Systematic Reviews criteria [24] was used for rating the risk of bias of the included studies, independently assessed by three reviewers (H.A., C.R., and A.R-L.). Unpublished data were requested when necessary from the authors of the original studies. Disagreements were resolved by consensus. In this analysis, the maximum possible score was 10, given that it was not possible to blind the participants and the professionals administering the intervention; accordingly, results should be considered cautiously. These two items were marked as "not applicable". Studies that met ≥5 of the 10 identified criteria were considered to have a low risk of bias.

The heterogeneity of the interventions across the studies did not allow for a meta-analysis. Therefore, a qualitative analysis was carried out, critically assessing the methodological quality of the included studies and the consistency of their findings.

## 3. Results

A final sample of seven studies [25–31] met the inclusion criteria for this systematic review. A flow diagram of the selection process is presented in Fig. 1. Details of the participants and the interventions are summarized in Table 2.

### 3.1. Description of the population

Baseline functional characteristics of participants varied across studies. The mean average age ranged between 78.4 and 92.0 years for the control group and 75.4–93.4 years for the intervention group. Participant gait speed was higher than 0.47 m/s in four of the seven studies [25–28], and participants needed as little as 15.7s ± 4.4 s to perform the TUG test in the study by Au-Yeung et al. [25] as opposed to 131.3 s ± 85.4 s in the study by Tsaih et al. [31] (Table 2).

### 3.2. Type of activities of control groups

Participants in the control groups mostly performed ROM exercises [25,26,28,30,31], while others continued with their routine medical care [27,29].

### 3.3. Description of the evolution of control groups

All the studies included in this review reported worse results for the control groups in the TUG test after the intervention period [25–31]. Regarding gait speed, five studies reported worse results for the control groups [25–27,30,31] and two reported an improvement [28,29]. Three studies analyzed differences within the control group, and