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Contents lists available at ScienceDirect

Geriatric Nursing

journal homepage: www.gnjournal.com

Exercise merging physical and cognitive stimulation improves physical fitness and cognitive functioning in older nursing home residents: a pilot study

José Marmeleira, PhD ^{a,b,*}, Luís Galhardas, MS ^a, Armando Raimundo, PhD ^{a,b}

^a Departamento de Desporto e Saúde, Escola de Ciências e Tecnologia, Universidade de Évora, Évora, Portugal

^b Research Centre in Sports Sciences, Health Sciences and Human Development, CIDESD, Vila Real, Portugal

ARTICLE INFO

Article history:

Received 14 July 2017

Received in revised form 25 October 2017

Accepted 30 October 2017

Available online

Keywords:

Multimodal exercise

Older adults

Nursing homes

Physical fitness

Cognitive functioning

ABSTRACT

The main purpose of this pilot study was to examine the feasibility and the effects of a multimodal exercise intervention on the physical and cognitive functioning of institutionalized older people. Twenty-one older adults (83.5 ± 4.9 years) living in two nursing home residences, were tested on two occasions 4 weeks apart to establish a baseline measure, and then engage in the exercise program twice weekly for 8 weeks. Participants were tested again after the exercise program. Almost all physical fitness and cognitive tests were unchanged at baseline measures, but after the exercise program, significant improvements ($p < 0.05$) were found in all physical fitness variables (strength, cardiorespiratory endurance, flexibility and balance) and in the majority of cognitive variables (visual attention, executive functioning and information processing speed). Exercise merging physical and cognitive stimulation could have broad impacts in the individual's level of functioning and should be promoted in nursing home residences for the elderly.

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Introduction

The aging process leads to inevitable life changes and is characterized by a progressive loss of physiological and psychological functions. Physical activity and exercise is a recognized non-pharmacological strategy for promoting successful aging.^{1,2} Research has shown that the regular practice of physical activity is associated with several health and cognitive benefits in adults³ and that greater levels of physical activity are associated with decreased risk of a future diagnosis of mild cognitive impairment or dementia.⁴ Furthermore, there is evidence that exercise can be effective for improving the cognitive functions and functional status of older adults with and without cognitive impairment.^{5,6}

In recent years there has been a growing interest in the study of the effect of different types of intervention programs on the functional status of older adults. Combined cognitive and exercise interventions are gaining increased relevance due to their potential in the improvement of general capacities and especially on

cognitive functioning.^{5,7} These types of multimodal interventions combine cognitive training and exercise, and are either conducted in sequence or simultaneously under dual-tasking paradigms.⁵ Merging or including exercise and cognitive training in a single program could mobilize several types of mechanisms (e.g., learning, cerebral blood flow and neuroplasticity) underlying the effects of physical activity on brain and cognition.⁸ If exercise requires not only physical abilities but also demanding information processing (perceptual and cognitive components), it is reasonable to consider that their practice over time could have broader effects on the individual functional status.⁸

Multimodal interventions seem to benefit not only older cognitively healthy participants^{9,10} but also their counterparts with cognitive impairment.^{11,12} Moreover, studies that have compared the individual and combined effects of physical and mental exercise interventions reported cognitive benefits to be larger with the combined cognitive and physical training paradigms.^{10,13} One should note that some multimodal intervention studies with older adults used physical and cognitive training in separate moments,¹⁴ while others used interventions in which older adults engaged exclusively in physical exercise sessions that included activities with significant cognitive exertion.^{9,15} Recently, it was showed that cognitive functioning benefit more from simultaneous cognitive-physical training in comparison to exclusively physical multicomponent training in older adults without cognitive

Competing interests: None of the authors declare competing financial interests.

* Corresponding author. Departamento de Desporto e Saúde, Escola de Ciências e Tecnologia, Universidade de Évora, Pavilhão Gimnodesportivo da Universidade de Évora. Rua de Reguengos de Monsaraz, n° 44, 7005-399 Évora, Portugal.

E-mail address: jmarmel@uevora.pt (J. Marmeleira).

impairment,¹⁶ and in a study with elderly nursing home residents it was concluded that tai-chi can preserve functioning or delay decline in certain cognitive domains, also in those with significant cognitive impairment.¹⁷ The potential benefits of multimodal interventions could be particularly interesting due to the high prevalence of aging-associated neurocognitive changes and disorders (including mild cognitive impairment and dementia), which are characterized by a deterioration from a previously attained level of cognitive functioning.¹⁸ Moreover, the benefits of multimodal interventions incorporating both physical and cognitive components seem not to be restricted to cognition, but include positive effects on balance, functional mobility and gait speed.⁷

As the population is getting older in developed countries, a great number of people are living in institutionalized settings,¹⁹ which represent a challenge to the health systems, considering the multiple and complex needs in these care settings. A recent study with 640 nursing homes in Canada reported that the majority of persons admitted to nursing homes have great difficulty performing activities of daily living and have mild to severe cognitive impairment.²⁰ Another recent study showed a significant increase in the total number of health conditions and functional deficits among older people moving into care homes in England from 2002 to 2015, leading to the need of more care services after institutionalization.²¹ Therefore, one of the main challenges for the care of the institutionalized elderly is to maintain their functional status and their ability to cope with their limitations for as long as possible.^{19,22}

Although several experts recognize the importance of exercise for the quality of care in the long term care setting^{22,23} and the existence of an inverse association between physical activity and multimorbidity among elderly people,²⁴ there is generally a lack of proper environmental stimulation and physical activity opportunities in nursing home residences.^{5,21,25} Thus, evidence exists that most of the nursing home residents spend their day inactive in a lying or sitting position,^{26,27} a reality that contrasts with the fact that due to their generalized loss of capabilities and increased vulnerability, institutionalized elderly adults could benefit most from physical activity and exercise.^{22,23}

As we have seen before, exercise programs that merge physical and cognitive exertion could have broad impacts on the individual's level of functioning, as they mobilize several types of mechanisms underlying the effects of physical activity on physical fitness, health risk factors, the brain and cognition. Moreover, due to the nature of some of its activities (e.g., learning tasks and collaborative tasks), multimodal exercise has the potential to increase the level of satisfaction and motivation of elderly people, which are crucial for maintaining their participation and boosting the program effects.²² However, few intervention studies with institutionalized elderly have examined the results of merging exercise and cognitive training in a single program.^{8,28} Therefore, the main purpose of this study was to examine the feasibility and the effects of a multimodal exercise intervention in the physical and cognitive functioning of institutionalized older people. More specifically, we hypothesize that a number of cognitive abilities (information processing speed, visuospatial ability, and selective and sustained attention,) and physical fitness components (body strength, aerobic endurance and dynamic balance), would benefit from the multimodal exercise intervention.

Method

Study design and participants

Institutionalized older adults living in two nursing home residences in the region of Évora (Portugal) participated in this study. With the help of the health care personnel of the nursing homes

Table 1

Descriptive characteristics of the participants.

	M (SD)	Min, max
Age (years)	83.5 (4.9)	74, 92
MMSE (points)	25.7 (2.7)	20, 29
Length of stay in the nursing home (months)	23.4 (10.7)	11, 50
Education (years)	0.9 (1.3)	0, 3
Height (m)	1.57 (0.7)	1.44, 1.68
Weight (kg)	63.7 (6.7)	49.4, 75.2
BMI (kg/m ²)	25.7 (2.7)	22.2, 32.1

Note: MMSE = Mini Mental State Examination; BMI = Body Mass Index.

(which were informed of the study characteristics, including the inclusion criteria), twenty-one potential participants (from a total of fifty-five residents) were identified and invited to participate in the study. All residents who were invited agreed to participate and their eligibility was confirmed by a kinesiologist and a social assistant according to the following inclusion criteria: aged 75 years or more; absence of physical disabilities or other chronic health conditions compromising the multimodal program attendance; not engaged for more than one day per week in any exercise program for at least one year; and normal cognitive status on the Mini-Mental State Examination.²⁹

This was a non-random one-group repeated measures pilot study. Participants served as their own controls, and were tested before the exercise program at week 1 (pretest 1) and week 5 (pretest 2) to establish the baseline measures. Participants attended the exercise session 2 times a week for 8 weeks (weeks 6 to 13). They were tested again after the exercise program at week 14 (posttest). Previous exercise intervention studies with older adults (including institutionalized persons) have also used similar study designs.^{30,31} All participants remained in the program from the pretest 1 to the posttest. During this period, they were not engaged in any other type of physical program (e.g., physical therapy and occupational therapy).

Table 1 shows the general characteristics of the participants. The sample included 16 women and 5 men and was constituted by old and very old people. Eleven participants use a walking aid (crutches or cane). The majority (66.6%) of the participants had no formal education. All participants were informed about the objectives of the study and gave their informed consent prior to participation. The study was approved by the University of Évora ethics committee and conducted in accordance with the Declaration of Helsinki.

Procedures

Measures were performed individually at the nursing homes. They included cognitive function, physical function, body composition and socio-demographic characteristics. Cognitive variables were evaluated in a quiet room. Two experts with academic degrees in exercise and rehabilitation sciences conducted the participants' evaluation. As the participants in this study were not familiar with the type of cognitive tests that were selected, in order to control for learning effects, they all participated in a training session 1–2 weeks before the pretest 1. It was not necessary to plan a training session for the fitness tests, since the residents were already familiar to them (they were used previously in the nursing homes for gathering information on the health status of the residents).

The same evaluator performed each test at all times. An interviewer with a degree in social sciences filled out all the questionnaires and administered the Mini-Mental State Examination (MMSE). For facilitating the adherence of the participants to

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