

Original Article

Comparison of physical fitness in elderly submitted to different physical exercise interventions

Comparaç o da aptid o f sica em idosos submetidos a diferentes intervenç es de exerc cio f sico

Leonardo de Campos¹, Priscila Missaki Nakamura^{1,2}, Eduardo Kokubun¹

Abstract

The objective was to investigate the influence of two types of physical exercise intervention on elderly individuals' physical fitness. The study included 17 older adults with a mean age of 65.8 years (± 2.88), divided into two groups: Programa de Exerc cios F sicos em Unidades de Sa de (PEFUS - Physical Exercise Program in Health Units, $n = 8$) and Adapted Volleyball ($n = 9$). PEFUS classes were held three times a week and lasted 90 minutes, including strength, aerobic endurance, agility, coordination and balance exercises. Adapted Volleyball classes were performed two times per week and lasted 120 minutes, divided into skill volleyball exercises and game. For the evaluation of physical skills (strength, agility, coordination and flexibility), the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) set of tests was performed. All participants were assessed at the baseline and after three months of interventions. Statistical analysis was performed using factorial ANOVA through SPSS, version 17.0, and a significance level $p < 0.05$. Motor coordination showed significant improvements after three months of interventions, decreasing from 11.7 ± 2.3 to 10.1 ± 1.6 seconds for Adapted Volleyball and from 15.8 ± 3.3 to 12.0 ± 3.5 seconds for PEFUS ($p < 0.05$). Regarding strength endurance, there was a group-moment interaction ($p < 0.05$) and the PEFUS group showed an increase in this variable after intervention. The interventions are beneficial to the physical fitness of elderly individuals, because they increase or maintain such fitness after these interventions.

Keywords

Aged; Volleyball; Physical Fitness; Exercise; Primary Health Care.

Resumo

O objetivo foi verificar a influ ncia de dois tipos de intervenç es de exerc cio f sico sobre a aptid o f sica de idosos. Participaram do estudo 17 idosos com m dia de idade 65,8 anos ($\pm 2,88$) divididos em dois grupos, Programa de Exerc cios F sicos em Unidade de Sa de (PEFUS; $n=8$) e Voleibol Adaptado ($n=9$). As aulas do PEFUS foram realizadas tr s vezes na semana com duraç o de 90 minutos englobando exerc cios de for a, resist ncia aer bia, agilidade, coordenaç o e equil brio. As aulas do V lei Adaptado foram realizadas duas vezes por semana com duraç o de 120 minutos, dividida em fundamento e jogo. Para avaliaç o das aptid es f sicas foi realizada a bateria de testes da American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD). Todos os participantes foram avaliados no in cio das intervenç es e ap s tr s meses. Para an lise estat stica foi utilizada a ANOVA fatorial atrav s do SPSS vers o 17.0 e foi adotado n vel de signific ncia $p < 0,05$. Ap s tr s meses de intervenç o a vari vel coordenaç o apresentou melhoras significativas para o Voleibol Adaptado diminuindo de $11,7 \pm 2,3$ para $10,1 \pm 1,6$ segundos e para PEFUS de $15,8 \pm 3,3$ para $12,0 \pm 3,5$ segundos ($p < 0,05$). Na vari vel resist ncia de for a foi verificada uma intera o entre grupo e momento ($p < 0,05$), na qual o grupo PEFUS melhorou essa capacidade ap s a intervenç o. As intervenç es foram ben ficas a aptid o f sica de idosos devido ao aumento ou manutenç o dos componentes da aptid o f sica ap s intervenç o.

Palavras-chave

Idoso; Voleibol; Aptid o f sica; Exerc cio; Atenç o prim ria   sa de

Introduction

It is estimated that the world population aged more than 60 years will double from 11% to 22% between 2000 and 2050. It will take less than 25 years for the number of individuals aged more than 65 years to double in countries such as Brazil and China. By

1- UNESP, Biosciences Institute, Postgraduate Program of Kinetic Sciences, Rio Claro, S o Paulo, Brazil.

2- IFSULDEMINAS, Department of Physical Education, Muzambinho, Minas Gerais, Brazil.

2025, Brazil will have more than 12.5% of its population over the age of 60 years¹.

The Brazilian elderly population has increased the top of the age pyramid in the last decade. The last census conducted in 2010 showed that individuals aged more than 65 years totaled 7.4% of the population².

Aging promotes cardiovascular and musculoskeletal changes in an organism³. Among the harmful effects of the aging process that stand out are the loss of skeletal muscle mass and strength (sarcopenia), motor coordination, flexibility and aerobic capacity⁴. The effects of aging combined with physical inactivity increase the risk of institutionalization and development of diseases³ and decrease quality of life⁵.

Physical exercise can prevent, treat and delay the development of diseases associated with lifestyle. An active lifestyle enables improvements in physical fitness and decrease in the prevalence of diseases⁶. There is an inverse relationship between physical activity level and mortality. Additionally, a change in lifestyle, including physical exercise practice, has a positive impact on health and longevity, especially after the age of 50 years, with an increasing importance for the prevention and control of non-communicable diseases and other health conditions⁷.

However, a small number of individuals continue to be physically active when they reach the age of 60 years. Approximately 65% of the elderly population does not have a moderate and/or vigorous physical activity level to meet the global recommendations aimed at obtaining health benefits⁸, thus promoting the development of non-communicable diseases and other health conditions⁷.

In this sense, physical inactivity is a public health problem and the challenge in the 21st century is to enable individuals to become more physically active⁹. Among the innumerable ways to practical physical exercises in old age, adapted volleyball^{8,10,11} and physical exercise interventions¹² in primary care have been used to improve elderly individuals' fitness. Thus, the present study aimed to observe the influence of these two types of physical exercise interventions on their physical fitness.

Methods

Population and study design

Elderly individuals aged ≥ 60 years of both sexes and without medical restrictions for physical exercise practice (less than three risk factors in the Physical Activity Readiness Questionnaire – PAR-Q) participated in the present study. Participants were selected from Primary Care Units without a physical exercise intervention and among the elderly who practiced adapted volleyball at the Bank Workers' Club in the city of Rio Claro, SP, Brazil. The exclusion criterion was not having one of the evaluations performed.

The sample calculation was performed with the G-Power program, version 3.10, and the following values were used: effect size $f = 0.5$; $\alpha = 0.05$ and power of 0.8 for ANOVA for repeated measures with a total $N = 12$ (six per group).

- **Group 1:** Seven men and two women aged 65.1 ± 3.1 years participated in the adapted volleyball intervention. These individuals took part in an adapted volleyball program offered by the government of the city of Rio Claro and they had resumed their classes two weeks earlier, after nearly three months of vacation. The teacher was contacted and those who practiced this activity were subsequently invited to participate in the research project and have physical fitness tests performed. Of all 20 participants who had the first evaluation, 12

were older than 60 years and only nine continued to participate in the classes and had the second evaluation.

- **Group 2:** Eight women aged 64.3 ± 4.1 years participated in the physical exercise intervention at the Primary Care Unit. This group was part of a larger project conducted in Primary Care Units where only the elderly from such intervention were included in the present study. This intervention was at first promoted in locations near the health unit which did not have the *Programa de Exercícios Físicos em Unidades de Saúde* (PEFUS – Physical Exercise Program in Health Units), through newspaper advertisements, banners, invitation from the Physical Education professional to those who frequently used the unit and recommendation from other professionals. A total of 140 individuals signed up, 87 had the first evaluation performed, 46 began the program, ten were older than 60 years and eight stayed until the end of the intervention.

All participants who accepted to participate in this research project read and signed an Informed Consent Form approved by the Research Ethics Committee of the university where such project was developed, under number 822.

Classes

- **Group 1:** Adapted Volleyball classes (G1) – Classes were held twice a week and lasted 120 minutes, under the supervision of a Physical Education professional working for the city government. Classes followed the following structure: initial part, technical and tactical part, and main part (game). The main characteristic that distinguishes this type of volleyball from the conventional one is that holding and/or controlling the ball when receiving or passing it is also considered as a hit¹¹.
- **Group 2:** “Physical Exercise Program in Health Units” classes (G2) were held in a Primary Care Unit in the city of Rio Claro, SP, Southeastern Brazil, three times a week and including 90 minutes of general physical exercises with a moderate intensity, supervised by a Physical Education professional^{13,14}. The PEFUS intervention was conducted through activities planned according with the periodization principles of physical training, organized into cycles of four weeks that include cardiorespiratory and neuromotor exercises. Classes were divided into: initial part (10 minutes) with stretching exercises; main part (40 minutes) to perform cardiorespiratory and neuromotor activities and the final part (10 minutes) with more relaxing activities¹⁴. Participants were instructed to keep the intensity at level 13 of the subjective scale of effort¹².

Specific procedures

The evaluations of physical fitness and anthropometric characteristics were assessed at the baseline and after three months. Evaluators (undergraduate physical education students and postgraduate students) were trained and performed laboratory tests to familiarize with them before test application, maintaining the same evaluators and evaluation standards for the pre- and post-intervention moments.

Evaluation of the Physical Fitness Components

Evaluation of physical fitness was performed through tests recommended by the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD). This set of tests assesses flexibility, coordination, upper limb strength resistance, agility and dynamic balance¹⁵.

Statistical analysis

Factorial ANOVA with two factors (Moments and Groups) was performed with SPSS, version 17.0, for the statistical analysis, considering a significance level of $p < 0.05$. All results were expressed as means and standard deviations.

Results

G1 participants showed a higher level of education and greater height when compared to G2 participants. With regard to the remaining characteristics, there were no group effects as shown in Table 1.

TABLE 1 – Student's t-test for anthropometric characteristics of participants during the pre-intervention moment (elderly individuals from the city of Rio Claro, SP, Brazil, 2013).

	G1 (N=9)	G2 (N=8)	P
Age (years)	65.1 ± 3.1	64.3 ± 4.1	0.62
Level of education (years)	12.5 ± 3.3	3.6 ± 4.0	0.00*
Body weight (kg)	79.6 ± 11.4	77.5 ± 11.2	0.70
Height (meters)	1.65 ± 0.1	1.55 ± 0.1	0.01*
BMI (kg/m ²)	29. ± 3.2	32.0 ± 4.9	0.12

BMI – Body mass index; * Significant difference of $p < 0.05$ between G1 and G2

G1 participants had a better performance in all physical fitness tests when compared to G2. However, there was an interaction between moment and group for strength resistance. G2 participants showed better results of strength resistance after the intervention, although the opposite occurred among G1 participants. Additionally, both G1 and G2 participants showed improvements in the coordination test, decreasing the execution time after three months of intervention (Table 2 and Figure 1).

TABLE 2 – Factorial ANOVA with two factors (Moments and Groups) of physical fitness during the pre- and post-intervention moments for each group, with values expressed as means and standard deviations (elderly individuals from the city of Rio Claro, SP, Brazil, 2013).

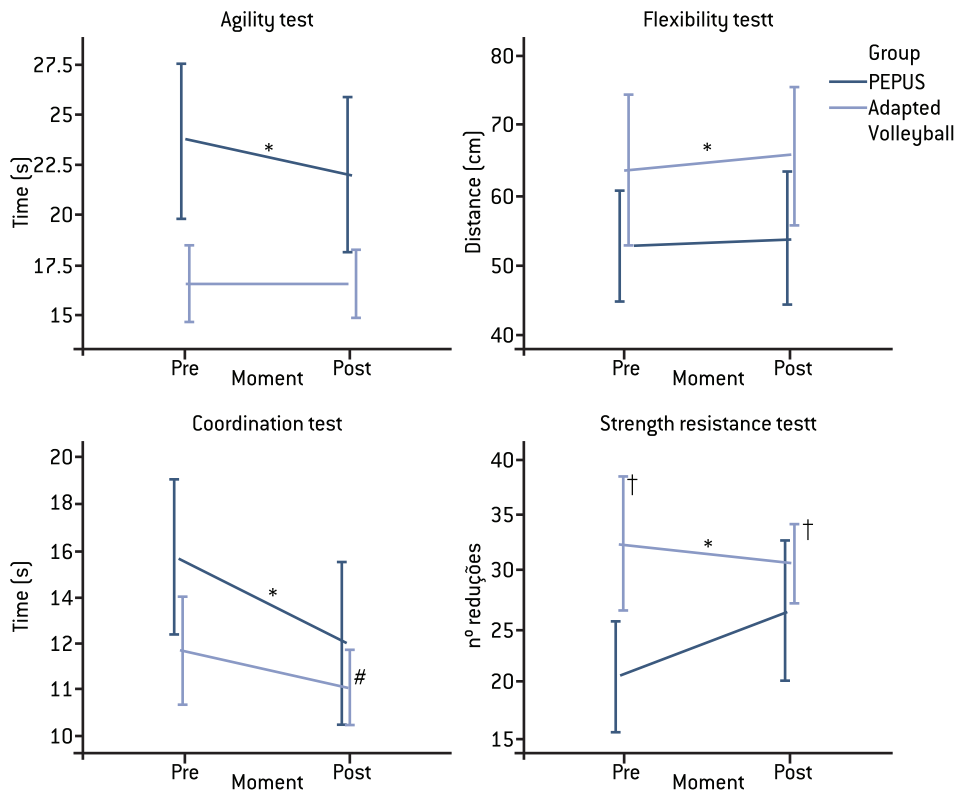
Physical fitness 81	G1 (N=9)		G2 (N=8)	
	Pre	Post	Pre	Post
Strength resistance (repetitions)*†	32.2 ± 6.1	30.4 ± 3.5	20.4 ± 5.0	26.3 ± 6.3
Coordination (seconds)*#	11.7 ± 2.3	10.1 ± 1.6	15.8 ± 3.3	12.0 ± 3.5
Agility (seconds)*	16.6 ± 1.9	16.6 ± 1.7	23.8 ± 3.9	22.0 ± 3.9
Flexibility (cm)*	63.6 ± 10.8	65.6 ± 9.9	52.8 ± 7.8	53.8 ± 9.4

* $p < 0.05$ – difference between groups; # $p < 0.05$ – statistical difference between the pre- and post-intervention moments; † $p < 0.05$ – interaction between moment and group;

Discussion

The present study aimed to verify the influence of two types of physical exercise interventions on elderly individuals' fitness. The initial hypothesis was that such interventions, regardless of the type of exercise, would be capable of maintaining or increasing elderly individuals' physical fitness level.

The adapted volleyball group (G1) showed better results in the physical capacity tests when compared to the PEFUS group (G2) ($p < 0.05$). Moreover, both groups showed significant improvements in the coordination test after interventions and there was an interaction between groups for the upper limb strength re-



* $p < 0.05$ – difference between groups; # $p < 0.05$ – statistical difference between the pre- and post-intervention moments; † $p < 0.05$ – interaction between moment and group.

FIGURE 1 – Results from the physical fitness test (AAHPERD) for the Adapted Volleyball and PEPUS groups during the pre- and post-intervention moments.

sistance test. With regard to the coordination test, groups reduced their execution time: G1, from 11.7 ± 2.3 to 10.1 ± 1.6 seconds; and G2, from 15.8 ± 3.3 to 12.0 ± 3.5 seconds ($p < 0.05$).

Findings from the present study are in agreement with the results found in the literature, where intervention programs with physical exercise can improve or maintain elderly individuals' physical capacities. These results emphasize the fact that physical exercise practice can improve or maintain elderly individuals' physical capacities. Considering that the aging process itself is harmful to physical fitness, simply maintaining one's fitness levels can already be a benefit for the quality of life of these individuals^{5,16,17}.

We could observe that the intervention performed with G2 was effective to improve the tests and that the intervention with G1 was capable of maintaining or improving some physical fitness components. The present study showed that G1 and G2 participants did not have the same initial performance, which can have an influence on the differences in the results obtained from the tests performed between these two groups, mainly in the initial results.

After three months of intervention, G1 and G2 participants showed significant improvements in coordination ($p < 0.05$). Such improvement through interventions, even with trained elderly individuals, reaffirms the fact that they maintain their trainability and through their physical training they are capable of achieving improvements in their muscular physical capacities⁶. This is also in agreement with findings from Pauli et al.⁵, where, similarly to our study, elderly individuals participating in a physical exercise program with general moderate-intensity activities showed significant improvements after 12 years of practice in a motor coord-

dination program.

Improvement in the results from the motor coordination test (AAHPERD) may have been influenced by activities of daily living that require a great deal from upper limbs¹⁹ and they are comprised of oculo-manual coordination activities¹⁸. Furthermore, improvement in fine motor coordination inherent in sports practice could explain the improvement in motor coordination in G1¹⁸. Another factor that could have influenced such improvement after the intervention is the intra- and intermuscular coordination that mainly occurred through training and specificity¹⁸, especially with G2.

The results of the present study also showed an interaction between moments and groups for upper limb strength resistance. The results shown are not statistically significant to affirm that a group improved or worsened, although an increase of 28.8% and a reduction of 5.5% for strength resistance occurred in G2 and G1, respectively. The possible increase in G2, decrease in G1 and effect of interaction between groups showed distinct behaviors. However, it is not possible to affirm that one intervention was better than the other. A new evaluation after a longer period of time may show statistical results for these differences.

The intervention in health units involved specific exercises of strength resistance using dumbbells, free weights or one's own weight in repetitions and sets with progressive overload, corroborating the findings from similar studies on improvement in such capacity^{17,20}. This increase in upper limb strength resistance can be partly explained by the greater number and use of motor units and muscle fibers, thus increasing strength resistance through training principles, especially specificity¹⁸.

The present study had some limitations, such as groups not being in the same initial condition; the frequency of classes of both groups not being controlled; and the analysis not being performed by sex due to the low number of men. However, the results of the present study show that, regardless of this, physical exercise interventions maintain and improve some physical fitness capacities of elderly individuals, an important factor to alleviate the harmful effects of the aging process.

Adapted Volleyball and PEFUS interventions can provide significant benefits to participants' motor coordination. Considering the fact that the aging process itself overloads the organism, these interventions are important to maintain and improve elderly individuals' physical fitness. Longitudinal studies and evaluations are required to assess the continuation and development of improvements in fitness aspects, especially strength resistance, which showed a trend towards different results between groups.

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**CORRESPONDING
AUTHOR**
LEONARDO DE CAMPOS
leocampos_89@hotmail.com

Avenida 57, número 1381
Jardim Kenessey, Rio Claro, SP, Brasil
13501-550
Telephone: 55 19 98423-9020

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