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Improvement of functional capacity among elderly people undergoing isostretching intervention

Aprimoramento da capacidade funcional de idosos submetidos a uma intervenção por isostretching

Carvalho AR[1], Assini TCKA[2]

Abstract

Objective: To investigate the improvement in functional capacity among elderly people undergoing an isostretching intervention. **Methods:** This study sample was composed of 39 elderly people of both genders who were sedentary, clinically healthy and aged 66.3±3.34 years. They were divided into two groups: control group (n=19) and experimental group (n=20). The experimental group underwent a ten-session intervention based on isostretching (which is classified as a postural method), applied once a week. Functional capacity was assessed using the six-minute walking test (6WT) at three times: after the screening evaluation (6WT INI), one day after the fifth session (6WT INTER) and one day after the tenth session (6WT FIN). The predicted distance, named the reference value (6WT REF), was calculated from the subjects' anthropometric data, through the formula of Enright & Sherrill. The data were normalized according to the reference values, and inter-group and intra-group comparisons were made, respectively, using independent t test and repeated-measures analysis of variance (ANOVA) with Tukey post-hoc test, with α=0.05. **Results:** There was no statistical difference in 6WT-REF between the groups. In the control group, all of the 6WT measurements were significantly smaller than the 6WT REF ($p<0.001$), thus indicating weak performance. In the experimental group, no statistical difference was observed between the 6WT REF and 6WT FIN ($p>0.05$), suggesting better performance in this group. **Conclusions:** Isostretching increased the elders' functional capacity and it could be a viable therapeutic resource for preventing the deleterious effects of aging on functional capacity.

Key words: physical fitness; elderly people; types of physical therapy; isostretching.

Resumo

Objetivo: Verificar o aprimoramento da capacidade funcional de idosos submetidos a uma intervenção por isostretching. **Métodos:** Estudo composto por 39 idosos, de ambos os sexos, sedentários, clinicamente saudáveis, com idade média de 66,3±3,34 anos, divididos em dois grupos: controle (GC, n=19) e experimental (GE, n=20). O GE foi submetido à intervenção baseada no isostretching, classificado como um método postural, aplicada uma vez por semana, durante dez sessões. A capacidade funcional foi mensurada pelo teste de caminhada de seis minutos (TC6) em três momentos: após a avaliação de triagem (TC6 INI), um dia após a quinta sessão (TC6 INTER) e um dia após a décima sessão (TC6 FIN). A distância predita, tida como valor de referência (TC6 REF), foi calculada a partir dos dados antropométricos dos sujeitos aplicados na fórmula de Enright & Sherrill. Os dados foram normalizados pelos valores de referência e as comparações inter e intragrupos foram feitas, respectivamente, pelo teste *t* não pareado e pela análise de variância (ANOVA) medidas repetidas com teste *post-hoc* de Tukey, com α=0,05. **Resultados:** Não houve diferença estatística no TC6 REF dos grupos. No GC, todas as medidas do TC6 foram significativamente menores do que o TC6 REF ($p<0,001$), indicando fraco desempenho. No GE, não se observou diferença estatística entre o TC6 REF e o TC6 FIN ($p>0,05$), indicando melhora do desempenho neste grupo. **Conclusões:** O isostretching aumenta a capacidade funcional dos idosos, podendo ser este um recurso terapêutico viável para impedir efeitos deletérios do envelhecimento sobre a capacidade funcional.

Palavras-chave: aptidão física; idoso; modalidades de fisioterapia; isostretching.

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[1] Universidade do Paraná (Unipar) – Toledo (PR), Brazil
[2] Physical therapist
Correspondence to: Alberito Rodrigo de Carvalho, Clínica Escola de Fisioterapia da Unipar, Avenida Santos Dumont, 2.171, Centro, CEP 85900-010, Toledo (PR), Brasil, e-mail: alberitorodrigo@gmail.com / alberitorodrigo_mg@yahoo.com.br

Introduction

For some decades now, differences have been established between physical fitness relating to athletic performance and physical fitness relating to health. The latter is recognized as an individual's ability to perform daily activities in a vigorous manner, together with a set of characteristics and capacities that are associated with a low risk of prematurely developing diseases linked with inactivity[1]. The abilities that compose physical fitness are: cardiorespiratory fitness (traditionally expressed by the maximum oxygen consumption), musculoskeletal fitness (strength, endurance and muscle flexibility), body composition and metabolism[2,3]. However, cardiorespiratory fitness has been shown to be the most important component of physical fitness. It can be influenced by many factors such as age, gender, health conditions, genetics and, especially, the level of physical activity. Elderly individuals thus present lower physical activity because of aging and life habits[4,5].

Other authors, however, have highlighted functional capacity as an important physical fitness ability and have defined it as the capacity to perform tasks that ensure independent life and overall wellbeing[6]. Thus, recommending physical activity and exercise programs is important as a healthy life habit and needs to be quantified in order to understand its contribution towards the health and functional capacity of the elderly population. One safe, simple and low-cost way to assess functional capacity is the six-minute walking test (6WT), which was introduced in 1968 as a guide for physical fitness. This test is not specific for any of the many systems that are directly involved during exercise, and merely provides an overall integrated assessment of all these systems[6-8].

Isostretching is a type of physical activity with therapeutic purposes and is considered to be a complementary form of therapy for treating postural instability. It aims to make musculature stronger and more flexible, by limiting its relaxation and retraction and by correcting posture and improving respiratory capacity. This is why it is classified as an overall postural method, since the exercises are performed using a vertebral position presenting the maximum alignment possible, with all of the body's musculature recruited and demanding from the vertebral column a self-stretching attitude. Consequently, this method promotes body awareness, neuromuscular control refinement, muscle flexibility, joint mobility, tonicity, strength and, especially, respiratory control. Respiration, focusing especially on exhalation, is the basis for the method[9,10]. Although this therapeutic resource is regularly used in clinical environments, studies justifying its use are few in number and limited in extent. Most of these few existing studies on the isostretching method focused on musculoskeletal fitness variables and only one study used elderly individuals. No studies investigating the effects of this technique on functional capacity were found[9,11,12].

With the aim of obtaining better understanding of the prevention and improvement of physical incapacity among the elderly, the present study tested the hypothesis that the physical capacity of elderly people, as assessed using the 6WT, could be increased through interventions consisting of exercises based on isostretching. Consequently, the objective of this study was to investigate the improvement of functional capacity among elderly individuals undergoing isostretching intervention.

Materials and methods

Study characterization

Before starting the study, it was approved by the Ethics Committee for Research Involving Human Beings (from portuguese Comitê de Ética em Pesquisa Envolvendo Seres Humanos, CEPEH) of the State University of Western Paraná (Unioeste), and registered under protocol 018220/2006, report 179/2006.

Subjects

Initially, 40 volunteers were interviewed. They were aged 60 or over, of both genders, and were participating in the "Giving Value to Old Age" project, which is maintained by the municipal authorities of Cafelândia/PR in partnership with a private physical therapy clinic, during the year 2006. After explaining the procedures and objectives of this study, the volunteers underwent a screening clinical evaluation, to verify their eligibility and record personal and anthropometric data. All the eligible individuals signed a free and informed consent statement.

Elderly individuals were included in the study if they declared that they had sedentary habits, characterized by not participating in any regular physical activity programs of frequency greater than or equal to twice a week; if they were clinically healthy and did not present heart or lung diseases or musculoskeletal disorders; and if, at the time of the tests, they were in an adequate hemodynamic condition. Volunteers were excluded from the study if they missed four or more sessions, presented a low cognitive level or physical limitations in relation to performing the proposed tasks, missed any of the evaluations or presented exacerbated postural abnormalities.

After verifying eligibility, the sample was randomly divided by means of a draw, into a control group (CG) that only performed habitual activities, and an experimental group (EG) that underwent the intervention procedure. Each group was initially composed of 20 elderly individuals. One volunteer in

the control group was excluded because he did not participate in all the evaluations. Thus, the final sample was composed of 19 volunteers in the CG (18 women and one man) and 20 in the EG (14 women and six men). No significant difference (p>0.05) was observed in relation to the anthropometric data that was collected during the screening, thus indicating that the sample was homogenous with regard to these data. The CG presented mean height, age and weight respectively of 1.62±0.11m, 66.3±3.3 years and 72.6±12.8kg. The EG presented mean height, age and weight respectively of 1.67±0.05m, 65.5±4.0 years and 68.7±6.6kg.

Assessment procedures

Functional capacity was assessed using the six-minute walking test (6WT), an instrument that is recognized as an indicator for overall physical capacity and mobility among the elderly[8]. The 6WT was used at three different times: before intervention and just after the clinical screening evaluation (6WT INI); in the intermediate evaluation (6WT INTER), one day after the fifth session of the protocol; and in the final evaluation (6WT FIN), one day after the tenth session.

Prior to performing each 6WT, the volunteers were instructed to remain seated for five minutes, so as to normalize their hemodynamics. Hemodynamic data, such as heart rate (HR) and arterial pressure (AP), were measured only to ensure that the volunteers were in an adequate clinical condition to undergo the tests. Those who presented AP higher than 150/100mmHg and/or HR higher than 110 beats per minute when resting were excluded. As a preparation for the 6WT, a sequence of light stretching exercises was carried out with sustained repetition for 30 seconds for each muscle group, for the main muscle groups in the lower limbs and trunk. All the examinations were carried out by a single evaluator and, to avoid circadian alterations, always at the same time of day.

The tests were performed over a 60m course, delimitated on the ground by a strip marked out in meters, and the volunteers walked to its end and back again. Before starting the test, the participants were instructed regarding its execution and were alerted to reduce their walking pace or even to stop, if they presented chest pains, severe muscle pain or respiratory discomfort. However, if this happened, the chronometer would remain switched on. The volunteers were also instructed to walk as fast as possible, but without running, until the examiner indicated the moment to stop, after six minutes had elapsed. Throughout the walk, at 30-second intervals, the examiner encouraged the participants verbally, with phrases such as "Keep going like that" or "Come on, you're doing great". While the test was being performed, the examiner walked discreetly behind, rather than at the side of each participant, so as to not influence the walking pace. At the end of six minutes, the distance covered by each volunteer was recorded[8,13,14].

From the anthropometric data that was collected at the screening evaluation, the expected distances for the age, gender, height and weight of each volunteer were calculated. These were taken to be reference values (6WT REF), and were calculated by means of the following formulas: expected distance for men (m)=(7.57 x height in cm) - (5.02 x age) - (1.76 x weight in kg) - 309 m; expected distance for women (m)=(2.11 x height in cm) - (5.78 x age) - (2.29 x weight in kg) + 667 m[7].

Intervention procedures

The intervention took place at a frequency of one session per week, for ten consecutive weeks, with a mean duration of 45 minutes per session. Before starting the intervention procedure, a session to teach the basic requirements for correct posture was held: segmental stabilization, which enhances the neuromuscular pattern and increases spinal stability, thus improving the deep abdominal muscle endurance; adequate alignment of the vertebral column for the postures, understood as rectification of vertebral curvatures; prolonged breathing; and self-stretching[10,15,16].

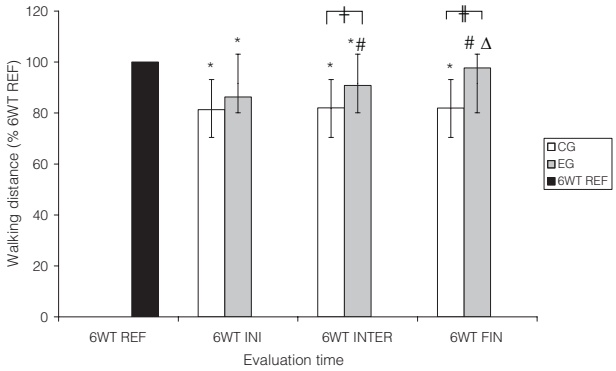
The selection of postures was adapted from those described in the literature[10,11,17] and followed these guidelines:

a) in each session, six or seven postures were chosen; all of them were symmetrical to make their implementation easier, and were carried out in orthostatic position (three postures), dorsal decubitus (two to three postures) and seated (one or two postures);
b) the selected postures prioritized a focus on the respiratory chains, hip anterointernal positions and the main posterior chain;
c) from the sixth session onwards, levels of difficulty were implemented, when possible and respecting the participants' individuality, using sticks and light balls;
d) the time for which each exercise was maintained was determined by the time taken to exhale through pursed lips, which should last around ten seconds;
e) each posture was performed three times, with 15-second intervals between each repetition, such that the first repetition was for understanding, the second for correction and the third for performing it in the best way possible;
f) in all postures that were performed, regardless of the level of difficulty, the first priority was correct alignment of the vertebral column, even if that meant that the limbs were not extended and maintained at the maximum movement amplitude while implementing the posture;
g) each posture was previously demonstrated by the researcher/instructor before the volunteers performed it;

h) the researcher/instructor corrected any volunteers who might not have been performing the exercise correctly, through verbal and/or tactile stimulation.

Statistical procedures

For the statistical treatment, the software used was GraphPad Prism 3.0. The data were normalized, dividing the test value by the predicted value and multiplying the result by one hundred (percentage values). They were presented using descriptive statistics (means and standard deviations) and inferential statistics, with comparisons within groups by means of the repeated measurement ANOVA test and post-hoc Tukey test, and comparisons between groups by means of the unpaired Student's t-test. Normalization made it easier to visualize how close the test value came to the predicted value, such that ratio <1 indicated that the individual did not reach the predicted value; ratio=1 indicated that the test value was equal to the predicted; and ratio >1 indicated that the test value surpassed the predicted value. To verify the homogeneity of the sample in relation to the anthropometric data, the unpaired Student's t-test was applied. The significance level adopted was α=0.05.



Predicted reference distance in the six-minute walking test (6WT REF); six-minute walking test (6WT); initial test (6WT INI); intermediate test (6WT INTER); final test (6WT FIN); control group (CG); experimental group (EG).
*p<0.001 compared with 6WT REF; For EG: #p<0.001 compared with 6WT INI; $^{\Delta}$p<0.01 compared with 6WT INTER; ǂp<0.01 compared with CG; ǂǂp<0.001 compared with CG. Note that CG presented 6WT values lower than predicted value in all the evaluations and that EG significantly and progressively increased the distance walked, up to the end of the intervention in relation to the CG.

Figure 1. Comparisons within and between groups of distances walked, expressed as percentages of the six-minute walking test (6WT REF), at the different evaluation times.

Results

The normalized mean values and standard deviations from the six-minute walking test (6WT), respectively for 6WT INI, 6WT INTER and 6WT FIN, in the CG and EG, are presented in Figure 1.

For both groups, in comparisons within the groups, it was observed that the distances walked at the different times (6WT INI, 6WT INTER and 6WT FIN) were lower than predicted distances (6WT REF) in all comparisons, except for the comparison in the EG between 6WT REF and 6WT FIN. A progressive increase in the mean distance walked was observed only for the EG, between 6WT INI and 6WT INTER, between 6WT INI and 6WT FIN and between 6WT INTER and 6WT FIN. It was also observed that the CG did not present alterations in the distance walked over the course of the evaluations. This means that, generally, the volunteers walked distances that were shorter than what was expected and only the EG managed to reach a value similar to the predicted distance, after the intervention.

In comparisons between the groups, no differences in the distances walked were observed in relation to 6WT INI; however, the EG presented longer distances walked than did the CG, in relation to 6WT INTER and 6WT FIN. The inferential data from comparisons between and within the groups can be seen in Figure 1.

Discussion

The results found from this study point to new evidence that the functional capacity of elderly individuals can be improved by applying exercises based on the isostretching method. The improvement was significant after the fifth session of isostretching and became equal to reference values after ten treatment sessions.

Recently, the 6WT has been recognized as an indicator of general physical capacity and mobility among elderly populations, and not just as a measurement of cardiorespiratory conditioning as traditionally presented. Thus, factors associated with mobility, such as strength, balance and speed, among others, can also influence the performance in the test[18-20]. Since the 6WT did not specifically identify which abilities and/or factors contributed towards the better performance of the EG in the present study, it is believed that the musculoskeletal, cardiopulmonary and nervous systems were all involved in the functional capacity improvement.

Because of the functional deterioration of many systems during aging, individuals' mobility becomes reduced, especially because of muscle strength loss in the lower limbs and diminished vibratory sensitivity, vision and postural reflexes[21]. The postures that were selected for our study emphasized not only the respiratory chain but also the muscles of the anterointernal chain of the hip and the main posterior chain, which

are mostly located in the lower limbs. Since isostretching demanded isometric and eccentric contractions, the strengthening of these muscles may have occurred in association with other benefits of the method, since isometric training induces functional adaptations such as improvement in strength and muscle endurance[22,23]. Therefore, the strength improvement in the lower limbs may be one explanation for the performance improvement in the EG.

However, the contribution of isostretching may be connected not only with muscle strength improvement, but also, in association, with greater neuromuscular activation and control in the abdomen, thus improving the walking performance as consequence of greater trunk stabilization. Spinal stabilization is ensured by the interactions between three systems: the passive system (vertebral structure, passive rigidity of the disks, spinal connections, joint capsule and passive muscle properties), the active system (contractive muscle properties) and the neural system (proprioception and other neural components). Many articles have emphasized the participation of muscles of the abdominal wall as column stabilization agents, as well as the efficiency of segmental stabilization exercises that promote this stability[24-27].

The interactions of respiratory training, segmental stabilization and pelvic-cervical-thoracic alignment promoted through the isostretching method may have improved spinal stabilization through its direct influence on the neural component of stabilization, and because it strengthens neuromuscular control in a harmonious joint position[27]. There is agreement in the literature regarding the concept that lower efficiency in the neuromuscular system can lead to damaged performance regarding lesions, and that trunk stability is an important component to promote a solid base and exert or resist to strength[28]. Therefore, the improvement of segmental stability and neuromuscular control over the trunk may have promoted better biomechanical conditions for gait, thus resulting in improved performance in the walking test.

The alterations to the pulmonary system caused by aging have been well described in the literature, especially the reduced thoracic patency, decreased inspiratory muscle strength, decline in expiratory flow rate and reduced costovertebral joint mobility. It is also known that the functioning of respiratory muscles may be related to the functional capacity, since training these muscles, which follows the same principles as in skeletal muscle training, improves the functional capacity of the elderly[29,30].

It is therefore proposed that isostretching method exercises improved the respiratory muscle function and consequently increased the functional capacity of the study's volunteers. A study by Brandt Ricieri and Griesbach[10] concluded that isostretching had an effective impact on respiratory function because of the improvement in diaphragmatic action during the mobilization of medium and high respiratory volumes. One of the explanations for this effect was the adaptation of respiratory muscles to expiration performed through pursed lips, which, among other implications, promoted active recruitment of the abdominal musculature during exhalation. However, new studies to prove this hypothesis are necessary.

One limitation of the present study was the difficulty in describing and following a specific protocol, since isostretching has many postures and all of them are rich in positioning and implementation detail that makes their description complex. We were thus obliged to use a broader approach in the method. Another difficulty was in relation to explaining the findings from specific studies using the method. For this reason, many hypotheses for mechanisms of action have been found, although the positive effect of the intervention was proven in this study. Therefore, in view of the frequent clinical application of isostretching, the few scientific foundations for it and the many mechanisms of action that have been put forward, there is a need for new researches that may support its use and elucidate which tissues it influences and how this takes place.

In conclusion, the results reported here point to new evidence that isostretching is capable of improving the functional capacity of elderly individuals and that this may be a viable therapeutic resource for stopping the deleterious effects of aging on functional capacity.

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