AEROBIC OR RESISTANCE EXERCISE IMPROVES PERFORMANCE IN ACTIVITIES OF DAILY LIVING IN ELDERLY WOMEN

EXERCISE AND SPORTS MEDICINE CLINIC

ORIGINAL ARTICLE

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ABSTRACT

The purpose of this randomized non-controlled study was to determine the effect of an aerobic or resistance exercise protocol on performance of activities of daily living in elderly women. The sample was constituted of 41 apparently healthy elderly women aged 60 to 85 years (x: 65.1 ± 7.9 years) randomly assigned in resistance exercise (n: 22) or aerobic groups (n: 19). The resistance exercise protocol consisted of three sets of eight to 12 repetitions at 60% of one repetition maximum test for the leg press 45º. The aerobic exercise protocol consisted in cycling in a cycle ergometer during 40 minutes at 60% of reserve heart rate. Both protocols were performed three times per week during five weeks. Activities of daily living were estimated by velocity to stand from sitting to standing position (VSitting), velocity to move from supine to standing position (VSupine), velocity to climb stairs (VCS) and velocity to wear sneakers (VWS). Volunteers of aerobic exercise protocol improved significantly the time to perform VWS (19.1%), while the volunteers of resistance exercise protocol improved the capacity to perform VCS (4.3%) and VSupine (8.9%). These results let us conclude that aerobic as well as resistance exercise protocols induced positive effect on activities of daily living, suggesting that both protocols must be associated for an adequate exercise program to improve the functional capacity of elderly people.

Keywords: activities of daily living, functional capacity, aging, aerobic exercise, muscle strength.

INTRODUCTION

Aging *per se* plays a deep impact on the functional capacity to perform the activities of daily living which can seriously compromise performance in many daily tasks[1]. The muscular functional characteristics significantly decline as a result from aging[2], especially associated with comorbidities[3]. Moreover, it has been suggested that the functional capacity to perform many activities of daily living seems to be sensibly dependent on the muscular function[4].

The scientific evidence has been well-established, demonstrating the benefits of the regular practice of resistance exercises in the apparently healthy population[5,6]and even in those individuals with non-transmissible chronic[7] orinfecto-contagious diseases[8,9]. The classical studies point benefits such as decrease of body adiposity[10], increase of muscle strength[11], increase of the individual myocyte size[12], decrease of the number of falls[13], increase of bone mineral density[14], shorter time of gastrointestinal transit[15], improvement of the glycolized hemoglobin response[16], besides increase of functional capacity[17]. Even though, the aerobic exercises still have been more frequently recommended. Therefore, considering the heterogeinity concerning the need of exercise prescription for elderly subjects, this study had the aim to determine the effect of aerobic or resistance exercise in the performance of activities of daily living ofelderly female subjects.

METHODS

Volunteers

In order to select the volunteers, information about a research project was spread in clubs, churches and associations visited by elderly people, besides on the media.

The interested volunteers were submitted to a preliminary triage constituted of questions about retrospective and current health status, use of medication, smoking and level of physical activity. Subsequently, they were invited to participate in the physical evaluation (anthropometric, metabolic and neuromotor variables) and functional capacity, as well as to receive detailed information on the program. The inclusion criteria were: 1) female gender; 2) age between 60 and 85 years; 3) to be apparently healthy; and 4) to be previously sedentary or do not participate in systematized program of physical activities in the three precedent months.

Exclusion criteria were: 1) to be under treatment for any kind of infectious disease; or to have 2) cardiovascular disease(s); 3) rheumatoid arthritis; 4) central nervous and/or peripheral system disorders; or even, to have 5) previous cancer history; 6) to have undergone surgery or 7) remained at forced rest in bed in the last three precedent months; or 8) to have any orthopedic disorder which contraindicated the participation in the physical evaluation, exercises performance and in the functional capacity tests.

Forty-one volunteers (60 to 85 years [x: 65.15 ± 7.88 years]) were submitted to physicaland functional capacity evaluation. After that phase, the volunteers were randomly divided in two groups. The resistance exercise group was composed of 22 volunteers (61.67 ± 13.88 years), while the aerobic exercise group of 19 volunteers (65.15 ± 7.88 years). All of them were informed that participation in the study was voluntary and they could give up at any moment. They were also informed about the possible benefits and health risks, inclusion and exclusion criteria, and adopted procedures. After these orientations, a Free and Clarified Consent Form (TCLE) was obtained from each volunteer according to the guidelines in the resolution # 196/96 of the National Health Board.

Adaptation period

Initially, he volunteers were submitted toone week of familiarization and learning. In that period, the volunteers learned the correct exercise performance technique and how to keep velocity in the cycle ergometer according to the percentage of the reserve heart rate ($HR_{reserve}$) prescribed. Moreover, the following recommendations were adopted for the volunteers of the resistance exercise group: 1) initially limit the range of motion until the volunteer was able to perform the exercise with comfortable complete amplitude and with no risk of injury; 2) period of two minutes of recovery between bouts; and 3) active breathing during the positive phase of the movement. Immediately after this period, the volunteers of the resistance exercise group were submitted to the test of repetition maximum (1RM) which served as parameter for prescription of the exertion intensity.

Experimental protocol

The protocols were performed three times a week during five weeks.The resistance exercise protocol consisted in performing three bouts of eight to 12 repetitions at 60% 1RM for the leg press 45º exercise with passive restof two minutes between bouts. This group performed the exercise in pairs to provide more security in the exercise performance.The volunteers of the aerobic exercise protocol performed exercise in cycle ergometer with intensity corresponding to 60% $HR_{reserve}$ during 40 minutes.

Before and after each session, the volunteers performed stretching exercises. The aerobic group pedaled during five minutes after the end of the lower velocity session, so that the cardiovascular functions returned more rapidly to rest conditions. All sessions were supervised and the volunteers could not engage in any other physical activity program not even join eating diets during the intervention period. The volunteers were also told to preserve the level of daily physical activity, as well as the eating habits during the intervention period.

Test of one repetition maximum (1RM)

The 1RM was applied to measure the muscle strength as criterion for prescription of exertion intensity in the leg press 45º exercise. The test procedure was to perform stretching exercises for the specific muscle groups and immediately after it, a bout of eight to 12 repetitions in the leg press 45º exercise with overload between 40% and 60% 1RM. The 1RM was considered as the highest weight quantity possible that the volunteer could lift in a single complete successful performance using the appropriate technique. The appropriate technique was defined as the exercise performance through the demanded muscle groups in the primary motor activity with no help from *momentum* or alterations in the body position which could aid in performing in the strength development.

The test started by arbitrarily and gradually increasing overload until the volunteer could perform a single repetition with the maximum weight possible. A minimum period of two minute-recovery between trials was respected, and the number of trials to reach the 1RM did not surpass three. In order to avoid the Valsalva maneuver, the volunteers were told to inhale before performing the movement, exhale during its positive phase and inhale again when the weight returned to initial position[18].

Activities of daily living (ADL)

The tests applied for analysis of performance in the ADL were velocity to stand from sitting position (VSitting); velocity to stand from supine position (VSupine); velocity to climb stairs (VCS) and velocity to wear and tie sneakers (VWS). The volunteers should briefly perform in the specific test as fast as possible. The best result out of three trials was considered for analysis, except for the VWS, which was performed in a single trial[19].

Statistical analysis

The Shapiro-Wilk test was applied for analysis of data normality The Student's *t* test for independent samples was applied for intergroup analysis in the pre-program period. While the Student's *t* test for dependent samples was used in the intragroup analysis; the significance level adopted was $p < 0.05$. The percentage delta was also calculated. The *Statistical Package for the Social Sciences* software (SPSS version 17.0) was applied for the calculations. The data are presented as mean ±standard deviation.

RESULTS

Table 1 presents the characteristics of the volunteers according to the groups and time.

It was verified that the volunteers of both groups did not present statistically significant difference in body weight, neither in the functional capacity regardless of the test in the pre-program period, suggesting hence that the illegibility criteria applied resulted in data normally distributed for all variables. The same phenomenon was observed in the post-program period regardless of the intervention strategy.

The volunteers of the resistance exercise protocol significantly reduced in 9% ($p < 0.05$) the time to perform the VSitting test. The volunteers of the aerobic exercise protocol demonstrated tendency of improvement in performance for VCS in 4%, while the volunteers of the resistance exercise protocol significantly reduced the time for the same performance in 4% ($p < 0.05$). The magnitude of effect induced by both protocols was higher for VWS. The volunteers of the aerobic exercise protocol significantly improved their capacity in 19%, but the same did not occur for the volunteers of the resistance exercise protocol (12%, $p > 0.05$) (table 2).

Table 1. Characteristics of the sample before (PRE) and after (POST) the intervention period.

		Aerobic exercise		Resistance exercise	
		mean ± standard deviation	Δ%	mean ± standard deviation	Δ%
Height (m)		1.56 ± 0.6	–	1.49 ± 0.4	–
Weight(kg)	Pre	63.7 ± 13.8	-2	67.4 ± 10.2	1
	Post	62.6 ± 8.0		68.2 ± 10.6	

Δ%: percentage alteration induced by the exercise protocol; *p < 0.05.

T**able 2.** Velocity to stand from a sitting position (VSitting) and supine position (VSupine), velocity to climb stairs (VCS) and velocity top wear sneakers (VWS) before (PRE) and after (POST) the intervention period.

		Aerobic exercise		Resistance exercise	
		mean ± standard deviation	Δ%	mean ± standard deviation	Δ%
VSitting(s)	Pre	3.4 ± 0.9	–6	3.3 ± 1.01	–9
	Post	3.2 ± 0.7		3.0 ± 1.0*	
VSupine (s)	Pre	4.5 ± 1.2	–6	4.0 ± 0.9	–6
	Post	4.2 ± 0.9		3.8 ± 0.8	
VCS (s)	Pre	8.0 ± 1.2	–4	8.3 ± 1.8	–4
	Post	7.7 ± 0.9		7.9 ± 1.6*	
VWS (s)	Pre	32.8 ± 14.5	–19	29.2 ± 8.1	–12
	Post	26.5 ± 7.9*		25.6 ± 6.3	

Δ%: percentage alteration induced by the exercise protocol; *p < 0.05.

DISCUSSION

The results demonstrated that the volunteers of the aerobic exercise protocol presented significant improvement in VWS (19%), while the ones of the resistance exercise increased performance in VSitting (9%) and VCS (4%). The effect induced in VSupine did not reach statistical significance regardless of the protocol.

The importance of this finding becomes more relevant when two very important intrinsic characteristics are considered: the short time interval of the study duration (five weeks) and the inclusion of only one exercise in the resistance exercise protocol. Moreover, after the intervention period, one of the volunteers who participated in the resistance exercise protocol reported to be able to stand from her bed alone, a task she did not perform without help from another person before engaging in the program.

These results corroborate the current scientific evidence which suggests the use of resistance exercises in the daily routine of exercise programs with for elderly subjects and is in agreement with the recommendations of physical activities in the main international institutions[5-7].

The volunteers of the resistance exercise protocol demonstrated statistically significant improvement in the tests which depended on the dislocation and transportation of body mass (VSitting and VCS). The improvement in performance in these activities is probably associated with the increase of muscular strength which may decrease the relative and absolute exertion and increase tolerance to peripheral and central fatigue during the performance of activities of daily living[5].

On the other hand, we were not able to devise a hypothesis which supported the improvement in in the velocity test to wear and tie sneakers reached by the volunteers of the aerobic exercise protocol (19%, p < 0.05). It is probable that, although not having reached statistical significance, the differential performance capacity presented by the pre-program groups represents an important aspect which cannot be discarded. It can be especially supported due to the fact that the clinical impactof this difference has been possibly more important than the statistical power.

The data observed in the present study may be compared to the results of the few investigations available in the literature which directly compare the effects of both exercise programs. Some studies suggest the existence of positive effect in the physical fitness as well as in the bone mass regardless of the exercise protocol (aerobic or resistance training)[20], besidesimprovement in the gait mechanics and decrease in complaint of pain on the knee joint[21].

More recently, it was verified that aerobic exercise did not induce greater effect in the LDL-C blood concentration in young adult menwhen compared with the program composed of aerobic exercise and resistance exercise[22]. Both protocols had characteristics similar to the ones in the present study. On the other hand, Raso *et al.*[23] suggested that muscular strength, more than peak oxygen consumption, seems to have been the main mediator of the effect induced by the resistance training of moderate intensity in the triglycerides concentration of clinically healthy elderly women. However, the same authors demonstrated that the exercise protocol was not efficient in altering the number of co-stimulatory molecules, markers of cellular activation and apoptosis, as well as the lymphocyte function[24], and that neither the muscular strength, not the aerobic power represented important phenotype or functional predictors of the immunological system of elderly women[25].

However, individuals with many types of cancer submitted to radio or chemotherapy decrease the complaints of fatigue related to this disease, improve functional capacity, emotional wellness, vitality and quality of life either after the home aerobic associated with resistance program[26] or as an effect induced to multiple exercise program of vigorous intensity[27]. Buchner *et al.*[28] also observed that the aerobic exercise program improved aerobic capacity of elderly subjects while the resistance program increased the capacity of production of isokinetic strength. However, neither of the two programs was efficient in improving the gaitor health status of the individuals. The evidence really seems to demonstrate that aerobic exercise has more potential to induce positive effect on the cardiovascular parameters, while the resistance exercises in the neuromotor variables[29]. Although there is no available scientific evidence on the comparative impact of both modalities in the functional capacity to perform the activities of the daily living, it is possible to suggest that resistance exercises may contribute to the decrease in the relative demand of the activities of the daily living[30].

The results of this study let us conclude that both the aerobic exercise protocol and the resistance exercises were sufficient to induce significant improvement in performance of the activities of daily living. Although these results are limited to the exercise protocols applied, the classical studies available in the literature demonstrate that engagement in onlyone exercise (in the case, resistance exercise) is sufficient to induce extremely high increase magnitude in the muscular strength (e.g., from 174%[11] to 227%[12]),

besides significant improvement in the muscular transverse section area and functional capacity to perform the activities of daily living[12]. Additionally, we can mention that the same studies ground the main international institutions on the change of paradigmconcerning the prescription of resistance exercises to elderly subjects[5-7]. Therefore, in another proportional scale, it is possible to suggest that engagement in exercise protocols similar to the ones applied in this study are initially efficient to elderly subjects who meet the eligibility criteria used here.

On the other hand, it cannot be ignored that the absence of control group, the isolate use of the exercise modalities without a third group associating both protocols (aerobic and resistance exercise), as well as the lack of control of the spontaneous daily physical activities represent important limitations which suggest that further studies should be carried out.

All authors have declared there is not any potential conflict of interests concerning this article.

REFERENCES

1. Studenski S. Bradypedia: is gait speed ready for clinical use? J Nutr Health Aging 2009;13:878-80.
2. Saini A, Faulkner S, Al-Shanti N, Stewart C. Powerful signals for weak muscles. Ageing Res Rev 2009;8:251-67.
3. Buchman AS, Boyle PA, Leurgans SE, Evans DA, Bennett DA. Pulmonary function, muscle strength, and incident mobility disability in elders. Proc Am Thorac Soc 2009;6:581-7.
4. Bassey EJ, Fiatarone MA, O'neill EF, Kelly M, Evans WJ, Lipsitz LA. Leg extensor power and functional performance in very old men and women. Clin Sci 1992;82:321-7.
5. Chodzko-Zajko WJ, Proctor DN, Fiatarone Singh MA, Minson CT, Nigg CR, Salem GJ, Skinner JS. Exercise and physical activity for older adults. Med Sci Sports Exerc 2009;41:1510-30.
6. Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, Macera CA, Castaneda-Sceppa C. Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association. Med Sci Sports Exerc 2007;39:1435-45.
7. Williams MA, Haskell WL, Ades PA, Amsterdam EA, Bittner V, Franklin BA, Gulanick M, Laing ST, Stewart KJ. Resistance exercise in individuals with and without cardiovascular disease: 2007 update: a scientific statement from the American Heart Association Council on Clinical Cardiology and Council on Nutrition, Physical Activity, and Metabolism. Circulation 2007;116:572-84.
8. Sakkas GK, Mulligan K, Dasilva M, Doyle JW, Khatami H, Schleich T, Kent-Braun JA, Schambelan M. Creatine fails to augment the benefits from resistance training in patients with HIV infection: a randomized, double-blind, placebo-controlled study. PLoS One. 2009;4:e4605.
9. Robinson FP, Quinn LT, Rimmer JH. Effects of high-intensity endurance and resistance exercise on HIV metabolic abnormalities: a pilot study. Biol Res Nurs 2007;8:177-85.
10. Taaffe, DR, Pruitt L, Reim J et al. Effect of sustained resistance training on basal metabolic rate in older women. J Am Ger Soc 1995;43:465-71.
11. Fiatarone MA, Marks EC, Ryan ND, Meredith CN, Lipsitz LA, Evans WJ. High intensity strength training in nonagenarians. JAMA 1990;263:3029-34.
12. Frontera WR, Meredith CN, O'Reilly KP, Knuttgen HG, Evans WJ. Strength conditioning in older men: skeletal muscle hypertrophy and improved function. J Appl Physiol 1988;64:1038-44.
13. Verfaillie DF, Nichols JF, Turkel E, Hovell MF. Effects of resistance, balance, and gait training on reduction of risk factors leading to falls in elders. J Aging Phys Act 1997;5:213-28.
14. Layne JE, Nelson ME. The effects of progressive resistance training on bone density: a review. Med Sci Sports Exerc 1999;31:25-30.
15. Koffler KH, Menkes A, Redmond RA, Whitehead WE, Pratley RE, Hurley BF. Strength training accelerates gastrointestinal transit in middle-aged and older men. Med Sci Sports Exerc 1992;24:415-9.
16. Durak EP, Jovanovic-Peterson L, Peterson CM. Randomized crossover study of effect of resistance training on glycemic control, muscular strength, and cholesterol in type I diabetic men. Diab Care 1990;31:1039-43.
17. Berg WP, Lapp BA. The effect of a practical resistance training intervention on mobility in independent, community-dwelling older adults. J Aging Phys Act 1998;6:18-35.
18. Heyward VH. Assessing strength and muscular endurance. In Vivian H Heyward. Advanced fitness assessment and exercise prescription. 3rd edition, Human Kinetics, USA 1998;105-20.
19. Raso V. A adiposidade corporal e a idade prejudicam a capacidade funcional para realizar as atividades da vida diária de mulheres acima de 47 anos. Rev Bras Med Esporte 2002;8:225-34.
20. Chow R, Harrison J, Notarius C. Effect of two randomised exercise programmes on bone mass of healthy postmenopausal women. Brit Med J 1987;295:1441-4.
21. Lipsitz L, Nakajima J, Gagnon M, Hirayama T, Connelly CM, Izumo H, Hirayama T. Muscle strength and fall rates among residents of Japanese and American nursing homes: an international cross-cultural study. J Am Ger Soc 1994;42:953-9.
22. Shaw I, Shaw BS, Krasilshchikov O. Comparison of aerobic and combined aerobic and resistance training on low-density lipoprotein cholesterol concentrations in men. Cardiovasc J Afr 2009;20:290-5.
23. Raso V, Paschalis V, Natale VM, Greve JMD'A. Moderate resistance training program can reduce triglycerides in elderly women: A randomized controlled trial. J Am Geriatr Soc 2010;58:2041-3.
24. Raso V, Benard G, Duarte AJS, Natale VM. Effect of resistance training on immunological parameters of healthy elderly women. Med Sci Sports Exerc 2007;39:2152-9.
25. Raso V, Natale VM, Duarte AJS, Greve JMD, Shephard RJ. Immunological parameters in elderly women: Correlations with aerobic power, muscle strength and mood state. Brain Behav Immun 2012;no prelo.
26. Mustian KM, Peppone L, Darling TV, Palesh O, Heckler CE, Morrow GR. A 4-week home-based aerobic and resistance exercise program during radiation therapy: a pilot randomized clinical trial. J Support Oncol 2009;7:158-67.
27. Adamsen L, Quist M, Andersen C, Møller T, Herrstedt J, Kronborg D, et al. Effect of a multimodal high intensity exercise intervention in cancer patients undergoing chemotherapy: randomised controlled trial. BMJ 2009;339:1-11.
28. Buchner DM, Gress ME, de Lauter BJ, Esselman PC, Margherita AJ, Price R, et al. The effect of strength and endurance training on gait, balance, fall risk, and health services use in community-living older adults. J Gerontol Med Sci 1997;52A:M218-24.
29. Hurley BF, Hagberg JM. Optimizing health in older persons: aerobic or strength training? Exerc Sports Sci Rev 1998;26:61-89.
30. Benn SJ, McCartney N, McKelvie RS. Circulatory responses to weight lifting, walking, and stair climbing in older males. J Am Greiatr Soc 1996;44:121-5.