ORIGINAL ARTICLE

Comparative analysis of flexibility in active and inactive elderly women

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ABSTRACT

With aging there comes a decline in physical fitness, including decreasing flexibility, and the practice of physical activity by older adults is an important factor for maintaining health and physical fitness during the aging process. **Objective:** To compare the flexibility of elderly women who practice either hydrogymnastics or combination exercise training with those who are not active. Sixty females participated in the study, aged between 60 and 80 years and divided into three groups: 20 subjects who actively practiced hydrogymnastics (G1), 20 subjects who actively practiced combination exercise training (G2), and 20 subjects who were not-active (G3). **Methods:** The subjects underwent anthropometric measurements consisting of weight, height, waist circumference, and flexibility. Measurements were taken with distance reached in the sit and reach test and the extent of flexion and hip extension by means of a goniometer. The assumptions of normality using the Shapiro-Wilk test for comparison between groups (G1, G2, G3) were checked, the one way ANOVA test, followed by the Tukey post hoc for the data with parametric distribution, and the Friedman test for samples with non-parametric distribution were performed. A significance level of $p < 0.05$ was assumed. **Results:** The anthropometric variables revealed no significant differences between groups. In the analysis of flexibility, significant differences were found in hip flexion and extension; the G1 and G2 groups showed greater values than the G3, and there were no significant differences between G1 and G2 nor between groups. **Conclusion:** The results suggest that hydrogymnastics and combination exercise training provided improvements in flexion and hip extension in elderly women, with no influence on the other variables studied.

Keywords: Physical Education and Training, Pliability, Aged, Women

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Financial Support:
CAPES/PROSUP

Received on December 02, 2014.
Accepted on February 11, 2015.

DOI: 10.5935/0104-7795.20150004

INTRODUCTION

The aging process causes a decline in biological, social, intellectual, and functional functions, including changes in the functional capacity components such as skin elasticity and suppleness, reduction in muscle strength, agility, and joint mobility.[1,2,3] In this way, the evaluation of functional capacity usually involves the performance of tests to assess muscle strength and flexibility, which are directly involved in the good performance of daily life activities by the elderly.[4] The decline of physical aptitude due to factors such as the reduction of aerobic capacity, muscle strength, flexibility, balance, reaction time, agility, and coordination is also associated with human aging, as a consequence of diseases, and physical inactivity.[5]

Aging affects the specific range of motion in the joints and the flexibility in the performance of gross motor tasks is reduced. The basic principle for interventions with exercise to improve flexibility is that the properties of the connective or muscular tissue can be improved.[6] As a person ages, flexibility diminishes, although maybe this occurs due more to inactivity than to the aging process itself.[7] Flexibility is considered decisive for movement and an essential component of an individual's functional aptitude, especially the elderly, for whom these abilities are reduced considerably over the years.[8] Physical activity is probably the best health investment for aging people,[9] minimizing the degenerative effects of advancing years.[10] In that sense, the practice of physical exercise by the elderly is an important factor in maintaining health and physical aptitude during the aging process, especially for the muscle strength and flexibility components.[3,11-17]

Participation in a physical exercise program is an effective modality of intervention to reduce/prevent the number of functional declines associated with aging. As for flexibility, physical exercises can provide benefits within three to four weeks of training.[6] Hydrogymnastics is used in physical exercise programs, which can provide benefits to physical aptitude and has been investigated in various studies.[18-22] Combination exercise training, which emphasizes strength and aerobic exercises[11,23-27] has been used in a number of studies. The effects of training on flexibility[11,19,28-36] have also been investigated in numerous studies, but no studies comparing the flexibility of elderly females who practice either hydrogymnastics or combination exercise training with the inactive have been found.

This is a study that seeks to investigate the regular practice of physical exercises such as hydrogymnastics and combination exercise training, which are the two modalities most often practiced by elderly females and that generate effects on their flexibility. Gyms and health clubs were chosen as locations for this study because that is where these physical exercise modalities are commonly practiced.

OBJECTIVE

The objective of this study was to compare the flexibility of elderly females who practice either hydrogymnastics or combination exercise training against those who are not active.

METHOD

The present study is observational and transversal. It was made in the city of Araçatuba, in the state of São Paulo, and included elderly females who were either active in hydrogymnastics, in combination exercise training, or who were not active.

It was a convenience sample, with three groups of elderly females aged between 60 and 80 years. The active subjects were members of four gyms and hydrogymnastics schools in the city and the non-active subjects were those who agreed to participate in the research respecting the proposed criterion. The former were recruited in gyms and the latter were personally invited by the researcher.

The sample consisted of 60 females: 40 active and 20 inactive. They were divided into three groups: those who actively practiced hydrogymnastics (G1) n = 20; those who actively practiced a combination of strength, aerobics, and flexibility exercises (G2) n = 20; and those who were not active (G3) n = 20. The inclusion criteria were: to be aged 60 or older and, for the active groups, to have been exercising for at least one year and be classified in the International Physical Activity Questionnaire (IPAQ) as either active or very active. For the non-active groups, to have not been exercising for at least one year and be classified in the IPAQ as either sedentary or irregularly active A or B. The exclusion criteria were: having a hip prosthesis, disk herniation, obesity grade II or III, or limited spinal mobility.

All the subjects signed the Free and Informed Consent form. The research was approved by the Research Ethics Committee of the University, protocol Nº 55/13.

The participants who practiced hydrogymnastics had classes two or three times a week, which lasted an average of 50 minutes, divided into 10 minutes for warm-up by running in place and jumping jacks; 30 minutes for the main part with strength exercises for the arms and legs with the help of hand weights, boards, and pool noodles, alternating by segment with moderate intensity. The aerobic workout was made with lateral movements, running in place, running forward and backwards, running zigzag, and finally another 10 minutes to cool down, with relaxation and general static active stretching, with each exercise lasting about 10 seconds.

The subjects who practiced combination exercise training had classes two or three times a week, lasting about 60 minutes. They started with a general stretch, static active, for three to five minutes, and each exercise lasted about 10 seconds. Right after that, they had 15 minutes of aerobic activity (walking on a treadmill or cycling on an ergometric bicycle), then they worked on muscle strength with eight exercises alternated by segment and, with the series varying between three and four, and the repetitions varying between 12 and 15 at the most. After the muscle strength exercises, they had 15 minutes of aerobic activity (treadmill or bicycle) and did general stretching which lasted between three to five minutes, with each exercise lasting about 10 seconds.

The evaluation protocol was standardized so that the subjects initially answered the health evaluation questionnaires and the IPAQ, then their anthropometric measurements were taken, the Schober test was applied, followed by the sit and reach test, and finally the goniometry with hip flexion and extension. All the tests were applied by the same examiner.

The state of health evaluation was done through a questionnaire,[37] and those who presented exclusion criteria were not included in the sample. As for the evaluation of physical activity, the IPAQ - short version classification levels were used. Anthropometric measurements for height, body mass, and waist circumference were taken. The body mass index (BMI) was calculated and for spinal mobility the Schober test was applied.[38]

The linear sit and reach test with the sit and reach box was used to evaluate the posterior chain flexibility. The subject would make

three movements and the greatest distance achieved during the test would be validated and recorded in centimeters.[39,40] After the linear test, the subjects were submitted to the angular test by means of a universal goniometer. The hip joint was evaluated for the flexion and extension movements.[41]

For the statistical analysis, the results were expressed as mean and standard deviation. For the analysis of the data obtained, the presuppositions of normality were verified through the Shapiro-Wilk test. To compare the groups (G1, G2, G3), the Anova one-way test was applied, followed by the Tukey post hoc test for the data with parametric distribution, and by the Friedman test for samples with non-parametric distribution. The significance level considered was $p < 0.05$. The data were processed in the SPSS version 17.0.

RESULTS

According to the health evaluation, the sample of participants who practiced hydrogymnastics presented two cases of diabetes mellitus, nine of hypertension, and three of hypercholesterolemia. The subjects who practiced combination exercise training presented five cases of hypertension, one of hypercholesterolemia, and one of labyrinthitis. The non-active subjects presented one case of *diabetes mellitus*, 11 of hypertension, two of hypercholesterolemia, and five of labyrinthitis. All of them were under medical treatment and were controlled without restriction to the practice of physical exercises and 20 subjects did not present any diseases. According to the IPAQ classification, of the 20 subjects who practiced hydrogymnastics, 19 were active and one was very active, while of the 20 subjects who practiced combination exercise training, 18 were active and two were very active. As for the non-active subjects, four were irregularly active A, eight were irregularly active B, and eight were sedentary.

No significant difference was found regarding age, anthropometric variables, and spinal mobility in the female groups. The values are shown in Table 1.

In the sit and reach test, no significant difference was found for the flexibility analysis. A significant difference was found in hip flexion, where the active groups had higher results than the non-active group, and in hip extension, where the active groups also had higher results than the non-active group, with no significant difference between the hydrogymnastics and the combination exercise training groups. The values are shown in Table 2.

DISCUSSION

None of the subjects presented any limitation to the practice of physical exercises, which is in agreement with the established criteria, and those who presented chronic diseases were under regular treatment and permitted to exercise, for they had diseases that were common in their age bracket. No significant age differences were found between the groups and the subjects showed no spinal mobility restriction, which also showed no significant differences between the groups, showing homogeneity.

No anthropometric differences were found between the groups, so that the practice of hydrogymnastics and combination exercise training might not have influenced the anthropometry of the individuals analyzed, which may be explained by the subjects' diet not being controlled, for physical training without dietary control provides little loss of body mass.[42,43]

It must be pointed out that individuals with grade II and III obesity have been excluded from the study, for they could present mechanical limitation in the range of movement; the BMI mean for the subjects in groups G1, G2, and G3 indicated they were overweight according to the World Health Organization.[44] The fact that BMI and waist circumference presented no significant differences also indicates that the groups were homogeneous in the anthropometric evaluation, therefore those variables did not influence the flexibility evaluation.

As for flexibility, in the sit and reach test no significant differences were found between the groups, suggesting that the exercises done in hydrogymnastics and combination exercise training did not provide enough stimulation to increase the range of movement and improve the lumbar spine and ischiotibial muscles of the subjects in the active groups. These results are in agreement with Pacheco et al.,[28] who also did not find any greater flexibility in the sit and reach test of four active elderly females (22.0 cm) and four non-active elderly females (17.5 cm).

The present study found results different from those of Fidelis et al.,[35] who found greater values in the sit and reach test of elderly subjects that practiced general physical conditioning and of non-active elderly subjects, but this may have occurred due to the characteristics of the exercise programs.

However, the data from this study agree with those of Campos et al.[36] who investigated 12 weeks of combination exercise training in 22 elderly females with a minimum age

Table 1. Mean, standard deviation, and result of statistical analysis for age, anthropometric variables, and spine mobility by the Schober test of the subjects in the hydrogymnastics (G1), combination exercise training (G2), and non-active (G3) groups

Variable	G1 (n = 20)	G2 (n = 20)	G3 (n = 20)
Age (years)[F]	67.80 ± 3.38	66.40 ± 5.03	65.60 ± 4.89
Body mass (kg)[F]	70.37 ± 13.43	66.76 ± 11.06	69.81 ± 14.09
Height (m)[A]	157.37 ± 6.96	158.70 ± 6.77	157.32 ± 6.32
BMI (kg/m^2)[A]	28.32 ± 4.54	26.53 ± 4.26	28.05 ± 4.72
Waist Circumference (cm)[F]	88.47 ± 11.13	81.57 ± 10.55	89.35 ± 10.66
Schober (cm)[A]	15.00 ± 1.25	14.97 ± 1.50	14.95 ± 1.23

cm: centimeters; kg: kilograms; m: meters; kg/m^2: kilograms per square meter; BMI: body mass index; [F] Friedman; [A] Anova one way

Table 2. Mean, standard deviation, and statistical analysis for flexibility through the sit and reach and goniometry tests of the subjects in the hydrogymnastics (G1), combination exercise training (G2), and non-active (G3) groups

Tests	G1 (n = 20)	G2 (n = 20)	G3 (n = 20)
Sit and Reach (cm)[F]	23.55 ± 7.97	26.70 ± 7.39	17.80 ± 11.80
Gon. Flexion (degrees)[A]	117.35 ± 3.54*	118.15 ± 4.29#	111.20 ± 4.84*#
Gon. Extension (degrees)[F]	19.10 ± 2.90*	19.10 ± 1.33#	13.40 ± 3.05*#

cm: centimeters; [F] Friedman; Gon.: goniometer; [A] Anova one way; * $p < 0.05$ (GF1 > GF3); # $p < 0.05$ (GF2 > GF3)

of 60 years, divided into five groups: AS (aerobic training followed by strength training n = 5) pre-test 18.2 cm; SA (strength training followed by aerobic training) pre-test 19.6 cm, post-test 20.6 cm; AG (aerobic group n = 5) pre-test 21.4 cm, post-test 23.4 cm; SG (strength group n = 4) pre-test 21.7 cm, post-test 23.0 cm; and CG (control group n = 3) pre-test 22.0 cm, post-test 21.3 cm. It is evident that the subjects who practiced physical exercise had no significant changes for flexibility in the sit and reach test, and with mean results close to those obtained by the subjects in the present study.

The goniometer obtained results that indicate greater values in the flexion and extension of the hip in the active groups (G1 and G2) than in the non-active group (G3). These data suggest that the regular practice of hydrogymnastics and of combination exercise training provide benefits to hip mobility in the sagittal plane of the active elderly female subjects.

It is noteworthy that the goniometer supplies angular measurements, used in this study to evaluate the specific movements of flexion and extension of the hip, while the sit and reach test provides a linear measurement that investigates the flexibility of the lumbar spine and of the ischiotibial muscles.

In a study with 35 elderly runners (55 to 71 years old), 22 males and 13 females, Fukuchi et al.[45] found values of 77.56 degrees for hip flexion and 16.78 degrees for hip extension, which are lower than the values for hip flexion in the six groups of the present study, but similar for hip extension. It should be noted that the individuals practiced running, and not the exercises analyzed in the present study.

The data obtained in the groups suggest that the practice of hydrogymnastics and of a combination of strength, aerobics, and flexibility exercises provide benefits to the flexion and extension of the hip, not merely the distance reached in the flexion of the trunk. One possible explanation is the specificity of the movements, for probably hip flexion and extension are performed more often than trunk flexion during the training sessions of the elderly females.

The limitations of the present study were not having controlled the intensity of training during the hydrogymnastics and combination exercise training sessions and that the sample was obtained by convenience. However, it is important to point out that the active subjects had been exercising two or three times per week for at least one year in health clubs and gyms, and the non-active subjects had not exercised at all for the same period of time.

Improvement was observed in flexibility in the active groups, demonstrated by the greater values for hip flexion and extension in comparison to the non-active group. However, no significant differences were observed in the distance reached in the sit and reach test, suggesting that the hydrogymnastics and combination exercise training, in the way they are practiced in health clubs and gyms, are not effective in improving the flexibility of the lumbar spine or of the ischiotibial muscles.

Although the active groups trained two or three times per week-that is, within the recommendations of the American College of Sports Medicine,[6] maybe the shorter duration of each stretching exercise, 10 seconds, less than recommended, did not offer enough overload to improve the flexibility of the lumbar spine of the elderly males and females studied. Another possible explanation for the active subjects not presenting improvement in the flexibility of the lumbar spine and of the ischiotibial muscles is the specificity of the movements during the hydrogymnastics and combination exercise training practices, lacking in exercises that involve the flexion of the trunk.

As a practical application of the results of the present study, we suggest that the stretches made either in the hydrogymnastics or in the combination exercise training classes have greater control on the duration, intensity, and types of exercises in order to generate more benefits, improving the flexibility of the lumbar spine and of the ischiotibial muscles in those who practice these modalities.

More studies are needed that investigate the influence of other physical exercise modalities on the flexibility of the elderly and on other physical capacities in those who practice hydrogymnastics and combination exercise training, in the way they are practiced in gyms and health clubs.

CONCLUSIONS

The flexibility results presented greater values for the hip flexion and extension of elderly females who practiced hydrogymnastics and combination exercise training, indicating that these modalities provide improvement in hip mobility in the sagittal plane, but with no significant differences between the groups in the distance reached in the sit and reach test, which suggest that these modalities, in the way they are practiced in health clubs and gyms, have no influence on the flexibility of the lumbar spine and of the ischiotibial muscles of elderly females.

ACKNOWLEDGEMENT

The authors thank the Coordination of Specialization of College Level Personnel (*Coordenação de Aperfeiçoamento de Pessoal de Nível Superior* - CAPES) for the concession of the CAPES/PROSUP fee.

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