RBCDH Revista Brasileira de CINEANTROPOMETRIA e Desempenho Humano

DOI: http://dx.doi.org/10.5007/1980-0037.2015v17n6p722

original article

Reach capacity in older women submitted to flexibility training

Capacidade de alcance em idosas submetidas a um treinamento de flexibilidade

Elciana de Paiva Lima Vieira[1]
Jonas Lírio Gurgel[1,2]
Tauan Nunes Maia[1]
Flávia Porto[3]
Julianne Quinellato Louro[1]
Edson Fernandes Silva[1]
Edmundo de Drummond Alves Junior[1]

Abstract – The aim of this study was to analyze the effect of flexibility training on the maximum range of motion levels and reach capacity of older women practitioners of aquatic exercises of the *Prev-Quedas* project. Participants were divided into two groups: intervention (IG, n = 25), which were submitted to flexibility training program and control (CG, n = 21), in which older women participated only in aquatic exercises. Flexibility training lasted three months with weekly frequency of two days, consisting of stretching exercises involving trunk and lower limbs performed after aquatic exercises. The stretching method used was passive static. Assessment consisted of the functional reach, lateral and goniometric tests. Statistical analysis was performed using the following tests: Shapiro-Wilk normality, ANCOVA, Pearson and Spearman correlations. Significant results for GI in gains of maximum range of motion for the right hip joint (p = 0.0025), however, the same result was not observed in other joints assessed, and there was no improvement in functional and lateral reach capacity for both groups. Significant correlations between reach capacity and range of motion in the trunk, hip and ankle were not observed. Therefore, flexibility training associated with the practice of aquatic exercises promoted increased maximum range of motion only for the hip joint; however, improvement in the reach capacity was not observed. The practice of aquatic exercises alone did not show significant results.

Key words: Elderly; Exercise; Stretching exercises.

Resumo – *O objetivo do presente estudo foi analisar a influência de um treinamento de flexibilidade nos níveis de amplitude articular máxima e capacidade de alcance em idosas praticantes de hidroginástica participantes do projeto Prev-Quedas. As idosas foram alocadas em dois grupos: Intervenção (GI, n=25), no qual foram submetidas a um programa de treinamento de flexibilidade; e Controle (GC, n=21), no qual as idosas participavam, apenas, das aulas de hidroginástica. O treinamento de flexibilidade teve a duração de três meses e frequência semanal de dois dias, composto por exercícios de alongamento envolvendo tronco e membros inferiores, realizados após as aulas de hidroginástica. O método de alongamento utilizado foi o estático passivo. A aferição foi constituída pelos testes de alcance funcional, lateral e goniométrico. A análise estatística foi feita através dos seguintes testes: normalidade de Shapiro-Wilk, ANCOVA, correlação de Pearson e de Spearman. Foram encontrados resultados significativos para o GI no ganho de amplitude articular máxima na articulação do quadril direito (p=0,0025), porém, o mesmo não foi visto nas demais articulações aferidas, assim como também, não houve melhora na capacidade de alcance funcional e lateral para ambos os grupos. Também não foram vistas correlações significativas entre a capacidade de alcance e amplitude articular no tronco, quadril e tornozelo. Portanto, o treinamento de flexibilidade associado à prática da hidroginástica, promoveu aumento da amplitude articular máxima somente na articulação do quadril, contudo, não foi visto melhora na capacidade de alcance. A prática, somente da hidroginástica, apresentou resultados não significativos.*

Palavras-chave: *Exercício; Exercícios de alongamento muscular; Idoso.*

1 Fluminense Federal University. Graduate Program in Health Care Sciences. Niterói, RJ. Brazil.

2 Fluminense Federal University. Graduate Program in Cardiovascular Sciences. Niterói, RJ. Brazil.

3 Rio de Janeiro State University. Graduate Program in Exercise and Sports Science. Institute of Physical Education and Sports. Rio de Janeiro, RJ. Brazil.

Received: September 23, 2014
Accepted: January 13, 2015

INTRODUCTION

Important factors influencing the decreased ability of posture control and therefore the risk of falling are the functional and lateral reach capacity and flexibility[1,2]. Such skills are compromised in people with advanced age, which influences the decreased efficiency to reach objects, delayed anticipatory preparation for the range of motion[3] and impaired coordination of postural adjustments[2] changing body balance.

Aquatic exercises, as a form of physical exercise able to mitigate the deleterious effects of aging, provides improvements in postural balance[4,5]. However, with respect to the levels of flexibility, literature is still inconclusive about the effects of aquatic exercises on increasing the range of motion. Some authors[6] investigated the effect of an aquatic exercise program on the neuromuscular function of older women and found significant results in the levels of flexibility and balance, suggesting this practice to reduce falls in this population. However, some studies found no gains in range of motion in older women after carrying out an aquatic exercise program[7,8].

Thus, the following question arose: Flexibility training associated with the practice of aquatic exercises influences the reaching capacity in the elderly?

The aim of this study was to analyze the influence of flexibility training on levels of flexibility and reaching capacity of older women engaged in aquatic exercise program under the assumption that flexibility training associated with aquatic exercises improves the reaching capacity in older women.

METHODOLOGICAL PROCEDURES

Sample

All participants were enrolled in aquatic exercise classes offered by the *Prev-Quedas* Project, an Extension Project promoted by the Institute of Physical Education of the Fluminense Federal University (UFF, Niterói-RJ), started in 2001.

To recruit the sample, posters and phone calls were used, whose data were identified in the anamnesis records of the project. The sample was initially composed of 57 older women participants of the *Prev-Quedas* aquatic exercise project. Individuals interested in participating in the intervention, respecting the eligibility criteria, were distributed into intervention group (IG), submitted to a flexibility training program held in the *Prev-Quedas* Project, in addition to aquatic exercise classes. Individuals interested in participating in the research but not in the intervention according to the eligibility criteria, were distributed into control group (CG), participating only in aquatic exercise classes. Inclusion criteria were: age greater than or equal to 60 years; female; not performing physical exercise in addition to aquatic exercise verified by the Modified Baecke Questionnaire[9]; aquatic exercise practice time of at least two years on the project, also verified by the same questionnaire; and medical clearance for physical exercise. Information of the inclusion criteria was confirmed through the anamnesis records of the project. The following exclusion criteria were adopted: elderly women who had two consecutive weekly absences or more during the training period without replacement in the same week or in the following week, elderly women with score lower than 24 points on the Mini Mental State Examination[10] and / or those who need assistive devices to walk or to remain in a standing position.

Thus, three participants were excluded from the IG due to low scores on the Mini Mental State Examination and other three due to unavailability of time for research participation. In the control group, five elderly women were excluded due to failure to attend scheduled evaluations. Finally, the final sample consisted of 46 participants, 25 in IG and 21 in CG.

Due to the difficulty of recruiting older individuals who showed willingness to participate in the IG, Intentional Sample technique based on non-probability sampling (Convenience) was applied for sample allocation.

The study was approved by the Ethics Research Committee of the Faculty of Medicine, Fluminense Federal University through CAAE process No. 10779012.2.0000.5243. All participants signed the informed consent form.

Assessments

Pre-intervention assessments occurred in the period from 05/20/2013 to 05/24/0213, and post-intervention assessments in the period from 08/19/2013 to 08/23/2013. Evaluations were performed by the same researcher, who received a previous training and participated in a pilot study. All evaluations were conducted in the Laboratory of Biodynamics of the Institute of Physical Education - Fluminense Federal University. The following variables were assessed: Body Mass; Height; Body Mass Index (BMI); Waist Circumference; Functional and Lateral Reaching Capacity and Maximum Range of Motion.

Body weight, height, BMI and waist circumference

Height was measured using an inelastic tape measure fixed to a wall, and results were presented in meters. Body mass was measured using a previously calibrated digital scale brand Welmy (BRAZIL), and results were presented in kilograms. BMI was calculated by the ratio between body mass and the square of height (kg/m^2). Waist circumference was measured using an inelastic tape measure placed on the individual umbilical scar, which was in the standing position with feet leaning against each other, and results were presented in centimeters.

Reaching tests: Functional Reach and Lateral Reach

These tests were developed to measure the reaching capacity in anterior-posterior[1] and medial-lateral directions[1], respecting the validated protocols with three attempts for each test. The following material was needed for the implementation of tests: an anthropometric tape brand Sanny, model ES2060 (Sao Paulo, Brazil), horizontally fixed to the wall at the time the acromion was evaluated. In the Functional Reach Test, the initial measurement corresponded to the position of the proximal end of the third finger (middle finger) on the anthropometric tape. Before the test, the individual was positioned sideways to the wall ten centimeters away from it with bare feet in parallel and in a comfortable position. The dominant upper limb was positioned with shoulder flexed to 90 degrees, with extended elbow and closed hand. Participant was told to extend the upper limb as far as possible along the anthropometric tape without leaning on the wall, remove heels from the ground, loose balance or take a step, holding this position for three seconds. In the Lateral Reach test, the participant was instructed to adopt the following position: standing, with dorsal region parallel to the wall, feet parallel at a distance of ten centimeters between the medial region of the heel without touching the wall, abduction of the right arm at 90 degrees and elbow extended. Fingers were kept extended, with the initial measurement corresponding to the position of the distal end (dactiloidal point) of the third finger (middle finger) on the anthropometric tape. The participant was instructed to move as much as possible to the right side without bending the knees, rotate or flex the trunk, keeping this position for three seconds, recording the maximum displacement of the dactiloidal point on the anthropometric tape. The same procedure was performed on the left side. In case of imbalance, the tests were repeated. Results were expressed in centimeters (cm).

Range of Motion

The instrument used for this measurement was a transparent acrylic goniometer with 25 cm in length brand Fibra Cirúrgica (Joinville, Santa Catarina, Brazil). Maximum range of motion was obtained through the active method in which the volunteer reaches the maximum range of motion without any aid[11]. Initially, the joint points were marked with adhesive tape brand Norton (Germany) according to literature. Later, the maximum range of motion was measured by the maximum angle obtained at each joint. The final result was the subtraction between the final and the initial measures so that the range of motion was calculated[12]. Three attempts were performed for each movement.

Goniometer was used in the hip joint in the flexion and abduction movements; in the ankle joint in plant flexion and dorsiflexion movements; and in the spine in spine flexion movement with hip flexion in the sitting position. In every movement, the right and left sides were measured, except for the last movement described, in which the participant was instructed to reach the maximum range of motion in the sitting position. The values are presented in degrees.

Flexibility training

The proposed training protocol lasted 12 weeks and was conducted from May 27 to August 16, 2013. The weekly frequency was two not consecutive days aimed at matching the training days with the days of aquatic exercise classes, which occurred after these classes.

Initially, there was a week to adapt and better familiarize with the exercises, the time and place of sessions, which was not included in the count of the total training duration.

Replacements of missing sessions were held in the days with no regular training in the morning and in the same place where the training was held.

Stretching exercises were performed, involving the lower limbs and trunk, lasting about 50 minutes. The passive static method was adopted, i.e., the exercise was conducted with the assistance of another person to achieve greater range of motion without pain[11,13]. To better match training session at the scheduled time, each exercise was carried out in pairs, so that all volunteers performed the proposed method for a period of 60 seconds in both limbs together with four replicates for each exercise[13]. The interval between each exercise and between each replicate was ten seconds[11,13], with no order of execution of exercises.

The flexibility training sessions were always held by the same appraiser, who helped participants to achieve the maximum range of motion without exposing them to a process of pain but rather to a mild discomfort.

Aquatic exercises

Classes took place twice a week lasting forty-five minutes each. Aerobic and muscle power exercises involving upper and lower limbs were performed, accompanied by music. Classes were divided into the following phases: warm-up, lasting five minutes, in which movement activities were performed within the pool in order to prepare the main muscle groups that would be worked out in class; main part, lasting 35 minutes, 15 minutes of aerobic exercises and 20 minutes of aerobic power exercises; recovery, lasting five minutes, in which exercises with lower intensities during the main part of the class were carried out. The main joint movements worked in class were: hip flexion, adduction and abduction; knee extension and flexion; elbow extension and flexion; and shoulder abduction, adduction and horizontal abduction and horizontal adduction. Floats were used during classes. Subjects performed the exercises at comfortable intensity. The teacher responsible for the classes demonstrated the exercises out of the pool, being assisted by another professional inside the pool to teach and assist in certain movements.

Statistical analysis

Data were submitted to the Shapiro-Wilk normality test then to descriptive statistics: mean and standard deviation for data with normal distribution, median and interquartile amplitude for data with non-normal distribution. Pre- and post-intervention differences of groups for all variables, including age, were tested by the following tests: Student's t test for dependent and independent parametric samples, Wilcoxon test for nonparametric dependent samples; and Mann-Whitney test for nonparametric independent samples.

Since there were differences in pre-intervention assessments, ANCOVA test was used to evaluate the effect of intervention taking into account the pretest difference, and data with nonparametric distribution were normalized by the Neperian logarithm and baseline measures were used as covariates. Then, *post hoc* Bonferroni was used for correction of values in the pre-intervention evaluation.

For correlations, Pearson's correlation test for parametric samples and Spearman for nonparametric distribution were used. In relation to the r values, those below 0.40 were considered low correlation, between 0.41 and 0.59 moderate correlation; between 0.60 and 0.79 strong correlation and above 0.80 very strong correlation[14]. Statistical treatment used the Bioestat 5.2 (Belem, PA, Brazil) and Stactic Package for the Social Sciences version 17.0 software for Windows (SPSS, Inc. Chicago, IL, USA). The level of significance was $p \leq 0.05$.

RESULTS

With regard to age, represented by average age, IG (66.72 ± 6.90 years) and CG (69.19 ± 6.30 years), groups showed no significant difference in the comparison carried out in the pre-intervention period (p = 0.0916).

Table 1 shows the anthropometric data of sample and comparisons between pre- and post-intervention assessments (intragroup) and between groups. No significant differences were found in the comparison between groups in both conditions, as well as in the intragroup comparison, except for variable height, which showed significant difference between IG and CG in both assessment conditions.

Table 1. Results of the study anthropometric variables

		IG (n=25)		CG (n=21)		
		x	IA	x	IA	p
MASS (kg)	Pre	70.45	8.15	67.85	15.25	0.6672
	Post	69.75	8.95	67.00	13.85	0.7325
	p	0.2209	-	0.8402	-	-
HEIGHT (m)	Pre	1.55	0.04	1.50	0.07	0.0472*
	Post	1.55	0.04	1.50	0.07	0.0472*
	p	1.0000	-	1.0000	-	-
BMI (kg/m²)	Pre	29.05	4.10	29.92	4.51	0.4981
	Post	29.27	4.29	29.77	6.09	0.3430
	p	0.5322	-	0.6677	-	-
WAIST (cm)	Pre	96.04	9.77	97.47	10.68	0.6367
	Pos	97.00	5.00	96.00	11.00	0.9736
	p	0.7642	-	0.9651	-	-

x = median; IA = interquartile amplitude; BMI = body mass index; * Significant value; $p \leq 0.05$.

Table 2 shows the time of participation of groups in aquatic exercises of the *Prev-Quedas* project. When groups were compared, significant difference was observed.

Table 2. Comparison of the time of participation in aquatic exercises

		IG			CG			
		n	x	IA	n	x	IA	p
	Pre	25	24.00	21.00	21	24.00	17.00	0.7744
Time of participation	Post	25	27.00	21.00	21	27.00	17.00	0.0741
(months)	p	-	< 0.0001*	-	-	< 0.0001*	-	-

n = sample size; x = median; IA = interquartile amplitude; P = Mann-Whitney comparison test for two nonparametric independent samples; p = Wilcoxon compared test for two nonparametric independent samples; * significant value; p ≤ 0.05.

Regarding the results of the reaching tests, there were no significant differences between groups regarding intervention as shown in Table 3. The p value represents the significance of the ANCOVA test shown in Tables 3 and 4.

Table 3. Results of the functional and lateral reaching tests

		IG (n= 25)		CG (n= 21)			
		X	SD	X	SD	p	Power
FR	Pre	30.00†	7.60	26.70	5.610	0.814	0.056
	Post	30.30†	7.17	28.80	5.60		
RLR	Pre	21.50†	7.70	19.54	5.66	0.363	0.146
	Post	22.50†	4.50	24.45	3.52		
LLR	Pre	21.31	6.37	18.77	4.58	0.915	0.051
	Post	19.88	4.78	22.27	3.69		

FR = functional reach; RLR = right lateral reach; LLR = left lateral reach; X = average; SD = standard deviation; † = median; p ≤ 0.05.

Table 4 presents the goniometric results of the sample. Only position right hip flexion (RHFL) showed significant difference between groups. With regard to this position, IG showed significant results when compared to each other (p = 0.0025), which was not observed for CG (p = 0.9248). The average and standard deviation values of IG were 89.66 ± 9.33 and 97.59 ± 7.73 in the pre- and post-intervention assessments, respectively. In the control group, the values were 96.00 ± 19.00 in the pre-intervention evaluation and 95.87 ± 10.39 in the post-intervention assessment.

Table 5 shows the correlations between differences in initial and final averages (Δ) of goniometer results and functional and lateral reach tests of volunteers. No significant correlations between data of all measured goniometric positions and those of the functional and lateral reach tests in both groups were found. Similar results were found in the correlations between data regarding BMI, waist circumference, and Goniometric results in SPINEFL position (r = - 0.1332; r = - 0.0029 respectively).

DISCUSSION

The hypothesis that flexibility training associated with aquatic exercises improves the reach capability in older women was refuted. Results of Func-

Table 4. Results (median and interval amplitude) of goniometric assessment performed.

	IG (n= 25)		CG (n= 21)			
	Pre	Post	Pre	Post (median)	p.	Power
RHFL (degrees)	89.66± 9.33	97.59± 7.73	96± 19	95.87± 10.39	0.041*	0.538
LHFL (degrees)	84± 13.66	90.33± 9	90± 12.66	86.33± 17.34	0.087	0.403
RHABD (degrees)	18.9± 5.65	22.33± 11.67	26.56± 9.22	24± 10.66	0.963	0.050
LHABD (degrees)	16.66± 9.67	22.96± 7.18	23.33± 10.67	24.91± 9.50	0.107	0.590
SPINEFL (degrees)	9.36± 5.08	10.26± 3.87	9.95± 6.35	8.69± 6.63	0.429	0.122
RDFL (degrees)	12.61± 4.2	9± 5.66	14.26± 5.40	9± 5.67	0.655	0.072
LDFL (degrees)	13.89± 3.77	12± 6.34	11.31± 3.87	8.66± 5.33	0.115	0.349
RPFL(degrees)	25.54± 6.64	48.23± 14.11	27.37± 8.95	45.96± 8.86	0.543	0.092
LPFL (degrees)	27.88± 9.80	46.31± 14.10	31.66± 9.65	47.94± 10.92	0.686	0.068

RHFL = right hip flexion; LHFL = left hip flexion; RHABD = right hip abduction; LHABD = left hip abduction; SPINEFL = spine flexion with hip flexion; RDFL = right dorsiflexion; LDFL = left dorsiflexion; RPFL = right plantar flexion; LPFL = left plantar flexion; * Significant value; $p \leq 0.05$.

Table 5. Correlation of pre- and post-intervention difference of variables measured

	ΔFR (r or rho)	p	ΔRLR (r or rho)	p	ΔLLR (r or rho)	p
Δ RHFL	-0.032	0.830	-0.139	0.355	-0.126	0.401
Δ LHFL	-0.169	0.260	-0.203	0.175	-0.169	0.260
Δ RHABD	0.130	0.386	-0.087	0.583	-0.219	0.142
Δ LHABD	-0.154	0.304	-0.152	0.310	-0.027	0.857
Δ SPINEFL	0.022	0.879	0.180	0.229	0.161	0.282
Δ RDFL	-0.032	0.829	-0.007	0.961	0.181	0.228
Δ LDFL	0.088	0.560	0.121	0.422	-0.109	0.470
Δ RPFL	0.159	0.289	-0.071	0.637	0.073	0.627
Δ LPFL	-0.113	0.454	-0.214	0.152	-0.059	0.694

R = Pearson correlation test for parametric samples; rho = Spearman correlation for nonparametric samples; $p \leq 0.05$.

tional and Lateral Reach Test showed no improvement in these capacities for both groups. In addition, the flexibility training increased the maximum range of motion, only in the right hip joint.

One of the possible factors that may contribute to explain these results is the combination of exercises performed by the IG, which could have caused an overload, so as not to significantly influence the reaching capacity. The study by Teixeira et al.[5] did not find significant results in the group of older women who practiced gymnastics in association with aquatic exercises; however, the opposite was found in groups who performed each of these exercises alone, which is in disagreement with findings of this study.

The practice of aquatic exercises alone in the study showed no improvement in the maximum range of motion in the joints of the lower limbs and trunk. Some authors[7], when comparing exercise programs on land and water, in sedentary older women, found results similar to those of the present study regarding the practice of aquatic exercises alone, with respect to gains in range of motion. The authors explained these findings claiming that the training program applied was not specific or long enough to provide improvements in muscle strength, flexibility and body composition. Similar findings were observed in the study by Passos et al.[8] with sedentary elderly who started the practice of aquatic exercises alone for 12 weeks and weekly frequency of three sessions. These findings do not corroborate those found in literature, which presented significant increase in the maximum range of motion, measured by the sit and reach test, arising from the practice of aquatic exercises. Bergamin et al.[15] and Murtezani et al.[16] compared sedentary elderly participants of an aquatic exercise program with others on land and found significant improvement in both groups regarding the levels of flexibility evaluated by the sit-and-reach test. Despite the divergence of results in relation to the benefits of aquatic exercises regarding gains in the range of motion, this study differs from the others because the sample was not composed of sedentary individuals, but rather active ones, and the intervention consisted of the performance of an aquatic exercise program associated with a flexibility program.

Another point that may explain the findings of this study is related to the principle of trainability[17], due to the longer time of practice of aquatic exercises in relation to the duration of the intervention. According to this principle, the more trained the subject, the more difficult and prolonged the development of distinct physical qualities required in his performance will be. Based on the above, the duration of the intervention may have been insufficient to achieve significant results.

Another important factor is related to waist circumference that in the present study was high, characterizing the sample as composed on obese older women[18] (68% in IG and 76% in CG). Thus, the high volume in the abdominal region of participants of both groups could have limited movement in this position. However, these measurements do not interfere in the results presented; therefore, no significant correlations between waist circumference, BMI, and goniometric results in this position were found.

In relation to the correlation between changes in the goniometric results and in functional and lateral reaching tests, no statistically significant correlation was observed. This result suggests that there is no relationship between the performance of participants in the reaching tests and flexibility gain. This can be attributed to the aging process, which leads to a reduction of 20 to 50% of flexibility, depending on the joint[19]. The reaching capacity required in the practice of daily activities is also impaired in older subjects and may lead to falls[20]. Other physical exercise programs for the elderly population, involving muscle strength and aerobic resistance promote improvements in flexibility, muscle strength and functional mobility, considered a means of preventing falls[21,22].

CONCLUSIONS

Flexibility training associated with aquatic exercises did not improve the functional and lateral reaching capacity; however, there was a significant increase in the maximum amplitude of the hip joint on the right side, which was not observed in other joints. The practice of aquatic exercises not associated with any other type of training did not show improvements in the aforementioned capacities. Therefore, the combination of flexibility training to an aquatic exercises program in the short term (12 weeks) does not appear to be a good strategy to obtain gains in the range of motion and improvements in postural balance.

Some factors may have limited the development of this work, for example, pre-intervention differences between groups, the non-randomization of the sample and the duration of the intervention, which may have been insufficient to promote morphological and functional changes, since both groups have practiced aquatic exercises for at least 24 months. In addition, the training intensity control was not ideal, which is considered a limitation of any flexibility program, and may also have influenced the results.

Further studies should be carried out using other training protocols or other cross-section methodological models for comparison with the findings of this study.

REFERENCES

1. Silveira KRM, Matas SLA, Perracini MR. Avaliação do Desempenho dos Testes Functional Reach e Lateral Reach em Amostra Populacional Brasileira. Rev Bras Fisioter 2006; 10(4):381-6.
2. Figueiredo KMOB, Lima KC, Guerra RO. Instrumentos de avaliação do equilíbrio corporal em idosos.Rev Bras Cineantropom Desempenho Hum 2007; 9(4):408-13.
3. Tantisuwat A, Chamonchat D, Booyong S. Multi-directional Reach Test: An Investigation of the Limits of Stability of People Aged between 20-79 Years. J Phys Ther Sci 2014; 26(6):877-80.
4. Meereis ECW, Favretto C, Souza J, Gonçalves MP, Mota CB. Influência da hidrocinesioterapia no equilíbrio postural de idosas institucionalizadas. Motriz 2013; 19(12): 269-277.
5. Teixeira ST, Lemos LFC, Lopes LFD, Rossi AG, Mota CB. Equilíbrio corporal e exercícios físicos: uma investigação com mulheres idosas praticantes de diferentes modalidades. Acta Fisiatr 2008; 15(3):156-69.
6. Moreira L, Fronza FC, dos Santos RN, Teixeira LR, Kruel LF, Lazaretti-Castro M. High-intensity aquatic exercises (HydrOS) improve physical function and reduce falls among post menopausal women. Menopause 2013; 20(10):1012-9.
7. Tauton JE, Rhode EC, Wolski LA, Donelly M, Warren J, Elliot J, et al. Effect of land-based and water-based fitness programs on the cardiovascular fitness, strength and flexibility of women aged 65-75 years. Gerontology 1996; 42(4):204-10.
8. Passos BMA, Souza LHR, Silva FM, Lima RM, Oliveira RJ. Contribuições da Hidroginástica nas Atividades da Vida Diária e na Flexibilidade de Mulheres Idosas. Rev Educ Fís/UEM 2008; 19(1):71-6.
9. Florindo AA, Latorre MRDO, Jaime PC, Tanaka T, Zerbini CAF. Metodologia para avaliação da atividade física habitual em homens com 50 anos ou mais. Rev Saúde Pública 2004; 38(2):307-14.
10. Brucki SMD, Nitrini R, Caramelli P, Bertolucci PHF, Okamoto IH. Sugestões para uso do Mini-Exame do Estado Mental no Brasil. Arq Neuro psiquiatr 2003; 61(3-B):777-81.
11. Cristopoliski F, Barela JA, Leite N, Fowler NE, Rodacki, ALF. Stretching Exercise Program Improves Gait in the Elderly. Gerontology 2009; 55(6):614-20.
12. Marques PA. Manual de Goniometria. 2ª edição. São Paulo: Manole; 2008.
13. Feland JB, Myrer JW, Schulthies SS,Fellingham GW, Meason GW. The effect of duration of stretching of the hamstring muscle group for increasing range of motion in people aged 65 years or older. PhysTher 2001; (81):1110-7.

14. Callegari-Jaques SM. Bioestatística: princípios e aplicações. Reimpressão. Porto Alegre: Artmed; 2008.
15. Bergamin M, Ermolao A, Tolomio S, Berton L, Sergi G, Zaccaria M. Water-versus land-based exercise in elderly subjects: effects on physical performance and body composition. Clin Interv Aging 2013; (8):1109-17.
16. Murtezani A, Nevzati A, Ibraimi Z, Sllamniku S, Meka VS, Abazi N. The Effect of Land versus Aquatic Exercise Program on Bone Mineral Density and Physical Function in Postmenopausal Women with Osteoporosis: a Randomized Controlled Trial. Ortop Traumatol Rehabil 2014;16(3):319-25.
17. Tubino MJG, Moreira SB. Metodologia Científica do Treinamento Desportivo. 3ª edição. Rio de Janeiro: Shape; 2003.
18. Silveira EA, Kac G, Barbosa LS. Prevalência e fatores associados à obesidade em idosos residentes em Pelotas, Rio Grande do Sul, Brasil: classificação da obesidade segundo dois pontos de corte do índice de massa corporal. Cad Saúde Pública 2009; 25(7):1569-77.
19. Holland GJ, Tanaka K, Shigematsu R, Nakagaichi M. Flexibility and physical functions of older adults: A Review. J Aging Phys Act 2002; 10(2):169-206.
20. Newton RA. Validity of the Multi-Directional Reach Test: A Practical Measure for Limits of Stability in Older Adults. J Gerontol 2001; 56A(4):248-52.
21. Fidelis LT, Patrizzi LG, Walsh IAP. Influência da prática de exercícios físicos sobre a flexibilidade,força muscular manual e mobilidade funcional. Rev Bras Geriatr Gerontol2013; 16(1):109-16.
22. Kim SB, O'Sullivan DM. Effects of Aqua Aerobic Therapy Exercise for Older Adults on Muscular Strength, Agility and Balance to Prevent Falling during Gait. J Phys Ther Sci 2013; 25(8):923-7.

Corresponding author

Elciana de Paiva Lima Vieira,
Universidade Federal Fluminense
Instituto de Educação Física
Rua Prof. Marcos Waldemar de Freitas Rei s/n, Rio de Janeiro, RJ, Brasil.
CEP 24201-201.
Email: elcianavieira@yahoo.com.br