

ORIGINAL ARTICLE

Corporal balance and physical exercises: an investigation in elderly women who practice different exercise modalities

Equilíbrio corporal e exercícios físicos: uma investigação com mulheres idosas praticantes de diferentes modalidades

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ABSTRACT

Life expectancy has been progressively increasing, which implies in an increase in the number of elderly individuals. As a consequence, several types of physical activities are offered to this population, aiming at improving some physical qualities. One of those qualities is corporal balance, which has been largely studied due to its association with many diseases that can affect the elderly. Thus, this study compared a group of elderly women that regularly practiced hydrogymnastics with sedentary ones. Fifty-one (51) elderly women with a mean age of 63.26 ± 9.63 years participated in the study group. Balance was evaluated through kinetic assessment, using an AMTI OR6-5 force platform (Advanced Mechanical Technologies, Inc.) at a frequency of 100 Hz. The analyzed variables were the amplitude of the force center displacement and the mean force center displacement in the anteroposterior and midlateral directions. The statistic analysis used the descriptive statistics, the Shapiro-Wilk's test and the Kruskal-Wallis test with a level of significance of 5%. The results showed statistically significant differences in the midlateral direction, both in range and the mean force center displacement between the groups. Thus, it is possible to conclude that there were differences regarding the balance in the midlateral direction and less instability was observed in the group of elderly women that practiced physical exercises.

KEYWORDS

balance, physical exercise, elderly people

RESUMO

Atualmente a expectativa de vida vem crescendo ano após ano, caracterizando um aumento no número de idosos. Com isso, diversos tipos de atividades físicas são ofertadas para essa população objetivando melhoras em algumas qualidades físicas. Uma dessas qualidades é o equilíbrio corporal, que vem sendo bastante estudado, em virtude de estar relacionado com diversas doenças que podem afligir os idosos. Com isso, esse estudo comparou mulheres idosas praticantes de hidroginástica, ginástica e mulheres idosas sedentárias. Fizeram parte do grupo de estudo 51 mulheres idosas com idade de $63,26 \pm 9,63$ anos. O equilíbrio foi coletado através da avaliação cinética, sendo utilizada uma plataforma de força OR6-5 AMTI (Advanced Mechanical Technologies, Inc.) a uma frequência de 100 Hz. As variáveis analisadas foram a amplitude do deslocamento do centro de força e o deslocamento médio do centro de força na nas direções ântero posterior e médio-lateral. Para análise estatística utilizou-se a descritiva, teste de Shapiro-Wilk e o teste Kruskal-Wallis com nível de significância utilizado de 5%. Os resultados mostraram diferenças estatisticamente significativas nas direções médio-lateral, tanto na amplitude quanto no deslocamento médio do centro de força entre os grupos. Conclui-se deste estudo que ocorreram diferenças no equilíbrio na direção médio-lateral, sendo que menores instabilidades foram encontradas nas idosas praticantes de ginástica.

PALAVRAS-CHAVE

equilíbrio, postura corporal, exercício físico, idosos, avaliação cinética

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INTRODUCTION

The world's population has been growing and one of the factors responsible for such growth is the increase in life expectancy. To live longer means, in most cases, to live better, with healthy habits and the practice of systematic physical activities. Considering that, scientific studies assessing elderly populations and the practice of physical activities are currently increasingly more frequent^{1,2,3} and, in many cases, the importance of the physical activity for the public health has a preventive role in this population. Other important studies found in the literature related to the elderly population mention physical activity as a way to attenuate health-related problems, such as osteoporosis, through the practice of physical exercises.^{4,5}

Through the practice of physical exercises one attains prevention, treatment and recovery of some pathologies. Currently, one of the concerns of academicians is related to the body instabilities that very often occur together with vestibular syndromes and problems related to falls. When reviewing body balance, one observes that it is one of the most important subjects of a very rich literature,⁶⁻⁹ which demonstrates the importance of this matter related to different age ranges. When related to the subjects of body balance and the practice of physical activity by elderly individuals, there is a wide variety of literature to study from. In the reviewed literature, Lord & Castell¹⁰ reported the improvement of balance in elderly individuals after 10 weeks of regular physical exercise practice. Topp et al¹¹ observed a tendency toward improvement of balance in elderly individuals submitted to a 12-week strength training. Hoerger & Hopkins¹² observed an increase of 12% in mobility in elderly individuals at the end of a 12-week physical exercise program. In a study of 15 female individuals older than 55 years using hydrogymnastics, the pre-and post-training analyses showed that after 20 sessions, there was a statistically significant improvement in balance, demonstrating that hydrogymnastics acts fast to improve this physical quality;¹³ this improvement was also observed in those engaged in body-building activities,¹⁴ considering that the maintenance of balance is related to the prevention and risk of falls.¹⁵

OBJECTIVE

Considering these facts, the present study aimed at verifying and comparing the static balance of elderly women that practiced gymnastics and hydrogymnastics, elderly women that practiced hydrogymnastics, elderly women that practiced gymnastics and hydrogymnastics and sedentary elderly women.

METHODS

This study is a clinical assay that evaluates elderly individuals who practice different modalities of physical exercise. The elderly individuals that participated in physical activities offered by a public federal institution and those from the community were invited to participate in the study.

The individuals included in the study were those that practiced hydrogymnastics and gymnastics and those that did not regularly practice physical exercises, but did not present any musculoskeletal problems or pathologies associated to balance and/or vestibular disorders and were

voluntarily willing to participate in the study. A total of 57 individuals were enrolled in the study and 6 male individuals were excluded.

The study then consisted of 51 elderly women, with a mean age of 63.26 ± 9.63 years, presenting varied degrees of sports practice for at least 5 consecutive years prior to data collection. Four groups of elderly individuals were assessed, as shown in Table 1, with distinct physical exercise practices, i.e., (1) sedentary women that did not practice any type of physical exercise; (2) those who practiced hydrogymnastics; (3) those who practiced gymnastics and (4) those who practiced both hydrogymnastics and gymnastics, systematically and simultaneously.

Table 1
Characterization of the assessed groups regarding age and Body Mass Index (BMI).

Study groups	1	2	3	4
Number of participants/idade	14	08	16	15
Mean age (years)	58.14	65.75	62.56	67.47
	± 12.93	± 9.62	± 5.86	± 7.53
BMI (kg/m ²)	27 ± 3.27	29.7 ± 4.97	28 ± 3.82	30.8 ± 3.53

(1) sedentary women that did not practice any type of physical exercise; (2) women that practiced hydrogymnastics; (3) women that practiced gymnastics and (4) women that practiced hydrogymnastics and gymnastics, systematically and simultaneously.

All elderly women signed the free and informed consent form, agreeing to participate in the study. Days were established for the collection of data from each elderly patient and these collections were developed in the laboratory.

Balance was assessed through the kinetic data of the center of power. To evaluate kinetics, we used a force platform OR6-5 AMTI (Advanced Mechanical Technologies, Inc.). The frequency of data acquisition of the platform was 100 Hz.

Throughout the data collection the participants remained barefoot with bipedal support and the arms along the body, in the anatomical position of reference. Before the collection, the individuals' height and weight were measured. The data were collected in the following situations: with the eyes open and with the eyes closed, with the feet positioned only on a platform, with a space equal to the hip width.

Each participant was asked to maintain the erect posture as stable as possible. As each one of the participants presented distinct body dimensions and, consequently, the hip width varied from participant to participant, at the first attempt for each study subject the platform was identified with adhesive tape, aiming at maintaining the individual in the same position in all attempts. With the eyes open, each subject was asked to keep the eyes on a fixed point on the wall at one meter from eye height of each individual, according to the recommendations by Freitas & Duarte.¹⁶ Six attempts were collected from each individual, with a 30-second duration for each of them. The data were analyzed only after 10 seconds from the start of the signal acquisition so that the center of power could be stabilized. Three collections were carried out for each situation, i.e., three with the eyes open and three for the eyes closed, totaling six attempts.

The variables analyzed were the range of displacement of the center of power in anteroposterior (COPap) and midlateral directions (COPml), mean displacement of the center of power in the anteroposterior (MDap) and midlateral (MDPml) directions, and the means of each of these variables were compared in both situations – with the eyes open and

with the eyes closed.

The data were analyzed using descriptive statistics. Data normality was verified by the Shapiro-Wilk's test. As the data did not present a normal distribution, the Kruskal-Wallis test was used to compare the study variables among the four groups. The level of significance was set at 5%.

RESULTS

The means, standard deviation values and the probability of significance (p value) of the analyzed variables are shown in Table 2. The values found for the analyzed variables, when the four studied groups are compared, show statistically significant differences in the static balance oscillations in the standing position.

Table 2

Means, standard deviation values and the probability of significance (p value) of the analyzed variables: range of displacement of the center of power in the anteroposterior (COPap) e midlateral directions (COPml), mean displacement of the center of power in the anteroposterior (DMap) and in the midlateral (DMml) direction of the four groups, during the static balance with the eyes open and closed.

Variables	Open eyes		p-value*	Closed eyes		p-value*
	Mean	SD		Mean	SD	
COPap (cm)	1.28 ^a	0.52	0,13	1.51 ^a	0.45	0,10
	1.23 ^a	0.35		1.59 ^a	0.57	
	1.26 ^a	0.53		1.40 ^a	0.60	
	1.47 ^a	0.62		1.46 ^a	0.43	
COPml (cm)	0.90 ^a	0.36	0,01	0.80 ^{ab}	0.25	0,03
	0.87 ^a	0.24		0.90 ^a	0.29	
	0.75 ^a	0.46		0.82 ^a	0.53	
	0.89 ^a	0.49		0.79 ^b	0.34	
Dmap (cm)	0.27 ^a	0.13	0,57	0.31 ^a	0.10	0,09
	0.25 ^a	0.10		0.31 ^a	0.12	
	0.28 ^a	0.16		0.27 ^a	0.12	
	0.30 ^a	0.15		0.29 ^a	0.09	
DMml (cm)	0.17 ^a	0.07	0,002	0.15 ^{ab}	0.05	0,04
	0.18 ^a	0.07		0.17 ^a	0.07	
	0.14 ^b	0.11		0.15 ^b	0.09	
	0.17 ^{ab}	0.11		0.16 ^{ab}	0.08	

* Kruskal Wallis Test – abDifferent letters indicate statistically significant differences (p < 0.05).

(1) sedentary women that did not practice any type of physical exercise; (2) women that practiced hydrogymnastics; (3) women that practiced gymnastics and (4) women that practiced hydrogymnastics and gymnastics, systematically and simultaneously.

Based on the results of Table 2, differences can be observed only in the midlateral direction. The variables COPml and DMml showed to be statistically different when the groups were compared, with the eyes both open and closed.

DISCUSSION

When analyzing the results obtained with the eyes open, it can be perceived that the direction in which the variable showed to be

different, i.e., the midlateral direction, the individuals that practiced gymnastics demonstrated better balance than the ones that practiced other modalities, with eyes both open and closed (Table 2).

However, this result was statistically significant only when associated with sedentary elderly individuals and with those that practice hydrogymnastics, in the situation with the eyes open. When compared with those that practiced two activities, i.e., hydrogymnastics + gymnastics, it was observed that there was no significant difference and that the higher oscillations were observed for COPml in sedentary elderly individuals and in DMml in elderly individuals that practiced hydrogymnastics.

The difference found with sedentary elderly individuals is easier to understand, as some studies have shown that the physical activity promotes some postural improvement and body balance to those who practice it. In the study by Prioli,¹⁷ for instance, it was observed that sedentary elderly individuals were more affected than active individuals by an experimental situation, in which a room was moved slightly, i.e., with a more apparent conflict situation. Based on these results, Prioli¹⁷ suggests that sedentary elderly individuals have difficulty to correctly discriminate sensory conflict situations, such as, for instance, the absence of sight and the practice of regular physical exercise.

Wiksten et al,¹⁸ in a study with a group of elderly individuals, found a positive and statistically significant correlation between lower-limb muscular strength and the performance in balance tasks. Based on that, the authors concluded that the increase in the strength of the lower-limb muscles can be important for elderly individuals to maintain postural control in different situations. Additionally, it must be remembered that during gymnastics, the elderly women have visual, proprioceptive and vestibular stimuli, and it can be inferred that this activity might be positive for the maintenance of body balance through the stimuli acquired by the practice. It is worth remembering that, related to the gains of muscular strength, gymnastics is the one that shows the highest degree of development of this capacity among the studied activities. Therefore, muscular strength gains might have influenced the results of the present study, improving the body balance of the elderly women that practiced this exercise modality. However, further studies must be carried out to clarify these associations.

Another reason for the elderly women who practice gymnastics to be more stable than the ones who practiced hydrogymnastics resides in the fact that there is a variable in the mean ages in these two groups. The women who practice gymnastics have a mean age of 62.56 years, whereas those who practice hydrogymnastics have a mean age of 65.75 years. Thus, according to Wiczorek,¹⁹ the aging process is characterized by a series of physical alterations and, among them, alterations that affect body balance. Considering only the balance problems, with the passing of time, one can observe in the geriatric population a progressively higher number of disorders of sensory functions, of the integration of central-peripheral information as well as the senescence of neuromuscular systems and skeletal function.²⁰ Therefore, it is suggested that this age variation might also be related to these differences. In addition, it can be inferred the reason why hydrogymnastics was chosen, when

it is suggested that the choice was due to an already established balance disorder and so, the choice of this modality might be associated to the objective, as the practice of hydrogymnastics can prevent falls that could occur with the practice of another exercise modality, which also offers the extra benefits of lower impact and safer exercises. Moreira²¹ reports that, inside the pool, there is no disagreeable mirror reflecting what, many times, one wishes to hide or complicated gymnastics and/or bodybuilding apparatus; also, the water allows each one to exercise at his or her own rhythm, without discriminating the weaker or the “newbie” and the affective exchange between the teacher and those practicing the exercise modality is much richer than the one during a gymnastics or bodybuilding class. Many times, the elderly, with debilitated balance and coordination, feels impotent in a room with so many apparatus that need adjustment all the time in order to be used. Maybe, for this reason, more and more people, and among them, the elderly seek aquatic activities, mainly hydrogymnastics, as a means to practice exercises.²¹

When analyzing the results obtained with the elderly women with the eyes closed, it was observed, once more, that the COPml as well as the DMml presented significant differences.

The variable COPml showed that the highest oscillations occurred when the individuals practicing hydrogymnastics were compared with those that practiced gymnastics, as well as with those that practiced hydrogymnastics + gymnastics. These findings demonstrated that the practice of gymnastics showed to be more effective to maintain body balance and that the female elderly individuals showed to be less dependent on the visual information when they practice gymnastics.

The DMml with the eyes closed showed that only those who practiced gymnastics showed differences when compared to the ones that practiced hydrogymnastics, by presenting better balance values.

No studies were found in the literature regarding such findings, as well as studies that specifically correlated the practice of two exercise modalities with balance. However, it is important to mention that there are different ways to perform the exercises in each modality. In hydrogymnastics, the possibility of performing the movements following a comfortable rhythm is much higher than in gymnastics, as the first does not require following music, as the latter does, which can result in greater and faster gains during the training.

CONCLUSION

We conclude that the practice of distinct physical activities by elderly individuals results in significant differences in the mid-lateral balance and the women that practiced physical exercises presented the lowest instabilities. However, in order to prove that this type of activity is more beneficial to balance, further studies assessing these activities are suggested, as well as a specific training program for each one of these activities.

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