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ORIGINAL RESEARCH

Comparison of postural balance among groups of women with different age ranges

Comparação do equilíbrio postural entre grupos de mulheres com diferentes faixas etárias

Comparación del balance postural en un grupo de mujeres de franjas etarias distintas

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ABSTRACT | Aging impairs the ability of the central nervous system (CNS) to perform the processing of signals from the sensory systems, which are responsible for maintaining the body balance, reducing the capacity of modifying adaptive reflexes. This study aimed to compare the postural balance among women of different age ranges. A total of 60 women participated in the study: 20 from the young group (YG), 20 from the adult group (AG) and 20 from the elderly group (EG). Center of pressure (COP) data were collected using a force plate AMTI OR6-6. The variables analyzed were the range of anteroposterior (COPap) and medial-lateral (COPml) displacement of COP. Three tries with eyes open (EO) and three tries with eyes closed (EC), lasting 30 seconds for each one, were performed. The results show statistically significant differences in COPml with EO between YG and EG (p=0.10). No statistically significant differences were found in the COPap variable. We conclude that there is an increased postural sway in the elderly in this study compared to young women.

Keywords | Postural Balance; Women; Aging.

RESUMO | O envelhecimento compromete a habilidade do sistema nervoso central (SNC) de realizar o processamento dos sinais dos sistemas sensoriais, os quais são responsáveis pela manutenção do equilíbrio corporal, diminuindo a capacidade de modificações dos reflexos adaptativos. Este estudo objetivou comparar o equilíbrio postural entre mulheres de diferentes faixas etárias. Participaram da pesquisa 60 indivíduos do sexo feminino, sendo 20 do grupo jovem (GJ), 20 do grupo adulto (GA) e 20 do grupo idoso (GI). Os dados do centro de pressão (COP) foram coletados por meio de uma plataforma de força AMTI OR6-6. As variáveis analisadas foram amplitudes de deslocamento do CQP nos eixos anteroposterior (COPap) e médio-lateral (COPml). Foram realizadas três tentativas de olhos abertos (OA) e três tentativas de olhos fechados (OF), com duração de 30 segundos cada. Os resultados apontam diferenças estatisticamente significativas no COPml na condição de OA entre GJ e GI (p=0,10). Na variável COPap não foram encontradas diferenças estatisticamente significativas. Conclui-se que há um aumento da oscilação postural nas idosas neste estudo, quando comparadas a mulheres jovens.

Descritores | Equilíbrio Postural; Mulheres; Envelhecimento.

RESUMEN | El envejecimiento compromete la habilidad del sistema nervioso central (SNC) en realizar el procesamiento de signos de los sistemas sensoriales, los cuales son responsables de la manutención del balance corporal, lo que disminuye la capacidad de modificaciones de los reflejos de adaptación. En este estudio se pretendió comparar el balance postural de mujeres en distintas franjas etarias. Han participado del estudio 60 mujeres, siendo 20 del grupo joven (GJ), 20 del grupo adulto (GA) y 20 del grupo de personas mayores (GPM). Se recolectaron los datos del centro de presión (COP) mediante la plataforma de fuerza AMTI OR6-6. Las variables evaluadas fueron amplitudes de

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desplazamiento del COP en el eje anteroposterior (COPap) y medial-lateral (COPml). Se llevaron a cabo tres intentos de ojos abiertos (OA) y otros tres de ojos cerrados (OC), con duración de 30 segundos cada uno. Los resultados mostraron diferencias estadísticamente significativas en COPml en la condición del OA entre el GJ y el GPM (p=0,10). En la variable COPap no se encontraron diferencias estadísticamente significativas. Se concluye que hubo un aumento en la oscilación postural en el grupo de personas mayores en comparación con el grupo joven.
Palabras clave | Balance Postural; Mujeres; Envejecimiento.

INTRODUCTION

Postural control is of fundamental importance to human actions in unstable conditions, and versatile enough to allow rapid starts of movement[1]. It has the ability to keep the body stable, due to the maintenance of the projected mass center within the area of support formed by the base feet[2,3,4].

The postural control system depends on three sensory systems: vestibular, proprioceptive, and visual[5,6]. The first one is responsible for the perception of angular and linear accelerations[5,7,8]; the proprioceptive allows the perception of the body and limbs in space in a reciprocity relation; and the visual one provides reference to verticality[8].

The maintenance of the postural balance depends on the integrity of these systems, but also on the sensory interaction by the central nervous system, which involves visual and spatial perception, an effective muscle tone, which adapts quickly to change, and finally muscle strength and joint flexibility[8]. The sensory organization consists of the ability of the CNS in selecting, supplying, and matching the vestibular, visual, and proprioceptive stimuli[8].

When the proprioceptive and visual information are absent or reduced, the SNC recognizes the vestibular system as the main source of sensory information. However, older adults have changes in this system, failing to employ the data provided by it effectively, showing imbalances and increased body sway[9,10].

As the chronological age increases, the human body goes through a period of transformations that generates decline in some physical abilities, such as decreased flexibility, agility, coordination, joint mobility and, mainly, balance[11]. Due to the aging process, the postural control components are affected by senility, decreasing the compensatory ability of the system, leading to an increase in instability[4,12-14].

Although there are several studies regarding the increase in postural instability of older adults[4,12-14], there is a gap in the literature about the so-called normal reference values of postural balance. This ultimately hinders the understanding of how this variable behaves in different age groups, but there are no studies that show us from what age group the decline in postural control starts. Since women have a higher risk of complications due to falls, related to a greater propensity to develop osteoporosis (WHO, 1994)[15], this study aimed to compare the postural balance between women from different age groups, with the initial hypothesis that older women have a greater postural sway than adult and young women.

METHODOLOGY

Research Subjects

The group studied was comprised by 60 individuals[16] of the female gender, being 20 from the young group (YG), 18 to 25 years old; 20 from the adult group (AG), 30 to 55 years old; and 20 from the older adults group (OAG), over 60 years old. The research was disseminated through posters and the volunteers were selected according to the inclusion criteria of the study.

To participate in the study, the subjects signed an Informed Consent Form. Inclusion criteria were: female gender, at least 18 years old, and not having any cognitive losses. Exclusion criteria were: having osteomioarticular problems (minus the ones related to the longitudinal arch of the foot), physical disabilities and/or mental, having a Body Mass Index greater than 30 kg/m^2[17], having hypertension or diabetes, labyrinthitis, spine ache, or other problems that might interfere with balance, and practicing regular physical activity more than twice a week[18]. The Mini Mental State Examination was performed in the older women[19]. The study was carried out complying with the ethical aspects following the principles of CNS Resolution 196/96, being approved by the Ethics and Research Committee of the institution (CAAE - 08398612.8.0000.5346).

Tools for data collection

Individuals selection

For the assessment of the individuals' BMI, a Welmy brand stadiometer with a resolution of 0.5 cm to measure the height, and a Welmy brand digital scale with a resolution of 0.1 kg for the measurement of body mass were used. The Mini Mental State examination was performed to assess whether there was a cognitive loss in the older adults group[19], which is characterized as a 30-point questionnaire used for tracking cognitive losses. Older women who have obtained a score of less than 25 points were excluded from the study.

Postural Balance

For the acquisition of data regarding the postural balance, the AMTI force platform model OR6-6-2000 was used (Advanced Mechanical Technologies, Inc.).

The sampling rate of the platform was of 100 Hz. The raw data of force and moment obtained by the platform were filtered with a low-pass Butterworth filter of 4th order and cutoff frequency of 10 Hz. After being selected, these data were used to calculate the coordinates of the center of pressure, from which the variables of interest derived.

The variables used were anteroposterior COP displacement amplitude (COPap) and COP medial-lateral displacement amplitude (COPml), which, when presenting higher values, indicate that there was a greater postural sway.

Procedures for data collection

The collections were made in the Biomechanics Laboratory of a higher education federal institution, where the subjects received a brief clarification of the procedure of collection and the older women performed the Mini Mental State Examination. After that, the evaluations of stature, body mass, and postural balance were performed while the subjects were barefoot. For the postural balance evaluation, individuals were instructed to stand on top of the strength platform in standing position with their feet directed forward and distanced approximately at the width of the hip. The position of the feet was marked on a sheet of paper so that all attempts were carried out with the same placement. During the test, the individual remained with the head directed ahead in two conditions: eyes open (EO) with focus set a target at a distance of approximately 2 meters, and eyes closed (EC), with the arms beside the body. Each attempt lasted 30 seconds, three with the eyes open, and three with the eyes closed. Individuals who use glasses remained with them during the collection of the data. There was a short break between each attempt, which consisted in the individual leaving the platform and returning to it.

The Shapiro-Wilk test was used to check data normality. As not all data showed normal distribution, a logarithmic transformation was used. The descriptive statistics of the data and the comparison between the groups were performed through the One-Way ANOVA test, along with the Bonferroni post-hoc. The statistical package used was the SPSS 17.0. The significance level adopted was 5% (α=0.05).

RESULTS

The descriptive results of the study are presented in Tables 1, 2, and 3.

The results show statistically significant differences in the COPml on the eyes opened condition between the YG and the OAG (p=0.01). However, with the eyes closed we did not observe any difference. In the COPap variable, we did not find any statistically significant differences in the conditions.

Table 1. Descriptive statistics of the characteristics of the research groups

	Age (years)		Mass (kg)		Height (m)	
	Average	Standard Deviation	Average	Standard Deviation	Average	Standard Deviation
YG	21.90	1.41	60.79	6.30	1.64	0.07
AG	43.90	8.17	58.79	6.63	1.59	0.06
OAG	66.55	6.00	63.90	10.93	1.55	0.05

YG: Young group; AG: Adult group; OAG: Older adults group

Table 2. Descriptive statistics of the variables of postural balance and ANOVA between groups

	EO				EC			
	COPap		COPml		COPap		COPml	
	Average ±SD	p	Average ±SD	p	Average ±SD	p	Average ±SD	p
YG	0.24±0.14	0.629	-0.06±0.15	0.013*	0.27±0.16	0.986	-0.05±0.16	0.154
AG	0.26±0.13		0.00±0.21		0.28±0.12		-0.00±0.16	
OAG	0.28±0.11		0.10±0.17		0.28±0.11		0.06±0.23	

* Indicate statistically significant differences for the p<0.05; COPap: amplitude of anteroposterior displacement of the center of pressure; COPml: range of medial-lateral displacement of the center of pressure; SD: standard deviation; YG: young group; AG: adult group; OAG: older adults group

Table 3. Descriptive statistics of the medial-lateral displacement amplitude of the COP, with eyes opened and from Bonferroni post-hoc

		Average ± SD	p
Young Group	COPml	0.90±0.34	0.010*
Older adults Group		1.37±0.46	

* Indicate statistically significant differences for the p<0.05. COPml: medial-lateral displacement amplitude of the force center

DISCUSSION

This study aimed to compare the postural balance between women from different age groups. The results show that without manipulating visual information, the oscillation in the medial-lateral direction of the older women studied is higher than that of young women.

Carvalho and Almeida[20] suggest that deficits in the balance of older adults may be related to structural and functional changes in the sensory and motor systems, as well as to problems in the integration of sensory information. The sensory information can change the postural balance in older adults, since the manipulation of systems involved in postural control provides change in balance[21].

With aging, certain central nervous system skills are compromised. Among them, we can list regions that perform signal processing of the visual, proprioceptive, and vestibular systems, characterized by the maintenance of postural balance, changing adaptative reflexes in a negative way. The degenerative processes can lead to postural imbalances problems for the older adults population, in addition to vertigo, dizziness and/or triggering factors for falls, and consequently fractures, loss of mobility, and loss of independence in of daily living activities[4,22,23].

The visual system of older adults undergoes a series of changes, such as decreased visual acuity and field, decrease in speed of adaptation to the dark, and increase in the luminous perception threshold[24]. This decrease in visual capacity is associated with increased body sway as visual inputs decrease in balance tests[25].

With reduced visual perception, balance control and obstacle avoidance skills are impaired due to misjudgment of distances and misinterpretation of spatial information[22]. Lord[21] observed that, among the various visual changes, reduced depth perception is one of the strongest risk factors for multiple falls from residents in a community of older adults. In addition to that, older adults present a decrease in the ability of seeing images with low spatial frequency due to physiological aging, thus damaging visual contrast[27]. It is believed that these visual deficits of older adults justify why we found difference only in the eyes open condition, because with the eyes closed, the visual system is inhibited for both young and older women.

In a study by Teixeira et al.[28], in which older adults' active balance and the influence of the manipulation of sensory stimuli were evaluated, the results found contrast with the ones we found. In the COPml, the authors found no difference in the balance of older adults in EO and EC conditions. However, this study was conducted with active older adults, comparing a condition of sensory manipulation with the other, and not with a young group. Another important consideration is that if we observe the average and the standard deviation of the COPml in the study from Teixeira et al.[28] with our results, we see that active older adults sway a lot less (0.78cm ± 0.43cm) than sedentary older adults (1.37cm ± 0.46cm), emphasizing the importance of physical activity for older adults.

The difference found between the YG and the OAG only occurred in medial-lateral direction, corroborating with Winter[7], who suggests that postural control

mechanisms are not the same in the medial-lateral and anteroposterior directions. According to the author, the placement of supports can influence directly in the creation of strategies for the control of postural balance. In this study, the feet were placed in parallel, therefore, postural balance is offset by the plantar and dorsal flexor muscles of the ankle. When the oscillation increase its magnitude or these muscles are prevented from acting, the strategy of the hip is used to re-establish body stability[7,29].

In addition to the aforementioned, Winter[7] points out that the strategy of the hip is the primary stabilizer of the balance in the medial-lateral direction, being related to the mechanism of increase of vertical force in the supports. However, there is a decline of up to 40% of the muscle strength of people aged over 50 years[30]. Besides, the hip muscle weakness has been seen as an important risk factor for the increase in postural instability, and consequently, the increased occurrence of falls[31], as it was reported in the study of Wingert et al.[32], in which the authors suggest that older adults have significantly higher errors of proprioception of the hip when compared to young and middle-aged adults. These proprioceptive deficits and strength in the hip joint of older people can justify greater oscillation on medial-lateral direction found in the group when compared to the young group.

CONCLUSION

We concluded that there is an increase in postural sway in the older women of this study when compared with young women. However, this difference was not found among the young and older adults when comparing both groups with adult women, and nor when suppressing visual information.

Older adults' sway was higher than that of young people only in medial-lateral direction, while in anteroposterior direction no differences among the groups were observed.

We suggest that further studies are performed with a larger numbers of individuals, and also that an evaluation of the dynamic balance is performed.

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