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CORRELATION BETWEEN FEET SENSITIVITY AND THE BALANCE OF ACTIVE ELDERLY IN THE COMMUNITY

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Abstract: The population has been aging more and more, considerably increasing the number of elderly people in the country. Linked to the aging process are the physiological and anatomical changes, which may influence the individual's physical capacity, making them more susceptible to falls. The purpose of the present study was to evaluate and correlate possible sensory alterations of the foot with the balance of the active elderly in the community. Fifteen active elderly people of both genders between 65 and 75 years old participated, classified by means of the International Physical Activity Questionnaire, who presented independent functional gait or with the aid of accessories; in addition, preserved cognitive assessed through the Mini Mental Examination Scale. To assess plantar sensitivity and balance, the esthesiometer and the Berg Functional Balance Scale were applied. As a statistical test, the Shapiro-Wilk test was used, which showed a correlation between the variables analyzed. Thus, the sensory alterations of the foot support the idea that there is a decrease in balance with the loss of plantar skin sensitivity in active elderly people in the community in the studied group.
Keywords: Aging; postural balance; sensory threshold.

INTRODUCTION

The average life expectancy in Brazil has increased, reaching 75 years, above the world average of 71.4. There has also been a considerable expansion where the number of elderly people in the country has expanded considerably (WHO, 2016).

Despite the fact that the worldwide phenomenon of the population aging process is one, there are changes in postural control, proprioceptive and sensorimotor information. These factors, which directly influence a decrease in body balance and sensitivity of the foot of the elderly, causing limitations in the execution of functional activities (SHAFFER and HARRISON, 2007).

According to Diana; Toledo and Barela (2010) somatosensory sensitivity changes with age, varying according to the sensory modality and body region, where there is a small decrease in the tactile sensitivity of the hand when compared to the plantar region of the feet, which is affected by degeneration. of skin receptors, limiting protective reactions and perception of the environment, making the elderly more susceptible to possible falls.

Knowledge of factors related to both changes in foot sensitivity and balance play a fundamental role in the rehabilitation and reintegration of the functional capacity of the active elderly (ARANEDA and SOLORZA, 2013), since their health is directly related to their lifestyle habits and level of physical activity, making it necessary to analyze whether there is interference in the probability of falling (PIMENTEL and SCHEICHER, 2009) so, to assess these factors, tools such as the Berg Balance Scale (ANSAI et al., 2014) , Stesiometer (FENG; SCHLOSSER and SUMPIO, 2011) and the International Physical Activity Questionnaire -IPAQ (MAZO and BENEDERRI, 2010) are used, evidencing the importance and reliability of such tools in the literature.

Taking all this into account, the objective of this study is to determine whether sensory changes in the foot may promote variations in balance values in active elderly patients in the community.

DESCRIPTION (MATERIALS AND METHODS)

The present study was submitted to and approved by the Research Ethics Committee and Scientific Merit of the Centro Universitário Hermínio Ometto under protocol number 1.681.065/2016. Therefore, it was carried out at the Clínica Escola de Fisioterapia of the Centro Universitário Hermínio Ometto - Uniararas, from November to December 2016. Fifteen elderly people of both genders between 65 and 75 years of age, active classified by age, were invited to the study. through the completion of the International Physical Activity Questionnaire - IPAQ (CELAFISCS, 2016), who had independent functional gait or with the aid of accessories such as a cane or walker; and preserved cognitive assessed through the Mini Mental Examination Scale (BRUCKI; NITRINI; CARAMELLI and OKAMOTO, 2003).

MATERIALS

- 01 room for triage and interview with patients;
- 01 air-conditioned room that allows the circulation of volunteers and the accommodation of the ergometers listed below;
- 01 Stesiometer Kit containing a set of 6 nylon monofilaments number 612, 38mm long and with different diameters - brand: SORRI® Bauru-SP;
- 01 file binder and office supplies;
- 01 computer and printer.

METHODS

All participants were informed about the purpose of this study and those who agreed to participate signed the free and informed consent form - TCLE. The work was carried out at the Clínica Escola do Centro Universitário Hermínio Ometto (FHO/UNIARARAS) – laying room, in the afternoon at room temperature.

PROTOCOL OF ASSESSMENTS

- The elderly underwent the Mini Mental State Examination (BRUCKI; NITRINI; CARAMELLI and OKAMOTO, 2003) as a preliminary test to avoid cognitive disorders and were clinically evaluated to verify the presence of independent gait;
- The Berg Functional Balance Scale (BERG KO, 1996) was applied to determine the patient's dynamic balance, consisting of fourteen tasks where the score of each item varies from 0 (poor balance) to 4 (normal balance) and the total score is 56 points (BRETAN; PINHEIRO e CORRENTE, 2010). And the Stesiometer, which assesses and monitors the degree of skin sensitivity to the perception of forces exerted as stimuli to the nerves sensitive to light touch and pressure, reflecting the functional thresholds considered most critical for the hands and feet, comprising six ranges between 0, 05gf (0.49mN) and 300gf (2.94N) (FRIST, 2016). **Note.:** The applicability of the Estesiometer and Berg was a blind study, that is, applied by another trained subject with a proper understanding of the scales, in order not to compromise and/or influence in any way the research objective.
- Afterwards, the correlation between the results of the two scales was performed.

INCLUSION CRITERIA

- Active elderly people between 65 and 75 years old classified through the International Physical Activity Questionnaire - IPAQ short version (CELAFISCS, 2016);
- Female and male gender;
- Independent gait or with the aid of accessories such as a cane or walker;
- Cognitive preserved.

EXCLUSION CRITERIA

- Sedentary, very active or irregularly active men and women (classified by the IPAQ) and outside the age group;

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- Elderly people who presented sensory changes and pathologies that could lead to sensory losses, such as neuritis, diabetes, etc. (verified in previous anamnesis);
- Congenital clubfoot, Poliomyelitis, deformities, calluses and/or extreme scarring on the feet (verified in previous anamnesis);
- Vertigo (verified in previous anamnesis);
- Visually and/or hearing impaired;
- Swollen and/or amputated lower limbs.

DADOS DATA ANALYSIS METHODOLOGY

For data analysis, the SPSS 20.0 statistical program was used. Descriptive statistics (mean and standard deviation) and Shapiro-Wilk test were performed to verify the normality of data distribution. As part of the variables rejected the hypothesis of normality, the Spearman correlation test was used. A significance level of $p<0.05$ was adopted.

RESULTS AND DISCUSSION

As the results are collected on the symbolic scale of colors and functional levels of sensitivity specific to the use of the esthesiometer to record the results, a mapping form was used representing both feet applied only once, as shown in Figure 1 below.

During the test, the patient's vision was obstructed in order not to observe the examined area and the examiner kept the device cable perpendicular to the skin surface with the nylon filament pressed for approximately 1.0 or 1.5 seconds at a distance of 2 cm. of the area to be tested (BORGES and CARDOSO, 2010). The patient was asked to answer "yes" when he felt the touch of the monofilament on the skin.

To enable a statistical analysis, a scale from 1 to 6 was created, associated with colors, with 1 being the best sensitivity and 6 the worst, as shown in Table 1.

The colors indicated by each patient for each point on the foot were replaced by the corresponding numbers, which in turn were used to calculate the average sensitivity for each of these points. After analyzing the data, the described in Table 2 and 3 can be observed.

There was a significant relationship between body balance (Berg) and sensitivity points: mean p2 ($p=0.056$); mean p3 ($p=0.014$) and mean p8 ($p=0.0305$) therefore, the study group delimited in this research shows a decrease in plantar cutaneous sensitivity in the feet of the elderly, which is also found in the literature, which assumes that there is a decrease in the tactile sensitivity of the feet with aging, whose intensity may suffer interference according to nationality and assessment on different days (JAIN et al., 2008), and there is also some discrepancy in the literature about whether or not there is a significant difference in loss in certain planting regions (ARANEDA and SOLORZA, 2013).

Another focus of the study is the direct relationship between decreased plantar sensitivity and reduced balance and functional capacity, with a consequent increase in the risk of falling in the elderly (FREITAS; CARVALHO and BOAS, 2013). Shaffer and Harrison (2007) examined the effects of aging on different sensory structures and stated that there is a large, varied and non-uniform decline in the morphology and physiological functions of the various sensory structures examined, with loss of proprioception, vibratory and discriminative sensitivity of the sensory structures. distal regions of the lower limbs. According to them, there is evidence linking proprioceptive and sensory-cutaneous losses with decreased balance in the elderly. As well as, they claim that the effects of aging are felt in the sensory fibers before reaching the motor ones.

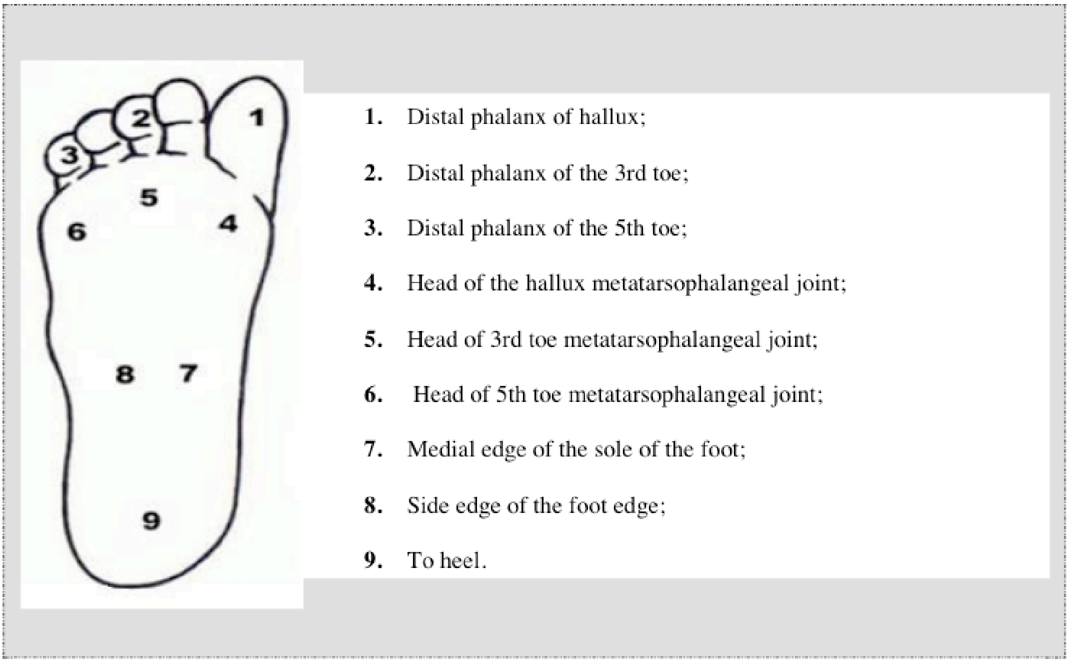

Figure 1. Application of the specific territories of the Stesiometer.

Source: SOUZA *et al.*, 2005

Punctuation monofilaments	**Specific colors of monofilamentos**	**Functional levels of sensitivity**
1	green -	0,05g
2	blue -	0,2g
3	Violet -	2,0g
4	red (closed)-	4,0g
5	red (mark with X)-	10,0g
6	red -	300g

Table 1. Numerical scale associated with the esthesiometer-specific color scale and sensitivity.

	Patients	N=15
	Age	67.93 ± 3.28 (years)
	Genre	9 women
P1	PD	2,86 ± 0,639
	PE	2,66 ± 1,17
P2	PD	2,80 ± 0,56
	PE	2,53 ± 0,74
P3	PD	2,80 ± 0,56
	PE	2,60 ± 0,73
P4	PD	2,80 ± 0,56
	PE	2,60 ± 0,73
P5	PD	2,86 ± 0,51
	PE	2,60 ± 0,73
P6	PD	2,86 ± 0,63
	PE	2,60 ± 0,73
P7	PD	2,73 ± 0,45
	PE	2,53 ± 0,74
P8	PD	2,80 ± 0,41
	PE	2,60 ± 0,73
P9	PD	3,06 ± 0,59
	PE	3,26 ± 0,88
AVERAGE	P1	2,76 ± 0,75
	P2	2,66 ± 0,55
	P3	2,66 ± 0,55
	P4	2,70 ± 0,59
	P5	2,73 ± 0,49
	P6	2,73 ± 0,59
	P7	2,63 ± 0,54
	P8	2,70 ± 0,49
	P9	3,16 ± 0,69

PD: Right foot; PE: Left foot; P1 to P9: Point

Table 2. Characteristics of the individuals who participated in the study. Values in mean and standard deviation.

		Variables	RhO	p
Berg scale	**P1**	PD	-0,213	0,445
		PE	-0,396	0,144
	P2	PD	-0,376	0,167
		PE	-0,459	0,085
	P3	PD	-0,376	0,167
		PE	-0,412	0,127
	P4	PD	-0,376	0,167
		PE	-0,351	0,199
	P5	PD	-0,345	0,208
		PE	-0,412	0,127
	P6	PD	-0,213	0,445
		PE	-0,412	0,127
	P7	PD	-0,389	0,152
		PE	-0,350	0,201
	P8	PD	-0,215	0,441
		PE	-0,170	0,544
	P9	PD	-0,042	0,881
		PE	-0,016	0,955
	AVERAGE	P1	-0,353	0,197
		P2	-0,502	**0,056***
		P3	-0,619	**0,014***
		P4	-0,393	0,147
		P5	-0,454	0,089
		P6	-0,333	0,225
		P7	-0,381	0,161
		P8	-0,284	**0,0305***
		P9	-0,029	0,917

* p<=0.05; PD: Right foot; PE: Left foot; P1 to P9: Sensitivity point

Table 3. Results of Spearman's correlation test between sensitivity points and body balance (Berg).

It is explained that the reduction in the number of mechanoreceptors in the feet and the increase in the threshold of vibratory and cutaneous plantar excitability in the elderly is a cause of decreased balance, and it is common to find loss of plantar sensitivity in elderly people who report falls (BRETAN; PINHEIRO e CORRENTE, 2012). There is a relationship between plantar sensitivity and postural control: asymmetries in postural control can be induced by the loss of plantar sensitivity, leading to loss of synchronization of the lower limbs, a factor that increases the risk of falls where plantar sensitivity influences the speed of COP (center of pressure), denoting that the lower plantar sensitivity leads to worse postural control (UEDA and CARPES, 2013). There are also reports of a direct relationship between the results of the Berg Balance Scale (BSE) and the results of plantar sensitivity tests (esthesiometer) (BRETAN; PINHEIRO and CORRENTE, 2010).

Decreased plantar sensitivity may increase the tendency to fall, due to the loss of information for balance control by encoding changes in pressure under the foot, especially during gait. Such information reveals to the brain the body position and this, if necessary, generates postural reflexes to maintain the vertical position (DIANA; TOLEDO and BARELA, 2010).

All these findings culminate in two important clinical applications: the need to perform plantar skin sensitivity tests, such as the esthesiometer, as a way of complementing and ensuring greater precision in the assessment of balance in the elderly, and the importance of performing a careful analysis to choose the foot stimulation activities in the treatment of the elderly (BORGES and CARDOSO, 2010), suggesting that increasing tactile information would be a useful instrument in this intervention, which can be achieved, for example, with the use of textured or vibrating insoles. (ABOUTORABI *et al.*, 2015).

CONCLUSION

There is a decrease in plantar skin sensitivity in the foot of the active elderly in the community, with losses measured by the esthesiometer in the studied group, as well as alterations in postural control, which can be a cause of instability, loss of balance and, consequently, increased risk. of falls of the elderly tested.

Clinically, this establishes two important actions: interventions that increase sensory information for the feet of the elderly, in addition to the need to promote more studies that act in the prevention and maintenance of the functionality of this individual living in this way, with greater autonomy and independence in senescence.

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