COMPARISON OF STATIC POSTURAL BALANCE BETWEEN HEALTHY SUBJECTS AND THOSE WITH LOW BACK PAIN

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ABSTRACT

Objective: To compare the static postural balance between women suffering from chronic low back pain and healthy subjects, by moving the center of pressure. Methods: The study included 15 women with low back pain (LBP group) and 15 healthy women (healthy group). They were instructed to remain in standing on the force platform for 30 seconds. We analyzed the area and the speed of displacement of center of pressure of both groups. Data analysis was performed using the Student's t-test, with significance of 5%. Results: Individuals with chronic low back pain showed a larger area of displacement of the center of pressure relative to the healthy ones but there was no significant difference in the speed of displacement of the center of pressure. Conclusion: Individuals with chronic low back pain had alterations in static balance with respect to healthy ones. ***Level of Evidence III, Prognostic Studies.***

Keywords: Low back pain. Postural balance. Body weight.

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INTRODUCTION

Low back pain is defined as painful symptoms in the lower lumbar, lumbosacral or sacroiliac regions of the spinal column.[1,2] This type of pain is characterized as chronic when it persists for more than six months, and may be associated with chronic pathological processes that cause continuous or recurring pain.[3,4] Its onset is often imprecise, with periods of exacerbation and regression.[5]
Low back pain is an important clinical, socioeconomic and public health problem that affects 70% of the population in general.[6,7] It mainly affects the population of economically active age, and can be highly incapacitating besides being one of the causes of absenteeism. This type of continuous pain over long periods of time affects some aspects of the individual's life.[7]
Recent studies indicate that patients with chronic low back pain present diminished postural control, manifesting problems in balance. Postural balance is controlled by sensory information, central processing and neuromuscular responses.[8] The sensory components include the vestibular, visual and somatosensory (cutaneous and proprioceptive) systems, which provide information to the central nervous system, which in turn sends nerve impulses to the muscles to coordinate and control the body segments.[9]
Alterations in proprioception are pinpointed as one of the possible causes of alteration of postural balance in individuals with low back pain. This type of pain is associated with diminished proprioception and muscle strength, which can affect the quality of the sensory information and compromise the relation between postural responses and sensory information.[8]
The force platform is commonly used to measure the postural balance by analyzing the center of pressure (CoP). The CoP is a displacement measure, which is influenced by the center of gravity position (CG).[10] Small amplitude CoP displacements reflect a "good" control of balance, while higher displacement amplitudes reflect "poor" control.[11]
Thus, it becomes important to identify the balance deficit in individuals with chronic low back pain in order to assist in their rehabilitation. The aim of the study was to compare static postural balance between individuals with chronic back pain and healthy women, using the area and the average speed of displacement of the center of pressure.

MATERIAL AND METHODS

Study characterization

This trial is a noninterventionist, transversal exploratory study, approved by the Institutional Research Bureau of UNIOESTE under opinion no. 495/2009-CEP. For the performance of the study, the individuals agreed to take part and signed the Informed Consent Form.

All the authors declare that there is no potential conflict of interest referring to this article.

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Sample characterization

The sample was composed of 30 women, with age ranging between 30 and 50 years. They were divided into two groups: Healthy Group (HG / n=15) composed of employees of the Rehabilitation Center of the Physiotherapy Clinic of UNIOESTE, and Low Back Pain Group (LBPG / n=15) composed of individuals with clinical diagnosis of chronic low back pain, recruited from the waiting list of the Rehabilitation Center of the Physiotherapy Clinic of UNIOESTE. (Table 1)

Individuals who did not report any chronic or acute musculoskeletal disease, vestibular or visual abnormalities, diabetes or other systemic diseases and who did not make regular use of any kind of medication, were included in the healthy group (HG).

In the low back pain group (LBPG) the inclusion criteria were: a) report of persistent low back pain lasting for more than six months; b) clinical diagnosis of specific or nonspecific low back pain; c) average score of pain in the last two months, prior to the evaluation, between three and seven, measured by the Visual Analogue Scale (VAS); d) subjects whose clinical and physical characteristics were compatible with categories 1 and 2 of the guidelines of evaluation and treatment proposed by the American College of Physicians and by the American Pain Society.[12] The exclusion criteria for this group were: a) low back pain whose clinical history could suggest classification in category 3 of the guidelines of evaluation and treatment proposed by the American College of Physicians and by the American Pain Society;[12] b) osteomuscular lesions in other joints and clinically diagnosed rheumatic diseases; c) use of drugs that would affect the central nervous system or balance, such as sedatives or tranquilizers; d) patients with clinical history of spine surgery; e) alterations of the center of gravity such as in pregnancy; f) diabetic individuals; g) individuals with temporomandibular dysfunctions; h) individuals with vestibular dysfunctions; i) chronic alcoholics or use of alcohol in the 24 hours preceding the tests; j) individuals with important visual acuity impairment (characterized by the need for help from other people or of aid devices to carry out daily activities under conditions of deprivation of the use of eyeglasses or lenses).

Evaluation procedures

The static postural balance was measured using the kinetic data of the center of pressure, obtained through a force platform (AMTI, model OR6-6, USA), with a data acquisition frequency of 200 Hz.

The height and body weight of the volunteers were measured prior to the data collection in order to perform the individual calibration of the platform through these values. Throughout the collection the participants maintained an erect posture on the force platform, standing on both feet, with the distance between the feet equal to the width of the hip and arms along the body. The data were collected with the eyes open, and each subject was asked to maintain as stable an erect posture as possible and to fix their eyes on a point marked on the wall at a distance of 3 meters, at eye level, as recommended by Freitas and Duarte.[13] Three attempts were collected for each subject, lasting for 30 seconds for each one of them with a two-minute interval. The data were analyzed 10 seconds after the start of signal acquisition, for the center of pressure to be stabilized.

The analyzed variables were the area of displacement of the center of pressure (A_{CoP}) and the average speed of displacement of the center of pressure (V_{CoP}), based on the mean value of the attempts.

For analysis, the data recorded in the force platform were processed in a specific routine (MATLAB, MathWorks, ver. 7.0) to calculate the A_{CoP}, which estimates the dispersion of CoP data through the area of the displacement map in the anterior-posterior direction versus displacement in the mediolateral direction, based on 95% of their points in ellipse format and calculation of the V_{CoP} based on the relation of the trajectory of the displacements of CoP in both directions and time of attempt. In the statistical analyses, the values of A_{CoP} and V_{CoP} were compared between the groups, through Student's t-test, with significance value of 5%.

Table 1. *Characterization of the sample with mean and standard deviation. LBPG – Low back pain group; HG – Healthy group.*

Variables	LBPG (n=15)	HG (n=15)
Age (years)	40±7.03	42±5.78
Height (m)	1.67±0.03	1.69±0.04
Weight (Kg)	64.2±6.08	61±3.20

RESULTS

Table 1 presents the sample characterization, through anthropometric data and the Visual Analogue Scale (VAS) of the evaluated groups.

The values of the area of displacement of the center of pressure (A_{CoP}) and of the average speed of displacement of the center of pressure (V_{CoP}), in the low back pain (LBPG) and healthy (HG) groups are illustrated in Figures 1 and 2, respectively.

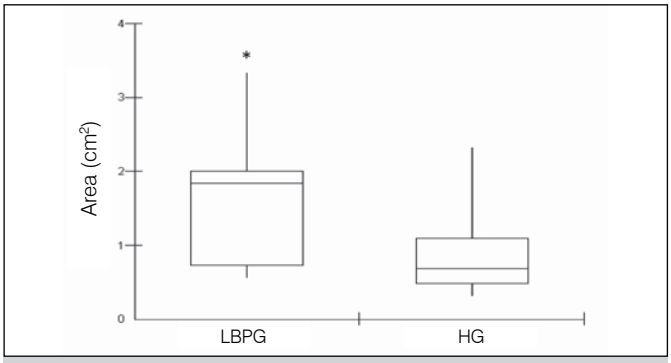

Figure 1. *Mean of the displacement area of the center of pressure (A_{CoP}). LBPG – Low Back Pain Group. HG – Healthy Group. * p<0.05.*

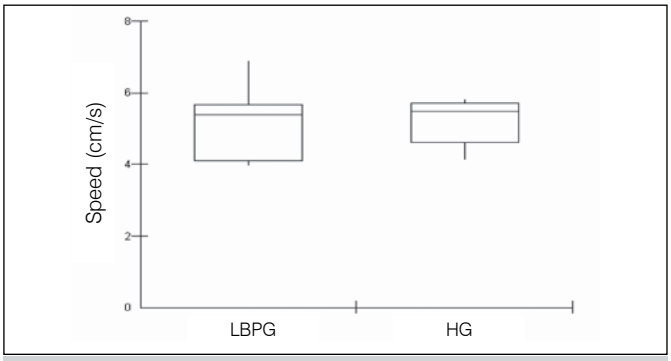

Figure 2. *Mean displacement speed of the center of pressure (V_{CoP}), LBPG – Low Back Pain Group. HG – Healthy Group.*

The mean of the area of displacement observed was 1.59±0.93 cm^2 in LBPG, and 0.89±0.58 cm^2 in HG, showing a statistically significant difference (p=0.01).
The average speed of displacement of the center of pressure (V_{CoP}) observed was 5.14±0.95 cm/s in LBPG, and 5.19±0.61 cm/s in HG, without statistically significant difference (p=0.84).

DISCUSSION

Low back pain may alter the sensory information for postural control, originating from the paraspinal muscles. This may be related to an increase in the parasynaptic inhibition of muscle input due to the pain. Adaptation of the cortical processing of the proprioceptive information can occur in chronic low back pain.[14]
A significant difference was found in the A_{CoP} between the groups analyzed in this study, which suggests a reduction of postural control in individuals with low back pain. The factors that cause this reduction include limited ability for use of a hip strategy in individuals with low back pain, due to the reduction in the strength and flexibility of the lumbopelvic region, as well as the deficit in the perception of position of the hip region, using the ankle strategy to maintain the erect posture for this reason.[15,16]
Mann et al.[14] analyzed the amplitude of the center of pressure displacement in the anterior-posterior (AP) and mediolateral (ML) directions and the displacement speed in healthy young women and women with low back pain with eyes open and closed, encountering a significant increase in the AP and ML displacement in the low back pain group both with eyes open and closed. In relation to V_{CoP}, the authors observed a significant increase in the low back pain group with eyes closed.
This study corroborates the findings of the present study, which observed an increase in the A_{CoP} (AP and ML displacement) in individuals with chronic low back pain analyzed only with eyes open. Moreover, there were no significant differences found in the V_{CoP} with eyes open in either one of the studies. This may be due to the fact that the individuals presented moderate pain intensity during the data collection and, despite the alteration of proprioception, had intact information systems (visual, vestibular and somatosensory). However, Brumagne et al.,[16] analyzing the anterior-posterior center of pressure (CoP) displacement on stable and unstable surface in individuals with recurrent low back pain compared to healthy individuals, did not find significant difference between the groups on stable surface. Nevertheless, the authors selected young individuals of both sexes and with average age of 23 years for the sample, while in the present study the sample was only composed of women with average age of 40 years.
Individuals with low back pain can present postural alteration. Considering pain as the only factor that contributes to changes in postural control, this alteration of the normal erect position leads to an increase of lumbar muscle activation, which will result in an increase in the rate of muscle fatigue.[17] These changes in the muscle activation pattern can occur as a strategy to limit spinal movements, regardless of the pain intensity, leading to the alteration of balance.[16,18,19]
The influence of muscle fatigue due to the alteration in the trunk position associated with pain can increase lumbar instability, especially if the individuals present chronic pain.[14,20]
Lemos et al.[21] analyzed the influence of lumbar pain on the balance of athletes from the Brazilian female canoe team and found an increase in the magnitude of CoP displacement in the athletes with presence of pain, which is associated with the results of this study.
Note that the difference in balance can be related to the presence of pain, both in individuals with low back pain and in healthy individuals who engage or do not engage in physical activity.

CONCLUSION

Thus it is concluded that individuals with chronic low back pain present alteration in static postural balance, since there was an increase in A_{CoP} in relation to healthy individuals of a similar age, yet these did not present a significant difference in V_{CoP}.

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