



## SPATIO-TEMPORAL PARAMETERS OF WALKING IN NONSPECIFIC CHRONIC LOW BACK PAIN: A COMPARATIVE STUDY

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### ABSTRACT:

**Objective:** To compare the stride frequency, length, and duration, as well as the horizontal speed and the walking's ratio, in three intensities of displacement (ID) levels between subjects with and without nonspecific chronic low back pain (NCLBP).

**Methods:** The sample was composed by volunteers with NCLBP, (LG/n=6) and healthy subjects (CG/n=7). The preferred horizontal velocity was determined by a treadmill protocol test and the battery of tests was divided into three blocks according to the intensity of the effort: preferred, 0.5 km.h<sup>-1</sup> below and above of the preferred. In each of the blocks volunteers had walked for five minutes while the recording of videos were made, during 20s, at the end of each block. The spatio-temporal parameters of walking (horizontal speed; stride length, duration, and frequency; beyond walking's ratio) were determined by kinematics and routines were developed for the Matlab software. The stride length was normalized by size of the lower limb. It was selected six cycles of stride chosen qualitatively after inspection of the videos. It was used ANOVA mixed model (group effect and ID) for statistical analysis with  $\alpha=0.05$ . **Results:** It was observed that ID caused significant changes in speed, stride length and frequency, although the duration and walking's ratio, which reveals a normal pattern of walking and it is independent of the speed, was not altered. There was not group effect. **Conclusion:** The NCLBP has not have effect on parameters of walking, however, the ID generated changes in the spatio-temporal of walking.

**Key-words:** Low back pain; human locomotion; walking

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### INTRODUCTION

Chronic low back pain (CLBP) is usually associated with functional and psychosocial impairment, and walking is often compromised<sup>[1]</sup>. Walking is an activity with both clinical and functional relevance for its impact on independence and quality of life. However, the impact of back pain on the walking's parameters still needs further understanding given the etiology complexity of this syndrome and the wide range of factors that can contribute to loss of motion<sup>[2,3,4]</sup>. The aim of this study was to compare the stride frequency, length, and duration, as well as the horizontal speed and the walking's ratio, in three intensities of displacement (ID) levels between subjects with and without nonspecific chronic low back pain (NCLBP).

### METHODS

This research was classified as observational study of type ex-post-facto, cross, descriptive and exploratory. Volunteers with NCLBP, both sexes, aged 25 to 59 years, from the Physical Rehabilitation Center (UNIOESTE), were recruited intentionally and not probabilistically to compose the LBP group (LG/43.5±8.8 years, 170.1±6.9 cm, 77.6±14.5 kg). The control group (CG/37.8±7.2 years, 176.5±8.0 cm, 76.2±10.6 kg) was composed by subjects without systemic or musculoskeletal disorders, chronic or acute, in lower limb and/or spine and they were matched for age, weight and height in relation to the LG. The volunteers of LG had to report persistent low back pain for more than three months without radiation to the lower limbs, and the clinical features had to be compatible with the physical assessment and treatment guidelines proposed

by the American College of Physicians and the American Pain Society<sup>[5]</sup> in the category of nonspecific low back pain.

The length of the lower limb ( $L_{LL}$ ), in meters, was obtained by measuring the greater trochanter to the ground through the lateral malleolus in the standing position. On this occasion the subjects were underwent a familiarization period on the treadmill for five minutes. After familiarization, it was determined the preferred self-selected speed (PS) on the treadmill.

The recording of the spatio-temporal parameters was did by kinematics. Four cameras (Casio High Speed - Exilim EX-FH25 HS) were placed obliquely to the treadmill, one at each border of the room. Data acquisition occurred at a frequency of 240 Hz (period =  $1240^{-1}$ ). The battery of tests was divided into three blocks according to intensity of the effort. In the first block each subject walked on a treadmill at preferred speed (PS) previously determined. The order of the two following blocks was selected so that, in one case, volunteers walked lower than PS (LW/ intensity 0.5  $\text{km.h}^{-1}$  below the PS) and the other in higher than PS (HI/intensity 0.5  $\text{km.h}^{-1}$  above the PS). In each block, the subjects walked barefoot for five minutes. To finished each block the subject remained seat for about five minutes. The capture of the images came in the fifth minute of each block to minimize variability between steps and 20s of walking were filmed.

For the spatio-temporal parameters determination was used the software Dvideow. After synchronization of cameras, which ensured that the analyzed range was the same for all cameras, it was selected six cycles of stride chosen qualitatively after inspection of the videos. Each cycle consisted the interval between the moment at foot lost the contact with the ground (take-off) until the next consecutive take-off of the same foot.

In each of the six cycles was determined by visual inspection the frames corresponding to the first take-off, to the time of touch heel on the ground (contact), and to the second take-off which closed the cycle. The stride length was normalized by  $L_{LL}$ . The walking's ratio was considered as the ratio of normalized stride length by stride frequency. The arrays of data from this analysis were treated in routines elaborated with the aid of software Matlab.

For the statistical analysis used the SPSS 15. Comparisons were made by ANOVA - mixed design isolating the main effects of group (having or not having low back pain) and the intensity of displacement. In post-tests, it was applied the Bonferroni. For all statistical tests it was adopted  $\alpha=0.05$ .

## RESULTS AND DISCUSSION

The ANOVA results for the main effects on the intensity of displacement are shown in Table 1. There was not statistical significance in any of the variables for the main effect of group.

**TABLE 1:** Results of ANOVA for spatio-temporal variables: the main effect of intensity of displacement and post tests when relevant.

Variables	Main effect of ID and post tests	Post tests
<b>Lstride</b>	F(2,20)=23.588; p<0.001*	AbXAc p<0.001* AbXVp p=0.013* AcXVp p<0.001*
<b>Dstride</b>	F(1,264, 2.643)=3.006; p=0.072	-
<b>FS</b>	F(2,20)=4.557; p=0.023*	AbXAc p<0.001* AbXVp p=0.001* AcXVp p=0.005*
<b>NWR</b>	F(2,20)=2.768; p=0.087	-
<b>Speed</b>	F(2,20)=6446.763; p<0.001*	AbXAc p<0.001* AbXVp p<0.001* AcXVp p<0.001*

**Caption:** stride length normalized by the length of the lower limb (Lstride), stride duration (Dstride), stride frequency (FS), horizontal velocity (Speed), normalized walking's ratio (NWR). \* Statistical significance (p<0.05).

The effect of velocity on the gait parameters has been reported in other studies, and the speed variation being accompanied by changes in the kinematic parameters<sup>[6]</sup>. Corroborating, it is emphasized that the walking speed is the product of the length and frequency of the stride, but at the same time, these parameters are also determined by the horizontal velocity, and this reflects the complex interaction between mechanical parameters, task demand and motor control<sup>[7]</sup>. This means that changes in spatio-temporal parameters observed in the present study, by the influence of ID, are supported in scientific and technical literature.

As the choice of the relationship between FS and length stride tends to be spontaneous in self selected speeds, even at different intensities of displacement, the walking's ratio (WR) is considered as an index of walking pattern which is independent of speed. Thus, a WR constant at different speeds shows a normal walking<sup>[8]</sup>. As the WR in this study, in the two groups, not showed statistical differences between the three IDs and not there significant effect of group, concluded that all study subjects were skilled enough to adjust their demand kinematic parameters of each task.

Although it has been observed an expected effect of the ID, the lack of group effect is not shared by other studies that investigated the gait between subjects with chronic low back pain and they founded deficits in kinetic and kinematic parameters of walking compared to healthy volunteers<sup>[9]</sup>.

## CONCLUSION

Nonspecific chronic low back pain has not have effect on the parameters of the walking, however the intensity of displacement generated changes in the spatio-temporal of walking.

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