ORIGINAL ARTICLE

# Secondary hyperalgesia in chronic nonspecific low back pain

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## ABSTRACT

**Objective:** Secondary hyperalgesia may be present in chronic nonspecific low back pain. The study compared pressure pain threshold (PPT) in the lumbar and thoracic paravertebral muscles in individuals with non-specific chronic low back pain correlating them with disability, functional mobility, age and body mass index. **Method:** This is a cross-sectional study involving individuals of both sexes diagnosed with non-specific chronic low back pain, aged between 18 and 65 years, with pain of moderate to severe intensity and with pain time of ≥ 12 weeks. The volunteers were evaluated for pain intensity through the Visual Analogue Scale (VAS), disability by the Roland Morris questionnaire, functional mobility by the Timed Up and Go test, and pressure pain threshold (PPT) by algometry. We used the t-test and made Pearson's correlation for data analysis that was done in the Graph Pad Instat program. **Results:** Fifty individuals (53.75 ± 13.65 years) participated in the study, and when comparing PPT values between the thoracic and lumbar regions, no significant difference was observed ($p = 0.19$). Moderate correlation was observed only between lumbar and thoracic PPT ($r = 0.65$). Other correlations, though some significant, were all weak. **Conclusion:** The data from this study allow us to conclude that individuals with chronic low back pain may present with secondary hyperalgesia, since the individuals presented similar values between the lumbar and thoracic PPTs, in addition to having a significant correlation between these two measures.

**Keywords:** Hyperalgesia, Low Back Pain, Pain Measurement

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## INTRODUCTION

Considered a public health problem, low back pain can be defined as pain, tension sensation, stiffness located below the marginal ribs and above the lower gluteal fold. [1,2,3,4] According to the Global Burden of Disease Study, low back pain is the disease that occurs with more frequency in the years lived with some kind of disability.[5] Yet, it is complex and multifactorial, which explains why 85-90% of patients with this disease do not have well-defined pathological diagnoses.[6,7,8,9]

Regarding the pathophysiology of chronic pain, central sensitization has been proposed as a pathophysiological mechanism for its explanation. It refers to pain that persists or arises as a result of processes and/or hypersensitivity within diffuse neural networks of the central nervous system involved in nociception. This type of sensitization implies in alterations of the peripheral impulses, occurring reduction of the threshold or increase of the response to the stimuli.

Thus, there is support for chronic conditions such as low back pain to alter the high sensitivity of pain to painful stimuli.[15] The sensation of pressure pain may be important to determine the development of chronic musculoskeletal disorders, therefore individuals with non-specific chronic low back pain may be with a lower threshold of pain tolerance than healthy individuals.[16,17] A way of measuring these painful points under pressure is by menas of a dolorimetry, which is the veritification of the pain sensitivity throguh a minimal pressure that causes pain or discomfort in a certain region of the body[18,19] This measure can determine the pressure pain threshold (PPT). [3,20]

This technique has been used in studies that seek to assess PPT in low back pain, such as the study by Imamura et al.[17] that compared individuals with and without chronic low back pain and found that those with low back pain had lower PPT values than those individuals considered healthy in almost all evaluated structures.

Farasyn et al.[20] found that there may be muscular disorder in the lumbar region in patients with non-specific chronic low back pain. Schenck et al.[3] concluded that chronic low back pain is not strongly associated with a generalized increase in the sensitivity of the muscles and ligaments of the lumbar region.

Recently, Imamura et al.[21] verified that there are negative correlations between the PPT and the pain intensity analyzed by the visual analogue scale and between the PPT and the disability assessed by the Roland Morris questionnaire among individuals with chronic low back pain. These authors analyzed several structures such as hip and lumbar spine muscles, as well as the cutaneous regions represented. However, according to our knowledge, none of them evaluated the lumbar and thoracic paravertebral musculature.

## OBJECTIVE

This study compared the threshold of pain tolerance to pressure in the lumbar and thoracic paravertebral muscles in individuals with non-specific chronic low back pain correlating them with functionality, functional mobility, age and body mass index.

## METHOD

The study was approved by the Research Ethics Committee of the Adventist University Center of São Paulo under number 1,221,945 and developed according to the resolutions presented in Resolution 466 of the National Health Council.

It is a cross-sectional observational study in which 50 individuals of both sexes participated. Persons with a diagnosis of non-specific chronic low back pain, aged between 18 and 65 years, with pain of moderate to severe intensity on the visual analogue scale (VAS) ≥ 4 cm and with duration of ≥ 12 weeks were included in the study. This study did not include those with: neurological deficits, equine tail compression; previous history of trauma in the spine region; lumbar spine surgery; pelvic pain; pregnancy; associated rheumatic, oncological or infectious diseases; severe psychiatric disorders; degenerative neuromuscular diseases; metabolic diseases such as diabetes and hyperthyroidism; coagulopathies (such as hemophilia and use of anticoagulants) and febrile condition.

The volunteers who agreed to participate signed the two-way informed consent form and were submitted to the evaluation of pain intensity, functionality, functional mobility and pressure tolerance threshold. To verify the intensity of the pain, the visual analogue scale was applied, which consists of the evaluation of the pain intensity. To do this, we used a 10 cm ruler, graduated as absence of pain (0) and pain of maximum intensity (10). The volunteers were instructed to mark, in the mentioned rule, the place that showed the intensity of the pain, in a scale of 0-10.

The functionality of the lumbar spine was verified using the Roland Morris questionnaire. This questionnaire has 24 affirmative phrases, which are marked if they are applicable to the subjects' daily life. Punctuation was assigned to each sentence, with a minimum score of zero and a maximum, that is, total functional disability of 24 points.[22]

The Timed Up & Go Test (TUG) was used to assess functional mobility. This test evaluates the level of mobility of the individual, measuring in seconds the time spent by the volunteer to get up from a chair, without the help of the arms; walk at a distance of 3 meters; turn around and return. At the beginning of the test, the volunteer was leaning against the back of the chair and, in the end, should lean back. The volunteer received the "go" instruction to perform the test; time was timed from the command voice to the moment the volunteer rested his back on the back of the chair. The test was performed once for familiarization and a second time for taking the time spent.[23]

Pressure pain threshold (PPT) was assessed using the J Tech algometer (JTech Medical, Salt Lake City, UT, USA). The algometer is a hand device formed by a piston that contains at its end a rubber of 1 $cm^2$ in diameter, able to register, through the electronic device, the pressure applied on a surface. Its reliability was previously demonstrated. [24,25]

For this evaluation, a pressure was applied at a constant velocity of 1kg/sec to the level where pain or discomfort was reported by the volunteer who was in the ventral decubitus position. The evaluated muscles were: paravertebral 2 centimeters distal lateral of the vertebral column in the lumbar region at the level of the L4-L5 vertebral segment. To evaluate the thoracic paravertebrae, the spine of the scapula was found and distanced 2cm from its border.

The reading was expressed in $kg/cm^2$. During the evaluation the volunteer was instructed to say "stop" as soon as the feeling of pressure went from unpleasant to painful. The final amount of applied pressure was recorded.

### Data analysis

The data were analyzed with the aid of the statistical package Graphy Pad In Stat. (Graph Pad Software, San Diego, California, USA, www.graphpad.com). Data are expressed as mean and standard deviation. To compare the PPT between the thoracic and lumbar region, Student's t test was used and to verify the correlations between age, TUG, body mass index (BMI), PPT in the thoracic and lumbar regions, Roland Morris Questionnaire and VAS, was made Pearson's correlation, following the following criteria: 0.0 <r <0.2: very weak correlation, 0.2 <r <0.4: weak correlation, 0.4 <r <0.6: moderate correlation, 0 , 6 <r <0.8: strong correlation, 0.8 <r ≤ 1.0: very strong correlation. In all cases, values of p <0.05 were considered statistically significant.

## RESULTS

The general characteristics related to the distribution of gender, age, BMI, pain intensity, thoracic PPT, lumbar PPT and disability are shown in Table 1. When comparing PPT values between the thoracic and lumbar region, no significant difference was observed (p = 0.19).

Table 2 shows that when correlations were performed, there was a significant but weak correlation between VAS and lumbar PPT, VAS and thoracic PPT, also between VAS and RM, RM and lumbar PPT, BMI and TUG, BMI and lumbar PPT. On the other hand, there was a moderate correlation between lumbar and thoracic PPT.

**Table 1.** Sample general characteristics

| Variables | n 50 |
|---|---|
| Age (years) | 53.75±13.65 |
| Gender M/F | 11/39 |
| BMI (Kg/m²) | 27.40±5.53 |
| VAS (cm) | 6.45±2.51 |
| TUG (s) | 12.99±4.65 |
| Thoracic algometry (kg/cm²) | 3.44±1.38 |
| Lumbar algometry (Kg/cm²) | 3.34±1.41 |
| Roland Morris (scores) | 13.57±5.45 |

Note: M- male, F- female, BMI - body mass index; cm- centimeter, Kg- kilograms; TUG- timed up and go test, s- seconds.

**Table 2.** Correlations between the variables: age, body composition index (BMI), pain intensity (VAS), disability (Roland Morris), pressure pain threshold (PPT)

| VARIABLES | r | p |
|---|---|---|
| Age X VAS | -0.09 | 0.52 |
| Age X TUG | Jan/00 | 0.53 |
| Age X RM | -0.22 | 0.11 |
| Age X Lumbar PPT | 0.24 | 0.08 |
| Age X Thoracic PPT | 0.22 | 0.11 |
| VAS X TUG | 0.15 | 0.28 |
| VAS X Lumbar PPT | -0.35 | 0.01 |
| VAS X Thoracic PPT | -0.27 | 0.05 |
| VAS X RM | 0.36 | 0.01 |
| RM X Lumbar PPT | -0.38 | 0.005 |
| RM X Thoracic PPT | -0.21 | 0.13 |
| BMI X EVA | -0.06 | 0.66 |
| BMI X TUG | 0.4 | 0.005 |
| BMI X RM | 0.13 | 0.36 |
| BMI X Lumbar PPT | 0.31 | 0.03 |
| BMI X Thoracic PPT | 0.27 | 0.06 |
| Lumbar PPT X Thoracic PPT | 0.65 | < 0.0001 |

## DISCUSSION

The results of this study show that PPT of thoracic and lumber paravertebrae had similar values. Still, these two measures showed a strong correlation.

An aspect to be highlighted in this study was the question of the average age of the volunteers that was about 50 years old and similar to other studies such as that of Imamura et al. [21] who also found the mean age in the fifth decade of life. No relation was found between age and body composition.

This indicates that perhaps although overweight is considered a risk factor for the development of low back pain there is no association between overweight and low back pain.[26] However, as observed in this study, there is a significant, although moderate, relationship between functional mobility and BMI, showing that the higher the body mass, the longer the TUG test execution time. Still, in relation to body composition, it is worth noting that there was a significant but weak relationship between BMI and PPT in the lumbar region, showing that the higher the body composition, the greater the pressure supported, thus overweight would be a "protective" factor in relation to the pressure pain threshold. This relationship has already been seen, however, in obese versus non-obese individuals, but without complaints of low back pain.[27]

Other associations such as functional functionality and functional mobility as well as the pressure pain threshold were also not associated with age, indicating that age probably will not interfere in these aspects. Regarding the pain that was verified by the VAS, it showed weak correlations with the pressure tolerance threshold. The issue of secondary hyperalgesia in low back pain has been studied by other authors. [17,21]

They discuss about this subject, however, they have only studied structures located in the hip of patients with non-specific chronic low back pain compared with healthy individuals. Schenck et al.[3] carried out a study in which assessed 6 structures by means of PPT: paravertebral muscles (long of the back and erector of the spine), lumbar quadrate, ileolumbar ligament, piriformis, major trochanter, but did not evaluate structures distant from the low back region.

Although there is a possibility of muscular disorder in the lumbar part of the spinal erector in patients with chronic low back pain, [20] the investigation of distant sites like the one in this study help to infer the existence of secondary hyperalgesia in thoracic spine muscles in chronic low back pain, which could also be found in the strong correlation between lumbar and thoracic PPT, indicating that the algometry of the lumbar region is correlated to the algometry of the thoracic region, that is, the less pressure is supported in the lumbar region, the less it is in the thoracic region, or the more pressure is supported in a region, more will be in the other.

An interesting aspect to be highlighted in this study was the use of a digital algometer. It is known that this is a gold standard for assessing the pressure pain threshold, aiding in the identification and differentiation of secondary hyperalgesia. [28]

Regarding lumbar incapacity, and the pressure pain threshold in the study by Farasyn et al.[20], when dividing into subgroups according to the degree of disability, no difference was found between PPT between the groups, showing that probably the disability Is not associated with the pressure pain threshold. Perhaps because of this fact, although it was significant, the relationship between lumbar incapacity and the pressure pain threshold of the lumbar region was weak.

## CONCLUSION

Future studies with larger samples and with association of other forms of evaluation such as the use of thermography, electromyography related to the pressure tolerance threshold, may help in the better understanding of hyperalgesia in conditions such as chronic low back pain. The results of this study are important since when treating individuals with chronic low back pain one should take into consideration some areas far from the lumbar, because due to hyperalgesia, these areas are probably also sensitized.

The data from this study allow us to conclude that individuals with chronic low back pain may present secondary hyperalgesia, since these individuals presented similar values between the lumbar and thoracic PPT, in addition to having a significant correlation between these two measures.

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