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Pressure pain threshold and functionality in people with knee osteoarthritis and chronic low back pain: observational study

Limiar de tolerância de dor à pressão e funcionalidade em pessoas com osteoartrite de joelho e lombalgia crônica: estudo observacional

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The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ABSTRACT

BACKGROUND AND OBJECTIVES: Chronic diseases such as chronic low back pain and knee osteoarthritis are associated with altered functionality and pressure pain threshold (PPT). Examining how these variables are present in each of these clinical conditions, or even when both diseases are present, is important for a better understanding of the pathophysiological mechanisms of pain in these highly prevalent diseases. The objective of this study was to compare the PPT and functionality of individuals with knee osteoarthritis, chronic low back pain, and both conditions.

METHODS: It was an observational cross-sectional study in which 113 individuals participated: 42 with low back pain (L), 33 with arthritis (OA) and 38 with both conditions (LOA). Pain intensity was assessed using the visual analogue scale, functional mobility was assessed using the Timed Up and Go test, and PPT was assessed using algometry. Participants completed the *and McMaster Universities Index* (WOMAC) e *Roland-Morris Disability questionnaires.*

RESULTS: A significant difference was observed between the L and LOA groups (p = 0.009) with regard to PPT in the right iliopsoas muscle. In the right vastus medialis, a difference was observed between OA and L (p = 0.042). The groups were similar in relation to functional mobility and pain intensity.

CONCLUSION: Although no significant differences were found in functionality, specific differences in PPT were observed in two of the 18 points evaluated. These findings suggest that the coexistence of chronic low back pain and knee OA does not necessarily contribute to increase pain and functional limitation in a generalized manner but may influence certain anatomical regions.

KEYWORDS: Pain, Low back pain, Osteoarthritis, Pain threshold.

RESUMO

JUSTIFICATIVA E OBJETIVOS: Doenças crônicas como lombalgia e osteoartrite de joelho são associadas com alteração da funcionalidade e do limiar de tolerância de dor à pressão (LTDP). Conhecer como estas variáveis estão presentes em cada uma destas condições clínicas, ou quando ambas as doenças estão presentes, é importante para melhorar a compreensão dos mecanismos fisiopatológicos da dor nestas doenças de alta prevalência. O objetivo deste estudo foi comparar o LTDP e a funcionalidade de indivíduos com osteoartrite de joelho, lombalgia crônica e com ambas as condições.

MÉTODOS: Estudo transversal observacional no qual participaram 113 indivíduos: 42 portadores de lombalgia (L), 33 de osteoartrite de joelho (OA) e 38 portadores de ambas as condições (LOA). A avaliação da intensidade da dor foi realizada pela Escala Analógica Visual, a mobilidade funcional foi avaliada pelo teste *Timed Up and Go*, e a avaliação do LTDP realizada pela algometria. Os participantes responderam aos questionários *Western Ontario and McMaster Universities Index* (WOMAC) e *Roland-Morris Disability*.

RESULTADOS: Observou-se diferença significativa entre os grupos L e LOA (p = 0.009) no que diz respeito ao LTDP no músculo iliopsoas direito. No vasto medial direito foi observada diferença entre OA e L (p = 0.042). Os grupos foram semelhantes em relação à mobilidade funcional e intensidade da dor.

CONCLUSÃO: Embora não tenham sido encontradas diferenças significativas na funcionalidade, foram observadas diferenças pontuais no LTDP em dois dos 18 pontos avaliados. Esses achados sugerem que a coexistência de lombalgia crônica e OA de joelho não necessariamente contribuem para o aumento da dor e a limitação funcional de forma generalizada, mas pode influenciar determinadas regiões anatômicas.

DESCRITORES: Dor, Dor lombar, Osteoartrite de joelho, Limiar da dor.

HIGHLIGHTS

- Chronic diseases such as low back pain and knee osteoarthritis present similar conditions in terms of pain intensity and functionality of both the spine and knee
- In general, pressure pain tolerance thresholds in regions distant from the affected area are similar in both low back pain and osteoarthritis, suggesting that central sensitization may be a pathophysiological mechanism of these diseases
- The coexistence of chronic low back pain and knee osteoarthritis does not necessarily exacerbate pain and functional limitation in a generalized manner, but it may influence specific anatomical areas in a specific manner

INTRODUCTION

Chronic low back pain and knee osteoarthritis, due to their high prevalence and impact on quality of life, stand out among chronic noncommunicable diseases that cause pain and functional limitations[1,2]. Low back pain has been one of the most discussed public health issues worldwide[3]. It is an extremely common disease, about 84% of adults experience it at some point in their lives, with more than one episode occurring in up to 50% of people[4]. In the elderly, low back pain can progress to important disability and associated comorbidities, culminating in loss of independence and high medical costs[5].

Osteoarthritis (OA) is the cause of various disabilities that affect the general population and also has a major impact on the health of the elderly[6]. With the increase in life expectancy in various populations, OA has become a matter of public health interest because it is a common chronic disease and the leading cause of pain and disability among adults and the elderly[7].

Given the importance of investigating these diseases, several tools have been used, including functional scales, pain assessment through direct measures such as algometry, skin temperature distribution through thermography, and analysis of biological markers[8,9]. Functional scales are widely used in clinical studies, such as the Roland Morris questionnaire for low back pain[10] and the WOMAC for knee osteoarthritis[11,12]. The Timed Up and Go test[13] is also widely used and can provide important data on the mobility of individuals affected by these musculoskeletal diseases[14].

The assessment of pain can be performed by pressure algometry, a technique that seeks to verify sensitivity to pain caused by minimal pressure that causes pain or discomfort in a specific region of the body, called the pressure pain threshold (PPT)[15,16]. Algometry has been used in studies involving individuals with chronic low back pain[17-19] and knee osteoarthritis[20-22]. Algometry also seeks to aid in understanding the pathophysiological mechanisms of these chronic diseases and central sensitization[23,24]. Such mechanisms include positive regulation of nociception due to increased secondary synaptic transmission, loss of inhibitory interneurons in the spinal cord, alteration of descending inhibitory pain pathways, facilitation of cognitive-affective mechanisms-affective mechanisms, and altered cortical processing of nociceptive information, which generate an intense and lasting response to painful stimuli and also cause non-harmful stimuli to be interpreted as painful[25].

Authors[25] found an association between the Central Sensitization Index (CSI) scores and pain intensity and disability in patients with knee osteoarthritis and chronic low back pain. Advances in knowledge about variables that interfere with PPT in osteoarthritis and low back pain may provide additional information about pain tolerance and functionality. In addition, low back pain is a common condition in individuals with knee osteoarthritis, but data on the association between these two conditions in relation to disability are still limited[2].

Using a questionnaire to assess pain and disability (Japanese Knee Osteoarthritis Measure - JKOM), another group of authors[2] demonstrated that low back pain interacts with knee pain intensity and contributes significantly to the level of disability in individuals with knee osteoarthritis. The authors concluded that the coexistence of low back pain and knee osteoarthritis results in a greater impact on disability compared to the isolated presence of each condition. However, the study relied on an indirect assessment of pain[2].

Therefore, the present study's objective was to evaluate and compare PPT and functionality in three groups of individuals: individuals with knee osteoarthritis, with chronic low back pain, and with both conditions.

METHODS

This observational cross-sectional study involved 113 individuals of both genders (recruited between May and August 2022), divided into three groups: individuals with low back pain (L, n=42), with knee osteoarthritis (OA, n=33), and 38 with both conditions simultaneously (LOA, n=38). The study was approved by the Research Ethics Committee of the Adventist University Center of São Paulo (UNASP) under number 5.486.926. This study followed the guidelines of the STROBE initiative (STrengthening the Reporting of OBservational studies in Epidemiology[26]) for the presentation of cross-sectional studies.

Evaluations were conducted at a college polyclinic linked to a private higher education institution in the city of São Paulo. Participants were recruited through referrals from the polyclinic professionals who received patients for treatment with exercises or physical therapy from Basic Health Units (UBS - *Unidades Básicas de Saúde*) in the area. After an initial telephone contact, the individuals who were interested in participating attended the polyclinic to receive information about the research, sign the Free and Informed Consent Term (FICT), and undergo the assessments.

The inclusion criteria were: clinical diagnosis of knee osteoarthritis and/or chronic low back pain; medical recommendation to participate in an exercise program or physical therapy; significant pain perception assessed by the Visual Analog Scale (VAS) as greater than 4 cm[27]. Individuals with concomitant chronic diseases, such as fibromyalgia, rheumatoid arthritis, heart disease, and uncontrolled hypertension, neurological diseases, such as stroke, as well as those with total or partial prostheses in one or both knees or hips, were excluded.

All participants underwent an initial individual assessment in a private area, which included the collection of demographic data (age, gender, weight, and height) to calculate body mass index (BMI), obtained by dividing weight (kg) by height squared (m^2).

Pain intensity was assessed using the VAS, which is a 10 cm line where the individual marks the point that best represents their pain, with the starting point indicating no pain and the end point indicating unbearable pain[27].

Functional mobility was measured using the Timed Up and Go (TUG) test[13] , which assesses the time in seconds required for the individual to get up from a chair, walk three meters, return, and sit down again. The test was repeated three times, and the shortest time recorded was considered.

All participants answered the WOMAC and Roland Morris questionnaires. The WOMAC (Western Ontario and McMaster Universities Osteoarthritis Index) evaluates pain, stiffness, and functionality in osteoarthritis, with scores ranging from 0 to 4. Higher values indicate greater limitation[11,12]. The Roland Morris questionnaire assesses lumbar spine function and consists of 24 statements, assigning one point for each affirmative answer, ranging from 0 (no disability) to 24 points (total functional disability)[9].

The PPT was assessed through algometry using the Wagner Force Dial algometer (Fdk/Fdn Series Push Pull Force Gauge, Greenwich, CT, USA). Pressure was applied at a constant speed of 1 kg/sec until the participant reported the onset of pain. The test was then terminated and the final pressure recorded. The assessments were performed in the supine and lateral positions at the following points: gluteus medius muscle, iliopsoas muscle, lumbar and thoracic paravertebral muscles, vastus medialis muscle, vastus lateralis muscle, anserine bursa, center of the patella, and patellar tendon[17-19].

The data were analyzed using the SPSS v.27 statistical package for Windows. The data normality was tested using the Kolmogorov-Smirnov method, and the results were presented as means ± standard deviations. Comparisons between groups were performed using one-way analysis of variance, with a significance level set at $p \leq 0.05$.

RESULTS

A total of 113 individuals (88 women and 25 men) with chronic musculoskeletal disorders participated in the study. Sociodemographic data and functional assessment results are presented in Table 1. The groups were homogeneous in terms of sociodemographic data. The post hoc calculation of sample size (GPower 3.1.9.2) revealed a statistical power (1-β) of 65%.

Table 2 presents the data referring to PPT. A significant difference was found between the L and LOA groups (p=0.009) in the right iliopsoas muscle, and in the right vastus medialis, the L group also showed significantly greater pain tolerance, but in relation to the OA group (p=0.042). No significant differences were found between the groups in the other evaluated points.

Table 1. Sociodemographic characteristics and functionality of the study groups.

	L	OA	LOA	p-value
n	42	33	38	
Age (years)	54.64±17.38	60.88±9.99	58.50±9.77	0.062
Visual analog scale (cm)	6.79±2.27	7.61± 2.27	7.53±2.15	0.188
Body mass index (kg/m^2)	29.25±6.36	29.94±4.87	31.10±5.68	0.356
TUG (s)	13.26±12.47	14.24±9.81	13.20±7.94	0.717
WOMAC total	55.95±18.12	52.14±18.46	57.33±17.71	0.620
WOMAC pain	53.52±17.20	55.00±20.04	60.55±17.14	0.314
WOMAC stiffness	47.05±24.41	58.59±25.28	56.59±25.61	0.300
WOMAC physical activity	52.33±9.49	55.92±19.87	56.47±19.59	0.764
Rolland Morris	14.00±6.05	13.67±5.27	15.69±4.30	0.288

L = low back pain; OA = osteoarthritis; LOA = low back pain + osteoarthritis; TUG = Timed Up and Go; kg = kilograms; s = seconds; m = meters; cm = centimeters. Data expressed as means ± standard deviations.

Table 2. Comparison of groups in relation to pressure pain tolerance.

	L	OA	LOA	p-value
Gluteus medius D	6.56 ± 2.65	5.85 ± 2.61	5.92 ± 2.36	0.461
Gluteus medius E	6.23 ± 2.79	5.52 ± 2.43	5.78 ± 2.27	0.525
Iliopsoas muscle D	5.76 ± 2.46[a]	4.73 ± 1.80[ab]	4.26 ± 1.64[b]	0.009
Iliopsoas muscle E	5.51 ± 2.22	4.79 ± 1.64	4.84 ± 2.06	0.278
Lumbar paravertebral D	7.14 ± 3.24	5.96 ± 2.41	6.53 ± 2.43	0.234
Lumbar paravertebral E	6.86 ± 2.70	6.12 ± 2.83	6.37 ± 2.70	0.565
Thoracic paravertebral D	7.03 ± 2.97	6.19 ± 2.56	6.03 ± 2.12	0.244
Thoracic paravertebral E	6.87 ± 2.82	5.95 ± 2.47	5.69 ± 2.11	0.130
Vastus medialis D	5.84 ± 2.03[a]	4.59 ± 1.74[b]	5.48 ± 2.12[ab]	0.042
Vastus medialis E	5.53 ± 2.54	4.76 ± 2.12	4.86 ± 2.14	0.341
Vastus lateralis D	6.14 ± 2.39	5.42 ± 2.46	4.96 ± 1.56	0.078
Vastus lateralis E	6.16 ± 2.37	5.31 ± 2.33	4.98 ± 2.02	0.088
Anserine bursa D	5.50 ± 2.34	4.84 ± 2.30	5.40 ± 2.35	0.489
Anserine bursa E	5.51 ± 2.16	4.31 ± 1.68	4.84 ± 2.51	0.095
Center of the patella D	5.46 ± 2.15	4.86 ± 1.91	5.29 ± 2.29	0.520
Center of the patella E	5.73 ± 2.26	4.57 ± 1.94	5.26 ± 2.40	0.125
Patellar tendon D	7.37 ± 2.37	6.17 ± 2.89	6.80 ± 2.72	0.212
Patellar tendon E	6.99 ± 2.39	5.93 ± 2.74	6.52 ± 2.97	0.304

L = low back pain; OA = osteoarthritis; LOA = low back pain + osteoarthritis. Data measured in kg/cm^2 and expressed as means ± standard deviations. Different letters indicate statistically significant differences.

DISCUSSION

The present study's objective was to verify and compare the pressure pain tolerance threshold and functionality of individuals with knee osteoarthritis, chronic low back pain, and those with both conditions.

The average age of participants is consistent with other studies indicating that these diseases predominantly affect people in their fifth and sixth decades of life[28,29]. Research highlights that the incidence of osteoarthritis increases with advancing age, especially in individuals over 60 years of age[30,31].

A literature review[32] found a high prevalence of low back pain in older adults, ranging from 21.7% to 75%. This prevalence is high in developed countries such as Canada (75%), the United States (67%), Sweden (49%), China (39.2%), and Japan (32%)[32]. In Brazil, estimates provide moderate-quality evidence that the point prevalence of low back pain in the elderly population is 25%[33]. The high prevalence of low back pain and osteoarthritis in older populations is well documented in the literature[34] , highlighting the debilitating impact of these conditions on quality of life. The presence of high BMI (average above 29 in the three groups in this study) and the coexistence of low back pain and osteoarthritis corroborate the literature, which points to excess weight as a risk factor for both low back pain and the development of OA[35,36]. This association underscores the importance of strategies for controlling and reducing body weight in patients with various chronic conditions.

Still in relation to excess weight, patients in groups L and OA were, on average, overweight, while the average BMI of the LOA group can be classified as obese. Both overweight and obesity increase the risk of low back pain[37-40] and OA[35,41]. Therefore, as a possible clinical implication of these findings, it should be emphasized that weight control in diseases such as knee OA should be an important treatment goal, since some modifiable factors, such as visceral fat area and body fat, may also be associated with increased sensitivity to pain[42].The same is likely to be true for patients with low back pain, as there are reports that a BMI above 27 can lead to a high risk of recurrent low back pain[43]. Maintaining BMI at healthy levels is extremely important, as a recent study of more than 600000 young people found that keeping BMI within normal ranges can help prevent low back pain[39].

Regarding functionality and pain assessed by questionnaires and VAS in this study, it is known that these are related to pain tolerance[18]. In the present study, functionality and pain assessed by scales were similar in the three groups. Individuals with knee OA, those with chronic low back pain, and those with both diseases had similar conditions of pain intensity (VAS) and functionality.

The fact that pain intensity was similar between groups is an important finding, as it shows the influence of the disease, rather than the pain itself, on functionality assessed by both the WOMAC questionnaire (which assesses functionality in OA) and the Roland Morris questionnaire (which assesses functionality in chronic low back pain).

The results also suggest that spine and knee function is affected by low back pain, OA, or both diseases, showing the interference of these conditions on the individual's physical function. These two musculoskeletal conditions are associated with significant impairments in functionality[44].

Another important aspect related to loss of functionality is the limitation of mobility evidenced in the three groups, which had mean values above 12 seconds when performing the TUG test, indicating a significant impairment of mobility and a high risk of falls. These findings are consistent with a reference study[45] that reported that individuals with chronic conditions had longer TUG times, reflecting a significant functional loss. In a meta-analysis conducted by another study[46], reference values were established, and the ideal average time was set at 8.1 seconds for people aged 60 to 69, 9.2 seconds for people aged 70 to 79, and 11.3 seconds for people aged 80 to 99.

Regarding the pressure pain tolerance threshold assessed by algometry, it should be noted that the values obtained were above 4 kg/cm^2. According to another author[47], this value is considered a cutoff point, i.e., individuals with some type of pain or clinical condition generally tolerate less than 4 kg/cm^2. Interestingly, volunteers from all groups tolerated values above this threshold, with the lowest value being 4.26 kg/cm^2 in the iliopsoas muscle in the LOA group. This point was one of two that showed significant differences between the groups, confirming the importance of this muscle in this type of disease. According the study[18], the iliopsoas is related to the function of the lumbar spine, as assessed by the Roland Morris questionnaire, and is an important structure for individuals with chronic low back pain due to its involvement in spinal stability.

Another point that showed differences between the groups was the vastus medialis muscle, evaluated in other studies on individuals with knee osteoarthritis[23], which showed that the symptomatic knee has a lower pressure pain tolerance threshold than the contralateral knee. Although the present study did not make a bilateral comparison, the authors noticed that the PPT was different only when comparing the groups with knee OA and low back pain, being lower in the first group. In other words, the threshold at this point was lower in individuals with OA.

Regarding the other points, the similarity in values leads to consider central sensitization. It is already known that osteoarthritis leads to central sensitization[48], recognized as a potential pathophysiological mechanism underlying various chronic pain conditions[49]. As in a previous study[18], this study speculates that central hypersensitization resulting from these diseases creates areas of hyperalgesia distant from the primary pain sites of low back pain and OA[23], causing these areas to also exhibit reduced pressure pain tolerance.

Thus, the present study findings, especially the significant differences in the pain threshold of the iliopsoas and vastus medialis muscles, can be understood in light of the concept of central sensitization. Recent literature[25,49] suggests that central sensitization may be a pathophysiological mechanism underlying several chronic pain conditions, including OA and low back pain. The reduction in pain threshold observed in these muscles may indicate a greater predisposition to hyperalgesia in patients with multiple chronic conditions.

Although the literature indicates that the coexistence of low back pain and osteoarthritis may result in greater disability, as demonstrated by another study[2], the results of the present study suggest that, although the coexistence of the conditions may exacerbate central sensitization in specific areas, overall functional limitation and pain perception assessed by VAS are similar between groups.

This may indicate that the combined influence of these conditions is not necessarily synergistic in all aspects but may impact functionality differently depending on the anatomical areas affected.

The lack of assessment of central sensitization using specific instruments, such as the Central Sensitization Inventory (CSI), and the exclusion of a group of healthy individuals are limitations of this study. Nevertheless, this does not invalidate the findings presented here, which provide evidence that the two chronic musculoskeletal diseases have a significant impact on the lives of their sufferers.

These findings reinforce the need for integrated and individualized physiotherapeutic approaches that consider both low back pain and osteoarthritis, with a particular focus on modulating central sensitization and managing body weight. Future studies should investigate specific interventions to reduce hyperalgesia in critical regions such as the iliopsoas and vastus medialis muscles, as well as explore the impact of weight control on the functionality and quality of life of these patients.

Although no significant differences were found in all parameters evaluated, specific differences were observed in the right iliopsoas and right vastus medialis muscles. These findings suggest that the coexistence of chronic low back pain and knee OA does not necessarily exacerbate pain and functional limitation in a generalized manner, but may influence specific anatomical regions in a specific manner.

Future research should explore interventions with the objective of reducing pain sensitivity and improving function, focusing on modifiable factors such as body mass index, body composition, and individualized physical therapy approaches.

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