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Comparison between pain intensity, functionality, central sensitization, and self-efficacy in individuals with unilateral or bilateral knee osteoarthritis: a cross-sectional study

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SUMMARY

OBJECTIVE: This study aimed to compare pain intensity, stiffness, functionality, central sensitization, and self-efficacy, between individuals with bilateral knee osteoarthritis and unilateral knee osteoarthritis.

METHODS: We included sedentary participants with knee osteoarthritis. The diagnosis was defined by a specialist, in which there was a complaint of pain and/or altered function in the lower limbs (duration ≥3 months); morning stiffness; pain intensity ≥3; Kellgren-Lawrence 2–3° associated with X-ray; persistence of symptoms >3 months. We used the following tools: Western Ontario and McMaster Universities Arthritis Index, Numerical Pain Scale, Central Sensitization Inventory, and Pain Self-Efficacy Questionnaire. Intergroup comparisons were performed using the t-test.

RESULTS: The sample consisted of 118 adult individuals, divided into two groups: bilateral knee osteoarthritis (n=59) and unilateral knee osteoarthritis (n=59). We observed a significant difference ($p<0.05$) and a large effect size ($d\geq0.8$), in the comparisons between: stature, body mass index, physical function, central sensitization, and self-efficacy.

CONCLUSION: Individuals with bilateral knee osteoarthritis have higher levels of central sensitization, impaired functionality, and a lower level of self-efficacy.

KEYWORDS: Osteoarthritis. Chronic pain. Musculoskeletal diseases. Central nervous system sensitization. Chronic disease. Exercise.

INTRODUCTION

Osteoarthritis is a chronic degenerative disease that affects the joints, in particular, the knee is the most commonly affected. Pain, stiffness, and crepitus in joint movement are some of the symptoms that disable individuals. The treatment of this disease includes control of body mass (weight reduction), use of anti-inflammatory drugs, and exercise[1].

Recent studies have focused on understanding the risks of comorbidities associated with knee osteoarthritis[2], the biochemical and gait parameters after arthroplasty[2,3], and prognosis after therapies in bilateral knee osteoarthritis (B-KO) and unilateral knee osteoarthritis (U-KO)[4].

Asymmetry between the lower limbs seems to be more prevalent in individuals with B-KO[5], while the reduction in muscle strength and volume of the affected limb is more observed in individuals with U-KO[6], and both (B-KO and U-KO) have already been associated with primary and secondary hyperalgesia[7]. However, these clinical differences have been less investigated.

Marmon et al.[8] and Messier et al.[9] described that, regardless of the number of affected knees, individuals with knee osteoarthritis have similar functional capacity and biomechanical parameters. Riddle and Stratford[10] pointed out that people with U-KO have higher levels of pain; however, according to the authors themselves, the differences between the clinical variables of bilateral and unilateral involvement in knee osteoarthritis remain controversial and little known. In this perspective, this study aimed to compare pain intensity, stiffness, functionality, central sensitization, and self-efficacy between individuals

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with B-KO and U-KO. The hypothesis of the present study describes those individuals with B-KO, compared to those with U-KO, have higher levels of disability and central sensitization.

METHODS

Study design and ethical considerations

Quantitative cross-sectional study in accordance with STrengthening the Reporting of OBservational studies in Epidemiology[11]. The research was carried out at the integrated health clinic of Universidade Nove de Julho (Brazil); recruitment took place between February 2018 and December 2019. Recruitment was carried out through the waiting list of four basic health units in three regions of the city of São Paulo (SP, Brazil). Invitations to participate were made by telephone or personal contact. All participants signed a consent statement and an informed consent form. This study was approved by the Research Ethics Committee of Universidade Nove de Julho (number 24568013.0.0000.5511).

Participants and study size

One a priori sample calculation was performed, using the t-test for the difference between two independent means (two groups) through G*Power (version 3.1.9.7). We used the effect size of 0.60, alpha of 0.04, power of 0.88, and critical f of 3.25. As such, the total sample size was estimated at 118 volunteers to build 2 groups, namely, B-KO and U-KO, with the same number of participants[12]. We included participants aged between 18 and 70 years, sedentary, according to the International Physical Activity Questionnaire[13].

The diagnosis of knee osteoarthritis was defined by a specialist physician, who complained of pain and/or altered function in the lower limbs, lasting for 12 weeks or more; morning stiffness; pain intensity, verified by numerical pain scale ≥3; Kellgren-Lawrence[14] grade 2 or 3, associated with X-ray; persistence of knee symptoms lasting for >3 months[15].

Participants with the following health problems capable of affecting functional assessments were excluded: presence of severe comorbidities in the heart, liver, and/or kidney; presence of neoplasia, severe psychiatric, systemic, autoimmune or concomitant inflammatory diseases (lupus, intestinal); hypothyroidism; fibromyalgia; pregnancy and/or breastfeeding; and presence of therapeutic intervention in the last 6 months.

Measurement and bias

Three researchers participated in the research. Researcher 1 was responsible for recruiting, confirming the diagnosis, and allocating the volunteers. Researcher 2, responsible for administering the assessments, was blinded in relation to the distribution of the groups. Researcher 3 performed the data analysis. All researchers are specialists in the management of chronic musculoskeletal pain, with an average training time of 6 years. In addition, they underwent prior training to improve the evaluation procedures of the present study.

Assessment tools

Western Ontario and McMaster Universities Arthritis Index (WOMAC), having reliability (ICC>0.80) and internal consistency (Cronbach's α≥0.86), was validated by Fernandes on the Brazilian population[16]. The Brazilian Portuguese version has three domains: pain (items 1, 2, 3, 4, and 5), stiffness (items 6 and 7), and physical function (items 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, and 24). However, Ferreira et al.[17] found that the Brazilian version of the WOMAC with two domains (pain, 4 items; physical function, 8 items) presents a more adequate structure. For each item, there are options of five responses (0–4); the score for each domain is calculated as the simple sum of the answered items: pain domain (0–20), stiffness (0–8), and physical function (0–68); the higher the score, the greater the impact of osteoarthritis on the domains.

Numerical pain scale (NPS) is an instrument validated by Ferreira-Valente et al. on Portuguese[18]. It consists of a sequence of numbers (from 0 to 10) in which the value 0 represents "no pain" and the numeral 10 represents "the worst pain imaginable." Thus, participants report pain based on these parameters.

Central sensitization inventory (CSI) was validated by Caumo et al.[19] on the Brazilian population. It has reliability (ICC>0.80) and internal consistency (Cronbach's α=0.91). It quantifies, through self-report, the degree of somatic and emotional complaints associated with central sensitization. It is divided into part A (25 items), in which each item can be scored on a Likert scale ranging from 0 to 4 points associated with the words "never" and "always"; and part B, a list of previous diagnoses related to central sensitization conditions. Severity levels are quantified in scores from 0 to 100; higher scores represent greater central sensitization.

Pain Self-Efficacy Questionnaire (PSEQ) has internal consistency (Cronbach's α=0.92) and reliability (0.93); it was validated by Nicholas et al.[20] on the Brazilian population It is a self-administered instrument capable of evaluating and expressing, in numbers, how confident the patient feels to express himself in the face of the situations presented in the 10 items. For each item, there are six options with their respective values in

ascending order, representing "not at all confident" to "completely confident." The final score ranges from 0 to 60 and is obtained by adding the values found. The higher the score, the greater the self-efficacy in pain conditions.

Statistical analysis

The distribution of variables was verified using the Kolmogorov-Smirnov test. We set the significance level at 5% for all statistical tests, which in turn were processed using the Statistical Package for the Social Sciences software, version 17.0 (Chicago, IL, USA). Comparisons between variables were performed using the t-test of independent samples and presented as follows: mean, standard deviation (SD), difference between means (MD), confidence interval (95%CI) of the difference between means and effect size, calculated using Cohen's d, with the following classification values: 0.2=small, 0.5=moderate, 0.8=large[21].

RESULTS

A total of 183 volunteers, with knee osteoarthritis, were recruited for the study, of which 65 were excluded, based on the eligibility criteria; thus, the final sample consisted of 118 adult participants, mostly female, divided into the following two groups: B-KO (n=59) and U-KO (n=59). Table 1 presents the characteristics of all participants.

In comparisons between groups, we observed a significant difference ($p<0.05$) and large effect size ($d\geq0.8$) in stature, body mass index (BMI), physical function, central sensitization, and participants' self-efficacy (Table 2).

DISCUSSION

Our results describe those individuals with B-KO have a greater impact on physical function, greater central sensitization, and lower self-efficacy. This analysis was performed on a number of individuals considered adequate for this study (according to the a priori sample calculation). The impact on physical function refers to the degree of difficulty in moving and performing self-care activities in the last 72 h; central sensitization refers to the presence of symptoms daily, or on most days, considering the last 3 months; and self-efficacy assesses how confident the individual was (considering the referred pain) at the time of this research consultation.

These findings should not be used as proof that B-KO individuals suffer more than U-KO individuals, as, according to the results, the variables "pain" and "stiffness" are not different ($p>0.05$) between the analyzed groups (B-KO vs U-KO). Still on the similarity of prognosis (B-KO and U-KO), Marmon et al.[8] described that the cases of B-KO and U-KO present clinical similarities in functional capacity, and Messier et al.[9] stated that the similarity in lower limb mechanics between individuals with B-KO and U-KO is sufficiently robust to consider the two subsets as a single sample.

Regarding pain intensity, our results differ from the study by Riddle and Stratford[10] (the authors reported that U-KO generates higher levels of pain). The existence of interpretive difficulties in outcomes that analyze pain in individuals with knee osteoarthritis has already been highlighted in previous studies. Cohort by Creaby et al.[22] indicates that the presence of unilateral pain seems to be associated with asymmetries in knee

Table 1. Clinical characteristics and all study participants (n=118) presented as a mean (standard deviation).

	B-KO (n=59)	U-KO (n=59)	t value	p-value
Sex (Female, %)[a]	56 (94.9)	51 (86.4)		0.11
Body mass (kg)[b]	72.16 (5.05)	70.28 (4.26)	2.18	0.03*
Stature (m)[b]	1.63 (0.07)	1.68 (0.05)	-3.87	<0.01*
BMI (kg/m^2)[b]	27.06 (2.88)	24.94 (2.17)	4.51	<0.01*
Age (years)[b]	65.54 (3.97)	68.25 (4.48)	-3.47	<0.01*
WOMAC (score)[b]				
Pain (0–20)	15.27 (2.36)	15.10 (1.43)	0.47	0.63
Stiffness (0–8)	6.13 (1.23)	5.93 (0.86)	1.03	0.30
Physical function (0–68)	51.81 (4.37)	48.25 (3.58)	4.83	<0.01*
NPS (0–10)[b]	5.57 (0.96)	5.52 (1.15)	0.26	0.79
CSI (0–100)[b]	29.71 (3.07)	22.42 (2.71)	13.64	<0.01*
PSEQ (0–60)[b]	21.96 (2.58)	28.16 (2.49)	-13.20	<0.01*

B-KO: bilateral knee osteoarthritis; U-KO: unilateral knee osteoarthritis; BMI: Body mass index; WOMAC: Western Ontario and McMaster Universities Arthritis Index; NPS: Numerical pain scale; CSI: Central sensitization inventory; PSEQ: Pain Self-Efficacy Questionnaire. [a]Values presented in absolute numbers (percentage), χ^2 test. [b]Values presented as average (standard deviation). *Significant difference (t-test of independent samples, p-value<0.05).

Table 2. Comparisons between groups (bilateral knee osteoarthritis; unilateral knee osteoarthritis) presented as mean, standard deviation, difference between means, confidence interval of this difference, and effect size (Cohen d).

Variables	Group	Mean	SD	MD	95%CI	d
Body mass (kg)	B-KO	72.16	5.05	1.88	0.17 to 3.58*	-0.40
	U-KO	70.28	4.26			
Stature (m)	B-KO	1.63	0.07	-0.44	-0.06 to -0.02*	0.82#
	U-KO	1.68	0.05			
BMI (kg/m²)	B-KO	27.06	2.88	2.12	1.19 to 3.06*	-0.83#
	U-KO	24.94	2.17			
Age (years)	B-KO	65.54	3.97	-2.71	-4.25 to -1.16*	0.64#
	U-KO	68.25	4.48			
WOMAC (score)						
Pain (0–20)	B-KO	15.27	2.36	0.16	-0.54 to 0.88	-0.08
	U-KO	15.10	1.43			
Stiffness (0–8)	B-KO	6.13	1.23	0.20	-0.18 to 0.59	-0.18
	U-KO	5.93	0.86			
Physical function (0–68)	B-KO	51.81	4.37	3.55	2.10 to 5.01*	-0.89#
	U-KO	48.25	3.58			
NPS (0–10)	B-KO	5.57	0.96	0.05	-0.33 to 0.43	-0.04
	U-KO	5.52	1.15			
CSI (0–100)	B-KO	29.71	3.07	7.28	6.23 to 8.34*	-2.51#
	U-KO	22.42	2.71			
PSEQ (0–68)	B-KO	21.96	2.58	-6.20	-7.13 to -5.27*	2.44#
	U-KO	28.16	2.49			

SD: standard deviation; MD: difference between means; B-KO: bilateral knee osteoarthritis; U-KO: unilateral knee osteoarthritis; BMI: Body mass index; WOMAC: Western Ontario and McMaster Universities Arthritis Index; NPS: Numerical pain scale; CSI: Central sensitization inventory; PSEQ: Pain Self-Efficacy Questionnaire. *Significant difference (t-test of independent samples, p-value<0.05). #Moderate effect size (Cohen's d≥0.5).

biomechanics, while bilateral pain is associated with symmetry (still needing further studies). Lange-Brokaar et al.[23] pointed out that the different patterns of synovitis, observed via magnetic resonance imaging with gadolinium chelate, were associated with different intensities of pain, but the mechanisms underlying these patterns of synovitis in individuals with knee osteoarthritis are still unknown.

When interpreting our data (Table 2), we observed a contradiction: self-efficacy was reported by individuals considering the level of perceived pain, however, when assessing pain in isolation (e.g., on a scale of 0–10), the groups were not different; thus, what explains individuals with B-KO having lower self-efficacy? The answer may be related to the significant difference (p<0.05) in the central sensitization variable (DM=7.28, d=2.51); however, this topic is still scarce in the literature.

These results also contribute to evidence-based clinical practice, as they show that pain intensity, although relevant in consultations with patients with knee osteoarthritis, should only be a variable parallel to other clinical observations from exams, tests, and questionnaires (e.g., central awareness, self-efficacy, and functionality); in addition, as pain intensity does not seem to be related to the level of knee involvement, patients with B-KO and U-KO should be equally evaluated.

The present study has limitations that must be addressed. The first is that we examined pain intensity and function severity, in both groups, through each patient's self-report (and it is known that self-report measures are influenced by pain intensity)[10]. The second refers to the design of this research (cross-sectional), which has no explanatory power on cause and effect. Thus, we suggest conducting a longitudinal study to provide additional information related to pain intensity, central sensitization, and severity of unilateral and bilateral function over time.

CONCLUSION

Individuals with B-KO have higher levels of central sensitization, impaired functionality, and a lower level of self-efficacy.

AUTHORS' CONTRIBUTIONS

LASO: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources,

Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **APS:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **CAFPG:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **KLBD:** Validation, Visualization, Writing – original draft, Writing – review & editing. **GHSA:** Validation, Visualization, Writing – original draft, Writing – review & editing. **ARO:** Validation, Visualization, Writing – original draft, Writing – review & editing. **AVDF:** Validation, Visualization, Writing – original draft, Writing – review & editing. **MAA:** Validation, Visualization, Writing – original draft, Writing – review & editing.

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