Assessment and correlation between subjective and physiological variables of chronic spinal pain

Avaliação e correlação entre as variáveis subjetivas e fisiológicas da dor crônica na coluna vertebral

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ABSTRACT

BACKGROUND AND OBJECTIVES: Chronic pain on the spine has a high prevalence. The assessment of subjective and physiological parameters over time, and how they relate is important to check changes in people's health status who suffer from this condition. The objective of this study was to evaluate and correlate the subjective and physiological variables of chronic pain on the spine.

METHODS: Observational, prospective study of repeated measures, carried out from September 2015 to January 2016, with 99 people registered on the waiting list of a University physiotherapy clinic of Minas Gerais. Four evaluations were performed with a 15-day interval.

RESULTS: It was found statistically significant reductions over time in pain intensity (p<0.001), in its interference with daily activities (p<0.001), in pain threshold (p<0.001) and physical impairment (p<0.001). There were negative correlations between pain threshold and pain intensity in evaluations three (p=0.003) and four (p=0.001); a positive correlation between pain intensity and physical impairment in all evaluations (p<0.001); and a negative correlation between pain threshold and physical impairment in evaluations one (p=0.001), three (p=0.043) and four (p=0.004). There are also positive correlations between pain intensity and its interference with daily activities (p<0.001); and a negative correlation between pain threshold and these activities, especially in evaluations three and four.

CONCLUSION: There are correlations between subjective variables and physiological characteristics of chronic pain on the spine.

Keywords: Chronic pain, Pain measurement, Spine.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A dor crônica na coluna vertebral possui uma prevalência elevada. A avaliação de parâmetros subjetivos e fisiológicos ao longo do tempo, e como se relacionam, é importante para verificar as mudanças no estado de saúde das pessoas que sofrem com essa condição. O objetivo deste estudo foi avaliar e correlacionar as variáveis subjetivas e fisiológicas da dor crônica na coluna vertebral.

MÉTODOS: Estudo observacional, prospectivo de medidas repetidas, realizado entre setembro de 2015 e janeiro de 2016, com 99 pessoas registradas em fila de espera da clínica de fisioterapia de uma universidade de Minas Gerais. Foram realizadas quatro avaliações, com um intervalo de 15 dias entre elas.

RESULTADOS: Verificou-se reduções estatisticamente significativas, ao longo do tempo, na intensidade da dor (p<0,001), na sua interferência nas atividades cotidianas (p<0,001), no limiar de dor (p<0,001) e na incapacidade física (p<0,001). Houve correlações negativas entre o limiar e a intensidade da dor nas avaliações três (p=0,003) e quatro (p=0,001); correlação positiva entre intensidade da dor e a incapacidade física em todas as avaliações (p<0,001); correlação negativa entre o limiar de dor e a incapacidade física nas avaliações um (p=0,001), três (p=0,043) e quatro (p=0,004). Também existem correlações positivas entre a intensidade da dor e a sua interferência nas atividades cotidianas (p<0,001); e correlação negativa entre o limiar de dor e essas atividades, principalmente nas avaliações três e quatro.

CONCLUSÃO: Existem correlações entre as variáveis subjetivas com as fisiológicas da dor crônica na coluna vertebral.

Descritores: Coluna vertebral, Dor crônica, Mensuração da dor.

INTRODUCTION

Chronic back pain, especially in the lumbar region, has a high prevalence[1]. Many are the impacts that pain may cause in people's lives, such as physical and functional disability, which leads to limitations in daily activities (difficult to get dressed, sit, stand, walk and lift objects), changes in sleep and constant concerns[2]. Changes in pain threshold can also occur since the individuals with back pain have a higher nociceptive sensitivity compared with healthy people[3].

Both subjective and physiological assessments are important because they provide a deeper view of the health state of these people and the changes that occur over time[4], facilitating the analysis of treatment response[5]. Such evaluations, when they

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are not considered, restrict the understanding of the course of the pain and the influence of clinical and demographic factors[6]. However, we noticed that such investigations emphasize the lumbar region[7]. Evidence involving the cervical region, and especially the thoracic region, are not yet well established in the literature and, up to now, no studies were found that propose to study the behavior of these variables related to chronic pain in all the three regions of the spine, by repeated measures.

Based on the above, this study aims to assess and correlate the subjective and physiological variables of chronic back pain.

METHODS

Observational, prospective study of repeated measures, carried out from September 2015 to January 2016, with 436 people registered on the waiting list of a University physiotherapy clinic of Minas Gerais. The eligibility criteria of the sample were the presence of pain in the cervical, thoracic and/or lumbar regions, from any source, and existing for three months or more[8]. In this phase, 111 volunteers were screened by telephone.

In order to determine the proper size of the sample for the study, we used the Stata software, version 12.0, for the test of averages with repeated measures. Pain intensity was considered the main variable (considering one point of variation in the numerical scale of 11 points), and it was adopted the statistical power of 95% and level of significance of 5%. Fifty-seven individuals were estimated to compose the sample of this study.

As inclusion criteria, we considered the age (≥18) and intensity of pain ≥ three, according to the Numerical Pain Rating Scale[9]. People who did not respond to three contact attempts, who did not accept to participate in the study and people with neuropathic or mixed pain were excluded. Therefore, the sample of the study had 99 subjects.

Four evaluations were performed, by the same assessor, with a 15-day interval (day zero, 15, 30 and 45). In the meantime, the volunteers remained to wait for physical therapy, and/or continued the pharmacological treatment.

For data collection, we used subjective and physiological pain assessment tools. For the subjective measurement, we used the Brief Pain Inventory (BPI)[10] and the Roland Morris Disability Questionnaire (RMDQ), for pain in General[11]. For the physiological variable, we took the pain threshold.

The BPI[10] has a diagram where the patient marks the site of the pain, as well as numerical scales used to measure the intensity of pain (zero - an absence of pain / 10 - unbearable pain), and its interference in daily activities (zero - no interference / 10 - total interference). Two final scores are obtained, related to the average of the four items that assess pain intensity, and the average of the seven items that assess pain interference with daily activities[12]. This instrument was translated and adapted to the Brazilian culture[13]. It has adequate psychometric characteristics since it presents high reliability in test-retest whether the pain is stable or not[12], and good sensitivity over time[14].

The RMDQ assesses the level of functional disability in daily activities in people with general pain[11], asking dichotomic questions, and a total that varies from zero (no disability) to 24 points (severe disability). The final score is the sum of all 'yes' answers[11]. It was translated, adapted and validated for the Brazilian version[15] and it has adequate psychometric properties[11] (62% sensitivity; 55% specificity, and 64% accuracy)[16], and it is a sensitive measure to detect the differences among groups or different conditions[11].

A Kratos® digital algometer was used to quantify the pain threshold when a mechanical stimulus was applied. The patient was placed on a stretcher, in the prone position. The assessment followed a standard in 14 tender points, defined by the researchers and always performed in the same order: insertions in the suboccipital muscles; descending trapezius to the level of the 5th and 6th cervical vertebrae; midpoint of the descending trapezius – between the acromion and the 7th cervical vertebra; ascending trapezius at the level of the inferior angle of the scapula; posterosuperior iliac spine; paravertebral muscle at the 4th and 5th lumbar vertebrae and gluteal muscle at the in the eminence of the sciatic nerve. The compression was gradually increased at a rate of 1kg/sec. Patients were told to press the interruption cable of the unit as they felt that the mechanical stimulus had become painful, it was then interrupted and the value marked on the device, referred to as the latency of the nociceptive threshold, was registered. Each of the 14 tender points was measured, and the average points per area (cervical/lumbar/thoracic) was used for data analysis.

This study was approved by a Committee of Ethics in Research (Report number 1.041.266 of 2015) and followed the principles established in the Declaration of Helsinki from the World Medical Association[17].

Statistical analysis

The data collected were analyzed using the Statistical Package for the Social Sciences, version 23.0, using descriptive statistics. The Kolmogorov Smirnov test was conducted to determine data normality, and for comparison, we used the Cochran and Friedman Q tests, followed by the Wilcoxon test, when necessary, and the Spearman Correlation at each assessment time. The level of significance adopted was 5%.

RESULTS

Amongst the 99 people who concluded the study, 77 (77.8%) were women. The average age was 49.87 and a standard deviation (σ) of 14.17 years. Most of the individuals (n=59; 59.6%) were married with complete secondary education (n=30; 30.3%). The presence of pain by spinal region was assessed longitudinally and is presented in table 1.

Table 2 shows the longitudinal behavior of pain.

Correlations between pain intensity and pain threshold; pain intensity and physical disability, and pain threshold and physical disability are shown in table 3.

Correlation between daily activities with pain intensity, and daily activities with pain threshold are shown in table 4.

Table 1. Presence of pain by region over time, Minas Gerais, 2017 (n=99)

Regions	AV 1	AV 2	AV 3	AV 4
	f (%)	f (%)	f (%)	f (%)
Cervical	35 (35.40)	26 (26.30)	19 (19.20)*	20 (20.20)**
Thoracic	27 (27,30)	25 (25.20)	27 (27.30)	22 (22.20)
Lower back	68 (68.70)	64 (64.60)	51 (51.50)*#	56 (56.60)**

According to Cochran's Q test: *Assessment 1 ≠ Assessment 3; **Assessment 1 ≠ Assessment 4; #Assessment 2 ≠ Assessment 3.

Table 2. Behavior of pain as for intensity, interference, threshold, and disability over time, Minas Gerais, 2017 (n=99

	AV 1	AV 2	AV 3	AV 4	
	μ±σ CI	μ±σ CI	μ±σ CI	μ±σ CI	p value
Pain intensity	4.70±2.11 4,55-5,39	3.98±2.4* 3,48-4,48	3.15±2.6**# 2.62-3.67	4.00±3.0***& 3.38-4.62	<0.001
Interference of pain in daily activities	4.82±2.69 4.28-5.35	3.07±2.75* 2.52-3.61	2.36±2.84**# 1.79-2.92	2.96±3.21***& 2.32-3.60	<0.001
Pain threshold	2.87±1.46 2,58-3,16	1.96±0.84* 1,79-2,12	2.00±0.82 1,84-2,17	2.03±0.86 1,85-2,20	<0.001
Physical disability	12.24±6.14 11.01-13.46	9.97±6.64* 8.64-11.29	9.10±6.92 7.71-10.48	9.83±7.55& 8,32-11.33	<0.001

μ = average; σ = standard deviation; CI: confidence interval at 95%. According to the Friedman test followed by the Wilcoxon test: *Assessment 1 ≠ Assessment 2; **Assessment 1 ≠ Assessment 3; ***Assessment 1 ≠ Assessment 4; #Assessment 2 ≠ Assessment 3; &Assessment 3 ≠ Assessment 4.

Table 3. Correlations between pain intensity and pain threshold; pain intensity and physical disability, and pain threshold and physical disability, Minas Gerais, 2017 (n=99)

		AV 1	AV 2	AV 3	AV 4
Pain threshold / pain intensity	p value	0.018	0.019	0.003*	<0.001*
	R	-0.283	-0.235	-0.298	-0,408
Physical disability/pain intensity	p value	<0.001*	<0.001*	<0.001*	<0.001*
	R	0.499	0.465	0.600	0.067
Physical disability/pain threshold	p value	0.001*	0.143	0.043*	0.004*
	R	-0.339	-0.148	-0.204	-0.029

*p<0.05; Spearman's rank correlation.

Table 4. Correlation between daily activities with pain intensity, and daily activities with pain threshold, Minas Gerais, 2017 (n=99)

Daily activities	Assessment	Pain intensity		Pain threshold	
		p value	R	p value	R
General activity	1	<0.001*	0.497	0.009*	-0.260
	2	<0.001*	0.596	0.185	-0.134
	3	<0.001*	0.763	0.016*	-0.243
	4	<0.001*	0.777	0.002*	-0.304
Mood	1	<0.001*	0.374	0.001*	-0.257
	2	<0.001*	0.434	0.115	-0.159
	3	<0.001*	0.705	0.035*	-0.212
	4	<0.001*	0.672	<0.001*	-0.400
Ability to walk	1	<0.001*	0.407	0.069	-0.184
	2	<0.001*	0.557	0.066	-0.185
	3	<0.001*	0.705	0.007*	-0.269
	4	<0.001*	0.701	0.005*	-0.281

Continue...

Table 4. Correlation between daily activities with pain intensity, and daily activities with pain threshold, Minas Gerais, 2017 (n=99) – continuation

Daily activities	Assessment	Pain intensity		Pain threshold	
		p value	R	p value	R
Work	1	<0.001*	0,653	0,127	-0.154
	2	<0.001*	0,541	0.017*	-0.240
	3	<0.001*	0,454	0.037*	-0.210
	4	<0.001*	0,481	<0.001*	-0.402
Relationship with other people	1	<0.001*	0,324	0.075	-0.180
	2	<0.001*	0,381	0.005*	-0.278
	3	<0.001*	0,551	0.039*	-0.207
	4	<0.001*	0,572	<0.001*	-0.399
Sleep	1	<0.001*	0,482	0.510	-0.067
	2	<0.001*	0,553	0.246	-0.118
	3	<0.001*	0,593	<0.001*	-0.359
	4	<0.001*	0,676	<0.001*	-0.439
Enjoy life	1	<0.001*	0,387	0.194	-0.132
	2	<0.001*	0,480	0.030*	-0.218
	3	<0.001*	0,531	0.133	-0.152
	4	<0.001*	0.497	0.002*	-0.301

*p<0.05; Spearman's rank correlation.

DISCUSSION

When assessing chronic pain in the spine during the four assessment times, using subjective and physiological variables, it was observed statistically significant reductions in pain intensity, its interference in daily activities, in the pain threshold, and physical disability, as well as the correlations among these variables at each time, making it possible to observe its negative impact on people's lives.

The lumbar region is considered the most affected site by pain, and in a more intense way[18], also seen in the present study. The assessment by repeated measures allowed to follow the frequency of people affected by pain at this site, with a decrease until the third assessment, and then a statistically significant increase. The lumbar spine is part of the lumbo-pelvic-hip complex, the gravity axis of the spine, where several movements initiate and load transmission between the vertebrae occurs. This region is, therefore, more susceptible to pain[19].

The pain that involves the cervical region also presented a similar behavior to that observed in the lumbar region, which was statistically significant. One in every two people may experience neck pain throughout their lives[20]. The persistent deterioration of the neuromuscular control of the neck muscles contributes, in part, to the chronicity and recurrence of the problem[21].

It is believed that the reduction in the number of people who have reported pain in these two regions during the assessments, can be related to behavior changes because they are being observed, a phenomenon known as Hawthorne effect[22]; or due to the adherence to pain control strategies during the follow-up period.

It was also found, statistically significant reductions over time in pain intensity, in its interference in daily activities, in pain threshold, and physical disability. These changes reinforce the importance in assessing these variables for a multidimensional follow-up of chronic pain.

Pain intensity, obtained using the numerical scale, can be considered the gold standard to measure this phenomenon[23]. Moreover, since musculoskeletal disorders of the spine are the most common cause of persistent and intense pain, and physical disability, it is paramount to assess the factors impacted by pain, such as functional capacity, fatigue, sleep, general well-being, among others[9].

In addition to these factors, the assessment of physiological variables is also important to help to understand the behavior of chronic pain, as well as its threshold, a quantitative variable that is reduced in people with persistent pain[24]. This can be related to the mechanisms of central sensitization that modify the normal processing of nociceptive and non-nociceptive information[25]. This neuroplasticity causes hyperalgesia and allodynia[26], with painful responses to normal stimuli[24].

When verifying the existence of correlations between the threshold and the intensity of pain during the four evaluations, we found statistically significant values in AV 3 and AV 4, as also observed in the study of Imamura et al.[7]. Given that, in order to establish a reliable assessment of chronic pain, it is imperative to confront subjective variables (pain intensity), with physiological variables (pain threshold), so that the assessment process over time is not only focused on the individual's report, allowing more concrete inferences.

It was also observed a significant correlation between pain intensity and physical disability in all the assessments, showing that physical disability increased proportionally to the intensity of pain. By limiting movements, impairing daily activities and

hurting social interactions, the intensity of the pain has a direct influence on the physical disability indexes[27]. Thus, the longitudinal assessment combined with the intensity of pain and disability is essential to establish pain prevention and control measures since one variable is directly influenced by the other.

This same relation also occurred between the pain threshold and the disability, however inversely proportional, in AV 1, AV3 and AV 4, as also found by Imamura et al.[7]. The correlation between these physiological and subjective variables strengthens even further the association between the threshold of pain and disability, and therefore they should be part of the parameters to assess chronic pain in individuals with pain in the spine.

It is also known that physical disability, besides the intensity of pain, is influenced by other factors, such as the received health care, the rehabilitation, the social and physical environment, the life style and the psychological attributes[18,28]. As for the threshold, pain modulation may be related to individual variation. Thus, patients with the pain threshold compromised are more susceptible to disability and, consequently, they tolerate less painful stimulus[29].

It was also found positive correlations between pain intensity and its interference in daily activities, showing that an increase or reduction in these variables is directly proportional. Specifically, there were found statistically significant correlations in general activities, mood, the ability to walk, work, relationship with others, sleep and enjoying life, in all assessments related to pain intensity. Similarly, negative correlations were found between the pain threshold and these activities, mainly in the AV 3 and AV 4. The existence of a correlation between these variables and the observation of its behavior over time also allows for verifying the importance of their associations to establish an adequate pain assessment.

In the face of the association between pain intensity, its interference in daily activities and its threshold we see that when chronic pain is no longer just one symptom and becomes a disease, it brings a series of changes in people's lives, limiting attitudes and decisions and defining behaviors. In the study by Sahu et al.[30], the authors pointed out that the aspects most influenced by pain are general activities, followed by impacts on mood, the ability to walk and work. In this scenario, the chronic low back pain is an important cause of disability and functional limitation since it directly impacts the performance of daily activities[31].

Among the limitations of the present study, we highlight the short follow-up period, the Hawthorn effect, and the fact that some variables that interfere with pain sensitivity were not controlled, as the menstrual cycle. For future studies, we suggest the assessments be performed for a longer period of time, controlling possible confusing variables, such as the menstrual cycle.

CONCLUSION

There are correlations between subjective and physiological variables characteristic of chronic pain on the spine.

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