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## Correlations among algometry, the visual analogue scale, and the numeric rating scale to assess chronic pelvic pain in women



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### ABSTRACT

**Objective:** To investigate the correlation between the numerical rating scale, visual analogue scale, and pressure threshold by algometry in women with chronic pelvic pain.

**Study design:** This was a cross-sectional study. We included 47 patients with chronic pelvic pain. All subjects underwent a pain assessment that used three different methods and were divided according to the cause of pain (endometriosis versus non-endometriosis). Moreover, we assessed the agreement between the scales (visual, analogue and algometry) using the intraclass correlation coefficient (ICC). **Results:** The ICC for the numeric rating scale and the visual analogue scale regarding pain (0.992), dysmenorrhea (1.00) and dyspareunia (0.996) were strong. The agreement between the scales was excellent ( $p \leq 0.01$ ). The correlation between algometry and the scales showed a moderate and inverse association, and this correlation was statistically significant: as the scores on the numeric rating scale and the visual analogue scale regarding dyspareunia increased, the algometry thresholds decreased.

**Conclusions:** The assessment of women with chronic pelvic pain should combine pressure algometry and the numeric rating scale or the visual analogue scale, because of their inverse correlations and satisfactory reliability and sensitivity, to make pain assessment less subjective and more accurate.

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### Introduction

Chronic pelvic pain (CPP) has a prevalence of 3.8% among women between 15- and 73-years-old. In women of reproductive age, CPP varies from 14% to 34%, having a direct impact on their conjugal, social, and professional lives [1].

The intensity of pain is the most assessed dimension and can be measured with different instruments. The visual analogue scale (VAS), numeric rating scale (NRS), and verbal descriptor scales are the most commonly used self-reported pain perception scales [2]. Nevertheless, pain provocation tests with the use of an algometer can also measure the intensity of pain through the pressure trigger points for pain [3].

Different studies have debated which method is the best for assessing pain [4,5]. Although the one-dimensional scales are a good way to assess pain, they cannot evaluate the continuous spectrum of pain [5]. Therefore, this study assessed the intensity of pain in women with CPP with two different methods in the hope of understanding the pain better and to evaluate the possibility of treating patients with better care once the pain intensity was evaluated on different dimensions.

### Materials and methods

#### Patients

Forty-seven women who had been referred to the gynaecology and obstetrics outpatient clinic of the Hospital de Clínicas de Porto Alegre from May 2012 to August 2013 participated in this cross-sectional study. The participants were divided into two groups, with endometriosis ( $n = 20$ ) and with other gynaecological causes ( $n = 27$ ) based on the laparoscopy diagnosis.

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The eligibility criteria were as follows: female patients, between 18- to 45-years-old, diagnosed with CPP and signed an informed consent form. The exclusion criteria were as follows: patients who underwent abdominal surgery, acute lumbar pain (less than six weeks), obesity defined as a body mass index (BMI) equal to or greater than 30 kg/m<sup>2</sup>, inflammatory disease, gastrointestinal or urinary disorders, menopausal women, women menstruating on the day of the assessment, hysterectomy, pregnant women and the use of analgesic medication in the past six months.

The inclusion of patients with endometriosis was confirmed (or excluded) by laparoscopy. Therefore, all patients suffering chronic pelvic pain were investigated by laparoscopy and biopsy of the suspected areas of endometriosis. All included patients with endometriosis had the peritoneal form of this disease. Deep or ovarian endometriosis was excluded by laparoscopy, physical exam and pelvic ultrasound. In addition, we only included subjects in this research protocol who underwent laparoscopy by our medical team during the study protocol.

The local ethics committee approved the study and all of the experiments under the number: 08-650, and all of the participants provided their informed, written consent.

#### Protocol and assessment

CPP was defined as a painful syndrome originating in one or more pelvic organs [6] that was not associated with menstruation; therefore, the pain was non-cyclic, lasted at least six months, and presented as continuous or intermittent pain that was intense enough to interfere with the patient's usual activities and required clinical or surgical treatment [7].

The participants' social and gynaecological histories, BMI, and information on CPP, including diagnosis, treatment, symptoms, location, and intensity of pain, were collected during a visit to the gynaecology and obstetrics outpatient clinic at Hospital de Clínicas de Porto Alegre (HCPA). The pain scores were determined based on pain intensity through the use of self-reported pain scales [2].

The two self-reported scales have verbal anchors at the beginning and end with "no pain" and "worst pain imaginable", respectively. Patients were asked to indicate their pain intensity on a 10 cm line when using the VAS [4] and the number that indicates the pain intensity when using the NRS [4].

The participants' pressure pain thresholds were assessed using an electronic pressure algometer (model Kratos Equipamentos Industriais LTDA; DDK 10 kg, São Paulo, Brazil). The manufacturer calibrated the compression gauge of the device, and the readings were expressed as kgf/cm<sup>2</sup>. The same examiner, a physical therapist trained to identify and locate the investigated trigger points, assessed all of the participants.

For the pressure algometry assessment, the participants were requested to lay in the supine position. The examiner located all of the trigger points in the abdominal, pubic, pelvic and lumbar areas by manual palpation following the positional release technique assessment protocol [8]. The trigger points assessed were as follows: anterior 1st lumbar points (A1Ls), which are located medially to the anterior-superior iliac spine (ASIS); anterior 2nd lumbar points (A2Ls), which are located on the medial surface of the anterior-inferior iliac spine; abdominal 2nd lumbar points (Ab2Ls), which are located on the abdominal surface, approximately 5 cm laterally and somewhat caudally to the umbilicus, corresponding to the lateral margin of the rectus abdominis muscle; iliac points (ILs), which are located approximately 3 cm medially to the ASIS and deep into the iliac fossa; superior pubic points (SPs), which are located on the superior surface of the pubic area, approximately 2 cm laterally to the pubic symphysis; and posterior lumbar points (P1L-P5L), which are located on the lateral surfaces of the spinous processes, paraspinal sulci or the posterior

surface of the transverse processes. All of the trigger points were assessed on the right and left sides.

The algometer was placed perpendicularly to the body surface at a constantly increasing pressure rate (1 kg/s) until the participants reported pain at the palpated site. Between the assessment of one point and the next, there was a 5-second interval. The measurements were performed twice, with a 20-minute interval between each series. The average of the measurements for each point was used for the statistical analysis.

#### Statistical analysis

Continuous variables are described as the average and standard deviation or as the median and interquartile range, according to their distribution. Categorical variables are expressed as the absolute and relative frequencies. The results of the right- and left-side algometric measurements and the NRS and VAS results were compared by Wilcoxon's test. The agreement between the scales was assessed by the intraclass correlation coefficient (ICC). Moreover, Bland-Altman's method was used to assess the agreement for pain, dysmenorrhea, and dyspareunia between the two one-dimensional scales.

The comparison of the scales and algometry results according to the cause of pain was determined by Mann-Whitney or Student's *t*-test for continuous variables, according to the distribution, and for categorical variables, Pearson's chi-square test was used. The correlation between the scales and algometry results was assessed using Spearman's correlation coefficient. The comparisons among the algometry results for the trigger points used Friedman's test, complemented by Wilcoxon's test. The level of significance was established at 5% ( $p < 0.05$ ), and the analyses were performed using SPSS version 18.0 (IBM, Armonk, NY, USA).

The post hoc power calculation showed a  $p\beta > 80\%$ , considering our sample size (47) [9].

#### Funding

None of the funding institutions participated in the collection, analysis and interpretation of the data.

#### Results

The patients had a median age of 40.00 [36.06–40.54]-years-old (median [25th–75th percentile]), a median weight of 65.00 [65.14–71.33] kg, a median height of 1.64 [1.61–1.64] m and an average BMI of 25.82 ± 3.50 kg/m<sup>2</sup> (average ± standard deviation 'SD'). A total of 76.6% of the participants were white, and 68.1% were in a relationship. The patients' educational level had an average of 8.72 ± 2.6 years of formal schooling. Other data referring to the sample characteristics that were collected during the study are shown in Table 1.

Considering the characteristics of CPP, the duration of pain was 73 [36–180] months (median [25th – 75th percentiles]). Table 2 presents the data from all patients ( $n = 47$ ) regarding pain site, symptoms and duration. The average scores on the scales were as follows: pain, 8.02 ± 1.39 on the NRS and 7.96 ± 1.4 on the VAS; dysmenorrhea, 8 [5–10] on the NRS and 7 [5–10] on the VAS; and dyspareunia, 7 [6–10] on the NRS and 7 [6–10] on the VAS.

The causes of CPP were categorized as endometriosis ( $n = 20$ ) and other causes ( $n = 27$ ). In the comparison regarding the cause of pain, the duration of the pain was 132 [39–240] months in women with endometriosis (42.55%) and 60 [24–120] months in the group with other causes (57.45%); that difference was statistically significant ( $p = 0.026$ ) (Table 3).

The intraclass correlation coefficient (ICC) between the scales was 0.992 for pain, 1.00 for dysmenorrhea and 0.996 for

**Table 1**  
Characterization of the study patients.

Variables	n (n%)
Ethnicity	
White	36.6 (76.6)
Black	11 (23.4)
Marital status	
Single	7 (14.9)
Married	32 (68.1)
Divorced	8 (17.0)
Physical activity	
Yes	8 (17.0)
No	39 (83.0)
Paid job	
Yes	25 (53.2)
No	22 (46.8)
Smoking	
Never	31 (66)
Smoker	15 (31.9)
Ex-smoker	1 (2.1)
Constipation	
Yes	25 (53.2)
No	22 (46.8)
Children	
Yes	40 (85.1)
No	7 (14.9)
No. of births	1 (1 – 3)
Contraceptive method	
Yes	23 (48.9)
No	24 (51.1)
Treatment	
Yes	33 (70.2)
No	14 (29.8)
Continuous treatment	
Yes	27 (57.4)
No	20 (42.6)
Delivery type (n = 40)	
Vaginal	21 (52.5)
Caesarean section	17 (42.5)
Vaginal + caesarean section	2 (5.0)

Legend: Continuous variables that characterize the study patients (n = 47). Variables are presented as the absolute and relative frequencies, "n" and "n%", respectively.

**Table 2**  
Characterization of the sample of patients with chronic pelvic pain.

Variables	Sample (n = 47)
Pelvic pain	
Right side	7 (14.9)
Left side	9 (19.1%)
Both sides	31 (66.0%)
Lumbar pain	
Right side	3 (6.4%)
Left side	2 (4.3%)
Both sides	26 (55.3%)
No pain	16 (34%)
Dyspareunia	40 (85.1)
Dysmenorrhea	37 (78.7%)
Activities of daily living	26 (55.3%)
Continuous pain	25 (53.2%)
Intermittent pain	22 (46.8%)

Legend: Analysis of patients who participated in the study. Variables evaluated pain site, symptoms, and duration. Data are presented as the absolute and relative frequency, n (n%), respectively. Statistical analysis was performed by chi-square testing.

dyspareunia, which denotes very good agreement ( $p < 0.01$ ). The agreement between the NRS and VAS was 93.6%, 97.9%, and 91.5% for pain, dysmenorrhea, and dyspareunia, respectively. Fig. 1 presents the Bland-Altman method of agreement for CPP symptoms based on the one-dimensional scales.

The pressure pain thresholds measured by algometry represent the average value of two measurements at each trigger point. The comparison of the thresholds between the right and left sides

**Table 3**  
Comparison of variables regarding pain location and measurements according to one-dimensional scales.

Variables	Endometriosis (n = 20)	Other causes (n = 27)	p-value
Duration of pain (months)	132 [39-240]	60 [24-120]	0.026*
Site of pelvic pain			0.819
Right	3 (15.0%)	4 (14.8%)	
Left	3 (15.0%)	6 (22.2%)	
Bilateral	14 (70.0%)	17 (63.0%)	
Site of lumbar pain			0.504
Right	1 (5.0%)	2 (7.4%)	
Left	0 (0.0%)	2 (7.4%)	
Bilateral	13 (65.0%)	13 (48.1%)	
No pain	6 (30.0%)	10 (37.0%)	
Symptoms			
Dyspareunia	17 (85.0%)	23 (85.2%)	1.000
Dysmenorrhea	14 (70.0%)	23 (85.2%)	0.286
During activities of daily living	10 (50.0%)	16 (59.3%)	0.738
Continuous pain	10 (50.0%)	15 (55.6%)	0.935
Scales			
NRS for pain	8.0 ± 1.4	8.0 ± 1.4	0.929
VAS for pain	8.0 ± 1.4	7.9 ± 1.4	0.861
NRS for dysmenorrhea	8[0-9.8]	7 [6-9]	0.991
VAS for dysmenorrhea	8[0-9.8]	7 [6-9]	0.965
NRS for dyspareunia	7[5-8.8]	8 [6-9]	0.310
VAS for dyspareunia	7[5.3-8.8]	8 [6-9]	0.406

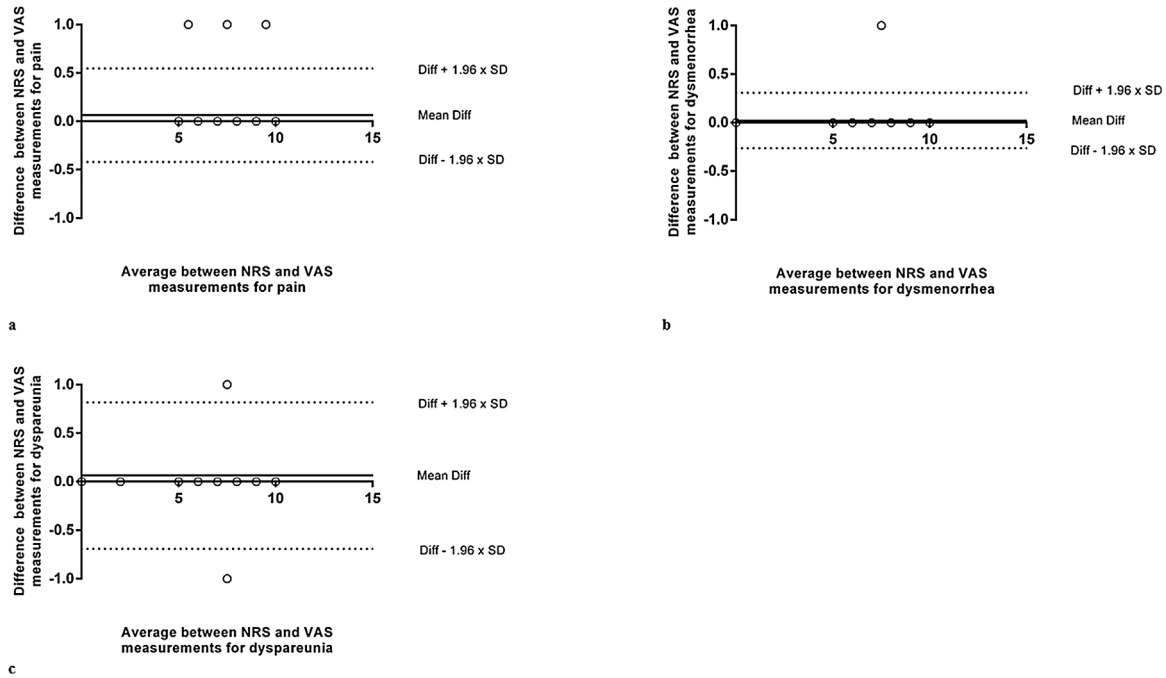
Legend: Comparison of variables regarding pain location and measurements according to two different one-dimensional scales; NRS stands for numerical rating scale, and VAS stands for visual analogue scale. Continuous variables are described as the mean ± SD or median [25th – 75th percentile]; Student's *t*-test and Mann-Whitney's test, respectively, were used, according to variables' distribution. Categorical variables are expressed as the absolute and relative frequencies, n (n%), respectively.

showed a significant difference only for the anterior 2nd lumbar point (A2L) with 1.03 [0.55–1.73] and 0.90 [0.62–1.45] kgf/cm<sup>2</sup> on the right and left sides, respectively, indicating a lower pressure pain threshold on the left side than on the right side ( $p = 0.026$ ; Student's *t*-test). The differences in the pressure pain thresholds between the right and left sides at the remaining trigger points assessed were not significant: anterior 1st lumbar point (A1L) ( $p = 0.664$ ), abdominal 2nd lumbar point (Ab2L) ( $p = 0.907$ ), superior pubic point (SP) ( $p = 0.057$ ), pelvic 1st lumbar point (P1L) ( $p = 0.882$ ), pelvic 2nd lumbar point (P2L) ( $p = 0.861$ ), pelvic 3rd lumbar point (P3L) ( $p = 0.941$ ), pelvic 4th lumbar point (P4L) ( $p = 0.421$ ), pelvic 5th lumbar point (P5L) ( $p = 0.070$ ) and Iliac point (IL) ( $p = 0.495$ ).

The comparison of the pressure pain thresholds among the investigated trigger points found a significant difference ( $p = 0.001$ ; Student's *t*-test). The trigger points with the lowest pressure pain thresholds were the Ab2L, SP, and IL, in that order, and the trigger points with the highest thresholds were the P1L and P2L, in that order.

The analysis of the algometry measurements regarding the causes of CPP showed that the pressure pain thresholds were lower at the following trigger points in the participants with endometriosis: the left A1L, 0.86 [0.62–1.18] kgf/cm<sup>2</sup> ( $p = 0.039$ ; Student's *t*-test); left A2L, 0.72 [0.44 – 0.98] kgf/cm<sup>2</sup> ( $p = 0.020$ ); and right SP, 0.54 [0.34–1.14] kgf/cm<sup>2</sup> ( $p = 0.014$ ). Table 4 describes the comparison of the trigger points assessed by algometry relative to the causes of pain.

The correlation between algometry and the pain scales is shown in Table 5. As the scores on the NRS and VAS regarding dyspareunia increased, the algometry thresholds decreased, except for the trigger points A1L and A2L on both sides; this association was moderate, inverse and statistically significant. There were inverse and significant correlations between the NRS and VAS scores



**Fig. 1.** Bland-Altman for the NRS and VAS scales regarding pain, dysmenorrhea, and dyspareunia.

Legend: Bland-Altman's method of agreement for pain, dysmenorrhea, and dyspareunia between two one-dimensional scales. (a) Bland-Altman's method for pain regarding the NRS and VAS agreement. The lower (-0.43) and upper (0.55) limits of agreement are represented as dotted lines, and the formula used to obtain the limits is found on the right side of the image. SD stands for standard deviation (0.25), and the mean difference (0.06) is represented as a continuous line. Statistical analysis was performed using Bland-Altman's method ( $p > 0.05$ ; paired  $t$ -test). (b) Bland-Altman's method for dysmenorrhea regarding the NRS and VAS agreement. The lower (-0.26) and upper (0.31) limits of agreements are represented as dotted lines, and the formula to obtain the limits is found on the right side of the image. SD stands for standard deviation (0.15), and the mean difference (0.02) is represented as a continuous line. Statistical analysis was performed using Bland-Altman's method ( $p > 0.05$ ; paired  $t$ -test). (c) Bland-Altman's method for pain regarding the NRS and VAS agreement. The lower (-0.69) and upper (0.82) limits of agreements are represented as dotted lines, and the formula to obtain the limits is found on the right side of the image. SD stands for standard deviation (0.38), and the mean difference (0.06) is represented as a continuous line. Statistical analysis was performed using Bland-Altman's method ( $p > 0.05$ ; paired  $t$ -test).

**Table 4**  
Comparison of algometry measures regarding the pain location and causes.

Variables	Endometriosis (n = 20)	Other causes (n = 27)	p-value
Anterior 1 <sup>st</sup> Lumbar point (A1L)			
Right	1.02 [0.46-1.86]	1.09 [0.74-1.54]	0.451
Left	0.86 [0.62-1.18]	1.19 [0.74-2.03]	0.039*
Anterior 2 <sup>nd</sup> Lumbar point (A2L)			
Right	0.71 [0.49-1.46]	1.27 [0.60-2.02]	0.057
Left	0.72 [0.44-0.98]	1.07 [0.71-1.56]	0.020*
Abdominal 2 <sup>nd</sup> Lumbar point (Ab2L)			
Right	0.49 [0.29-0.71]	0.59 [0.39-1.03]	0.333
Left	0.49 [0.32-0.91]	0.52 [0.34-1.15]	0.796
Superior Pubic point (SP)			
Right	0.54 [0.34-1.14]	1.04 [0.65-1.45]	0.014*
Left	0.55 [0.28-1.11]	0.95 [0.43-1.50]	0.083
Pelvic 1 <sup>st</sup> Lumbar point (P1L)			
Right	2.68 [1.21-4.16]	2.86 [1.86-3.99]	0.491
Left	2.63 [1.25-3.95]	2.87 [1.51-4.35]	0.439
Pelvic 2 <sup>nd</sup> Lumbar point (P2L)			
Right	1.99 [1.03-3.79]	2.16 [1.47-3.80]	0.651
Left	1.82 [1.11-3.70]	2.24 [1.61-3.54]	0.426
Pelvic 3 <sup>rd</sup> Lumbar point (P3L)			
Right	1.75 [0.92-2.93]	1.81 [1.19-2.54]	0.780
Left	1.54 [0.80-2.88]	1.74 [1.32-3.10]	0.407
Pelvic 4 <sup>th</sup> Lumbar point (P4L)			
Right	1.41 [0.75-2.34]	1.73 [0.92-2.37]	0.606
Left	1.34 [0.73-2.81]	1.74 [0.81-2.34]	0.813
Pelvic 5 <sup>th</sup> Lumbar point (P5L)			
Right	1.49 [0.71-2.35]	1.62 [0.73-2.36]	0.576
Left	1.37 [0.70-2.09]	1.64 [0.77-2.51]	0.302
Iliac point (IL)			
Right	0.62 [0.31-1.11]	0.84 [0.39-1.25]	0.259
Left	0.60 [0.32-0.77]	0.62 [0.31-1.11]	0.109

Legend: Comparison of algometry measures regarding location and causes of pain. The results were expressed as the median [25<sup>th</sup>-75<sup>th</sup> percentile] according to trigger points assessed by the physical therapist responsible for the measurements. p-Values with the (\*) symbol had values  $\leq 0.05$ , indicating a significant difference; Mann-Whitney's test.

**Table 5**

Correlation of the algometry pressure points and self-reported scales based on Spearman's correlation coefficient.

Variables	NRSpain	VASpain	NRS dysm	VAS dysm	NRS dysp	VAS dysp
Anterior 1 <sup>st</sup> Lumbar point (A1L)						
Right	0.0001	-0.024	-0.137	-0.145	-0.125	-0.125
Left	-0.043	-0.085	-0.145	-0.149	-0.134	-0.144
Anterior 2 <sup>nd</sup> Lumbar point (A2L)						
Right	-0.037	-0.063	-0.074	-0.080	-0.158	-0.155
Left	0.117	0.085	-0.086	-0.092	-0.141	-0.150
Abdominal 2 <sup>nd</sup> Lumbar point (Ab2L)						
Right	-0.161	-0.190	-0.305*	-0.311*	-0.174	-0.171
Left	-0.153	-0.191	-0.188	-0.192	-0.288*	-0.271
Superior Pubic point (SP)						
Right	-0.259	-0.301*	-0.216	-0.223	-0.258	-0.258
Left	-0.163	-0.199	-0.164	-0.172	-0.363*	-0.364*
Pelvic 1 <sup>st</sup> Lumbar point (P1L)						
Right	-0.175	-0.192	-0.094	-0.096	-0.344*	-0.318*
Left	-0.199	-0.219	-0.058	-0.054	-0.399**	-0.373**
Pelvic 2 <sup>nd</sup> Lumbar point (P2L)						
Right	-0.120	-0.127	-0.093	-0.092	-0.315*	-0.305*
Left	-0.107	-0.120	0.011	0.014	-0.371**	-0.362*
Pelvic 3 <sup>rd</sup> Lumbar point (P3L)						
Right	0.002	-0.010	0.071	0.071	-0.223	-0.196
Left	-0.127	-0.141	0.046	0.052	-0.412**	-0.392**
Pelvic 4 <sup>th</sup> Lumbar point (P4L)						
Right	0.027	0.003	0.106	0.110	-0.249	-0.230
Left	-0.114	-0.137	0.064	0.066	-0.333*	-0.317*
Pelvic 5 <sup>th</sup> Lumbar point (P5L)						
Right	-0.039	-0.062	0.051	0.049	-0.274	-0.259
Left	-0.170	-0.200	0.053	0.054	-0.362*	-0.343*
Iliac point (IL)						
Right	0.009	-0.019	-0.091	-0.098	-0.256	-0.251
Left	-0.020	-0.055	-0.079	-0.076	-0.343*	-0.315*

Legend: Correlation of algometry trigger point measurements and one-dimensional scales regarding pain assessment and its symptoms based on Spearman's correlation coefficient. The table's first column shows the one-dimensional scale for pain assessment and its symptoms: NRSpain - numerical rating scale for pain; VASpain - visual analogue scale for pain; NRSdysm - numerical rating scale for dysmenorrhea; VASdysm - visual analogue scale for dysmenorrhea; NRSdysp - numerical rating scale for dyspareunia; VASdysp - visual analogue scale for dyspareunia. Measurements with (\*) had a statistically significant difference with  $p \leq 0.05$ , and those with (\*\*) had a statistically significant difference with  $p < 0.01$ ; Spearman's correlation coefficient.

regarding dysmenorrhea and the threshold of the right Ab2L trigger point and between the VAS score for pain and the right SP trigger point.

### Comment

In the present study, we investigated the correlation between self-reported pain perception instruments, the NRS and the VAS, as well as the correlation between those scales and a pain provocation test with pressure algometry in women with CPP.

We used one-dimensional instruments that have been recommended by several studies [5,9,10]. However, other authors have disagreed with that approach, as they consider one-dimensional instruments to be less effective because they do not reflect the full complexity of the painful experience [12,13].

A study conducted in Brazil found that the average time from the onset of pain to a diagnosis of endometriosis is 7.0 years [14]. In the present study, that interval was 11 years (132 months), which agrees with the results of a comparative study that found that the diagnostic delay was 12 years in the United States versus 8 years in the United Kingdom [15].

A previous comparison between women with CPP due to endometriosis or other gynaecological causes did not find any difference in the levels of pain [16]. The results of our study were similar; the assessment of pain by NRS and VAS did not differ between the women with CPP due to endometriosis and women with pelvic pain from other gynaecological or idiopathic causes. However, in the algometry assessment, the participants with endometriosis exhibited lower pressure pain thresholds compared with women with CPP from other gynaecological causes. The

reason for this finding might be that endometriosis is an inflammatory disease, while none of the other gynaecological or idiopathic causes of CPP are characterized by inflammation.

ICC assessed the correlation between the self-reported instruments for pain assessment, the NRS, and the VAS, regarding pain, dysmenorrhea, and dyspareunia, and the results showed excellent agreement between the two scales. Our results are supported by the findings of other studies, which indicate a strong positive correlation between the NRS and VAS, suggesting that both can be considered equally efficient for pain assessment [14,17–19].

The results of the present study agree with the findings reported in the meta-analysis by Hjerstad et al., who concluded that the numeric, verbal and visual analogue scales exhibit satisfactory agreement [5] and could be recommended for the assessment of the intensity of pain. In particular, the NRSs are the most widely recommended scales, as a function of their better response capacity and ease of use, which make them more widely applicable compared with the VASs and verbal rating scales [5].

The complexity of the experience of pain requires multidimensional assessment that combines pain intensity scores and other measurements of the various domains of pain. It is worthwhile to stress the need to standardize the assessment of the subjective experience of pain to improve its management and promote research [5]. One weak point of our study is related to the fact that we investigated the correlation between one-dimensional measures only and did not include multidimensional instruments that are able to encompass the complexity of pain and its multiple dimensions.

The crucial feature in the assessment of pain is not the choice of the scale to be used but the conditions of its use, which includes the

following: the standardized anchor descriptors, methods of application, time intervals, interpretation of the clinical meaning, level of cognitive development, age, educational level, and patient's preferences [20].

Upon the comparison of the algometry test and the NRS and VAS instruments regarding pain, dysmenorrhea, and dyspareunia, the correlations that were found had moderate strength and were statistically significant. These results agreed with previous reports in the literature, which also found moderate [21] or good [22] correlation between these measures. However, it should be noted that other studies have found only weak correlations between pressure algometry and the pain analogue scales [20].

According to some authors, the correlation between psychophysical indices, such as pressure algometry, and the subjective reports of pain, such as with scales, is usually poor [22]. That may be due to the different nature of both types of instruments, because although they measure the same feature, they do so in different manners [10].

None of the currently available instruments is able to provide a global and unbiased assessment of pain. Our results suggest that it is advisable to combine a self-reported instrument, such as the scales, and provocation tests, such as algometry, when selecting methods for pain assessment to obtain a more thorough picture of pain in women with CPP; therefore, patients might be able to better locate their pain and be treated in a better way. Therefore, the main clinical application of this research is to introduce a new instrument to quantify and better understand the pain quantity and even the pain mechanism in the clinical setting. The new forms of treatments (drugs that act on the central or peripheral nervous system) and clinical presentations (pain centralization) in those patients with chronic pain were not properly evaluated and validated. Thus, in the assessment of chronic pelvic pain, the use of this cheap and easy-to-use instrument (algometry) could be essential to better characterize this common and important condition (chronic pain).

Furthermore, we recommend that future studies achieve the following goals: investigate the correlation of the various causes of CPP with algometry and self-reported scales (the VAS and NRS); perform subgroup analyses of the women with endometriosis and CPP, correlating the disease stage and localization with the results of algometry and self-reported scales; investigate the correlation of the serum interleukin (e.g., IL-1 and IL-6) levels with the results of algometry and the self-reported scales; and investigate the correlation between the algometry results of women with CPP and asymptomatic women.

#### Authors' contributions

MMF, MMCM, and JSCF were responsible for the statistical analysis and the draft of the manuscript. RC and CABS were responsible for obtaining patient data, organizing databases and patient recruitment. VKG was responsible for analysing the data, patient recruitment and the draft of the manuscript. All authors agreed with the final version.

#### Conflicts of interests

The authors declare that they have no conflicts of interest.

#### Ethics approval and consent to participate

The bioethics committee of the Hospital de Clínicas de Porto Alegre (IRB) approved this research project. All forty-seven participants signed an informed consent form to participate in the study.

#### Consent for publication

Not applicable.

#### Availability of data and material

The datasets used and analysed during the study are available from the corresponding author upon reasonable request.

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#### References

- [1] Grace V, Zondervan K. Chronic pelvic pain in women in New Zealand: comparative well-being, comorbidity, and impact on work and other activities. *Health Care Women Int* 2006;27:585–99.
- [2] Huskisson EC. Measurement of pain. *Lancet* 1974;2:1127–31.
- [3] Jensen MP, Karoly P, Braver S. The measurement of clinical pain intensity: a comparison of six methods. *Pain* 1986;27:117–26.
- [4] Hjermstad MJ, Fayers PM, Haugen DF, et al. Studies comparing Numerical Rating Scales, Verbal Rating Scales, and Visual Analogue Scales for assessment of pain intensity in adults: a systematic literature review. *J Pain Symptom Manage* 2011;41:1073–93.
- [5] Hjermstad MJ, Gibbins J, Haugen DF, Caraceni A, Loge JH, Kaasa S. Pain assessment tools in palliative care: an urgent need for consensus. *Palliat Med* 2008;22:895–903.
- [6] Fenton BW, Palmieri PA, Durner C, Fanning J. Quantification of abdominal wall pain using pain pressure threshold algometry in patients with chronic pelvic pain. *Clin J Pain* 2009;25:500–5.
- [7] Campbell F, Collett BJ. Chronic pelvic pain. *Br J Anaesth* 1994;73:571–3.
- [8] D'Ambrogio K, Roth G. Terapia de liberação posicional: avaliação e tratamento da disfunção músculo esquelética. São Paulo: Manole; 2001.
- [9] Walter SD, Eliasziw M, Donner A. Sample size and optimal designs for reliability studies. *Stat Med* 1998;17:101–10.
- [10] Caraceni A, Cherny N, Fainsinger R, et al. Pain measurement tools and methods in clinical research in palliative care: recommendations of an Expert Working Group of the European Association of Palliative Care. *J Pain Symptom Manage* 2002;23:239–55.
- [12] Castro C. A formulação neurolingüística da Dor – versão brasileira do questionário McGill de dor. 1999.
- [13] Chapman CR, Casey KL, Dubner R, Foley KM, Gracely RH, Reading AE. Pain measurement: an overview. *Pain* 1985;22:1–31.
- [14] Andrella G, Araujo P, Lima S. Estudo Comparativo entre duas escalas de dor e a aplicação em doentes. *Estud. Goiânia* 2007;34:21–34.
- [15] Hadfield R, Mardon H, Barlow D, Kennedy S. Delay in the diagnosis of endometriosis: a survey of women from the USA and the UK. *Hum Reprod* 1996;11:878–80.
- [16] Low WY, Edelmann RJ, Sutton C. A psychological profile of endometriosis patients in comparison to patients with pelvic pain of other origins. *J Psychosom Res* 1993;37:111–6.
- [17] Poletto PR, Gil Coury HJ, Walsh IAP, Mattiello-Rosa SM. Correlação entre métodos de auto-relato e testes provocativos de avaliação da dor em indivíduos portadores de distúrbios osteomusculares relacionados ao trabalho. *Rev Bras Fisioter* 2004;8:223–9.
- [18] Perry F, Heller PH, Levine JD. A possible indicator of functional pain: poor pain scale correlation. *Pain* 1991;46:191–3.
- [19] Jensen MP, Turner JA, Romano JM. What is the maximum number of levels needed in pain intensity measurement? *Pain* 1994;58:387–92.
- [20] Isselée H, De Laat A, De Mot B, Lysens R. Pressure-pain threshold variation in temporomandibular disorder myalgia over the course of the menstrual cycle. *J Orofac Pain* 2002;16:105–17.
- [21] Sand T, Zwart JA, Helde G, Bovim G. The reproducibility of cephalic pain pressure thresholds in control subjects and headache patients. *Cephalalgia* 1997;17:748–55.
- [22] Bajaj P, Bajaj P, Madsen H, Arendt-Nielsen L. Endometriosis is associated with central sensitization: a psychophysical controlled study. *J Pain* 2003;4:372–80.