 ORIGINAL ARTICLE

Relationship between the Widespread Pain Index and the PainMAP software for pain sites measurement in patients with Widespread Pain

Relação entre o Índice de Dor Espalhada e o software PainMAP para medida de localização da dor em pacientes com dor espalhada

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ABSTRACT

BACKGROUND AND OBJECTIVES: Identifying pain sites is essential to managing patients with Widespread Pain. Several instruments have been developed, including pain drawings, a grid system and computerized methods. However, it is not yet known whether the Widespread Pain Index matches an automated method (painMAP) for quantifying the number of pain areas. Therefore, this study aimed to identify the relationship between the Widespread Pain Index and the painMAP software to measure pain sites in participants with Widespread Pain.
METHODS: A pre-planned secondary analysis of data collected from 311 patients with musculoskeletal pain was conducted. The Widespread Pain Index and the painMAP software assessed pain sites. Spearman's correlation coefficient investigated the correlation between the Widespread Pain Index and the painMAP software.
RESULTS: A total of 98 participants with Widespread Pain were included in this study. Most participants were female (67; 83.7%), with a mean age of 57,7±11,5 years, mean height of 1.6 (0.1) meters and mean weight of 73.2 (11.8) kilograms. The mean pain intensity was 6.7 (2.0), and the pain duration was 92.3 (96.3) months. The mean number of pain sites in the Widespread Pain Index was 10.1 (3.7), and in the painMAP software, it was 11.7 (8.8). A weak positive correlation (rho = 0.26, 95% CI 0.45 to 0.04, p = 0.022) between the Widespread Pain Index and the painMAP software was found.
CONCLUSION: The Widespread Pain Index and the painMAP software showed a weak correlation for assessing pain sites in participants with Widespread Pain.
Keywords: Chronic Pain, Fibromyalgia, Pain management, Pain measurement.

RESUMO

JUSTIFICATIVA E OBJETIVOS: A identificação dos locais de dor é um aspecto essencial no manejo de pacientes com Dor Espalhada. Vários instrumentos foram desenvolvidos, incluindo desenhos de dor, um sistema de grade e métodos computadorizados. No entanto, ainda não se sabe se o Índice de Dor Espalhada coincide com um método automatizado (painMAP) para quantificar o número de áreas de dor. Portanto, este estudo teve como objetivo identificar a relação entre o Índice de Dor Espalhada e o *painMAP* para medir as áreas doloridas em participantes com esse quadro de dor.
MÉTODOS: Uma análise secundária pré-planejada de dados coletados de 311 pacientes com dor musculoesquelética foi realizada. O Índice de Dor Espalhada e o *painMAP* avaliaram as áreas de dor. O coeficiente de correlação de Spearman foi utilizado para investigar a correlação entre o Índice de Dor Espalhada e o *software painMAP*.
RESULTADOS: Um total de 98 participantes com Dor Espalhada foram incluídos neste estudo. A maioria dos participantes era do sexo feminino (67;83,7%), com média de idade de 57,7±11,5 anos, média de altura de 1,6 (0,1) metros e média de peso de 73,2 (11,8) quilogramas. A média de intensidade da dor foi de 6,7 (2,0) e da duração da dor de 92,3 (96,3) meses. O número médio de áreas de dor no Índice de Dor Espalhada foi de 10,1(3,7) e no *software painMAP* foi de 11,7 (8,8). Uma correlação positiva fraca (rho=0,26, IC de 95% 0,45-0,04, p=0,022) entre o Índice de Dor Espalhada e o *painMAP* foi encontrada.
CONCLUSÃO: O Índice de Dor Espalhada e o *painMAP* mostraram correlação positiva fraca para avaliar as áreas de dor em participantes com dor espalhada.
Descritores: Dor Crônica, Fibromialgia, Manejo da dor, Medição da Dor.

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INTRODUCTION

Musculoskeletal health conditions are a common cause of pain in the general population. Patients with musculoskeletal pain (MP) commonly present pain in more than one body region[1,2]. Chronic Widespread Pain (CWP) can be classified as chronic primary pain (i.e., pain in one or more body regions that persists or recurs for longer than three months and is associated with significant emotional distress or that cannot be better accounted for by another chronic pain condition)[3]. In the general population, one in every 10 adults had CWP[4], accounting for about 46% of all outpatient consultations in Europe[5,6]. In Brazil, 24% of the women had CWP[7]. Multiple pain sites have been associated with increased pain severity[8,9], restricted activities of daily living[2], reduced quality of life[8,9], and poor prognosis regardless of treatments[10]. Thus, identifying Widespread Pain (WP) patients is crucial to assist clinicians and researchers in offering appropriate treatment approaches.

Several instruments are available for the assessment of pain distribution. The pain drawing is one of the health professionals' strategies most used to quantify pain distribution[11,12]. Several studies related to the reliability of measuring pain distribution and location use the pain drawing[13-19]. The total area of the body in pain and the pain's anatomical location is commonly measured by clinicians and researchers[13]. A grid system[20] and computerized assessment score the pain sites[11,12,19]. Although the evaluation of pain sites can be performed by reliable and valid instruments such as ImageJ software[12], it is worth noting that these instruments are challenging for participants to complete and represent a time-consuming evaluation for clinicians.

Instruments chosen by clinicians and researchers to assess pain sites should be simple, easy, fast, and low-cost. In this sense, the Widespread Pain Index (WPI) was designed to evaluate pain distribution according to the number of reported painful body regions. WPI is a self-reported list of painful sites composed of 19 body areas[21] and demonstrated good construct and criterion validity between young patients with painful conditions[22]. WPI is a clear, well-organized and low-cost instrument compared to the Regional Pain Scale[23] and the Self-Assessment Pain Scale[24] to determine pain sites. WPI has been used in patients with chronic pain[25,26], surgical samples[27], and young individuals with painful conditions[22].

However, WPI can be confusing for participants who are not used to the terminologies of body site instruments, with a body chart likely to assist the participant in visualizing pain sites. On the other hand, the painMAP software was developed to quantify the number of pain sites and areas, with excellent inter and intra-rater reliability in patients with low back pain[19]. No study has evaluated the correlation between WPI and a computerized method to assess pain sites. Therefore, the present study aimed to identify the relationship between the WPI and the painMAP software for measuring pain sites in participants with WP. The present study hypothesized that painMAP would positively correlate to WPI for measuring pain sites in participants with WP.

METHODS

The present study undertook a pre-planned secondary analysis of data collected from a previous study by this same group[28]. The current study is a cross-sectional study following the STrengthening the Reporting of OBservational Studies in Epidemiology (STROBE) requirements[29]. Similarly, the original research was cross-sectional and followed the STROBE criteria[29]. The original study included 311 participants with MP to compare the pain characteristics according to the painDETECT questionnaire classification as nociceptive pain, unclear and neuropathic-like symptoms[28]. The original study included participants with MP (aged 18 years and over), with acute pain (pain duration less than three months) and chronic pain (pain duration greater than three months). MP was defined as pain perceived in a region of the body with muscular, ligament, bone, or joint origin. The original study excluded participants who had a surgical procedure on the spine, pregnant women, patients with rheumatologic diagnosis in the acute inflammatory phase, tumors, were illiterate, or could not complete the self-reported questionnaires.

The current study excluded 213 participants with MP without WP and had a final sample of 98 patients with WP. The original study was approved by the Research Ethics Committee of the Federal Institute of Rio de Janeiro (number: 02228818.0.3001.5258) following the Helsinki Declaration for research in humans. All patients met the eligibility criteria and signed the Free and Informed Consent Term (FICT) form before the study procedures.

Study Participants

Consecutive participants with WP (aged 18 years and over) from two outpatient Physical Therapy departments (Gaffrée and Guinle University Hospital and Augusto Motta University Center), two private clinics, and an outpatient multidisciplinary rehabilitation department (Cabo Frio Rehabilitation Center) in Rio de Janeiro State, Brazil, were enrolled when they sought treatment between March and September 2019. The study included participants with WP (n=98). Of these, 18 participants were excluded because they had painted the area with red and blue pens (n=11), only blue pens (n=2), for not respecting the borders of the body charts (n=1) or for not having pain sites recognized by the painMAP software (n=4).

Therefore, 80 participants with WP were included. Even though the terminology "generalized pain" has been extensively used[21], this research chose WP, following the recent classification of chronic pain for the International Classification of Diseases (ICD-11)[30]. Widespread Pain was defined when the participant reported pain in at least 4 of 5 regions (left and right upper, left and right lower, and axial) in the WPI. Jaw, chest, and abdominal pain are not included in the WP definition[21]. Participants who had a surgical procedure on the spine in the last year, pregnant women, participants with rheumatologic diagnoses in the acute inflammatory phase, with tumors, that were illiterate, or could not complete the self-reported questionnaires were excluded from the study.

Procedures

Participants were referred for an initial evaluation of the clinical history and physical examination. The WPI assessed pain sites at the time of assessment. Subsequently, an examiner using the painMAP software calculated the number of pain sites and areas.

Outcomes measures

WPI is a self-reported list of painful regions composed of 19 body areas, and participants must mark the areas in which they felt pain during the last week. Each marked area is equivalent to 1 point. The final score varies between zero and 19 points. The American College of Rheumatology criteria recognizes that a participant had WP when the participant reported pain in at least 4 of 5 regions (left and right upper, left and right lower, and axial) in the WPI. Jaw, chest, and abdominal pain are not included in the WP definition[21]. The psychometric assessment of the WPI demonstrated good construct and criterion validity between young patients with painful conditions[22].

The PainMAP software is a tool for automated image processing for quantifying the number of pain sites and the area from pain drawings in digitized body charts. The painMAP software processes the digitized body charts in image calibration and object detection without any input from the user[19]. The body chart consisted of a 10 x 10 cm (head to feet distance: 6.7 cm) print image containing two views (anterior and posterior), as illustrated in figure 1.

Participants were requested to identify painful areas on the body chart using a red pen during the clinical assessment (Figure 2). Pain drawings were excluded from the study if the

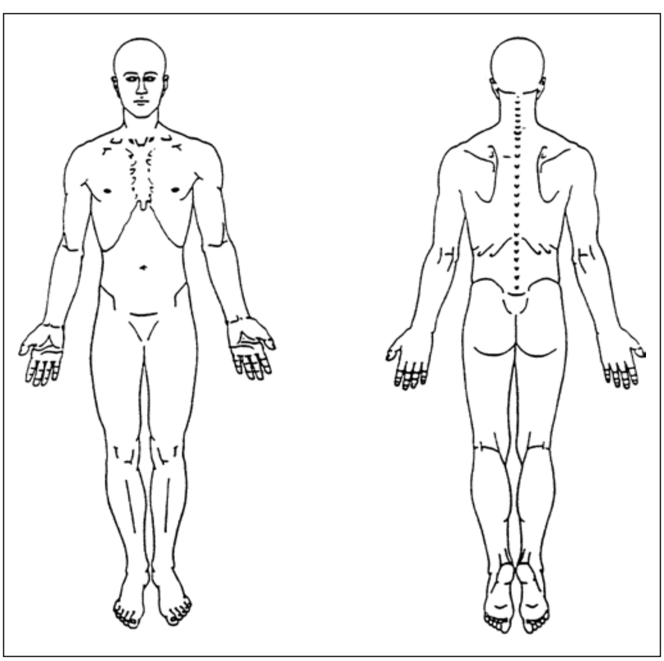

Figure 1. Body chart (10 x 10 cm).

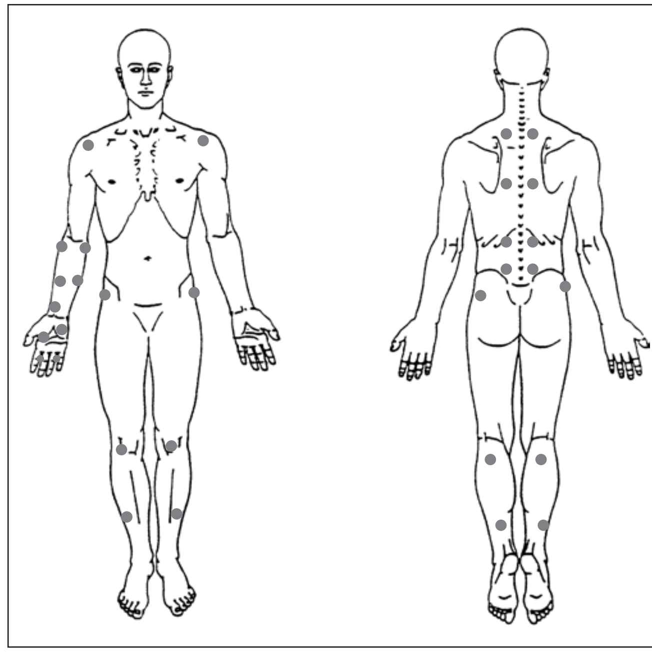

Figure 2. Examples of a body map photo of a participant with chronic Widespread Pain.

participant had not filled in the body area correctly (i.e., had painted the area with red and blue pens or only blue pens or had not respected the borders of the body charts). The validity of the shaded pain sites and the exclusions were assessed by an examiner (JVB) with four years of work experience in treating patients with MP. For a pragmatic assessment, all body charts were photographed once by an examiner (JVB) using one smartphone (Motorola G5). For offline analysis, all digitized images were stored as JPEG files (resolution set to 72 DPI).

Sample size calculation

Sample size calculations assumed a two-sided correlation test, a type I error rate of 0.05 (5%) and 95% of power, taking the pain sites as the unit of analysis. In addition, a minimum Pearson's correlation coefficient of 0.4 between WPI and painMAP software for the pain sites was chosen to determine a sufficient sample size. Therefore, a total of 75 participants with WP was necessary. Ninety-eight participants with WP were recruited, assuming potential data loss. The sample size calculation was performed *a priori* in the G*Power software version 3.1.9.4 (Heinrich-Heine-Universität, Düsseldorf, Germany).

Statistical analysis

The demographic (age, gender, weight and height) and clinical variables (pain intensity and pain duration) of the study participants were summarized descriptively. Paired samples t-tests were used to compare the mean differences between WPI and painMAP software. Categorical variables are presented in absolute frequency and proportion of the sample, and continuous variables as means and standard deviation (SD). For continuous variables, the normal distribution of the outcomes was verified by the Shapiro-Wilk test.

Due to the non-normal distribution of data, the Spearman correlation was used. Spearman's correlations (rho) assessed the relationship between the WPI and the painMAP software. Rho < 0.30 was interpreted as a weak correlation, from 0.30 to 0.60 as a moderate correlation, and ≥ 0.60 as a good correlation[31]. Outliers were excluded by the ROUT method with Q = 1.0%[32]. Statistical evidence of significance level was set to less than 5% for all analyses. Statistical analysis was performed using JASP (version 0.16.1) and Prism for Macintosh, Version 8 (GraphPad Software Inc., San Diego, CA).

RESULTS

Characteristics of the participants

Eight participants with WP were enrolled in this study, 67 (83.7%) females, with a mean age of 57.7 (11.5) years, mean body height of 1.6 (0.1) meters, mean weight of 73.2 (11.8) kg, mean body mass index of 27.6 (6.8) kg/m². More than half (56.9%) of participants with WP reported primary school as their highest educational level, 20.2% reported high school, and 18.9% reported undergraduate-level education. Regarding pain characteristics, the mean pain intensity at the moment was 6.7 (2.3) out of 10, the strongest pain level in the last 4 weeks was 8.3 (2.0) out of 10, pain level on average in the previous 4 weeks was 7.3 (2.0) out of 10, and pain duration 92.4 (96.3) months. Moreover, 71 (88.7%) participants with WP were classified with chronic WP, 6 (7.5%) were classified with acute WP, and 3 (3.7%) did not report the duration of their pain.

Table 1. Characteristics of the study participants (n = 80)

Variables	Values (n= 80)
Age (years), mean (SD)	57.7 (11.5)
Height (meters), mean (SD)	1.6 (0.1)
Weight (kg), mean (SD)	73.2 (11.8)
Body mass index (kg/m²), mean (SD)	27.7 (6.8)
Highest educational level, n (%)	
Primary school, n (%)	45 (56.9)
High school, n (%)	16 (20.2)
Undergraduate level, n (%)	15 (18.9)
Not declare, n (%)	3 (3.7)
Missing, n (%)	1 (0.3)
Pain characteristics	
Pain intensity, mean (SD)	6.7 (2.0)
Pain duration (months), mean (SD)	92.4 (96.3)
Chronic pain, n (%)	71 (88.7)
Number of pain sites (WPI), mean (SD)	10.2 (3.7)
Distribution of painful sites, n (%)	
Neck	59 (73.7)
Upper back	65 (81.2)
Low back	65 (81.2)
Left shoulder	60 (75.0)
Right shoulder	65 (81.2)
Left Upper arm	43 (53.7)
Right Upper arm	43 (53.7)
Left Lower arm	26 (32.5)
Right Lower arm	26 (32.5)
Left hip	53 (66.2)
Right hip	55 (68.7)
Left Upper leg	35 (43.7)
Right Upper leg	37 (46.2)
Left Lower leg	51 (63.7)
Right Lower leg	50 (62.5)
Number of pain sites (painMAP software), mean (SD)	11.7 (8.8)
Pain area (painMAP software), mean (SD)	0.86 (1.1)

Continuous variables are expressed in mean (standard deviation) and categorical variables in absolute (frequency).

The results of the pain sites analysis reported by the participants with WP revealed that the mean number of pain sites in WPI was 10.2 (3.7); the most marked regions in WPI was: upper back (81.2%), lower back (81.2%), right shoulder (81.2%), neck (73.7%), right hip (68.7%), left hip (66.2%), left lower leg (63.7%), right lower leg (62. 5%), and left and right upper arms (53.7%). Data from the painMAP software showed that the mean number of pain sites marked by participants was 11.7 (8.8), and the mean pain area in painMAP software was 0.8 (1.1). Furthermore, paired samples t-test showed there was no significant difference between the mean pain sites marked in the WPI 10.2 (3.7) and the mean pain sites observed in the painMAP software were 11.7 (8.8) (W = 1316.500; z = -0.758; p = 0.449) (Table 1).

A Spearman's correlation coefficient analysis showed a weak positive correlation between WPI and painMAP software for identifying pain sites in participants with WP (rho = 0.26, 95%CI 0.45 to 0.04, p = 0.022) (Figure 3).

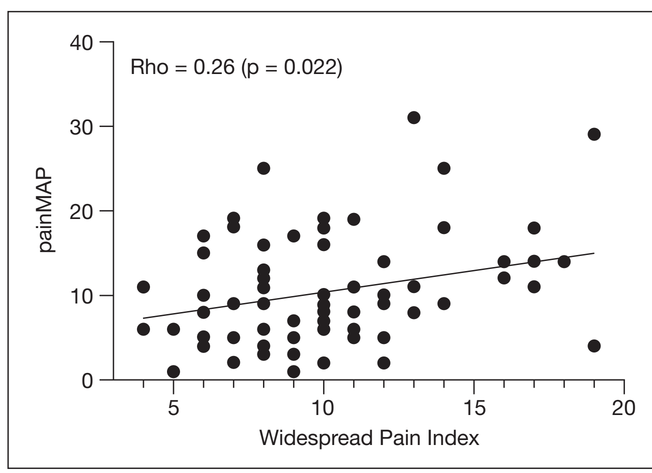

Figure 3. Correlation between the WPI and painMAP software

DISCUSSION

The present study presented a relationship between the number of pain sites in the WPI and painMAP software in patients with WP. Comparing both instruments concerning the mean number of pain sites, similar results were found both in the WPI and in the painMAP software. However, the results of this study found a weak correlation between WPI and painMAP software for the number of pain sites. Pain drawings are often used in clinical practice to clarify the number of pain sites. Although establish the number of pain sites is necessary, healthcare professionals should consider other relevant information when caring for patients with WP. For instance, painMAP software can provide a total pain area that cannot find in a simple pain drawing.

Regarding the strengths and limitations, this study is the first that assessed the relationship between WPI and computerized methods to determine the pain sites in patients with WP. Secondly, the painMAP software is more detailed compared to the WPI (e.g., while WPI recognizes the left upper arm region only, the painMAP software can identify some regions in the left upper arm, such as anterior and posterior, medial and lateral, proximal and distal). Thirdly, automated downloadable software (i.e., painMAP) can facilitate clinical use. Moreover, the painMAP software is a resource easy to use and does not require user input for image processing/analysis, a specialist and not require much training for image inspection.

Regarding the limitations of the study, the main one is that there is no gold-standard instrument for identifying pain sites. Secondly, the clinical diagnosis of the patients included was not controlled and may affect pain site response. Also, caution is needed with the generalisability of the findings because the results of this research should be tested in different populations. Therefore, further studies that include samples with more patients with other conditions are needed. Finally, precise instruction is required to properly guide participants in completing the body map, since the painMAP software could incorrectly consider painted areas (for instance, outside the body map).

The findings of this research showed a weak correlation between the two methods, contradicting a prior study that reported a strong correlation between similar pain measures[33]. Another study demonstrated that a greater number of pain sites in WPI was associated with a greater number of pain sites on the body diagram ($r=0.57$, $p<0.001$) in young patients with painful conditions[22]. Similarly, there is a strong relationship between the painMAP software and ImageJ software for the number of pain sites ($R^2=0.985$) and pain areas ($R^2=0.952$) domains in body charts of patients with low back pain[19].

The health condition studied (i.e., WP) could have interfered with the findings of this research due to the nature of the high number of pain sites reported by each participant. Arguably, a more localized pain (e.g., knee osteoarthritis) may present a stronger correlation between the instruments (WPI and painMAP software). Additionally, both devices measure painful regions but using a distinct manner. For instance, a body region marked in WPI may have more than one tag in painMAP software. Furthermore, the WPI does not display options for particular areas such as the wrist, ankle, and foot. Therefore, categorizing pain sites using WPI likely loses information and underestimates pain assessment in patients with WP.

Evidence suggests that patients with chronic pain can present distorted body image (i.e., tend to perceive their painful area of the body as increased or reduced)[34-37]. The body image was negatively related to the intensity of pain in men suffering from chronic pain (i.e., rheumatoid arthritis and low back pain)[38]. Patients with chronic low back pain had a more negative body image than patients with subacute low back pain and healthy control group subjects[39]. Moreover, chronic WP patients reported significantly more comorbidities and psychosomatic symptoms than patients with local chronic low back pain[40]a common type of CLP, in primary care settings. METHODS: Fifty-eight German general practitioners (GPs. Arguably, patients with chronic pain conditions present several impairments that may alter the body pain drawings.

Clinicians should be aware of using other computerized methods which can provide valuable information beyond the number of pain sites. Future research must evaluate the relationship between different approaches to assessing pain sites and areas. Pain measurements have been extensively used in WP, but many aspects could be improved in the measurement properties. For instance, pain intensity measures have low or very low-quality evidence for content validity in patients with low back pain, and there is no instrument with superior measurement properties[41].

CONCLUSION

WPI and painMAP software showed a weak correlation in assessing the number of pain sites in patients with WP.

AUTHORS' CONTRIBUTIONS

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