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Title Page

Pain Extent is Associated with the Emotional and Physical Burdens of Chronic Tension Type Headache, but not with Depression or Anxiety

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Abstract

Objective: Earlier studies suggest that pain extent, extracted from the patients' pain drawing, can help clinicians to identify people with central sensitization or worse clinical features. Our aim was to investigate possible associations between perceived pain extent and clinical pain features, burden of headache, psychological outcomes, and pressure sensitivity in people with chronic tension type headache (CTTH). **Methods**: Ninety-nine people (27% male) with CTTH reported their pain on four different body charts representing the head and neck. Pain extent and frequency maps were obtained using customized software. Clinical features of headache, burden related to headache (Headache Disability Inventory, HDI), anxiety and depression (Hospital Anxiety-Depression Scale, HADS), and anxiety state/trait (State-Trait Anxiety Inventory, STAI) levels were assessed. Pressure pain thresholds (PPTs) were assessed over the temporalis muscle (trigeminal area), the cervical spine (extra-trigeminal area), and tibialis anterior muscle (distant pain-free area) to determine widespread pressure sensitivity. Associations between pain extent and all outcomes were analysed. **Results**: Pain extent showed significant positive associations with age (r=.221, P=.029) and burden of the headache (emotional: r=.213, P=.030; physical: r=.208, P=.039) but no other significant association was found. **Conclusions**: Pain extent weakly correlated with older age as well as with higher emotional and physical burden of the headache in CTTH In this population, there was no relationship between pain extent and PPTs indicating that larger pain areas were not associated with signs of central sensitization. Pain drawings can complement other clinical pain features for better characterization of CTTH, but further studies are needed.

Key words: tension type headache, pain area, burden, pressure pain, anxiety, depression

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Introduction

Tension type headache is the most common primary headache affecting up to 80% of the general population at some time during their life (1). Prevalence estimates of tension type headaches are more variable than of migraine and range between 21% to 63% (2,3). Current evidence supports the presence of peripheral and central sensitization processes in tension type headache (4,5). In fact, it seems that pressure pain hypersensitivity is one of the main features of patients with this headache type (6). A recent review concluded that pressure pain thresholds are consistently lower in individuals with primary headaches compared to asymptomatic people with the trigeminal area the most sensitive to pressure pain (7). In addition, widespread pressure pain sensitivity in extra-trigeminal distant pain-free areas is also a feature of people with chronic tension type headache (CTTH) (8).

Pain drawings are used to obtain a graphic representation of pain location and distribution in people with pain by asking them to draw where they feel pain on a body chart. Evaluation of pain drawings has revealed that there is an overlapping symptomatology between patients with tension type headache and patients with temporo-mandibular pain (9,10). In addition, Alonso-Blanco et al observed that the spontaneous pain pattern of tension type headache is consistent between adults and children since they exhibited similar location of pain (11). Nevertheless, these studies did not investigate the extent of the symptomatic painful area in this headache population.

It is accepted that an expanded distribution of pain represents a clinical sign of central sensitization (12,13). There is preliminary evidence suggesting that enlarged pain areas are associated with more severe pain (14) and higher pressure pain hypersensitivity (15) in people with painful knee osteoarthritis and associated with higher disability and depression in chronic whiplash-associated disorders (16) These results suggest that pain drawings can help clinicians to identify people with central sensitization or worse clinical features.

No previous study has investigated if pain extent is associated with clinical, psychological or sensitization outcomes in patients with CTTH. Thus, the aims of the current study were to examine whether the extent of pain, extracted from pain drawings, was associated with clinical pain features, anxiety, depression, burden of headache, or widespread pressure hypersensitivity in individuals with CTTH.

Methods

Participants

Participants with headache, recruited from a University-based hospital between January 2015 and January 2016, were screened for possible eligibility criteria. CTTH was diagnosed according to the International Classification of Headache Disorders criteria, third edition (ICHD-III beta 2013) down to third-digit level (code 2.2, 2.3) by a neurologist with expertise in headache diagnosis (17). Potential participants underwent a face-to-face interview followed by a general and neurological examination. To be included in this study, patients had to have experienced all typical features of CTTH for at least one year: bilateral location, pressing and tightening pain, moderate intensity (≤6 on a 10-points numerical pain rate scale), and no aggravation of pain during physical activity. As listed in the ICHD-III beta diagnostic criteria (17), potential participants should not have reported more than one of photophobia, phonophobia, or mild nausea, and they also should not have reported either moderate or severe nausea or vomiting.

Clinical history included headache-family history, headache features, temporal pattern, and medication intake. Patients completed a headache diary for 4 weeks to substantiate the diagnosis and to calculate the headache clinical features (18). On this headache diary, patients registered the number of days with headache (days/week), the duration of each pain attack (hours/day), and the headache intensity on an 11-point numerical pain rate scale (NPRS; 0: no pain, 10: maximum pain). The use of preventive medication intake was also recorded in the diary.

Participants were excluded if they presented with: 1, other primary/secondary headache; 2, medication overuse headache as defined by the ICHD-III; 3, history of neck or head trauma (i.e., whiplash); 4, pregnancy; 5, history of cervical herniated disc and/or cervical osteoarthritis; 6, any systemic degenerative disease, e.g., rheumatoid arthritis, lupus erythematous; 7, comorbid diagnosis of fibromyalgia syndrome; 8, had received anesthetic block within the previous 6 months; or, 9, received physical treatment to the neck or head region in the last 6 months. All participants read and signed a written consent form prior to their inclusion in the study. The local Ethics Committee approved the study design protocol (URJC 23/2014, HRJ 07/14).

The following evaluations were conducted when all participants were headache-free. They were asked to avoid any analgesic or muscle relaxant 24 hours prior to the examination. No change was made to their prophylactic treatment.

Pain drawings

Participants were instructed once to complete a pain drawing indicating their pain location and extent on four different paper body charts of the head and neck region: one illustrating a frontal view of head, one illustrating a dorsal view of head, and two illustrating a lateral view of head (left and right). Participants were instructed to colour, using a pencil, every part of the body chart where they perceived pain, independently from the type and the severity of pain. They were asked to report their usual pain experienced during headache attacks. Subsequently, all pain drawings on the paper body charts were copied onto a digital body chart by two trained operators using an image analysis software (Inkscape version 0.48). This procedure to digitalize pain drawings has been previously described and its reliability was confirmed (19,20). Pain extent was computed using software developed and tested in a previous study (21). The software counted the number of pixels included in each pain drawing and any pencil mark drawn outside of the body chart borders was not included in the analysis. Pain extent for each patient was reported as the sum of the pixels in the frontal and in the dorsal view of head, and expressed as the percentage of the total body chart area (i.e. 507778 pixels, frontal: 252617 pixels, dorsal: 255166 pixels). Pain frequency maps were also generated for the four different body charts of the head to illustrate where pain was most frequently perceived by the enrolled patients. Pain frequency maps were obtained by superimposing all the pain drawings produced on the same body chart from all participants.

Headache Disability Inventory (HDI)

The HDI was designed to assess the burden of headache using 25 items that inquire about the perceived impact of headache on emotional functioning (e.g., "Because of my headaches I feel handicapped") and daily activities (e.g., "Because of my headaches I feel restricted in performing my routine daily activities") (22). Possible answers for each item are YES (4 points), SOMETIMES (2 point) and NO (0 points). Thirteen items assess the emotional component of headache (HDI-E, maximum score: 52), and the remaining 12 items assess the physical component (HDI-P, maximum score: 48). A greater score suggests a greater burden/disability of headache. The HDI has exhibited good stability in the short (r=0.93-0.95) and long-term (r=0.76-0.83) (23).

Hospital Anxiety and Depression Scale (HADS)

The HADS was used to determine the presence of anxiety and depressive symptoms. This questionnaire consists of 14 items scored on a 4-point scale ranging from 0 to 3 points, with 7 of the items assessing anxiety (HADS-A) and 7 of the items assessing depressive symptoms (HADS-D) (24). This questionnaire is considered reliable and valid for assessing anxiety (Cronbach's α: 0.83) and depression (Cronbach's α: 0.82) separately (25). The HADS has also shown good internal consistency in people with headache (26).

State-Trait Anxiety Inventory (STAI)

The STAI is a 40-item scale assessing separate dimensions of state anxiety (items l-20, STAI-S) and trait anxiety (items 21-40, STAI-T) (27). The STAI-S assesses anxiety levels experienced at the time of questionnaire completion. Participants use a 4-point response scale ranging from "not at all" to "very much", to indicate the extent to which they experience each emotion. The STAI-T scale measures a stable propensity to experience anxiety, and tendencies to perceive stressful situations as threatening. It consists of 20 statements requiring individuals to rate how they generally feel on a 4-point scale. In both scales, higher scores indicate greater levels of state or trait anxiety. Both STAI subscales have shown an internal consistency of 0.89 and test-retest reliability of 0.88 (28).

Pressure Pain Thresholds (PPT)

PPT, i.e., the amount of pressure where a sensation of pressure first changes to pain, was recorded with an electronic algometer (Somedic AB®, Farsta, Sweden). Pressure was applied using a 1cm^2 probe at a rate of approximately 30kPa/s. Participants were instructed to press the "stop-button" of the algometer as soon as the pressure resulted in the first sensation of pain. A trial was first performed over the wrist extensor muscles of the right forearm to familiarise the participants with the procedure. To determine widespread pressure sensitivity, PPT was assessed bilaterally over trigeminal (temporalis muscle), extra-trigeminal (C5/C6 zygapophyseal joint), and a pain-free distant (tibialis anterior muscle) area. The order of assessment was randomized between subjects. The mean of 3 trials on each point was calculated and used for the analysis. A 30 s rest period was given between trials to avoid temporal summation (29). The reliability of algometry is high (30).

Sample size calculation

The sample size was calculated using Ene 3.0 software (Autonomic University of Barcelona, Spain). The sample calculation was based on detecting significant moderate correlations (r=0.4) between the studied variables with an alpha level (α) of 0.05, and a desired power (β) of 95%. This generated a sample size of at least 71 subjects.

Statistical analysis

The Shapiro-Wilk normality test revealed significant deviation from normality for several variables including the distribution of pain extent, year with TTH, intensity, frequency and duration of headache, as well as HADS-A and STAI-trait outcomes. Therefore, non-parametric tests were used in the correlational analysis. Spearman's rho rank-order correlation coefficients (r_s) were computed to reveal possible associations between pain extent and self-rated outcomes, i.e., clinical pain features, anxiety, depression, burden of headache and widespread pressure sensitivity. Correlations were considered weak when r<0.3, moderate when 0.3<r<0.7, and strong when r>0.7 (**31**). The correlational analysis was conducted in the total sample as well as grouped by those taking or not taking prophylactic medication. Differences in clinical features, anxiety, depression, burden of headache and widespread pressure sensitivity between patients grouped by the use of prophylactic medication intake were assessed with the nonparametric Wilcoxon rank test. The statistical analysis was performed using R version 3.2.2. Significance was set to α=0.05.

Results

From 120 eligible people with headache who accepted to participate, 21 were excluded for the following reasons: co-morbid migraine (n=12); previous neck trauma (n=5); or diagnosis of fibromyalgia (n=4). Finally, 99 participants (27% men) with CTTH were included. Fifty-three (52%) were taking prophylactic medication, i.e., amitriptyline on a regular basis. No differences were observed in any outcome between patients taking or not taking prophylactic medication (all, P>0.154. **Table 1** summarizes the pain extent, clinical, psychological, and related-disability outcomes as well as PPT data of the entire sample. Pain extent was 14.6 ± 10.8% across the entire group of subjects with CTTH. Pain frequency maps for the participants with CTTH are illustrated in **Figure 1**.

Correlations between pain extent and clinical symptoms as well as the burden of headache are reported in **Table 1**. Pain extent was significantly associated with age (*r*=.221, P=.029) and the burden of the headache (emotional: *r*=.213, P=.030; physical: *r*=.208, P=.039): the larger the pain extent, the higher the physical and emotional burden of the headache (**Figure 2**). No significant associations were observed between pain extent and clinical features of the headache (all, P>.380). These associations were not associated with the use of preventive medication (P>0.05).

Moreover, no significant associations were found between pain extent and psychological factors such as anxiety (HADS-A, P=.573) or depressive (HADS-D, P=.902) symptoms, or with anxiety trait (STAI-T, P=.894) or state (STAIT-S, P=.512) levels. Lastly, no associations were observed between pain extent and measures of widespread pressure pain sensitivity (all, P>.312).

Discussion

The results of the current study revealed that pain extent is correlated with older age as well as with higher physical and emotional burden of headache in people with CTTH. No associations were observed between pain extent and other clinical outcomes, anxiety, depression, or pressure pain sensitivity. Although it is generally accepted that people with CTTH exhibit pain in the trigemino-cervical area, the location of pain is highly variable among patients. In fact, a systematic evaluation of pain drawings in individuals with CTTH is lacking in the current literature. Therefore, this is the first study systematically investigating pain drawings and pain extent in individuals with CTTH. The pain frequency maps obtained from our sample of people with CTTH reveal that most patients perceived pain all over their head during their headache attacks with the frontal and suboccipital areas being the most commonly affected. Since there is an overlap of painful areas between patients with headache and temporo-mandibular pain (9,10), the use of specific pain drawings may help to further differentiate these painful disorders.

Spreading pain and widespread pressure hypersensitivity have been associated with stronger centralized sensitization (7,8,12,13); however, in our study we did not observe any association between pain extent within the trigemino-cervical area and widespread pressure pain sensitivity in individuals with CTTH. This is in contrast with the results observed in other painful conditions such as knee osteoarthritis where larger pain extent was associated with greater pressure hypersensitivity (15). Moreover, no associations were identified between pain extent and clinical or psychological outcomes in our sample of individuals with CTTH, contrary to previous findings reported for those with knee osteoarthritis (14) or whiplash-associated disorders (16). One possible explanation for these discrepancies could be that painful areas are usually limited to the trigemino-cervical area in CTTH, whereas pain symptoms are more widespread in knee osteoarthritis or chronic neck pain following a whiplash injury. It is also plausible that our recruited sample of middle-age individuals with CTTH had a relative homogeneous pattern of their headache features (as reflected by narrow confidence intervals) and this lack of variability across patients explains the lack of associations between pain extent and clinical features. Nevertheless, the lack of association between pain extent and psychological features including anxiety and depressive levels agrees with a systematic review showing that expanded pain drawings are not associated with worse psychological functioning (32).

Pain extent was significantly, albeit weakly, associated with both the emotional and physical burden of headache indicating that larger painful areas are associated with higher burden for the patient. Enlarged self-perceived areas of pain may be perceived as poorer health status by the patients and therefore the emotional or physical burden of the condition would be worse. It has been recently proposed that examination of patients with chronic pain should contain multiple domains of pain including, among others, extension, location and distribution of pain (33). Current results suggest that pain drawings could complement other clinical pain features for better characterization of CTTH. Future studies should investigate this hypothesis.

Although this study included a procedure for extracting pain extent from self-reported pain drawings which was done without any subjective assessor influence; there are some methodological issues that should be considered. First, we collected data from subjects with CTTH recruited from a tertiary-based hospital and current results should not be extrapolated to the general population with this condition. Second, we only evaluated the pain area once in our sample of patients. Although the reliability of this procedure of pain drawing assessment was found to be high (21), it has not been specifically assessed in people with CTTH. Longitudinal studies are needed to understand if pain extent changes over time in patients with TTH. Third, we collected static outcomes of sensitization and only from one stimulus, pressure pain thresholds. We do not know if pain extent is associated with more advanced dynamic outcomes of sensitization such as wind-up, spatial or temporal summation, or conditioned pain modulation. Fourth, since CTTH can be associated with widespread pain beyond the head and neck, future studies may consider capturing pain areas from charts of the full body, instead of only the head and neck. Finally, we recognize that multiple tests of correlation were included in the analysis without any correction of the significance level, but, the multiple correction method has been questioned (34).

Conclusions

This study, using an objective assessment procedure for the quantification of pain extent, found that larger pain extent correlated with age and higher burden of the headache in individuals with CTTH, but not with clinical outcomes, anxiety, or depression. Pain extent was also not associated with generalized pressure pain hypersensitivity. Pain drawings may complement other clinical pain features for better characterization of CTTH, but further studies are needed.

Conflict of Interest Statement and Funding Statement

The authors have no conflicts of interest to declare. No funds were received for this study

Contributors

All authors contributed to the study concept and design. MB and FG did the main statistical analysis. MPC, MB, DF and CFdlP contributed to analysis and interpretation of data. CFdlP and LAN contributed to draft the report. LAN and CFdlP provided administrative, technical, and material support. LAN and CFdlP supervised the study. All authors revised the text for intellectual content and have read and approved the final version of the manuscript.

Legend of Figures

Figure 1: Pain frequency maps generated by superimposing the pain drawings of all participants with chronic tension type headache (n=99). The colour bar represents the frequency of coloured areas. Dark red indicates the most frequently reported area of pain.

Figure 2: Scatter plots of correlations between the pain extent with the emotional (A) and physical (B) burden of headache in individuals with chronic tension type headache (n=99). Note that several points are overlapping. A positive linear regression line is fitted to the data.

References

1. Schramm SH, Obermann M, Katsarava Z, Diener HC, Moebus S, Yoon M. Epidemiological profiles of patients with chronic migraine and chronic tension-type headache. *J Headache Pain* 2013; 14: 40.

2. Vuković V, Plavec D, Pavelin S, Jančuljak D, Ivanković M, Demarin V. Prevalence of migraine, probable migraine and tension-type headache in the Croatian population. *Neuroepidemiology* 2010; 35: 59-65.

3. Katsarava Z, Dzagnidze A, Kukava M et al. Primary headache disorders in the Republic of Georgia: prevalence and risk factors. *Neurology* 2009; 73: 1796-1803.

4. Yu S, Han X. Update of chronic tension-type headache. *Curr Pain Headache Rep* 2015; 19: 469.

5. de Tommaso M, Fernández-de-las-Peñas C. Tension type headache. *Curr Rheumatol Rev* 2016; 12: 127-39.

6. Abboud J, Marchand A, Sorra K, Descarreaux M. Musculoskeletal physical outcome measures in individuals with tension-type headache: a scoping review. *Cephalalgia* 2013; 33: 1319-36.

7. Andersen S, Petersen MW, Svendsen AS, Gazerani P. Pressure pain thresholds assessed over temporalis, masseter, and frontalis muscles in healthy individuals, patients with tension-type headache, and those with migraine: a systematic review. *Pain* 2015; 156: 1409-23.

8. Ashina S, Bendtsen L, Ashina M, Magerl W, Jensen R. Generalized hyperalgesia in patients with chronic tension type headache. *Cephalalgia* 2006; 26: 940-8.

9. Svenson P. Muscle pain in the head: overlap between temporomandibular disorders and tension-type headaches. *Curr Opin Neurol* 2007; 20: 320-5.

10.Conti PC, Costa YM, Gonçalves DA, Svensson P. Headaches and myofascial temporomandibular disorders: overlapping entities, separate managements? *J Oral Rehabil* 2016 doi: 10.1111/joor.12410.

11. Alonso-Blanco C, Fernández-de-las-Peñas C, Fernández-Mayoralas DM, de-la-Llave-Rincón

AI, Pareja JA, Svensson P. Prevalence and anatomical localization of muscle referred pain from active trigger points in head and neck musculature in adults and children with chronic tension-type headache. *Pain Med* 2011; 12: 1453-63.

12. Graven-Nielsen T, Arendt-Nielsen L. Assessment of mechanisms in localized and widespread musculoskeletal pain. *Nat Rev Rheumatol* 2010; 6: 599-606.

13. Arendt-Nielsen L, Graven-Nielsen T. Translational musculoskeletal pain research. *Best Pract Res Clin Rheumatol* 2011; 25: 209-26.

14. Wood L, Peat G, Thomas E, Duncan R. Knee osteoarthritis in community-dwelling older adults: are there characteristic patterns of pain location? *Osteoarthritis Cartilage* 2007; 15: 615-23.

15. Lluch Girbés E, Dueñas L, Barbero M, et al. Expanded distribution of pain as a sign of central sensitization in individuals with symptomatic knee osteoarthritis. *Phys Ther* 2016; 96: 1196-207.

16. Falla D, Peolsson A, Peterson G, et al. Perceived pain extent is associated with disability, depression and self-efficacy in individuals with whiplash-associated disorders. *Eur J Pain* 2016; 20: 1490-501.

17. ICHD-III International Classification of Headache Disorders: Headache Classification Subcommittee of the International Headache Society, 3nd edition. *Cephalalgia* 2013; 33: 629-808.

18. Jensen R, Tassorelli C, Rossi P, et al. A basic diagnostic headache diary (BDHD) is well accepted and useful in the diagnosis of headache. a multicentre European and Latin American study. *Cephalalgia* 2011; 31: 1549-60.

19. Dos Reis FJ, de Barros E, Silva V, de Lucena RN, Mendes Cardoso BA, Nogueira LC. Measuring the pain area: An intra- and inter-rater reliability study using image analysis software. *Pain Pract* 2016; 16: 24-30.

20. Persson AL, Garametsos S, Pedersen J. Computer-aided surface estimation of pain drawings - intra- and inter-rater reliability. *J Pain Res* 2011; 4: 135-41.

21. Barbero M, Moresi F, Leoni D, Gatti R, Egloff M, Falla D. Test-retest reliability of pain extent and pain location using a novel method for pain drawing analysis. *Eur J Pain* 2015; 19: 1129-38.

22. Jacobson GP, Ramadan NM, Norris L, Newman CW. The Henry Ford Hospital Headache Disability Inventory. *Neurology* 1994; 44; 837-42.

23. Jacobson GP, Ramadan NM, Norris L, Newman CW. Headache disability inventory (HDI): short-term test-retest reliability and spouse perceptions. *Headache* 1995;35: 534-9.

24. Zigmond AS, Snaith RP. The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand* 1983; 67: 361-370.

25. Bjelland I, Dahl AA, Tangen Haug T, Neckelmann D. The validity of The Hospital Anxiety and Depression Scale: an updated literature review. *J Psychosom Res* 2002; 52: 69-77.

26. Juang KD, Wang SJ, Lin CH, Fuh JL. Use of the Hospital Anxiety and Depression Scale as a screening tool for patients with headache. *Zhonghua Yi Xue Za Zhi* (Taipei) 1999; 62: 749-55.

27. Spielberger CD. *State-Trait Anxiety Inventory: a comprehensive bibliography*. Palo Alto, CA: Consulting Psychologists Press, 1989.

28. Barnes LLB, Harp D, Jung WS. Reliability generalization of scores on the Spielberger State-Trait Anxiety Inventory. *Educ Psychol Meas* 2002; 62: 603-618.

29. Nie H, Arendt-Nielsen L, Andersen H, Graven-Nielsen T. Temporal summation of pain evoked by mechanical stimulation in deep and superficial tissue. *J Pain* 2005; 6: 348-355.

30. Walton DM, Macdermid JC, Nielson W, Teasell RW, Chiasson M, Brown L. Reliability, standard error, and minimum detectable change of clinical pressure pain threshold testing in people with and without acute neck pain. *J Orthop Sports Phys Ther* 2011; 41: 644-50.

31. Dancey CP, Reidy J. *Statistics without maths for psychology: Using SPSS for Windows*. New York: Prentice Hall, 2004.

32. Carnes D, Ashby D, Underwood M. A systematic review of pain drawing literature: should pain drawings be used for psychologic screening? *Clin J Pain* 2006; 22: 449-457.

33. Fillingim RB, Loeser JD, Baron R, Edwards R. Assessment of chronic pain: Domains, methods, and mechanisms. *J Pain* 2016; 17: T10-20

34. Rothman KJ. No adjustments are needed for multiple comparisons. *Epidemiology* 1990; 1: 43-6