symmetry

MDPI

Article

Sex-Based Differences in Pressure Pain Thresholds of Myofascial Trigger Points in Cervical and Cranial Muscles in Tension-Type Headache: A Cross-Sectional Study

Sofía Monti-Ballano, María Orosia Lucha-López *, César Hidalgo-García *, Loreto Ferrández-Laliena, Lucía Vicente-Pina, Rocío Sánchez-Rodríguez, Héctor José Tricás-Vidal and José Miguel Tricás-Moreno

Unidad de Investigación en Fisioterapia, Spin off Centro Clínico OMT-E Fisioterapia SLP, Universidad de Zaragoza, Domingo Miral s/n, 50009 Zaragoza, Spain; smonti@unizar.es (S.M.-B.); lferrandez@unizar.es (L.F.-L.); l.vicente@unizar.es (L.V.-P.); 739468@unizar.es (R.S.-R.); hjtricas@unizar.es (H.J.T.-V.); jmtricas@unizar.es (J.M.T.-M.)

* Correspondence: orolucha@unizar.es (M.O.L.-L.); hidalgo@unizar.es (C.H.-G.); Tel.: +34-626-480-131 (M.O.L.-L.)

Abstract: Background: Tension-type headache (TTH) is the most prevalent primary headache. Pressure pain thresholds (PPTs) reflect the pressure pain sensitivity of the tissues. Women with TTH have showed greater pressure hypersensitivity in some muscles compared to men. The aim of this study was to compare the PPTs from myofascial trigger points in cervical and cranial muscles which might contribute to headaches between men and women with TTH. Methods: An observational and correlation cross-sectional study was performed. PPTs were evaluated bilaterally and compared between men and women in the following muscles: upper trapezius, splenius capitis and cervicis, semispinalis, rectus capitis posterior major, obliquus capitis superior and inferior, occipitofrontalis posterior and anterior, temporalis, masseter, clavicular and sternal head of sternocleidomastoid, zygomaticus major, and levator scapulae. The mean PPT was calculated as well. Results: Significant differences showing lower PPTs in women compared to men were found in the mean PPT (p = 0.000) and in all the points except in the left clavicular head of the sternocleidomastoid (p = 0.093) and in the left masseter (p = 0.069). Conclusions: Lower PPTs from myofascial trigger points in cervical and cranial muscles, which might contribute to headaches, were observed in women compared to men with TTH. The mean PPT was also lower in women than in men, suggesting the need for gender-specific approaches in the treatment of TTH.

Keywords: tension-type headache; dry needling; active myofascial trigger points; neurologic manifestations; muscle tenderness; referred pain; clinical trial; headache intensity; perceived clinical change

check for updates

Citation: Monti-Ballano, S.; Lucha-López, M.O.; Hidalgo-García, C.; Ferrández-Laliena, L.; Vicente-Pina, L.; Sánchez-Rodríguez, R.; Tricás-Vidal, H.J.; Tricás-Moreno, J.M. Sex-Based Differences in Pressure Pain Thresholds of Myofascial Trigger Points in Cervical and Cranial Muscles in Tension-Type Headache: A Cross-Sectional Study. *Symmetry* **2024**, *16*, 1087. https://doi.org/10.3390/sym16081087

Academic Editor: John H. Graham

Received: 19 July 2024
Revised: 12 August 2024
Accepted: 19 August 2024
Published: 21 August 2024

1. Introduction

Tension-type headache (TTH) is the most prevalent primary headache. In 2016, it was the third most prevalent condition worldwide [1]. Although other types of headaches, such as migraines, incur higher economic costs than TTH [2], TTH accounts for 12% of the total annual cost of all headaches in the European Union, amounting to approximately €20 billion [3].

As defined by the International Classification of Headache Disorders (ICHD-III) [4], TTH is generally characterized by bilateral pain that feels like pressing or tightening, with a mild to moderate intensity, and can persist for a duration ranging from minutes to days. The prevalence of TTH is higher in women [5].

In addition to headaches, patients with TTH often experience other associated symptoms, such as loss of motor control [6,7] in the cervical region, cranial autonomic symptoms [8], a forward head posture [9,10], anxiety and depression [11,12], and the presence of myofascial trigger points (MTrPs) [13,14] with reduced pressure pain thresholds (PPTs) [14–16].

The term "myofascial trigger point" (MTrP), popularized in the 1950s, refers to a hyperirritable area within a taut band of skeletal muscle [17]. A decrease in PPTs at MTrPs has been observed in patients with TTH compared to asymptomatic individuals [14]. An increased sensitivity of myofascial tissues in the cranial region has also been noted in these patients [18]. A possible explanation for the chronification of this condition lies in the fact that muscle stiffness may promote peripheral sensitization, which, if persistent over time, can lead to central sensitization [19].

Current research has identified MTrPs in various muscles associated with TTH, including the suboccipital muscles, upper trapezius, sternocleidomastoid, obliquus capitis superior, temporalis, levator scapulae, masseter, and splenius capitis [13,14].

PPTs are a crucial aspect of clinical evaluation in patients with TTH, as they allow for the assessment of MTrPs and other affected areas. These thresholds reflect the pain sensitivity of the tissues [20].

A 2012 review [21] concluded that there is overwhelming evidence indicating that women generally exhibit higher sensitivity to pain compared to men, based on various epidemiological and laboratory data. Despite ongoing debates and challenges in reaching a consensus on this topic, the existing literature suggests a consistent pattern of women being more sensitive to pain, especially in the context of chronic pain syndromes.

Differences in pain perception between men and women are influenced by a range of factors, including anatomical, physiological, neural, hormonal, psychological, social, and cultural elements. Research indicates that women tend to report pain more often and have a lower pain threshold compared to men [22]. In a recent literature review, the importance of hormones in pain perception is highlighted. While testosterone tends to reduce headaches and musculoskeletal pain, fluctuations in estrogen levels may offer a possible explanation for the lower pain thresholds observed in females [23]. These female hormones have also been associated with the presence of TTH [24–27].

Other reviews, in addition to focusing on hormones, have observed that male and female rodents do not use the same cells in the central nervous system to mediate pain [28]. In the review by Lenert et al. [29], these differences are explored by suggesting a potential influence on sensory neuron activity through the interaction between hormones and the immune system.

Thus, it seems that an asymmetry phenomenon is present in pain physiology according to sex. Although asymmetry in pain perception has been noted between men and women with a consistent pattern, the presence of sex-based asymmetry in the PPTs at MTrPs in TTHs is scarce.

There is only one study investigating sex differences related to PPTs in TTH. The study from 2009 [30] concluded that women had lower PPTs than men in the three muscles studied: the masseter, temporalis, and splenius capitis. Two subsequent reviews [20,31] compiled several studies on different types of headaches and determined that females reported lower PPT values in neck points. They concluded this about the following four muscles: the upper trapezius, temporalis, masseter, and frontalis. Possible differences in pain perception between men and women have also been studied with other pain thresholds. A study found that males and females had similar heat pain thresholds but males exhibited higher heat pain tolerance limits [32].

Therefore, women with TTH have showed greater pressure hypersensitivity of the MTrPs in some muscles compared to men, but this issue has not been studied yet in all the muscles which might contribute to TTH.

Thus, the aim of this study was to compare the PPTs from MTrPs in cervical and cranial muscles which might contribute to headaches between men and women with a diagnosis of TTH.

2. Materials and Methods

An observational and correlation cross-sectional study following *The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies* [33] was performed.

The study protocol adhered to the principles of the Declaration of Helsinki [34] and was approved by the Ethics Committee of Clinical Research of Aragon (CEICA) (protocol code PI23-418/date of approval: 18 October 2023).

2.1. Participants

The sample size calculation was made using GPower software, version 3.1.9 (https://www.psychologie.hhu.de/arbeitsgruppen/allgemeine-psychologie-und-arbeitspsychologie/gpower, accessed on 20 October 2023). The options used were as follows: an expected difference between the pressure pain threshold (PPT) from the cervical spine in men and women of 1.19 kg/cm^2 according to data published previously [35], an alpha risk of 0.05, a beta risk of 0.05, a standard deviation of 0.55 [36], and the two-sided test. A proportion of around 0.33 was expected between men and women [35,37]. A minimal number of 4 men and 14 women was obtained.

Researchers, considering potential missing data in some measures, finally recruited 32 participants, 8 men and 24 women, for this study (Figure 1). Recruitment of participants was conducted through publications in social media and informative banners in physiotherapy clinics and universities.

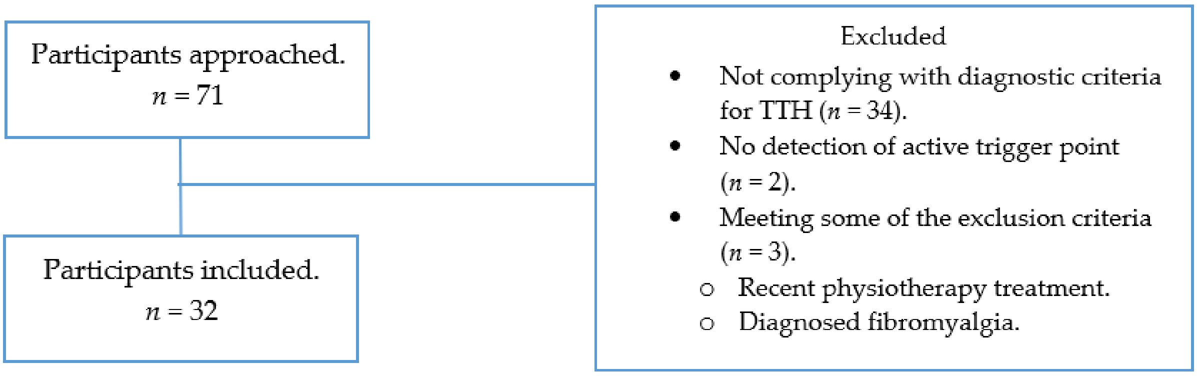

Figure 1. Flow diagram of participant enrolment.

The inclusion criteria of the participants were as follows: patients were under the supervision of a specialist of neurology. Patients had to meet the criteria defined for TTH in the International Classification of Headache Disorders, third edition [4]: bilateral location, pressing and tightening pain, mild to moderate intensity, and no aggravation of pain during physical activity. Patients should report no more than one of the following symptoms: photophobia, phonophobia, or mild nausea, and no moderate or severe nausea or vomiting, as established by the ICHD-III diagnostic criteria. The sample was also required to have been suffering from TTH for more than six months, to have experienced at least one and up to 30 headache episodes per month, and to have at least one active trigger point in any of the muscles that refer pain to the head, in accordance with the diagnostics criteria and referred pain description of Travell and Simons [38]. All participants provided written informed consent prior to their inclusion in the study.

The exclusion criteria were as follows: (1) major trauma in the cervical area and/or recent surgery. (2) Pregnancy. (3) Diagnosed fibromyalgia. (4) Inflammatory, hormonal, or neurological disorders. (5) Chronic orthopaedic problems in the spine and/or shoulder region such as scoliosis, impingement syndrome, or acromion type. (6) Severe psychiatric illnesses. (7) Inability to complete the form in Spanish. (8) Having received physiotherapy treatment for headaches in the last month.

2.2. Measurements

Clinical history: Patients were asked about their sex, age, and duration of suffering from TTH. PPT distal point: before measuring the MTrPs, PPT was measured at the base of the thumb as a distal point unrelated to the TTH.

PPTs Examination in the MTrPs

All the muscles whose referred pain pattern, according to Travell and Simons [38], is located in the cranial or facial regions, which are normally associated with headaches, were selected for examination. The muscles explored bilaterally were as follows: upper trapezius, splenius capitis and cervicis, semispinalis, rectus capitis posterior major, obliquus capitis superior and inferior, occipitofrontalis posterior and anterior, temporalis, masseter, clavicular and sternal head of sternocleidomastoid, and zygomaticus major musculature. Additionally, the levator scapulae was included, due to the fact that a previous study found that patients with TTH exhibit active MTrPs in this muscle [39].

MTrPs' location in the previous muscles was performed according to the anatomical location of each MTrP stablished by Travell and Simons [38] and to the following criteria: presence of a taut band in the muscle and presence of a painful tender spot under compression in the taut band [40]. The location of MTrPs in the upper trapezius has shown moderate to good reliability with intraclass correlation coefficients of 0.62 and 0.81, indicating moderate to good agreement [41].

For the establishment of the PPT in each MTrP, the digital algometer (Somedic AB Farsta, Sweden) was used (Figure 2). The round pressure area of the algometer was 1 cm^2, and a pressure with a speed of 1 $kg/cm^2/s$ was applied to each MTrP. The PPT was identified as the minimum stimulus intensity with which the subject perceived mechanical pressure pain [42]. The participant indicated when the sensation changed from pressure to pain. The PPT was recorded for each MTrP in each individual.

(**A**) (**B**)

Figure 2. Demonstration of the assessment of pressure pain thresholds in the posterior occipitofrontal region (**A**) and in the semispinalis 1 (**B**).

2.3. Statistical Analysis

Age, the PPT of each MTrP, and the mean PPT, considering all the MTrPs evaluated, were described with the mean and the standard deviation (SD), with the sample stratified by sex. The mean PPT was calculated by adding the PPT of the MTrP and dividing the sum by the total number of points.

Differences in the PPT of each point and in the mean PPT between men and women were analysed using the Mann–Whitney U test for independent samples.

Data were analysed with SPSS Statistics Software version 25.0 (IBM Corporation, New York, NY, USA). The statistical significance was established at p value < 0.05.

3. Results

Table 1 provides the description of the demographic data and PPT measurements. Specifically, the table lists the age of the subjects, the mean PPT, and the individual PPT for each muscle evaluated, differentiated by gender. Additionally, it includes the p value resulting from the comparative study between men and women. No statistically significant difference was found in age between men and women (p = 0.695).

Table 1. Age and pressure pain thresholds of male and female participants.

	Male	**Female**	***p* Value ***
n	8	24	-
Age (years)	41.25 ± 15.92	38.38 ± 12.01	0.695
Thumb R (kg/cm^2)	4.91 ± 0.43	3.44 ± 0.21	0.012
Thumb L (kg/cm^2)	4.24 ± 0.39	3.43 ± 0.16	0.085
Mean PPT (kg/cm^2)	3.57 ± 0.48	2.41 ± 0.52	0.000
Upper trapezius R (kg/cm^2)	4.24 ± 0.76	2.74 ± 0.86	0.001
Upper trapezius L (kg/cm^2)	4.75 ± 1.19	2.90 ± 1.02	0.001
Levator scapulae R (kg/cm^2)	4.74 ± 1.27	3.35 ± 0.91	0.007
Levator scapulae L (kg/cm^2)	4.81 ± 1.12	2.99 ± 0.90	0.001
Splenius capitis R (kg/cm^2)	3.55 ± 0.72	2.53 ± 0.65	0.003
Splenius capitis L (kg/cm^2)	3.64 ± 0.84	2.44 ± 0.78	0.003
Splenius cervicis R (kg/cm^2)	3.24 ± 0.56	2.29 ± 0.67	0.002
Splenius cervicis L (kg/cm^2)	3.28 ± 0.78	2.32 ± 0.78	0.011
Semispinalis 1 R (kg/cm^2)	4.54 ± 1.19	3.19 ± 0.93	0.010
Semispinalis 1 L (kg/cm^2)	5.04 ± 0.80	3.16 ± 0.87	0.000
Semispinalis 2 R (kg/cm^2)	4.70 ± 0.87	3.33 ± 1.04	0.003
Semispinalis 2 L (kg/cm^2)	4.41 ± 0.83	3.09 ± 1.12	0.006
Semispinalis 3 R (kg/cm^2)	4.00 ± 0.94	2,78 ± 0.69	0.005
Semispinalis 3 L (kg/cm^2)	3.79 ± 0.89	2.91 ± 0.94	0.033
Rectus capitis posterior major R (kg/cm^2)	4.38 ± 0.77	2.70 ± 0.76	0.000
Rectus capitis posterior major L (kg/cm^2)	4.13 ± 0.79	2.76 ± 0.87	0.002
Obliquus capitis superior R (kg/cm^2)	3.60 ± 0.70	2.50 ± 0.71	0.003
Obliquus capitis superior L (kg/cm^2)	3.48 ± 0.91	2.34 ± 0.61	0.004
Obliquus capitis inferior R (kg/cm^2)	3.61 ± 0.64	2.24 ± 0.68	0.000
Obliquus capitis inferior L (kg/cm^2)	3.41 ± 0.80	2.00 ± 0.66	0.000
Occipitofrontalis posterior R (kg/cm^2)	4.31 ± 0.77	3.18 ± 0.77	0.004
Occipitofrontalis posterior L (kg/cm^2)	4.25 ± 0.90	3.22 ± 1.02	0.011
Occipitofrontalis anterior R (kg/cm^2)	3.13 ± 0.82	2.09 ± 0.72	0.002
Occipitofrontalis anterior L (kg/cm^2)	3.51 ± 0.80	2.40 ± 0.71	0.003
Temporalis R (kg/cm^2)	3.50 ± 0.65	2.48 ± 0.68	0.002
Temporalis L (kg/cm^2)	3.76 ± 0.65	2.49 ± 0.71	0.001
Masseter R (kg/cm^2)	2.11 ± 0.65	1.36 ± 0.38	0.003
Masseter L (kg/cm^2)	2.34 ± 0.98	1.60 ± 0.53	0.069
Clavicular sternocleidomastoid R (kg/cm^2)	2.31 ± 0.70	1.62 ± 0.56	0.014
Clavicular sternocleidomastoid L (kg/cm^2)	2.26 ± 0.88	1.70 ± 0.62	0.093
Sternal sternocleidomastoid R (kg/cm^2)	2.19 ± 0.34	1.33 ± 0.48	0.000
Sternal sternocleidomastoid L (kg/cm^2)	1.83 ± 0.37	1.15 ± 0.47	0.002
Zygomaticus major R (kg/cm^2)	2.15 ± 0.27	1.40 ± 0.48	0.001
Zygomaticus major L (kg/cm^2)	2.40 ± 0.67	1.52 ± 0.53	0.003

PPT: pressure pain threshold; R: right; L: left; * Mann–Whitney U tests.

Of the 17 points evaluated bilaterally, statistically significant differences in the PPTs between men and women were found in 32. Thus, statistically significant differences were found in all of them except in the PPT of the left clavicular head of the sternocleidomastoid (p = 0.093) and in the PPT of the left masseter (p = 0.069). In all the other points, lower

PPTs were observed in women compared to men. Additionally, a statistically significant difference was found in the mean PPT (p = 0.000).

4. Discussion

The primary aim of this study was to compare the PPTs from MTrPs in cervical and cranial muscles between men and women diagnosed with tension-type headache (TTH). Our findings revealed that, in most of the evaluated points, there were statistically significant differences indicating that women had lower PPT levels compared to men.

These results align with previous research. For instance, Cigarán et al. [35] reported significant differences between men and women ($p < 0.001$) in the temporal muscle region in patients with TTH. However, Dawson et al. [43] found no statistically significant differences in PPTs in the masseter muscle region among healthy subjects—although women had lower thresholds than men, this difference was not significant. This discrepancy highlights the potential impact of headache disorders on pain perception.

From all the literature reviewed, there are no previous studies that have evaluated as many PPT points as the current study. It appears that in patients with TTH, the muscle most frequently evaluated for PPTs is the temporal muscle.

In the present study, men obtained PPT values in the temporal muscle of 3.50 kg/cm^2 and 3.76 kg/cm^2 on the right and left sides, respectively, while women had PPT values of 2.48 kg/cm^2 on the right side and 2.49 kg/cm^2 on the left side. These values are higher than those previously reported by other authors. In the study by Buchgreitz et al. [44], male subjects with TTH obtained values of 2.34 kg/cm^2 and females obtained slightly lower values of 2.16 kg/cm^2. In the study by Cigarán et al. [35], even lower PPT values were found for women (1.97 kg/cm^2) and with a greater difference compared to men (2.69 kg/cm^2). This statistically significant difference, with a p value lower than 0.001, is consistent with the significant differences found in our sample (p = 0.002 for the right side and p = 0.001 for the left side). On the other hand, other authors have found values like those of the current study in the temporal muscle. Blanco Muñiz et al. [45], in their sample of subjects with headaches, a PPT of 3.0 kg/cm^2 on the right side and of 2.9 kg/cm^2 on the left side was found. Although their study did not differentiate between sexes, women constituted 90% of the sample, thus their values are more comparable to those found in the female population.

These differences in the literature may be due to the fact that the temporal muscle does not have a single described MTrP; numerous MTrPs may be present in the different fibrillar regions of the muscle. In 2017, the study by Palacios Ceña et al. [46] divided the temporal muscle into nine regions, and the PPTs were assessed in each of these regions in patients with TTH. Lower values were observed in the anterior region, with means ranging from 1.74 kg/cm^2 to 1.96 kg/cm^2, while the highest values were found in the most caudal region of the posterior zone, with values ranging from 2.41 kg/cm^2 to 2.58 kg/cm^2.

Another muscle analyzed in the current study is the occipitofrontal anterior muscle. The sample reported an average of 3.13 kg/cm^2 on the right side and 3.51 kg/cm^2 on the left side in men, and an average of 2.09 kg/cm^2 on the right side and 2.40 kg/cm^2 on the left side in women. These differences between men and women in our study were statistically significant. These values differ notably from those found by Drummond et al. [47] in 2011, where subjects with TTH presented an average of 0.73 kg/cm^2 in men and 0.61 kg/cm^2 in women. It is important to note that in that study, the evaluator applied a pressure rate of 80 g/cm^2/s, in contrast to the 1 kg/cm^2/s used in the current study. This variation in the technique of measurement could have influenced the outcomes. The patients may have experienced pain at a lower threshold, given that the assessment time was longer. In contrast, our data are like those found in the sample of Schoenen et al. [48], with values of 1.95 kg/cm^2 in the frontal region in women.

In previous studies, the suboccipital musculature has been analyzed, although, unlike in the present study, it is usually evaluated collectively without specifying which muscles are being assessed. To discuss our data with data from other studies, we have chosen to utilize the average of the values found in the three muscles evaluated in the suboccipital region. This approach covers a larger area and corresponds more closely with the assessment areas of other studies. Male subjects had PPT values of 3.86 kg/cm^2 and 3.67 kg/cm^2 in the suboccipital region in contrast to the 2.48 kg/cm^2 and 2.37 kg/cm^2 obtained from the female subjects. As no studies differentiate between sexes, we have used the data from Schoenen et al. [48], which evaluates only women, to enable comparison. Schoenen et al. reported an average PPT of 1.80 kg/cm^2 in the suboccipital region. Another study by Moraska, with a sample consisting of 86% women, described average values of 1.56 kg/cm^2 in the suboccipital musculature.

The last muscle previously analyzed is the upper trapezius. In the current study, men exhibited PPT values of 4.24 kg/cm^2 and 4.75 kg/cm^2, whereas women showed values of 2.74 kg/cm^2 and 2.90 kg/cm^2. In a recent study [36], more similar values were found between men and women for this muscle, with differences of less than 0.70 kg/cm^2. Although these differences were smaller than those found in our study, they were statistically significant, with a p value lower than 0.001, similar to that observed in our sample.

As it has been shown, to compare our results with the previous literature is complicated because previous assessments have not been performed in all the same MTrPs and the samples are not homogeneous. Nevertheless, due to the results obtained, it is evident that in patients with tension-type headache, women have lower values in the PPTs of the muscles that may be related to their headaches compared to men.

This suggests a heightened sensitivity to pressure pain in women with TTH that, mediated by the variety of factors named previously (anatomical, physiological, neural, hormonal, psychological, social, and cultural), may favour a central sensitization condition in the women with this pathology. This indicates the need for gender-specific approaches in the management and treatment of TTH, considering this sensitization condition. Thus, it should be necessary to include pain education programs in the management of the pathology. The need to adequate the physiotherapy treatment doses in order to not exacerbate the sensitization condition is highlighted as well. Finally, the need for social and psychological support should be considered.

Limitations

The study's limitations include the omission of the measurement of psychological variables such as anxiety, depression, or sleep disturbances, which could potentially influence PPT. Another limitation is that the reliability of the PPT measurements has not been established for all the points analyzed, although in those where it has been studied the values are good [41].

5. Conclusions

Lower PPTs from MTrPs in cervical and cranial muscles which might contribute to headaches were observed in women compared to men with TTH, in all the muscles except in the left clavicular head of the sternocleidomastoid and in the left masseter. Additionally, the mean PPT was lower in women than in men. These observations suggest a heightened sensitivity to pressure pain in women with TTH, maybe mediated by a central sensitization condition favoured by the pathology. As such, we advise for gender-specific approaches in the treatment of TTH.

Author Contributions: Conceptualization, M.O.L.-L., R.S.-R. and S.M.-B.; methodology, C.H.-G., S.M.-B. and L.F.-L.; formal analysis, M.O.L.-L., L.V.-P. and H.J.T.-V.; investigation, S.M.-B., R.S.-R. and L.V.-P.; resources, C.H.-G. and J.M.T.-M.; data curation, L.F.-L., L.V.-P. and H.J.T.-V.; writing—original draft preparation, M.O.L.-L., R.S.-R., L.V.-P. and S.M.-B.; writing—review and editing, S.M.-B., L.F.-L., R.S.-R., M.O.L.-L. and H.J.T.-V.; visualization, C.H.-G. and L.F.-L.; supervision, C.H.-G. and J.M.T.-M.; project administration, J.M.T.-M. and M.O.L.-L. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Ethics Committee of COMITÉ ÉTICO DE INVESTIGACIÓN CLÍNICA DE ARAGÓN (protocol code PI23-418 and date of approval: 18 October 2023).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The original contributions presented in the study are included in the article, further inquiries can be directed to the corresponding author.

Acknowledgments: The authors wish to thank the subjects participating in the study for their collaboration.

Conflicts of Interest: The authors declare no conflicts of interest.

References

1. Vos, T.; Abajobir, A.A.; Abbafati, C.; Abbas, K.M.; Abate, K.H.; Abd-Allah, F.; Abdulle, A.M.; Abebo, T.A.; Abera, S.F.; Aboyans, V.; et al. Global, Regional, and National Incidence, Prevalence, and Years Lived with Disability for 328 Diseases and Injuries for 195 Countries, 1990–2016: A Systematic Analysis for the Global Burden of Disease Study 2016. *Lancet* **2017**, *390*, 1211–1259. [CrossRef]
2. Shao, Q.; Rascati, K.L.; Barner, J.C.; Lawson, K.A.; Sonawane, K.B.; Rousseau, J.F. Healthcare Utilization and Costs among Patients with Chronic Migraine, Episodic Migraine, and Tension-Type Headache Enrolled in Commercial Insurance Plans. *Headache* **2022**, *62*, 141–158.
3. Linde, M.; Gustavsson, A.; Stovner, L.J.; Steiner, T.J.; Barré, J.; Katsarava, Z.; Lainez, J.M.; Lampl, C.; Lantéri-Minet, M.; Rastenyte, D.; et al. The Cost of Headache Disorders in Europe: The Eurolight Project. *Eur. J. Neurol.* **2012**, *19*, 703–711. [CrossRef]
4. Headache Classification Committee of the International Headache Society (IHS) the International Classification of Headache Disorders, 3rd edition. *Cephalalgia* **2018**, *38*, 1–211. [CrossRef]
5. Crystal, S.C.; Grosberg, B.M. Tension-Type Headache in the Elderly. *Curr. Pain Headache Rep.* **2009**, *13*, 474–478.
6. Marchand, A.-A.; Cantin, V.; Murphy, B.; Stern, P.; Descarreaux, M. Is Performance in Goal Oriented Head Movements Altered in Patients with Tension Type Headache? *BMC Musculoskelet. Disord.* **2014**, *15*, 179. [CrossRef]
7. Fernández-De-Las-Peñas, C.; Falla, D.; Arendt-Nielsen, L.; Farina, D. Cervical Muscle Co-Activation in Isometric Contractions Is Enhanced in Chronic Tension-Type Headache Patients. *Cephalalgia* **2008**, *28*, 744–751. [CrossRef]
8. Straburzyński, M.; Waliszewska-Prosół, M.; Nowaczewska, M.; Czapińska-Ciepiela, E.K.; Gryglas-Dworak, A.; Budrewicz, S. Prevalence of Cranial Autonomic Symptoms in Episodic Tension-Type Headache. *Cephalalgia* **2023**, *43*, 1–333. [CrossRef]
9. Elizagaray-Garcia, I.; Beltran-Alacreu, H.; Angulo-Díaz, S.; Garrigós-Pedrón, M.; Gil-Martínez, A. Chronic Primary Headache Subjects Have Greater Forward Head Posture than Asymptomatic and Episodic Primary Headache Sufferers: Systematic Review and Meta-Analysis. *Pain Med.* **2020**, *21*, 2465–2480. [CrossRef]
10. Sohn, J.-H.; Choi, H.-C.; Lee, S.-M.; Jun, A.-Y. Differences in Cervical Musculoskeletal Impairment between Episodic and Chronic Tension-Type Headache. *Cephalalgia* **2010**, *30*, 1514–1523. [CrossRef]
11. Romero-Godoy, R.; Romero-Godoy, S.R.; Romero-Acebal, M.; Gutiérrez-Bedmar, M. Psychiatric Comorbidity and Emotional Dysregulation in Chronic Tension-Type Headache: A Case-Control Study. *J. Clin. Med.* **2022**, *11*, 5090. [CrossRef]
12. Corrêa Rangel, T.; Falcão Raposo, M.C.; Sampaio Rocha-Filho, P.A. The Prevalence and Severity of Insomnia in University Students and Their Associations with Migraine, Tension-Type Headache, Anxiety and Depression Disorders: A Cross-Sectional Study. *Sleep Med.* **2021**, *88*, 241–246. [CrossRef] [PubMed]
13. Fernández-de-las-Peñas, C.; Cook, C.; Cleland, J.A.; Florencio, L.L. The Cervical Spine in Tension Type Headache. *Musculoskelet. Sci. Pract.* **2023**, *66*, 102780. [CrossRef]
14. Chatchawan, U.; Thongbuang, S.; Yamauchi, J. Characteristics and Distributions of Myofascial Trigger Points in Individuals with Chronic Tension-Type Headaches. *J. Phys. Ther. Sci.* **2019**, *31*, 306–309. [CrossRef]
15. Stroppa-Marques, A.E.Z.; De Melo-Neto, J.S.; Do Valle, S.P.; Pedroni, C.R. Muscular Pressure Pain Threshold and Influence of Craniocervical Posture in Individuals with Episodic Tension-Type Headache. *Columna* **2017**, *16*, 137–140. [CrossRef]
16. Fernández-de-las-Peñas, C.; Madeleine, P.; Caminero, A.B.; Cuadrado, M.L.; Arendt-Nielsen, L.; Pareja, J.A. Generalized Neck-Shoulder Hyperalgesia in Chronic Tension-Type Headache and Unilateral Migraine Assessed by Pressure Pain Sensitivity Topographical Maps of the Trapezius Muscle. *Cephalalgia* **2010**, *30*, 77–86. [CrossRef]
17. Travell, J.G.; Simons, D.G. *Myofascial Pain and Dysfunction: The Trigger Point Manual*; Volume 2, The Lower Extremities; Lippincott Willians e Wilkins: Philadelphia, PA, USA, 1992.
18. Ashina, S.; Babenko, L.; Jensen, R.; Ashina, M.; Magerl, W.; Bendtsen, L. Increased Muscular and Cutaneous Pain Sensitivity in Cephalic Region in Patients with Chronic Tension-Type Headache. *Eur. J. Neurol.* **2005**, *12*, 543–549. [CrossRef]
19. Bezov, D.; Ashina, S.; Jensen, R.; Bendtsen, L. Pain Perception Studies in Tension-Type Headache. *Headache* **2011**, *51*, 262–271. [CrossRef]
20. Castien, R.F.; van der Wouden, J.C.; De Hertogh, W. Pressure Pain Thresholds over the Cranio-Cervical Region in Headache: A Systematic Review and Meta-Analysis. *J. Headache Pain* **2018**, *19*, 9. [CrossRef] [PubMed]

21. Mogil, J.S. Sex Differences in Pain and Pain Inhibition: Multiple Explanations of a Controversial Phenomenon. *Nat. Rev. Neurosci.* **2012**, *13*, 859–866. [CrossRef] [PubMed]
22. Gutiérrez Lombana, W.; Gutiérrez Vidal, S.E. Pain and Gender Differences: A Clinical Approach. *Colomb. J. Anesthesiol.* **2012**, *40*, 207–212. [CrossRef]
23. Athnaiel, O.; Cantillo, S.; Paredes, S.; Knezevic, N.N. The Role of Sex Hormones in Pain-Related Conditions. *Int. J. Mol. Sci.* **2023**, *24*, 1866. [CrossRef]
24. Ailani, J. Tension-Type Headache and Women: Do Sex Hormones Influence Tension-Type Headache? *Curr. Pain Headache Rep.* **2010**, *14*, 436–440. [CrossRef] [PubMed]
25. Spierings, E.L.H.; Ranke, A.H.; Honkoop, P.C. Precipitating and Aggravating Factors of Migraine vs. Tension-Type Headache. *Headache J. Head Face Pain* **2001**, *41*, 554–558. [CrossRef]
26. Arjona, A.; Rubi-Callejon, J.; Guardado-Santervas, P.; Serrano-Castro, P.; Olivares, J. Menstrual Tension-Type Headache: Evidence for Its Existence. *Headache J. Head Face Pain* **2007**, *47*, 100–103. [CrossRef]
27. Zivadinov, R.; Willheim, K.; Sepic-Grahovac, D.; Jurjevic, A.; Bucuk, M.; Brnabic-Razmilic, O.; Relja, G.; Zorzon, M. Migraine and Tension-Type Headache in Croatia: A Population-Based Survey of Precipitating Factors. *Cephalalgia* **2003**, *23*, 336–343. [CrossRef]
28. Sorge, R.E.; Totsch, S.K. Sex Differences in Pain. *J. Neurosci. Res.* **2017**, *95*, 1271–1281. [CrossRef]
29. Lenert, M.E.; Avona, A.; Garner, K.M.; Barron, L.R.; Burton, M.D. Sensory Neurons, Neuroimmunity, and Pain Modulation by Sex Hormones. *Endocrinology* **2021**, *162*, BQAB109. [CrossRef] [PubMed]
30. Peddireddy, A.; Wang, K.; Svensson, P.; Arendt-Nielsen, L. Stretch Reflex and Pressure Pain Thresholds in Chronic Tension-Type Headache Patients and Healthy Controls. *Cephalalgia* **2009**, *29*, 556–565. [CrossRef]
31. Andersen, S.; Petersen, M.W.; Svendsen, A.S.; 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*, 1409–1423. [CrossRef]
32. Defrin, R.; Shramm, L.; Eli, I. Gender Role Expectations of Pain Is Associated with Pain Tolerance Limit but Not with Pain Threshold. *Pain* **2009**, *145*, 230–236. [CrossRef]
33. Von Elm, E.; Altman, D.G.; Egger, M.; Pocock, S.J.; Gøtzsche, P.C.; Vandenbroucke, J.P. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement: Guidelines for Reporting Observational Studies. *PLoS Med.* **2007**, *4*, 1623–1627. [CrossRef]
34. Association, W.M. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *JAMA* **2013**, *310*, 2191–2194. [CrossRef]
35. Cigarán-Méndez, M.; Jiménez-Antona, C.; Parás-Bravo, P.; Fuensalida-Novo, S.; Rodríguez-Jiménez, J.; Fernández-de-las-Peñas, C. Active Trigger Points Are Associated With Anxiety and Widespread Pressure Pain Sensitivity in Women, but Not Men, with Tension Type Headache. *Pain Pract.* **2019**, *19*, 522–529. [CrossRef]
36. Embaby, E.; Khalil, A.A.; Mansour, A.; Hamdy, H.A. The Relationship between Myofascial Trigger Points Sensitivity, Cervical Postural Abnormality, and Clinical Tension-Type Headache Parameters. *J. Man. Manip. Ther.* **2024**, *32*, 390–399. [CrossRef]
37. Fernández-de-Las-Peñas, C.; Cuadrado, M.L.; Pareja, J.A. Myofascial Trigger Points, Neck Mobility, and Forward Head Posture in Episodic Tension-Type Headache. *Headache* **2007**, *47*, 662–672. [CrossRef]
38. Simons, D.G.; Travell, J.G.; Simons, L.S. *Travell & Simons' Myofascial Pain and Dysfunction: The Trigger Point Manual*; Volume 1, Upper Half of Body; Williams & Wilkins: Baltimore, MD, USA, 1999; ISBN 9780683083637.
39. Fernández-de-las-Peñas, C.; Ge, H.Y.; Alonso-Blanco, C.; González-Iglesias, J.; Arendt-Nielsen, L. Referred Pain Areas of Active Myofascial Trigger Points in Head, Neck, and Shoulder Muscles, in Chronic Tension Type Headache. *J. Bodyw. Mov. Ther.* **2010**, *14*, 391–396. [CrossRef]
40. Donnelly, J.M.; Fernández de las Peñas, C.; Simons, D.G.; Cummings, B.D.; Jiménez González, D.; Travell, J.G.; Simons, L.S. *Dolor y Disfunción Miofascial: Manual de Los Puntos Gatillo*; Wolters Kluwer: Alphen aan den Rijn, The Netherlands, 2019; ISBN 9788417602024.
41. Barbero, M.; Bertoli, P.; Cescon, C.; Macmillan, F.; Coutts, F.; Gatti, R. Intra-Rater Reliability of an Experienced Physiotherapist in Locating Myofascial Trigger Points in Upper Trapezius Muscle. *J. Man. Manip. Ther.* **2012**, *20*, 171–177. [CrossRef] [PubMed]
42. Finocchietti, S.; Graven-Nielsen, T.; Arendt-Nielsen, L. Dynamic Mechanical Assessment of Muscle Hyperalgesia in Humans: The Dynamic Algometer. *Pain Res. Manag.* **2015**, *20*, 29–34. [CrossRef]
43. Dawson, A.; List, T. Comparison of Pain Thresholds and Pain Tolerance Levels between Middle Easterners and Swedes and between Genders. *J. Oral Rehabil.* **2009**, *36*, 271–278. [CrossRef]
44. Buchgreitz, L.; Lyngberg, A.C.; Bendtsen, L.; Jensen, R. Increased Prevalence of Tension-Type Headache over a 12-Year Period Is Related to Increased Pain Sensitivity. A Population Study. *Cephalalgia* **2007**, *27*, 145–152. [CrossRef] [PubMed]
45. del Blanco Muñiz, J.Á.; de la Flor, Á.G.; Balmaseda, D.D.; Vera, D.M.; Sierra, A.S.; de Sevilla, G.G.P. Pain Sensitization and Atrophy of Deep Cervical Muscles in Patients with Chronic Tension-Type Headache. *Rev. Assoc. Med. Bras.* **2023**, *69*, 1–5. [CrossRef]
46. Palacios Ceña, M.; Castaldo, M.; Wang, K.; Madeleine, P.; Guerrero, Á.L.; Arendt-Nielsen, L.; Fernández-de-las-Peñas, C. Topographical Pressure Pain Sensitivity Maps of the Temporalis Muscle in People with Frequent Episodic and Chronic Tension-Type Headache. *Pain Pract.* **2017**, *17*, 12565. [CrossRef]

47. Drummond, P.D.; Knudsen, L. Central Pain Modulation and Scalp Tenderness in Frequent Episodic Tension-Type Headache. *Headache J. Head Face Pain* **2011**, *51*, 375–383. [CrossRef]
48. Schoenen, J.; Bottin, D.; Hardy, F.; Gerard, P. Cephalic and Extracephalic Pressure Pain Thresholds in Chronic Tension-Type Headache. *Pain* **1991**, *47*, 145–149. [CrossRef]