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Abstract

Objectives: Office workers with chronic neck pain demonstrates signs of widespread hyperalgesia, less efficient descending pain modulation, which could indicate sensitization of central pain pathways. No studies have assessed a wide variety of office workers with different chronic neck pain disorders and assessed the impact of pain intensity on assessments of central pain pathways. This study aimed to assessed pressure pain thresholds (PPTs), temporal summation of pain (TSP) and conditioned pain modulation (CPM) and to associate these with pain intensity and disability in subgroups of office workers.

Methods: One hundred-and-seventy-one office workers were distributed into groups of asymptomatic and chronic neck pain subjects. Chronic neck pain was categorized as chronic trapezius myalgia and chronic non-specific neck pain and as 'mild-pain' (Visual Analog Scale [VAS]≤3) and 'moderate-pain' (VAS>3) groups. PPTs, TSP, CPM, and Copenhagen Psychosocial Questionnaire II were assessed in all subjects. Neck Disability Index and Pain Catastrophizing Scale were assessed in all the symptomatic office workers.

Results: PPTs were lower in moderate pain (n=49) and chronic trapezius myalgia (n=56) compared with asymptomatic subjects (n=62, p<0.05). TSP was facilitated in moderate pain group compared with mild pain (n=60, p<0.0001) group and asymptomatic subjects (p<0.0001). No differences were found in CPM comparing the different groups (p<0.05). Multiple regression analysis identified Neck Disability Index and TSP as independent factors for prediction of pain intensity in chronic trapezius myalgia (R^2=0.319) and chronic non-specific neck pain (R^2=0.208). Somatic stress, stress and sleep as independent factors in chronic non-specific neck pain (R^2=0.525), and stress in moderate pain group (R^2=0.494) for the prediction of disability.

Conclusions: Office workers with chronic trapezius myalgia and moderate pain intensity showed significant signs of widespread pressure hyperalgesia. Moreover, the moderate pain group demonstrated facilitated TSP indicating sensitization of central pain pathways. Neck Disability Index and TSP were independent predictors for pain intensity in pain groups. Sleep and stress were independent predictors for disability.

Keywords: chronic neck pain; conditioned pain modulation; office workers; pressure pain thresholds; sensitization; temporal summation of pain.

Introduction

Chronic neck pain (CNP) is prevalent in 20–42% of office workers [1–3]. The 2017 Neck Pain Clinical Guidelines demonstrated weak evidence for diagnosis and classification of neck pain, after the exclusion of a clear pathoanatomical features [4]. The primary International Classification of Diseases-11 (ICD-11) [5] includes codes for idiopathic conditions named chronic primary cervical pain, and for myalgia, as possible causes for neck pain.

Office workers performed monotonous and repetitive tasks mainly on the computer, and work-related myalgia is a common disorder affecting the neck/shoulder area, predominantly affecting the upper trapezius muscle [6, 7]. Trapezius myalgia is characterized by CNP, tightness, and palpable tenderness in the upper trapezius muscle [6–8].

In chronic primary cervical pain, the mechanisms are non-specific [5]. However, pain intensity can be enhanced by central mechanisms without a specific pathology.

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Understanding the different potential mechanisms between different subgroups may facilitate better treatments tailored to the subgroups [9].

Pain chronicity is associated with quantitative changes in parameters probing the peripheral or central nervous systems excitabilities [9–12]. Quantitative sensory tests (QST) aim to assess sensory function. A reduction of pressure pain threshold (PPT) at a painful local site might reflect localized pressure hyperalgesia. In contrast, a decrease in PPTs at sites distant from the painful areas can reflect widespread pressure hyperalgesia [11, 13]. Temporal summation of pain (TSP) is a human surrogate model that may reflect the wind-up processes in dorsal horn excitability, which is often found facilitated in many chronic pain conditions [14].

Furthermore, assessment of TSP has shown predictive value for outcome after e.g., surgery [14–17], or pharmaceutical interventions [18] and hence may be a clinically relevant parameter [11, 19]. Condition pain modulation (CPM) assesses the balance of descending pain inhibitory and facilitatory mechanisms, and this is often found impaired in severe chronic pain conditions [11, 20]. Previous studies demonstrated associations in higher clinical pain intensities with more widespread hyperalgesia, facilitated TSP, and impaired CPM [21–23].

Pain catastrophizing is associated with higher pain intensity, sleeping problems, and higher levels of depression/anxiety in CNP [24]. In a longitudinal study with a 12-month follow-up, stress, anxiety, and depression are predictors for disability, which is the main predictor for CNP [25]. Pain catastrophizing has also been associated with TSP and CPM findings [26], indicating a possible link between cognitive factors and central pain mechanisms.

Office workers with CNP demonstrates signs of widespread hyperalgesia [27], less efficient descending pain modulation [28, 29], which could indicate sensitization of central pain pathways. Chronic trapezius myalgia is also associated with widespread hyperalgesia [30, 31], with no clear differences in muscle morphology and physiology comparing with healthy controls [32]. Moreover, there is a strong association between pain intensity and perceived muscle tenderness in upper trapezius in office workers [33, 34]. No studies have assessed a wide variety of office workers with different neck pain disorders and assessed the relationship between pain intensity on assessments of central pain pathways.

Thus, the primary aim of this study was to assess PPTs, TSP and CPM in office workers presenting with chronic trapezius myalgia, chronic non-specific neck pain and asymptomatic subjects. In addition, office workers with different pain intensities (mild, moderate and no pain) were assessed. Finally, this study aimed to investigate associations between clinical pain intensities and disability with pain catastrophizing, psychological factors and quantitative sensory tests.

Methods

Participants

A total of 171 office workers with or without pain in the neck region were recruited to participate. The population was selected as a subsample of the 601 office workers from Lisbon University, Algarve University, and Albufeira City Council, who participated in a cross-sectional epidemiological study online survey. In this study, data were collected from February 2018 to May 2019. The eligible criteria were adult office workers from 25 to 60 years of age, working at least for more than one year in the same job position and working at least 3/4 of the working hours on a computer, as used in previous studies [27, 31, 35].

The online survey included the Portuguese validated version of the Standardized Nordic Musculoskeletal Questionnaire [36]. Office workers reporting neck-shoulder trouble (pain, ache, or discomfort) for more than 90 days during the last year were assigned to a pain group. Office workers reporting no neck and upper limb symptoms were assigned to the asymptomatic control group. The exclusion criteria for office workers were: medical history of cardiovascular, cerebrovascular events; major chronic diseases; neurologic diseases; metabolic diseases; pregnancy; rheumatologic diseases; fibromyalgia; whiplash disorders; cervical disc herniation or severe disorders of the cervical spine such severe osteoarthritis; and past neck fractures. The symptomatic office workers were excluded if reported more than 30 days of pain in more than three out of eight major body regions (neck/shoulder, low back, and left or right arm/hand, hip, knee, foot) to exclude widespread musculoskeletal diseases [37, 38].

A standard clinic examination was performed, by one examiner with more than 15 years of clinic experience, to ensure that the subjects met the above criteria. This examination included questions about pain duration (to be considered chronic pain must be present for more than three months); pain intensity; pain localization; tiredness and stiffness in the neck and shoulder region on the day of examination; neck and shoulder range of motion according to Ohlsson and Kristensen [6, 8]. Office workers were asked to not take any analgesics or nonsteroidal anti-inflammatory drugs (NSAIDs) 24 h before the examination.

The study population was divided into office workers with CNP and asymptomatic office workers. The office workers with CNP were categorized into pain conditions groups and pain intensity groups, each in two groups. The pain conditions groups were divided into chronic trapezius myalgia group and chronic non-specific neck pain group. The pain intensity groups were obtained accordingly with VAS score based on the average pain intensity in the last seven days (mean ± SD pain intensity in VAS: 2.96 ± 1.77), into mild pain group (VAS≤3) and in moderate pain group (VAS>3) [14, 39]. The asymptomatic office workers were assigned as a control group.

The mandatory diagnosis criteria for trapezius myalgia were: (1) CNP mainly in upper trapezius muscle; (2) tightness of the trapezius muscle (i.e., a feeling of stiffness in the descending region of the trapezius muscle was reported by the subject at the examination of lateral flexion of the head); (3) tenderness on palpation of the upper trapezius muscle; (4) cervical spine was to have non-painful, normal or only slightly decreased range of motion [35, 40, 41]. The examination protocol allowed the examiner to identify and exclude the subjects with pain in the trapezius region that was most likely referred from painful tendons or nerve compressions in the neck and shoulder area [6, 8]. If there was a decrease in neck range of motion, pain during neck movement, or pain not specific in upper trapezius the condition was considered to be non-specific CNP. Office workers were considered to be asymptomatic based on VAS score (VAS=0) in the neck and upper limb [28], and no more than three body regions with more than 30 days of trouble or pain, both in the online survey and in the clinic examination [37, 40].

Demographics and clinical characteristics

Demographic variables included were age, gender, BMI, working hours with a computer per week, working hours with computer per day, number of years working with computers, pain intensity, pain duration, analgesics or NSAIDs taking from more than 24 h for the neck pain, and current treatment for neck pain.

Self-reported measures

Pain intensity: The pain intensity at present day and the average in the last seven days as assessed on a Visual Analog Scale (VAS), anchored at 0: no pain and 10: worst pain imaginable.

Neck Disability Index: Neck Disability Index is a 10-item self-reported questionnaire in the following domains: pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping and, recreation. Each question contains six answer choices, scored 0 (no disability) to 5 (complete disability). Higher scores mean more disability [42]. This questionnaire was translated, adapted, and validated to the Portuguese Language [37], with a good internal consistency of 0.95 (α Cronbach), high test–retest reliability (ICC=0.90), and good construct validity in a Portuguese population with CNP [43].

Pain Catastrophizing Scale: Pain Catastrophizing Scale is a 13-item self-reported measured designed to assess catastrophic thoughts or feelings when experience pain. It is composed with three subscales: rumination, magnification and, helplessness; items are rated on a five-point scale ranging from 0 (not at all) to 4 (all the time), the maximum score is 52 being 30 points considered to be a clinically relevant level of catastrophizing [44]. This questionnaire was translated, adapted, and validated to the Portuguese population with chronic pain with a good internal consistency in all subscales: rumination (0.796), magnification (0.789), and helplessness (0.897) [45].

Copenhagen Psychosocial Questionnaire II: The long version is designed to assess psychosocial work factors, workers health, and wellbeing, and is composed by 128-item standardized self-reported belonging to 41 scales that represent seven domains [46], and the Portuguese version adapted by Silva et al. [47]. In this study, the domain health and wellbeing were used, composed of six scales: burnout, stress, sleeping problems, depressive symptoms, somatic stress, and cognitive stress. The questionnaire included one general health question, with a total of 26 questions. They were scored on a five-point Likert Scale ranging from 1 (not at all) to 5 (all the time), except for the general health question that ranged from 1 (excellent) to 5 (poor). The scales scores were calculated as an average of the items included. Each scale has a good internal consistency between 0.7 and 0.9 in the Portuguese population [48]. For easier reading and interpretation, sleeping troubles will be mentioned as sleep.

Quantitative sensory testing

Pressure pain threshold: PPTs were assessed using a hand-held pressure algometer consisted of a 1 cm^2 rubber tip applicator, placed perpendicularly to the skin, mounted on a force transducer at an application rate of 1.0 kgF/s (JTech Medical, Salt Lake City, USA). PPT was defined as the minimum pressure first evoking a sensation of pain. An upper cut-off limit of 500 kPa was used. PPTs were measured twice with an interval of 10 s for each point, and the mean value was used for statistical analysis, as previously described [49].

Four different assessment sites were used: upper trapezius in the most painful side/dominant side, the same point in the contralateral muscle, extensor carpi ulnaris and tibialis anterior. The upper trapezius point was localized in the midpoint between C7 and acromion [28]; the extensor carpi ulnaris muscle belly point was localized from the lateral epicondyle that was the reference point: 40 mm inferior in a vertical line and then 20 mm posterior [28, 50]; the tibialis anterior point was defined approximately 2.5 cm lateral and 5 cm inferior to the tibial tubercle [51]. This point was chosen to determine widespread pressure pain hyperalgesia [13, 27]. The extensor carpi ulnaris and tibialis anterior points were on the same side as the most painful side/dominant side in upper trapezius. For upper trapezius measurement the office workers were in prone position and for extensor carpi ulnaris and tibialis anterior in supine position. Each PPT localization was marked by a pen marker.

Temporal summation of pain (TSP): A modified von Frey stimulator (Aalborg University, Aalborg, Denmark) with a weighted load of 25.6 g was used to induce TSP. The procedure consisted of the application on 10 consecutive stimulations with a 1-s interval between stimulations, in the upper trapezius on the most painful side/dominant side in the same point previously described with the subjects in a sitting position. Each subject was asked to rate the pain intensity from the first and last stimulus on the VAS (0–10). TSP was calculated as the difference in pain intensity between the first and the last stimuli, as previously described. High TSP scores indicated facilitated temporal summation [14, 15, 17].

Conditioned pain modulation (CPM): CPM was measured as the difference in PPTs at the upper trapezius before and after the cold pressor test (CPT) [14]. Measurements were done with the subject in a sitting position, the contralateral hand of the most painful side/dominant side immersed up to the wrist in a cold water bath maintained at 2–3 °C. The subjects were asked maintain the hand immersed for a maximum time of 2 min or to remove the hand when a pain intensity of 7 out of 10 was reached on a 0 (no pain) to 10 (worst imaginable pain) scale [52]. After removing their hand from the cold water, PPT was immediately measured in the upper trapezius.

Experimental protocol

All the quantitative sensory measurements were performed by the principal investigator who was not blinded to group allocation but was blinded to the three questionnaires outcomes (Neck Disability Index, Pain Catastrophizing Scale, Copenhagen Psychosocial Questionnaire II). A code was introduced for each group for the statistical analyzes assessor remain blinded to group allocation. After the clinic examination the sequence of the quantitative sensory procedures were: (1) PPT measured in the upper trapezius in the most painful side/dominant, the same point in the contralateral muscle, in the extensor carpi ulnaris and in the tibialis anterior (ipsilateral); (2) TSP measurement; (3) CPM assessment. There was a 5-min interval between PPT and TSP and between TSP and CPM.

Statistics

Descriptive statistics were calculated for age, gender, BMI, number of working hours per week, number of working hours on the computer and number of years working on the computer. The Kolmogorov–Smirnov test was used for normality assessment, and all data were normally distributed. Unpaired t-test was used to compare differences between the symptomatic groups for pain intensity (current pain and pain within the last seven days), pain duration, analgesics or NSAIDs taking from more than 24 h for the neck pain, and current treatment for neck pain, NDI and PCS. Descriptive statistics are reported as means ± standard deviation (SD), and 95% confidence interval in text and tables.

Univariate analysis of covariance (ANCOVA), with covariate adjustment for gender, was used to determine differences between groups for PPT, TSP and Copenhagen Psychosocial Questionnaire II. A two-way repeated measure mixed ANCOVA (gender as a covariate) was conducted comparing the differences in PPT over time for CPM in pain conditions groups and pain intensity groups. The Tukey post hoc test was used in case of significant factors ($p<0.05$).

Pearson's product-moment correlation was used to assess the associations between pain intensity and disability, with PPT, TSP, CPM, Pain Catastrophizing Scale and Copenhagen Psychosocial Questionnaire II variables in the symptomatic groups. For each dependent variable, pain intensity and disability, a backward stepwise multiple regression analysis was employed considering as candidate predictors the variable gender and the ones that present a significant correlation ($p<0.05$) with the dependent variable.

The prevalence rate of Portuguese office workers with CNP is 19.2% [2]. The sample size was determined based on the number of available surveys (n=601) from a previous cross-sectional study without a priori power calculation. Considering a 95% confidence interval with a 5% margin of error, and a desired power of 80%, originates the total sample size of 171 office workers needed for the current study.

The statistical analysis was conducted using SPSS 25.0 software (SPSS Inc., Chicago, IL, USA).

Results

Office workers demographics

One-hundred-and-seventy-one office workers (age 43.3 ± 7.9; 41 males and 135 females, weight 67.5 ± 13.2 kg, height 165.7 ± 8.7 cm) were enrolled from the Albufeira City Council (59.1%), from the Lisbon University (28.7%), and from Algarve University (12.2%). The office workers with CNP were categorized into subjects with chronic trapezius myalgia (n=56) and chronic non-specific neck pain (n=53); and into mild pain (n=60) and moderate pain (n=49) (flow-chart in Figure 1). Asymptomatic subjects were classified as controls (n=62). See Tables 1 and 2 for demographic information.

Females were more frequently found in the symptomatic groups compared with asymptomatic office workers (see Tables 1 and 2). A secondary analysis of gender within and between groups was conducted for the exposure factors and pain variables (intensity and duration). There were no differences in pain variables within all groups. In the moderate pain group, males work more time per week and more hours at a computer per day ($p=0.25$, $p=0.04$, respectively). In the control group, females were older compared with males ($p=0.19$). Between groups pain at present day was higher in chronic trapezius myalgia compared with non-specific CNP ($p=0.01$), and also in moderate pain group compared with mild pain group ($p<0.001$). In the moderate pain group females work less hours per day at computer compared with mild pain group and controls group ($p=0.037$) (Appendix).

The chronic trapezius myalgia group had a higher analgesic consumption (more than 24 h) ($p=0.026$) and higher clinical pain intensity at the present day ($p=0.009$) comparing with chronic non-specific neck pain group (Table 1). The moderate pain group had higher clinical pain intensity at the present day ($p<0.0001$) comparing with mild pain group (Table 2).

Self-reported measures

Neck Disability Index

In the pain condition groups, there was a significant difference in disability, $t(107)=2.017$, $p=0.046$, with higher Neck Disability Index in the chronic trapezius myalgia

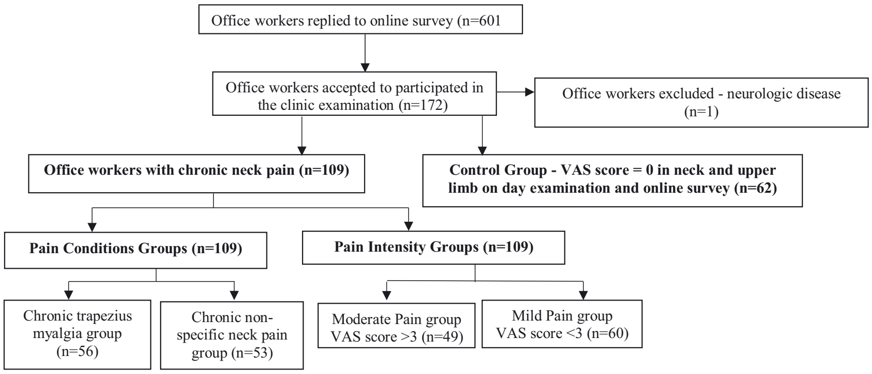

Figure 1: Flowchart diagram of office workers.

Table 1: Descriptive characteristics of office workers in pain condition groups.

Variable	Chronic trapezius myalgia (n=56)	Chronic non-specific neck pain (n=53)	Controls (n=62)	p-Value
Age, years	42.80 ± 7.3	45.45 ± 7.9	43.09 ± 8.3	0.162
Sex, n (%) female/male	50 (89.3%)/6 (10.7%)	47 (88.7%)/6 (11.3%)	38 (61.3%)/24 (38.7%)	**<0.001**[a]
BMI, kg/m^2	24.17 ± 3.83	24.22 ± 3.09	24.88 ± 3.80	0.537
Working time, h/wk	36.80 ± 4.5	37.15 ± 7.6	38.22 ± 6.0	0.422
Computer work, h/day	6.56 ± 1.2	6.18 ± 1.1	6.48 ± 1.3	0.310
Computer work, years	15.89 ± 7.7	18.03 ± 8.7	18.11 ± 7.6	0.250
VAS (0–10 cm) (present day)	2.31 ± 1.80	1.44 ± 1.58	NA	**0.009**[b]
VAS (0–10 cm) (last seven days)	3.27 ± 1.74	2.65 ± 1.78	NA	0.069
Pain duration, months	77.92 ± 63.73	90.94 ± 67.03	NA	0.301
Analgesic + 24 h, n (%) yes/no	15 (26.8%)/41 (73.2%)	5 (9.4%)/48 (90.6%)	NA	**0.026**[b]
Treatment, n (%) yes/no	5 (8.9%)/51 (91.1%)	7 (13.2%)/46 (86.8%)	NA	0.550
Pain <3 and >3 VAS (0–10), n (%)	29 (51.8%)/27 (48.2%)	31 (58.5%)/22 (41.5%)	NA	0.482

Data are expressed as mean ± SD of the mean, or in percentage frequencies (%). Bold indicates significant (p<0.05). [a]Between controls group with chronic trapezius myalgia and chronic non-specific neck pain groups, χ^2 test. [b]Between chronic trapezius myalgia with chronic non-specific neck pain, unpaired t-test. NA, not available; VAS, Visual Analog Scale.

Table 2: Descriptive characteristics of office workers in pain intensity groups.

Variable	Mild pain (n=60)	Moderate pain (n=49)	Controls (n=62)	p-Value
Age, years	44.21 ± 7.7	43.93 ± 7.7	43.0 ± 8.3	0.719
Sex, n (%) female/male	52 (86.7%)/8 (13.3%)	45 (91.8%)/4 (8.2%)	38 (61.3%)/24 (38.7%)	**<0.0001**[a]
BMI, kg/m^2	23.97 ± 3.63	24.47 ± 3.29	24.88 ± 3.80	0.347
Working time, h/wk	37.93 ± 5.9	35.79 ± 6.3	38.22 ± 6.0	0.122
Computer work, h/day	6.37 ± 1.0	6.34 ± 1.4	6.48 ± 1.3	0.882
Computer work, years	17.31 ± 8.0	16.46 ± 8.5	18.11 ± 7.6	0.863
VAS (0–10 cm) (present day)	1.18 ± 1.02	2.76 ± 2.04	NA	**<0.0001**[b]
VAS (0–10 cm) (last seven days)	1.60 ± 0.86	4.62 ± 0.94	NA	**<0.0001**[b]
Pain duration, months	86.83 ± 71.36	81.60 ± 58.02	NA	0.088
Analgesic + 24 h, n (%) yes/no	8 (13.3%)/52 (86.7%)	12 (24.5%)/37 (75.5%)	NA	0.146
Treatment, n (%) yes/no	10 (16.7%)/50 (83.3)	2 (4.1%)/47 (95.9%)	NA	0.062

Data are expressed as mean ± SD of the mean, or in percentage frequencies (%). Bold indicates significant (p<0.05). [a]Between controls group with mild pain and moderate pain groups, χ^2 test. [b]Between moderate pain group with mild pain group, unpaired t-test. NA, not available; VAS, Visual Analog Scale.

Table 3: Self-reported measures in pain condition groups.

Variables	Chronic trapezius myalgia (n=56)		Chronic non-specific neck pain (n=53)		Controls (n=62)		Test statistic
	M (SD)	95% CI	*M* (SD)	95% CI	*M* (SD)	95% CI	
NDI (0–50)	10.4 (4.9)	[1.0, 23.0]	8.6 (4.21)	[1.0, 18.0]	–	–	t=2.01[a]
PCS (0–52)	15.3 (10.7)	[0.0, 40.0]	11.9 (9.94)	[0, 39.0]	–	–	t=1.75
Copenhagen Psychosocial Questionnaire II							
Sleep (1–5)	2.5 (0.90)	[2.2, 2.7][b]	2.5 (0.80)	[2.3, 2.8][c]	1.9 (0.78)	[1.7, 2.1]	F=7.206
Burnout (1–5)	2.9 (0.90)	[2.7, 3.1][b]	2.7 (0.78)	[2.5, 2.9][c]	2.3 (0.79)	[2.1, 2.5]	F=3.411
Stress (1–5)	3.0 (0.78)	[2.8, 3.2][b]	2.7 (0.76)	[2.5, 2.9][c]	2.4 (0.74)	[2.2, 2.6]	F=4.466
Depression symptoms (1–5)	1.9 (0.66)	[1.7, 2.1][b]	2.0 (0.73)	[1.8, 2.2][c]	1.6 (0.53)	[1.5, 1.8]	F=2.988
Somatic stress (1–5)	2.3 (0.72)	[2.1, 2.5][b]	2.1 (0.59)	[1.9, 2.3][c]	1.7 (0.50)	[1.6, 1.8]	F=8.328
Cognitive stress (1–5)	2.4 (0.67)	[2.2, 2.6][b]	2.4 (0.68)	[2.2, 2.6][c]	2.1 (0.66)	[1.9, 2.2]	F=2.110

[a]Between chronic trapezius myalgia group with chronic non-specific neck pain, independent *t*-test (p=0.046); [b]Between chronic trapezius myalgia group with controls group, Tukey post hoc (p<0.05); [c]Between chronic non-specific neck pain with controls group, Tukey post hoc (p<0.05). NDI, Neck Disability Index; PCS, Pain Catastrophizing Scale.

group (*M*=10.4, SD=4.9) compared with chronic non-specific neck pain group (*M*=8.6, SD=4.2) (Table 3).

In the pain intensity groups, there was a significant difference in disability, *t*(107)=4.22, p<0.001, with higher Neck Disability Index in the moderate pain group (*M*=11.5, SD=4.9) compared with mild pain group (*M*=8.0, SD=3.8) (Table 4).

Pain Catastrophizing Scale

No significant differences was found comparing the pain condition groups [*t*(107)=1.752, p=0.083] and the pain intensity groups [*t*(107) = 0.645, p=0.519] (Tables 3 and 4).

Copenhagen Psychosocial Questionnaire II

In the pain conditions groups, there was a significant difference in all variables (p<0.05), with higher values in chronic trapezius myalgia and chronic non-specific neck pain groups compared with control group (Table 3).

In the pain intensity groups, there was a significant difference in sleep, burnout, stress, depression symptoms and somatic stress (p<0.05), with higher values in the moderate pain and mild pain groups compared with control group. In addition, somatic stress was higher in the moderate pain compared with mild pain groups (p=0.030), and in cognitive stress was higher in the moderate pain group compared with control group (p=0.013) (Table 4).

Table 4: Self-reported measures in pain intensity groups.

Variable	Mild pain (n=60)		Moderate pain (n=49)		Controls (n=62)		Test statistic
	M (SD)	95% CI	*M* (SD)	95% CI	*M* (SD)	95% CI	
NDI (0–50)	8.0 (3.8)	[1.0, 16.0]	11.5 (4.9)	[1.0, 23.0]	–	–	t=4.22[a]
PCS (0–52)	13.1 (10.2)	[0, 36.0]	14.4 (10.7)	[0.0, 40.0]	–	–	t=0.62
Copenhagen Psychosocial Questionnaire II							
Sleep (1–5)	2.3 (0.78)	[2.1, 2.5][c]	2.7 (0.90)	[2.4, 3.0][b]	1.9 (0.78)	[1.7, 2.1]	F=5.248
Burnout (1–5)	2.7 (0.83)	[2.4, 2.9][c]	3.0 (0.82)	[2.8, 3.2][b]	2.3 (0.79)	[2.1, 2.5]	F=3.130
Stress (1–5)	2.7 (0.76)	[2.5, 2.9][c]	3.0 (0.77)	[2.8, 3.3][b]	2.4 (0.74)	[2.2, 2.6]	F=3.963
Depression symptoms (1–5)	1.9 (0.67)	[1.7, 2.1][c]	2.0 (0.73)	[1.7, 2.2][b]	1.6 (0.53)	[1.5, 1.8]	F=2.897
Somatic stress (1–5)	2.1 (0.63)	[1.9, 2.2][c]	2.4 (0.67)	[2.2, 2.5][b,d]	1.70 (0.50)	[1.6, 1.8]	F=8.690
Cognitive stress (1–5)	2.4 (0.69)	[2.2, 2.5]	2.4 (0.66)	[2.2, 2.6][b]	2.1 (0.66)	[1.9, 2.2]	F=2.091

[a]Between moderate pain group with mild pain group, independent t-test, (p<0.001); [b]Between moderate pain group with controls group, Tukey post hoc (p<0.05); [c]Between mild pain group with controls group, Tukey post hoc (p<0.05); [d]Between moderate pain group with mild pain group, Tukey post hoc (p=0.03). NDI, Neck Disability Index; PCS, Pain Catastrophizing Scale.

Quantitative sensory testing

Pressure pain thresholds

In the pain conditions groups, significant lower PPTs were found in the upper trapezius at the painful/dominant side [$F(2, 165) = 15.184$, p<0.001], and the contralateral side [$F(2, 165)=8.439$, p<0.001]. Post hoc analysis showed lower PPTs in the chronic trapezius myalgia group comparing with chronic non-specific neck pain group (p<0.021) and control group (p<0.001), and lower PPTs in the chronic non-specific neck pain group comparted with control (p<0.08). Significant lower PPTs were found at extensor carpi ulnaris [$F(2, 165)=5.250$, p<0.0001]. Post hoc analysis showed lower PPTs in the chronic trapezius myalgia group comparing with chronic non-specific neck pain group (p=0.05) and control group (p<0.001). Significant lower PPTs were found at tibialis anterior [$F(2, 165)=5.259$, p=0.006] in the chronic trapezius myalgia group compared with control group (p<0.011) (Figure 2A).

In the pain intensity groups, significant lower PPTs were found at both the painful/dominant side [$F(2, 165)=11.696$, p<0.0001] and contralateral side [$F(2, 165)=7.102$, p=0.001] of upper trapezius. Post hoc analysis showed lower PPTs in the moderate pain and mild pain groups compared with control group (p<0.0001). Significant lower PPTs were found at extensor carpi ulnaris [$F(2, 165)=3.322$, p=0.039]. Post hoc analysis showed lower PPTs in the moderate pain and mild pain groups compared with control group (p<0.013). Significant lower PPTs were found at tibialis anterior [$F(2, 165)=5.430$, p=0.005], in moderate pain group compared with control group (p<0.0001) (Figure 2B).

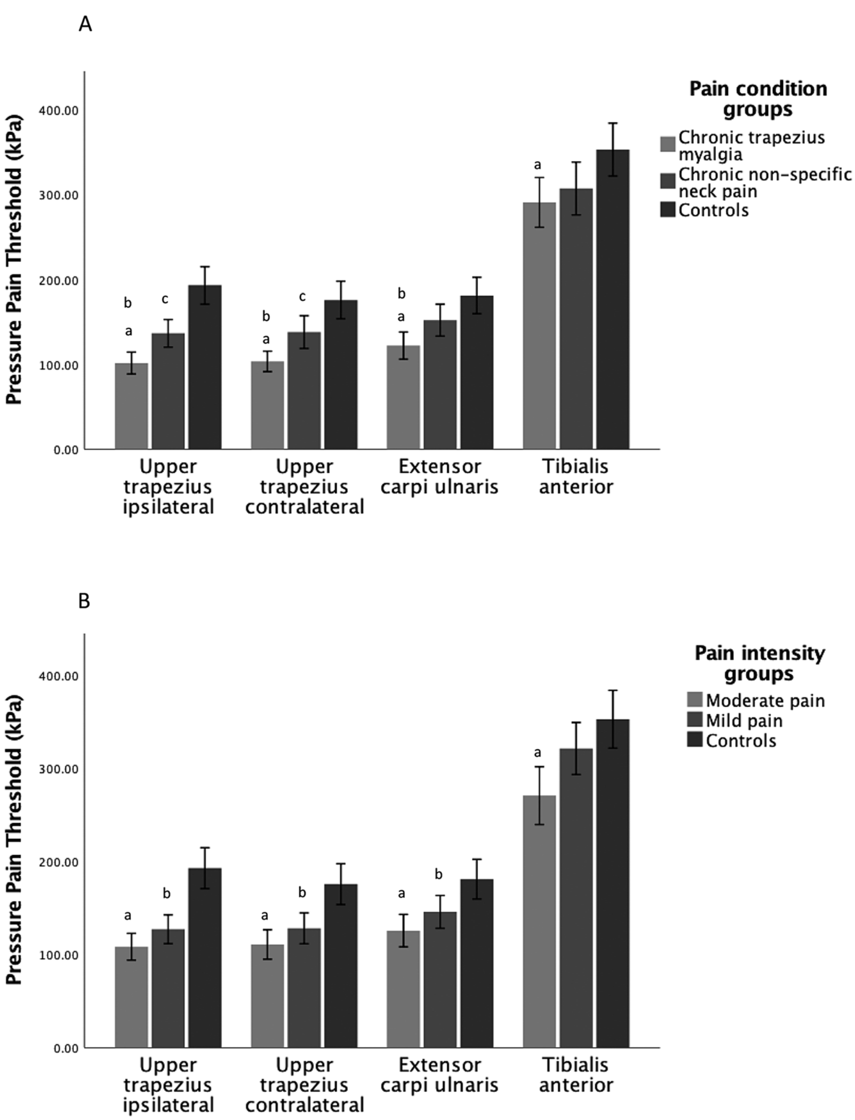

Figure 2: Pressure pain threshold (PPTs) measured at upper trapezius (ipsilateral and contralateral), extensor carpi ulnaris and tibialis anterior. (A) Pain Condition Groups; [a]Indicates significant differences (p<0.05) between chronic trapezius myalgia group with controls group. [b]Indicates significant differences (p<0.05) between chronic trapezius myalgia group with chronic non-specific neck pain group. [c]Indicates significant differences (p<0.05) between chronic non-specific neck pain group with controls group. (B) Pain Intensity Groups; [a]Indicates significant differences (p<0.05) between moderate pain with controls group. [b]Indicates significant differences (p<0.05) between mild pain with controls group. Error bars represent SE.

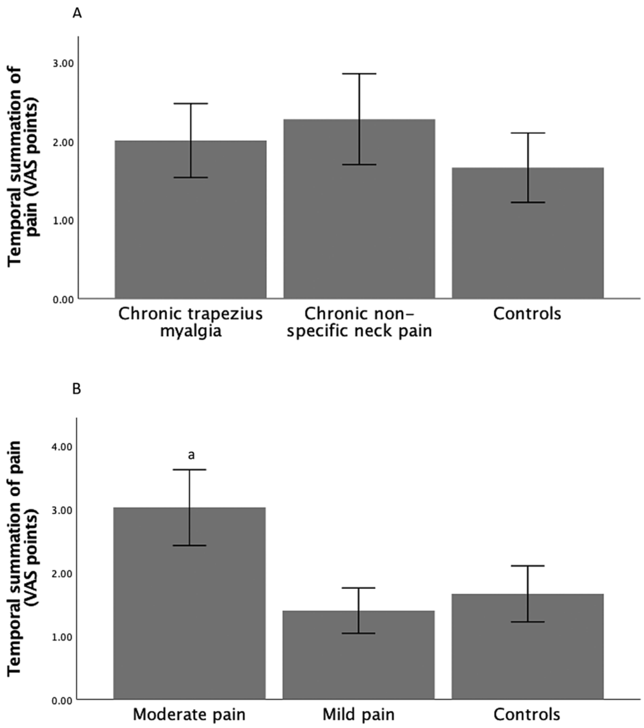

Figure 3: Temporal summation of pain, Pain – (A) Pain Condition Groups; no statistical differences between groups. (B) Pain Intensity Groups; [a]Indicates significant differences (p<0.001) between moderate pain with mild pain and controls groups. Error bars represent SE.

Temporal summation of pain

No statistical difference was found comparing the pain condition groups (Figure 3).

In the pain intensity groups, there was a significant higher TSP [$F(2, 156)=5.523$, $p<0.0001$]. Post hoc analysis showed a higher TSP in the moderate pain group compared with mild pain group ($p<0.001$) and control group ($p<0.001$) (Figure 4).

Conditioning pain modulation

The average water temperature was 2.90 ± 0.95 °C, the average hand immersion time in the cold water was 56.19 ± 39.48 s, and the average pain intensity rated after the cold water was 5.76 ± 2.22 on the VAS. There was a significant difference in hand immersion time being higher in the asymptomatic group compared with all the symptomatic groups ($p<0.005$), and the moderate pain group reported a higher pain intensity from the cold water comparing with the mild pain group ($p=0.011$).

There was a significant difference in PPT over time in the pain conditions groups [$F(2, 165)=13.754$, $p<0.0001$], and in the pain intensity groups [$F(2, 165)=9.320$, $p<0.0001$], but post hoc analysis of the groups shown no significant differences. The post-hoc analysis on PPTs before and after the cold pressor test, revealed that PPTs after the cold pressor test compared to baseline assessment were significantly higher for all groups ($p<0.05$) as an indicator of efficient CPM (Figure 4).

For the CPM effect there was a higher effect without significant difference in controls group compared with pain conditions groups [$F(2, 165)=0.915$, $p=0.402$], and with pain intensity groups [$F(2, 165)=0.108$, $p=0.898$] (Figure 4).

Pooling all office workers with CNP and compared with controls there was a significant difference in PPT over time in both groups [$F(1, 169)=27.990$, $p<0.0001$]. PPTs were significantly higher for both groups after the cold pressor test ($p<0.0001$) as an indicator of efficient CPM (Figure 4).

Pain intensity association with self-reported measures and quantitative sensory testing

In the pain conditions groups, significant positive correlations were found between pain intensity and Neck Disability Index and TSP in the chronic trapezius myalgia group and in the chronic non-specific neck pain group. In addition, a positive association between sleep, cognitive stress, somatic stress with clinic pain intensity were found in the chronic trapezius myalgia group. Significant negative correlation were found for PPTs in upper trapezius contralateral point, extensor carpi ulnaris and tibialis anterior with clinical pain intensity in chronic trapezius myalgia group (Table 5).

In the pain intensity groups, a significant positive correlation was found between clinical pain intensity with Neck Disability Index in moderate pain and mild pain groups (Table 5).

The linear multiple stepwise regression showed that disability and TSP were independent parameters associated with clinic pain intensity, in chronic trapezius myalgia group, $F(2, 50)=13.171$, $p<0.0001$, adj. $R^2=0.319$ and in CNP $F(2, 47)=7.439$, $p=0.002$, adj. $R^2=0.208$. Regression coefficients and standard errors can be found in Table 7.

Disability association with self-reported measures and quantitative sensory testing

Significant negative correlations were found between disability and PPTs, in all points in the chronic trapezius myalgia and in the moderate pain groups, and between

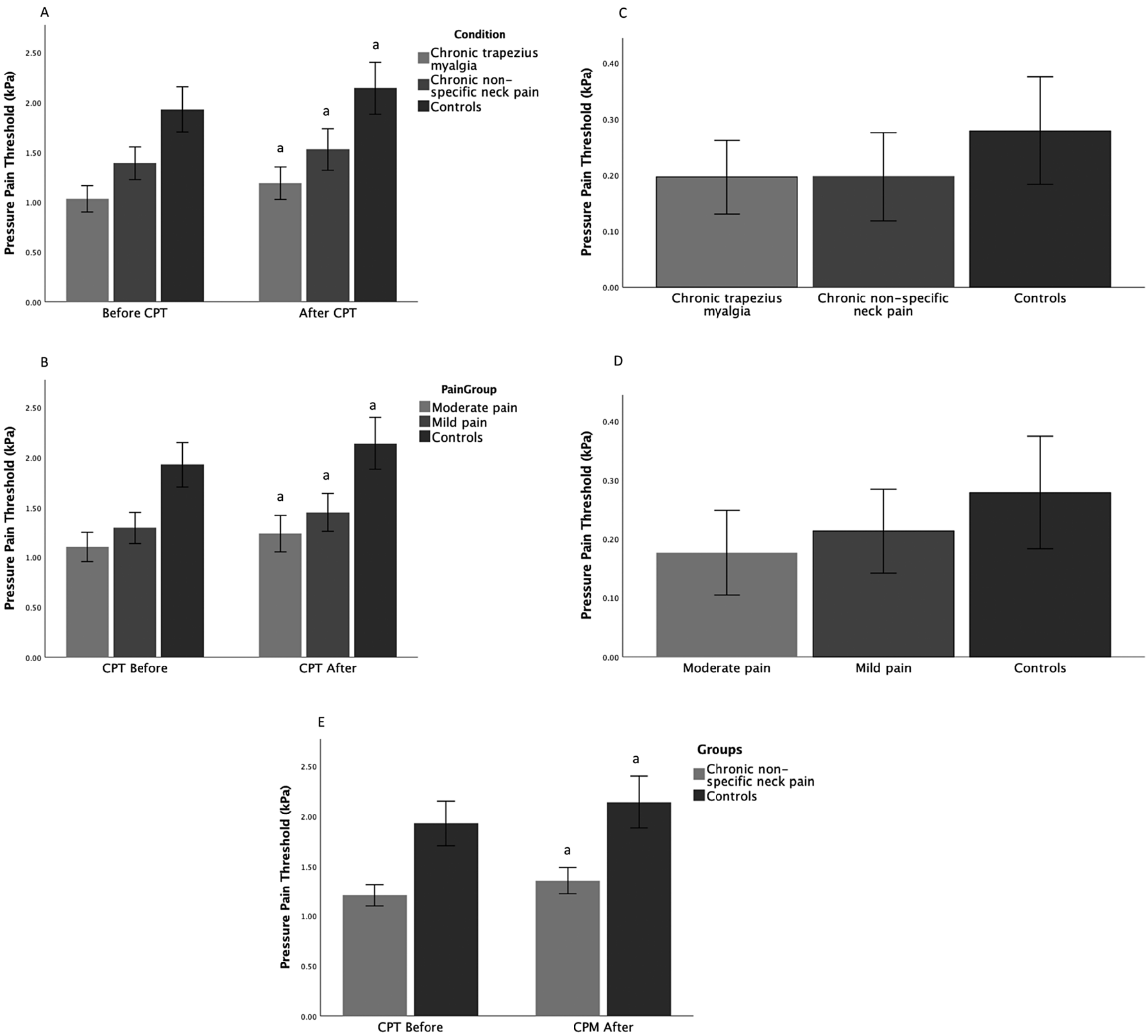

Figure 4: Pressure pain threshold (PPTs) assessed at upper trapezius in the most painful side/dominant side before and after the cold pressor test (conditioned pain modulation).
(A) Pain Condition Groups. (B) Pain Intensity Groups. [a]Indicates significant differences (p<0.05) in PPTs were observed after the cold pressure test as compared with before within all groups, but not between groups. (C) CPM effect in Pain Condition Groups. (D) CPM effect in Pain Intensity Groups. (E) All office workers with chronic pain pooled together compared with controls. [a]Indicates significant differences (p<0.05) in PPTs were observed after the cold pressure test as compared with before within all groups, but not between groups. Error bars represent SE. CPT, cold pressure test.

upper trapezius at the most painful side and tibialis anterior in chronic non-specific neck pain group. A positive correlation between disability with TSP was found in chronic trapezius myalgia group and most of the Copenhagen Psychosocial Questionnaire subscales (sleep, burnout, stress, somatic stress and cognitive stress) and in the Pain Catastrophizing Scale in all groups (Table 6).

The linear multiple stepwise regression showed that somatic stress was the independent parameters associated with disability, $F(1, 54)=15.772$, $p<0.0001$, adj. $R^2=0.212$ in chronic trapezius myalgia group. Somatic stress, cognitive stress and sleep were an independent predictor for disability ($F(3, 49)=20.168$, $p<0.0001$, adj. $R^2=0.525$) in chronic non-specific neck pain group. Regression coefficients and standard errors can be found in Table 8.

In the pain intensity groups, the linear multiple stepwise regression showed that stress was the independent parameter associated with disability $F(1, 47)=47.776$, $p<0.0001$, adj. $R^2=0.494$ in moderate pain group. Somatic stress and sleep $F(2, 57)=11.447$, $p<0.0001$, adj. $R^2=0.262$ were independent predictors of disability in the mild pain

Table 5: Pearson correlation between pain intensity with self-reported measures and quantitative sensory testing.

Variable	Pain condition groups		Pain intensity groups	
	Chronic trapezius myalgia	Chronic non-specific neck pain	Mild pain	Moderate pain
	R	R	R	R
Self-reported measures				
Neck Disability Index	0.523**	0.381**	0.347**	0.296*
Pain Catastrophizing Scale	0.151	0.071	0.057	0.275
Copenhagen Psychosocial Questionnaire II				
Sleep	0.308*	0.175	0.161	0.058
Burnout	0.236	0.195	0.044	0.195
Stress	0.295*	0.179	0.081	0.276
Depression symptoms	−0.033	0.049	−0.159	0.057
Somatic stress	0.273*	0.230	0.145	0.162
Cognitive stress	0.198	−0.050	−0.150	0.253
Quantitative sensory testing				
PPT upper trapezius (ipsilateral)	−0.213	−0.152	−0.096	−0.225
PPT upper trapezius (contralateral)	−0.284*	−0.080	−0.073	−0.220
PPT extensor carpi ulnaris	−0.279*	−0.052	−0.008	−0.232
PPT tibialis anterior	−0.399**	−0.201	−0.189	−0.268
TSP	0.414**	0.363**	−0.059	0.037
CPM	−0.146	0.075	0.141	−0.157

*p<0.05, **p<0.01. CPM, conditioned pain modulation; PPT, pressure pain threshold; TSP, temporal summation of pain.

Table 6: Pearson correlation between disability with self-reported measures and quantitative sensory testing.

Variable	Pain condition groups		Pain intensity groups	
	Chronic trapezius myalgia	Chronic non-specific neck pain	Mild pain	Moderate pain
	R	R	R	R
Self-reported measures				
Pain Catastrophizing Scale	0.309*	0.391**	0.259*	0.468**
Copenhagen Psychosocial Questionnaire II				
Sleep	0.372**	0.564**	0.427**	0.375**
Burnout	0.370**	0.542**	0.323*	0.510**
Stress	0.451**	0.662**	0.347*	0.710**
Depression symptoms	0.141	0.422**	0.194	0.328*
Somatic stress	0.475**	0.557**	0.456**	0.509**
Cognitive stress	0.443**	0.346*	0.343**	0.458**
Quantitative sensory testing				
PPT upper trapezius (ipsilateral)	−0.359**	−0.277*	−0.230	−0.428**
PPT upper trapezius (contralateral)	−0.383**	−0.241	−0.231	−0.383**
PPT extensor carpi ulnaris	−0.313*	−0.186	−0.192	−0.305*
PPT tibialis anterior	−0.312*	−0.352**	−0.253	−0.304*
TSP	0.343*	0.084	0.030	0.067
CPM	−0.147	0.097	0.001	−0.024

*p<0.05, **p<0.01. CPM, conditioned pain modulation; PPT, pressure pain threshold; TSP, temporal summation of pain.

group. Regression coefficients and standard errors can be found in Table 8.

Discussion

Widespread pressure hyperalgesia was found in chronic trapezius myalgia and in the moderate pain intensity groups when compared with asymptomatic office workers. In addition, temporal summation was facilitated in the moderate pain group compared with the mild pain group and asymptomatic office workers. Further, no differences in conditioning pain modulation were found across the different pain conditions or different pain intensities. Finally, disability and temporal summation of pain were independently predictors for pain intensity in pain conditions groups, and stress, somatic stress and sleep were independent predictors for disability.

Assessment of central pain mechanisms in CNP

Widespread hyperalgesia has been reported in a number of painful conditions [13], but the evidence for widespread hyperalgesia in CNP in office workers is conflicting. Ge et al. [28], found no differences in PPTs in upper trapezius, extensor carpi ulnaris and tibialis anterior in office workers with CNP compared with healthy controls. Similar, Heredia-Rizo et al. [53] found no differences in PPTs in upper trapezius and extensor carpi ulnaris in office workers with and without pain. Johnston et al. [27] demonstrated signs of widespread hypersensitivity in moderate/severe pain and disability group compared with the milder pain and disability group, with no disability group and control group. Nielsen et al. [40] demonstrated lower PPTs in upper trapezius and tibialis anterior in office workers with chronic trapezius myalgia compared with healthy workers. The current study demonstrated localized and widespread pressure hyperalgesia in the moderate pain and chronic

Table 7: Multivariate regression models for pain intensity in pain condition groups.

	Adj. R^2	F	Independent variables	*B*	SE *B*	*β*	p-Value
Chronic trapezius myalgia group							
Overall model	0.319	13.171					
			Neck Disability Index	0.150	0.041	0.444	0.001[b]
			TSP	0.256	0.119	0.262	0.037[a]
Chronic non-specific neck pain group							
Overall model	0.208	7.439					
			Neck Disability Index	1.35	0.052	0.331	0.013[a]
			TSP	0.288	0.110	0.335	0.012[a]

[a]p<0.05, [b]p<0.001. TSP, temporal summation of pain.

Table 8: Multivariate regression models for disability in pain condition groups and pain intensity groups.

	Adj. R^2	F	Independent variables	*B*	SE *B*	*β*	p-Value
Pain condition groups							
Chronic trapezius myalgia							
Overall model	0.212	15.772					
			Somatic stress	3.224	0.812	0.475	0.0001[c]
Chronic non-specific neck pain							
Overall model	0.525	20.168					
			Somatic stress	1.760	0.835	0.246	0.040[a]
			Stress	2.057	0.703	0.373	0.005[b]
			Sleep	1.556	0.574	0.299	0.009[b]
Pain intensity groups							
Moderate pain group							
Overall model	0.494	47.776					.
			Stress	4.440	0.642	0.710	0.0001[c]
Mild pain group							
Overall model	0.262	11.447					
			Somatic stress	2.115	0.731	0.347	0.005[b]
			Sleep	1.471	0.588	0.300	0.015[a]

[a]p<0.05, [b]p<0.01, [c]p<0.001.

trapezius myalgia groups as compared with asymptomatic controls. In addition, all the symptomatic groups had lower PPTs in upper trapezius compared with asymptomatic controls, indicating the presence of localized pressure hyperalgesia in office workers with CNP. The current study adds to the literature that specific subgroups of office workers might display widespread pressure hyperalgesia.

Facilitated TSP might be indicative of the sensitivity of dorsal horn neurons, as shown in animal models of muscle pain [54]. Facilitated TSP has been found in many severe chronic pain conditions [13], and studies have found that a long pain duration (years with chronic pain) and increasing clinical pain intensity are associated with facilitated TSP [13, 21, 22]. Recently, Heredia-Rizo et al. [53] showed no differences in TSP comparing officer workers with and without pain. The current study found facilitated TSP in the moderate pain group compared with the mild pain group and asymptomatic subjects, which could support that increasing clinical pain intensity is associated with facilitated TSP in CNP. In our regression model, TSP was one of the independent variables that explained pain intensity in chronic trapezius myalgia and chronic non-specific neck pain groups. To our knowledge, the current study and the study from Heredia-Rizo et al. [53] are the only studies that assessed TSP in this specific population.

CPM is impaired in multiple chronic pain conditions when compared to pain-free subjects [14], and it seems likely that multiple factors can affect CPM such as physical activity [55] or the use of opioids [56]. Heredia-Rizo et al. [53] found that CPM was similar to comparing office workers without pain and with moderate pain intensities, which was similar to Ge et al. [28] and the current study.

Shahidi et al. [29] and Shahidi and Maluf [57], found that the assessment of CPM was a risk factor for pain at 12 months follow-up in patients with CNP, which could indicate that some office workers with pain might display impaired CPM. Further studies are needed to investigate the role of CPM in neck and shoulder pain and to a possible predictive role for chronicity of neck and shoulder pain.

Pain intensity and disability

Neck and low back pain are the worldwide leading cause of disability [58], and neck pain alone causes a significant disability [59, 60]. In office workers with CNP the average of self-reported productivity loss ranged between 20 and 32% [61, 62], and the inability to perform daily work due to neck and shoulder pain was also reported by office workers of both sexes [3].

In the current study, disability was an independent variable associated with pain intensity in all symptomatic groups. Furthermore, our regression model showed that the independent variables stress, somatic stress, and sleep explained from 21.2 up to 52.5% of the disability in all the symptomatic groups. In three prospective studies, stress, disability, and pain intensity were associated with CNP in workers [25, 63, 64]. In the large cohort longitudinal study from Fanavoll et al. [63], with a follow-up of 11 years with more than 25.000 workers without neck pain, perceived work stress was a predictor for chronic neck/shoulder pain in the working population. In the study from Moloney et al. [25], disability and stress were baseline predictors for higher pain levels in CNP; and in the study from Svedmark et al. [64], where almost 70% of the sample size was constituted by office workers, higher perceived stress was associated with higher neck pain and disability.

A causal relationship between work-related stress and disorders in the upper limb and neck was also demonstrated in general workers [7, 65]. In office workers, stress is a work-related risk factor for neck pain, caused by "high job strain" [66–68], or "high job demands" [66, 69, 70]. Stress is also being linked with the sensation of muscle tension, and "high muscle tension" is a risk factor for neck pain reported by a systematic review and meta-analysis, which only included prospective studies (RR: 2.75, CI: 1.60–4.72, p=0.0002) [71].

Subjects with higher levels of stress and anxiety also have sleep disturbances [72, 73]. General workers with moderate to severe sleep problems were associated with a risk of 1.16–1.89 times more to work disability due to musculoskeletal problems [74]. In a large study base-population, co-morbid pain and insomnia together increased the risk for work disability [75]. In our study, there was only a correlation between sleep and pain in chronic trapezius myalgia group. Still, there is some evidence that sleep problems precede pain and increases the risk for the development of chronic pain [76, 77].

Moreover, there are some findings that stress and sleep contribute to sensitization. Higher levels of stress were associated with widespread hyperalgesia with lower PPT in the upper trapezius, in the supraspinatus, and in the tibia, both in men and women [78]. In a large population-based study, sleep impairment was associated with increased pain sensitivity [77]. Curatolo et al. [79] also found that pain-related with sleep interference was associated with pain hypersensitivity. From healthy subjects, sleep disturbance significantly impaired CPM [76, 80, 81], increased pain sensitivity [81, 82] and facilitated TSP [81]. The negative correlation of all PPT's points in the chronic trapezius myalgia group and moderate pain group with disability, the positive correlation between sleep and stress with pain intensity in chronic trapezius myalgia group, and the association of stress with disability might explain the widespread hyperalgesia verified in these groups.

Clinical implications

An office worker with CNP, without a clear pathoanatomical cause [4], reporting a moderate pain intensity, can be indicative of a central facilitation of the repeated nociceptive input. Further pain mechanism assessment is required, and pressure pain threshold and temporal summation of pain are possible clinic tests. Inquiring about disability, stress and sleep patterns are essential clinical keys features to be addressed. Strategies to improve these outcomes should be implemented in pain management [9, 12].

Limitations

A higher number of male subjects were found in the asymptomatic group compared with the symptomatic groups in the current study. Although the statistical analysis was conducted to minimize the gender effect, it is well known that females have a greater risk of chronic pain and that several QST parameters are different comparing females and males [83–85]. Also, the principal investigator was not blinded to group allocation, and we cannot exclude the possibility of some detection bias. Therefore, the results of the current studies should be interpreted with care.

Conclusion

Office workers with chronic trapezius myalgia and moderate pain intensity show signs of sensitization demonstrated by widespread pressure hyperalgesia in distal segmental areas. Moreover, office workers with moderate pain intensity showed facilitated temporal summation when compared with mild intensity and asymptomatic groups. This could be indicative of a central facilitation of the repeated nociceptive input.

Temporal summation of pain and disability were independently associated with pain intensity in pain conditions groups, and stress and sleep were independently associated with disability. Quantitative sensory testing and psychosocial factors, mainly sleep and stress, provide insight into the fundamental aspects of CNP in office workers with pain.

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Author contributions: AN and ME conceptualized the study and collected data. All authors were involved in data analysis and discussed the results. AN drafted the first version of the manuscript. All authors contributed to the final version of the manuscript.

Competing interests: All authors declare no conflicts of interest.

Informed consent: All participants gave written informed consent prior to enrollment.

Ethical approval: This study was conducted in accordance with the Declaration of Helsinki and was approved by the Ethic Council (CEFMH) at the Faculty of Human Kinetics – Lisbon University (Approval Number: 23/2017). All participants gave written informed consent prior to enrollment.

Appendix

Table 1: Descriptive characteristics of office workers within and between-group gender differences in pain condition groups.

Variable	Chronic trapezius myalgia (n=56)			Chronic non-specific neck pain (n=53)			Controls (n=62)			Between groups	
	Female	Male	t-test	Female	Male	t-test	Female	Male	t-test	Female	Male
Age, years	42.5 ± 7.1	45.1 ± 8.6	0.406	45.8 ± 7.9	42.5 ± 8.0	0.341	45.0 ± 8.3	40.0 ± 7.6	**0.019**	0.095	0.333
Working time, h/wk	36.4 ± 4.2	39.5 ± 5.9	0.122	37.1 ± 7.9	37.5 ± 4.1	0.907	38.5 ± 5.7	37.7 ± 6.4	0.623	0.277	0.803
Computer work, h/day	6.5 ± 0.10	7.0 ± 2.6	0.336	6.1 ± 1.0	6.6 ± 1.6	0.282	6.4 ± 1.3	6.5 ± 1.3	0.940	0.299	0.789
Computer work, years	16.0 ± 7.5	16.6 ± 9.7	0.834	18.1 ± 9.2	17.5 ± 3.1	0.874	18.5 ± 8.5	17.4 ± 6.1	0.575	0.330	0.965
VAS (0–10) (present day)	2.3 ± 1.9	1.9 ± 1.0	0.536	1.5 ± 1.6	1.3 ± 0.9	0.791	NA	NA	NA	**0.01**	0.166
VAS (0–10) (last seven days)	3.3 ± 1.7	2.8 ± 1.6	0.539	2.7 ± 1.8	2.3 ± 1.4	0.650	NA	NA	NA	0.113	0.547
Pain duration, months	79.6 ± 65.0	68.0 ± 58.0	0.678	90.8 ± 65.2	92.0 ± 86.7	0.968	NA	NA	NA	0.579	0.568

Data are expressed as mean ± standard deviation. Bold indicates significant ($p<0.05$).

Table 2: Descriptive characteristics of office workers within and between-group gender differences in pain intensity groups.

Variable	Mild pain (n=60)			Moderate pain (n=49)			Controls (n=62)				
	Female	Male	t-test	Female	Male	t-test	Female	Male	t-test	Female	Male
Age, years	43.8 ± 7.8	46.6 ± 7.6	0.351	44.4 ± 7.7	38.2 ± 6.2	0.126	45.0 ± 8.3	40.0 ± 7.6	**0.019**	0.755	0.095
Working time, h/wk	38.1 ± 6.3	36.5 ± 2.8	0.471	35.2 ± 6.0	42.5 ± 6.4	**0.25**	38.5 ± 5.7	37.7 ± 6.4	0.623	**0.037***	0.229
Computer work, h/day	6.4 ± 1.0	6.1 ± 1.3	0.470	6.2 ± 1.1	8.2 ± 2.8	**0.04**	6.4 ± 1.3	6.5 ± 1.3	0.940	0.466	0.08
Computer work, years	17.5 ± 8.2	15.7 ± 7.2	0.557	16.3 ± 8.7	19.7 ± 6.0	0.453	18.5 ± 8.5	17.4 ± 6.1	0.575	0.469	0.570
VAS (0–10) (present day)	1.2 ± 1.0	1.2 ± 0.8	0.965	2.8 ± 2.1	2.3 ± 0.9	0.677	NA	NA	NA	**<0.001**	**<0.001**
VAS (0–10) (last seven days)	1.6 ± 0.9	1.7 ± 0.6	0.765	4.6 ± 0.9	4.4 ± 0.8	0.625	NA	NA	NA	**<0.001**	**<0.001**
Pain duration, months	85.3 ± 71.0	96.7 ± 77.2	0.677	84.7 ± 58.1	46.5 ± 50.5	0.210	NA	NA	NA	0.998	0.101

Data are expressed as mean ± standard deviation. Bold indicates significant ($p<0.05$). *Between moderate pain group compared with mild pain and controls group.

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