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ORIGINAL RESEARCH

Psychosocial burden and central sensitization–related symptoms in the association between temporomandibular-region and pelvic pain: a cross-sectional study

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Abstract

Background: Chronic pelvic pain and temporomandibular pain frequently co-occur, yet their combined psychosocial and sensitization profile remains poorly characterized. We quantified their association, compared psychosocial and sensitization burden across presentations, and examined associations of central sensitization–related symptoms with psychosocial factors and pain intensity. **Methods**: In this cross-sectional study, 133 Spanish-speaking adults were classified into neither temporomandibular nor pelvic pain (n = 18), temporomandibular pain only (n = 17), pelvic pain only (n = 30), and combined pain (n = 68). Central sensitization–related symptoms (Central Sensitization Inventory (CSI)), kinesiophobia, perceived stress, state anxiety, quality of life, and regional pain intensity were assessed. Poisson regression with robust variance estimated prevalence ratios (PRs) for pelvic pain; groups were compared using Kruskal–Wallis tests with Dunn *post-hoc* comparisons and Spearman correlations. **Results**: Temporomandibular pain was associated with pelvic pain unadjusted (crude PR = 1.28; 95% confidence interval (CI) 1.00–1.63; $p = 0.047$), but not after adjustment for age, sex, perceived stress, and central sensitization–related symptoms (adjusted prevalence ratio (aPR) = 1.12; 95% CI 0.87–1.43; $p = 0.378$). Perceived stress (aPR = 1.01; $p = 0.016$) and CSI (aPR = 1.01; $p = 0.003$) remained independently associated with pelvic pain. The combined group showed the highest CSI scores and perceived stress (both $p < 0.001$). CSI correlated with perceived stress ($\rho = 0.52$), pain intensity ($\rho = 0.40$–0.52), and inversely with quality of life ($\rho = -0.63$; all $p < 0.001$). **Conclusions**: Co-occurring temporomandibular and pelvic pain is a high-burden multisite presentation in which psychosocial distress and central sensitization–related symptoms are more closely associated with pelvic pain than temporomandibular status alone. The cross-sectional design precludes causal interpretation. **Clinical Trial registration**: NCT07323797 (https://clinicaltrials.gov/study/NCT07323797).

Keywords

Chronic pain; Cross-sectional studies; Pain management; Pelvic pain; Temporomandibular joint disorders

1. Introduction

Chronic pelvic pain (CPP) and temporomandibular disorders (TMD) are prevalent and disabling conditions that illustrate the complexity of chronic pain within a biopsychosocial framework. Throughout, chronic pain denotes symptoms persisting for three months or longer, consistent with the International Classification of Diseases (ICD)-11 and chronic overlapping pain conditions (COPC) criteria; the temporomandibular and pelvic pain examined here represent this chronic phenotype rather than acute, subacute, or episodic pain. CPP affects up to one quarter of women and frequently co-occurs with nonpelvic pain syndromes and musculoskeletal dysfunction, indicating contributions from centrally mediated mechanisms [1]. Similarly, painful TMD is common in young adults, strongly associated with psychological distress, and often overlaps with headaches and other pain complaints [2]. These patterns align with the construct of COPCs, where central sensitization, psychosocial burden, and multisite pain contribute to symptom severity and disability [3, 4].

Emerging evidence suggests that pelvic and orofacial pain may reflect shared, sensitization-related processes.

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In women with endometriosis, pelvic pain correlates with temporomandibular joint symptoms, headaches, and bruxism [5], while other studies link TMD with pelvic floor dysfunction, stress, and sexual pain [6]. Reviews consistently report high comorbidity between TMD and functional pain syndromes such as irritable bowel syndrome, supporting altered central nervous system processing as a shared underlying process [4]. Temporomandibular and pelvic pain were paired for specific reasons beyond their shared COPC status: both are muscle-based pain conditions (masticatory and pelvic-floor musculature) prone to myofascial and centrally mediated mechanisms, both show a marked female preponderance, and a direct clinical link between them has been repeatedly reported, including in women with endometriosis and pelvic-floor dysfunction. This makes the temporomandibular–pelvic dyad a biologically and clinically motivated model of overlapping pain, rather than an arbitrary pairing.

Altered nociceptive processing is well documented in TMD, including impaired conditioned pain modulation and elevated depressive symptoms, anxiety, fear-avoidance, and catastrophizing, features consistent with central sensitization [3, 7]. Notably, central sensitization and chronic overlapping pain associations are reported most consistently for the myofascial (muscle-related) temporomandibular phenotype rather than for intra-articular derangements; the present study therefore concerns pain-related temporomandibular symptoms, which are predominantly of this myofascial type [3, 8]. Neurophysiological evidence further highlights increased intracortical facilitation linked to psychosocial distress [9]. Comparable mechanisms are observed in CPP, which frequently overlaps with conditions such as fibromyalgia and migraine, with trauma and emotional distress influencing pain modulation [1]. Multidisciplinary management is therefore recommended over isolated organ-based approaches [10]. These psychosocial constructs each have a defined role in chronic pain. Kinesiophobia sustains disability across musculoskeletal and pelvic pain and is therefore relevant to multisite presentations; perceived stress and anxiety index the affective load repeatedly linked to central sensitization; and health-related quality of life captures the functional consequences of multisite pain.

Despite this convergence, psychosocial and sensitization profiles in individuals presenting with both pelvic and temporomandibular pain remain insufficiently characterized. Although the temporomandibular–pelvic overlap has been noted, prior work has rarely characterized this specific pairing across psychosocial and sensitization domains simultaneously. The novelty of the present study lies not in a wider anatomical scope, but in the combined psychosocial and central-sensitization characterization of co-occurring temporomandibular and pelvic pain within a single sample. Chronic pelvic pain is most often described in women and several of its common drivers are female-specific, pelvic pain is not exclusive to women; the present study included adults of any sex, while recognizing that the sample was predominantly female.

Therefore, this cross-sectional study had three aims: (1) to quantify the co-occurrence of temporomandibular and pelvic pain and estimate the strength of their association using adjusted prevalence ratios (aPR). These estimates were adjusted for age, sex, perceived stress, and central sensitization–related symptoms, each treated as a potential confounder because it is independently associated with both temporomandibular and pelvic pain in prior literature and could otherwise generate a spurious association between them; (2) to compare central sensitization–related symptoms, psychosocial burden, and health-related quality of life across no-pain, temporomandibular-only, pelvic-only, and combined-pain groups; and (3) to quantify the correlations of central sensitization–related symptoms with perceived stress, kinesiophobia, anxiety, and regional pain intensity. Given the cross-sectional design, all aims were framed as associations rather than causal or directional effects. We hypothesized that (i) temporomandibular and pelvic pain would co-occur more often than expected by chance, but that their association would attenuate after adjustment for shared psychosocial and sensitization-related factors; (ii) central sensitization–related symptom burden and perceived stress would be greatest in the combined-pain group; and (iii) central sensitization–related symptoms would correlate with psychosocial burden and pain intensity.

2. Materials and methods

2.1 Design

This study employed an observational, crosssectional analytical design aimed at examining psychosocial factors and sensitizationrelated symptoms across individuals with diverse chronic pain presentations. The reporting of the study was conducted according to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines to ensure transparency and methodological rigor [11]. The research protocol received ethical approval from the Human Research Ethics Committee of the University of Valencia (reference 2025-FIS-4199837) and was conducted in accordance with the Declaration of Helsinki. The study was prospectively registered at ClinicalTrials.gov under the identifier NCT07323797. All participants provided written informed consent prior to enrollment.

2.2 Setting

Data were collected through an online research platform using self-administered questionnaires designed for secure remote participation. Recruitment and data collection occurred between September and December 2025. Participants were community-dwelling adult volunteers from the general Spanish community (not a representative population sample) rather than care-seeking patients recruited from a clinical setting. They were reached through digital dissemination channels, including university and professional-association mailing lists, social-media advertisements, and community outreach networks; interested individuals followed a link to the screening questionnaire and self-selected into the study. All assessments were completed electronically. No follow-up period was required given the cross-sectional design, and all data were captured within a single assessment session. Several measures safeguarded data integrity. The survey was ad-

ministered through Google Forms with sign-in restricted to authenticated Google accounts and limited to one response per account, which prevented duplicate submissions; all items were configured as required, so incomplete forms could not be submitted.

2.3 Participants

Participants were eligible if they were adults (≥18 years), able to read and understand Spanish, and willing to provide written informed consent; completion of the unsupervised online assessment additionally required basic digital literacy and internet access. Because recruitment used open digital channels within Spain, the sample was predominantly of Spanish nationality, and race and ethnicity were not formally recorded. Eligible participants completed a single-session, self-administered online assessment that included detailed questions on pain location and characteristics alongside validated psychometric instruments. Exclusion criteria were inability to read Spanish or failure to provide informed consent. The screening did not exclude participants on the basis of pregnancy, prior pain-related surgery, or specific identifiable causes of pain such as active malignancy, infection, or recent trauma; the implications of these broad criteria are addressed in the limitations. Because these conditions were not formally screened, participants were community volunteers rather than acute-care patients, and current medication use was recorded and used as a proxy for treated comorbidity in a sensitivity analysis. Coexisting central sensitivity conditions were neither an exclusion criterion nor separately ascertained; instead, overall multisite pain burden was captured by the Chronic Overlapping Pain Conditions Screener (COPCS) body map.

2.4 Sample size

Sample size was estimated a priori using G*Power (version 3.1.9.3; Franz Faul, Universität Kiel, Kiel, SH, Germany). As no prior study had quantified the temporomandibular–pelvic prevalence ratio (PR), the calculation was based on the secondary between-group comparisons of central sensitization and psychosocial burden, for which a medium effect size (f = 0.25), a two-tailed α = 0.05, and power of 0.80 yielded a minimum of 120 participants. Because no prior estimate of the temporomandibular–pelvic PR was available, the study was exploratory with respect to the primary outcome, and the a priori calculation informed the secondary between-group comparisons only. *Post hoc*, given a pelvic-pain prevalence of approximately 74% and the observed group sizes, the study had limited power to detect small PRs, which we acknowledge in the limitations section.

2.5 Variables

A comprehensive set of demographic, clinical, socioeconomic, and psychosocial variables was collected. Demographic variables included age, sex, height, weight, and marital status. Region-specific pain was ascertained by asking participants whether they experienced pain in the temporomandibular and pelvic regions; those endorsing pain rated its intensity on the Numerical Rating Scale (NRS) and reported its duration by directly indicating how long they had experienced it (in months), and a separate item recorded whether the pain had been present for at least three months. Pain was classified as present when the NRS score exceeded zero and as chronic when its reported duration was three months or longer, consistent with ICD-11 and COPC criteria. This duration-based ascertainment was intended to distinguish persistent regional pain from transient or episodic symptoms, such as an isolated toothache or a single episode of dysmenorrhea. Socioeconomic variables comprised educational level, classified according to the International Standard Classification of Education [12], and monthly household income categorized into national deciles based on data from the Spanish National Institute of Statistics [13].

Instruments were selected to capture the core constructs of the chronic overlapping pain framework using tools validated in Spanish to ensure measurement adequacy in this population. To assess overlapping chronic pain presentations, participants completed the the COPCS, a validated instrument for identifying individuals presenting with one or more chronic overlapping pain conditions [14]. Pain intensity in the temporomandibular and pelvic regions was measured using the 0–10 NRS (scoring 0–10 (higher = worse)), on which participants rated their average pain over the preceding week, with higher scores reflecting more severe pain [15]. Kinesiophobia was evaluated using the Tampa Scale of Kinesiophobia for Temporomandibular Disorders (TSK-TMD) (10-item Spanish version; total-score range 10–40; higher = greater kinesiophobia) in its validated Spanish version, which has demonstrated adequate reliability and validity [16]. Central sensitization–related symptoms were assessed with the Spanish version of the Central Sensitization Inventory (CSI) (0–100 (higher = greater central-sensitization–related symptom burden; ≥40 commonly used as the threshold suggestive of central sensitization)), validated in Spanish samples, which identifies symptoms associated with enhanced central nervous system responsiveness [17]. Health-related quality of life was measured using the Short Form-12 (SF-12). Because item-level responses were not retained, the SF-12 was analyzed as a single overall summary score (higher values indicating better functioning) rather than as the standard Physical (PCS) and Mental (MCS) Component Summaries; this scoring limitation is addressed below [18]. Perceived stress was quantified using the Spanish version of the Perceived Stress Scale-10 (PSS-10) (0–40 (higher = greater stress; bands 0–13 low, 14–26 moderate, 27–40 high)), where higher scores indicate greater perceived stress [19]. State anxiety was assessed using the shortened State–Trait Anxiety Inventory (STAI-6) (summed short-form score, range 6–24; higher = greater anxiety), validated for Spanish samples [20]. Table 1 summarizes each instrument's construct, scoring range, direction, and available interpretive cut-offs.

2.6 Statistical methods

Statistical analyses were conducted using IBM SPSS Statistics for macOS (version 29; IBM Corp., Armonk, NY, USA). Continuous variables were summarized as means (standard deviation (SD)), and categorical variables as frequencies and

TABLE 1. Measurement instruments. Constructs, scoring and interpretation.

Instrument	Construct assessed	Score range	Scoring direction	Interpretation/established cut-off
NRS	Pain intensity, average over the past week	0–10 (per region)	Higher = greater pain	No universal cut-off; ≥4 commonly denotes at least moderate pain
COPCS	Number and location of painful body regions (multisite pain)	Count of regions	More regions = greater multisite burden	Screening instrument; no diagnostic cut-off
TSK-TMD	Kinesiophobia (fear of jaw movement)	10–40	Higher = greater kinesiophobia	No established clinical cut-off
CSI (Part A)	Central sensitization–related symptom burden (self-report proxy)	0–100	Higher = greater symptom burden	≥40 suggestive of central sensitization
PSS-10	Perceived stress	0–40	Higher = greater perceived stress	0–13 low, 14–26 moderate, 27–40 high
STAI-6	State anxiety	6–24 (short-form summed score)	Higher = greater anxiety	No established cut-off for the 6-item summed score
SF-12	Health-related quality of life	Summary score	Higher = better functioning	Norm-based (population mean ≈50); no single clinical cut-off

COPCS: Chronic Overlapping Pain Conditions Screener; CSI: Central Sensitization Inventory; NRS: Numerical Rating Scale; PSS-10: Perceived Stress Scale-10; SF-12: Short-Form-12; STAI-6: State–Trait Anxiety Inventory-6; TSK-TMD: Tampa Scale of Kinesiophobia for Temporomandibular Disorders. Ranges reflect the validated versions used; the STAI-6 was scored as a summed short-form total (rather than the transformed 20–80 metric), and the SF-12 was available as a single summary score (physical and mental component summaries could not be derived).

percentages. Normality and homoscedasticity were assessed using the Shapiro–Wilk and Levene tests to determine the use of parametric or non-parametric procedures. Because all survey items were configured as required responses, there were no missing data on the analyzed variables, and all analyses used complete cases.

The primary outcome was the adjusted association between temporomandibular pain and the prevalence of pelvic pain, expressed as an aPR. Participants were classified into four mutually exclusive groups according to the presence of region-specific pain on the NRS (score >0): neither temporomandibular nor pelvic pain, temporomandibular pain only, pelvic pain only, and combined pain. The pain-free group was included to provide a normative anchor and to test whether the sensitization and psychosocial gradient was specific to the symptomatic groups rather than a general feature of the sample. Because NRS >0 captures any pain, we repeated the primary analysis using a clinically oriented threshold of NRS ≥3 to define region-specific pain (sensitivity analysis). For descriptive purposes, NRS scores of 1–2 were considered mild pain of limited clinical significance. To determine whether temporomandibular pain was associated with a higher prevalence of pelvic pain, Poisson regression models with robust variance were fitted to estimate crude PRs and aPRs with 95% CIs. The adjusted model included a priori covariates selected for their conceptual relevance to pelvic pain: age, sex, perceived stress (PSS-10), and central sensitization–related symptoms (CSI). The TSK-TMD was administered to all participants regardless of temporomandibular status and is therefore reported descriptively for every group; however, because it frames kinesiophobia specifically around jaw movement, the covariate set was pre-specified on conceptual grounds. In other words, the TSK-TMD was administered to all participants but excluded as a covariate because it frames kinesiophobia around jaw movement and is not interpretable as general kinesiophobia in participants without temporomandibular pain; state anxiety (STAI-6) was not included because it indexes a transient state rather than a stable determinant of pain prevalence; and the SF-12 was excluded as a downstream consequence rather than a determinant of pain. Robustness was assessed using logistic and log-binomial specifications.

To compare symptom burden across the four groups, central sensitization–related symptoms, psychosocial measures, health-related quality of life, and pain intensity were compared using Kruskal–Wallis tests, as the Shapiro–Wilk test indicated non-normal distributions, with Bonferroni-adjusted Dunn tests for pairwise comparisons; an η^2-based effect size is reported for each comparison, and rank-biserial correlations are reported as effect sizes for each significant pairwise *post-hoc* comparison. Associations of central sensitization–related symptoms with psychosocial constructs and regional pain intensity were quantified using Spearman correlation coefficients. Poisson regression with robust (sandwich) variance was used to obtain valid PRs for a common binary outcome without invoking the rare-disease assumption; the Kruskal–Wallis and Dunn tests assume independent observations and ordinal or continuous data without requiring normality; and Spearman correlations assume a monotonic relationship between variables. Exact *p*-values are reported throughout, and statistical significance was set at $p < 0.05$.

To minimize information bias, all outcomes were assessed using validated, standardized self-report instruments delivered through a single online platform with identical item wording, ordering, and instructions for every participant; because administration was unsupervised and remote, conditions such as setting and timing could not be controlled, which is acknowledged as a limitation. Selection bias was mitigated through uniform eligibility criteria applied regardless of pain presentation. Residual confounding was addressed through a priori covariate adjustment in the multivariable models.

3. Results

3.1 Participants

The survey was distributed through digital channels; because responses were captured only on submission and all items were required, the number who opened the survey without completing it could not be determined. A total of 133 participants submitted complete responses, all of whom met eligibility criteria and were included in the analysis, with no post-consent exclusions (Fig. 1). All these were included in the analysis and classified into four groups by region-specific pain: neither temporomandibular nor pelvic pain (n = 18), temporomandibular pain only (n = 17), pelvic pain only (n = 30), and combined temporomandibular and pelvic pain (n = 68). Because recruitment used open digital dissemination, the number of individuals who viewed the invitation could not be determined; all 133 participants who completed the questionnaire were retained, with no exclusions after consent. The mean age was 41.7 years (SD = 14.1), with younger individuals more frequent in the no-pain and temporomandibular-only groups (mean 33.0 and 35.8 years, respectively) and older individuals in the pelvic-only group (48.2 years). Women accounted for 80% of the sample, reaching 90% in the combined-pain group. Anthropometric measures were broadly comparable across groups. Demographic and socioeconomic characteristics are presented in Tables 2 and 3.

Pain duration varied widely. Defining chronic pain as a duration of three months or longer, most participants with pain reported chronic symptoms: 76% (13/17) of the temporomandibular pain-only group, 90% (27/30) of the pelvic-only group, and 90% (61/68) of the combined-pain group. Pain intensity followed expected anatomical distributions, with elevated NRS scores in the symptomatic regions of each group. The combined-pain group had the highest perceived stress (median 26, IQR 21–32) and CSI scores (median 49, IQR 42–63), and the pelvic-only and combined groups had lower SF-12 scores (medians 34 and 36) than the no-pain and temporomandibular pain-only groups (medians 41 and 41); differences are quantified in Table 4. Educational attainment ($\chi^2 = 17.07$, $p = 0.707$) and household income ($\chi^2 = 26.37$, $p = 0.498$) did not differ between groups.

Body pain distributions captured using the COPCS are shown in Fig. 2. In the anterior view, the pelvic region displayed the highest prevalence of symptoms (62.4%), followed by the temporomandibular (38.3%), anterior cervical

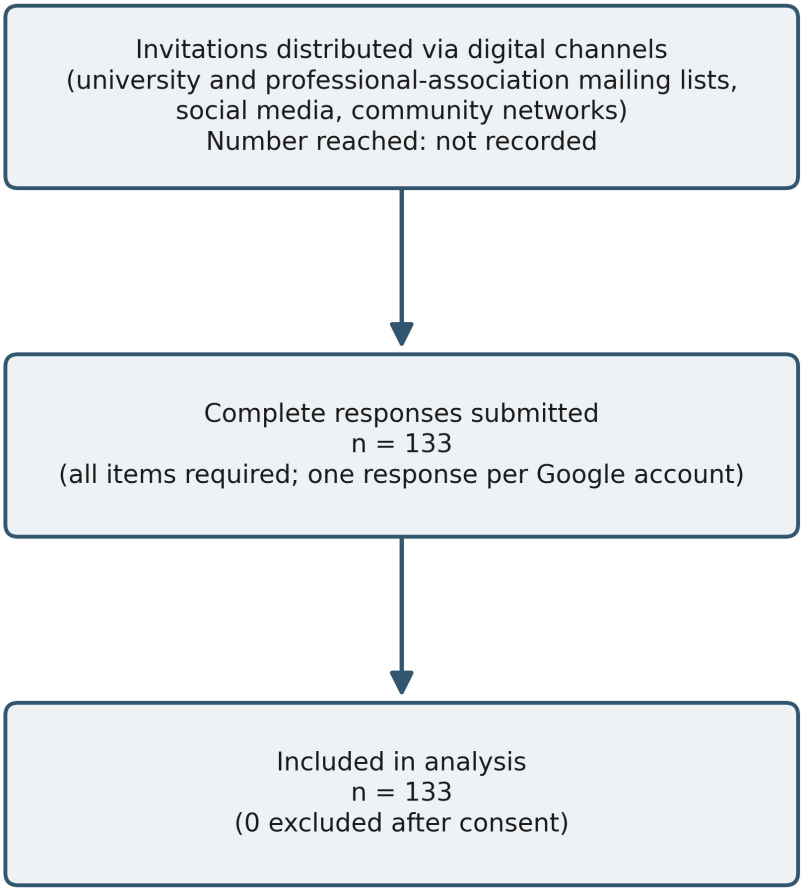


FIGURE 1. Participant flow from digital recruitment to analysis.

TABLE 2. Participant's baseline characteristics.

	Total (n = 133)	None (n = 18)	TMD Pain (n = 17)	Pelvic Pain (n = 30)	TMD + Pelvic Pain (n = 68)
Age (yr) (SD) median [IQR]	41.7 (14.1) 40 [30–52]	33.0 (13.0) 28 [24–38]	35.8 (16.0) 31 [23–45]	48.2 (13.5) 48 [40–59]	42.5 (12.6) 41 [34–51]
Sex					
Female	107 (80%)	14 (78%)	14 (82%)	18 (60%)	61 (90%)
Male	26 (20%)	4 (22%)	3 (18%)	12 (40%)	7 (10%)
Height (meters) median [IQR]	1.7 (0.1) 1.6 [1.6–1.7]	1.6 (0.1) 1.6 [1.6–1.7]	1.6 (0.1) 1.6 [1.6–1.7]	1.7 (0.1) 1.7 [1.7–1.7]	1.6 (0.1) 1.6 [1.6–1.7]
Weight (kilograms) median [IQR]	66.0 (12.6) 64 [57–73]	66.0 (9.2) 64 [60–70]	65.4 (14.5) 64 [57–70]	68.5 (13.8) 68 [60–73]	65.1 (12.5) 62 [56–72]
Marital status					
Single	74 (56%)	13 (72%)	11 (65%)	14 (47%)	36 (53%)
Married	54 (41%)	5 (28%)	5 (29%)	13 (43%)	31 (46%)
Divorced	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Widowed	5 (3%)	0 (0%)	1 (6%)	3 (10%)	1 (1%)
Duration (mon)					
None	18 (14%)	18 (100%)	0 (0%)	0 (0%)	0 (0%)
From 0 to 3 mon	9 (7%)	0 (0%)	2 (12%)	1 (3%)	6 (9%)
From 3 to 12 mon	16 (12%)	0 (0%)	4 (24%)	4 (13%)	8 (12%)
From 12 to 60 mon	29 (22%)	0 (0%)	7 (41%)	8 (27%)	14 (21%)
More than 60 mon	56 (42%)	0 (0%)	2 (12%)	15 (50%)	39 (57%)
NRS-TMD median [IQR]	2.8 (2.7) 2 [0–5]	0 (0.0) 0 [0–0]	3.9 (1.9) 4 [2–5]	0 (0.0) 0 [0–0]	4.5 (2.2) 5 [2–6]
NRS-Pelvic Pain median [IQR]	4.2 (3.3) 5 [0–7]	0 (0.0) 0 [0–0]	0 (0.0) 0 [0–0]	6.4 (2.3) 7 [5–8]	5.5 (2.5) 6 [4–8]
TSK-TMD median [IQR]	20.6 (7.7) 20 [14–26]	20.4 (7.2) 20 [14–26]	24.5 (7.0) 22 [19–30]	14.9 (7.1) 11 [11–14]	22.3 (7.0) 21 [18–26]
PSS-10 median [IQR]	22.7 (8.7) 21 [17–27]	16.0 (5.1) 16 [13–19]	17.8 (8.4) 17 [12–23]	21.1 (7.8) 18 [16–22]	26.3 (8.3) 26 [21–32]
STAI-6 median [IQR]	14.8 (1.9) 15 [14–16]	14.5 (1.7) 14 [13–16]	14.8 (2.1) 15 [14–16]	14.5 (2.0) 15 [14–15]	15.0 (1.9) 15 [14–16]
SF-12 median [IQR]	35.7 (6.4) 36 [31–41]	40.7 (3.8) 41 [39–43]	40.2 (4.1) 41 [36–44]	33.6 (5.7) 34 [30–37]	34.2 (6.5) 36 [28–40]
CSI median [IQR]	45.1 (17.1) 44 [34–58]	29.4 (16.1) 24 [18–38]	35.6 (16.9) 40 [19–45]	42.4 (13.2) 39 [34–55]	52.7 (14.8) 49 [42–63]

CSI: Central Sensitization Inventory; NRS: Numerical Rating Scale; PSS-10: Perceived Stress Scale-10; SF-12: Short-Form-12; SD: Standard Deviation; STAI-6: State-Trait Anxiety Inventory-6; TSK-TMD: Tampa Scale for Kinesiofobia in Temporomandibular Disorders; TMD: temporomandibular disorders; IQR: interquartile range. Duration reflects pain in the affected region(s) and was not specifiable for 5 participants who reported recurrent/intermittent pain without a defined onset; chronic pain was defined as a duration of ≥3 months.

TABLE 3. Participant's socioeconomic status category frequencies.

	Total (n = 133)	None (n = 18)	TMD Pain (n = 17)	Pelvic Pain (n = 30)	TMD + Pelvic Pain (n = 68)
Educational level					
Level 0	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Level 1	1 (1%)	0 (0%)	0 (0%)	0 (0%)	1 (1%)
Level 2	1 (1%)	0 (0%)	0 (0%)	1 (3%)	0 (0%)
Level 3	6 (5%)	0 (0%)	0 (0%)	1 (3%)	5 (7%)
Level 4	23 (17%)	1 (6%)	3 (18%)	5 (17%)	14 (21%)
Level 5	22 (16%)	2 (11%)	3 (18%)	4 (13%)	13 (19%)
Level 6	36 (27%)	8 (44%)	5 (29%)	8 (27%)	15 (22%)
Level 7	36 (27%)	6 (33%)	6 (35%)	10 (33%)	14 (21%)
Level 8	8 (6%)	1 (6%)	0 (0%)	1 (3%)	6 (9%)
Household monthly income level					
<700€	9 (7%)	2 (11%)	1 (6%)	1 (3%)	5 (7%)
700–1200€	8 (6%)	1 (6%)	1 (6%)	2 (7%)	4 (6%)
1201–1400€	14 (11%)	1 (6%)	4 (24%)	2 (7%)	7 (10%)
1401–1600€	5 (4%)	1 (6%)	2 (12%)	0 (0%)	2 (3%)
1601–1800€	8 (6%)	2 (11%)	0 (0%)	3 (10%)	3 (4%)
1801–2000€	13 (10%)	3 (17%)	2 (12%)	0 (0%)	8 (12%)
2001–2400€	23 (17%)	1 (6%)	2 (12%)	6 (20%)	14 (21%)
2401–3000€	17 (13%)	1 (6%)	1 (6%)	6 (20%)	9 (13%)
3001–5000€	26 (20%)	3 (17%)	3 (18%)	6 (20%)	14 (21%)
>5000€	10 (8%)	3 (17%)	1 (6%)	4 (13%)	2 (3%)

TMD: temporomandibular disorders.

TABLE 4. Adjusted prevalence ratios for pelvic pain according to TMD pain and covariates.

Outcome	B (Coefficient)	SE	Adjusted PR (Exp(B))	95% CI	*p*-value
TMD Pain	0.112	0.127	1.12	0.87–1.43	0.378
Sex	−0.191	0.125	0.83	0.65–1.06	0.126
Age	0.010	0.004	1.01	1.00–1.02	0.009
PSS-10	0.014	0.006	1.01	1.00–1.02	0.016
CSI	0.011	0.004	1.01	1.00–1.02	0.003

CI: Confidence Interval; CSI: Central Sensitization Inventory; PR: Prevalence Ratio; PSS-10: Perceived Stress Scale-10; SE: Standard Error; TMD: temporomandibular disorders.

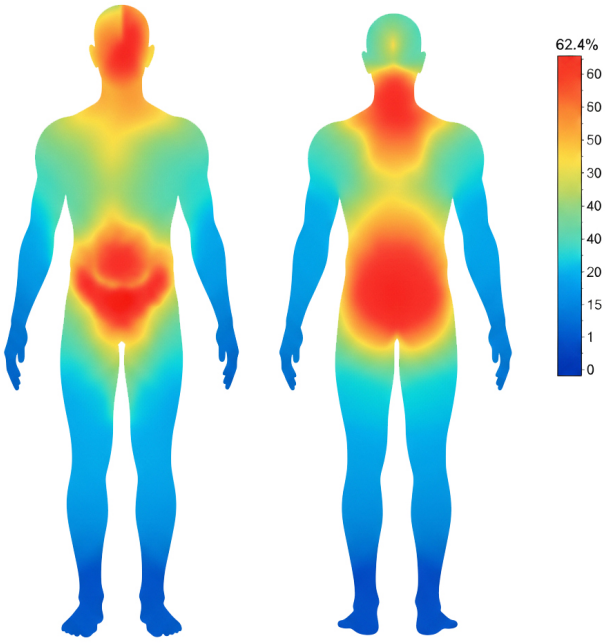


FIGURE 2. Pain distribution across body regions.

(35.3%), and frontal (33.8%) regions. Moderate prevalence levels were observed in the lower abdomen (25.6%), shoulders (19.5–24.1%), hips (19.5–21.8%), and thighs (20.3%). Lower extremity involvement ranged from 13.5% to 15.8%, while upper extremity involvement remained comparatively low (6.8–14.3%). Posteriorly, the lumbar region was most frequently endorsed (58.6%), followed by the interscapular (22.6%), occipital (19.5%), and midback (18.8%) regions. Taken together, pelvic, temporomandibular, and lumbar pain emerged as the predominant symptom sites, consistent with pain distribution patterns described in COPC cohorts. Participants frequently reported pain in multiple regions: the median number of painful body regions was 2 in the no-pain group, 3 in the temporomandibular pain-only group, 3 in the pelvic-only group, and 6.5 in the combined-pain group (maximum 23). Notably, even participants without temporomandibular or pelvic pain reported pain in a median of two body regions, underscoring that these presentations reflect multisite rather than anatomically isolated pain.

3.2 Outcome data

Crossclassification of temporomandibular and pelvic pain revealed that multimorbidity was markedly more common than isolated pain presentations. Assessment of distributional assumptions using the Shapiro–Wilk test confirmed that several continuous variables were nonnormally distributed, supporting the use of non-parametric methods for secondary analyses.

3.3 Main results

Temporomandibular pain was associated with a higher prevalence of pelvic pain in unadjusted analysis (crude PR = 1.28; 95% CI: 1.00–1.63; $p = 0.047$). After adjustment for age, sex, perceived stress, and central sensitization–related symptoms, this association was attenuated and no longer statistically significant (aPR = 1.12; 95% CI: 0.87–1.43; $p = 0.378$; Table 4). This attenuation is consistent with the temporomandibular–pelvic association being substantially explained by shared factors: relative to a model adjusted for age and sex only (PR = 1.33), adding perceived stress and CSI scores reduced the prevalence ratio to 1.12, a reduction of approximately 61% in the association. These proposed relationships are summarized as a conceptual model in Fig. 3.

In the adjusted model, perceived stress (aPR = 1.01 per point; 95% CI: 1.00–1.02; $p = 0.016$) and central sensitization–related symptoms (aPR = 1.01 per point; 95% CI: 1.00–1.02; $p = 0.003$) remained independently associated with pelvic pain, and older age was associated with a small increase in prevalence (aPR = 1.01 per year; 95% CI: 1.00–1.02; $p = 0.009$). Although the per-point PRs for stress and sensitization were close to unity, they correspond to meaningful differences across the observed range of scores; for central sensitization–related symptoms, the approximately 23-point gap between the no-pain and combined-pain groups equates to roughly a 1.2-fold difference in pelvic-pain prevalence. Sex was not independently associated with the outcome (aPR = 0.83; 95% CI: 0.65–1.06; $p = 0.126$). Only seven men were in the combined-pain group; the sex coefficient is therefore estimated with limited precision, and its CI should be interpreted with caution.

Results were materially unchanged in logistic and log-binomial sensitivity models. Findings were robust to the pain-definition threshold. Using NRS $\geq$3 (neither temporomandibular nor pelvic pain n = 31, temporomandibular pain-only n = 16, pelvic-only n = 40, combined n = 46), temporomandibular pain remained associated with pelvic pain in unadjusted analysis (crude PR = 1.32; 95% CI 1.02–1.69; $p = 0.032$) but not after adjustment (aPR = 1.12; 95% CI 0.86–1.44; $p = 0.402$), while perceived stress (aPR = 1.02; 95% CI 1.01–1.03; $p < 0.001$) and CSI scores (aPR = 1.01; 95% CI 1.00–1.02; $p = 0.002$) remained independently associated. Under the stricter NRS $\geq$4 threshold, the crude temporomandibular–pelvic association was no longer significant (crude PR = 1.24; 95% CI 0.95–1.63; $p = 0.116$), whereas perceived stress and CSI scores remained independently associated (both $p < 0.001$), confirming that the choice of threshold did not alter the main conclusions. Because low-back pain was highly prevalent (58.6% lumbar involvement on the body map), a further sensitivity analysis added body-map low-back pain to the adjusted model. Low-back pain was not independently associated with pelvic pain (aPR = 0.96; 95% CI 0.78–1.19; $p = 0.716$), and the temporomandibular (aPR = 1.12; 95% CI 0.87–1.43; $p = 0.387$), perceived stress (aPR = 1.01; $p = 0.015$), and central sensitization (aPR = 1.01; $p = 0.004$) estimates were essentially unchanged, indicating that low-back pain did not confound the temporomandibular–pelvic association.

Because identifiable organic or acute causes of pain were not ascertained, current medication use was used as a proxy for treated comorbidity, and the primary model was repeated in participants reporting no medication (n = 52). The same pattern was preserved: temporomandibular pain remained non-significantly associated with pelvic pain (aPR = 1.44; 95% CI 0.73–2.85; $p = 0.297$), whereas perceived stress (aPR = 1.02; 95% CI 1.00–1.04; $p = 0.043$) and CSI scores (aPR = 1.02; 95% CI 1.00–1.04; $p = 0.026$) remained independently associated, although the smaller subsample widened the CIs.

3.4 Secondary analyses

Clear differences emerged across the four groups (Table 5 and Fig. 4). Perceived stress ($H = 33.80$; $p < 0.001$; $\eta^2 = 0.24$) and central sensitization–related symptoms ($H = 32.67$; $p < 0.001$; $\eta^2 = 0.23$) were highest in the combined-pain group, which differed significantly from every other group on both measures. Health-related quality of life differed across groups ($H = 27.85$; $p < 0.001$; $\eta^2 = 0.19$), with the pelvic-only and combined-pain groups scoring lower than the no-pain and temporomandibular pain-only groups. Kinesiophobia also differed across groups ($H = 31.27$; $p < 0.001$), but the pattern was driven by the pelvic-only group scoring lowest on the temporomandibular-specific TSK-TMD; because this instrument is anchored to jaw movement, the finding most likely reflects the absence of temporomandibular pain in that group rather than lower fear of movement *per se* and is interpreted with caution. State anxiety did not differ across groups ($H = 2.40$; $p = 0.493$).

Central sensitization–related symptoms correlated moder-

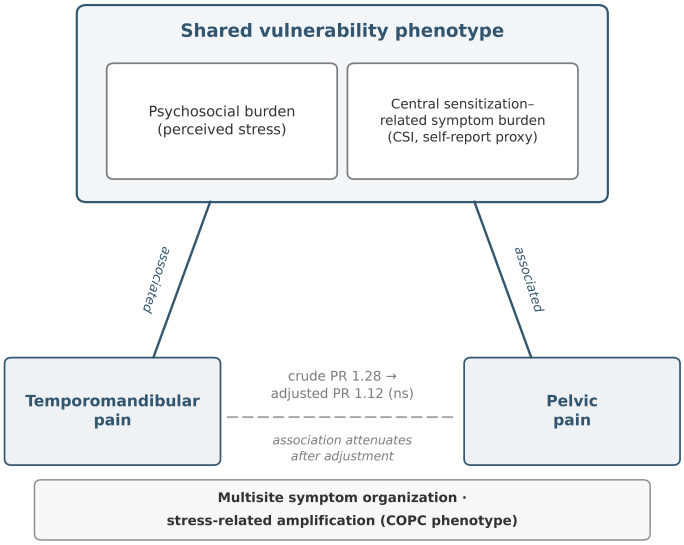


FIGURE 3. Proposed model of the relationship between temporomandibular and pelvic pain. This is a hypothetical conceptual model, not a tested causal pathway. A shared vulnerability phenotype is associated with both temporomandibular and pelvic pain. The crude association between the two regional pains attenuated to non-significance after adjustment for these shared factors. Connectors denote statistical associations observed in a cross-sectional design and do not imply direction or causation; the dashed connector marks the attenuated temporomandibular–pelvic association. CSI: Central Sensitization Inventory; PR: Prevalence Ratio; COPC: chronic overlapping pain condition; ns: not significant.

TABLE 5. Group differences in psychometric and health-related outcomes: descriptive and inferential statistics.

Outcome/comparison	Test statistic	Median difference (95% CI)	Effect size	*p*
TSK-TMD	$H = 31.27$ ($df = 3$)	—	$\eta^2 = 0.22$	<0.001
None *vs.* Pelvic	$z = 2.92$	8.5 (3.0–14.0)	$r = 0.53$	0.021
TMD only *vs.* Pelvic	$z = 4.55$	11.0 (7.0–19.0)	$r = 0.74$	<0.001
Combined *vs.* Pelvic	$z = 5.09$	10.0 (7.5–12.0)	$r = 0.65$	<0.001
PSS-10	$H = 33.80$ ($df = 3$)	—	$\eta^2 = 0.24$	<0.001
Combined *vs.* None	$z = 4.85$	10.0 (6.0–13.0)	$r = 0.73$	<0.001
Combined *vs.* TMD only	$z = 3.77$	9.0 (3.0–14.0)	$r = 0.55$	<0.001
Combined *vs.* Pelvic	$z = 3.19$	7.5 (4.5–9.5)	$r = 0.44$	0.008
SF-12	$H = 27.85$ ($df = 3$)	—	$\eta^2 = 0.19$	<0.001
None *vs.* Pelvic	$z = 3.90$	7.0 (4.0–9.0)	$r = 0.71$	<0.001
None *vs.* Combined	$z = 3.90$	5.0 (2.5–10.5)	$r = 0.58$	<0.001
TMD only *vs.* Pelvic	$z = 3.54$	7.0 (2.0–10.0)	$r = 0.65$	0.002
TMD only *vs.* Combined	$z = 3.50$	5.0 (2.0–10.5)	$r = 0.54$	0.003
CSI	$H = 32.67$ ($df = 3$)	—	$\eta^2 = 0.23$	<0.001
Combined *vs.* None	$z = 4.97$	24.5 (15.5–36.5)	$r = 0.70$	<0.001
Combined *vs.* TMD only	$z = 3.47$	9.0 (3.0–29.0)	$r = 0.54$	0.003
Combined *vs.* Pelvic	$z = 2.98$	10.0 (2.0–20.0)	$r = 0.42$	0.018
STAI-6	$H = 2.40$ ($df = 3$)	—	$\eta^2 = 0.00$	0.493

Omnibus differences: Kruskal–Wallis H (df = 3) with η^2 effect size. Pairwise comparisons: Dunn test (Bonferroni-adjusted) z statistic, median difference with bootstrap 95% CI, and rank-biserial correlation (r); only significant pairwise comparisons are shown, with the higher-scoring group listed first. Effect-size bands: r ≈ 0.1 small, 0.3 medium, 0.5 large. Group medians and interquartile ranges are reported in Table 2. CSI: Central Sensitization Inventory; PSS-10: Perceived Stress Scale-10; SF-12: Short-Form-12; STAI-6: State–Trait Anxiety Inventory-6; TSK-TMD: Tampa Scale of Kinesiophobia for Temporomandibular Disorders; CI: Confidence Interval; TMD: temporomandibular disorders; df: degrees of freedom.
Pairwise effect sizes are rank-biserial correlations (r); r ≈ 0.1 small, 0.3 medium, 0.5 large.

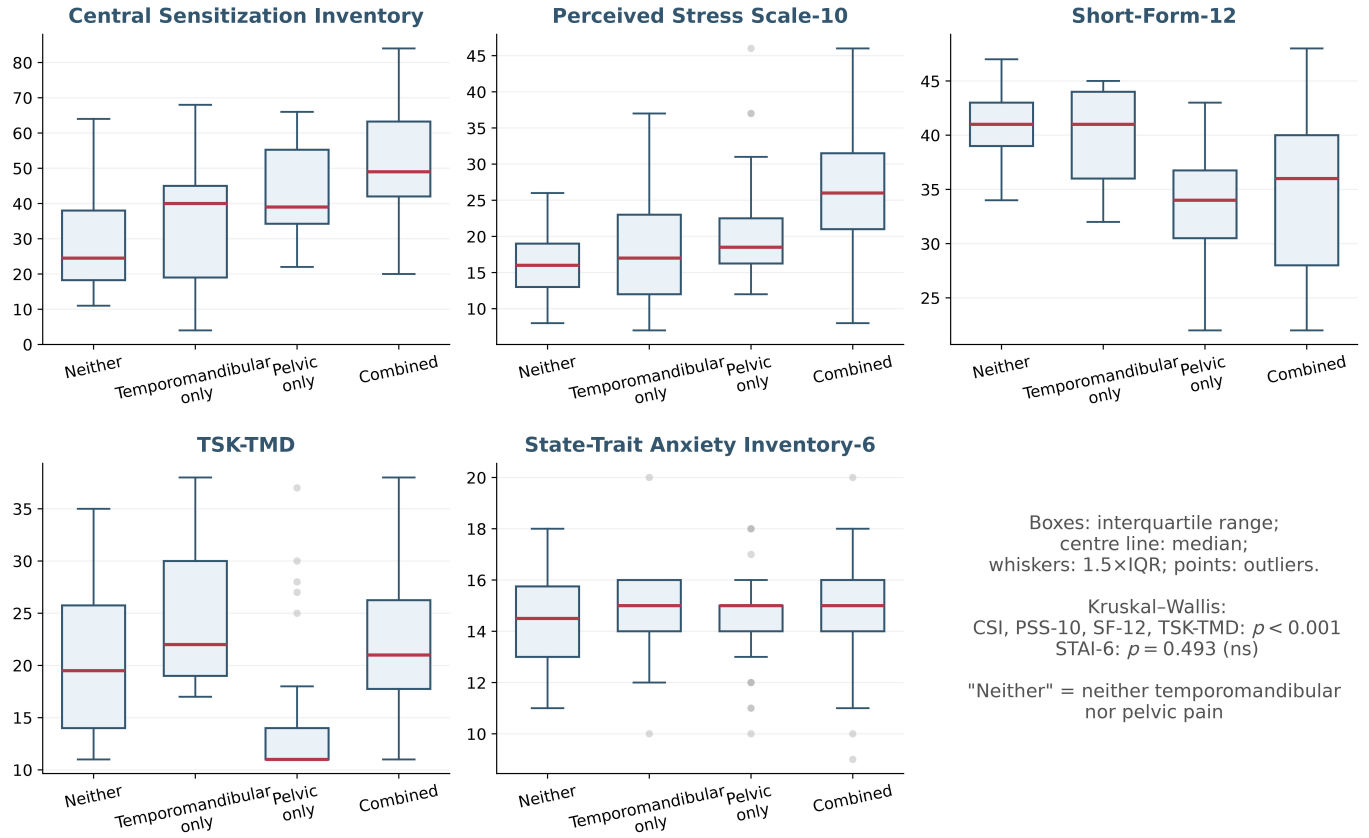


FIGURE 4. Psychological and health-related outcomes across pain groups. CSI: Central Sensitization Inventory; PSS-10: Perceived Stress Scale-10; SF-12: Short-Form-12; STAI-6: State–Trait Anxiety Inventory-6; TSK-TMD: Tampa Scale of Kinesiophobia for Temporomandibular Disorders; ns: not significant; IQR: interquartile range.

ately with perceived stress (ρ = 0.52; $p < 0.001$) and with regional pain intensity (temporomandibular $\rho = 0.40$; pelvic $\rho = 0.52$; both $p < 0.001$), and strongly and inversely with health-related quality of life ($\rho = -0.63$; $p < 0.001$). Correlations of central sensitization with kinesiophobia ($\rho = 0.16$; $p = 0.062$) and with state anxiety ($\rho = 0.04$; $p = 0.620$) were weak and did not reach statistical significance. Sensitivity analyses using log-binomial and logistic regression were consistent with the primary model.

4. Discussion

This cross-sectional study quantified the co-occurrence of temporomandibular and pelvic pain, compared clinical and psychosocial profiles across pain presentations, and examined how central sensitization–related symptom burden (CSI) relates to psychosocial constructs and pain intensity. Temporomandibular pain was associated with pelvic pain in unadjusted analysis, but this association did not persist after adjustment for age, sex, perceived stress, and CSI scores, suggesting that the two regional pains co-occur largely by virtue of a shared vulnerability phenotype: a common psychosocial and central-sensitization–related burden that substantially explains the temporomandibular–pelvic association. Perceived stress and CSI scores remained independently associated with pelvic pain. Secondary analyses showed a graded pattern in which individuals with combined temporomandibular and pelvic pain reported the greatest perceived stress and CSI scores, and lower health-related quality of life than participants with neither temporomandibular nor pelvic pain or temporomandibular pain alone. Anxiety did not differ across groups, and apparent differences in kinesiophobia reflected the temporomandibular-specific nature of the measure. Body-map data indicated that pelvic, temporomandibular, and lumbar regions were the most frequently affected sites and that pain was typically multisite, consistent with the COPC framework.

Our findings refine current understanding of temporomandibular–pelvic pain co-occurrence by suggesting that shared psychosocial burden and sensitization-related processes, rather than temporomandibular status *per se*, better account for pelvic pain prevalence in community respondents. This interpretation is concordant with contemporary models of nociplastic and overlapping pain, which emphasize the interplay of central sensitization–related symptoms, psychosocial distress, and multisite pain in shaping symptom severity and disability [1, 3, 4, 21]. The adverse profile observed in the combined-pain group echoes reports of multimorbid COPC phenotypes and extends evidence of links between orofacial and pelvic systems beyond simple co-occurrence to a multidimensional pattern involving stress and fear-avoidance [5, 6]. Neurophysiological observations of altered cortical excitability in painful TMD, together with higher depression and catastrophizing in severe phenotypes, offer a biologically plausible context for the associations we observed [7, 9]. Finally, recent syntheses reporting more favorable outcomes with multidisciplinary than with

single-discipline care for pelvic pain underscore the clinical relevance of addressing psychosocial load and sensitization alongside regional symptoms [1, 10]. Our framework emphasizes central sensitization and psychosocial burden, but peripheral and anatomical accounts may also contribute. Proposed myofascial continuities (*e.g.*, the deep front line), dural and craniosacral tension relationships, and shared embryological origins of craniofacial and pelvic structures have been advanced as substrates linking jaw and pelvic-floor function. Although not testable with our data, these peripheral hypotheses are complementary to a central-sensitization account and warrant integrated investigation.

Three practical implications emerge, all of which are associational and require prospective confirmation. First, assessing central sensitization–related symptoms and perceived stress in patients presenting with temporomandibular and/or pelvic pain may be informative, because these domains were more closely associated with pelvic pain than temporomandibular status itself. Second, the combined-pain group represented a high-burden, multisite presentation, which is consistent with comprehensive, multidisciplinary rather than region-specific assessment [1, 10]. Third, our data support the value of whole-body symptom mapping to capture the multisite involvement typical of COPCs [3, 4]. The clinical relevance of these targets is reinforced by evidence that central sensitization is common in chronic pelvic pain and endometriosis-related overlapping pain syndromes and relates to greater symptom burden [22, 23], supporting routine assessment of psychosocial burden and central sensitization–related symptoms in these populations. Outcomes that our findings suggest may benefit from routine assessment of psychosocial burden and central sensitization–related symptoms.

Several limitations should be considered. First, the cross-sectional design precludes any causal or directional inference. Second, pain groups were defined by self-reported region-specific pain; because most participants reported pain in several body regions, these groups capture the presence of temporomandibular and pelvic pain within a broader multisite pattern rather than anatomically isolated pain, and widespread-pain phenotypes cannot be excluded. Relatedly, temporomandibular pain was ascertained from self-reported symptoms without a clinical examination, so we could not apply the Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) or distinguish myofascial from intra-articular temporomandibular disorders; our findings therefore pertain to pain-related, predominantly myofascial presentations rather than to specific diagnostic subtypes [24]. Third, recruitment through open online channels among community-dwelling, predominantly Spanish respondents limits generalizability, and the screening did not exclude pregnancy, prior pain-related surgery, or specific identifiable causes of pain, which may have introduced heterogeneity. Because malignancy, infection, pregnancy, and recent trauma were not specifically ascertained, participants with organic or acute pain sources could not be identified or excluded; medication use served only as a crude proxy for treated comorbidity, and residual inclusion of non-central pain cannot be ruled out. Recruitment via university email, social media, and self-selection cannot yield a population-representative sample and likely skewed it toward younger, more digitally literate participants (volunteer bias); the group proportions reported here should therefore not be read as population prevalence estimates. Fourth, the temporomandibular-specific TSK-TMD is not anchored to pelvic symptoms and should not be interpreted as a general measure of kinesiophobia in participants without temporomandibular pain. Fifth, the no-pain and temporomandibular-only groups were small, reducing precision for some comparisons. Groups also differed in age (Kruskal–Wallis $p < 0.001$; pelvic-only median 48 *vs.* no-pain 28 years); although age was included as a covariate and as a between-group descriptor, residual age-related confounding cannot be excluded and may partly account for the group differences. Relatedly, men were few overall and especially in the combined-pain group (n = 7), so the non-significant association for sex may reflect limited statistical power (Type II error) rather than a true absence of effect.

Also, anxiety did not differ between groups, but the brief STAI-6 may underdetect domain-specific anxiety, and it was scored as a summed total rather than the standard transformed metric, which may further limit its sensitivity. The SF-12 was available only as a single summary score; because item-level data were not retained, the standard Physical and Mental Component Summaries could not be derived, and the quality-of-life findings should be interpreted as a global index rather than as component-specific effects. In addition, the region and source of pain were self-localized by participants completing an online questionnaire without clinical examination, so nociceptive or visceral pain cannot be fully distinguished from centrally mediated pain, and some non-central pain may have been captured within the presentations examined. Low-back pain was highly prevalent in this sample (58.6% lumbar involvement); although a sensitivity analysis adjusting for body-map low-back pain left the findings unchanged, other unmeasured co-occurring pain sites could still contribute to the observed associations. Similarly, other central sensitivity conditions frequently comorbid with temporomandibular and pelvic pain were not separately quantified and could not be adjusted for; although the COPCS captured overall multisite burden, condition-specific contributions to the observed associations could not be isolated.

Additionally, the primary group definition (NRS >0) classified participants with minimal pain (NRS 1–2) as having pain, which could dilute between-group contrasts by placing clinically minor cases alongside more substantial pain. Reassuringly, sensitivity analyses restricting pain to NRS ≥ 3 and ≥ 4 yielded consistent conclusions, indicating that this dilution did not materially bias the findings. Finally, Recruitment partly through professional-association mailing lists and pain-related community networks may have preferentially attracted individuals with higher pain burden, plausibly inflating the prevalence of the combined-pain group relative to the general population and limiting prevalence generalizability; our associative estimates, however, are less susceptible to this selection than the raw group proportions.

Our cross-sectional design cannot establish which condition arises first or whether one triggers the other. Longitudinal and register-based studies suggest that temporomandibular

symptoms often emerge in early adulthood, whereas pelvic pain frequently relates to later gynecological or pelvic-floor events; the temporal ordering in overlapping cases, however, remains unresolved and is a priority for prospective research. Prospective studies using standardized clinical criteria for temporomandibular and pelvic pain, longitudinal designs to clarify directionality, and biobehavioral phenotyping are needed. Trials embedding stress-reduction and sensitization-targeted components within multidisciplinary care pathways may help determine whether modifying these factors improves outcomes in the combined-pain presentation [1, 10].

This study suggests that coexisting temporomandibular and pelvic pain is best understood within a chronic overlapping pain framework, in which psychosocial load and central sensitization–related symptoms are more strongly associated with pelvic pain than temporomandibular status alone. The consistent, graded differences across groups are consistent with a multisite, high-burden presentation that warrants recognition through comprehensive, whole-person assessment [1, 3, 4, 10]. These associations require confirmation in prospective, longitudinal research before clinical or causal conclusions are drawn.

5. Conclusions

In this community-based, cross-sectional sample, temporomandibular and pelvic pain frequently co-occurred, but temporomandibular pain was not independently associated with pelvic pain after accounting for perceived stress and central sensitization–related symptoms, which were themselves the factors most closely associated with pelvic pain and were highest, alongside the greatest psychosocial burden and lowest quality of life, in the combined-pain group. These associations characterise co-occurring temporomandibular and pelvic pain as a high-burden, multisite presentation that supports evaluating central sensitization–related symptoms and psychosocial factors within a comprehensive, whole-person assessment.

AVAILABILITY OF DATA AND MATERIALS

The data that support the findings of this study are openly available in Mendeley Data at https://data.mendeley.com/datasets/spbp74krp8/1, reference number (DOI: 10.17632/spbp74krp8.1).

AUTHOR CONTRIBUTIONS

BPD, CGM, MRC and MBD—designed the research study. CGM and MRC—performed the research and curated the data. MBD—provided supervision and methodological guidance; critically reviewed and edited it. EDM—administered the project. BPD—analyzed and validated the data and produced the figures. BPD, CGM and MRC—wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Research Ethics Committee of the University of Valencia (reference number 2025-FIS-4199837). All participants provided written informed consent before taking part.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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