Perceived Stress and HanuSandhi (Temporomandibular Joint) Dysfunction among Medical Students: A Cross-Sectional Study

Abstract

Temporomandibular disorders (TMDs) may be influenced by psychosocial stress through sustained muscle activity, parafunctionalbehaviour, altered pain processing and sleep disturbance. Medical students represent a population exposed to persistent academic and clinical stress. Ayurveda describes HanuSandhi as a functionally important joint and considers aggravated Vata and ManasikaBhava relevant to painful or restricted jaw movement. This study examined the association between perceived stress and clinical dysfunction of the temporomandibular joint among medical students.

A cross-sectional analysis was performed using PSS-10 and Helkimo Index records. PSS-10 scores were classified as low (0–13), moderate (14–26) or high (27–40). The Helkimo clinical dysfunction score (Di, 0–25) was classified as no dysfunction (0), mild (1–4), moderate (5–9) or severe (10–25). Because Di is discrete and bounded, Spearman rank correlation was specified as the primary analysis. Pearson correlation, Kruskal–Wallis testing across stress categories and chi-square analysis of stress category versus calculated Di category were supportive analyses. Effect estimates, 95% confidence intervals and exact two-sided p-values are reported.

The supplied sheets contained 117 analyzable records. Mean PSS-10 score was 19.99 ± 6.07 and mean Di score was 4.64 ± 4.11. Stress was low in 16 (13.7%), moderate in 85 (72.6%) and high in 16 (13.7%) students. PSS-10 and Di showed a modest positive correlation (Spearman ρ=0.347, 95% CI 0.177–0.498, $p<0.001$). Di differed significantly across stress groups (Kruskal–Wallis H=11.31, p=0.0035, ε^2=0.082); mean Di scores were 3.25, 4.27 and 8.00 in the low-, moderate- and high-stress groups, respectively. The association between stress category and calculated Di severity was also significant (χ^2=15.24, df=6, p=0.018), although sparse expected frequencies require caution.

Greater perceived stress was associated with greater clinical TMJ dysfunction among medical students. The result supports rejection of the null hypothesis, but the modest association and cross-sectional design do not establish causality. Screening for stress and early TMJ symptoms may be useful in student-health programmes, with referral for definitive clinical assessment where indicated.

Perceived stress; PSS-10; temporomandibular disorder; HanuSandhi; Helkimo Index; medical students; cross-sectional study.

Introduction

The Temporomandibular joint, also known as HanuSandhi in ayurveda, plays a crucial role in speech, facial expressions and mastication.[1] In Ayurveda, Hanusandhi is categorised under vayastundsandhi.[2] Inthemoderncontext,itisclassifiedunderthecondylarjoint. Stress is clinically

UNDER PEER REVIEW IN IJAR

relevant because it can increase jaw-muscle activity, clenching and bruxism, disturb sleep and influence the perception and modulation of pain. Medical education combines academic load, examinations, clinical responsibility, time pressure, financial concerns and reduced opportunity for recovery. MedicalStudents face significant stress that may lead to muscular tension and disorders in Temporomandibular joint.[3]A studyfound that 77.3% of student's experienced moderate stress and 5.7% severe stress, the study similarly reported that 78% of students faced moderate to high stress levels, primarily due to academic pressure, financial concerns, and personal and social challenges .[4]This study explores the relationship between stress levels and HanuSandhi Dysfunction among Medical students. Medical education combines academic load, examinations, clinical responsibility, time pressure, financial concerns and reduced opportunity for recovery. [5]The Perceived Stress Scale (PSS), developed by Cohen, Kamarck and Mermelstein, assesses the extent to which life situations are experienced as unpredictable, uncontrollable and overloading during the preceding month. The 10-item version is widely used in young-adult and student populations.

In Ayurveda There is no open or specific discussion of relationship between stress and Hanusandhi dysfunction but there is a correlation between Vata and stress. Restricted movement, pain and stiffness of the jaw are conceptually compatible with Vata-dominant dysfunction, while psychological strain may be considered within ManasikaBhava. This framework is interpretive and complementary; it does not replace contemporary diagnosis of TMD or establish an Ayurvedic causal mechanism from cross-sectional data.

Objectives

1. To estimate perceived-stress levels among medical students using the PSS-10.
2. To assess TMJ symptoms and clinical dysfunction using the Helkimo Anamnestic and Clinical Dysfunction Indices.
3. To determine the association between PSS-10 score and Helkimo clinical dysfunction score.
4. To compare clinical dysfunction across low-, moderate- and high-stress groups.
5. To interpret the findings in an integrative HanuSandhi and ManasikaBhava context without making causal claims.

Hypothesis

Null hypothesis (H0): There is no statistically significant association between perceived-stress score and clinical dysfunction of HanuSandhi/TMJ among the participating medical students.

Alternative hypothesis (H1): Higher perceived-stress score is significantly associated with greater clinical dysfunction of HanuSandhi/TMJ.

UNDER PEER REVIEW IN IJAR

Materials and Methods

Study design and setting

This was an institution-based cross-sectional observational study among medical students. The manuscript was prepared in accordance with principles of the STROBE reporting guideline for cross-sectional research.

Participants and sample

The protocol proposed 117 students aged 18–30 years. Students with low, moderate or high stress, who were willing to participate were eligible. Students with a history of trauma to the TMJ, TMJ surgery or systemic joint disease were excluded.

Study instruments

[5]**Perceived Stress Scale-10 (PSS-10).** The 10 items are scored from 0 (never) to 4 (very often), with positively worded items reverse scored before summation. Total scores range from 0 to 40. For the present analysis, scores were categorized as low (0–13), moderate (14–26) and high (27–40).

[6]**Helkimo Anamnestic Index (Ai).** Subjective symptoms were classified as Ai 0 (no symptoms), Ai I (mild symptoms such as clicking or mild stiffness) or Ai II (severe symptoms such as pain or difficulty in jaw movement).

Helkimo Clinical Dysfunction Index (Di). Five domains—mandibular mobility, TMJ function, muscle pain, TMJ pain and pain during mandibular movement—were each scored 0, 1 or 5. Their sum ranges from 0 to 25 and was interpreted as Di 0 (0, no dysfunction), Di I (1–4, mild), Di II (5–9, moderate) or Di III (10–25, severe). Two source categories conflicted with these cut-offs: S.No. 27 and 105 each had Di=1 but were labelled category 0. The score-derived Di I classification was used in categorical analysis while the original entries were preserved in the master workbook.

Statistical analysis

Continuous variables were summarized using mean, standard deviation, median and range; categorical variables were summarized using frequency and percentage. Spearman rank correlation between PSS-10 total and Di total was the prespecified primary analysis because Di is discrete, bounded and not expected to follow a normal distribution. A Fisher z-transformed approximate 95% confidence interval was calculated for the correlation coefficient. Pearson correlation was conducted as a sensitivity analysis. Di distributions across the three stress groups were compared using the Kruskal–Wallis test, with epsilon-squared (ε^2) as an effect-size estimate. Association between stress category and calculated Di severity category was explored using Pearson's chi-square test. Because several expected cell counts were below five, the chi-square result was treated as supportive. All tests were two-sided and $p<0.05$ was considered statistically significant. Analysis was independently reproduced using Python/SciPy and in a formula-driven Excel master workbook.

UNDER PEER REVIEW IN IJAR

Literature Review

The term Sandhi denotes the union or meeting point of two or more anatomical structures. In Ayurveda, Sandhi is described as an important structural component of the body and is associated with movement and stability.Hanu refers to the jaw/mandible region. The HanuSandhi may be correlated anatomically with the temporomandibular joint (TMJ).Ayurvedic descriptions of Sandhi include structural classifications based on their morphology. The VayastundaSandhi is described in relation to the Hanu region and has been correlated by Ayurvedic authors with the temporomandibular joint. Such correlations should be regarded as an interpretative anatomical correlation rather than an exact one-to-one equivalence with modern anatomical terminology.

The temporomandibular joint (TMJ), is a paired and highly specialized synovial joint. Its unique structure permits both rotational and translational movements. The joint consists of the mandibular condyle, mandibular fossa, articular eminence, articular disc, joint capsule, ligaments and associated muscles. Because the two TMJs function together, alteration in one component can influence the functioning of the entire masticatory system.

In recent years, increasing attention has been directed toward the role of psychological stress in temporomandibular disorders (TMDs). Stress may influence the stomatognathic system through changes in muscle activity, parafunctional habits such as tooth clenching and bruxism, altered pain perception and psychological responses.

From an Ayurvedic perspective, VataDosha has a major role in movement and neuromuscular activity. Disturbance of Vata can therefore manifest as abnormalities of movement, stiffness, pain or functional restriction.

This becomes particularly relevant to the present study because psychological stress may be considered, within an Ayurvedic interpretative framework, as a factor capable of disturbing normal Dosha equilibrium and influencing neuromuscular function.

dynamics, sleep, pain perception and behaviour may contribute to chronic pain conditions

Results

Descriptive findings

The mean PSS-10 score was 19.99 ± 6.07 (median 20; range 0–39). Most participants had moderate stress (85/117; 72.6%), while low and high stress were each observed in 16 participants (13.7%). Mean Di was 4.64 ± 4.11 (median 4; range 0–20). Based on score-derived categories, 20 students (17.1%) had no dysfunction, 45 (38.5%) had mild dysfunction, 41 (35.0%) had moderate dysfunction and 11 (9.4%) had severe dysfunction.

Table 1. Stress-group profile and Helkimo clinical dysfunction

Stress group	n (%)	PSS mean	Di mean ± SD	Di median

UNDER PEER REVIEW IN IJAR

Stress group	n (%)	PSS mean	Di mean ± SD	Di median
Low	16 (13.7)	9.69	3.25 ± 2.18	4.0
Moderate	85 (72.6)	20.15	4.27 ± 3.93	4.0
High	16 (13.7)	29.44	8.00 ± 4.95	7.5
Overall	117 (100)	19.99 ± 6.07	4.64 ± 4.11	4.0

Values are based on 117 complete records. PSS: Perceived Stress Scale; Di: Helkimo Clinical Dysfunction Index.

Primary correlation analysis

PSS-10 total score showed a statistically significant positive association with Di total score (Spearman ρ=0.347, 95% CI 0.177–0.498, p=0.000124). The magnitude indicates a modest relationship: students reporting greater perceived stress tended to have greater clinical dysfunction, but stress alone explained only part of the variation in Di. Pearson correlation yielded a similar estimate (r=0.353, p=0.000096), supporting robustness to the correlation method.

Table 2. Statistical association between perceived stress and TMJ dysfunction

Analysis	Effect/test statistic	p-value	Interpretation
Spearman correlation	ρ=0.347 (95% CI 0.177–0.498)	0.000124	Significant modest positive association
Pearson correlation	r=0.353	0.000096	Concordant sensitivity result
Kruskal–Wallis	H=11.31; df=2	0.00350	Di differs across stress groups
Kruskal–Wallis effect size	ε^2=0.082	—	Small-to-moderate group effect
Chi-square association	χ^2=15.24; df=6	0.0185	Supportive; sparse expected counts

Comparison across stress categories

Clinical dysfunction increased across the ordered stress categories. Mean Di was 3.25 in the low-stress group, 4.27 in the moderate-stress group and 8.00 in the high-stress group. The Kruskal–Wallis result was significant (H=11.31, p=0.0035), with ε^2=0.082. Thus, approximately 8% of rank variability in clinical dysfunction was attributable to between-group differences under this effect-size formulation. The overall test does not identify which individual pairs differ; adjusted post-hoc pairwise comparisons should be added if required by the target journal.

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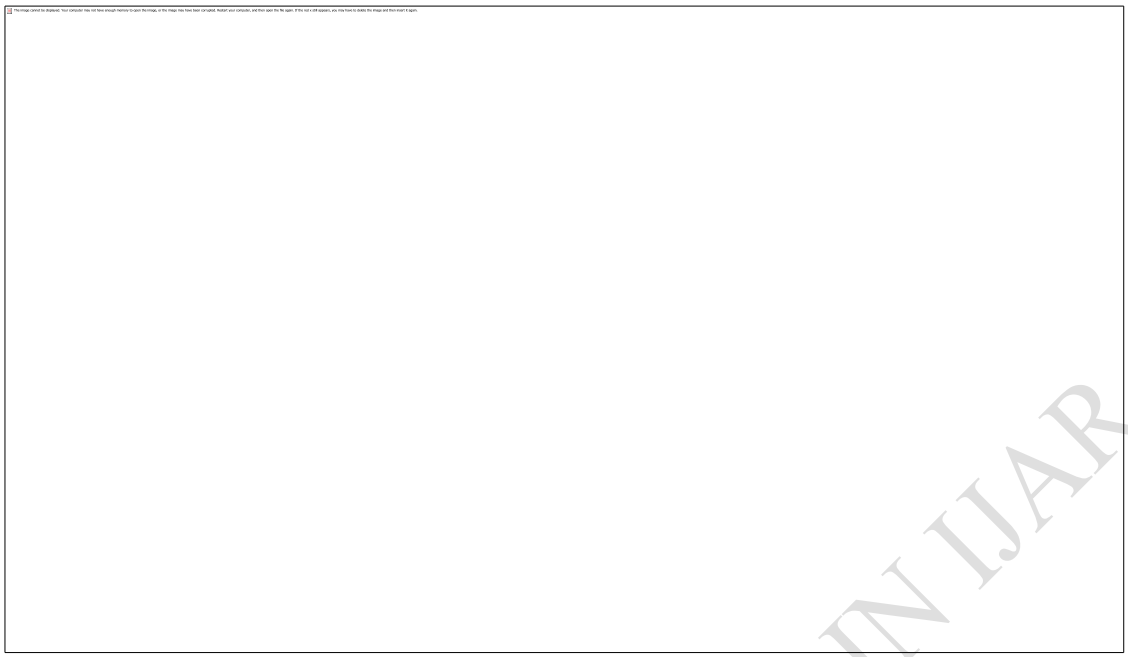

Figure 1. Mean Helkimo Di score by PSS-10 stress category. Error bars represent standard deviations.

Stress category and dysfunction severity

Table 3. Calculated Di severity within each stress group

Stress group	No dysfunction	Mild	Moderate	Severe	Total
Low	2	11	3	0	16
Moderate	17	31	30	7	85
High	1	3	8	4	16
Total	20	45	41	11	117

Pearson $\chi^2=15.24$, $df=6$, $p=0.0185$. Several expected counts were below five; interpret this analysis as exploratory/supportive.

Result

Principal findings

This cross-sectional study found a statistically significant, modest positive association between perceived stress and clinical TMJ dysfunction among medical students. The result was consistent using both rank-based and product-moment correlation. Students in the high-stress category had the greatest mean and median Di scores, and the overall difference across stress categories remained significant with a small-to-moderate effect size. Accordingly, the null hypothesis was rejected.

The magnitude of $\rho=0.347$ is clinically important to interpret carefully. It indicates that stress and dysfunction move together to a modest degree, not that stress is a sole or sufficient cause of TMD. Occlusal factors, parafunctional habits, sleep, posture, trauma, systemic conditions,

UNDER PEER REVIEW IN IJAR

anxiety, sex, age and pain sensitivity may contribute independently or interact with perceived stress. These factors were not available for adjusted analysis in the supplied dataset.

Comparison with previous research

The present direction of association agrees with earlier research in student and community samples. Ahuja and colleagues reported that perceived stress was relevant to the initiation and maintenance of TMD among dental students. Augusto and colleagues found a high prevalence of TMD and observed relationships with perceived stress and common mental disorders. Saczuk and colleagues similarly reported higher perceived-stress levels among people with TMD and bruxism symptoms. Recent student studies continue to identify examination-related stress, oral parafunctions and TMD symptoms as interrelated concerns. Differences in effect size across studies are expected because diagnostic criteria, stress instruments, examination timing and student characteristics vary.

Discussion

Two major physiological systems are particularly important for stress-

A. Sympathetic-adrenomedullary system Stress perception activates the sympathetic nervous system and adrenal medulla.

This results in release ofNoradrenaline andAdrenaline, which produces the rapid fight or flight response including increased heart rate, blood pressure and alertness

B. Hypothalamic-pituitary-adrenal axisThe HPA axis is activated during psychological stress.

The pathway can be represented as:

Stress → Hypothalamus → CRH → Anterior pituitary → ACTH → Adrenal cortex → Cortisol

Cortisol is the principal glucocorticoid in humans and plays an important role in adaptation to stress.Persistent stress may result in repeated activation of the sympathetic and HPA systems and may contribute to allostatic load.Alterations in autonomic regulation, cortisol dynamics, sleep, pain perception and behavior may contribute to chronic pain conditions

Stress may contribute to jaw dysfunction through several mutually reinforcing pathways. Increased sympathetic arousal can elevate muscle tone; awake clenching or sleep bruxism may overload masticatory muscles and joint structures; reduced sleep quality can impair tissue recovery and amplify pain; and stress-related attentional and emotional processes can lower pain thresholds. Conversely, persistent jaw pain may worsen sleep and perceived stress, creating bidirectional reinforcement.

Ayurvedic interpretation

From an Ayurvedic perspective, painful restriction or altered movement of HanuSandhi may be interpreted through disturbed Vata function, while sustained psychological strain may be viewed through ManasikaBhava. This conceptual convergence may support integrative

UNDER PEER REVIEW IN IJAP

prevention—regular routine, adequate sleep, relaxation, mindful reduction of clenching and clinically appropriate local or systemic management.

Implications

Student-health programmes may consider brief stress screening together with questions about jaw pain, clicking, locking, restricted opening, headache and clenching. Students with persistent pain, functional limitation, trauma, neurological signs or suspected inflammatory joint disease require formal dental or medical assessment. Stress-management interventions may be reasonable as part of a multimodal strategy, but they should not substitute for diagnosis or treatment of structural and systemic causes.

Strengths and Limitations

Strengths include use of a recognised perceived-stress instrument, an objective clinical dysfunction score, retention of continuous scores, a prespecified non-parametric primary analysis, reporting of confidence interval and effect size, and explicit reconciliation of source-category inconsistencies.

The study also has important limitations. First, its cross-sectional design precludes temporal or causal inference. Second, participants were drawn from one institution and may not represent all medical students. Third, the dataset lacked sex, academic year, examination period, sleep, bruxism, anxiety, depression, pain duration, medication, occlusion and other potential confounders; adjusted modelling was therefore not possible. Fourth, the planned sample was 118 but only 117 records were supplied. Fifth, some chi-square expected counts were small. Sixth, measurement reliability and examiner calibration were not documented in the available material. Finally, PSS category cut-offs aid description but should not be treated as a clinical diagnosis of stress.

Conclusion

Perceived stress was significantly and positively associated with Helkimo clinical dysfunction among the analysed medical students. The high-stress group showed the greatest TMJ dysfunction, and the overall between-group difference was statistically significant. These findings support rejection of the null hypothesis and justify further prospective research, but they do not prove that stress causes TMD. Future multicentre studies should include validated diagnostic criteria, examiner calibration, relevant confounders and longitudinal follow-up, and should evaluate whether combined stress-management and TMJ-focused prevention reduces symptoms and functional limitation.

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UNDER PEER REVIEW IN IJAR

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