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Impact of Daily Screen Time on Headache Patterns and Musculoskeletal Pain in Patients with Temporomandibular Disorders: A Pilot Cross-Sectional Study

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Abstract

Background and Objective: Temporomandibular disorders (TMD) are a prevalent source of chronic orofacial pain. Increased digital device usage has raised concerns regarding its contribution to musculoskeletal complaints. This study assessed the association between daily screen time exposure and the prevalence of headache and widespread musculoskeletal pain among patients with TMD in Navi Mumbai.

Methods: A cross-sectional analytical study was conducted among 20 patients diagnosed with TMD based on DC/TMD criteria. Data were collected using a validated structured questionnaire and standardized clinical examination. Statistical analysis was performed using SPSS v21.0. Associations were evaluated using Chi-square test and Pearson's correlation, with statistical significance set at $p < 0.05$.

Results: Frequent episodic TTH was observed in 40% of participants, new daily persistent headache in 25%, and migraine without aura in 15%. Widespread musculoskeletal pain was reported by 75% of the cohort. Screen time exceeding four hours per day demonstrated a statistically significant association with headache occurrence and widespread pain, with a moderate positive correlation noted between screen duration and WPI scores ($r = 0.41$).

Conclusion: Higher daily screen exposure was significantly associated with increased headache prevalence and musculoskeletal symptom burden among TMD patients. Incorporating ergonomic counselling and digital-use assessment into routine orofacial pain management may assist in mitigating symptom severity. Larger multi-centre studies are recommended to validate these findings.

Keywords: Screen time, Temporomandibular disorders, Headache, Musculoskeletal pain, Visual display terminal syndrome.

1. Introduction

The TMDs represent a heterogeneous group of musculoskeletal and neuromuscular conditions affecting the temporomandibular joint (TMJ), masticatory muscles, and associated craniofacial structures [1]. Clinically, these disorders are characterized by joint pain, limitation of mandibular movement, joint sounds, and myofascial tenderness, frequently resulting in chronic non-dental orofacial pain. Epidemiological studies estimate that TMD affects approximately 5–12% of the global population, with a higher prevalence reported among women between 20 and 50 years of age [2,3]. The multifactorial etiology of TMD involves a complex interaction of biomechanical, neuromuscular, psychological, and behavioural factors.

Current diagnostic frameworks categorize TMD into major subgroups including myogenous disorders, arthrogenous joint disorders, and headache attributed to TMD [4]. Notably, headache disorders frequently coexist with TMD, particularly tension-type headache (TTH) and migraine, including in children [5]. Prolonged use of visual display terminals (VDTs) has been associated with visual strain, musculoskeletal discomfort, and postural abnormalities, collectively described as VDT syndrome [6,7]. Sustained forward-head posture during screen interaction increases biomechanical loading on cervical and masticatory musculature, potentially contributing to muscular fatigue, trigger point activation, and pain amplification within the cranio-cervico-mandibular region [8]. This overlap has been attributed to shared nociceptive pathways, trigeminocervical convergence, and mechanisms of central sensitization within the cranio-cervico-mandibular complex [9,10]. Consequently, individuals with TMD often experience a broader spectrum of symptoms that extend beyond localized joint pain to include headache and widespread musculoskeletal discomfort.

In parallel with these clinical observations, modern lifestyles have undergone profound transformation due to the rapid expansion of digital technologies. Smartphones, laptops, tablets, and other digital devices have become integral to occupational, academic, and recreational activities [5,9,10]. This shift has resulted in a substantial increase in daily screen exposure across multiple populations.

Emerging literature suggests that extended screen exposure may contribute to headache development and musculoskeletal pain. Nakazawa et al. demonstrated that individuals exposed to more than four hours of daily VDT use reported significantly higher rates of musculoskeletal symptoms and headache complaints [11]. Similarly, Montagni et al. identified an association between screen exposure duration and headache frequency in young adults [12,17]. Despite these findings, relatively few studies have examined the relationship between digital device use and symptom patterns among patients diagnosed with TMDs.

This gap is particularly relevant in rapidly urbanizing regions such as Navi Mumbai, where technology-driven work environments, hybrid employment models, and prolonged digital engagement are increasingly common. Understanding whether screen exposure contributes to symptom burden in TMD patients

may help clinicians identify modifiable behavioural risk factors and develop targeted preventive strategies.

Rationale of the Study

Despite the growing prevalence of technology-dependent lifestyles, limited evidence currently exists regarding the association between daily screen exposure and headache patterns among patients with TMDs in the Indian population. Therefore, exploring this relationship may provide valuable insights into the role of digital lifestyle factors in TMD symptomatology and support the development of preventive ergonomic interventions.

Research Question

Does prolonged daily screen exposure correlate with the occurrence of headaches and widespread musculoskeletal pain among individuals diagnosed with TMDs?

Hypothesis

The present study aimed to evaluate the association between daily screen time duration and the prevalence of headache and widespread musculoskeletal pain among patients diagnosed with TMDs.

2. Materials and Methods

2.1 Study Design and Setting

This was a cross-sectional analytical pilot study conducted in the Department of Oral Medicine and Radiology, Terna Dental College, Navi Mumbai, Maharashtra, India. The study complied with the Declaration of Helsinki on research involving human subjects. Required patient consent was obtained. No institutional review board (IRB) was required for this study

2.2 Study Population and Sampling

Twenty individuals diagnosed with TMDs based on the Diagnostic Criteria for TMD (DC/TMD) were recruited from outpatient attendees during the study period using non-probability convenience sampling. Participants were not selected based on predefined screen time exposure. All eligible patients diagnosed with TMDs according to DC/TMD criteria were consecutively recruited. Daily screen exposure was assessed as a study variable and subsequently stratified into predefined categories for analytical comparison. The sample size was considered adequate for a pilot exploration aimed at feasibility assessment and effect-size estimation. A preliminary pilot application (n = 20) was performed prior to commencement to optimize the data collection instrument and protocol workflow. Eligibility was determined according to predefined inclusion and exclusion criteria. (Figure 1)

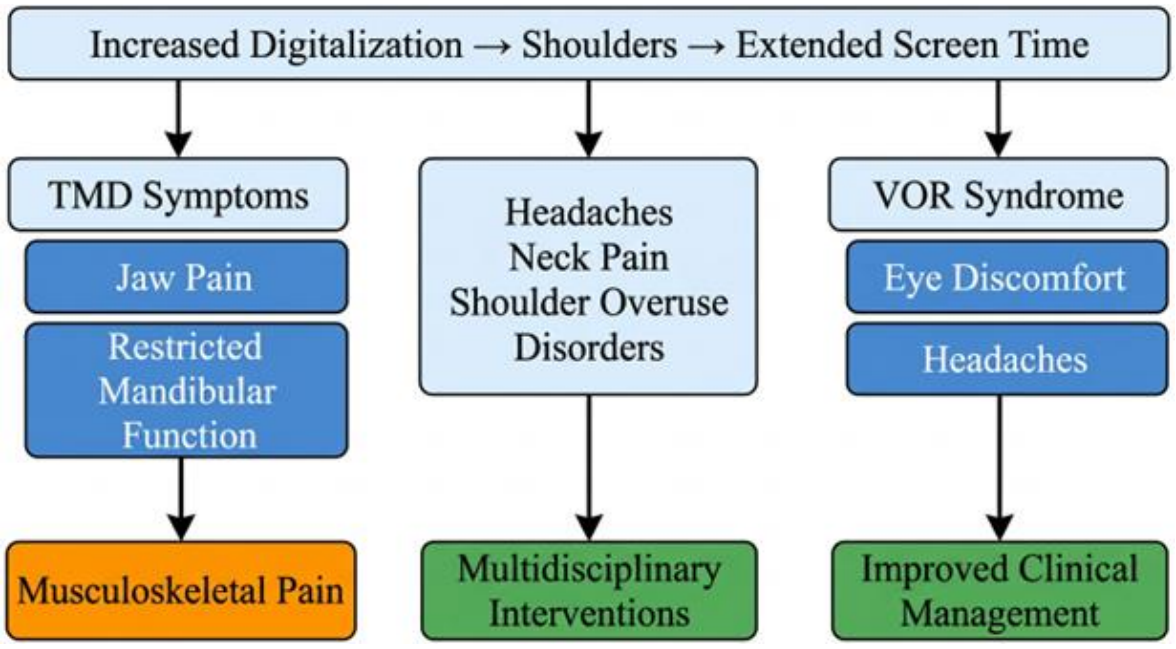

Figure 1. Impact of Digitalization on Musculoskeletal Health

2.3 Data Collection Procedures

Data collection was performed in two stages:

Structured Questionnaire: capturing demographic data, daily screen exposure (hours/day), headache characteristics according to the International Classification of Headache Disorders (ICHD-III), and widespread musculoskeletal pain based on the Widespread Pain Index (WPI). (Table 1)

Section / Item	Response Options
Demographic Details	Name / Gender / Age / Patient Registration No. / Mobile No. / Occupation / Socio-economic status
Have you ever experienced headaches?	a) Yes b) No c) Not sure
Frequency of headache *(If Q1 = Yes)*	d) Daily e) Weekly f) Monthly g) Yearly h) Occasional / Cannot specify
Duration of headaches	i) Seconds j) Minutes k) Hours l) Days
Number of headache episodes per day	m) 1 n) 2 to 4 o) 5 to 9 p) ≥10
Quality of headache pain	q) Throbbing r) Pulsating s) Pounding t) Dull aching u) Sharp

6. Intensity of headache	v) Mild w) Moderate x) Severe
7. Headache aggravated by	y) Routine physical activity z) Food aa) Irregular eating habits bb) Menstrual cycle cc) Lack of sleep dd) Stress ee) Others (specify)
8. Headache accompanied by	a) Nausea / vomiting b) Photophobia c) Phonophobia d) Others (specify)
9. Headache relieved by	a) Hot/cold fomentation b) Medications c) Applying pressure d) Rest e) Tea/Coffee f) Others (specify)
10. Patient's behaviour during headache	a) Lies down b) Stays in dark c) Moves around / restless d) Takes medication e) Minimally affects routine f) Others (specify)
11. Location of headache	a) Forehead

	b) Temple c) Top of head (parietal) d) Back of head (occipital) e) Behind eye / Retro-orbital
12. Headache laterality	a) Unilateral b) Bilateral
13. Family history of headache	a) Yes b) No c) Not sure
14. Does the headache occur at same time as TMD pain?	a) Yes b) No c) Not sure
15. Do you experience body pain elsewhere?	a) Yes b) No c) Not sure
16. Widespread Pain Index (WPI)	Body regions marked (per standard WPI chart)
17. Screen time usage per day (mobile / laptop / tablet etc.)	a) < 4 hours b) 4 – 6 hours c) 6 – 8 hours d) 8 – 12 hours e) > 12 hours

Table 1. Questionnaire for Headache and Body ache Assessment (Based on ICHD-III)

2. **Clinical Examination**: standardized intra- and extraoral evaluation conducted by a single calibrated examiner to minimize examiner-related variability.

2.4 Instrument Quality and Validation

Content validity was assessed using the Item-level Content Validity Index (I-CVI), calculated as the proportion of experts rating each item as relevant (score ≥3 on a 4-point Likert scale), with a threshold of ≥0.78 considered acceptable.

Construct validity was evaluated using exploratory factor analysis (EFA) with principal component extraction. Factor loadings ≥0.50 were considered significant. Composite Reliability (CR) and Average Variance Extracted (AVE) were calculated to assess internal consistency and convergent validity, using standard formulas:

CR = (Σ factor loadings) ² / [(Σ factor loadings) ² + Σ error variances]
AVE = Σ (factor loadings ²) / number of items

Values of CR > 0.70 and AVE > 0.50 were considered indicative of acceptable reliability and convergent validity.

The questionnaire underwent multi-layered validation prior to field use (Table 2)

Parameter	Result
Face validity	Verified by three subject experts
Construct validity	Composite Reliability (CR > 0.70) and AVE > 0.50
Content validity	Item-level CVI (I-CVI = 0.83), exceeding the recommended threshold (≥0.78)

Table 2: Algorithm to test reliability and conceptual adequacy of the instrument

2.5 Statistical Analysis

Data entry was performed in Microsoft Excel and statistical analyses were conducted using IBM SPSS Statistics (Version 21.0; IBM Corp., Armonk, NY, USA). Descriptive statistics (frequency, percentage, mean ± standard deviation) were computed for all variables. Normality of continuous data was assessed using the Shapiro–Wilk or Kolmogorov–Smirnov tests. Screen time was treated as an independent variable and analyzed both as a categorical and continuous parameter to evaluate its association with headache characteristics and musculoskeletal pain.Categorical associations were examined using the Chi-square test, while linear associations between continuous variables were evaluated using Pearson's correlation coefficient. A two-tailed p-value < 0.05 was considered statistically significant.

3. Results

3.1 Demographic Characteristics

A total of 20 patients diagnosed with TMD according to the DC/TMD criteria were included in this pilot analysis. The mean age of participants was 27.4 ± 7.79 years, with the majority of patients (65%) belonging to the 20–35-year age group. Females represented 72% of the study population, reflecting the well-documented higher prevalence of TMD among women. The predominant clinical diagnosis was myofascial pain with or without referral, occasionally accompanied by temporomandibular joint arthralgia or disc displacement with reduction, consistent with commonly reported TMD presentations in clinical practice.

3.2 Headache and Bodyache Profile

Headache symptoms were reported by 19 of the 20 participants (90%), indicating a high prevalence of headache comorbidity among patients with TMD (Table 3). Based on the ICHD-III, the most frequently observed headache subtype was frequent episodic TTH, accounting for 40% of cases.

Reg No	Gender	Age	DC/TMD Diagnosis	Headache Diagnosis (ICHD-3)	Bodyache (Yes/No)
DC14 243334	F	27	Rt Myofascial pain with referral (ICD-10 M79.1)	Frequent episodic TTH (2.2)	Yes
JA20-248385	M	27	Lt Myofascial Pain (ICD-10 M79.1)	NDPH (4.10)	Yes

JA20-248386	F	27	B/L Myofascial Pain with referral (ICD-10 M79.1), B/L Arthralgia (ICD-10 M26.62), ADDWR Rt side (ICD-10 M26.63)	Migraine without Aura (1.1)	Yes
DC71-147792	F	23	Rt Myofascial pain with referral (ICD-10 M79.1)	Chronic Migraine (1.3)	Yes
JA30-249180	F	23	Rt Myofascial Pain (ICD-10 M79.1)	Infrequent episodic TTH (2.1)	Yes
IL20-198000	F	27	B/L Myofascial Pain with referral (ICD-10 M79.1), Arthralgia Lt side (ICD-10 M26.62)	Frequent episodic TTH (2.2)	Yes
JA20-248399	F	27	Lt Myofascial Pain (ICD-10 M79.1)	NDPH (4.10)	Yes
JA20-248400	M	27	Lt Myofascial Pain with referral (ICD-10 M79.1)	Frequent episodic TTH (2.2)	No
JA20-248402	F	27	Rt Myofascial Pain (ICD-10 M79.1)	Migraine without Aura (1.1)	No
JA20-248403	F	23	B/L Myofascial Pain with referral (ICD-10 M79.1)	Frequent episodic TTH (2.2)	Yes
JA20-248404	F	28	B/L Myofascial Pain with referral (ICD-10 M79.1), Arthralgia Lt side (ICD-10 M26.62)	NDPH (4.10)	Yes
DC71-253218	F	23	Rt Myofascial pain with referral (ICD-10 M79.1)	Migraine without Aura (1.1)	Yes
DC71-253219	F	23	Rt Myofascial pain with referral (ICD-10 M79.1)	Infrequent episodic TTH (2.1)	Yes
DC71-253876	F	36	Lt Myofascial Pain (ICD-10 M79.1)	NDPH (4.10)	No
MG03-253805	F	25	Rt Myofascial Pain (ICD-10 M79.1)	Frequent episodic TTH (2.2)	Yes
MG05-253806	F	27	Lt Myofascial Pain (ICD-10 M79.1)	Migraine with Aura (1.2)	No

JA20-253807	F	21	B/L Myofascial Pain (ICD-10 M79.1)	NDPH (4.10)	Yes
JA20-253808	F	23	B/L Myofascial Pain with referral (ICD-10 M79.1)	Frequent episodic TTH (2.2)	Yes
JA20-253809	F	27	B/L Myofascial Pain (ICD-10 M79.1)	Frequent episodic TTH (2.2)	No
JA20-253810	F	21	B/L Myofascial Pain with referral (ICD-10 M79.1)	Frequent episodic TTH (2.2)	Yes

Table 3. Prevalence of Headache Types

The second most common presentation was new daily persistent headache (NDPH), observed in 25% of participants. Migraine without aura was reported by 15% of individuals (Figure 2).

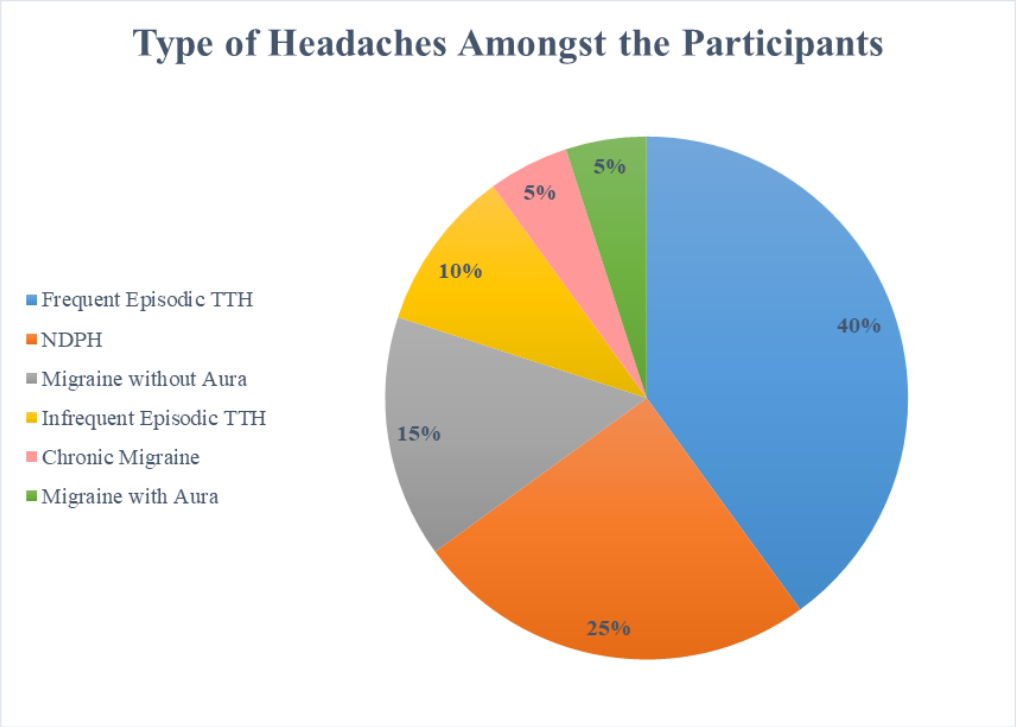

Figure 2. Distribution of the type of Headache amongst the participants

Less frequent headache types included infrequent episodic TTH, chronic migraine, and migraine with aura, each contributing to a smaller proportion of cases. Overall, the headache profile observed in this cohort predominantly reflected tension-type and persistent headache patterns, which are commonly associated with myogenous TMDs. Widespread musculoskeletal pain was reported by most participants, affecting 75% of the cohort, while only 25% reported no associated body pain (Figure 3). This high prevalence highlights the frequent coexistence of generalized musculoskeletal symptoms in patients with temporomandibular disorders, suggesting broader involvement beyond localized orofacial pain.

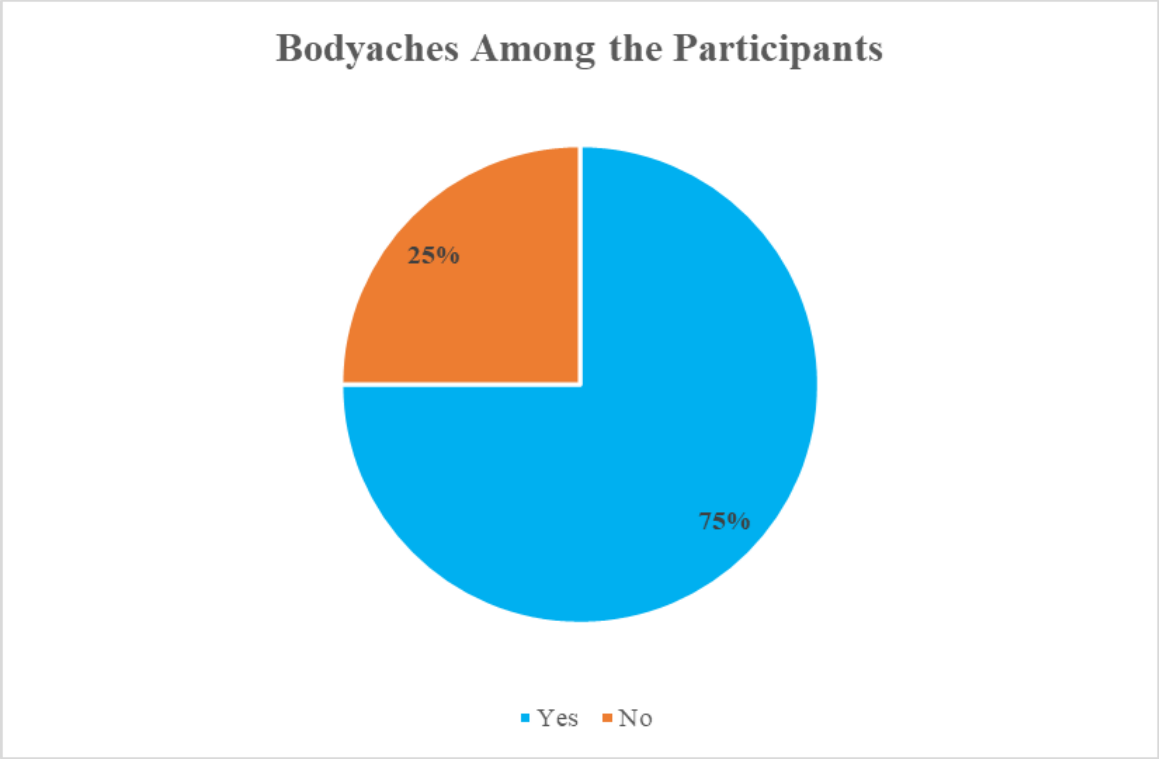

Figure 3. Frequency of Bodyaches among the participants

3.3 Widespread Musculoskeletal Pain Distribution

Widespread musculoskeletal pain was reported by 75% of participants, highlighting the frequent coexistence of generalized pain symptoms in individuals with TMD. The cervical region, shoulder girdle, and lower back were the most affected anatomical areas. This pattern suggests involvement of the cranio-cervico-mandibular musculoskeletal complex, which plays an important role in the pathophysiology of TMD-related pain syndromes. Participants experiencing widespread musculoskeletal pain frequently reported concurrent headache symptoms, indicating a potential overlap between regional musculoskeletal strain and headache generation mechanisms.

3.4 Screen Time Stratification Versus Headache Pattern

Analysis of screen exposure revealed that participants with greater daily screen time tended to exhibit more persistent headache phenotypes. Patients diagnosed with new daily persistent headache (NDPH) reported the highest screen exposure durations, typically ranging between 8–12 hours per day (Table 4). In contrast, participants experiencing migraine with or without aura most frequently reported moderate screen exposure levels of approximately 4–6 hours daily. The highest screen time exposure was observed among patients with TTH (54%), followed by those with new daily persistent headache (42%), while patients with migraine demonstrated comparatively lower screen exposure (21%) (Figure 4). Individuals presenting with TTH demonstrated the widest distribution of screen exposure patterns, including some of the highest exposure categories exceeding 13 hours per day.

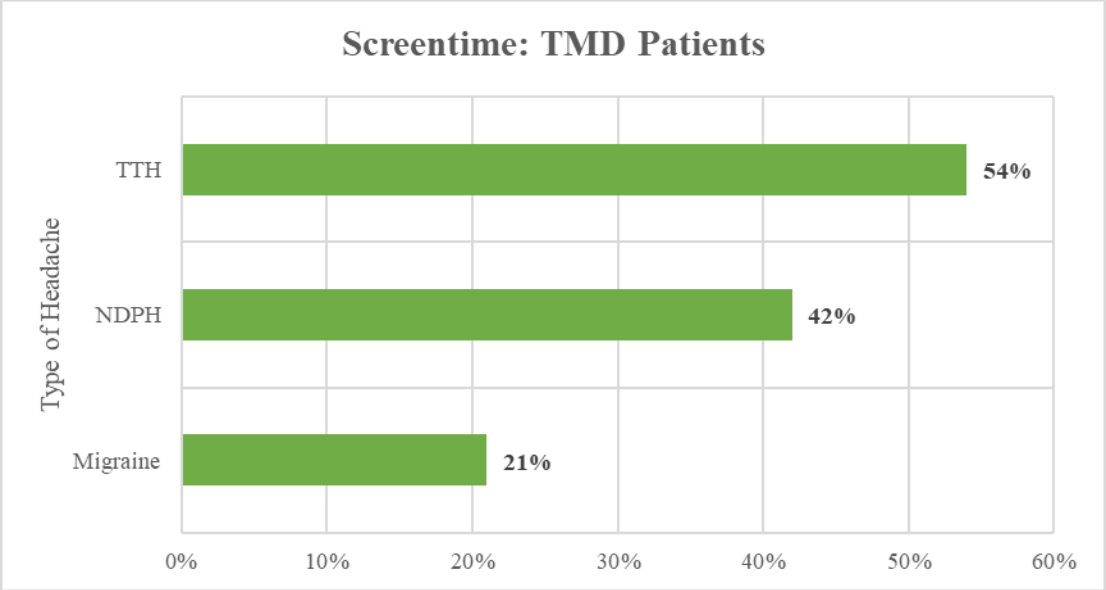

Figure 4. Screen Time usage among TMD patients

Headache Type	Associated Screen Time (hours/day)	Number of Patients (n)
Migraine (with/without Aura)	4 – 6 hours/day	5
NDPH	8 – 12 hours/day	10
Frequent/Infrequent TTH	> 13 hours/day	5

Table 4: Association Between Screen Time Exposure Categories and Headache Patterns

These findings suggest a potential relationship between prolonged digital device use and increased headache persistence in TMD patients. (Table 4)

3.5 Inferential Statistical Outcomes

Statistical analysis demonstrated a significant association between daily screen exposure exceeding four hours and the presence of headache and widespread musculoskeletal pain (Chi-square test, $p < 0.05$). Furthermore, Pearson correlation analysis revealed a moderate positive correlation between screen exposure duration and Widespread Pain Index (WPI) scores ($r = 0.41$). This indicates that increasing screen time was associated with greater musculoskeletal pain burden among participants.

These findings suggest that prolonged digital device use may contribute to increased symptom severity in individuals with TMDs.

4. Discussion

The present pilot study investigated the relationship between daily screen exposure and the occurrence of headache and widespread musculoskeletal pain among patients diagnosed with TMD. The findings demonstrated a high prevalence of headache symptoms within this cohort, with TTH emerging as the most frequent subtype. Additionally, greater screen exposure appeared to be associated with increased headache prevalence and musculoskeletal pain burden.

The WPI has been shown to be a reliable tool for quantifying the extent and distribution of musculoskeletal pain, with demonstrated correlation to structured pain-mapping systems, supporting its use in assessing generalized pain burden in clinical settings [13].

Additionally, emerging evidence indicates that prolonged screen exposure is associated with increased musculoskeletal

discomfort, particularly neck pain, likely mediated through sustained postural strain and reduced physical activity [14].

TMD represent a multifactorial group of musculoskeletal conditions affecting the temporomandibular joint, masticatory muscles, and associated craniofacial structures [1]. Headache disorders are frequently reported among patients with TMD, reflecting shared nociceptive pathways within the trigeminocervical complex [9,10]. In the present study, headache symptoms were reported by the majority of participants, with frequent episodic TTH being the most common presentation. This finding is consistent with previous literature suggesting that myogenous TMD is often associated with TTHs due to sustained muscular contraction and increased activity within the masticatory and cervical musculature [15].

Widespread musculoskeletal pain was also commonly observed among participants, particularly involving the cervical region and shoulder girdle. The cranio-cervico-mandibular complex functions as an integrated biomechanical system, and dysfunction within one region may contribute to pain perception in adjacent anatomical areas. Altered cervical posture and muscle imbalance have previously been associated with both TMD and headache disorders, supporting the distribution of pain observed in this cohort [8].

One of the key objectives of the present study was to explore the potential relationship between digital device use and symptom patterns in individuals with TMD. The ICHD-III provides a standardized framework for accurately classifying headache subtypes, thereby improving diagnostic consistency and clinical interpretation in studies evaluating headache patterns [16]. Participants with higher daily screen exposure demonstrated a greater prevalence of persistent headache patterns and widespread musculoskeletal pain. These findings are consistent with earlier studies linking prolonged VDT use to musculoskeletal complaints and headache symptoms. Nakazawa et al. reported that individuals exposed to more than four hours of daily screen use experienced significantly higher rates of musculoskeletal discomfort.[11] Similarly, Montagni et al. identified an association between screen exposure duration and headache reporting among young adults [17].

From a clinical perspective, these findings suggest that behavioural factors such as digital device usage may play an important role in the symptom profile of TMD patients. Incorporating lifestyle assessment, including screen time habits and ergonomic practices, into routine clinical evaluation may help clinicians identify modifiable contributors to symptom persistence. Patient education regarding posture correction, scheduled screen breaks, and ergonomic workstation adjustments may therefore represent useful adjuncts in the multidisciplinary management of TMD.

Limitations

Several limitations should be considered when interpreting the findings of the present study. First, the study was conducted as a pilot investigation with a relatively small sample size, which may limit the statistical power and generalizability of the results to broader populations. Second, the cross-sectional design of the study does not allow determination of causal relationships between screen exposure and the development or progression of headache and musculoskeletal symptoms. Therefore, the observed associations should be interpreted as exploratory rather than definitive. Additionally, screen time exposure was assessed using self-reported measures, which may introduce recall bias or reporting inaccuracies. Variations in posture, type of device used, and ergonomic conditions during screen use were not objectively assessed and may represent additional confounding factors influencing musculoskeletal strain. Finally, the study population was recruited from a single institutional setting, which may limit the external validity of the findings.

Future Directions

Future research involving larger sample sizes and multicentre recruitment is necessary to validate the associations observed in this pilot investigation. Longitudinal studies would be particularly valuable in determining whether prolonged screen exposure contributes to the onset or progression of TMD symptoms over time. Further studies incorporating objective assessments of screen exposure, ergonomic posture, and musculoskeletal loading may provide deeper insight into the biomechanical mechanisms linking digital device use with TMD-related symptoms. Additionally, evaluating the effectiveness of ergonomic interventions, digital-use modification strategies, and posture-correction programs may help determine whether behavioural modifications can reduce headache frequency and musculoskeletal pain in patients with TMDs.

Understanding these relationships may ultimately contribute to the development of evidence-based preventive and therapeutic strategies addressing digital lifestyle factors in the management of TMD.

5. Conclusion

This pilot study demonstrates that increased daily screen exposure is associated with a higher prevalence of headache and greater widespread musculoskeletal pain among patients with TMDs. These findings underscore the importance of recognizing digital lifestyle factors as modifiable contributors to symptom burden in TMD. Incorporating targeted history-taking on screen use, along with ergonomic counselling and posture-focused interventions, may enhance routine clinical management of orofacial pain. While exploratory in nature, this study highlights a clinically actionable link that warrants validation through larger, longitudinal investigations to inform evidence-based, multidisciplinary care strategies.

Disclosures

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The authors declare that no financial support, funding, or sponsorship was received for this study.

Conflicts of Interest

The authors declare no conflicts of interest.

Ethical Approval:

Written informed consent was not required as the study was observational in nature, involved no therapeutic intervention, and utilized anonymized data collected during routine clinical assessment. The study was classified as minimal risk by the Institutional Ethics Committee, and patient confidentiality was strictly maintained.

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