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Association between Smartphone Screen Time and Cervicogenic Headache Severity in Young Adults, a Cervical Flexion-Rotation Test-Based: A Cross-Sectional Study

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Author`s Contribution

[1 5] Substantial contributions to the conception or design of the work for the acquisition, analysis or interpretation of data for the work, [2]Drafting the work or reviewing it critically for important intellectual content, [1-5]Final approval of the version to be published, Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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A B S T R A C T

Background: With increased use of smartphones, extended screen time is associated with musculoskeletal disorders such as cervicogenic headaches. Poor postures and forward head posture can cause cervical spine dysfunction and result in headache. Young adults, especially students, are highly susceptible because of overuse of smartphones. The prevalence and severity of cervicogenic headaches in this population need to be identified for early treatment and prevention.

Objective: To determine the association between smartphone screen time and cervicogenic headache severity in young adults.

Methodology: This cross-sectional study was conducted on Doctor of Physical Therapy (DPT) students (n=175) using a non-probability convenience sampling technique. Participants included both male and female DPT students aged 18–25 years with more than three hours of daily smartphone screen time, while individuals with systemic diseases, whiplash injuries, psychiatric illnesses, or a history of cervical spine tumors were excluded. Cervicogenic headache severity was assessed using the Numeric Pain Rating Scale (NPRS), and cervical spine dysfunction was evaluated through the Cervical Flexion-Rotation Test (FRT).

Results: Of the 175 participants, 137 tested positive and 39 tested negatives on the Flexion Rotation Test (FRT). According to the NPRS (Numeric Pain Rating Scale), 35.4% of participants reported mild pain, 55.4% had moderate pain, and 9.1% experienced severe pain. Screen time and Cervicogenic Headache CGH pain severity were statistically significantly correlated, with a chi-square test value of 63.742 and a p-value of <0.001.

Conclusion: The majority of students experienced cervicogenic headaches associated with excessive smartphone use. Moreover, a statistically significant association was found between increased screen time and higher cervicogenic headache severity (χ^2 = 63.742, p <0.001), indicating that prolonged smartphone use may contribute to increased headache intensity in young adults.

Keywords: Cervicogenic Headache, Smartphone Addiction, Screen Time, Young Adult.

Introduction

Cervicogenic headache (CGH) is a secondary headache that originates from cervical spine dysfunction, particularly the upper cervical vertebrae, associated muscles, joints, and neural structures.[1] Pain typically initiates in the neck and radiates to the occipital and frontal regions of the head and exacerbates by neck movements.[2] Patients frequently exhibit stiffness in their muscles, particularly in the levator scapulae, sternocleidomastoid, and upper trapezius, as well as decreased cervical mobility.[3,4]

The pathophysiology of CGH involves the convergence of the nociceptive afferents from the upper cervical spinal nerves (C1-C3) and the trigeminal nerve within the trigeminocervical nucleus, resulting in referred pain in the head.[5] The anatomical structures involved are the C2-C3 intervertebral discs, upper cervical synovial joints, dura mater, and vascular elements such as the internal carotid artery.[6,7] Poor posture, especially forward head posture, can contribute to CGH by increasing strain on cervical muscles and compromising motor control resulting in functional limitations.[8]

CGH pain is usually non-throbbing, originates in the upper neck, and radiates forward. It is frequently provoked by movements of the neck or trigger points in the muscles.[9] Increased stiffness in the superficial neck muscles and weakness of the deep neck flexors are also linked to CGH.[10] The pain process may also be exacerbated by inflammatory mediators such as nitric oxide and cytokines.[11]

Globally, headache disorders affect approximately 47% of the population, with CGH accounting for 15–20% of cases.[12] The condition has been said to happen two to four times as frequently in women as men. However, it is often misdiagnosed as migraines or cluster headaches due to overlapping symptoms.[13] Cervical spondylosis and other degenerative spinal changes may also contribute to CGH development.[14]

In recent years, excessive smartphone use has emerged as a major risk factor for musculoskeletal complaints, including CGH. Prolonged screen time often leads to poor posture and forward head positioning, which overloads cervical muscles and weakens deep neck flexors.[15] Among young adults, especially students and heavy social media users, smartphone addiction rates range from 8.4% to 24.9% raising concerns about long-term spinal heath. [16,17]

The Flexion-Rotation Test (FRT) is a valid tool for assessing upper cervical mobility, particularly at C1–C2 level, and is frequently used in CGH diagnosis.[18] Headache severity is commonly measured using the Numeric Pain Rating Scale (NPRS), which ranges from 0 (no pain) to 10 (worst pain).[19]

Given the increasing reliance on smartphones among young adults, screen overuse has emerged as a potential contributor to musculoskeletal disorders, particularly cervicogenic headache (CGH). Despite its rising prevalence, the relationship between screen time and CGH severity remains underexplored. Investigating this link is important for identifying modifiable risk factors and guiding early prevention strategies. This study aims to determine the association between smartphone screen time and CGH severity in young adults, offering insights into the musculoskeletal impact of smartphone use and informing clinical and public health interventions.

Methodology

This cross-sectional study was conducted on Doctor of Physical Therapy (DPT) students at Lahore University of Applied Sciences (LUBAS) from September 2023 to January 2024. A non-probability convenience sampling technique was employed. The sample size was calculated using Taro Yamane's formula, based on a population size of 311 DPT students enrolled in the Department of Physical Therapy at LUBAS. The calculated sample size (n = 175) was determined using 95% confidence level, with an anticipated population proportion (p = 0.05) and a precision level (d = 0.05). Ethical approval for this study was obtained from the Ethical Research Committee (ERC) of University of Biological and Applied Sciences under reference number DPT/ERB/19 on 20-09-2023.

Both male and female DPT students aged between 18-25 years with self-reported mobile phone screen time of more than three hours per day were included in the study. However, participants with any systemic disease, a history of whiplash injury, psychiatric illness or mental disorder, or tumors of the cervical spine were excluded. Informed consent was obtained from all participants before their inclusion in the study, and participation was entirely voluntary. Confidentiality of participant data was strictly maintained, and all communication was conducted with transparency.

The data was collected by a physical performance test which was Cervical Flexion Rotation Test (FRT) and pain was assessed by Numeric Pain Rating Scale (NPRS). FRT sensitivity and specificity were 92% ($p < .001$). The overall diagnostic accuracy was $\kappa = 0.85$ and 89% ($p < 0.001$).[20-22] Whereas, NPRS showed moderate reliability (ICC = 0.67).[23]

All collected data were entered and analyzed using the Statistical Package for Social Sciences (SPSS), version 26. Descriptive statistics such as frequencies, percentages, means, and standard deviations were used to summarize the

data. The chi-square test was used to assess associations between categorical variables (e.g., screen time and CGH severity; gender and FRT outcomes). Spearman's correlation was applied to determine the relationship between screen time and pain intensity. For comparison of pain intensity between male and female participants, an independent samples t-test was used. A p-value of less than 0.05 was considered statistically significant.

Results

Out of the 175 participants (aged between 18 and 25 years), the mean age was 22.01 ± 2.29 years. Among them, 74 (42.3%) were male and 101 (57.7%) were female. Regarding screen time 48.6% (n= 85) of participants reported using their smartphones for 6–8 hours per day, while 44% (n=77) spent 4-6 hours and only 7.4% (n=13) used their phones for more than eight hours a day. Whereas, Flexion Rotation Test (FRT) was positive in 137 participants (77.7%) as shown in figure 1.

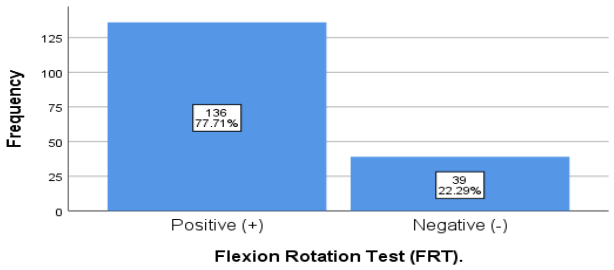

Figure 1: Bar-Chart showing frequency of Flexion Rotation Test

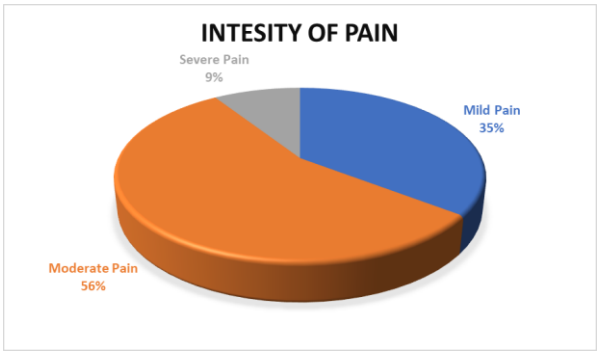

Figure 2: Pie-Chart showing the intensity of pain according to NPRS

Regarding pain intensity, most participants (56%, n=97) reported moderate pain, followed by mild pain (35%, n=62) and severe pain (9%, n=16), as shown in Figure 2. A statistically significant association was found between smartphone screen time and cervicogenic headache severity (χ^2 = 63.742, p <0.001; Table 1). Participants with mild pain primarily reported 4–6 hours of daily screen time, while those with moderate and severe pain increasingly reported longer screen exposure, with half of the severe cases using screens for more than 8 hours per day.

Spearman's correlation coefficient (0.445) indicates a moderate positive association between smartphone screen time and pain intensity, with a statistically significant p-value of <0.001 as shown in table 2.

Table 3 represents the association between gender and FRT results. Among 175 participants, 136 (77.7%) tested positive, with 60 (44.1%) males and 76 (55.9%) females. There were 25 (64.1%) females and 14 (35.9%) males in the negative group. The chi-square test showed no statistically significant association between gender and FRT outcomes (p = 0.360).

Table 4 presents a comparison of pain intensity between male and female participants. Males (1.93 ± 0.67) reported a higher mean pain intensity than females (1.59 ± 0.53). An independent samples *t*-test showed a statistically significant difference between genders ($t = 3.723$, $p < 0.001$), with a mean difference of 0.338 (95% CI: 0.159–0.518).

An independent samples t-test was conducted to compare pain intensity between male and female participants, as the dependent variable (NPRS score) was continuous and the independent variable (gender) had two independent groups. Levene's test confirmed the assumption of equal variances (F = 0.296, p = 0.587), thereby validating the use of the equal variances t-test. The results showed a statistically significant difference in pain intensity between genders (t = 3.723, df = 173, p <0.001), with males reporting higher mean pain scores (M = 1.93, SD = 0.67) compared to females (M = 1.59, SD = 0.53).

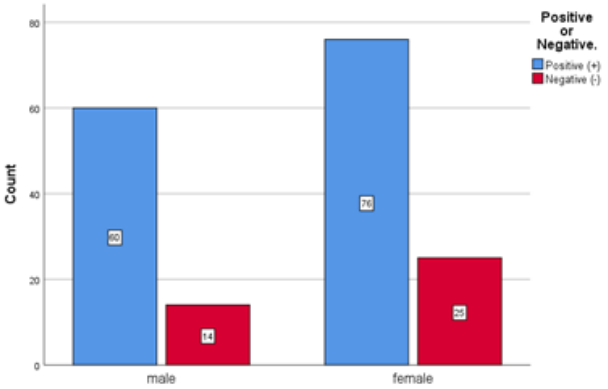

Figure 3: Bar Chart for CGH Prevalence and Severity by Gender

Figure 3 represents 60 (44.1%) males and 76 (55.9%) females had a positive FRT result. In contrast, 14 (35.9%) males and 25 (64.1%) females had a negative FRT result.

Table 1: Association Between Screen Time and CGH Severity

Intensity of Pain	Screen Time Per Hour			Total	Chi-square	p-value
	4-6 hours	6-8 hours	>8 hours			
Mild (0-3)	41	21	0	62	63.742[a]	<0.001
Moderate (4-7)	36	56	5	97		
Severe (8-10)	0	8	8	16		
Total	77	85	13	175		

a. 2 cells (22.2%) have expected count less than 5. The minimum expected count is 1.19.

Table 2: Spearman's Correlation Between Smartphone Screen Time and Pain Intensity

Variable	Screen Time	Intensity of Pain
Spearman's rho	1.000	0.445**
Sig. (2-tailed)	-	<0.001
N	175	175

***Correlation is significant at the 0.01 level (2-tailed).*

Table 3: Association Between Gender and Flexion Rotation Test Results

Gender	Flexion Rotation Test		Total	Chi-Square	p-value
	Positive (+ve)	Negative (-ve)			
Male	60 (44.1%)	14 (35.9%)	74 (42.3%)	0.839 a	0.360
Female	76 (55.9%)	25 (64.1%)	101 (57.7%)		
Total	136 (100%)	39 (100%)	175 (100%)		

a. 0 cells (0.0%) had an expected count less than 5. The minimum expected count was 16.49.

Table 4: Comparison of Pain Intensity by Gender – Descriptive and Inferential Statistics

Gender	N	Mean Pain Intensity	S. D	t-value	df	P-value	Mean Diff.	Std. Error Diff.	95% CI (Lower–Upper)
Male	74	1.93	0.67						
Female	101	1.59	0.53						
Comparison				3.723	173	<0.001	0.338	0.091	0.159 – 0.518

Note: Levene's Test for Equality of Variances: F = 0.296, p = 0.587 (equal variances assumed).

Discussion

The purpose of this study was to determine the association between smartphone screen time and cervicogenic headache severity in young adults. According to the results, 77.7% of subjects had positive Flexion Rotation Test (FRT) results, suggesting that CGH is quite prevalent among smartphone users. Recent study showed a significant positive correlation between screen time and pain intensity, with a moderate correlation coefficient of 0.445 (p = 0.000). This suggests that as screen time increases, so does the intensity of pain. These findings support the link between extended smartphone usage and cervicogenic dysfunction, as demonstrated by a cross-sectional survey conducted by Aabrooi et al. (2022) that found 56% of students with cell phones had positive CFRT results.[24]

Javed et al. conducted a similar study to examine cervicogenic headache and neck pain in computer users. They found that 64.5% of people who used computers or laptops more than 3 hours had head and neck pain, with 40% indicating that their pain was between a 4 and a 6.[25] This result is similar to that of the current study, in which 9.1% of participants reported severe pain (NPRS score of 8–10) while the majority (55.4%) reported moderate pain intensity (NPRS score of 4–7). These results are consistent, indicating that extended screen time whether from computers or smartphones plays a major role in cervicogenic headaches and neck pain.

A cross-sectional study conducted by Almutair et al. (2024) support recent research by showing how extended screen usage harms both visual and musculoskeletal health. According to their study, 79.5% of college students had neck pain, and a notable prevalence of visual disorders, such as nearsightedness (38%) and dry/itchy eyes (49%), which were reported by 62% of their participants. Whereas, there was a substantial correlation between higher neck impairment scores especially among female students and screen usage surpassing five hours.[26] Likewise, current study revealed a favorable relationship between the amount of time spent on smartphones and the severity of discomfort.

Current study's results are in contrast to those of Correia et al. (2021), who looked into the connection between adult neck pain and text neck. There was no significant correlation between the prevalence, frequency, or

degree of neck discomfort and the cervical flexion angles during smartphone use (OR = 1.00; 95% CI: 0.98–1.02, p = 0.66 for standing, and OR = 0.99; 95% CI: 0.98–1.01, p = 0.93 for sitting).[27] However, present study showed a somewhat positive relationship between screen time and pain intensity, with a Spearman's rho of 0.445 (p = 0.000), indicating that more screen time is linked to more intense pain. Specifically, participants who used their smartphones for 6–8 hours reported moderate discomfort, whereas those who used them for more than 8 hours reported severe pain.

The association between office workers' neck pain and excessive smartphone use was examined in a cross-sectional study by Nazi et al. (2021). According to the findings, neck pain was reported by 30.1% of participants, with a higher prevalence among females (33.3%) and younger workers (42.2 years). Notably, neck discomfort was six times more common in people with a smartphone overuse (SO) diagnosis (95% CI: 4.44–8.09, p < 0.001). Additionally, the study found a strong link between excessive smartphone use and psychological distress, such as melancholy, stress, and anxiety.[28] These results are consistent with present study findings, which showed a substantial correlation between screen time and the intensity of cervicogenic headache (CGH). This suggests that extended screen time may make neck pain and related symptoms worse.

In a study conducted by Chen et al. (2021), the authors examined the relationship between screen time and musculoskeletal and visual discomfort among young smartphone users. The findings showed that all of the subjects reported experiencing visual discomfort, especially fatigued eyes. Furthermore, there was a positive correlation between screen time and eye strain (p < 0.05), with neck pain being the most important musculoskeletal symptom linked to prolonged screen use.[29] These results are in line with current study's findings, which further support the notion that extended screen time leads to musculoskeletal discomfort by showing a strong association between increased screen time and the intensity of neck pain.

There are several limitations to this study. The cross-sectional design restricts the ability to establish causality between screen time and musculoskeletal pain, while the reliance on self-reported screen time may introduce recall bias. Additionally, time constraints during data collection and low engagement from some participants during the Flexion Rotation Test (FRT) could have influenced the accuracy of results. The detailed explanation required for the FRT and Numeric Pain Rating Scale (NPRS) also prolonged the assessment process. Furthermore, the study sample was limited to students from Lahore University of Biological and Applied Sciences (LUBAS), which may affect the generalizability of findings.

Future research should consider randomized controlled trials (RCTs) to test the effectiveness of posture correction and screen-time reduction interventions in reducing cervicogenic headache severity. Additionally, longitudinal cohort studies involving larger and more diverse populations from different academic and occupational settings could help establish causal relationships. Incorporating objective screen time tracking tools (e.g., smartphone usage apps or wearable devices) and repeated clinical assessments such as the Flexion-Rotation Test (FRT) and muscle endurance measures would enhance data accuracy and reliability.

Conclusion

A significant association was found between increased smartphone screen time and the severity of cervicogenic headaches in young adults. Participants with prolonged daily screen exposure reported greater neck pain intensity and reduced cervical mobility, as assessed by the cervical flexion-rotation test. These findings highlight the need to monitor screen time and encourage ergonomic practices to prevent cervicogenic symptoms and promote cervical spine health in this population.

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