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Original Article

Correlation Between Upper Cross Syndrome and Smartphone Addiction in University Students

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ABSTRACT

Background: Smartphone addiction is increasingly common among university students and may contribute to sustained forward head posture, rounded shoulders, and postural muscle imbalance associated with Upper Cross Syndrome. Objective: To determine the correlation between smartphone addiction severity and clinical indicators of Upper Cross Syndrome among university students. Methods: This cross-sectional observational study included 167 university students aged 19–24 years from universities in Lahore who used smartphones for at least four hours daily and met predefined Smartphone Addiction Scale–Short Version thresholds. Smartphone addiction was assessed using the SAS-SV, while Upper Cross Syndrome-related findings were evaluated through pectoralis major contracture, middle trapezius weakness, and lower trapezius weakness tests. Descriptive statistics were used for demographic and clinical variables, and correlation analysis was performed between SAS-SV scores and Upper Cross Syndrome-related clinical findings. Results: The sample included 46 males (27.5%) and 121 females (72.5%), with a mean age of 21.51 ± 1.51 years and mean SAS-SV score of 44.37 ± 6.64. Pectoralis major contracture was present in 60 participants (35.9%), middle trapezius weakness in 109 (65.3%), and lower trapezius weakness in 102 (61.1%). SAS-SV score showed weak positive correlations with middle trapezius weakness (r = 0.24), lower trapezius weakness (r = 0.23), and composite Upper Cross Syndrome status (r = 0.22), while correlation with pectoralis major contracture was weaker (r = 0.11). Conclusion: Upper Cross Syndrome-related findings were common among students with elevated smartphone addiction scores, particularly posterior scapular stabilizer weakness. Smartphone addiction severity showed weak positive associations with trapezius weakness and composite Upper Cross Syndrome status. Keywords: Upper Cross Syndrome; Smartphone Addiction; University Students; Posture; Trapezius Weakness; Musculoskeletal Disorders

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INTRODUCTION

Musculoskeletal pain is a common health concern among young adults and university students, with neck, shoulder, and upper-back symptoms frequently associated with prolonged sitting, sedentary academic routines, poor postural habits, and sustained use of electronic devices. These symptoms may reduce functional capacity, restrict participation in academic and daily activities, and contribute to reduced physical activity, psychological distress, and impaired quality of life. University students are particularly vulnerable because their academic workload often requires prolonged static postures during reading,

writing, laptop use, and smartphone use, while structured physical activity may be insufficient to counterbalance sustained postural loading (1,2).

Upper Cross Syndrome is a postural dysfunction characterized by muscular imbalance across the cervical, scapular, and upper thoracic regions. It commonly involves tightness of tonic or postural muscles such as the pectoralis major and minor, upper trapezius, levator scapulae, and sternocleidomastoid, together with weakness or inhibition of phasic stabilizers such as the deep cervical flexors, middle trapezius, lower trapezius, and scapular retractors. This imbalance may produce forward head posture, rounded shoulders, increased thoracic kyphosis, altered scapular positioning, reduced cervical mobility, and neck or shoulder discomfort. The clinical relevance of Upper Cross Syndrome lies not only in pain generation but also in its potential contribution to altered biomechanics, reduced postural endurance, and recurrent musculoskeletal symptoms in young adults exposed to repetitive or sustained postural stress (3,4).

Poor posture has been recognized as an important contributor to musculoskeletal dysfunction, particularly when sustained for long periods without adequate movement variation or muscular conditioning. Forward head posture shifts the cervical spine anteriorly and increases mechanical demand on the posterior cervical and upper thoracic musculature, while rounded shoulders and shortened anterior chest musculature may further disturb scapulothoracic mechanics. In university students, these postural deviations may be reinforced by prolonged sitting, extended study hours, laptop use, and frequent smartphone use. Studies from student and young adult populations have reported a substantial burden of neck pain, poor posture, and Upper Cross Syndrome-related findings, suggesting that postural dysfunction in this age group is not limited to older or occupational populations (5–7).

Smartphones have become essential tools for communication, learning, social interaction, entertainment, and access to digital information. Their portability and multifunctionality have increased daily exposure time, particularly among adolescents and university students. Although smartphone use provides educational and social benefits, excessive use may progress into problematic or addictive patterns characterized by impaired control, preoccupation, tolerance-like behavior, distress during restricted access, and interference with daily functioning. Smartphone addiction has been associated with reduced sleep quality, lower academic performance, psychological distress, physical inactivity, and musculoskeletal symptoms, making it a relevant behavioral exposure in student health research (8–11).

The physical mechanism linking smartphone use to musculoskeletal symptoms is biologically plausible. During prolonged smartphone use, users commonly adopt a flexed cervical posture with forward head positioning, protracted shoulders, and reduced postural variation. This position increases the mechanical load on cervical and upper thoracic structures and may promote adaptive shortening of anterior shoulder muscles with weakness or reduced endurance of scapular stabilizers. Previous research has reported associations between smartphone addiction or excessive smartphone use and neck pain, shoulder symptoms, upper-limb musculoskeletal disorders, and functional discomfort among university students and young adults (12–15). However, pain and disability outcomes do not fully represent the specific muscular imbalance pattern required for clinical identification of Upper Cross Syndrome.

Existing literature has examined Upper Cross Syndrome in relation to physical activity, prolonged sitting, occupational posture, and student lifestyle, while separate studies have explored smartphone addiction in relation to neck pain, upper-limb pain, sleep quality, and mental health. However, fewer studies have directly evaluated whether smartphone addiction severity is associated with objective clinical components of Upper Cross Syndrome, such as pectoralis major contracture and middle or lower trapezius weakness, particularly among university students in Lahore. This distinction is important because smartphone addiction reflects behavioral dependence and usage intensity, whereas Upper Cross Syndrome reflects measurable postural and muscular impairment. A student may report high smartphone addiction scores without necessarily demonstrating the specific biomechanical pattern of Upper Cross Syndrome, and conversely, postural dysfunction may arise from multiple contributors beyond smartphone use, including prolonged sitting, poor ergonomics, inadequate physical activity, gender-related differences, and body composition.

The present study was therefore conducted to determine the correlation between smartphone addiction and Upper Cross Syndrome among university students. Specifically, the study assessed smartphone addiction using the Smartphone Addiction Scale–Short Version and evaluated clinical components of Upper Cross Syndrome through pectoralis major contracture, middle trapezius weakness, and lower trapezius weakness tests. The study aimed to determine whether higher smartphone addiction scores were associated with Upper Cross Syndrome-related clinical findings and to estimate the occurrence of Upper Cross Syndrome components among university students who met the predefined smartphone addiction threshold. The study hypothesis was that smartphone addiction score would be positively correlated with clinical indicators of Upper Cross Syndrome among university students.

MATERIALS AND METHODS

This study used a cross-sectional observational design to examine the relationship between smartphone addiction and clinical indicators of Upper Cross Syndrome among university students. The design was selected because the objective was to assess the presence of smartphone addiction scores and Upper Cross Syndrome-related clinical findings at a single point in time and to determine the statistical association between these variables without assigning an intervention or follow-up exposure period. The study was conducted among students from universities in Lahore, including the University of Management and Technology, Superior University, and the University of Lahore.

Participants were recruited using a non-probability convenience sampling technique. Eligible participants were male and female university students aged 19 to 24 years who used smartphones for at least four hours per day and met the predefined Smartphone Addiction Scale–Short Version threshold, defined as a score greater than 31 for males and greater than 33 for females. Students were excluded if they had a history of upper-body trauma, postural structural deformity, neurological disease, pregnancy, malignancy involving soft tissue or joints, or recent surgery. A total of 167 eligible participants were included in the final analysis.

Approval was obtained from the departmental research committee before data collection. Permission was obtained from the relevant university authorities, and informed consent was taken from each participant before enrollment. Participants were informed about the purpose of the study, the voluntary nature of participation, and the use of collected information for research purposes. Data were collected using a structured assessment format that included demographic and clinical variables followed by standardized assessment of smartphone addiction and Upper Cross Syndrome-related clinical tests.

Smartphone addiction was assessed using the Smartphone Addiction Scale–Short Version. The assessment form also recorded participant characteristics including age, gender, body mass index category, dominant hand, and duration of smartphone use. The total SAS-SV score was treated as a continuous variable for correlation analysis. Higher scores represented greater severity of smartphone addiction. Upper Cross Syndrome-related clinical findings were assessed using the pectoralis major contracture test, middle trapezius weakness test, and lower trapezius weakness test. Each clinical test was recorded as positive or negative according to the observed test finding. Upper Cross Syndrome was operationally assessed through the combined presence of these clinical components, reflecting the pattern of anterior muscle tightness and posterior scapular stabilizer weakness that characterizes the syndrome.

The main exposure variable was smartphone addiction severity, measured by the total SAS-SV score. The primary outcome variable was Upper Cross Syndrome status based on clinical test findings. Secondary outcome variables included individual clinical components of Upper Cross Syndrome, including pectoralis major contracture, middle trapezius weakness, and lower trapezius weakness. Age, gender, body mass index category, dominant hand, and smartphone usage duration were recorded as participant-level characteristics relevant to interpretation of musculoskeletal and postural findings.

Data were entered and analyzed using Statistical Package for the Social Sciences version 22.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Frequencies and percentages were calculated for categorical variables, including gender, body mass index category, and positive or

negative clinical test findings. Mean and standard deviation were calculated for continuous variables, including age and total SAS-SV score. The association between total SAS-SV score and binary clinical findings of Upper Cross Syndrome components was analyzed using correlation testing appropriate for a continuous addiction score and dichotomous clinical outcomes. Correlation coefficients were interpreted according to direction and magnitude, and p-values were used to determine statistical significance. A p-value of less than 0.05 was considered statistically significant.

To support consistency and reduce measurement-related error, the same data collection structure was applied across participants, and clinical findings were recorded using predefined positive and negative categories. Data were checked for completeness before statistical analysis. Ethical principles were followed throughout the study, including voluntary participation, informed consent, confidentiality of participant information, and use of data only for the stated research purpose.

RESULTS

A total of 167 university students were included in the final analysis. The sample comprised 46 males (27.5%) and 121 females (72.5%). Participants were aged 19 to 24 years, with a mean age of 21.51 ± 1.51 years. The mean Smartphone Addiction Scale–Short Version (SAS-SV) score was 44.37 ± 6.64, with scores ranging from 32 to 60.

Table 1. Demographic and Smartphone Addiction Characteristics of Participants

Variable	Category/Measure	n	%	Mean ± SD	Minimum	Maximum
Gender	Male	46	27.5	—	—	—
Gender	Female	121	72.5	—	—	—
Age	Years	167	—	21.51 ± 1.51	19	24
SAS-SV score	Total score	167	—	44.37 ± 6.64	32	60

Abbreviation: SAS-SV, Smartphone Addiction Scale–Short Version.

The study population was predominantly female, with females accounting for nearly three-fourths of the sample. Participants represented a narrow young-adult age range, and the SAS-SV scores were consistent with the study's eligibility criteria for elevated smartphone addiction risk.

Table 2. Body Mass Index Distribution of Participants

BMI Category	n	%
Underweight	40	23.95
Normal	91	54.49
Overweight	32	19.16
Obese	4	2.40
Total	167	100.00

Abbreviation: BMI, body mass index.

More than half of the participants were in the normal BMI category, representing 91 students (54.49%). Underweight participants accounted for 40 students (23.95%), while 32 students (19.16%) were overweight and 4 students (2.40%) were obese.

Table 3. Distribution of Upper Cross Syndrome Component Findings

Clinical Test	Positive n (%)	Negative n (%)	Total n (%)
Pectoralis major contracture test	60 (35.9)	107 (64.1)	167 (100.0)
Middle trapezius weakness test	109 (65.3)	58 (34.7)	167 (100.0)
Lower trapezius weakness test	102 (61.1)	65 (38.9)	167 (100.0)

Positive findings for Upper Cross Syndrome components were common in the sample. Middle trapezius weakness was the most frequent clinical finding, observed in 109 participants (65.3%), followed by lower trapezius weakness in 102 participants (61.1%). Pectoralis major contracture was less frequent, affecting 60 participants (35.9%). Overall, posterior scapular stabilizer weakness was more prevalent than anterior pectoral contracture.

Table 4. Correlation Between SAS-SV Score and Upper Cross Syndrome Component Findings

Variable	n	r	95% CI	p-value
Pectoralis major contracture test	167	0.11	-0.04 to 0.26	0.157
Middle trapezius weakness test	167	0.24	0.09 to 0.38	0.002
Lower trapezius weakness test	167	0.23	0.08 to 0.37	0.003
Composite Upper Cross Syndrome status	167	0.22	0.07 to 0.36	0.004

Abbreviations: CI, confidence interval; SAS-SV, Smartphone Addiction Scale–Short Version. Correlation coefficients represent the association between SAS-SV total score and clinical Upper Cross Syndrome component findings.

The SAS-SV score showed a weak positive correlation with pectoralis major contracture; however, the confidence interval crossed zero and the association was not statistically significant (r = 0.11, 95% CI: -0.04 to 0.26, p = 0.157). Weak positive correlations were observed between SAS-SV score and middle trapezius weakness (r = 0.24, 95% CI: 0.09 to 0.38, p = 0.002), lower trapezius weakness (r = 0.23, 95% CI: 0.08 to 0.37, p = 0.003), and composite Upper Cross Syndrome status (r = 0.22, 95% CI: 0.07 to 0.36, p = 0.004). These findings indicate that higher smartphone addiction scores were associated with positive findings for posterior scapular stabilizer weakness and composite Upper Cross Syndrome status, although the strength of association was small.

Overall, the results showed a high frequency of Upper Cross Syndrome-related clinical findings among university students with elevated smartphone addiction scores. Middle and lower trapezius weakness were the predominant findings, while pectoralis major contracture was less common. Smartphone addiction severity demonstrated weak but consistent positive associations with posterior muscle weakness and composite Upper Cross Syndrome status, suggesting that posterior scapular stabilizer dysfunction may be more closely related to smartphone addiction severity than anterior pectoral contracture in this sample.

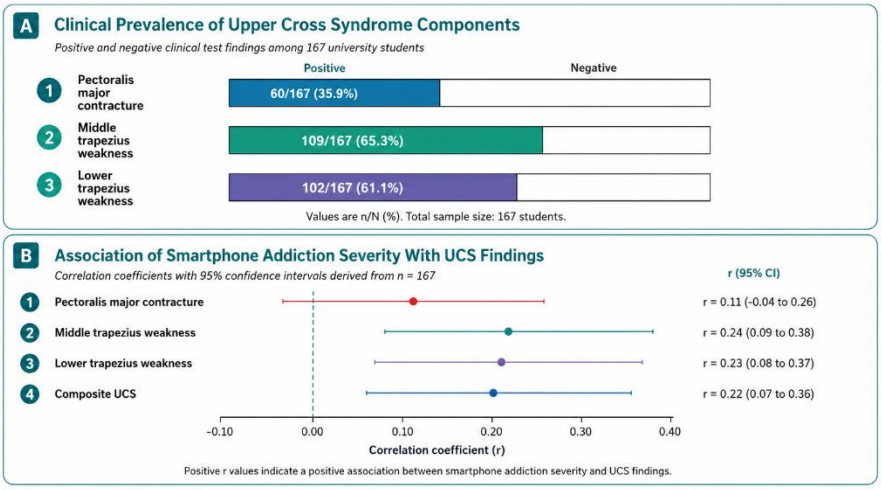

Figure 1. Upper Cross Syndrome Profile and Smartphone Addiction Correlation Among University Students. The clinical profile showed that posterior scapular stabilizer weakness was more frequent than anterior muscle tightness, with middle trapezius weakness present in 109 of 167 participants (65.3%) and lower trapezius weakness in 102 of 167 participants (61.1%), compared with pectoralis major contracture in 60 of 167 participants (35.9%). Correlation analysis demonstrated a weak positive association between SAS-SV score and pectoralis major contracture (r = 0.11, 95% CI: -0.04 to 0.26), whereas middle trapezius weakness (r = 0.24, 95% CI: 0.09 to 0.38), lower trapezius weakness (r = 0.23, 95% CI: 0.08 to 0.37), and composite Upper Cross Syndrome status (r = 0.22, 95% CI: 0.07 to 0.36) showed weak positive associations with confidence intervals above zero. These findings indicate that smartphone addiction severity was more closely related to posterior scapular stabilizer weakness than to pectoralis major contracture in this student sample.

DISCUSSION

This cross-sectional study examined the relationship between smartphone addiction severity and clinical indicators of Upper Cross Syndrome among university students aged 19 to 24 years. The findings showed that Upper Cross Syndrome-related clinical findings were common in this sample, particularly weakness of the middle and lower trapezius muscles. Middle trapezius weakness was observed in 65.3% of

participants, lower trapezius weakness in 61.1%, and pectoralis major contracture in 35.9%. Correlation analysis demonstrated weak positive associations between SAS-SV score and middle trapezius weakness, lower trapezius weakness, and composite Upper Cross Syndrome status, while the association with pectoralis major contracture was weak and not statistically significant. These findings suggest that greater smartphone addiction severity was more consistently related to posterior scapular stabilizer weakness than to anterior chest muscle tightness in this student population.

The predominance of middle and lower trapezius weakness is clinically meaningful because these muscles contribute to scapular retraction, depression, upward rotation, and postural control during sustained sitting and upper-limb activities. In Upper Cross Syndrome, inhibition or weakness of scapular stabilizers may coexist with adaptive tightness of anterior shoulder and cervical muscles, producing rounded shoulders, forward head posture, increased thoracic kyphosis, and altered scapulothoracic mechanics. Previous studies have reported that Upper Cross Syndrome and related postural deviations are common in young adults exposed to prolonged sitting, insufficient physical activity, and sustained academic postures. The present findings are consistent with this pattern, as a substantial proportion of university students demonstrated positive clinical findings for scapular muscle weakness, supporting the view that postural muscle imbalance can emerge early in young adult student populations (5–7).

The weak but statistically significant correlations between SAS-SV score and middle trapezius weakness, lower trapezius weakness, and composite Upper Cross Syndrome status indicate that smartphone addiction severity may contribute to postural muscle imbalance, although the magnitude of association remained small. This is important because smartphone addiction is primarily a behavioral construct and does not directly quantify biomechanical exposure such as neck flexion angle, duration of sustained posture, screen height, frequency of movement breaks, or ergonomic positioning. Therefore, a weak correlation is plausible: students with higher smartphone addiction scores may spend longer periods using smartphones, but the development of Upper Cross Syndrome is likely influenced by multiple additional factors, including prolonged sitting, study posture, laptop use, physical inactivity, muscle endurance, gender distribution, body composition, and habitual ergonomics.

The findings also align with previous research linking smartphone addiction or excessive smartphone use with neck pain, shoulder symptoms, upper-limb musculoskeletal disorders, and functional discomfort among students and young adults. Studies using pain and disability outcomes have generally reported positive associations between excessive smartphone use and musculoskeletal complaints, particularly in the neck and upper body region (12–15). However, the present study extends this evidence by focusing on clinical components of Upper Cross Syndrome rather than pain alone. This distinction is important because pain intensity and disability may fluctuate with activity level, psychological distress, sleep quality, and acute strain, whereas clinical findings such as trapezius weakness and pectoralis major contracture reflect postural and muscular characteristics that may develop over time.

The absence of a statistically significant association between SAS-SV score and pectoralis major contracture suggests that anterior muscle tightness may not be explained by smartphone addiction severity alone. Pectoralis major tightness may be influenced by broader postural habits, thoracic mobility, resistance training patterns, prolonged desk work, shoulder positioning during laptop use, and long-term musculoskeletal adaptation. In contrast, the observed associations with middle and lower trapezius weakness may reflect reduced postural endurance and insufficient activation of posterior scapular stabilizers during sustained forward-flexed smartphone posture. This pattern indicates that smartphone-related postural exposure may be more strongly reflected in weakness or inhibition of posterior stabilizing muscles than in measurable anterior muscle contracture in young adults.

The demographic distribution of the sample should also be considered when interpreting the findings. Females represented 72.5% of the participants, which may have influenced the prevalence of musculoskeletal findings and the strength of correlations. Previous research has suggested that gender may modify the relationship between smartphone use and upper-body musculoskeletal symptoms, potentially due to differences in muscle mass, pain reporting, postural endurance, device-use behavior,

and physical activity patterns (15). Since the present analysis did not provide gender-stratified correlation estimates, the observed associations should be interpreted as overall sample-level findings rather than gender-specific effects.

The findings have practical implications for student health, physiotherapy screening, and preventive ergonomics. Even though the correlations were weak, the high frequency of trapezius weakness indicates a need for early postural education, movement breaks, scapular stabilizer strengthening, stretching of shortened anterior musculature when present, and awareness of smartphone posture among university students. Preventive programs should not focus only on reducing smartphone use time but should also address the quality of posture during use, screen positioning, cervical and thoracic mobility, posterior shoulder endurance, and structured physical activity. Screening students with high smartphone addiction scores for postural muscle imbalance may help identify those at risk of developing persistent neck or shoulder symptoms.

Several methodological considerations are relevant to interpretation. The cross-sectional design limits temporal interpretation because smartphone addiction severity and Upper Cross Syndrome findings were measured at the same time. The convenience sampling approach may limit generalizability beyond the participating universities. The inclusion of students who met SAS-SV threshold criteria restricted the range of smartphone addiction scores, which may have reduced the ability to detect stronger exposure-response associations. The study also relied on clinical component tests rather than instrumented posture analysis, digital inclinometry, electromyography, or objective smartphone-use tracking. Important confounders such as physical activity level, study hours, laptop use, ergonomic setup, neck pain intensity, sleep quality, and psychosocial stress were not included in adjusted models. Future studies should use larger and more balanced samples, include non-addicted comparison groups, apply objective posture and smartphone-use measurements, and perform multivariable analysis to clarify whether smartphone addiction independently predicts Upper Cross Syndrome after controlling for lifestyle and ergonomic factors.

Overall, the study contributes preliminary evidence that smartphone addiction severity is weakly but positively associated with clinical indicators of Upper Cross Syndrome, particularly posterior scapular stabilizer weakness, among university students. The findings support a multifactorial interpretation in which smartphone addiction may be one behavioral marker of postural risk rather than the sole cause of Upper Cross Syndrome. This interpretation is more consistent with the observed weak correlations and with the broader literature on student posture, sedentary behavior, and smartphone-related musculoskeletal symptoms.

CONCLUSION

This study found that Upper Cross Syndrome-related clinical findings were common among university students with elevated smartphone addiction scores, with middle trapezius weakness and lower trapezius weakness occurring more frequently than pectoralis major contracture. Smartphone addiction severity showed weak positive associations with middle trapezius weakness, lower trapezius weakness, and composite Upper Cross Syndrome status, while its association with pectoralis major contracture was weak and not statistically significant. These findings suggest that higher smartphone addiction scores may be related more closely to posterior scapular stabilizer weakness than to anterior muscle tightness. Preventive strategies for university students should therefore combine smartphone-use awareness with posture education, regular movement breaks, ergonomic correction, and strengthening of scapular stabilizers to reduce the risk of postural dysfunction and related musculoskeletal symptoms.

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