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Original Article

Correlation Between Excessive Smartphone Usage Pattern and the Prevalence of Medial Epicondylar Pain

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ABSTRACT

Background: Excessive smartphone use is increasingly recognized as a potential contributor to musculoskeletal symptoms among young adults because prolonged screen time, sustained gripping, repetitive thumb and wrist movements, one-handed handling, and prolonged elbow positioning may increase mechanical loading across the upper limb. Objective: To determine the frequency of self-reported elbow/medial epicondylar-region pain and examine its association with smartphone-use patterns among university students and young adults. Methods: This cross-sectional observational survey included 196 participants aged 18–30 years recruited from the University of Lahore and the University of Lahore Teaching Hospital using convenience sampling. Data were collected using a structured questionnaire, Nordic Musculoskeletal Questionnaire, Visual Analog Scale, and Smartphone Addiction Scale–Short Version. Descriptive statistics and chi-square-based association testing were performed using SPSS version 25.0. Results: The mean age was 24.52 ± 3.72 years, and 106 participants (54.1%) were female. Smartphone use exceeded 3 hours/day in 161 participants (82.1%), while 126 participants (64.3%) reported one-handed use. Elbow pain was reported by 90 participants (45.9%) over the previous 12 months and 63 participants (32.1%) over the previous 7 days. The Pearson chi-square test did not show a statistically significant association between smartphone-use pattern and elbow/medial epicondylar-region pain ($\chi^2 = 218.716$, df = 216, $p = 0.436$), although sparse expected cell counts limited interpretability. Conclusion: Elbow-region pain was common among frequent smartphone users, but the available analysis did not provide statistically robust evidence of an independent association with smartphone-use patterns. Keywords: smartphone use, smartphone addiction, elbow pain, medial epicondylar pain, musculoskeletal disorders, young adults

INTRODUCTION

Smartphone use has become deeply integrated into daily communication, education, entertainment, and social interaction among young adults, particularly university students. Although smartphones provide considerable functional and academic benefits, their prolonged and repetitive use has raised increasing concern regarding musculoskeletal health. Sustained neck flexion, unsupported upper-limb posture, repetitive thumb and wrist movements, prolonged gripping, and extended elbow positioning during smartphone use may increase mechanical load on the cervical spine, shoulder girdle, forearm, wrist, hand, and elbow region. Evidence from biomechanical and epidemiological studies suggests that smartphone use is associated with increased activity of the upper trapezius, neck extensors, erector spinae, and upper-limb muscles, along with postural adaptations such as forward head posture, head tilt, and prolonged static loading, which may contribute to musculoskeletal pain and discomfort in frequent users (1).

Previous studies have reported a high prevalence of musculoskeletal symptoms among smartphone and handheld-device users, with pain most commonly affecting the neck, shoulder, upper back, wrist, hand, thumb, and elbow regions. Thorburn et al. reported musculoskeletal symptoms in approximately 59.9% of adult smartphone and tablet users, with stiffness and neck symptoms being common complaints, particularly after sustained use sessions (2). Baabdullah et al. found that smartphone addiction and longer daily smartphone use were significantly associated with pain in the neck, wrist/hand, shoulder, and upper back among university students (3). Similar findings have been reported in medical, nursing, and physical therapy student populations, where excessive smartphone use and higher Smartphone Addiction Scale scores were associated with musculoskeletal discomfort, particularly in the neck and upper extremity (4,5). These findings indicate that young adult student populations are an important group for investigating smartphone-related musculoskeletal symptoms because they commonly combine prolonged screen exposure with academic workload, sedentary behavior, and repetitive handheld device use.

The upper limb may be particularly vulnerable to smartphone-related strain because smartphone interaction often requires repetitive thumb activity, sustained gripping, wrist deviation, forearm muscle activation, and prolonged elbow flexion. One-handed smartphone use may further increase muscular demand by requiring greater stabilization from the wrist and forearm flexor-pronator muscle group. Lee et al. demonstrated that one-handed smartphone use increased upper-extremity muscle activity and pain sensitivity compared with two-handed use, supporting the biomechanical plausibility that handling pattern may influence upper-limb discomfort (6). Depreli and Angin also reported significant relationships between wrist and elbow position during smartphone use, pain, smartphone addiction, and hand function among university students (7). In addition, studies examining upper-limb musculoskeletal disorders during the COVID-19 period found that smartphone addiction or overuse was associated with increased odds of shoulder, elbow, and wrist/hand symptoms, suggesting that the elbow region may be affected as part of broader upper-limb overuse patterns (8).

Despite this growing evidence, most available studies have focused primarily on neck pain, shoulder pain, wrist/hand symptoms, thumb pain, carpal tunnel-related complaints, or general upper-limb musculoskeletal disorders. Comparatively fewer studies have specifically examined pain localized to the medial elbow or medial epicondylar region in relation to smartphone-use behavior. This distinction is clinically important because medial epicondylar-region pain may reflect mechanical loading of the common flexor-pronator origin, repetitive gripping, resisted wrist flexion, forearm pronation stress, or sustained elbow positioning. However, self-reported elbow pain does not necessarily confirm medial epicondylitis unless anatomical localization and clinical diagnostic criteria are clearly applied. Therefore, studies examining smartphone-use patterns and medial epicondylar-region pain should define the outcome carefully and avoid equating general elbow pain with clinically confirmed medial epicondylitis.

Several behavioral features of smartphone use may be relevant to medial elbow symptoms, including daily duration of use, one-handed versus two-handed handling, repetitive texting or browsing, gaming, sustained gripping, and prolonged elbow flexion. Prolonged flexed elbow posture has also been discussed in relation to ulnar nerve irritation and elbow-region symptoms among cell phone users, suggesting that smartphone-related upper-limb discomfort may arise through multiple mechanisms, including muscular overuse, tendon loading, nerve compression, and sustained static positioning (9). However, the extent to which these usage patterns are associated with self-reported medial epicondylar-region pain among young adults remains insufficiently established, particularly in local university populations where prolonged academic and recreational smartphone exposure is common.

The present cross-sectional study was therefore designed to assess the frequency of self-reported medial epicondylar-region/elbow pain among university students and young adults and to examine its association with excessive smartphone-use patterns. Using a PICO framework, the population comprised young adults and university students aged 18–30 years who had used smartphones for at least one year; the exposure was excessive or higher-risk smartphone-use behavior, including longer daily smartphone use, one-handed use, and higher smartphone addiction score; the comparison was lower-duration or lower-risk smartphone-use behavior; and the outcome was self-reported elbow or medial epicondylar-region pain assessed through standardized musculoskeletal and pain measures. The study hypothesized that excessive smartphone-use patterns would be associated with a higher frequency of self-reported medial epicondylar-region pain among young adults and university students.

MATERIALS AND METHODS

This study was conducted as a cross-sectional observational survey to determine the frequency of self-reported medial epicondylar-region/elbow pain and to assess its association with smartphone-use patterns among young adults and university students. A cross-sectional design was appropriate because the study aimed to estimate symptom prevalence and examine exposure–outcome associations at a single point in time rather than determine causal or temporal relationships. The study was carried out at the University of Lahore and the University of Lahore Teaching Hospital over a four-month period after approval of the research synopsis. Participants were recruited from the target young adult population using a convenience sampling technique, and a total of 196 eligible participants were included in the final analysis.

Participants were eligible if they were 18–30 years of age, were university students or young adults, had used a smartphone for at least one year, were able to complete the study questionnaires, agreed to participate voluntarily, had no previously diagnosed severe musculoskeletal disorder, and were able to perform daily activities independently without assistive devices. Participants were excluded if they had a previous history of elbow trauma, fracture, or surgery involving the medial epicondyle region; systemic musculoskeletal or neurological disease such as rheumatoid arthritis or multiple sclerosis; less than one hour of smartphone use per day; inability to understand the questionnaire or study procedures; or current use of medications likely to alter musculoskeletal pain perception, including chronic pain medication or corticosteroids. These criteria were applied to reduce obvious sources of misclassification and to limit the inclusion of participants whose elbow pain could be primarily explained by major trauma, systemic disease, neurological pathology, or medication-related alteration of pain reporting.

After screening for eligibility, participants were informed about the purpose and procedures of the study, and written informed consent was obtained before data collection. Participation was voluntary, and participants were informed that they could withdraw at any stage without penalty. Data were collected using a structured questionnaire that included demographic characteristics, smartphone-use characteristics, musculoskeletal symptoms, smartphone addiction score, and pain severity. Demographic variables included age, gender, height, and weight. Smartphone-use variables included daily duration of smartphone use, categorized as 1–3 hours, 3–5 hours, and more than 5 hours per day, and hand-use pattern, categorized as one-handed or two-handed smartphone use. Smartphone addiction or problematic smartphone-use behavior was assessed using the Smartphone Addiction Scale–Short Version.

Musculoskeletal symptoms were assessed using the Nordic Musculoskeletal Questionnaire, which is a standardized tool used in epidemiological studies to identify the presence of musculoskeletal pain or discomfort across body regions, including symptoms reported during the previous 7 days and previous 12 months. In the present study, the elbow-region component was used to identify self-reported elbow pain during these timeframes. Because self-reported elbow pain does not by itself confirm clinically diagnosed medial epicondylitis, the outcome was interpreted as self-reported elbow or medial epicondylar-region pain rather than imaging-confirmed or examination-confirmed medial epicondylitis. Pain severity was assessed using the Visual Analog Scale, recorded on a scale from 0 to 10, where 0 represented no pain and 10 represented the worst imaginable pain. Smartphone addiction was assessed using the Smartphone Addiction Scale–Short Version, a 10-item scale scored on a 6-point Likert format, with total scores ranging from 10 to 60 and higher scores indicating greater smartphone addiction or problematic smartphone-use tendency.

The primary outcome variable was the presence of self-reported elbow or medial epicondylar-region pain, assessed for both the previous 12 months and the previous 7 days. Pain severity score was treated as an additional outcome for descriptive analysis. The main exposure variables were daily smartphone-use duration, hand-use pattern, and total Smartphone Addiction Scale–Short Version score. Daily smartphone-use duration and hand-use pattern were treated as categorical variables, while the Smartphone Addiction Scale–Short Version score was summarized as a continuous variable and could be categorized for association testing only when clinically or statistically justified. Age, gender, height, and weight were treated as participant-characteristic variables and were considered relevant covariates because musculoskeletal symptoms may vary according to demographic and anthropometric characteristics.

To improve internal validity, participants with major prior elbow trauma, systemic musculoskeletal disease, neurological disease, and medication-related alteration of pain perception were excluded. The use of standardized instruments was intended to improve consistency of measurement across participants. Data were collected using the same questionnaire structure for all participants, and completed responses were checked for completeness before entry. Data were entered into SPSS version 25.0 for analysis, and variables were coded consistently according to predefined categories. Descriptive statistics were calculated for all participant characteristics, smartphone-use variables, and pain outcomes. Continuous variables, including age, height, weight, and Smartphone Addiction Scale–Short Version score, were summarized using mean, standard deviation, minimum, and maximum values. Categorical variables, including gender, daily smartphone-use duration, hand-use pattern, and elbow-pain status, were summarized using frequencies and percentages.

Associations between smartphone-use patterns and self-reported elbow or medial epicondylar-region pain were planned using cross-tabulation with appropriate inferential testing. Pearson's chi-square test was considered suitable only when expected cell-count assumptions were met. When sparse cells or expected counts below acceptable limits occurred, categories were to be collapsed into clinically meaningful groups or exact testing was to be preferred. For categorical exposure–outcome comparisons, p-values were to be reported alongside effect-size measures such as phi coefficient or Cramer's V, and odds ratios with 95% confidence intervals were to be reported where binary comparisons were appropriate. For ordinal smartphone-use duration, a trend test could be considered only when the ordinal structure of categories was clinically meaningful and statistical assumptions were appropriate. A p-value less than 0.05 was considered statistically significant. Missing or incomplete responses were checked during data cleaning, and analyses were conducted using valid available data for each variable.

Ethical principles related to voluntary participation, informed consent, anonymity, privacy, and confidentiality were followed throughout the study. Participant identity was not disclosed during data handling or reporting, and the collected information was used only for research purposes. The study was conducted according to institutional ethical requirements and principles consistent with the Declaration of Helsinki. Data integrity was supported through standardized questionnaire administration, consistent coding of variables, review of completed forms before analysis, and use of a single statistical software platform for final data analysis.

RESULTS

A total of 196 participants were included in the analysis. Descriptive statistics were calculated to summarize demographic characteristics, smartphone-use behavior, smartphone addiction scores, and the prevalence and severity of self-reported elbow/medial epicondylar-region pain. Inferential analysis was subsequently performed to examine the association between smartphone-use patterns and pain outcomes.

The demographic and anthropometric characteristics of the participants are presented in Table 1. The mean age of the participants was 24.52 ± 3.72 years, with ages ranging from 18 to 30 years. The average height was 167.13 ± 10.02 cm, while the mean body weight was 67.09 ± 11.19 kg. The mean Smartphone Addiction Scale–Short Version (SAS-SV) score was 33.97 ± 8.96, with scores ranging from 15 to 56. The 95% confidence interval for the mean SAS-SV score was 32.72–35.22, indicating a relatively high level of smartphone engagement within the study population.

Table 1. Baseline Characteristics and Smartphone Addiction Score of Participants (n = 196)

Variable	Mean ± SD	Minimum	Maximum	95% CI for Mean
Age (years)	24.52 ± 3.72	18.00	30.00	24.00–25.04
Height (cm)	167.13 ± 10.02	140.10	195.20	165.72–168.53
Weight (kg)	67.09 ± 11.19	39.90	99.20	65.52–68.65
SAS-SV Total Score	33.97 ± 8.96	15.00	56.00	32.72–35.22

The study sample consisted of both male and female participants, with females representing a slightly larger proportion of the population. As shown in Table 2, 106 participants (54.1%) were female, whereas 90 participants (45.9%) were male. The relatively balanced gender distribution enhances the representativeness of the sample and allows for broader interpretation of the findings across both sexes.

Table 2. Gender Distribution of Participants (n = 196)

Gender	Frequency	Percentage	95% CI for Percentage
Female	106	54.1%	47.1–60.9
Male	90	45.9%	39.1–52.9
Total	196	100.0%	—

Participants reported varying durations of daily smartphone use. Table 3 demonstrates that the largest proportion of participants used smartphones for more than 5 hours per day (43.4%), followed by those using smartphones for 3–5 hours per day (38.8%). Only 17.9% of participants reported smartphone use between 1 and 3 hours daily. Overall, 82.2% of participants reported using smartphones for more than 3 hours per day, indicating a high level of smartphone exposure within the study population.

Table 3. Daily Smartphone-Use Duration Among Participants (n = 196)

Daily Smartphone Use	Frequency	Percentage	95% CI for Percentage
1–3 hours/day	35	17.9%	13.1–23.8
3–5 hours/day	76	38.8%	32.2–45.8
>5 hours/day	85	43.4%	36.6–50.4
Total	196	100.0%	—

The pattern of smartphone handling is summarized in Table 4. One-handed smartphone use was considerably more common than two-handed use. A total of 126 participants (64.3%) reported predominantly using their smartphones with one hand, whereas 70 participants (35.7%) reported two-handed use. This finding suggests that most participants adopted a usage pattern that may place greater repetitive demands on one upper limb during smartphone operation.

Table 4. Smartphone Hand-Use Pattern Among Participants (n = 196)

Hand-Use Pattern	Frequency	Percentage	95% CI for Percentage
One-handed use	126	64.3%	57.4–70.7
Two-handed use	70	35.7%	29.3–42.6
Total	196	100.0%	—

The prevalence of self-reported elbow or medial epicondylar-region pain was assessed over two time periods: the previous 12 months and the previous 7 days. As shown in Table 5, 90 participants (45.9%) reported experiencing elbow pain during the previous 12 months, while 106 participants (54.1%) reported no pain during that period. When considering more recent symptoms, 63 participants (32.1%) reported elbow pain during the previous 7 days, whereas 133 participants (67.9%) reported no recent pain. These findings indicate that elbow-region discomfort was relatively common among participants, although recent symptoms were less prevalent than symptoms reported over the preceding year.

Table 5. Prevalence of Self-Reported Elbow Pain During the Previous 12 Months and Previous 7 Days (n = 196)

Pain Timeframe	Pain Status	Frequency	Percentage	95% CI for Percentage
Previous 12 months	No	106	54.1%	47.1–60.9
Previous 12 months	Yes	90	45.9%	39.1–52.9
Previous 7 days	No	133	67.9%	61.0–74.0
Previous 7 days	Yes	63	32.1%	26.0–39.0

Pain severity scores ranged from 0 to 6 on the assessment scale. Table 6 shows that more than half of the participants (54.1%) reported a pain score of 0, indicating no pain at the time of assessment. Among participants reporting pain, scores of 2, 3, and 4 were the most frequently observed, accounting for 12.8%, 12.8%, and 12.2% of the sample, respectively. Higher pain scores were relatively uncommon, with only 2.6% reporting a score of 5 and 1.0% reporting a score of 6. Overall, the distribution suggests that pain severity was generally mild to moderate among symptomatic participants.

Table 6. Distribution of Pain Severity Scores Among Participants (n = 196)

Pain Score	Frequency	Percentage	95% CI for Percentage
0	106	54.1%	47.1–60.9
1	9	4.6%	2.4–8.5
2	25	12.8%	8.8–18.2
3	25	12.8%	8.8–18.2
4	24	12.2%	8.4–17.6
5	5	2.6%	1.1–5.8
6	2	1.0%	0.3–3.6
Total	196	100.0%	—

Summary of Pain Severity

A summary of pain severity measures is presented in Table 7. Of the 196 participants, 106 (54.1%) reported no pain, while 90 participants (45.9%) reported a pain score greater than zero. The mean pain score for the entire sample was 1.36 ± 1.68, with a 95% confidence interval of 1.13–1.60. Among participants who reported pain, the mean pain score increased to 2.97 ± 1.18, with a 95% confidence interval of 2.72–3.21. These findings indicate that although a substantial proportion of participants experienced elbow-region pain, the average severity among symptomatic individuals remained within the mild-to-moderate range.

Table 7. Summary of Pain Severity Scores

Pain Severity Measure	Value
Participants with pain score = 0	106 (54.1%)
Participants with pain score >0	90 (45.9%)
Mean pain score in full sample	1.36 ± 1.68
95% CI for mean pain score in full sample	1.13–1.60
Mean pain score among participants with pain >0	2.97 ± 1.18
95% CI for mean pain score among participants with pain >0	2.72–3.21
Minimum recorded pain score	0
Maximum recorded pain score	6

To investigate the relationship between smartphone-use patterns and self-reported elbow/medial epicondylar-region pain, chi-square analyses were performed. As shown in Table 8, the Pearson chi-square test did not demonstrate a statistically significant association between smartphone-use pattern and pain status ($\chi^2 = 218.716$, df = 216, $p = 0.436$). Similarly, the likelihood ratio test was not statistically significant ($\chi^2 = 184.087$, df = 216, $p = 0.944$). However, the linear-by-linear association test yielded a statistically significant result ($\chi^2 = 25.283$, df = 1, $p = 0.001$), suggesting the possibility of an ordinal trend within the data. Because the primary Pearson chi-square test was not significant, no definitive association between smartphone-use pattern and elbow pain could be established based on this analysis alone.

Table 8. Association Between Smartphone-Use Pattern and Self-Reported Elbow/Medial Epicondylar-Region Pain

Test	Test Statistic	df	p-value
Pearson Chi-square	218.716	216	0.436
Likelihood Ratio	184.087	216	0.944

Test	Test Statistic	df	p-value
Linear-by-Linear Association	25.283	1	0.001
Valid Cases	196	—	—

The validity of the chi-square analysis was evaluated by examining expected cell frequencies. As presented in Table 9, 255 cells (98.5%) had expected counts below 5, and the minimum expected count was 0.01. These findings indicate substantial violation of the assumptions required for reliable interpretation of the Pearson chi-square test. Consequently, the results of the association analysis should be interpreted with caution, as the sparse distribution of observations across categories may have reduced the reliability of the statistical estimates.

Table 9. Chi-square Assumption Assessment

Parameter	Value
Cells with expected count <5	255
Percentage of cells with expected count <5	98.5%
Minimum expected count	0.01
Valid cases	196

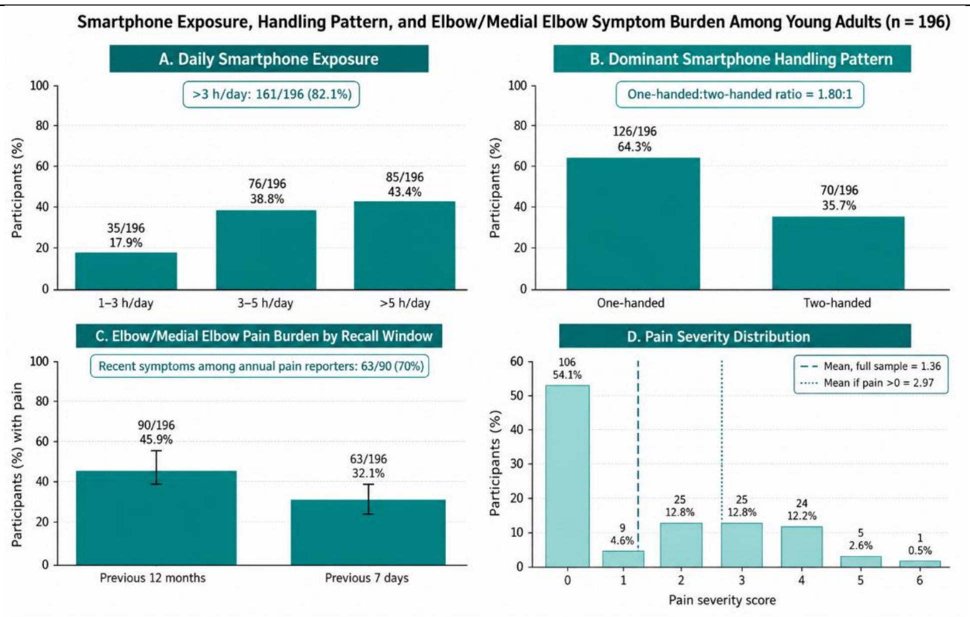

Figure 1 The panelled figure shows a high smartphone-exposure burden among the 196 participants, with 161 participants (82.1%) reporting more than 3 hours of daily smartphone use and 85 participants (43.4%) exceeding 5 hours/day. One-handed smartphone handling was the dominant pattern, reported by 126 participants (64.3%), giving a one-handed to two-handed use ratio of 1.80:1. Elbow/medial elbow pain was reported by 90 participants (45.9%) over the previous 12 months and by 63 participants (32.1%) over the previous 7 days, indicating that recent symptoms represented approximately 70.0% of the annual symptom burden. Pain severity was predominantly absent to mild–moderate, with 106 participants (54.1%) reporting no pain, while symptomatic participants had a mean pain score of 2.97, supporting clinically relevant but generally non-severe elbow-region discomfort in a population with substantial smartphone exposure.

DISCUSSION

The present study examined the frequency of self-reported elbow/medial epicondylar-region pain and its association with smartphone-use patterns among young adults and university students. The findings showed that smartphone exposure was high in this population, with 161 of 196 participants (82.1%) reporting more than 3 hours of smartphone use per day and 85 participants (43.4%) reporting more than 5 hours of daily use. One-handed smartphone handling was also common, reported by 126 participants (64.3%), while 70 participants (35.7%) reported two-handed use. Despite this high exposure burden, the reported Pearson chi-square analysis did not show a statistically significant association between smartphone-use pattern and elbow/medial epicondylar-region pain ($\chi^2 = 218.716$, df = 216, $p = 0.436$). However, this finding requires cautious interpretation because the chi-square assumption was violated, with 255 cells (98.5%) having expected counts below 5 and a minimum expected count of 0.01. Therefore, the present findings should not be interpreted as definitive evidence of no association; rather, they indicate that the available cross-tabulated analysis was insufficiently stable to establish a statistically reliable relationship.

The descriptive findings suggest a clinically relevant burden of elbow-region symptoms in this young adult sample. Elbow pain during the previous 12 months was reported by 90 participants (45.9%), while pain during the previous 7 days was reported by 63 participants (32.1%). Pain severity was generally mild to moderate, with 106 participants (54.1%) reporting no pain and symptomatic participants showing a mean pain score of 2.97 ± 1.18. These findings indicate that although severe pain was uncommon, elbow-region discomfort was not rare among frequent smartphone users. This pattern is consistent with previous evidence showing that smartphone and handheld-device users commonly report musculoskeletal symptoms in the neck, shoulder, wrist, hand, upper back, and elbow regions, particularly when use is prolonged or ergonomically unfavorable (1–3,8,10).

The high proportion of participants reporting prolonged daily smartphone use is consistent with previous studies in student populations. Baabdullah et al. reported that smartphone addiction and longer daily smartphone use were associated with musculoskeletal pain in the neck, wrists/hands, shoulders, and upper back among university students (3). Phuyal et al. similarly reported that excessive smartphone use among medical and nursing students was associated with increased neck and wrist/hand pain (4). Mersal et al. also found that mobile phone use for more than 5 hours per day was associated with musculoskeletal complaints among nursing students (11). The present study differs from these studies by focusing specifically on the elbow or medial elbow region rather than broader upper-limb or spinal symptoms. This narrower anatomical focus may partly explain why a statistically significant association was not clearly demonstrated, particularly because elbow symptoms may be influenced by additional factors such as sport participation, typing workload, gym activity, dominant-hand use, occupational tasks, and prior musculoskeletal complaints.

One-handed smartphone use was the dominant handling pattern in the present study, reported by nearly two-thirds of participants. This finding is biomechanically relevant because one-handed use may increase the demand on the thumb, wrist, and forearm flexor-pronator musculature, potentially increasing load near the medial epicondylar region during sustained gripping, texting, browsing, or gaming. Lee et al. reported higher upper-extremity muscle activity and pain sensitivity during one-handed smartphone use compared with two-handed use, supporting the possibility that handling pattern may influence upper-limb loading (6). Depreli and Angin also found significant relationships between smartphone-use position, pain, smartphone addiction, and hand function, suggesting that wrist and elbow posture during smartphone use may contribute to discomfort (7). Wang et al. further reported that smartphone posture and hand-use pattern influenced pain distribution in the neck, trunk, and upper limbs among smartphone users (12). Although these studies support a plausible biomechanical pathway, the present dataset did not provide complete exposure-by-outcome crosstabs to determine whether one-handed use was directly associated with higher elbow-pain prevalence.

The absence of a statistically significant Pearson chi-square association in the present study may reflect methodological and analytical limitations rather than a true absence of clinical relationship. The reported chi-square test had a very high number of degrees of freedom, indicating that too many categories may have been cross-tabulated, most likely involving multiple response categories or continuous scores treated as categorical variables. The resulting sparse-cell structure makes the Pearson chi-square result unreliable. In contrast, the reported linear-by-linear association was statistically significant ($\chi^2 = 25.283$, df = 1, $p = 0.001$), but this test was not interpreted in the original analysis and can only be considered meaningful if the categories were ordinal and correctly specified. Therefore, the association analysis should be repeated using clinically meaningful collapsed exposure categories, such as 1–3 hours, 3–5 hours, and more than 5 hours of daily smartphone use, and one-handed versus two-handed handling, with elbow pain coded as present or absent. Such analysis should report effect sizes, odds ratios, and 95% confidence intervals rather than relying on p-values alone.

Another important consideration is outcome specificity. The present study aimed to investigate medial epicondylar pain, but the available results primarily report elbow pain assessed through self-reported questionnaire data. Although medial epicondylar pain may plausibly occur due to repetitive gripping, wrist flexion, pronation stress, and sustained forearm muscle loading, self-reported elbow pain does not confirm clinically diagnosed medial epicondylitis. Konarski et al. emphasized that medial epicondylitis involves pain and tenderness around the medial epicondyle and is related to common flexor-pronator tendon pathology, but accurate classification requires appropriate clinical localization and diagnostic assessment (13). Therefore, the present findings are best interpreted as preliminary evidence regarding elbow or medial elbow-region symptoms among smartphone users, rather than definitive evidence regarding confirmed medial epicondylitis.

The findings should also be interpreted in the context of the study design. A cross-sectional survey can estimate symptom frequency and explore associations but cannot establish whether smartphone use preceded elbow pain or whether participants with elbow pain changed their smartphone-use behavior. Recall bias may also have affected reporting of 12-month pain, daily smartphone use, and pain severity. Convenience sampling from a limited university and teaching-hospital setting may restrict generalizability to other age groups, occupational groups, or populations with different smartphone-use habits. In addition, potentially important confounders, including physical activity level, hand dominance, academic writing load, laptop use, occupational tasks, sports participation, prior upper-limb symptoms, and ergonomic posture, were not included in the available analysis.

Despite these limitations, the study contributes useful preliminary data by focusing attention on the elbow/medial elbow region, an anatomical area that has received less attention than the neck, shoulder, wrist, and hand in smartphone-related musculoskeletal research. The high prevalence of prolonged smartphone use and the notable frequency of elbow-region pain suggest that ergonomic education remains relevant even though the available inferential analysis did not establish a robust association. Future studies should use a longitudinal design, probability-based or multicenter sampling, clinically confirmed medial epicondylar pain criteria, objective or app-based smartphone-use measurement, and statistical models that adjust for relevant confounders. Complete reporting of crosstabulated counts, effect sizes, confidence intervals, and sensitivity analyses would improve interpretability and allow clearer conclusions regarding whether smartphone-use duration, addiction score, and one-handed handling independently contribute to medial elbow symptoms.

CONCLUSION

This cross-sectional study found that prolonged smartphone exposure and one-handed smartphone handling were common among young adults and university students, with 82.1% of participants using smartphones for more than 3 hours per day and 64.3% reporting one-handed use. Self-reported elbow/medial elbow-region pain was also frequent, affecting 45.9% of participants over the previous 12 months and 32.1% over the previous 7 days, while pain severity among symptomatic participants was generally mild to moderate. The reported Pearson chi-square analysis did not show a statistically significant association between smartphone-use pattern and elbow/medial epicondylar-region pain; however, the result should be interpreted cautiously because the test assumptions were substantially violated by sparse expected cell counts. Overall, the study suggests a meaningful symptom burden among frequent smartphone users but does not provide statistically robust evidence that excessive smartphone-use patterns are independently associated with elbow/medial epicondylar-region pain. Future research should use clinically confirmed outcome assessment, complete exposure-by-outcome reporting, appropriately powered analyses, and longitudinal designs to clarify the relationship between smartphone-use behavior and medial elbow symptoms.

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