

Research Article

Exploring The Link between Smartphone Use and De Quervain's Tenosynovitis: A Focus on Ergonomic Influences

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INTRODUCTION

Over the past decade, smartphones have become an essential part of everyday life, providing convenient access to communication, internet browsing, entertainment, and gaming.(1) In Pakistan, approximately 193.4 million cellular mobile connections were reported during 2023–2024, corresponding to more than 75% of the country's population(2). The widespread and prolonged use of smartphones and other touchscreen devices often involves holding the device with one or both hands below eye level, maintaining a forward-flexed or downward-tilted head position, and repeatedly operating the screen predominantly with the thumb(3). Such sustained exposure to awkward postures and repetitive hand and thumb movements has been associated with an increased risk of musculoskeletal discomfort and overuse-related disorders. Among these conditions, De Quervain's disease is a common repetitive strain disorder characterized by stenosing tenosynovitis involving the abductor pollicis longus and extensor pollicis brevis tendons within the first dorsal compartment of the wrist(4).

Extensive research has identified a positive correlation between excessive smartphone usage and De Quervain's tenosynovitis. However, the specific factors contributing to this condition such as smartphone usage

behavior and ergonomic aspects, such as holding gestures, the weight and size of the device, remain insufficiently explored.(5,6)These identified gaps underscore the urgent need for more targeted investigations into the role of smartphones in the development of De Quervain's tenosynovitis

This study seeks to address existing gaps by investigating smartphone usage behaviors including screen time, repetitive gestures, and ergonomic risk factors particularly weight and size of the device that contributes to De Quervain's tenosynovitis. By examining usage patterns, ergonomic practices, and their relationship with symptom development, the research aims to enhance understanding of this condition. Ultimately, the findings will offer evidence-based insights to guide preventive strategies, ergonomic improvements, and awareness initiatives, reducing the health risks linked to excessive smartphone use.

Objectives:

Primary Objective:

- To determine the association between smartphone use and the frequency of De Quervain's Tenosynovitis among adults.

Secondary Objectives:

- To evaluate the impact of selective ergonomic factors—such as smartphone

weight, screen size, screen time and holding gestures—on the development of De Quervain's Tenosynovitis.

METHODOLOGY

This cross-sectional study was conducted at the outpatient department (OPD) of Sohail Trust Hospital, Karachi, Pakistan, over a six-month period. Adults aged 18–60 years who were regular smartphone users (≥ 2 hours daily) and provided written informed consent were included. Exclusion criteria comprised pre-existing musculoskeletal disorders unrelated to smartphone use, recent wrist or thumb injuries (within 30 days), heavy thumb/wrist activity in the preceding two weeks, prior diagnosis of De Quervain's Tenosynovitis, or prolonged daily use of devices such as keyboards, mice, or micropipettes (>6 hours/day).

De Quervain's Tenosynovitis was diagnosed clinically using the Finkelstein Test, performed by primary investigator in which the thumb is tucked into the palm, fingers wrapped over it, and the wrist deviated ulnarward; pain along the radial side of the wrist was considered positive. (7) Smartphone screen time was recorded using built-in software (Digital Wellbeing for Android, Screen Time for iOS). Device weight was measured in grams using a digital scale, and device size was measured

diagonally in inches with a ruler. Smartphone holding gestures were assessed using schematic diagrams adapted from a validated pictorial questionnaire(5) illustrated in figure 1, with participants identifying most appropriate gesture that best represented their usage habits.

Recruitment was carried out via verbal announcements in OPD waiting areas. Demographic and ergonomic data were collected using a structured questionnaire, and each participant was assigned a unique study code to ensure confidentiality. Ethical approval was obtained from the ERC department of JMDC prior to study initiation.

The sample size was calculated using the OpenEpi proportion method, based on a reported prevalence of 67% from a prior study on teenage mobile users, (8) with 95% confidence level and 5% precision, yielding a required sample of 340 participants.

Data were analyzed using SPSS version 22. Frequencies and percentages were calculated for qualitative variables, while means and standard deviations were reported for quantitative variables. Associations between ergonomic factors and De Quervain's Tenosynovitis were tested using Chi-square and, with $p < 0.05$ considered statistically significant.

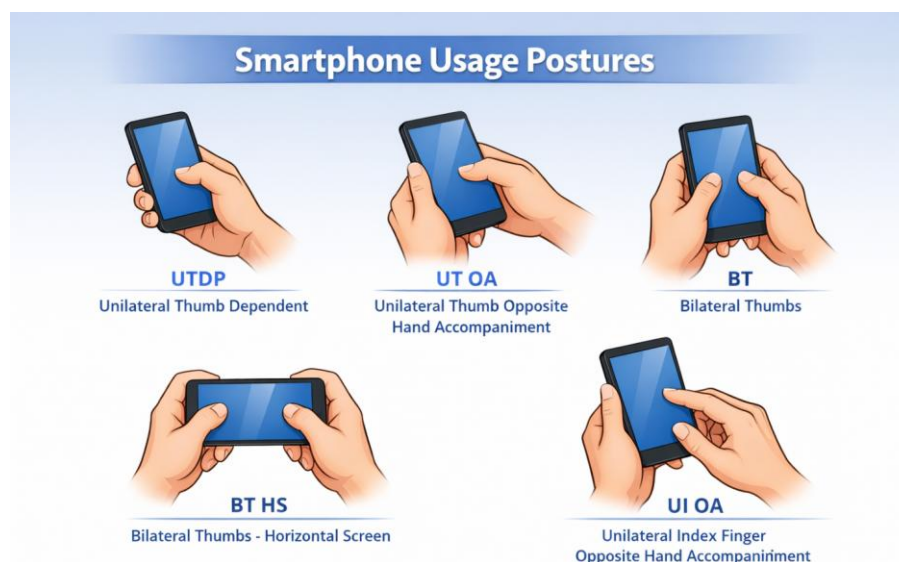


Figure 1: Schematic representation of smartphone usage postures assessed in the study. (A) Unilateral Thumb Dependent Posture (UTDP): holding the smartphone in one hand and operating it primarily with the thumb of the same hand. (B) Unilateral Thumb

Opposite Hand Accompaniment (UT OA): holding the smartphone with one hand while the opposite hand provides support, operated by the thumb of the holding hand. (C) Bilateral Thumbs (BT): holding the smartphone vertically with both hands and operating it

using both thumbs. (D) Bilateral Thumbs – Horizontal Screen (BT HS): holding the smartphone horizontally and operating it using both thumbs. (E) Unilateral Index Finger – Opposite Hand Accompaniment (UI OA): holding the smartphone with one hand while the opposite hand stabilizes, operated by the index finger of the holding hand.

RESULTS

A total of 350 participants were included in the study, comprising 186 males (53.1%) and 164 females (46.9%). Age ranged from 18 to 58 years, with a mean of 27.9 years (SD = 8.2; N

= 350). For comparative analysis, participants were divided into two age groups: 18–35 years and 36–58 years. The majority reported no comorbidities (89.4%), with hypertension (5.1%) and diabetes (2.9%) being the most common conditions. Participants represented diverse occupational groups, with students (34.0%), office and professional workers (21.4%), and homemakers (17.4%) forming the largest categories. The detailed distribution of participant demographics, comorbidities, and occupational groups is presented in Table 1.

Variable	Category	n (%)
Gender	Male	186 (53.1)
	Female	164 (46.9)
Comorbidities	None	313 (89.4)
	Hypertension	18 (5.1)
	Diabetes	10 (2.9)
	Asthma	2 (0.6)
	Thyroid disease	3 (0.9)
	CLD	1 (0.3)
	PCOS	2 (0.6)
	Thalassemia minor	1 (0.3)
Occupation	Healthcare professional	44 (12.6)
	Homemaker	61 (17.4)
	Student	119 (34.0)
	Laborer	12 (3.4)
	Office/Professional jobs	75 (21.4)
	Self-employed	26 (7.4)
	Education sector	13 (3.7)

Table 1: Participant Characteristics (N = 350)

Overall, 190 participants (54.3%) demonstrated a positive Finkelstein's test. Right-hand involvement was the most common one that was observed in 85 participants. and left-hand involvement in 33 participants while bilateral positivity was seen in 74 participants .This distribution is illustrated in Figure 2.

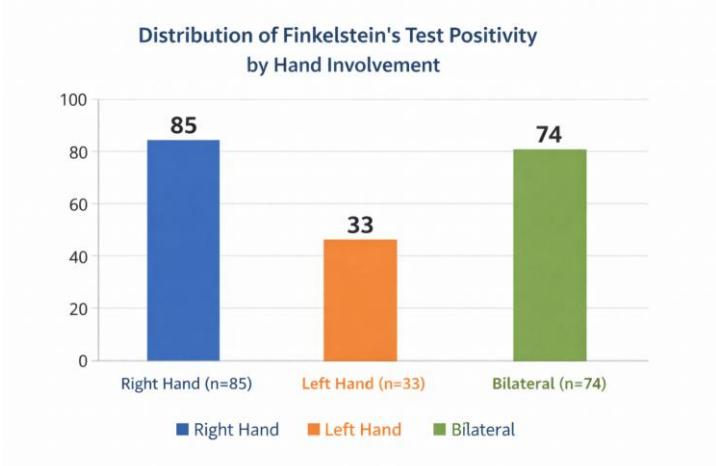


Figure 2: Frequency of Finkelstein's Test Positivity by Hand Involvement.

Associations between demographic, comorbidity, occupational, smartphone holding gestures, and ergonomic/device characteristics with Finkelstein's test outcomes are summarized in Table 3. It showed that gender and most comorbidities were not significantly associated with Finkelstein's test, though diabetes showed a borderline trend ($p = 0.098$). positive Finkelstein's test results were most frequent among healthcare professionals (61.4%), homemakers (59.0%), and students (55.5%). However, chi-square testing revealed no statistically significant association between occupation and De Quervain's tenosynovitis

($\chi^2 = 3.839$, $df = 6$, $p = 0.698$). Analysis of smartphone holding gestures showed that Unilateral Thumb Dependent Posture (UTDP) was the most prevalent (67.4%), followed by Bilateral Thumbs (19.7%). Among the gestures, Unilateral Thumb Opposite Hand Accompaniment (UT OA) demonstrated a statistically significant association with De Quervain's tenosynovitis ($p = 0.022$), while other gestures did not reach significance. Device characteristics further influenced outcomes. Larger screen size (>6.5 inches) was significantly associated with positive Finkelstein's test ($p = 0.034$).

Table 3: Association of Participant Variables and Device Characteristics with Finkelstein's Test Outcomes (N = 350)

Variable	Category	Negative (n)	Positive (n)	χ^2 Value	p-value
Age	15-35	135	162	0.053	0.817
	36	25	28		
Gender	Male	88	98	0.408	0.523
	Female	72	92		
Comorbidities	Hypertension	9	9	0.140	0.708
	Diabetes	2	8	2.743	0.098
	Asthma	0	2	1.694	0.193
	Thyroid disease	2	1	0.535	0.464
	CLD	1	0	1.191	0.275
	PCOS	1	1	0.015	0.903
	Thalassemia minor	0	1	0.845	0.358
Occupation	Healthcare professional	12	27	3.839	0.698
	Homemaker	25	36		
	Student	53	66		
	Laborer	6	6		
	Office/Professional jobs	38	37		
	Self-employed	15	11		
	Education sector	6	7		
Smartphone Holding Gestures	UTDP	116	120	3.452	0.063
	UT_OA	7	21	5.262	0.022*
	BT	33	36	0.154	0.694
	BT_HS	3	6	0.571	0.450
	UI_OA	2	7	2.054	0.152
Hand Dominance	Right	141	171	0.316	0.574
	Left	19	19		
Screen Time Groups	2-5 hrs	73	72	2.203	0.332
	5.1-8 hrs	62	86		
	8.1-13 hrs	25	32		
Device Size	5.0-6.5 inch	58	49	4.478	0.034*
	>6.5 inch	102	141		
Device Weight	100-150 g	1	1	2.576	0.462
	151-200 g	74	76		
	201-250 g	82	105		
	>250 g	3	8		

**significant p value <0.05*

Device weight showed descriptive trends, with heavier devices (>200 g) linked to higher prevalence of positive tests, though regression analysis indicated weight was not an independent predictor ($R^2 = 0.006$, $p = 0.146$). Screen time also showed weak correlation ($R^2 = 0.004$, $p = 0.246$), with the highest prevalence in the 5.1–8 hour groups shown in Table 4.

However Cross tabulation demonstrated that heavier devices combined with longer screen time increased the likelihood of positive Finkelstein's test. This association was statistically significant ($\chi^2 = 14.091$, $p = 0.029$), shown in Table 5 highlighting that cumulative ergonomic load (weight + screen time) is a meaningful risk factor, even though weight and screen time individually were weak predictors.

Table 4: Regression Analysis of Screen Time and Device Weight with Finkelstein's Test Outcomes

Predictor Variable	R	R ²	Beta
Screen Time	0.062	0.004	0.062
Device Weight	0.078	0.006	0.078

Both screen time and device weight showed weak correlations ($R^2 = 0.004$ and 0.006 , respectively) and were not statistically significant ($p > 0.05$).

Table 5: Association between Device Weight, Screen Time, and Finkelstein's Test Outcomes

Groups by Weight * Groups by Screen Time * FINKELISTEIN_TEST Cross tabulation							
FINKELISTEIN_TEST			Groups by Screen Time			χ^2	P value
			2 Hr- 5 Hrs	5.1 Hrs- 8 Hrs	>8 Hrs		
NEGATIVE	Group by Weight	100-150 gm	0	1	0	6.879	0.332
		151-200 gm	36	25	13		
		201-250 gm	34	36	12		
		>250	3	0	0		
POSITIVE	Group by Weight	100-150 gm	0	0	1	14.091	0.029*
		151-200 gm	24	36	16		
		201-250 gm	46	44	15		
		>250	1	7	0		

Table X: Cross-tabulation showing the relationship between device weight and screen-time groups with Finkelstein's test results.

**significant p value <0.05*

DISCUSSION

Prolonged smartphone use is increasingly being recognized as an important contributor to musculoskeletal health problems, with De Quervain's tenosynovitis (DQT) representing a clinically relevant condition associated with repetitive thumb movements and sustained non-neutral wrist postures.⁹ In the present study, 54.3% of participants demonstrated a positive Finkelstein's test, indicating a substantial prevalence of DQT-related clinical findings. This prevalence is broadly consistent with the findings of Nie et al.⁵, who reported a prevalence of 52% among Chinese college students, while Asad et al.⁸ observed a comparatively higher prevalence of 67.5% among Saudi teenagers. Similarly, Benites-Zapata et al.¹⁰ reported a positivity rate of

53% and identified a significant association between DQT and problematic mobile phone use, further supporting the potential relationship between intensive smartphone exposure and thumb-related musculoskeletal disorders. More recently, Bezie et al.¹¹, in a systematic review and meta-analysis, reported a pooled prevalence of 46.3% (95% CI: 35.4–57.3), highlighting the considerable burden of DQT across different populations.

The consistency of these findings with the present study strengthens the external validity of our results and suggests that smartphone-related ergonomic factors may represent a widespread risk for DQT. A distinctive strength of the present study is its inclusion of participants across a broad age range from the general population, rather than being

restricted to specific age groups, students, or populations selected on the basis of individual predictors. This broader population-based approach provides a more comprehensive assessment of the potential burden of DQT associated with contemporary smartphone use.

Demographic factors such as age and gender were not significantly associated with DQT in our study, consistent with findings of the previous studies (10,12) similarly different comorbidities were not statistically significant, however diabetes showed a borderline trend, echoing Clinical Rheumatology (13) which implicated metabolic disorders in tendon vulnerability. This suggests systemic conditions may act as modifiers rather than primary drivers of tendon pathology.

Occupational categories revealed higher prevalence among healthcare professionals, homemakers, and students, though statistical testing did not support occupation as an independent risk factor. Comparable findings were reported in previous studies (14) and (15) where ergonomic exposure rather than professional role was emphasized as the determinant of risk.

Smartphone holding gestures collectively emerged as a critical variable in previous study from China (5). Among all these gestures the Unilateral Thumb Opposite Hand Accompaniment (UT OA) posture demonstrated a significant association with positive Finkelstein's test, consistent with the Journal of Musculoskeletal Pain (16), which identified thumb-intensive gestures as independent predictors of DQT. Other gestures, including the more common UTDP, did not reach statistical significance, though their high prevalence suggests potential cumulative risk over time.

Device characteristics further shaped outcomes. Larger screen sizes (>6.5 inches) were significantly associated with positive Finkelstein's test results, corroborating prior evidence from previous studies (17,18)

In our study, device weight and screen time showed descriptive trends but were not statistically significant. Regression analysis revealed that neither variable independently predicted musculoskeletal strain. This contrasts with previous studies, which consistently reported a positive correlation between longer device use and musculoskeletal discomfort [19,20], this apparent contradiction may be explained by passive device use, situations where time is

recorded but active musculoskeletal engagement is minimal thereby diluting the predictive strength of time in regression models.

Importantly, cross-tabulation revealed that combined ergonomic load — heavier devices coupled with longer screen time — was statistically significant, substantially increasing risk. This cumulative effect aligns with findings from the *Ergonomics Journal* (21) and the *International Journal of Occupational Safety* (22), both of which emphasized that prolonged exposure to multiple ergonomic stressors constitutes a meaningful risk factor for musculoskeletal strain.

Our study reinforces the concept that smartphone-related DQT is not merely a function of usage duration but results from the interplay of holding gesture, device design, and cumulative ergonomic load.

This study is among the few to evaluate multiple ergonomic and behavioral factors related to De Quervain's tenosynovitis (DQT) collectively in the general population, rather than focusing on isolated predictors. The use of built-in mobile software for screen time and device data collection reduced recall bias compared to self-reported measures, and the integration of observed ergonomic assessments with clinical testing (Finkelstein's test) strengthened the validity of associations. Furthermore, employing both regression and cross-tabulation analyses allowed identification of cumulative ergonomic effects that may be overlooked when variables are examined independently.

Several limitations should also be acknowledged. First, the cross-sectional design restricts causal inference. Second, although mobile software improved accuracy compared to self-report, it could not distinguish periods of passive use, potentially diluting associations. Third, the study population was drawn from a single region, which may limit generalizability. Fourth, ergonomic assessments relied on observed postures rather than biomechanical measurements, which could underestimate subtle strain patterns. Finally, comorbidity prevalence was relatively low, reducing statistical power to detect associations with systemic conditions.

Future research should incorporate longitudinal designs to establish causality between smartphone use and DQT. Biomechanical analyses, including tendon loading and kinematic studies, would provide deeper insight into posture-related risks.

Broader, multicenter studies could enhance generalizability across diverse populations. Preventive strategies should focus on ergonomic education, device design improvements (lighter weight, optimized screen size), and moderated screen time. Incorporating workplace and educational interventions may further mitigate risk among high-use groups such as healthcare professionals and students.

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