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SMARTPHONE OVERUSE AS A RISK FACTOR FOR CARPEL TUNNEL SYNDROME AND HAND DYSFUNCTION AMONG YOUNG ADULTS: A CROSS-SECTIONAL STUDY SMARTPHONE OVERUSE AND CTS

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ABSTRACT

Background: In the modern digital era, smartphone integration into daily life is nearly universal, yet the ergonomic consequences remain under-investigated in younger populations. **Objective:** This study aims to determine the prevalence of Carpal Tunnel Syndrome (CTS) and general hand dysfunction in young adults (aged 18–30) specifically in relation to daily usage time and the presence of systemic comorbidities. **Methods:** A cross-sectional study was conducted using a sample of young adults. Clinical assessment tools included the Boston Carpal Tunnel Questionnaire (BCTQ), the Wrist Ratio Index, and goniometry to measure Range of Motion (ROM). **Results:** Smartphone usage showed a strong positive correlation with BCTQ symptom severity ($r = 0.822$, $p < 0.001$) and functional status ($r = 0.831$, $p < 0.001$). A moderate positive correlation was observed between smartphone use and Wrist Ratio Index ($r = 0.429$, $p = 0.001$ o). Significant negative correlations were found between smartphone usage and wrist ROM, including flexion ($r = -0.860$, $p < 0.001$), extension ($r = -0.649$, $p < 0.001$), ulnar deviation ($r = -0.656$, $p < 0.001$), and radial deviation ($r = -0.656$, $p < 0.001$). Increased smartphone use was also associated with reduced sensory discrimination. **Conclusion:** Excessive smartphone use is a primary modifiable risk factor for CTS. Targeted ergonomic interventions and behavioral modifications are necessary to prevent long-term musculoskeletal damage in young adults.

1. INTRODUCTION

The evolution of mobile technology has shifted the smartphone from a simple communication tool to an indispensable hub for work, education, and social interaction. However, this "digital appendage" comes at a physical cost. As usage hours climb, particularly among the "digital native" generation, clinicians are observing a rise in repetitive strain injuries that were once primarily associated with industrial manual labor.

1.1 OBJECTIVE

The primary objective of this study is to evaluate the physiological impact of smartphone overuse on the median nerve and overall hand function among young adults.

1.2 Rational of Study

With the global digital surge, colloquial terms like "text neck" and "smartphone thumb" have entered the medical lexicon. However, the internal physiological changes—specifically the compression of the carpal tunnel—require deeper academic scrutiny. This study focuses on the repetitive micro-trauma caused by the prolonged static gripping of devices and the high frequency flexion of the thumb. By establishing a clear "usage threshold," we can provide better clinical guidelines for prevention.

Research Que: Does smartphone usage exceeding 3 hours daily significantly increase the risk of developing clinical symptoms of CTS

Hypothesis: There is a significant positive correlation between smartphone usage duration and the severity of CTS symptoms and functional hand impairment.

Null/Alternate Hypothesis: H0: Smartphone usage duration has no effect on hand function or median nerve health.

H1: Smartphone usage for >3 hours significantly increase the risk of CTS and hand dysfunction.

2. REVIEW OF LITERATURE

Recent literature highlights a worrying trend: the repetitive flexion and extension of the thumb, combined with the static isometric contraction required to hold a smartphone, increases the fluid pressure within the carpal tunnel. Studies have shown that the median nerve, which passes through this narrow corridor in the wrist, is highly sensitive to these pressure changes. Existing research suggests that young adults are the highest consumers of mobile data globally, often spending upwards of 5 to 7 hours on their devices. This makes them the most vulnerable demographic for early-onset musculoskeletal disorders. Previous studies have often focused on office workers and keyboard usage; however, the unique ergonomics of smartphone use—characterized by a smaller "pinch" grip and sustained wrist deviation—presents a different set of mechanical stresses that necessitate specific study.

3. MATERIAL METHOD (CROSS-SECTIONAL)

3.1 Study Design

This study employed an cross-sectional analitical design to capture a snapshot of the relationship between smartphone habits and hand health within the target population at a single point in time.

3.2 Duration of Study

The data collection and clinical assessment phase of this study were conducted over a period of 3 months, allowing for a robust sample size and thorough physical examinations.

3.3 Inclusion Criteria

Young adults aged 18–30 years.
Regular smartphone users (minimum 1 hour of daily use).
Individuals capable of providing informed consent and undergoing physical measurements.

3.4 Exclusion Criteria

To ensure that symptoms were not related to prior trauma, we excluded participants with:
A history of significant trauma to the wrist or hand (fractures, etc.).
Diagnosed cervical radiculopathy (which can mimic CTS symptoms).
Recent hand or wrist surgery (within the last 24 months).

3.5 Outcomes

- Primary Outcomes: Symptom severity and functional status as measured by the BCTQ.
- Secondary Outcomes: Wrist morphology (Wrist Ratio Index), joint flexibility (Range of Motion), and neurological sensitivity (2-point discrimination).

3.6 Scales / Tools

- Boston Carpal Tunnel Questionnaire (BCTQ): A validated tool to assess symptom intensity.
- Wrist Ratio Index: Calculated using calipers to measure the depth and width of the wrist (Ratio=Width Depth). A ratio >0.69 is often a predisposition to CTS.
- Goniometry: Used to measure the degree of wrist flexion and extension.
- 2-Point Discriminator: To assess sensory loss in the fingertips.

4. RESULTS (FINDINGS / STATISTICS)

Data was analyzed using SPSS version 26.0. Descriptive statistics characterized the demographic, while Spearman's rho Correlations and Pearson Correlations were used to compare the heavy-use (>3 hours) and light-use (<3 hours) groups. Smartphone usage showed a strong positive correlation with BCTQ symptom severity ($r = 0.822$, $p < 0.001$) and functional status ($r = 0.831$, $p < 0.001$). A moderate positive correlation was observed between smartphone use and Wrist Ratio Index ($r = 0.429$, $p = 0.006$). Significant negative correlations were found between smartphone usage and wrist ROM, including flexion ($r = -0.860$, $p < 0.001$), extension ($r = -0.649$, $p < 0.001$), ulnar deviation ($r = -0.656$, $p < 0.001$), and radial deviation ($r = -0.656$, $p < 0.001$). Increased smartphone use was also associated with reduced sensory discrimination. Participants with diabetes and osteoarthritis demonstrated greater severity of dysfunction.

Frequencies

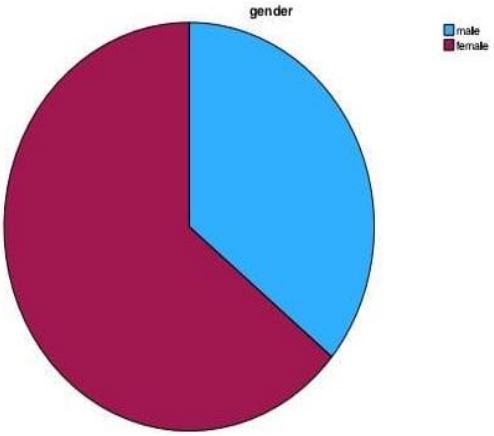
Statistics

gender

N	Valid	50
	Missing	0

gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	male	18	36.0	36.0	36.0
	female	32	64.0	64.0	100.0
	Total	50	100.0	100.0	



Point Discrimination

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
smartphone usage hours	50	1.00	2.00	1.6800	.47121
Sensations on dominent hand	50	1.00	3.00	1.7200	.72955
Sensations on less dominent hand	50	1.00	3.00	2.6400	.59796
Valid N (listwise)	50				

Correlations

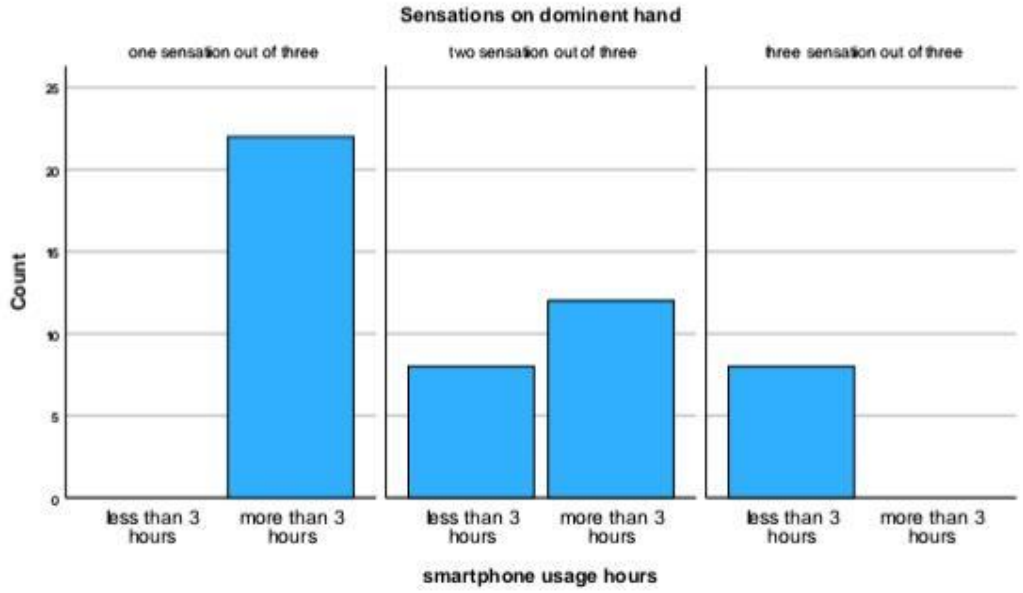
Correlations

		smartphone usage hours	Sensations on dominent hand	Sensations on less dominent hand
smartphone usage hours	Pearson Correlation	1	-.741***	-.345*
	Sig. (2-tailed)		<.001	.014
	N	50	50	50
Sensations on dominent hand	Pearson Correlation	-.741***	1	.466***
	Sig. (2-tailed)	<.001		<.001
	N	50	50	50
Sensations on less dominent hand	Pearson Correlation	-.345*	.466***	1
	Sig. (2-tailed)	.014	<.001	
	N	50	50	50

***. Correlation at 0.001(2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed).

Graph



1. BOSTON CARPEL TUNNEL QUESTIONNAIRE

Nonparametric Correlations

Correlations

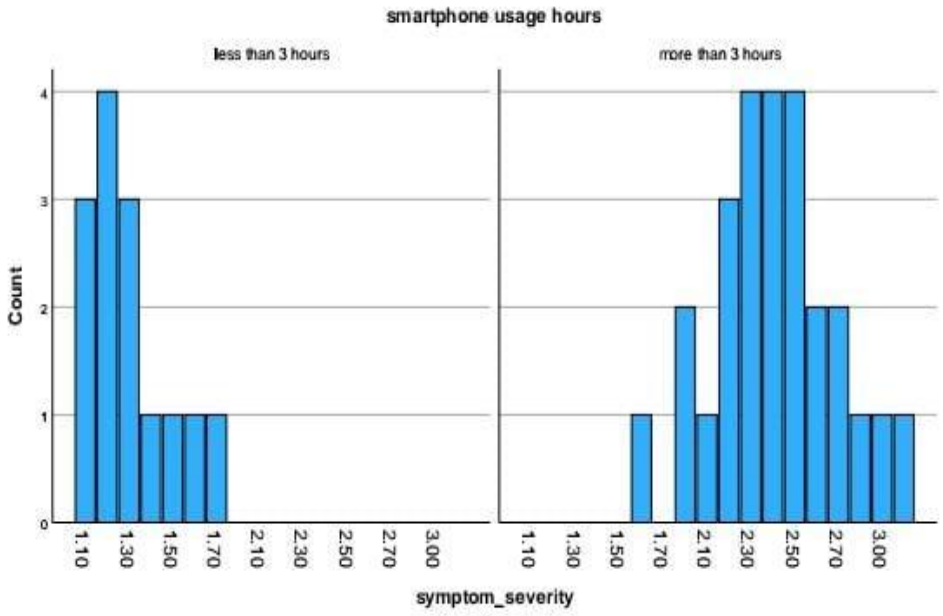
			smartphone usage hours	symptom_severity
Spearman's rho	smartphone usage hours	Correlation Coefficient	1.000	.822***
		Sig. (2-tailed)	.	<.001
		N	40	40
	symptom_severity	Correlation Coefficient	.822***	1.000
		Sig. (2-tailed)	<.001	.
		N	40	40
	functional_status	Correlation Coefficient	.831***	.822***
		Sig. (2-tailed)	<.001	<.001
		N	40	40

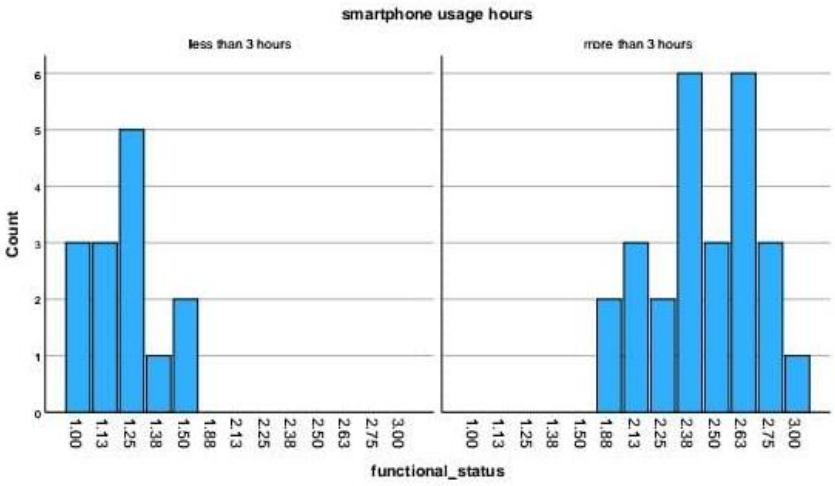
Correlations

			functional_status
Spearman's rho	smartphone usage hours	Correlation Coefficient	.831***
		Sig. (2-tailed)	<.001
		N	40
	symptom_severity	Correlation Coefficient	.822***
		Sig. (2-tailed)	<.001
		N	40
	functional_status	Correlation Coefficient	1.000
		Sig. (2-tailed)	.
		N	40

***. Correlation is significant at the 0.001 level (2-tailed).

Graph





2. WRIST RATIO INDEX

Descriptives

[DataSet8] C:\Users\Ahmed Raza\Downloads\wrist ratio index.sav

Descriptive Statistics

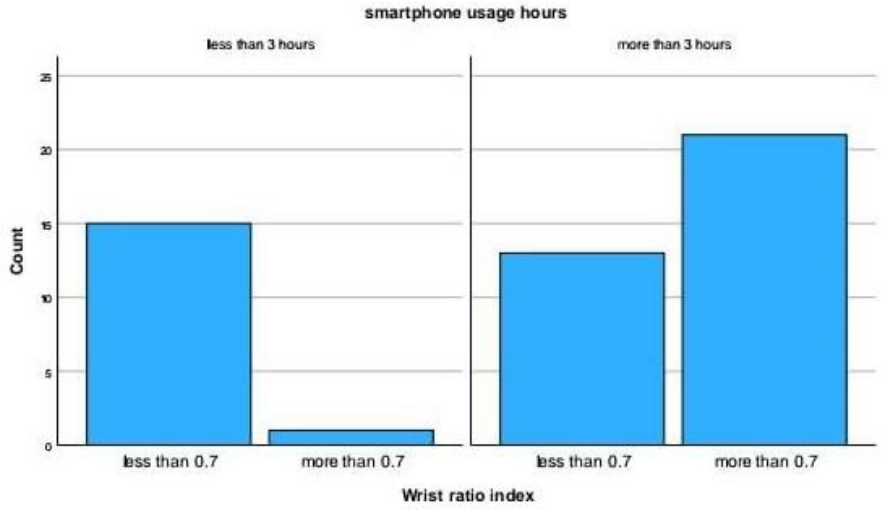
	N	Minimum	Maximum	Mean	Std. Deviation
smartphone usage hours	50	1.00	2.00	1.6800	.47121
Wrist ratio index	50	1.00	2.00	1.4400	.50143
Valid N (listwise)	50				

Correlations

Correlations

		smartphone usage hours	Wrist ratio index
smartphone usage hours	Pearson Correlation	1	.522***
	Sig. (2-tailed)		<.001
	N	50	50
Wrist ratio index	Pearson Correlation	.522***	1
	Sig. (2-tailed)	<.001	
	N	50	50

***. Correlation at 0.001(2-tailed)



3. ROM WITH GONIOMET

Descriptives

```
[DataSet6] C:\Users\Ahmed Raza\Downloads\ROM With goniometer.sav
```

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
smartphone usage hours	50	1.00	2.00	1.6800	.47121
flexion	50	1.00	3.00	1.9600	.80711
extension	50	1.00	3.00	1.8400	.68094
ulnar deviation	50	1.00	3.00	1.8200	.66055
radial deviation	50	1.00	3.00	1.7600	.65652
Valid N (listwise)	50				

Correlations

Correlations

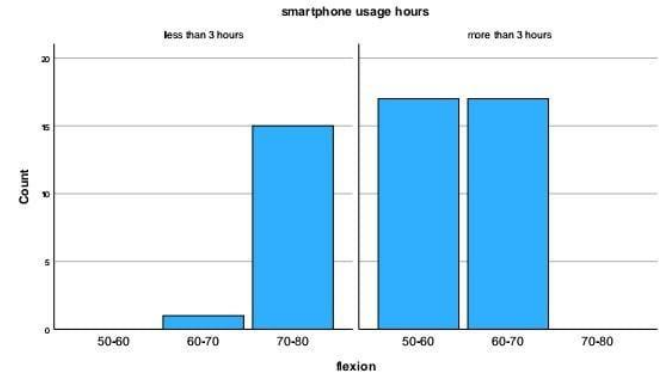
		smartphone usage hours	flexion	extension	ulnar deviation
smartphone usage hours	Pearson Correlation	1	-.839***	-.672***	-.648***
	Sig. (2-tailed)		<.001	<.001	<.001
	N	50	50	50	50
flexion	Pearson Correlation	-.839***	1	.731***	.714***
	Sig. (2-tailed)	<.001		<.001	<.001
	N	50	50	50	50
extension	Pearson Correlation	-.672***	.731***	1	.525***
	Sig. (2-tailed)	<.001	<.001		<.001
	N	50	50	50	50
ulnar deviation	Pearson Correlation	-.648***	.714***	.525***	1
	Sig. (2-tailed)	<.001	<.001	<.001	
	N	50	50	50	50
radial deviation	Pearson Correlation	-.649***	.752***	.460***	.510***
	Sig. (2-tailed)	<.001	<.001	<.001	<.001
	N	50	50	50	50

Correlations

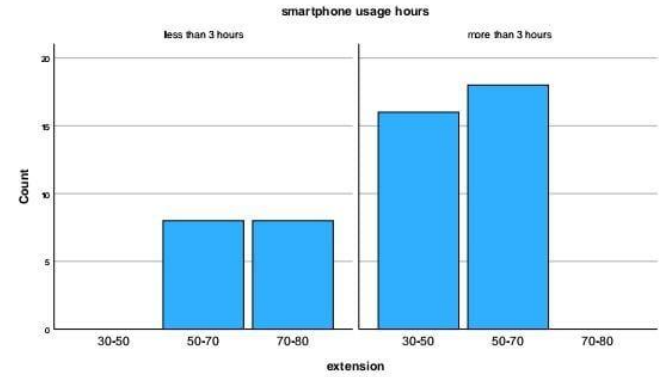
		radial deviation
smartphone usage hours	Pearson Correlation	-.649***
	Sig. (2-tailed)	<.001
	N	50
flexion	Pearson Correlation	.752***
	Sig. (2-tailed)	<.001
	N	50
extension	Pearson Correlation	.460***
	Sig. (2-tailed)	<.001
	N	50
ulnar deviation	Pearson Correlation	.510***
	Sig. (2-tailed)	<.001
	N	50
radial deviation	Pearson Correlation	1
	Sig. (2-tailed)	
	N	50

***. Correlation at 0.001(2-tailed)

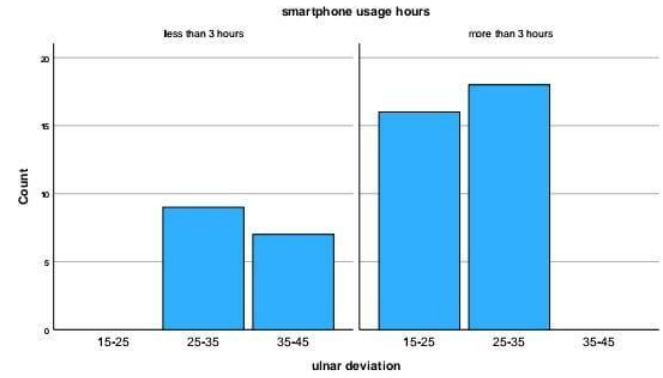
Graph



Graph



Graph



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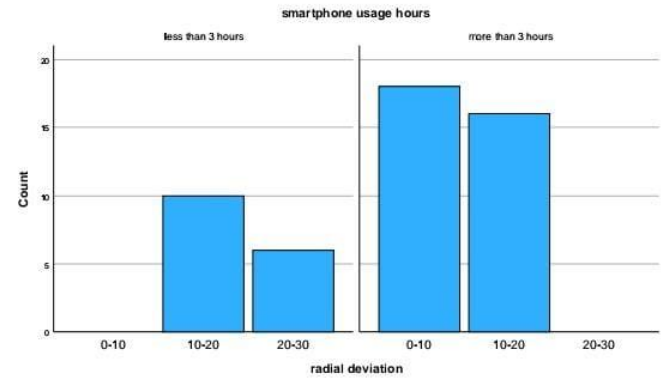

5. DISCUSSION

The findings of this study suggest a clear "threshold effect." When smartphone use exceeds 3 hours per day, the cumulative strain on the median nerve appears to surpass the body's natural recovery rate, leading to the clinical symptoms of CTS. The higher Wrist Ratio Index observed in the >3 hour group is particularly interesting. It suggests that either individuals with certain wrist morphologies are more prone to injury, or that chronic inflammation from overuse is causing slight morphological changes over time. Notably, the additional risk found in diabetic and arthritic patients indicates that smartphone overuse acts as a synergistic stressor. In these patients, connective tissues and nerves are already compromised by systemic inflammation or metabolic changes; the mechanical stress of mobile use then acts as a "catalyst," accelerating the onset of hand dysfunction. This suggests that "safe usage" limits should be even lower for individuals with pre-existing conditions.

CONCLUSION

Smartphone usage for more than 3 hours daily is a significant, independent risk factor for developing CTS symptoms and hand dysfunction in young adults. This risk is exponentially higher in individuals with pre-existing conditions like diabetes and arthritis. As digital consumption shows no signs of slowing down, ergonomic interventions—such as using larger grips, voice-to-text features, and mandatory timed breaks—are no longer optional; they are essential for the long-term health of this demographic.

Strength

Validated Tools: The use of the BCTQ and Wrist Ratio Index provides clinical depth beyond simple surveys.

Targeted Demographic: Focusing on the 18–30 age bracket addresses a gap in traditional CTS research. Comorbidity Analysis: Identifying how diabetes and arthritis multiply the risk provides a more nuanced understanding of the disorder.

LIMITATION

Short time limit

Self-Reported Usage: Participants may under or overestimate their actual screen time.

Cross-Sectional Nature: While correlations are strong, a longitudinal study would be required to definitively prove causation over several years.

Recommendation -> future researchers.

Future studies should utilize software-tracked screen time (app usage data) to ensure 100% accuracy in usage duration. Additionally, investigating the impact of different smartphone sizes and weights could help determine if hardware design can mitigate some of these ergonomic risks.

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