RESEARCH PAPER

Smartphone dependency and its effect on upper limb musculoskeletal integrity and hand function: A Review of Literature

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ABSTRACT

Background

Smartphone use has become universal, but excessive and addictive patterns are increasingly linked to musculoskeletal health problems.

Objective

This literature review synthesizes evidence on the relationship between smartphone addiction and upper limb musculoskeletal integrity.

Methods

A structured search across multiple databases (2010–2025) identified 11 eligible studies. Inclusion criteria focused on musculoskeletal outcomes such as pain prevalence, posture, hand strength, proprioception, and biomarkers.

Results

Findings revealed high prevalence of pain in the neck, shoulders, upper back, wrists, and hands, with greater severity among individuals using smartphones for more than four hours daily. Postural deviations such as forward head posture and rounded shoulders were common, alongside reduced respiratory function. Functional impairments included diminished grip and pinch strength, altered thumb mobility, and proprioceptive deficits. Biomarker studies reported oxidative stress and impaired collagen repair in addicted users.

Conclusion

Smartphone addiction is a multifactorial health concern with clear musculoskeletal consequences. Preventive strategies, ergonomic awareness, and responsible smartphone use are essential to reduce long-term risks.

Keywords: Smartphone addiction, upper limb musculoskeletal disorders, hand function, posture, grip strength, repetitive strain injury

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Introduction

Smartphones have rapidly evolved into essential tools for communication, education, entertainment, and social interaction.[1] By 2025, the number of smartphone users worldwide is projected to exceed 7 billion, reflecting their ubiquitous presence in daily life [2]. While smartphones offer convenience, their excessive and prolonged use has raised concerns about physical health, particularly musculoskeletal disorders (MSDs) affecting the upper body [2,3].

Problematic smartphone use, often described as *smartphone addiction*, is characterized by compulsive usage patterns, withdrawal symptoms, and interference with daily activities [4]. This behavioral addiction has been associated with mental health issues such as anxiety, depression, and poor sleep quality [5,6]. However, growing evidence also highlights its impact on

musculoskeletal health, with repetitive thumb movements, sustained neck flexion, and poor ergonomic posture contributing to pain and dysfunction in the neck, shoulders, wrists, and hands [7,8].

Several studies have demonstrated that smartphone addiction correlates with increased musculoskeletal pain prevalence. For example, university students with high addiction scores reported significantly greater pain in the neck, upper back, and wrists/hands [9]. Prolonged smartphone use has also been linked to altered posture, including forward head position and rounded shoulders, which in turn impairs respiratory function [10]. Biomarker-based studies further suggest that smartphone addiction may be associated with physiological changes such as increased oxidative stress and altered collagen metabolism, reinforcing its role in musculoskeletal deterioration [11].

The impact of smartphone use extends beyond adults. Children and adolescents have shown reduced hand strength, impaired pinch grip, and altered nerve conduction when exposed to prolonged smartphone use [12]. Experimental studies, including randomized controlled trials, have examined the immediate effects of texting and handwriting on handgrip and pinch strength, though findings suggest no acute changes, emphasizing the importance of long-term exposure in musculoskeletal outcomes [13].

Given the widespread prevalence of smartphone use and its potential to compromise musculoskeletal integrity, reviewing the available literature is essential. This review consolidates findings from cross-sectional, observational, biomechanical, and experimental studies to evaluate the relationship between smartphone addiction and upper limb musculoskeletal health, including pain prevalence, posture changes, hand strength, and biological markers.

Methodology

A structured search strategy was applied across PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar covering publications from 2010 to 2025. Boolean operators were used to refine results, for example: *("smartphone addiction" OR "problematic smartphone use") AND ("musculoskeletal pain" OR "hand strength" OR "posture")*. Truncation and phrase searching ensure the inclusion of all relevant variations. Reference lists of retrieved articles were also screened manually.

Inclusion criteria were studies involving children, adolescents, or adults using smartphones; designs such as cross-sectional, observational, experimental, or randomized controlled trials; outcomes related to musculoskeletal pain, posture, hand strength, proprioception, respiratory function, or biomarkers; and publications in English peer-reviewed journals. Exclusion criteria were studies focusing only on psychological outcomes, reviews or editorials, case reports, non-English papers, and duplicates.

The initial search identified over 500 records. After removing duplicates and screening titles/abstracts, 45 articles were shortlisted. Following full-text review, 11 articles met the criteria and were included in this literature review. Data extracted from each study included year, author, sample size, design, intervention, outcome measures, and findings.

This approach ensured academic rigor by combining multiple databases, applying Boolean logic, defining clear inclusion/exclusion criteria, and systematically extracting comparable data across studies. The final pool of 11 full-text articles represents diverse populations, countries, and methodologies, providing a comprehensive overview of smartphone addiction and musculoskeletal health.

Result

The reviewed studies consistently demonstrate a strong association between smartphone addiction and upper limb musculoskeletal impairments. Pain prevalence was highest in the neck, upper back, wrists/hands, and shoulders, with rates ranging from 45% to 70% across populations.

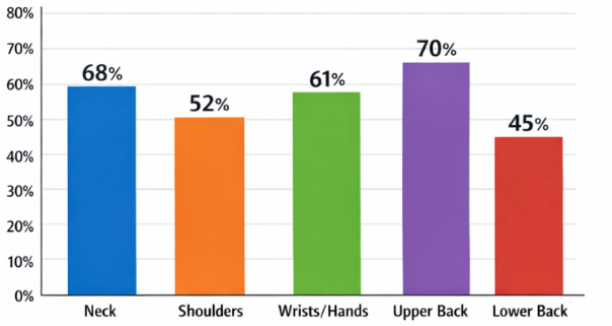

FIGURE 1- Prevalence of Musculoskeletal Pain by Body Region

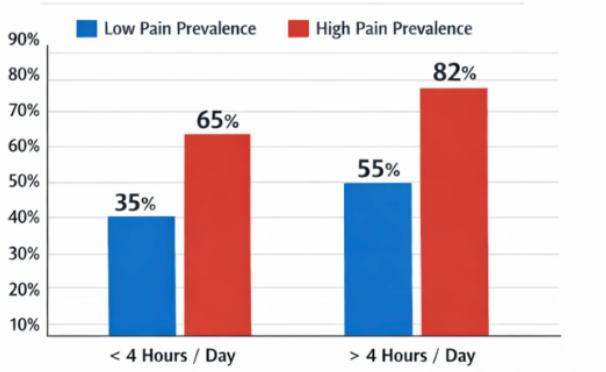

FIGURE 2- Smartphone usage duration vs Pain Prevalence

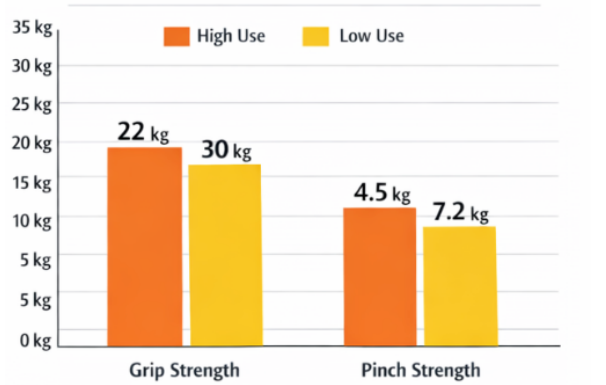

FIGURE 3- Hand Strength Outcomes

Individuals using smartphones for more than four hours daily showed significantly greater postural deviations and pain intensity compared to low-use groups. Hand strength outcomes revealed reduced grip and pinch strength in high-use participants, particularly among children and young adults. A summary of all included studies is presented in **Table 1**

Sn. No.	**Year**	**Authors**	**Sample Size**	**Intervention / Study Design**	**Outcome Measures**	**Key Findings**
1	2025	Zaghloul et al.	~300 university students	Cross-sectional survey on smartphone addiction and MSD	Smartphone Addiction Scale (SAS), musculoskeletal pain questionnaires	High smartphone addiction linked to increased musculoskeletal pain in the neck, shoulders, and hands.
2	2024	Depreli & Angin	200 university students	Posture analysis with smartphone use	Posture angles, musculoskeletal pain survey	Smartphone addiction associated with forward head posture and musculoskeletal pain.
3	2020	Radwan et al.	60 children (9–15 yrs)	Observational study comparing high vs low smartphone users	Hand grip strength, pinch strength, hand function tests	High smartphones use impaired hand strength and function in children.
4	2022	Ahmed et al.	326 college students (Bangladesh & India)	Cross-sectional study	SAS-SF, NDI, SPADI, OES, CHDQ	Smartphone addiction significantly correlated with neck, shoulder, elbow, and hand pain.

5	2022	Sirajudeen et al.	313 Saudi university students	Cross-sectional study during COVID-19	SAS-SV, Nordic Musculoskeletal Questionnaire, IPAQ	Smartphone addiction strongly associated with shoulder, elbow, and wrist/hand MSDs (OR up to 15.38).
6	2024	Jain et al.	80 adults (25–35 yrs, India)	Cross-sectional study	SAS-SV, Hand grip dynamometer, muscle length-tension tests	85% showed smartphone addiction; reduced grip strength; extrinsic muscles more affected than intrinsic.
7	2023	Altiparmak et al.	100 university students (18–25 yrs, Turkey)	Cross-sectional study	SAS-SF, PRWHE, ROM (goniometer), proprioception tests	Addiction correlated with thumb flexion/abduction ROM, wrist radial deviation, and proprioceptive errors.
8	2025	Alghadir et al.	250 Saudi university students	Cross-sectional + biomarker analysis	SAS, NDI, CHDQ, VAS, serum biomarkers (TIMP-1, TIMP-2, 5-HT, TG, MDA, TAC)	Addiction linked to neck/hand pain and biological changes: ↓TIMP-1/TIMP-2, ↓TAC, ↑5-HT, TG, MDA.
9	2021	Mustafaoglu et al.	249 Turkish university students	Cross-sectional study	SAS, Modified Nordic Musculoskeletal Questionnaire	Addiction associated with pain in neck, wrists/hands, shoulders, and upper back (OR up to 2.83).
10	2016	Jung et al.	50 South Korean students	Comparative study (<4h vs >4h smartphone use)	Craniovertebral angle, scapular index, spirometry (FVC, FEV1, PEF)	Prolonged use caused forward head posture, rounded shoulders, and reduced peak expiratory flow.
11	20	El-gohary &	50 female	RCT (texting vs	Hand grip strengt	No significant

	23	Aljohani	physiotherapy students (Saudi Arabia)	handwriting, 10–15 min)	h, key-pinch strength	immediate effect of texting/handwriting on grip or pinch strength; posture awareness emphasized.

Discussion

Prevalence of Musculoskeletal Pain

Across the reviewed studies, musculoskeletal pain was consistently reported as a major consequence of excessive smartphone use. Mustafaoglu et al. found that the upper back (70.3%), neck (65.9%), and wrists/hands (68.7%) were the most affected regions among Turkish university students. Similarly, Sirajudeen et al. reported a 12-month prevalence of shoulder (20.1%), elbow (5.1%), and wrist/hand (13.4%) disorders among Saudi students, with significantly higher odds in those classified as addicted. These findings highlight that pain prevalence is not confined to one region but spans multiple joints of the upper body, reflecting the repetitive and static nature of smartphone use.

Postural Changes and Respiratory Function

Postural deviations were another recurring theme. Jung et al. demonstrated that students using smartphones for more than four hours daily exhibited forward head posture and rounded shoulders, alongside reduced peak expiratory flow. Depreli and Angin also confirmed that smartphone addiction was associated with forward head posture and musculoskeletal discomfort. These results suggest that prolonged smartphone use not only alters spinal alignment but also compromises respiratory efficiency, reinforcing the link between posture and systemic health.

Hand Strength and Muscle Performance

Several studies investigated hand strength and muscle performance. Radwan et al. showed that children with high smartphone use had reduced grip and pinch strength, indicating early functional impairment. Jain et al. reported that extrinsic hand muscles were more affected than intrinsic ones, with 85% of participants showing weak grip strength. In contrast, El-gohary and Aljohani found no immediate effect of short bouts of texting or handwriting on grip or pinch strength, suggesting that cumulative exposure rather than short-term activity drives musculoskeletal decline.

Range of Motion and Proprioception

Altiparmak et al. highlighted that smartphone addiction correlated with reduced thumb flexion and abduction range of motion, decreased wrist radial deviation, and impaired proprioception. These findings emphasize that smartphone use affects fine motor control and joint awareness, which are critical for functional hand performance.

Biological Markers and Physiological Changes

A novel dimension was introduced by Alghadir et al. , who examined serum biomarkers. They found that addicted students had lower levels of TIMP-1 and TIMP-2 (collagen repair markers) and total antioxidant capacity, alongside elevated serotonin, triglycerides, and malondialdehyde. These biochemical changes suggest that smartphone addiction may contribute to oxidative stress, impaired tissue repair, and systemic musculoskeletal vulnerability.

Age and Population Differences

Evidence also indicates that age influences outcomes. Radwan et al. demonstrated functional impairment in children, while Mustafaoglu et al. and Zaghloul et al. reported pain prevalence in young adults. Jain et al. extended these findings to adults aged 25–35 years, showing reduced grip strength and altered muscle tension. Collectively, these studies suggest that musculoskeletal consequences of smartphone use span across age groups, with early onset in children and progressive deterioration in adults.

Conclusion

This literature review highlights that excessive smartphone use and addiction are consistently associated with adverse musculoskeletal outcomes. Evidence across diverse populations shows increased prevalence of pain in the neck, shoulders, upper back, wrists, and hands, alongside postural deviations such as forward head posture and rounded shoulders. Functional impairments including reduced grip strength, altered thumb mobility, and proprioceptive deficits were observed, while biomarker studies revealed oxidative stress and impaired collagen repair in addicted users. Although short bouts of texting or handwriting did not produce immediate

strength changes, cumulative exposure was clearly linked to musculoskeletal strain.

Smartphone addiction is a multifactorial health concern with clear physical consequences. The findings emphasize the need for preventive strategies, ergonomic awareness, and responsible smartphone use to mitigate long-term musculoskeletal risks. Future research should adopt longitudinal designs and integrate both biomechanical and biochemical measures to deepen understanding of these effects.

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