

Smartphone Addiction and Hand Health among Young Medical Students: A Cross-Sectional Study

Divyasree B¹, Dr. N Kavitha², Dr. M Suresh Kumar³

¹Intern, SVIMS

²Ph.D., Faculty SVIMS

³Ph.D., Faculty SVIMS

Abstract: ***Background:** Smartphones have become indispensable tools in medical education, facilitating academic learning, communication, and access to digital resources. However, prolonged and uncontrolled smartphone use has emerged as a significant public health concern, particularly among young adults. Excessive smartphone usage has been associated with behavioural dependence and several musculoskeletal disorders affecting the upper extremities. Medical students constitute a high-risk population because of their extensive academic and recreational dependence on smartphones. **Objective:** This study investigated the prevalence of smartphone addiction and examined its association with hand health problems and behavioural outcomes among young medical students. **Methods:** A descriptive cross-sectional survey was conducted among 200 medical students selected through voluntary participation. Data were collected using a structured questionnaire covering demographic characteristics, smartphone usage behaviour, addiction-related symptoms, hand health complaints, ergonomic practices, and behavioural consequences. Descriptive statistics, reliability analysis, Pearson's correlation, one-way ANOVA, and linear regression were employed to analyse the data. **Results:** Most respondents were aged 19–22 years (69%), and females constituted 77.5% of the sample. More than half of the participants reported difficulty reducing smartphone use, while prolonged uninterrupted usage was highly prevalent. Hand-related symptoms, particularly thumb pain, wrist discomfort, finger stiffness, and grip weakness, were frequently reported. Correlation analysis demonstrated significant positive relationships between smartphone addiction, hand health problems, and behavioural disturbances. Regression analysis indicated that smartphone addiction significantly predicted hand health problems, explaining 46.5% of the variance. **Conclusion:** The findings demonstrate that excessive smartphone use is significantly associated with adverse hand health outcomes and behavioural disturbances among medical students. Although many symptoms remain mild, persistent overuse combined with inadequate ergonomic practices may increase the likelihood of chronic musculoskeletal disorders. Educational interventions promoting healthy smartphone habits, ergonomic awareness, and regular digital breaks are essential to minimise long-term health risks.*

Keywords: Smartphone addiction, Hand health, Medical students, Musculoskeletal disorders, Ergonomics, Behavioural health

1. Introduction

The rapid advancement of mobile technology has fundamentally transformed modern communication, education, and healthcare. Smartphones have evolved from simple communication devices into multifunctional digital platforms that support academic learning, clinical decision-making, information retrieval, entertainment, and social networking. Among university students, particularly those enrolled in medical programmes, smartphones have become indispensable educational tools because they provide immediate access to electronic textbooks, clinical guidelines, virtual learning environments, research databases, and collaborative learning platforms.

Despite these educational advantages, the increasing dependence on smartphones has generated considerable concern among healthcare professionals and researchers. Excessive smartphone (Kwon et al., 2013; Griffiths, 2013) use has been recognised as a behavioural addiction characterised by compulsive usage, impaired self-control, anxiety when access is restricted, and interference with academic, social, and physical well-being. Young adults are especially vulnerable because smartphones are deeply integrated into their daily academic and personal activities. Consequently, prolonged exposure to repetitive smartphone use has raised important questions regarding its long-term health consequences.

One of the emerging health issues associated with excessive smartphone use is the development of musculoskeletal disorders involving the hand, wrist, fingers, and thumb. Continuous thumb movements, repetitive gripping, awkward wrist positions, and prolonged static postures increase mechanical stress on tendons, muscles, ligaments, and peripheral nerves. (Kim & Kim, 2015; Mustafaoglu et al., 2021; Zirek et al., 2022). These biomechanical stresses may result in pain, stiffness, reduced grip strength, impaired coordination, and functional limitations that interfere with routine activities and academic performance. (Al-Dhafer et al., 2023; Zirek et al., 2022). In addition to physical discomfort, excessive smartphone use has also been linked to behavioural problems such as sleep disturbances, reduced concentration, diminished academic productivity, and psychological distress. (Kim et al., 2015; Lee et al., 2014; Lepp et al., 2015).

Medical students represent a particularly important population for investigating these concerns. Their demanding academic schedules require extensive use of smartphones for educational purposes while simultaneously encouraging prolonged engagement with digital communication and social media. Consequently, distinguishing beneficial academic use from excessive or addictive use has become increasingly important. Understanding the relationship between smartphone addiction and hand health among future healthcare professionals is also essential because they are expected to

promote healthy technology use within society. Although previous studies have documented smartphone addiction and musculoskeletal discomfort separately, relatively few investigations have comprehensively examined their combined influence on hand health and behavioural outcomes among Indian medical students. Furthermore, limited evidence exists regarding the extent to which smartphone addiction contributes to functional hand impairment and behavioural changes within this population.

Against this background, the present study investigates smartphone addiction and its impact on hand health among young medical students using empirical evidence obtained through a structured cross-sectional survey. The study also explores behavioural consequences associated with prolonged smartphone use and provides evidence that may assist educational institutions and healthcare professionals in designing preventive interventions aimed at promoting healthy digital behaviour and reducing technology-related musculoskeletal problems.

2. Review of Literature

The widespread adoption of smartphones has attracted considerable research attention because of their influence on physical, psychological, and academic well-being. Previous studies have demonstrated that excessive smartphone use contributes to behavioural addiction, musculoskeletal discomfort, sleep disturbances, and reduced academic performance among university students.

Kwon et al. (2013) developed the Smartphone Addiction Scale (SAS), which has become one of the most widely accepted instruments for assessing problematic smartphone use. Their study established smartphone addiction as a behavioural condition characterised by compulsive use, withdrawal symptoms, tolerance, and disruption of daily activities.

Griffiths (2013) explained that behavioural addictions involving digital technologies exhibit characteristics similar to substance addiction, including salience, mood modification, tolerance, withdrawal, conflict, and relapse. Smartphone dependency therefore represents a significant behavioural health issue requiring systematic investigation.

Chen et al. (2016) reported that prolonged smartphone use significantly increases the risk of musculoskeletal disorders affecting the neck, shoulders, wrists, and thumbs. Repetitive thumb movements and sustained awkward wrist postures were identified as important contributors to pain and functional impairment.

Kim et al. (2015) observed that excessive smartphone use adversely affects sleep quality among young adults. Increased bedtime smartphone use was associated with delayed sleep onset, poor sleep efficiency, and daytime fatigue, which ultimately reduced cognitive performance and academic productivity.

Lee et al. (2014) examined the relationship between smartphone use and academic achievement and concluded that non-academic smartphone engagement during study

hours negatively influences concentration, learning efficiency, and examination performance.

Straker et al. (2017) investigated ergonomic posture during mobile device use and found that prolonged use in inappropriate positions increases muscular loading of the upper extremities, thereby elevating the likelihood of developing repetitive strain injuries.

Twenge (2017) argued that extensive smartphone engagement has transformed the lifestyle of young adults by reducing physical activity, increasing sedentary behaviour, and altering interpersonal communication patterns, thereby influencing both physical and psychological health.

The World Health Organization (2020) highlighted the importance of reducing sedentary behaviour and incorporating regular movement breaks during prolonged screen-based activities to minimise musculoskeletal complications and improve overall health outcomes.

Collectively, previous research demonstrates that smartphone addiction extends beyond psychological dependence and substantially affects physical health, ergonomic behaviour, sleep quality, and academic performance. Nevertheless, relatively limited evidence simultaneously examines smartphone addiction, hand health, and behavioural outcomes among Indian medical students using comprehensive statistical analysis. The present study seeks to address this gap.

3. Research Gap

Although numerous studies have investigated smartphone addiction among university students, most have concentrated primarily on psychological dependence, social media behaviour, or academic performance. Comparatively fewer studies have examined the physical consequences of excessive smartphone use, particularly hand-related musculoskeletal disorders among medical students. Medical students constitute a particularly vulnerable population because of their extensive dependence on smartphones for both academic and personal purposes. However, empirical evidence examining the interaction between smartphone addiction, ergonomic practices, and hand health among this group remains inadequate. The present study addresses these research gaps by providing empirical evidence on the prevalence of smartphone addiction and evaluating its influence on hand health and behavioural outcomes among young medical students.

4. Objectives of the Study

The study was undertaken with the following objectives:

- To examine the prevalence of smartphone addiction among young medical students.
- To assess the pattern and duration of smartphone usage.
- To identify the common hand health problems associated with prolonged smartphone use.
- To evaluate the behavioural consequences of excessive smartphone usage.
- To analyse the relationship between smartphone addiction and hand health problems.

- To determine the influence of smartphone addiction on hand health among medical students.

5. Hypotheses

The study was guided by the following hypotheses:

- **H₀₁:** There is no significant relationship between smartphone addiction and hand health problems among medical students.
- **H₁₁:** There is a significant relationship between smartphone addiction and hand health problems among medical students.
- **H₀₂:** Smartphone addiction does not significantly influence hand health problems among medical students.
- **H₁₂:** Smartphone addiction significantly influences hand health problems among medical students.

6. Materials and Methods

Research Design

The present investigation employed a descriptive cross-sectional research design to examine smartphone addiction and its association with hand health among young medical students. The design was considered appropriate because it enables the assessment of behavioural characteristics and health outcomes within a defined population at a specific point in time.

Study Population

The target population comprised undergraduate medical students enrolled at a medical institution. These students routinely utilise smartphones for academic learning, communication, clinical reference, and recreational purposes, making them an appropriate population for investigating technology-related health issues.

Sample Size

A total of 228 students were approached to participate in the survey. Of these, 200 students provided informed consent and completed the questionnaire, yielding an effective response rate of 87.7%.

Sampling Technique

Participants were selected using a convenience sampling approach based on their availability and willingness to participate. Participation was entirely voluntary, and informed consent was obtained before data collection.

Data Collection Instrument

Primary data were collected using a structured questionnaire comprising five sections:

- Demographic characteristics
- Smartphone usage behaviour
- Smartphone addiction indicators
- Hand health symptoms
- Behavioural and ergonomic practices

The questionnaire incorporated both categorical and Likert-scale items designed to evaluate smartphone dependence, physical symptoms, and behavioural outcomes.

Reliability of the Instrument

The internal consistency of the questionnaire was assessed using Cronbach's Alpha. The overall reliability coefficient exceeded the recommended threshold ($\alpha = 0.856$), indicating satisfactory reliability and internal consistency of the measurement instrument.

Statistical Analysis

The collected data were analysed using IBM SPSS (V.25). The following analytical techniques were employed:

- Frequency and Percentage Analysis
- Descriptive Statistics
- Cronbach's Alpha Reliability Analysis
- Pearson Correlation Analysis
- One-way Analysis of Variance (ANOVA)
- Simple Linear Regression Analysis

A significance level of 5% ($p < 0.05$) was adopted for hypothesis testing throughout the study.

7. Results and Discussion

7.1 Demographic Profile and Smartphone Usage Pattern

- The study analysed responses from 200 medical students, of whom the majority (69%) were aged between 19 and 22 years, representing the typical age group of undergraduate medical education. Female students constituted 77.5% of the respondents, indicating greater female participation in the survey.
- Daily smartphone usage was substantial across the sample. Approximately two-thirds of the participants reported using smartphones between two and six hours per day, while 15.5% used their devices for more than six hours daily. More importantly, 69.5% admitted to using smartphones continuously for over 30 minutes without taking breaks, reflecting prolonged exposure to repetitive hand movements.
- Behavioural indicators of smartphone dependence were also evident. More than half of the respondents reported difficulty reducing smartphone usage, while a considerable proportion acknowledged using smartphones longer than originally intended. Smartphone use before bedtime was highly prevalent, suggesting increasing dependence on mobile devices beyond academic requirements.
- These findings indicate that smartphones have become deeply integrated into the everyday academic and personal routines of medical students. Although smartphones are valuable educational tools, prolonged and uncontrolled use may increase exposure to both behavioural dependence and physical health problems. (Kwon et al., 2013; Mustafaoglu et al., 2021).

7.2 Hand Health Problems Associated with Smartphone Use

- Hand-related musculoskeletal symptoms were common among the respondents, with nearly two-thirds reporting hand or wrist pain. Thumb pain was the most frequently reported complaint, followed by wrist discomfort, muscular weakness, tingling sensations, finger stiffness and reduced grip strength. Although symptoms were predominantly mild, the occurrence of moderate-to-

severe discomfort among some students indicates that prolonged smartphone use may have functional consequences.

- These symptoms may be associated with repetitive thumb movements, sustained gripping and prolonged wrist positioning during smartphone use. Similar associations between excessive smartphone use and upper-extremity musculoskeletal symptoms have been reported among university students and young adults (Kim & Kim, 2015; Mustafaoglu et al., 2021; Zirek et al., 2022; Al-Dhafer et al., 2023). Thus, the present findings suggest that frequent and uninterrupted smartphone use may contribute to cumulative mechanical stress on the hand and wrist, particularly when adequate ergonomic practices and usage breaks are absent.

7.3 Behavioural Consequences of Smartphone Addiction

- In addition to physical symptoms, excessive smartphone use influenced several behavioural dimensions among respondents. Many participants reported smartphone use during study periods for non-academic purposes, while bedtime smartphone use was also widespread.
- Although a considerable proportion perceived only a mild impact on academic performance, one-fourth of respondents acknowledged moderate or severe academic interference resulting from smartphone use. These findings suggest that behavioural addiction extends beyond excessive screen time and influences concentration, study efficiency, and learning behaviour.
- The findings further indicate that ergonomic awareness alone does not necessarily translate into healthy behavioural practices. While approximately half of the respondents were aware of proper hand ergonomics, only a relatively small proportion consistently maintained appropriate posture during smartphone use. This discrepancy highlights the gap between awareness and actual health-promoting behaviour.

7.4 Reliability of the Measurement Instrument

- The reliability analysis confirmed that the research instrument possessed satisfactory internal consistency. The overall Cronbach's Alpha coefficient exceeded the recommended threshold of 0.80, demonstrating that the questionnaire reliably measured smartphone addiction, hand health, and behavioural constructs.
- The acceptable reliability values strengthen confidence in the consistency of the collected data and support the validity of subsequent statistical analyses.

7.5 Relationship between Smartphone Addiction and Hand Health

- Pearson's correlation analysis revealed statistically significant positive relationships among smartphone addiction, hand health problems, and behavioural outcomes.
- A strong positive correlation was observed between smartphone addiction and hand health problems ($r = 0.624$, $p < 0.01$). Similarly, smartphone addiction demonstrated an even stronger association with behavioural disturbances ($r = 0.671$, $p < 0.01$). Hand

health problems also showed a moderate positive relationship with behavioural changes ($r = 0.589$, $p < 0.01$).

- These findings indicate that increasing levels of smartphone addiction are accompanied by greater physical discomfort and behavioural disruption. The positive correlations support the argument that excessive smartphone dependence affects both physical and psychological dimensions of health.
- Comparable findings have been reported by Chen et al. (2016), who identified a strong association between prolonged smartphone use and upper limb musculoskeletal disorders, and by Griffiths (2013), who highlighted the behavioural consequences of technology addiction.

7.6 Influence of Smartphone Usage on Hand Health

- One-way ANOVA demonstrated significant differences in hand health problems across different categories of smartphone usage duration ($F = 5.872$, $p = 0.001$). This finding confirms that students with longer daily smartphone exposure experience significantly greater hand-related symptoms than those with shorter usage durations.
- The results reinforce the hypothesis that prolonged smartphone exposure is an important determinant of musculoskeletal discomfort. Continuous thumb movements, sustained gripping, and repetitive wrist postures likely contribute to cumulative tissue stress over time. (Kim & Kim, 2015; Mustafaoglu et al., 2021; Zirek et al., 2022).

7.7 Predictive Effect of Smartphone Addiction on Hand Health

- Simple linear regression analysis further established smartphone addiction as a significant predictor of hand health problems.
- The regression model explained 46.5% of the total variation in hand health outcomes ($R^2 = 0.465$), indicating substantial explanatory power. The standardized regression coefficient ($\beta = 0.682$, $p < 0.001$) demonstrated that increasing smartphone addiction significantly increased the severity of hand health problems among medical students.
- This finding suggests that smartphone addiction is not merely associated with hand discomfort but serves as a meaningful predictor of musculoskeletal health. The result provides strong empirical evidence supporting the need for interventions aimed at reducing excessive smartphone dependence.

7.8 Discussion

- The findings demonstrate that excessive smartphone use is associated with both physical and behavioural consequences among young medical students. The predominance of thumb pain, wrist discomfort, finger stiffness, and reduced grip strength observed in the present study is consistent with previous evidence linking prolonged smartphone use with upper-extremity musculoskeletal symptoms (Kim & Kim, 2015;

Mustafaoglu et al., 2021; Zirek et al., 2022; Al-Dhafer et al., 2023). Repetitive thumb activity, sustained gripping, and prolonged wrist positioning may contribute to mechanical loading and musculoskeletal discomfort during extended smartphone use.

- The significant correlation between smartphone addiction and hand health problems, together with the ANOVA and regression findings, further indicates that greater smartphone dependence and longer usage are associated with increased hand-related symptoms. This finding is consistent with previous research reporting associations between problematic smartphone use and musculoskeletal complaints among young adults (Mustafaoglu et al., 2021; Al-Dhafer et al., 2023).
- Behavioural consequences were also evident, particularly bedtime smartphone use, non-academic use during study periods, and difficulty limiting smartphone use. Previous studies have similarly associated problematic smartphone use with sleep disturbance and reduced academic performance among young adults and university students (Kim et al., 2015; Lepp et al., 2015). Taken together, the findings indicate the importance of promoting responsible smartphone use alongside ergonomic awareness among medical students.

8. Practical Implications

- The findings of this study have important implications for medical education, student health, and institutional policy. Medical students increasingly rely on smartphones for learning, clinical communication, and information access. While these devices enhance academic efficiency, excessive and prolonged use may adversely affect musculoskeletal health and behavioural well-being.
- Medical colleges should integrate ergonomic education and digital well-being programmes into student orientation and health-promotion initiatives. Awareness programmes focusing on responsible smartphone use, appropriate posture, regular movement breaks, and ergonomic practices may help minimise prolonged sedentary behaviour and musculoskeletal strain (World Health Organization, 2020; Zirek et al., 2022).
- Healthcare professionals, physiotherapists, and occupational therapists can utilise the findings to design preventive interventions targeting young adults who are at greater risk of developing repetitive strain injuries due to excessive smartphone usage.

9. Recommendations

Based on the findings of the study, the following recommendations are proposed:

- 1) Medical students should consciously regulate daily smartphone usage and avoid unnecessary screen time (World Health Organization, 2020).
- 2) Regular breaks should be taken after every 20–30 minutes of continuous smartphone use to minimise repetitive strain.
- 3) Hand, wrist, and finger stretching exercises should be incorporated into daily routines to improve flexibility and reduce muscular fatigue.

- 4) Appropriate ergonomic posture should be maintained while operating smartphones, particularly during prolonged academic activities (Straker et al., 2017; Zirek et al., 2022).
- 5) Smartphones should be used with alternating hands whenever possible to reduce repetitive loading of the dominant thumb and wrist.
- 6) Educational institutions should organise periodic workshops on digital wellness and ergonomic practices.
- 7) Students experiencing persistent pain or functional limitations should seek early medical evaluation rather than ignoring symptoms.
- 8) Institutions should encourage responsible digital behaviour by promoting digital detox activities and healthy screen-time management.

10. Strengths of the Study

The present study possesses several important strengths. It simultaneously examined smartphone addiction, hand health problems, and behavioural outcomes within a single analytical framework. The use of validated statistical procedures, including reliability analysis, Pearson's correlation, ANOVA, and regression analysis, enhanced the scientific robustness of the findings. The relatively high response rate further improved the credibility of the collected data. Moreover, the study provides empirical evidence from a population of young medical students, a group that relies heavily on smartphones for both academic and personal purposes.

11. Limitations of the Study

Despite its contributions, the study has certain limitations. The cross-sectional research design restricts the establishment of causal relationships between smartphone addiction and hand health problems. The findings are based on self-reported responses, which may be influenced by recall bias or subjective perceptions. Since the study was conducted among students from a single institution, the generalisability of the findings to other educational settings may be limited. Additionally, clinical assessment of hand function and objective measurement of smartphone usage duration were beyond the scope of the present investigation.

12. Directions for Future Research

Future investigations may employ longitudinal research designs to better understand the long-term effects of smartphone addiction on musculoskeletal health. Comparative studies involving students from different professional disciplines and geographical regions would enhance the generalisability of findings. Researchers may also incorporate clinical assessments, wearable digital monitoring devices, and biomechanical evaluations to objectively measure smartphone usage and physical health outcomes. Furthermore, intervention-based studies evaluating the effectiveness of ergonomic education, digital detox programmes, and physiotherapy-based preventive strategies would provide valuable evidence for reducing smartphone-related health problems.

13. Conclusion

Smartphones have become indispensable tools in contemporary medical education, offering substantial benefits for academic learning, communication, and access to clinical information. However, the findings of the present study demonstrate that excessive smartphone use is accompanied by important physical and behavioural consequences among young medical students.

The study identified a high prevalence of prolonged smartphone usage, addictive behavioural tendencies, and musculoskeletal symptoms affecting the hands and wrists. Thumb pain, wrist discomfort, finger stiffness, and reduced grip strength emerged as the most frequently reported health complaints. Statistical analyses further confirmed significant positive relationships between smartphone addiction, hand health problems, and behavioural disturbances. The regression model demonstrated that smartphone addiction is a meaningful predictor of hand health outcomes, emphasising its role as an important public health concern among young adults. Although many respondents reported only mild symptoms, continued exposure to prolonged smartphone use without appropriate ergonomic practices may contribute to chronic musculoskeletal disorders and reduced functional performance over time. The findings therefore highlight the need for early preventive interventions, improved ergonomic awareness, healthy digital habits, and institutional initiatives promoting responsible smartphone use.

Overall, this study contributes to the growing evidence on technology-related health problems among medical students and underscores the importance of balancing the educational benefits of smartphones with appropriate behavioural and ergonomic practices. Developing healthier digital lifestyles will not only improve students' physical well-being but also support their academic performance and long-term professional health.

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