

## *Association between Smartphone Addiction and Functional Neck Disability among University Students: A Cross-Sectional Study*

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### ABSTRACT

**Objective:** The primary objective of this study was to examine the prevalence of smartphone addiction and analyze its relationship with functional neck disability among university students at Gopal Narayan Singh University.

**Methods:** A cross-sectional observational study was conducted from March to May 2026, involving 205 university students aged 17–30 years. Data were collected using a structured questionnaire that included demographic details, smartphone usage habits, the Smartphone Addiction Scale-Short Version (SAS-SV) to assess addiction levels, and the Neck Disability Index (NDI) to measure functional impairment.

**Results:** The study revealed a high prevalence of smartphone addiction, with 67.3% (n = 138) of participants classified as "High Risk." Item-level analysis of the NDI indicated that "Moderate Disability" was the most frequently reported functional limitation (44.8%). A statistically significant positive correlation was identified between smartphone addiction scores and neck disability (Pearson  $r = 0.248$ ,  $p < 0.001$ ). Furthermore, a Chi-square analysis demonstrated a direct dependency between daily smartphone usage duration and neck disability ( $\chi^2$  ( $x^2$ ) = 31.11,  $p = 0.0019$ ), with severe functional restrictions notably increasing when usage exceeded six hours daily. No statistically significant differences were observed between genders regarding smartphone addiction or neck disability levels.

**Conclusion:** The findings confirm a significant positive relationship between smartphone addiction and functional neck disability among university students. The compounding effect of prolonged daily usage on cervical spine health highlights the urgent need for ergonomic awareness, postural correction education, and interventions to promote balanced digital habits to prevent long-term musculoskeletal complications.

**Keywords:** Alcohol-related Health Conditions, Dietary Behaviors, Health Risk Behavior, Lifestyle Diseases, University Students.

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### Introduction

In the modern educational environment, smartphones have become an essential tool for university students, yet their excessive use has led to a growing psychological and physical crisis known as smartphone addiction. This addiction is defined as a behavioral dependency where students lose control over their screen time, often experiencing anxiety or distress when away from their devices. This psychological drive is the

primary variable that forces the body into sustained, harmful positions for hours at a time. As students focus intensely on their screens, they neglect their physical posture, leading to a cascade of musculoskeletal issues. The transition from a simple habit to a physical ailment begins with this addiction, which then manifests as faulty posture, leading to a significant reduction in muscle strength and eventually resulting in

chronic neck pain and functional disability. Increased smartphone accessibility has normalized addictive behaviors, sparking widespread concern. This phenomenon is a direct result of fast-paced technological evolution.<sup>1</sup>

The first major variable in this study is smartphone addiction, which serves as the foundation for all subsequent physical ailments. Modern young adults have matured in an era where smartphones are an integral part of daily existence. As mobile technology evolves to offer increasingly diverse functionalities, global data confirms a significant rise in device ownership among the youth.<sup>2</sup> According to the research established in the development of the Smartphone Addiction Scale, this condition is not just about high usage but a deep psychological reliance that interferes with daily life and health.<sup>1</sup> Recent statistics indicate that smartphone penetration has reached near-saturation levels in developed nations, with ownership rates of 92% in the United States and 95% in Australia among individuals aged 18 to 34. Emerging markets show similar upward trends; for instance, ownership in Kenya grew from 26% in 2016 to 41% by 2019, while Nigeria saw an increase from 28% to 39% in the same period.<sup>3</sup>

When a student becomes addicted, they remain in a fixed position for extended periods, completely unaware of the strain on their body. This leads to the development of physical limitations that can be measured using the Neck Disability Index (NDI). Developed by Howard Vernon, the NDI is a gold-standard tool that evaluates how much a student's neck issues are interfering with ten essential areas of daily life, such as sleep, concentration, and the ability to work.<sup>3</sup> This measurement is crucial because it tracks the shift from minor muscle soreness to a state of functional disability that hinders academic success.

The intersection of addiction and poor habits has led to a massive rise in the prevalence of neck pain among university students. Analytical studies indicate that over 60% of students now

suffer from persistent neck discomfort, which is directly linked to the duration and frequency of their smartphone use.<sup>3</sup> This pain is often the result of "muscle endurance failure". As students maintain a tilted head position, the endurance of their neck muscles significantly decreases, making them prone to fatigue and stiffness. Furthermore, this ergonomic crisis extends to the hands and wrists; the repetitive nature of scrolling and gripping a phone leads to a measurable reduction in hand grip and pinch strength. This shows that the impact of addiction is not limited to the spine but affects the entire upper kinetic chain, making even simple manual tasks like writing or lifting objects difficult for the student.<sup>4</sup>

According to Derakhshanrad et al. (2021), dependency on smartphones for social interaction and entertainment further compounds daily exposure. This synergy of academic and recreational screen time may significantly heighten the risk of musculoskeletal issues among university students. International studies have reported a wide range of neck pain prevalence in this demographic—from moderate to high—which may be attributed to differing assessment tools, definitions of pain, cultural habits, and usage patterns.<sup>6</sup>

Specifically, the research indicates that sustained cervical flexion creates excessive mechanical stress on the spine, leading to delayed activation of essential stabilizing muscles like the Deep Neck Flexors (DNF). When the head is tilted forward at a 60-degree angle, it exerts nearly 27kg of pressure on the cervical spine. This sustained load leads to chronic neck pain and rounded shoulders, creating a permanent postural imbalance. To prevent this, students must be educated on ergonomic safety, such as holding devices at eye level and taking regular breaks to ensure their digital habits do not lead to lifelong physical disability.<sup>7</sup> Given that a vast majority of university students now report neck discomfort, there is an urgent need for ergonomic awareness and postural education. Consequently, the present investigation evaluated the point

prevalence of smartphone addiction along with functional neck disability while exploring the explicit correlation driven by prolonged mobile device exposure.<sup>7</sup>

### Research Gap

Although several studies have investigated smartphone addiction, neck pain, and musculoskeletal disorders among students, limited evidence is available regarding the relationship between smartphone addiction severity and functional neck disability using validated assessment tools such as the Smartphone Addiction Scale–Short Version (SAS-SV) and the Neck Disability Index (NDI) among Indian university students. Furthermore, institution-specific evidence from Gopal Narayan Singh University is currently unavailable. Therefore, the present study was undertaken to determine the prevalence of smartphone addiction and evaluate its association with neck disability among university students.

### Aim of Study

The aim of this study is to determine the prevalence of smartphone addiction and to examine its relationship with neck disability among students of Gopal Narayan Singh University.

### Objectives of Study

1. To assess the average duration and frequency of smartphone usage among university students.
2. To determine the prevalence and severity of neck disability among university students.
3. To analyze the relationship between smartphone addiction levels and neck disability among university students.

### Rationale of the Study

With the rapid increase in smartphone usage among students for academic, social, and entertainment purposes, there has been a noticeable rise in health issues related to prolonged device use. Neck pain, often linked to poor posture and extended screen time, is becoming increasingly common among young adults. Despite its growing prevalence, many

students remain unaware of the long-term consequences of improper smartphone usage.

This study is necessary to highlight the impact of smartphone habits on physical health, particularly neck discomfort. It will help in identifying risky behaviors and promoting awareness about ergonomic practices. The findings can assist students, educators, and healthcare professionals in developing strategies to prevent and manage neck pain, ultimately contributing to better student health and well-being.

### Operational Definitions

#### Smartphone Addiction:

Smartphone addiction refers to excessive and uncontrolled smartphone use that interferes with daily functioning and is measured using the Smartphone Addiction Scale–Short Version (SAS-SV).

#### Neck Disability

Neck disability refers to limitations in daily functional activities resulting from neck pain and discomfort, assessed using the Neck Disability Index (NDI).

### Significance of the Study

The present study is significant because it provides evidence regarding the prevalence of smartphone addiction and its association with neck disability among university students. The findings may assist healthcare professionals, physiotherapists, educators, and policymakers in developing preventive strategies, ergonomic awareness programs, and health promotion initiatives aimed at reducing musculoskeletal problems associated with excessive smartphone use.

### Review of Literature

1. Recent studies have increasingly focused on the impact of smartphone usage on musculoskeletal health, particularly neck pain among university students.<sup>8</sup>

2. Talib et al. (2026) conducted a study to determine the prevalence of neck pain and its association with smartphone usage among university students. The findings revealed that a significant proportion of students experienced neck pain, with a strong positive correlation between prolonged smartphone usage (more than four hours daily) and increased neck disability. The study emphasized that excessive screen time is a major contributing factor to musculoskeletal discomfort.<sup>9</sup>
3. Kailashram et al. (2025) explored the relationship between smartphone addiction and neck muscle endurance among college students. Their results indicated that individuals with higher levels of smartphone dependency reported greater pain intensity and reduced muscular endurance in the cervical region. This suggests that behavioral addiction to smartphones can negatively affect physical health.<sup>10</sup>
4. A 2025 report on sedentary behavior highlighted that prolonged use of digital devices, including smartphones, contributes significantly to neck pain. The study explained that extended screen exposure leads to sustained static posture, resulting in muscle fatigue and strain in the cervical spine.<sup>11</sup>
5. Elvan et al. (2024) examined the association between mobile phone usage duration, neck muscle endurance, and neck pain among university students. The study found that longer usage duration was significantly associated with reduced neck muscle endurance and increased pain levels. Students who used smartphones excessively were more likely to develop musculoskeletal issues.<sup>12]</sup>
6. In another study, Elvan et al. (2024) further emphasized that usage exceeding four hours per day significantly increases the risk of cervical discomfort and functional limitations. The study highlighted the importance of limiting screen time to prevent long-term musculoskeletal disorders.<sup>13</sup>
7. Marko (2024) discussed the concept of “tech neck,” explaining how prolonged forward head posture during smartphone use increases mechanical stress on the cervical spine. This condition may lead to chronic pain and structural changes if not addressed early.<sup>14</sup>
8. Verywell Health (2024) reported that improper ergonomics, such as holding the phone below eye level and prolonged usage without breaks, are primary causes of neck pain. The study suggested that preventive strategies, including posture correction and regular breaks, can significantly reduce symptoms.<sup>15</sup>
9. Maayah et al. (2023) investigated neck pain associated with smartphone usage among university students and found that both duration of use and poor posture significantly contribute to neck and shoulder discomfort. The study emphasized that maintaining proper posture is essential to minimize the risk of musculoskeletal problems.<sup>16</sup>
10. Iqbal et al. (2023) analyzed smartphone usage patterns and identified forward head posture as a major risk factor for neck pain. The study concluded that students who frequently use smartphones in improper positions are more likely to experience musculoskeletal discomfort.<sup>17</sup>
11. Al-Hadidi et al. (2019) conducted a cross-sectional study to assess the association between mobile phone use and neck pain. The findings demonstrated a significant relationship between duration of mobile phone use and pain intensity. The study concluded that increased usage and poor posture contribute to worsening symptoms over time.<sup>18</sup>

## Methodology

**Study Design:** Cross sectional observational

**Study setting:** Gopal Narayan Singh University

**Study Duration:** March to May 2026

**Sample Size:** A total of 220 students were approached for participation in the study. After screening the collected responses, 15 questionnaires were excluded due to incomplete or inconsistent data. Therefore, the final sample

included 205 participants whose responses were considered suitable for statistical analysis.

### Sample Size Justification

The sample size was determined using Cochran's formula for prevalence studies with a 95% confidence level and a 5% margin of error. Considering the expected prevalence of smartphone-related musculoskeletal symptoms among university students, a minimum sample size of approximately 196 participants was required. To improve statistical reliability and account for incomplete responses, 220 students were approached, and 205 complete responses were included in the final analysis.

### Participant Recruitment Flow

A total of 220 university students were approached for participation in the study. After screening and data verification, 15 responses

were excluded due to incomplete or inconsistent questionnaire data. Therefore, the final statistical analysis included 205 participants who met all eligibility criteria and provided complete responses.

### Sampling Technique: Convenience Sampling Inclusion Criteria-

1. College students aged 17-30 years at GNSU.
2. Minimum 2 hours daily smartphone usage.
3. Willing to provide informed consent and complete questionnaires.

### Exclusion Criteria

1. History of neck fracture, surgery, or serious injury
2. Chronic neck pain (>6 months) or neurological disorders
3. Pregnancy or severe co morbidities affecting data validity

### Materials /Tools

| Tools         | Purpose                   | Description                             |
|---------------|---------------------------|-----------------------------------------|
| SAS - SV      | Smartphone usage patterns | 10 item scale measuring addiction habit |
| NDI           | Neck Disability           | 10 item functional assessment           |
| Questionnaire | Demographics              | Age, Gender, Course, usage habits       |

### Variable

| Type        | Variable                 | Description                        |
|-------------|--------------------------|------------------------------------|
| Independent | Smartphone usage pattern | Daily hours, SAS – SV total score. |
| Dependent   | Disability               | NDI percentage score               |

### Data Collection Method

Data were collected through a primary source using a structured survey questionnaire. The survey was designed to gather information on demographics, smart phone usage habits, and neck pain status. Each participant provided their details based on their daily routine and physical discomfort.

### Procedure

The procedure for this study was conducted in the following systematic steps:

**Selection of Participants:** Students meeting the inclusion criteria were identified and approached across university networks.

**Information Sharing:** The purpose of the study and the impact of prolonged smartphone usage on spinal and neck health were explained to each participant.

**Informed Consent:** Every participant provided their consent before starting the survey, agreeing that their data would be kept confidential and used only for research purposes.

Data confidentiality was strictly maintained throughout the study. Participant identities were not recorded, and all collected information was used exclusively for academic and research purposes.

**Distribution of Performa:** The structured questionnaire/Performa was distributed digitally via Google Forms link across student groups, platforms, and official communication channels.

**Assessment:** Participants filled in their demographic details, active daily hours spent on smartphones, common postures used while texting and their neck pain status.

**Review:** Each submitted form was automatically checked for completeness (using mandatory question constraints) before being accepted for the final statistical analysis.

### Outcome Measures

**The study used specific research instruments to measure the outcomes:**

**Smartphone Addiction Level:** Calculated using the Smartphone Addiction Scale (SAS), which measures the severity of mobile device dependency, tolerance, and daily-life disturbance among young adults.

**Neck Disability Index (NDI):** Used to measure how much the neck pain affects the participant's daily activities (such as lifting, reading, concentration, and driving), scoring the overall level of functional disability from 0 to 50.

**Note:** For participants who did not drive vehicles, the driving-related item of the Neck Disability Index was considered not applicable. Such responses were excluded from item-level aggregation where appropriate, in accordance with standard NDI scoring recommendations.

### Research Hypotheses

**H01:** There is no significant relationship between smartphone addiction and neck disability among university students.

**H02:** There is no significant association between daily smartphone usage duration and neck disability among university students.

**H03:** There is no significant difference in smartphone addiction scores between male and female participants.

**H04:** There is no significant difference in neck disability scores between male and female participants.

### Statistical Analysis

#### Statistical Objectives

1. To determine the level of smartphone addiction among participants using the Smartphone Addiction Scale–Short Version (SAS-SV).
2. To assess neck disability among participants using the Neck Disability Index (NDI).
3. To evaluate the relationship between smartphone addiction and neck disability.
4. To determine the association between smartphone usage duration and neck disability.
5. To compare smartphone addiction and neck disability scores between male and female participants.

#### Statistical Analysis Strategy

All compiled survey data was normalized, structured, and analyzed via verified statistical software packages. Descriptive summary profiles (mean, standard deviation, raw frequencies, and percentages) were developed for demographic metrics and scale intervals.

Before applying inferential models, data tracking metrics were evaluated for structural normality. Because the Smartphone Addiction Scale–Short Version (SAS-SV) and aggregate Neck Disability Index (NDI) scores demonstrated minor non-Gaussian distribution properties, both parametric and non-parametric validations were executed. Pearson linear correlation coefficients quantified baseline linear interactions, while Spearman's rank correlation protected the statistical output from variance distortions caused by score outliers.

Categorical associations between daily screen duration parameters and grouped disability brackets were mapped via Chi-square cross-tabulations. Differences in scale mean values based on binary gender groupings were calculated using Independent Sample t-tests. Complete statistical significance thresholds across all computational models were structurally bound at  $p < 0.05$ .

All statistical analyses were performed using IBM SPSS Statistics Version 26 (IBM Corp., Armonk, NY, USA). Descriptive statistics were calculated for demographic variables and outcome measures. Inferential statistical analyses included Pearson correlation, Spearman rank correlation, Chi-square test, and Independent Samples t-test. Statistical significance was established at  $p < 0.05$ .

**Data Distribution and Metric Aggregation Assumptions**

Before running inferential tests, data distributions were evaluated for normality. Smartphone Addiction Scale–Short Version (SAS–SV) totals and cumulative Neck Disability Index

(NDI) scores exhibited minor deviations from ideal Gaussian curves. Consequently, both parametric and non-parametric tests were applied to the primary objective: Pearson correlation was utilized to evaluate linear relationships, while Spearman's rank correlation was simultaneously executed to ensure robust validation against scale score outliers. NDI metrics were evaluated on two distinct tiers throughout this study: a cumulative patient-level score for comparative/associative statistics, and an item-level aggregate pool completed individual domain responses) to evaluate specific symptomatic profiles across separate functional tasks.

| Variable    | Mean ± SD    | Minimum | Maximum |
|-------------|--------------|---------|---------|
| Age (Years) | 21.25 ± 1.81 | 17      | 30      |

Note: N = 205 participants

**Table 1: Demographic Characteristics of Participants.**

**Interpretation**

The mean age of participants was 21.25 ± 1.81 years, indicating that most respondents belonged to the young adult age group.

| Gender | Frequency (n) | Percentage (%) |
|--------|---------------|----------------|
| Male   | 91            | 44.4           |
| Female | 114           | 55.6           |
| Total  | 205           | 100            |

Note: N = 205 participants

**Table 2: Gender Distribution.**

**Interpretation**

Among 205 participants, 44.4% were males and 55.6% were females, indicating a female predominance in the study sample.

Gender Distribution of Study Participants

Percentage distribution of participants according to gender.



Figure 1: Gender Distribution (Pie Chart).

Interpretation

The pie chart shows that female participants constituted the majority (approximately 55.6%) of the study population.

| Addiction Risk Classification | Frequency (n) | Percentage (%) |
|-------------------------------|---------------|----------------|
| Addicted (High Risk)          | 138           | 67.3           |
| Non-Addicted (Low Risk)       | 67            | 32.7           |
| Total                         | 205           | 100.0          |

Table 3: Distribution of Smartphone Addiction Status (SAS-SV) (N = 205).

Interpretation

Based on the validated gender-specific cutoff scores of the Smartphone Addiction Scale–Short Version (SAS-SV), 138 participants (67.3%) were classified as addicted (high risk) to smartphone

use, while 67 participants (32.7%) were categorized as non-addicted (low risk). These findings indicate a high prevalence of problematic smartphone use among the college students included in the study.

| Daily Device Active Usage Category | Frequency (n) | Percentage (%) |
|------------------------------------|---------------|----------------|
| 1–2 Hours                          | 15            | 7.3            |
| 3–4 Hours                          | 78            | 38.0           |
| 5–6 Hours                          | 66            | 32.2           |

| Daily Device Active Usage Category | Frequency (n) | Percentage (%) |
|------------------------------------|---------------|----------------|
| More than 6 Hours                  | 46            | 22.4           |
| Total Cohort Volume                | 205           | 100.0          |

Table 4: Daily Smartphone Exposure Windows among Participants.

Distribution of Smartphone Addiction Risk Classification

Percentage distribution of participants classified as addicted and non-addicted based on smartphone addiction risk.

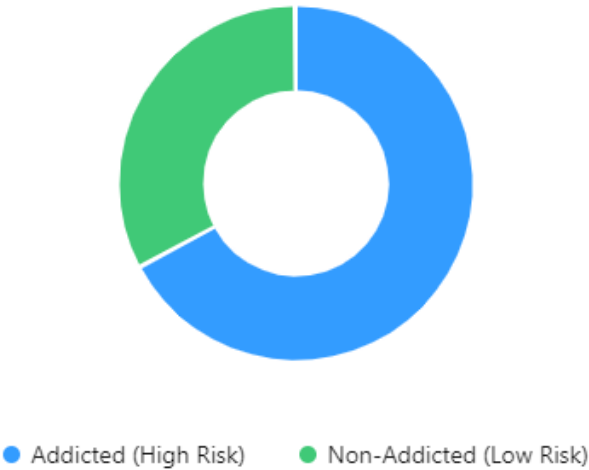


Figure 2: Daily Smartphone Usage.

Interpretation

Out of the 205 participants, 138 (67.3%) were classified as addicted (high risk), while 67 (32.7%) were classified as non-addicted (low

risk). The findings indicate that approximately two-thirds of the study population exhibited a high risk of smartphone addiction.

| Statistic          | Value |
|--------------------|-------|
| Sample Size        | 205   |
| Mean Score         | 25.40 |
| Standard Deviation | 6.85  |
| Median             | 24    |
| Minimum            | 3     |
| Maximum            | 45    |

Note: N = 205 participants

Table 5: Smartphone Addiction Score.

Interpretation

The mean smartphone addiction score was  $25.40 \pm 6.85$ , suggesting a moderate level of smartphone addiction among participants.

| Response Severity Category      | Cumulative Frequency (Across 10 Domains) | Percentage (%) |
|---------------------------------|------------------------------------------|----------------|
| Score 0 (No Disability)         | 673                                      | 34.6           |
| Score 1 (Mild Disability)       | 341                                      | 17.5           |
| Score 2 (Moderate Disability)   | 872                                      | 44.8           |
| Score 3 (Severe Disability)     | 38                                       | 2.0            |
| Score 4/5 (Complete Disability) | 22                                       | 1.1            |
| Total Checked Items             | 1,946                                    | 100.0          |

Table 6: Item-Level Response Distribution across NDI Functional Domains.

**Note:** Data represent the cumulative aggregate of individual responses across the ten functional domains of the Neck Disability Index (NDI) obtained from all 205 participants.

Interpretation:

An item-level analysis of responses across the ten domains of the Neck Disability Index (NDI) revealed that out of 1,946 completed response items, the most frequently reported category was Score 2 (Moderate Disability), accounting for 872

responses (44.8%). This was followed by Score 0 (No Disability), with 673 responses (34.6%). Mild disability (Score 1) constituted 17.5% of responses, while severe disability (Score 3) and complete disability (Scores 4/5) were reported less frequently, representing 2.0% and 1.1% of responses, respectively. These findings suggest that moderate functional limitations related to neck pain were the most commonly experienced difficulties among the study participants.

Item-Level Response Distribution Across NDI Functional Domains

Cumulative frequency of responses across 10 NDI domains.

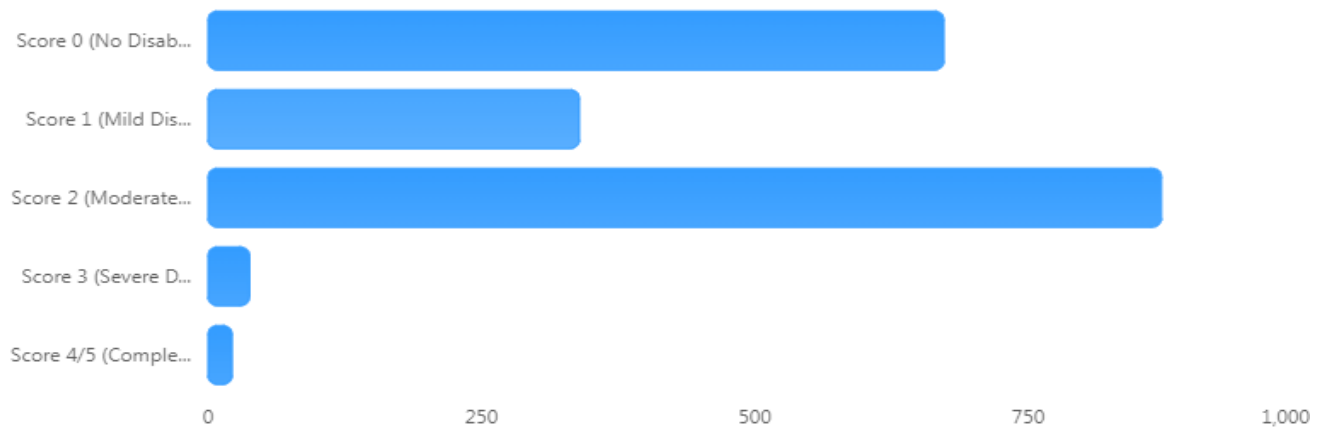


Figure 3: Item-Level Distribution of NDI Domain Scores

Interpretation

Moderate disability was the predominant category, suggesting that prolonged smartphone

use may be associated with noticeable neck-related symptoms and functional impairment.

Correlation between Smartphone Addiction Score and Neck Disability Index

| Variables Compared                   | Correlation Coefficient (r/ρ) | p-value | Interpretation            |
|--------------------------------------|-------------------------------|---------|---------------------------|
| SAS-SV Score vs NDI Score (Pearson)  | 0.248                         | 0.0003  | Weak Positive Correlation |
| SAS-SV Score vs NDI Score (Spearman) | 0.206                         | 0.003   | Weak Positive Correlation |

Note: N = 205 participants

Table 7: Pearson and Spearman Correlation Analysis.

Interpretation

Pearson correlation analysis revealed a statistically significant positive correlation between Smartphone Addiction Scale (SAS-SV) scores and Neck Disability Index (NDI) scores ( $r = 0.248$ ,  $p < 0.001$ ). Similarly, Spearman correlation analysis showed a significant positive association ( $\rho = 0.206$ ,  $p = 0.003$ ).

These findings indicate that as smartphone addiction increases, neck disability scores also tend to increase. Although the correlation

strength is weak, the association is statistically significant.

While the correlation coefficients ( $r = 0.248$ ;  $\rho = 0.206$ ) are classified as weak, their high statistical significance ( $p < 0.01$ ) underscores that smartphone addiction is a persistent, non-trivial factor in neck disability. Because musculoskeletal pathology is highly multifactorial—influenced by desk ergonomics, physical activity, and baseline posture—discovering a clear, isolated linear signature from screen time alone highlights its clinical relevance for young adult populations.

Item-Level Response Distribution Across NDI Functional Domains

Cumulative frequency of responses across 10 NDI domains.

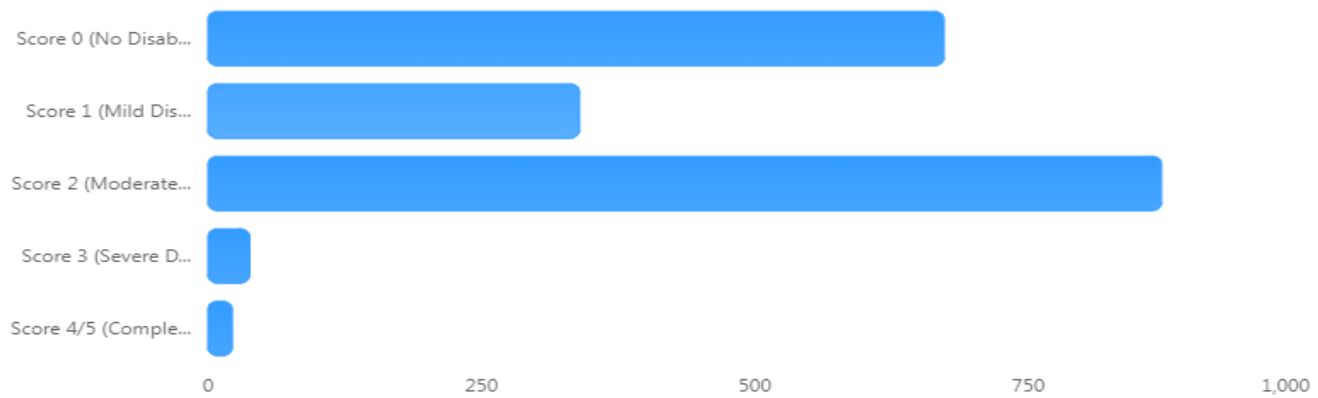


Figure 4: Correlation between Smartphone Addiction and Neck Disability.

**Interpretation**

The scatter plot demonstrates a positive trend between smartphone addiction scores and neck

disability scores, indicating that higher smartphone dependence may be associated with greater neck-related disability.

**Association between Daily Smartphone Usage and Neck Disability**

| Statistical Test   | Value       |
|--------------------|-------------|
| $\chi^2 (\chi^2)$  | 31.11       |
| Degrees of Freedom | 12          |
| p-value            | 0.0019      |
| Significance       | Significant |

**Effect Size Interpretation**

According to Cohen's criteria, the observed association demonstrated a small-to-moderate effect size. This finding indicates that smartphone usage duration contributes meaningfully to neck disability; however, other physical, ergonomic, and behavioral factors may also influence disability outcomes.

The Chi-square test showed a statistically significant association between daily smartphone usage duration and neck disability category ( $\chi^2 = 31.11$ ,  $p = 0.0019$ ).

This finding suggests that participants who spent more time using smartphones were more likely to report higher levels of neck disability.

| Smartphone Usage          | No Disability | Mild Disability | Moderate Disability | Severe Disability | Complete Disability |
|---------------------------|---------------|-----------------|---------------------|-------------------|---------------------|
| 1–2 Hours                 | 6             | 6               | 6                   | 1                 | 1                   |
| 3–4 Hours                 | 17            | 14              | 46                  | 1                 | 0                   |
| 5–6 Hours                 | 16            | 16              | 31                  | 2                 | 1                   |
| More than 6 Hours         | 10            | 21              | 7                   | 3                 | 0                   |
| <b>Total Group Metric</b> | <b>49</b>     | <b>57</b>       | <b>90</b>           | <b>7</b>          | <b>2</b>            |

Note: N = 205 participants

**Table 9: Empirical Cross-tabulation Matrix of Daily Smartphone Usage vs. NDI Status Categories.**

Note on High-Usage Distribution Dynamics: Interestingly, while moderate neck disability peaks in the 3–4 hour (59.0%) and 5–6 hour (47.0%) brackets, it drops significantly to 17.1% ( $n = 7/41$ ) in the "More than 6 Hours" cohort. Conversely, severe functional restrictions reach their highest absolute frequency ( $n = 3$ ) within this maximum exposure tier. This shift suggests a compounding threshold effect: beyond 6 hours of daily device posture, clinical presentations may progress out of "moderate" states and intensify

into advanced, severe symptomatic profiles, or track alongside distinct behavioral adaptations.

**Interpretation**

Cross-tabulation distributions show that moderate neck disability presentations are heavily concentrated in mid-to-high level daily device exposure brackets. Within the 3–4 hours daily usage interval, 59.0% ( $n = 46/78$ ) of that specific sub-group displayed moderate disability indicators. Similarly, for individuals interacting with screens for 5–6 hours daily, 47.0% ( $n =$

31/66) were bound to the moderate disability tier. Notably, severe functional restrictions increased as usage duration surpassed the 6-hour daily threshold, indicating a compounding effect on mechanical neck stress as duration scales up.

Item-Level Response Distribution Across NDI Functional Domains

Cumulative frequency of responses across 10 NDI domains.

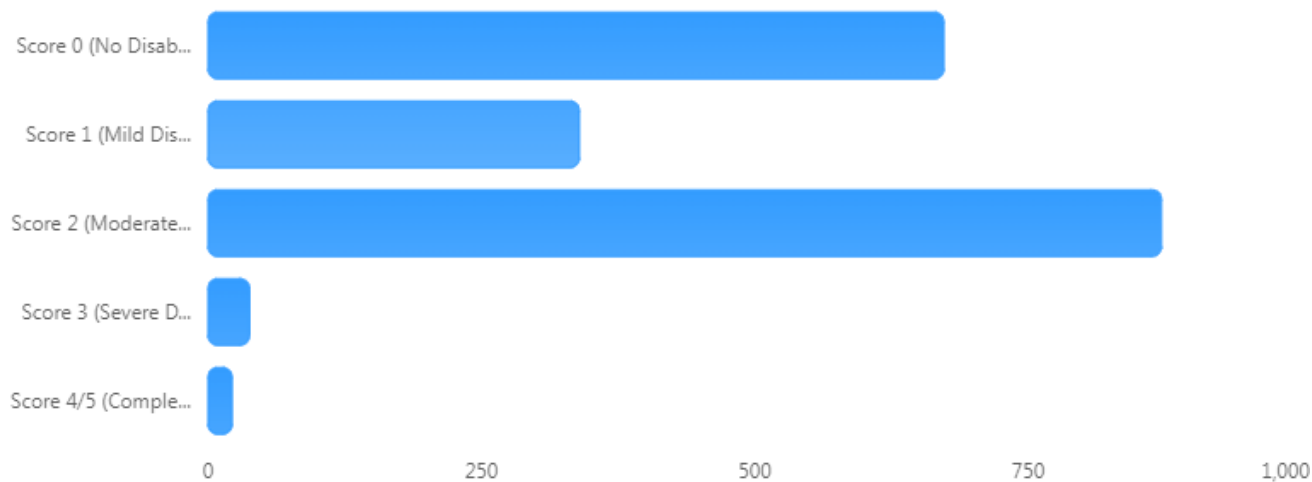


Figure 5: Smartphone Usage and Neck Disability.

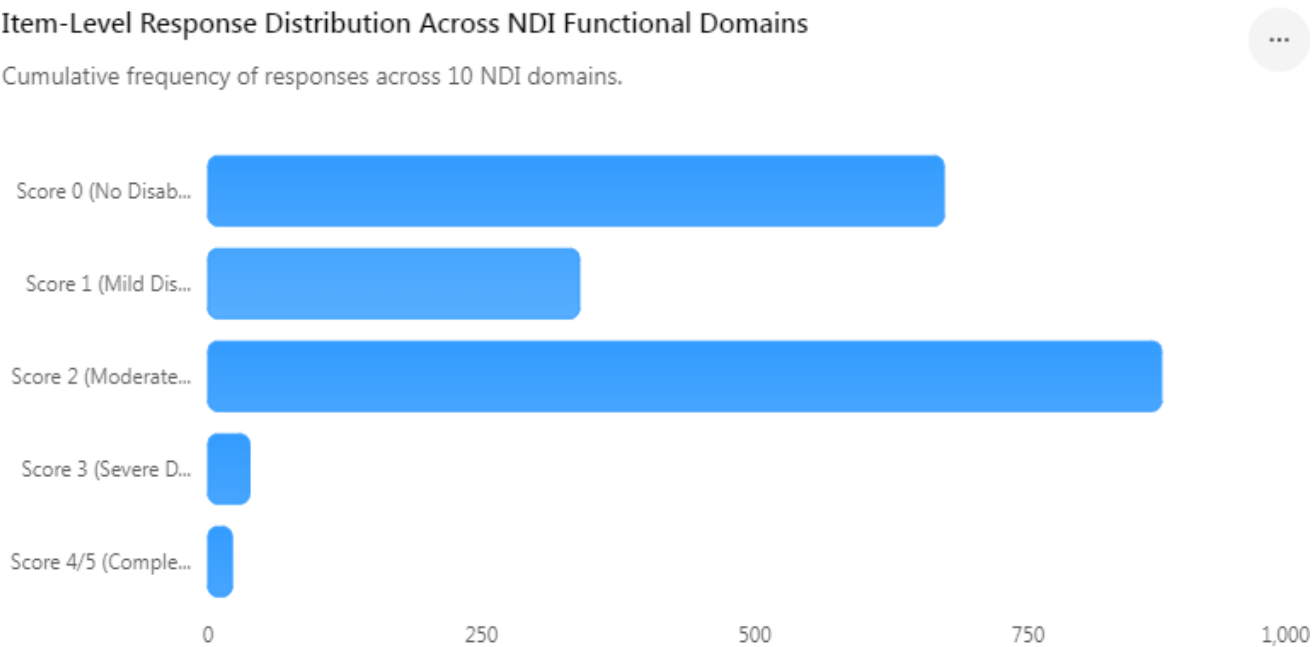
**Interpretation**  
The graph shows that moderate neck disability was most frequently observed among participants using smartphones for 3–4 hours and 5–6 hours daily.

Gender-wise Comparison of Smartphone Addiction Scores

| Gender Class | Sample Size (n) | Mean Addiction Score | Standard Deviation (SD) | t-value | p-value |
|--------------|-----------------|----------------------|-------------------------|---------|---------|
| Male         | 91              | 25.04                | 7.12                    | 0.674   | 0.501   |
| Female       | 114             | 25.68                | 6.62                    | --      | --      |

**Note:** N = 205 participants, Certain participants did not respond to specific Neck Disability Index domains, particularly the driving-related item, as it was not applicable to their daily activities. Therefore, the cumulative number of completed responses was lower than the theoretical maximum response count.

**Interpretation**  
Female participants demonstrated slightly higher smartphone addiction scores than males; however, the difference was not statistically significant (p = 0.501). This indicates that smartphone addiction levels were comparable between male and female participants.



**Figure 6: Gender-wise Comparison of Smartphone Addiction Scores.**

**Interpretation**

The graph demonstrates minimal differences in smartphone addiction scores between male and female participants.

**Gender-wise Comparison of Neck Disability Scores**

| Gender           | Mean NDI Score  |
|------------------|-----------------|
| Male             | 12.83           |
| Female           | 11.24           |
| Statistical Test | Value           |
| t-value          | 1.288           |
| p-value          | 0.201           |
| Significance     | Not Significant |

Note: N = 205 participants

**Table 11: Comparison of NDI Scores by Gender (Independent t-test).**

**Interpretation**

Male participants exhibited slightly higher neck disability scores compared with females. However, the difference was not statistically significant (p = 0.201).

Therefore, neck disability levels were similar across genders.

| Analytical Correlation Pathway                                           | Test Framework Implemented           | Observed Structural Outcome | Explicit p-value | Final Significance Assessment |
|--------------------------------------------------------------------------|--------------------------------------|-----------------------------|------------------|-------------------------------|
| Smartphone Addiction Severity vs. Neck Disability Index (NDI)            | Pearson Correlation (r)              | Positive Linear Correlation | 0.0003           | Statistically Significant     |
| Smartphone Addiction Severity vs. Neck Disability Index (NDI)            | Spearman Rank Correlation ( $\rho$ ) | Positive Non-Linear Trend   | 0.0030           | Statistically Significant     |
| Daily Smartphone Usage Duration vs. NDI Categories                       | Chi-square Test ( $\chi^2$ )         | Direct Variable Dependency  | 0.0019           | Statistically Significant     |
| Gender vs. Smartphone Addiction Scale-Short Version (SAS-SV) Mean Scores | Independent Samples t-test           | Homogeneous Mean Profiles   | 0.5010           | Not Statistically Significant |
| Gender vs. Neck Disability Index (NDI) Mean Scores                       | Independent Samples t-test           | Homogeneous Mean Profiles   | 0.2010           | Not Statistically Significant |

Note: N = 205 participants

**Table 12: Summary of Inferential Statistical Analysis.**

### Overall Findings

The study included 205 participants with a mean age of  $21.25 \pm 1.81$  years. Most participants used smartphones for 3–4 hours daily and demonstrated moderate levels of smartphone addiction. A significant positive relationship was

observed between smartphone addiction and neck disability. Smartphone usage duration was significantly associated with neck disability; however, no significant gender differences were identified in smartphone addiction or neck disability scores.

### Hypothesis Testing Summary

| Hypothesis                                                                       | Result   |
|----------------------------------------------------------------------------------|----------|
| H01: No relationship exists between smartphone addiction and neck disability     | Rejected |
| H02: No association exists between smartphone usage duration and neck disability | Rejected |
| H03: No gender difference exists in smartphone addiction scores                  | Accepted |
| H04: No gender difference exists in neck disability scores                       | Accepted |

### Statistical Conclusion

The findings of the present study demonstrated a significant positive relationship between smartphone addiction and neck disability among participants. Increased smartphone usage duration was significantly associated with higher levels of neck disability. However, no significant gender differences were observed in smartphone addiction or neck disability scores. These findings suggest that prolonged smartphone use and increased smartphone addiction may contribute to the development of neck-related musculoskeletal symptoms among young adults.

### Practical Implications

The findings highlight the importance of promoting healthy smartphone usage habits among young adults. Educational interventions focusing on posture correction, ergonomic practices, regular breaks during smartphone use, and awareness regarding smartphone addiction may help reduce the risk of neck-related musculoskeletal problems.

### Recommendations

1. Young adults should be educated regarding healthy smartphone usage practices.

2. Regular postural correction exercises should be encouraged during prolonged smartphone use.
3. Ergonomic awareness programs should be conducted in educational institutions.
4. Future studies should include larger sample sizes and longitudinal designs to establish causal relationships between smartphone addiction and neck disability.

## Discussion

The research consistently demonstrates a strong, significant relationship between the digital habits of students and the development of musculoskeletal strain. A central finding across these studies is that prolonged screen time forces users into a state of continuous cervical flexion, often described as "forward head posture". This specific posture places a substantial mechanical load on the cervical spine, which leads to muscle fatigue and long-term strain. The frequency and duration of adopting this posture are identified as the primary contributors to the development of symptoms collectively known as Text Neck Syndrome.

The findings of the present study are consistent with previous research demonstrating a significant association between excessive smartphone use and neck-related musculoskeletal symptoms among university students. Ahmed et al. (2022) reported that increased smartphone dependency was significantly associated with neck and shoulder pain among college students. Similarly, Derakhshanrad et al. (2021) observed that prolonged smartphone use was associated with increased musculoskeletal discomfort and functional limitations. These findings support the present study's observation that higher smartphone addiction scores are associated with greater neck disability.

There is a high prevalence of musculoskeletal disorders among students, with direct links established between smartphone usage patterns and neck pain. Studies consistently report a significant, positive correlation between the frequency of device use and increased scores on the Neck Disability Index (NDI). Beyond mere

physical discomfort, the research shows that this pain results in measurable functional disability, which limits the ability of students to effectively perform their daily academic and personal tasks.

Furthermore, psychosocial barriers play a major role in student health. Smartphone dependency, including levels of "nomophobia"—the fear of being without a phone—acts as a significant psychological barrier to adopting healthier usage habits. Even when students are aware of the physical toll their devices take, the psychological reinforcement provided by social media and constant connectivity makes it challenging to limit daily screen time. Consequently, the persistence of these digital habits often exacerbates the intensity of pain over time, creating a cycle that is difficult for students to break.

To mitigate these issues, the literature reaches a consensus that ergonomic awareness is essential for prevention. Specifically, adjusting screen height to maintain a neutral neck position is a critical step. Additionally, the research emphasizes that regular movement breaks are vital; the constant load on cervical muscles must be interrupted to prevent chronic strain. The adoption of simple, actionable practices, such as the 20-20-20 rule, is highly recommended to help students manage their screen time in a more sustainable and physically healthy manner. The observed correlation between smartphone addiction and neck disability was statistically significant; however, the strength of the relationship was weak. This finding suggests that smartphone addiction is one of several contributing factors associated with neck disability. Other factors such as physical activity level, study posture, ergonomic practices, and duration of academic work may also influence cervical musculoskeletal health.

The findings of the present study are consistent with previous studies that reported a positive association between excessive smartphone use and neck-related musculoskeletal disorders among university students. Similar observations have been reported by Ahmed et al. (2022),

Derakhshanrad et al. (2021), and Maayah et al. (2023), who found that prolonged smartphone use contributes to cervical discomfort, postural alterations, and functional limitations. The current findings further support the growing evidence that smartphone addiction may represent an important behavioral factor associated with neck disability among young adults.

Although the observed correlation was statistically significant, its magnitude was weak, suggesting that smartphone addiction represents only one of several factors associated with neck disability among university students.

### Conclusion

The findings of this study demonstrated a statistically significant positive relationship between smartphone addiction and neck disability among university students. Participants with higher smartphone addiction scores tended to report greater levels of neck-related functional disability. Furthermore, prolonged daily smartphone usage was significantly associated with increased neck disability. No significant gender differences were observed in either smartphone addiction or neck disability scores. These findings highlight the importance of promoting healthy smartphone usage habits, ergonomic awareness, and preventive interventions to reduce the risk of musculoskeletal problems among young adults.

### Strengths of the Study

The present study utilized two internationally validated assessment instruments, namely the Smartphone Addiction Scale–Short Version (SAS-SV) and the Neck Disability Index (NDI), to evaluate smartphone addiction and functional neck disability. The study included an adequate sample size and employed multiple statistical methods to validate the findings. Furthermore, it provides institution-specific evidence regarding smartphone addiction and neck disability among university students, contributing valuable data to the existing literature.

### Limitations of the Study

The present study was based on self-reported questionnaire responses and may therefore be influenced by recall bias and subjective interpretation of symptoms. Furthermore, the cross-sectional design permits the identification of associations but does not establish causality between smartphone addiction and neck disability. Other potentially influential factors, including physical activity levels, ergonomic practices, academic workload, psychological stress, and posture, were not objectively assessed. Additionally, participants were recruited from a single university, which may limit the generalizability of the findings to broader student populations.

### Practical and Clinical Implications

From a clinical standpoint, physical therapists and healthcare screening providers should evaluate young adults presenting with persistent musculoskeletal or cervical complaints for screen time volume, joining corrective ergonomic counseling directly with physical rehabilitation procedures. Institutionally, universities are encouraged to run structural digital health campaigns and interactive workspace postural workshops.

### Recommendations and Future Scope

1. Students should deliberately position handheld displays closer to horizontal eye alignment fields to minimize linear mechanical forces shifting onto deep neck flexor frameworks.
2. Academic communities should institutionalize the systemic '20-20-20' rule during electronic curriculum modules to periodically disrupt persistent spinal strain loading windows.
3. Future research architectures should organize longitudinal investigations monitoring multi-institutional clinical profiles to map long-term causal variations.

### Declarations and Disclosures

#### Ethical Considerations

Participation in this study was voluntary. Informed consent was obtained from all participants before data collection. Participant

anonymity and confidentiality were maintained throughout the study. No personally identifiable information was collected. The study involved a questionnaire-based survey with minimal risk to participants.

### Author Contributions

The author conceptualized and designed the study, conducted participant recruitment and data collection, performed statistical analyses, interpreted the findings, prepared the manuscript, and approved the final version for publication.

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contributed valuable information for the successful completion of the research.

### Data Availability Statement

The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

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