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Association between smartphone addiction and neck disability among university students

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Abstract:
Smartphones have become an essential part of university students' academic, social and recreational activities. Although these devices provide convenient access to educational resources and communication platforms, excessive and problematic smartphone use may contribute to musculoskeletal complaints, particularly neck pain and functional disability. Smartphone addiction is characterized by persistent and poorly controlled smartphone use, frequent checking behaviour, psychological dependence and difficulty reducing screen engagement despite negative consequences. These behaviours may increase the duration of sustained cervical flexion, static loading of the neck and repetitive upper-limb activity, potentially contributing to cervical discomfort and limitations in daily functioning. This article examines the association between smartphone addiction and neck disability among university students, with particular attention to behavioural dependence, smartphone-use patterns, cervical biomechanics, postural characteristics and functional consequences. Recent evidence indicates that smartphone overuse is associated with increased neck-pain risk, while university-based studies have reported relationships between smartphone addiction, cervical posture, neck pain and disability. The Smartphone Addiction Scale–Short Version (SAS-SV) and Neck Disability Index (NDI) provide practical tools for evaluating these constructs, although their interpretation should consider cultural validation, measurement limitations and relevant confounding variables. The proposed research framework recommends a cross-sectional assessment of smartphone addiction, daily smartphone-use duration, continuous-use periods, posture, physical activity, previous neck pain and neck-related functional limitations. An integrated physiotherapy approach incorporating digital-wellness education, ergonomic modification, cervical and scapular strengthening, movement breaks and behavioural self-management may help address potentially modifiable risk factors. Longitudinal and intervention-based research is required to establish temporal relationships and determine whether reducing problematic smartphone use produces meaningful improvements in neck-related disability among university students.

Keywords:
Smartphone Addiction, Neck Disability, University Students, Smartphone Addiction Scale–Short Version, Neck Disability Index, Cervical Posture, Text Neck, Musculoskeletal Health, Physiotherapy, Digital Wellness.

1. Introduction:
Smartphones have transformed the academic and social environment of university students. They are routinely used for online lectures, electronic learning platforms, research activities, communication, social networking, entertainment, navigation and personal organization. Their portability and continuous internet connectivity allow students to access information and educational resources at almost any time. However, the increasing dependence on smartphones has raised concerns regarding the physical and psychological consequences of prolonged and uncontrolled use. University students may be particularly exposed because academic responsibilities frequently overlap with recreational screen engagement, social communication and online entertainment. Consequently, smartphone use may extend across much of the day, including during study periods, meals, commuting and before sleep. Although frequent smartphone use does not automatically indicate addiction, persistent use accompanied by loss of control, withdrawal-like discomfort and interference

with daily activities may represent problematic smartphone behaviour (Amez & Baert, 2020, Karila et al., 2025). Smartphone addiction is generally understood as a behavioural pattern involving excessive or poorly regulated engagement with smartphone activities. Common features include repeatedly checking notifications, difficulty limiting screen time, using the device to regulate negative emotions, experiencing discomfort when access is restricted and continuing use despite adverse effects on academic performance, sleep, relationships or health. The term smartphone addiction is widely used in research, although it should not automatically be interpreted as a formal clinical diagnosis. The Smartphone Addiction Scale–Short Version (SAS-SV) is frequently used to identify problematic patterns through a structured self-report assessment. Recent psychometric studies have examined its reliability and validity across different populations, including university students and young adults (Nagata et al., 2023, Zhao et al., 2022, Rajesh et al., 2025). Neck disability is an important musculoskeletal outcome because cervical symptoms can interfere with academic participation, reading, writing, computer use, sleep, driving and other routine activities. Neck disability is not equivalent to neck pain alone. Pain describes the subjective sensory experience, whereas disability reflects the degree to which symptoms restrict everyday function. A student may experience mild neck discomfort without substantial functional limitation, while another may report difficulty concentrating, reading, sleeping or completing academic tasks because of persistent cervical symptoms. The Neck Disability Index (NDI) is a commonly used instrument for measuring the functional consequences of neck problems. Its domains include pain intensity, personal care, lifting, reading, headaches, concentration, work, driving, sleeping and recreation. Recent psychometric evidence supports the continued use of the NDI while emphasizing the importance of measurement quality and appropriate interpretation (Saltychev et al., 2024). The relationship between smartphone addiction and neck disability may involve several interacting mechanisms. Students with problematic smartphone use may spend longer periods using devices, engage in repeated checking, postpone breaks and maintain sustained forward-head or neck-flexed positions. These behaviours may increase the cumulative exposure of cervical muscles and passive tissues to static loading. Smartphone activities may also involve repetitive thumb movements, unsupported arm positions and prolonged shoulder protraction. Over time, these patterns may contribute to muscular fatigue, discomfort and reduced tolerance for sustained postures. However, neck symptoms are multifactorial, and smartphone use should not be considered the sole explanation for cervical disability. Physical inactivity, academic workload, psychological stress, sleep disturbance, previous neck pain and workstation ergonomics may also influence symptoms (Xie et al., 2017, Zirek et al., 2020, Gao et al., 2023). Recent evidence has strengthened the rationale for investigating this relationship. A systematic review and meta-analysis published in 2025 reported a significantly higher risk of neck pain among individuals with smartphone overuse compared with those without overuse (Chen et al., 2025). University-based studies have also examined smartphone addiction alongside neck pain, cervical muscle endurance, posture and functional outcomes (Correia et al., 2023, Elvan et al., 2024, Alghadir et al., 2025). Research published in 2026 has directly assessed smartphone addiction and neck-related functional disability in undergraduate populations, further supporting the relevance of behavioural and ergonomic factors in this area (John et al., 2026, Yapalı et al., 2026). The present article discusses the potential association between smartphone addiction and neck disability among university students, explains the proposed behavioural and biomechanical pathways, reviews relevant assessment instruments and presents a practical physiotherapy framework. It also outlines a proposed cross-sectional research methodology that can be adapted for institution-based research. The central research question is whether higher smartphone addiction scores are associated with greater neck disability among university students after accounting for smartphone-use duration, posture, physical activity and other relevant factors.

2. Conceptual framework linking smartphone addiction, cervical loading and neck disability:

Smartphone addiction may influence neck-related outcomes through behavioural and biomechanical pathways. Behavioural dependence can increase the frequency and duration of device engagement, reduce awareness of time spent using the smartphone and make it difficult to interrupt prolonged activities. These patterns may increase exposure to sustained cervical flexion, forward-head posture and unsupported upper-limb positioning. Repeated static loading may contribute to muscular fatigue and discomfort, while persistent symptoms may interfere with academic and daily activities. The conceptual relationship is illustrated in Fig. 1, which places smartphone addiction upstream of smartphone-use behaviour and cervical exposure while recognizing that individual, psychosocial and environmental factors may modify the association.

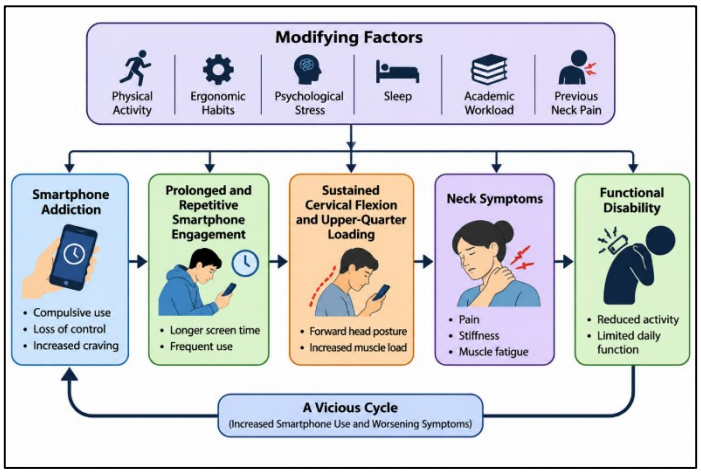


Figure. 1: Conceptual framework linking smartphone addiction, cervical loading and neck disability among university students

3. Study workflow and proposed assessment sequence:

A cross-sectional study can assess the relationship between smartphone addiction and neck disability by collecting demographic, behavioural and musculoskeletal information from eligible university students. Following recruitment and informed consent, participants complete a demographic and smartphone-use questionnaire, the SAS-SV and the NDI. Additional information about posture, physical activity, and movement breaks and previous neck pain can help identify potential confounding variables. Data should be checked for completeness, coded and analysed using suitable descriptive and inferential statistical methods. The proposed sequence is presented in Fig. 2.

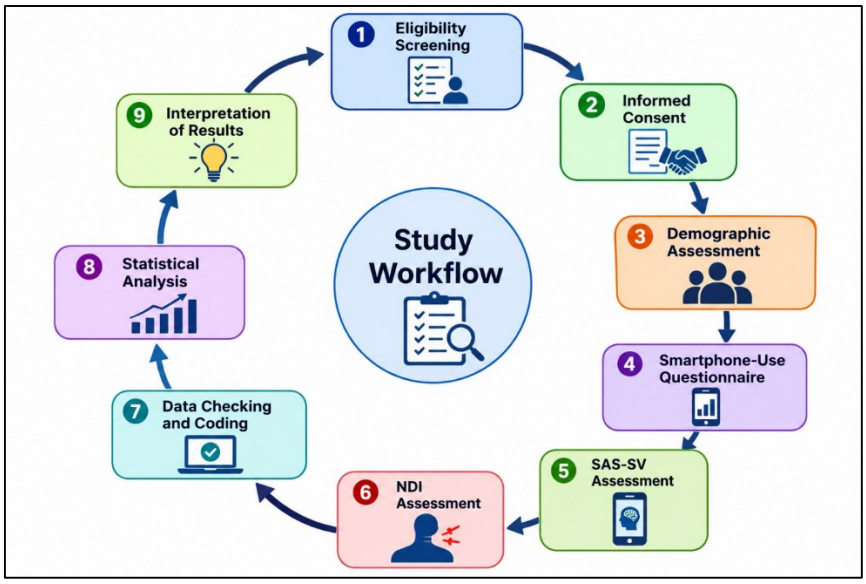


Figure. 2: Study workflow from participant recruitment and consent to assessment, statistical analysis and interpretation

4. Integrated physiotherapy and digital-wellness framework:

The relationship between smartphone behaviour and neck disability suggests that prevention and management should address both digital habits and musculoskeletal function. A physiotherapy programme may include screening for problematic smartphone use, assessment of cervical symptoms, ergonomic education, movement-break strategies, cervical and scapular exercises and follow-up evaluation. Behavioural strategies should focus on reducing unnecessary checking and improving the ability to interrupt prolonged device use.

5. Smartphone addiction among university students:

University students represent a population with frequent exposure to digital technologies. Smartphones support educational activities such as accessing online learning platforms, reading electronic documents, communicating with faculty members and participating in academic groups. They also provide access to social networking, video streaming, gaming and instant messaging. The coexistence of academic and recreational activities on the same device makes it difficult to distinguish necessary use from excessive use. A student may use a smartphone for several hours each day because of academic requirements without demonstrating

addictive behaviour. Conversely, another student may use a device for a shorter duration but experience substantial difficulty controlling use. Therefore, smartphone addiction and total screen time should be considered separate but related variables. Problematic smartphone use is often associated with repeated checking behaviour. Students may unlock their devices automatically, respond immediately to notifications or repeatedly switch between applications while studying. Such behaviours can fragment attention and extend device engagement beyond the original purpose. The constant availability of social feedback and entertainment may reinforce repeated interaction. Students may also use smartphones to manage boredom, loneliness or academic stress, potentially strengthening habitual engagement. These patterns can make it difficult to stop using the device even when physical discomfort develops. The academic environment may further reinforce smartphone exposure. Digital notes, online assessments, learning-management systems and electronic communication can increase the amount of time students spend looking at screens. Students may use smartphones while sitting in classrooms, lying in bed, walking or studying at desks that are not ergonomically designed. These different environments can influence head position, shoulder alignment and the amount of muscular activity required to maintain the device. Therefore, an assessment of smartphone behaviour should include not only total daily duration but also the context and pattern of use. Smartphone addiction is not synonymous with high smartphone use. Duration provides an estimate of exposure, whereas addiction scales attempt to measure behavioural and psychological features. A high SAS-SV score may indicate problematic use, but it does not establish a clinical diagnosis. Similarly, a student with a relatively low score may still experience neck symptoms because of prolonged academic computer work, poor posture or previous musculoskeletal problems. Both behavioural dependence and physical exposure should therefore be assessed independently.

6. Understanding neck disability in university students:

Neck disability refers to limitations in activities and participation associated with neck symptoms. In university students, these limitations may affect reading, writing, attending lectures, using computers, carrying backpacks, sleeping and participating in recreational activities. Symptoms may include cervical pain, stiffness, muscular fatigue, restricted movement and discomfort during sustained postures. The severity and functional impact of symptoms can vary substantially between individuals. Neck pain among young adults is influenced by multiple physical, behavioural and psychosocial factors. Prolonged sitting, inadequate movement, repetitive upper-limb activity, poorly arranged study environments and insufficient recovery periods may contribute to symptoms. Psychological stress and academic pressure may influence pain perception, muscle tension, sleep quality and coping behaviour. Previous neck pain is also important because recurrent symptoms may increase the likelihood of future disability. A research model that examines smartphone addiction without considering these factors may overestimate or underestimate the association. The NDI provides a structured method for evaluating functional limitations. It consists of ten sections, each scored from 0 to 5, producing a total score from 0 to 50 when all items are completed. Higher scores indicate greater self-reported disability. If a percentage score is required, the total score can be divided by the maximum possible score and multiplied by 100. When one or more items are missing, the scoring procedure specified by the validated version should be followed rather than assuming that all items were completed. Researchers should use an appropriately validated language version and report the scoring method clearly. The NDI should be interpreted as a measure of perceived neck-related functional limitation rather than a diagnostic test for a particular cervical disorder. A high score does not identify the underlying pathology, and a low score does not exclude intermittent neck pain. It is also important to distinguish disability categories from continuous NDI scores. Continuous scores retain more information for statistical analysis, whereas categories can help describe the distribution of disability within a sample.

7. Biomechanical mechanisms linking smartphone use with cervical symptoms:

The cervical spine supports the head while allowing a wide range of movement. During smartphone use, users commonly look downward toward a screen held below eye level. This position may increase cervical flexion and alter the mechanical demands placed on the neck and upper-quarter muscles. The degree of loading depends on head position, duration, device height, arm support, individual anatomy and the frequency of posture changes. A forward-flexed posture is not inherently harmful when used briefly, concern arises when the position is sustained repeatedly without adequate movement or recovery. The head creates a gravitational moment around the cervical region. As the head moves forward relative to the trunk, the external moment that must be controlled by cervical muscles may increase. This can require greater muscular activity to maintain the position. Biomechanical studies have examined the effects of neck-flexion angle and device-use posture on cervical muscle activity and loading (Tapanya et al., 2021, Yoon et al., 2021). These findings provide a

plausible explanation for why prolonged smartphone use may contribute to muscular fatigue, although the magnitude of the effect varies across individuals and tasks. The cervical extensors and other supporting muscles may remain active during sustained downward viewing. The upper trapezius, levator scapulae and shoulder-girdle muscles may also contribute to maintaining the position of the head and upper limbs. If the smartphone is held without adequate arm support, shoulder elevation and static upper-limb activity may increase. Repeated exposure may reduce tolerance for prolonged sitting and contribute to perceived tightness or discomfort. However, muscle activity alone does not prove tissue damage, and symptoms should not be attributed to a single posture. Forward-head posture is frequently discussed in relation to smartphone use. It describes a position in which the head is translated anteriorly relative to the trunk. The craniovertebral angle is commonly used in research to quantify this alignment. A smaller craniovertebral angle generally indicates a more forward head position when measured using standardized photographic or observational procedures. Studies have investigated associations among smartphone addiction, craniovertebral angle and scapular characteristics in student populations (Akodu et al., 2018, Sirajudeen et al., 2022). Neck flexion angle may be particularly relevant because the mechanical demands of smartphone use can vary substantially according to screen height. A device held near waist level may encourage greater downward gaze than a device held closer to eye level. However, maintaining a device at eye level for prolonged periods can increase shoulder and arm demands if the upper limbs are unsupported. Ergonomic recommendations should therefore balance cervical positioning with comfortable arm support and regular changes in posture rather than prescribing a single rigid position. The term text neck is often used to describe neck discomfort associated with prolonged device-related postures. It is a descriptive term rather than a universally accepted clinical diagnosis. Researchers should avoid using it as a substitute for a comprehensive musculoskeletal assessment. A more precise approach is to document symptoms, functional limitations, posture, exposure duration and relevant clinical findings.

8. Behavioural mechanisms and prolonged device engagement:

Smartphone addiction may influence neck disability through behavioural mechanisms that extend beyond the number of hours spent using a device. Students who experience difficulty controlling smartphone use may be more likely to continue activities despite discomfort, postpone movement breaks or use devices during periods intended for rest. Repeated checking may also produce fragmented periods of exposure throughout the day. These short periods may accumulate into substantial daily exposure, particularly when smartphone use occurs during study, transport and leisure. A second mechanism involves reduced awareness of body position. Students engaged in social media, gaming or video content may focus on the screen and remain in the same posture for longer than intended. The absence of regular posture changes may increase static muscular demand. In contrast, students who use smartphones for brief academic tasks may naturally interrupt use when the task is completed. Thus, the behavioural pattern may be relevant independently of total daily duration. A third mechanism involves the interaction between psychological dependence and recovery behaviour. Some students may use smartphones immediately before sleep or during periods of physical discomfort. Continued device engagement may displace activities such as walking, exercise, stretching and sleep. Reduced physical activity may influence general conditioning and musculoskeletal tolerance. The relationship is likely to be bidirectional: neck discomfort may also influence device-use behaviour, concentration and emotional well-being.

9. Evidence linking smartphone addiction with neck pain and disability:

Research on smartphone use and musculoskeletal symptoms has developed substantially over the past decade. Systematic reviews have described associations between mobile-device use and complaints affecting the neck, shoulders and upper limbs. Xie et al. (2017) reviewed musculoskeletal complaints associated with mobile handheld devices, while Zirek et al. (2020) examined symptoms and pathologies related to mobile phone use. These reviews highlight the importance of exposure duration, posture and repetitive device interaction, although differences in study design and outcome measurement limit direct comparisons. Studies involving university students have reported associations between smartphone-related behaviours and cervical symptoms. Damasceno et al. (2018) investigated text-neck-related posture and neck pain among young adults. Akodu et al. (2018) examined relationships among smartphone addiction, craniovertebral angle and scapular characteristics in physiotherapy undergraduates. Namwongsa et al. (2018) investigated factors associated with neck disorders among university student smartphone users. These studies suggest that smartphone-related neck problems should be considered within a broader postural and behavioural context. Sirajudeen et al. (2022) examined text-neck posture, smartphone addiction and neck disorders among university students in Saudi Arabia during the COVID-19 pandemic. Their work is relevant because it considered behavioural dependence and postural characteristics within the same population. The pandemic period also involved changes in online

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learning, screen exposure and daily movement patterns, which may have influenced the observed associations. Findings from pandemic-era studies should therefore be interpreted in relation to the specific educational and lifestyle conditions of the participants. Correia et al. (2023) investigated smartphone addiction, musculoskeletal pain and functionality in university students. Their findings support the importance of considering functional consequences rather than focusing only on pain prevalence. Elvan et al. (2024) examined mobile-phone usage duration, neck muscle endurance and neck pain among university students. Their study reported relationships between smartphone-use duration, pain and cervical muscle endurance, suggesting that exposure patterns may be relevant to cervical function. Alghadir et al. (2025) also examined smartphone addiction and musculoskeletal-associated disorders using biomechanical measures and questionnaire-based assessment. The 2025 systematic review and meta-analysis by Chen et al. reported a higher risk of neck pain among individuals with smartphone overuse. The pooled adjusted odds ratio was 2.34, with a 95% confidence interval of 1.44–3.82. This result supports an association between overuse and neck pain, but it should not be interpreted as proof that smartphone use directly causes cervical disability. The included studies were observational, and differences in exposure definitions, participant characteristics and confounding adjustment may influence pooled estimates. Research published in 2026 has provided more direct evidence concerning smartphone addiction and neck-related functional disability among university students. John et al. (2026) examined smartphone addiction, nomophobia and neck-related functional disability among 399 undergraduate students in Nigeria. The authors reported a positive association between smartphone addiction and neck-related functional disability, while forward-flexed neck posture was also associated with the outcome. Yapalı et al. (2026) investigated smartphone use, addiction, neck pain, disability, physical activity, and forward-head posture, cervical range of motion and neck muscle endurance in female college students. These studies reinforce the value of evaluating behavioural and biomechanical variables together. The findings across these studies are not identical. Some focus on neck pain, others on posture, muscle endurance or disability. Differences in sample size, sex distribution, smartphone-use definitions, addiction scales and clinical measurements make direct comparisons difficult. The overall evidence nevertheless supports further investigation of the relationship between problematic smartphone behaviour and cervical functional outcomes in university populations.

Table. 1: Recent evidence examining smartphone use, addiction and neck-related outcomes

Author and year	**Population or evidence type**	**Main focus**	**Relevance to neck disability**
Xie et al. (2017)	Systematic review	Mobile handheld device-related musculoskeletal complaints	Identifies neck and upper-limb symptoms associated with device use
Damasceno et al. (2018)	Young adults	Text neck and neck pain	Examines posture and cervical symptoms
Akodu et al. (2018)	Physiotherapy undergraduates	Addiction, craniovertebral angle and scapular variables	Links behavioural and postural characteristics
Namwongsa et al. (2018)	University students	Factors associated with neck disorders	Highlights multiple exposure-related factors
Zirek et al. (2020)	Systematic review	Musculoskeletal symptoms related to mobile phones	Summarizes the broader musculoskeletal evidence
Sirajudeen et al. (2022)	University students	Text-neck posture, addiction and neck disorders	Integrates behavioural and postural measures
Correia et al. (2023)	University students	Smartphone addiction, pain and functionality	Considers functional consequences
Elvan et al. (2024)	University students	Phone-use duration, neck pain and muscle endurance	Examines cervical function and exposure
Chen et al. (2025)	Systematic review and meta-analysis	Smartphone overuse and neck pain	Reports increased odds of neck pain with overuse
John et al. (2026)	Undergraduate students	Addiction, nomophobia and neck disability	Directly assesses behavioural dependence and functional disability
Yapalı et al. (2026)	Female college students	Smartphone use, addiction and cervical outcomes	Examines posture, disability and cervical function

10. Smartphone addiction and neck disability: the importance of distinguishing pain from function:

Neck pain and neck disability are related but distinct outcomes. Pain intensity describes the severity of discomfort, while disability describes the impact of symptoms on functional activities. This distinction is important when evaluating university students because mild pain may not prevent academic participation, whereas persistent symptoms may interfere with reading, writing, sleeping and concentration. A study that measures only pain intensity may therefore fail to capture the wider consequences of cervical symptoms. The NDI provides a standardized way to assess these functional consequences. Its use allows researchers to examine whether higher smartphone addiction scores are associated not only with the presence of discomfort but also with greater difficulty performing routine activities. However, the NDI includes domains that may be influenced by factors beyond smartphone use. For example, sleep difficulty may be associated with stress or sleep habits, while work and recreation may vary according to academic demands and lifestyle. Interpretation should therefore consider the broader context of each participant. A continuous NDI score is generally preferable for primary statistical analysis because it retains more information than categories. Disability categories can be reported descriptively, but the cut-off values and interpretation should follow the specific validated version and scoring convention used by the investigators. Researchers should also report the mean, standard deviation, median and range as appropriate, rather than relying only on a percentage classified as having disability.

11. Assessment of smartphone addiction using the SAS-SV:

The SAS-SV is a brief questionnaire designed to assess problematic smartphone-use behaviours. It includes ten items that address features such as daily-life disturbance, withdrawal, overuse, tolerance and cyberspace-oriented relationships. Responses are scored on a Likert-type scale, with higher total scores indicating greater problematic-use characteristics. Its short format makes it suitable for university-based research where multiple questionnaires may be administered. The SAS-SV should be used in a validated language version appropriate for the study population. Recent studies have examined its psychometric properties among Japanese adults, Chinese college students and young adults in India (Nagata et al., 2023, Zhao et al., 2022, Rajesh et al., 2025). These studies demonstrate the importance of checking whether the instrument performs adequately in the intended population. Researchers should report the language version, scoring procedure and any established cut-off used to classify high-risk smartphone use. A major advantage of the SAS-SV is that it assesses behavioural features rather than relying exclusively on screen-time estimates. However, self-report measures may be influenced by recall errors, social desirability and individual interpretation of questionnaire items. Some participants may underreport their smartphone dependence, while others may interpret frequent academic use as problematic even when they retain control over their behaviour. The questionnaire should therefore be supplemented with objective smartphone-use records when feasible.

12. Assessment of neck disability using the NDI:

The NDI is widely used in clinical and research settings to assess functional limitations associated with neck symptoms. Its ten domains provide a broad overview of how cervical complaints influence daily life. The questionnaire is relatively easy to administer and can be completed without specialized equipment. Recent psychometric research has examined its reliability, validity and measurement properties, supporting the need for careful selection of the appropriate language version (Saltychev et al., 2024). In a university-based study, the NDI should be administered using standardized instructions. Participants should be asked to answer according to their current neck-related difficulties and the reference period specified by the validated version. Investigators should avoid changing item wording or response options without appropriate adaptation and validation. Missing responses should be handled according to the instrument's scoring guidance. The NDI can be used alongside a pain-intensity scale, such as a visual analogue scale or numerical rating scale. This combination helps distinguish symptom severity from functional impact. Additional physical assessment may include cervical range of motion, craniovertebral angle, cervical flexor endurance and scapular posture. These measurements can provide complementary information, although they are not substitutes for the participant's report of disability.

Table. 2: Recommended assessment variables and measurement tools for a university-based study

Variable	Suggested measurement	Purpose
Smartphone addiction	Smartphone Addiction Scale–Short Version	Quantifies problematic smartphone-use characteristics

Neck disability	Neck Disability Index	Measures functional limitations related to neck symptoms
Neck pain intensity	Numerical Rating Scale or Visual Analogue Scale	Quantifies perceived pain intensity
Daily smartphone use	Device screen-time record and questionnaire	Estimates total exposure duration
Continuous-use duration	Structured smartphone-use questionnaire	Identifies prolonged uninterrupted sessions
Smartphone-use behaviour	Primary-use categories and checking habits	Describes academic, social and recreational use
Cervical posture	Craniovertebral angle or standardized photographic assessment	Estimates forward-head posture
Cervical mobility	Goniometric or validated inclinometer assessment	Evaluates cervical range of motion
Neck muscle endurance	Standardized cervical flexor and extensor endurance tests	Assesses muscular endurance
Physical activity	International Physical Activity Questionnaire–Short Form or another validated tool	Assesses activity level as a potential confounder
Previous neck pain	Structured history questionnaire	Identifies prior symptoms and recurrence
Psychosocial factors	Validated stress or psychological questionnaires, if included	Assesses potential confounding or modifying factors

13. Factors that may influence the association:

The relationship between smartphone addiction and neck disability is unlikely to be explained by a single factor. Age, sex, academic discipline, year of study, previous neck pain, physical activity, sleep, stress and other screen exposure may influence both smartphone behaviour and musculoskeletal outcomes. These variables should be considered during study planning and statistical analysis. Sex and gender-related differences may influence smartphone-use patterns, symptom reporting, physical activity and musculoskeletal characteristics. However, these differences should not be assumed without examining the study data. Researchers should report the demographic distribution of the sample and consider whether subgroup analyses are justified by sample size and study objectives. Academic discipline may influence smartphone exposure. Students in health sciences, engineering, management, humanities and other programmes may have different academic requirements and patterns of digital engagement. Some students may use smartphones extensively for electronic textbooks and educational videos, while others may rely more heavily on laptops or desktop computers. Measuring smartphone use separately from total digital-device exposure can help clarify the specific contribution of smartphone behaviour. Physical activity is another important variable. Students who spend more time sitting and less time engaging in regular physical activity may have different levels of musculoskeletal conditioning and recovery. Physical activity may also be associated with smartphone-use habits. It should therefore be considered when examining the relationship between addiction scores and neck disability. Previous neck pain should be documented because recurrent symptoms may influence current disability. A student with a history of cervical pain may report higher NDI scores even if current smartphone use is moderate. Conversely, students without previous neck symptoms may tolerate similar exposure without substantial functional limitation. Failure to account for previous symptoms may complicate interpretation. Psychological stress and sleep quality may also influence the association. Academic pressure, anxiety and insufficient sleep can affect pain perception, muscle tension, recovery and digital behaviour. Smartphone use may be used as a coping strategy during stressful periods, potentially creating an association between problematic use and symptoms that is partly explained by shared psychosocial factors. These variables should be measured when they are central to the research question and when validated instruments are available.

14. Proposed research methodology:

A cross-sectional analytical study is suitable for examining the association between smartphone addiction and neck disability at a defined point in time. The study may be conducted among undergraduate students enrolled in a university or a group of affiliated colleges. The target population should be clearly described, and

recruitment should include students from different academic disciplines and years of study where feasible. The primary objective should be to determine whether SAS-SV scores are associated with NDI scores among university students. Secondary objectives may include describing the prevalence of high-risk smartphone-use characteristics, estimating the distribution of neck disability, examining relationships between daily smartphone-use duration and NDI scores, and assessing whether the addiction–disability association remains after adjustment for relevant confounders. The target population may include full-time university students aged 18 years or older who regularly use smartphones. Inclusion criteria should be defined before recruitment. Possible exclusion criteria may include recent major cervical trauma, known severe cervical pathology, neurological disorders affecting neck function or inability to complete the questionnaires reliably. Exclusion criteria should not be unnecessarily broad, because removing every participant with previous neck pain could reduce the relevance of the study to the general student population. Previous neck pain can instead be recorded and considered during analysis. Sample size should be calculated before data collection. For a correlation-based primary objective, the calculation should be based on the expected correlation coefficient, desired statistical power, significance level and allowance for incomplete responses. If the main analysis is multivariable regression, the anticipated model complexity and expected effect size should also be considered. The sample size should not be selected solely by convenience or by copying the sample size of another study. A structured questionnaire can collect demographic and smartphone-use information. Suggested variables include age, sex, academic discipline, year of study, average daily smartphone use, longest uninterrupted use period, primary purpose of use, and use before sleep, frequency of movement breaks, physical activity and previous neck pain. Where possible, participants should be encouraged to refer to their smartphone's screen-time or digital-wellbeing records rather than relying exclusively on memory. The SAS-SV and NDI should be administered using validated versions. Questionnaires should be completed in a quiet environment, with standardized instructions. If data are collected electronically, the survey should be designed to prevent accidental omission of required items while allowing participants to withdraw without pressure. A small pilot study can identify unclear questions, technical problems and the approximate time needed for completion.

15. Sampling and recruitment:

A probability-based sampling method is preferable when the university has an accessible student sampling frame. Stratified sampling by academic discipline or year of study can help improve representation. If convenience sampling is used, the limitation should be acknowledged, and recruitment procedures should be described transparently. Investigators should avoid recruiting only students from physiotherapy or health-science programmes if the stated target population is university students generally. Recruitment may be conducted through academic departments, student notices and institutional communication channels. Participation should be voluntary. Faculty members should not pressure students to participate, and refusal should not affect academic standing. Informed consent should be obtained before questionnaire completion.

16. Data collection and quality control:

Data collection should follow a standardized protocol. Each participant should receive a unique study identification code that does not contain identifying personal information. Completed questionnaires should be checked for missing responses and inconsistent entries. Electronic data should be stored in a password-protected system with access restricted to authorized research personnel. If objective screen-time records are collected, investigators should define the observation period and the method used to obtain the information. Different smartphone operating systems may display usage data differently. Researchers should document whether the reported value represents total screen time, application-specific use or time spent with the screen active. Self-reported estimates and device-recorded exposure should not be treated as identical measurements. Postural assessment, if included, should use standardized positioning, camera distance and anatomical landmarks. The craniovertebral angle can be calculated from a standardized lateral photograph using defined landmarks. Assessors should be trained, and intra-rater or inter-rater reliability should be considered. If the study does not include objective postural assessment, the manuscript should state that posture was self-reported or not measured rather than implying that cervical alignment was clinically evaluated.

17. Statistical analysis:

Descriptive statistics should summarize participant characteristics, smartphone-use patterns, SAS-SV scores and NDI scores. Continuous variables may be reported as mean and standard deviation when distributions are approximately normal, or median and interquartile range when distributions are skewed. Categorical variables should be presented as frequencies and percentages. The primary association between SAS-SV and NDI scores can be examined using Pearson correlation when the assumptions are adequately met. Spearman rank

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correlation may be more appropriate when distributions are markedly skewed, relationships are monotonic but not linear, or influential outliers are present. The correlation coefficient should be reported with a confidence interval and exact p-value where possible. Statistical significance should not be interpreted as clinical importance, the magnitude and precision of the association should also be discussed. Multiple linear regression can be used to examine whether smartphone addiction scores are associated with NDI scores after adjustment for relevant covariates. Potential adjustment variables include age, sex, daily smartphone-use duration, previous neck pain, physical activity and academic discipline. The final model should be based on the study question and a defensible causal framework rather than indiscriminately including every collected variable. Multicollinearity, residual distribution, influential observations and model fit should be assessed. If NDI scores are categorized for descriptive purposes, logistic or ordinal regression may be considered depending on the outcome definition and assumptions. Categorization should not replace continuous-score analysis without a clear justification, because it can reduce statistical information. Researchers should also avoid selecting cut-offs after examining the results. Missing data should be reported. The number of participants with incomplete SAS-SV or NDI responses should be stated, along with the method used to handle missing values. Complete-case analysis may be acceptable when missingness is limited and plausibly random, but more substantial missingness may require sensitivity analysis or appropriate imputation methods. The statistical plan should be finalized before data analysis whenever possible.

Table. 3: Proposed statistical analysis plan for evaluating smartphone addiction and neck disability

Research objective	**Variables**	**Suggested analysis**	**Reporting**
Describe participant characteristics	Age, sex, academic discipline, year of study	Descriptive statistics	Mean, SD, median, frequency and percentage
Describe smartphone-use patterns	Daily duration, continuous-use periods, primary purpose	Descriptive statistics	Hours, categories and percentages
Estimate problematic smartphone-use characteristics	SAS-SV total score	Descriptive statistics	Mean, SD, range and validated risk classification if applicable
Describe neck-related disability	NDI total score	Descriptive statistics	Mean, SD, median and disability distribution
Examine the primary association	SAS-SV and NDI scores	Pearson or Spearman correlation	Correlation coefficient, confidence interval and p-value
Assess the independent association	NDI as outcome, SAS-SV and covariates as predictors	Multiple linear regression	Regression coefficient, 95% CI, p-value and model fit
Explore duration-related differences	Smartphone-use duration and NDI	Correlation, regression or group comparison	Effect estimate and confidence interval
Examine potential subgroup patterns	Sex, academic discipline or study year	Interaction or stratified analysis, if justified	Subgroup estimates and interaction tests

18. Ethical considerations:

The study should receive approval from the appropriate institutional ethics committee before recruitment begins. Participants should receive information about the research purpose, procedures, possible discomforts, confidentiality protections and voluntary nature of participation. Informed consent should be documented according to institutional requirements. The study should collect only information necessary to answer the research question. Personal identifiers should be separated from research data or avoided entirely where possible. Participation should not affect academic assessment, attendance or access to university services. Participants who report substantial or persistent neck symptoms should be advised to seek appropriate clinical evaluation rather than relying on the research questionnaire as a diagnostic assessment.

19. Discussion:

The association between smartphone addiction and neck disability is clinically and academically relevant because university students often combine extended digital engagement with prolonged sitting and limited movement. Smartphone addiction may contribute to increased exposure by making it difficult to disengage from device-related activities. When this behaviour is accompanied by sustained neck flexion, unsupported arm positioning and inadequate movement breaks, cervical muscles may experience repeated static demands. These mechanisms provide a plausible explanation for the association observed in several student-based studies. However, the relationship should not be interpreted as a simple direct pathway from addiction to disability. Smartphone addiction is a behavioural construct, whereas neck disability is a functional musculoskeletal outcome. The two may be connected through several intermediate variables, including exposure duration, posture, physical activity, sleep and psychological factors. A student with a high addiction score may not necessarily have neck disability, and a student with substantial disability may have little or no problematic smartphone behaviour. The distinction between smartphone-use duration and addiction is especially important. Duration provides information about exposure time, but it does not describe the student's ability to regulate use. A student may use a smartphone for several hours for academic purposes while maintaining regular breaks and comfortable posture. Another may use a device for fewer hours but engage in repeated checking and prolonged uninterrupted sessions. The SAS-SV can help identify behavioural features that are not captured by screen-time records alone. The recent meta-analysis by Chen et al. (2025) provides broader evidence that smartphone overuse is associated with neck pain. Nevertheless, neck pain and neck disability are not interchangeable outcomes. Pain may be present without substantial functional limitation, while disability may reflect the combined influence of symptom severity, psychological responses and activity demands. Studies using the NDI can therefore provide additional information about how smartphone-related behaviour may relate to daily functioning. The university-based findings reported by Correia et al. (2023), Elvan et al. (2024) and Alghadir et al. (2025) are relevant because they examine musculoskeletal outcomes in student or young-adult populations. The 2026 studies by John et al. and Yapalı et al. further demonstrate the value of integrating behavioural and biomechanical variables. Collectively, these studies suggest that future investigations should avoid relying on smartphone duration alone and should incorporate validated measures of problematic use, disability and relevant ergonomic exposures. A key implication is the need to distinguish statistical association from causality. Cross-sectional studies measure exposure and outcome at approximately the same time. They cannot establish whether problematic smartphone use preceded neck disability or whether students with neck symptoms developed different smartphone-use habits. Reverse causation is possible. For example, students with limited mobility or discomfort during other activities may spend more time using smartphones. Longitudinal research is needed to determine whether problematic smartphone behaviour predicts the development or progression of neck disability.

20. Clinical implications for physiotherapy:

Physiotherapists can contribute to the prevention and management of smartphone-associated neck problems through comprehensive assessment and individualized education. Assessment should include symptom history, functional limitations, cervical mobility, muscle performance, posture, daily activity and relevant digital-use habits. The SAS-SV may be useful as a research or screening measure, but it should not replace a clinical interview or be treated as a diagnostic instrument. Ergonomic education should emphasize variation rather than rigid posture correction. Students can be encouraged to raise the device toward a comfortable viewing height, support the forearms when possible and avoid maintaining a fixed neck position for prolonged periods. A comfortable posture should allow relaxed shoulders, adequate visual access and regular changes in position. There is no single ideal posture that must be maintained continuously. Movement breaks may help interrupt prolonged static exposure. Students can be encouraged to stand, walk briefly, change position or perform gentle cervical and shoulder movements during longer study sessions. Break frequency should be practical and individualized. The purpose is not to prescribe an unsupported universal time threshold but to reduce prolonged uninterrupted exposure and promote regular movement. Exercise programmes may include cervical flexor endurance training, scapular stabilization, thoracic mobility and general physical activity. Deep cervical flexor exercises can be introduced with appropriate instruction and progressed according to symptom response. Scapular strengthening may target the muscles involved in controlling shoulder-girdle position. Thoracic mobility exercises can complement cervical rehabilitation when restricted thoracic movement is relevant. Exercise selection should be based on individual assessment rather than assuming that all smartphone users have the same impairment. Behavioural strategies may also be useful. Students can review their device-use records, disable non-essential notifications, establish phone-free study intervals and avoid unnecessary checking during periods of focused work. These strategies aim to improve self-regulation rather than prohibit

smartphone use. Academic access to digital resources should remain available, while recreational engagement can be managed through practical boundaries.

21. Proposed integrated physiotherapy and digital-wellness intervention:

An integrated programme may begin with screening for neck symptoms, functional disability and problematic smartphone-use behaviours. Students with significant symptoms should receive an appropriate clinical assessment to identify possible red flags or alternative causes. Students with mild symptoms may benefit from education and a self-management programme. Those with persistent or progressive symptoms may require individualized physiotherapy or referral. The education component should explain the relationship between prolonged static posture, movement variation and cervical loading. Students should be encouraged to recognize early signs of fatigue and discomfort and to modify their device-use environment. Education should avoid fear-based messages suggesting that ordinary smartphone use inevitably damages the cervical spine. The exercise component may include gentle cervical mobility, deep neck flexor activation, cervical extensor endurance, scapular retraction and strengthening, thoracic extension and general conditioning. Exercise intensity should be progressed gradually. Students should be advised to stop or modify exercises that provoke unusual or worsening symptoms and seek professional guidance when necessary. The digital-wellness component may include monitoring screen-time patterns, reducing unnecessary notifications, setting realistic recreational-use boundaries and using reminders to change position. Students should be encouraged to balance screen-based activities with walking, physical activity and adequate sleep. Follow-up assessment can repeat the NDI and relevant clinical measures to evaluate change.

22. Limitations of the current evidence:

The literature has several limitations. Many studies use cross-sectional designs, which restrict causal interpretation. Smartphone-use duration is frequently self-reported and may be affected by recall error. Different studies use different smartphone-addiction instruments and cut-off values, making prevalence comparisons difficult. Some studies measure neck pain without assessing functional disability, while others use different postural or muscle-performance tests. Sample sizes and participant characteristics also vary. Some studies include only female students, health-science students or participants with existing neck pain. These sampling decisions may limit generalizability to the wider university population. The use of convenience sampling may further introduce selection bias. Another limitation is the lack of consistent objective exposure measurement. Device-recorded screen time can improve measurement of duration, but it does not always identify the posture, activity or context in which the smartphone was used. A student may use a smartphone while walking, sitting upright, lying down or maintaining sustained neck flexion. Future research should combine objective screen-time information with standardized postural assessment and validated functional outcomes. The concept of smartphone addiction also requires careful interpretation. High scores on a screening questionnaire should not automatically be treated as a clinical diagnosis. Behavioural dependence may vary according to academic requirements, cultural context and individual circumstances. Studies should describe the instrument and classification procedure clearly.

23. Future research directions:

Future studies should use prospective designs to examine whether problematic smartphone behaviour predicts subsequent neck pain or disability. Repeated measurement of SAS-SV and NDI scores may help establish temporal patterns. Researchers should also examine whether changes in smartphone-use behaviour are followed by changes in cervical symptoms and functional outcomes. Intervention studies could compare digital-wellness education alone with combined behavioural and physiotherapy programmes. Outcomes may include NDI scores, pain intensity, and smartphone-use duration, and movement-break frequency, cervical range of motion and muscle endurance. Randomized controlled trials would provide stronger evidence regarding the effectiveness of specific interventions. Objective measurement should be improved through device-recorded screen time, standardized posture assessment and, where feasible, wearable movement sensors. Such approaches could help distinguish total smartphone exposure from time spent in sustained neck-flexed positions. Researchers should also examine the role of academic workload, psychological distress, sleep quality and physical activity. Studies in different cultural and educational settings are required because smartphone-use patterns and academic demands vary across universities. Multicentre research may improve generalizability and permit more reliable subgroup analyses. The psychometric performance of translated versions of SAS-SV and NDI should also be examined in the intended student population.

24. Conclusion:

Smartphone addiction may be associated with neck disability among university students through behavioural and biomechanical pathways involving prolonged device engagement, repeated checking, sustained cervical flexion and reduced movement variation. Current evidence supports concern about smartphone overuse and neck-related symptoms, while recent university-based research has begun to examine the relationship between problematic smartphone use and functional disability more directly. However, smartphone addiction should not be considered the sole cause of neck disability, because cervical symptoms are influenced by multiple physical, psychological and environmental factors. The SAS-SV and NDI provide practical instruments for examining behavioural dependence and functional limitations, respectively. Future research should combine validated questionnaires with objective exposure and postural measures, adjust for important confounders and use longitudinal or intervention-based designs. Physiotherapy strategies that integrate ergonomic education, cervical and scapular exercise, movement breaks and digital self-management may provide a practical approach to promoting healthier smartphone habits and reducing the functional impact of neck symptoms in university students.

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