

Smart Neck Guard: A Survey-Based Study on Smartphone Use, Neck Posture, and Awareness for Preventing Smartphone Zombie Syndrome

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Research Article

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Smart Neck Guard: A Survey-Based Study on Smartphone Use, Neck Posture, and Awareness for Preventing Smartphone Zombie Syndrome

A cross sectional survey and proposed wearable intervention

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Abstract

Background: Prolonged smartphone use may contribute to poor neck posture, musculoskeletal discomfort, visual fatigue, compulsive checking, and reduced awareness of the surrounding environment. These interconnected physical and behavioral effects are increasingly associated with the concept of “smartphone zombie” behavior. This study examined smartphone-use patterns, posture-related symptoms, visual strain, phubbing, phantom-phone experiences, and environmental awareness among young adult smartphone users. It also explored participants’ perceptions of the proposed Smart Neck Guard as a posture-monitoring intervention.

Methods: A cross-sectional survey was conducted over five months among 185 young adult smartphone users recruited from selected universities through convenience sampling. Data were collected using a structured online questionnaire comprising demographic and smartphone-use questions, the 33-item Smartphone Addiction Scale, the 8-item Phubbing Scale, phantom-phone phenomenon items, and exploratory digital-behavior items. Descriptive statistics were used to summarize the responses. Cronbach’s alpha was calculated to assess internal consistency, while Spearman’s rank correlation was used to examine associations between prolonged daily smartphone use and the measured behavioral outcomes.

Results: Among the participants, 64.9% reported using their smartphones for more than four hours per day. Unnecessary scrolling was reported by 88.6%, tired eyes by 85.7%, failure to take regular breaks by 84.9%, forward or slouched neck posture by 80.0%, reduced environmental awareness by 75.9%, and neck stiffness by 71.1%. The measured scales demonstrated high internal consistency, with Cronbach’s alpha values ranging from 0.950 to 0.982. Prolonged smartphone use showed statistically significant positive correlations with smartphone addiction ($\rho = 0.355, p < 0.001$), phantom-phone phenomena ($\rho = 0.336, p < 0.001$), exploratory digital behaviors ($\rho = 0.298, p < 0.001$), and phubbing ($\rho = 0.239, p = 0.001$).

Conclusion: Prolonged smartphone use was associated with greater smartphone addiction, phubbing, phantom-phone experiences, and exploratory digital behaviors. A substantial proportion of participants also reported neck stiffness, visual fatigue, poor posture, missed breaks, and reduced environmental awareness. These findings support further investigation of integrated preventive strategies. The proposed Smart Neck Guard may provide posture monitoring, haptic feedback, and break reminders, but its effectiveness must be evaluated through prototype development and controlled clinical testing.

Keywords: smartphone use, smartphone addiction, neck posture, neck stiffness, visual fatigue, phubbing, phantom-phone phenomenon, environmental awareness, Smart Neck Guard

Introduction

Smartphones are routinely used for communication, study, navigation, and leisure. Attention directed toward a screen during walking can reduce awareness of the surrounding environment. The term “smartphone zombie” has been used in research on distracted walking, including a study examining the relationship between fear of missing out and smartphone use while walking [1]. In an observational study of 3,301 pedestrians in Spain, 361 participants, representing 10.9% of those observed, were classified as “smombies.” This behavioral category included pedestrians who walked while actively looking at, typing on, or otherwise interacting with their smartphone screens [2]. These observations describe a pattern of distracted pedestrian behavior rather than a formally recognized medical diagnosis.

Posture represents another concern associated with prolonged smartphone use. A biomechanical model proposed that increasing head flexion places greater mechanical demand on the cervical spine [9]. These estimated mechanical loads should be interpreted as biomechanical calculations rather than direct evidence of tissue damage or future cervical disease. Among university students, Mustafaoglu et al. identified associations between smartphone addiction scores, daily smartphone-use duration, and musculoskeletal pain in areas including the neck, upper back, shoulders, and wrists or hands [4]. Ayhuallem et al. similarly reported that prolonged smartphone use and failure to take breaks were associated with self-reported neck pain among university students [5].

Visual symptoms may also occur during sustained smartphone viewing. Digital eye strain includes symptoms such as tired or aching eyes, dryness, irritation, blurred vision, headache, and difficulty refocusing after prolonged digital-device use [13]. Its reported prevalence varies according to the population, duration of exposure, type of device, viewing conditions, and assessment method. Consequently, visual fatigue should be measured and reported using clearly defined symptoms and response criteria.

Physical symptoms, postural habits, visual fatigue, problematic smartphone use, phubbing, phantom-phone experiences, and environmental awareness have frequently been examined as separate concerns. Studying these domains together may provide a broader understanding of how intensive smartphone engagement affects young adults. At the same time, physical symptoms, behavioral patterns, and attentional experiences must remain conceptually distinct because they represent different outcomes and may arise through different mechanisms.

Therefore, the present study examined smartphone-use patterns, self-reported neck posture, physical and visual symptoms, break-taking behavior, environmental awareness, smartphone addiction, phubbing, phantom-phone experiences, and exploratory digital behaviors among young adult smartphone users. The study also explored participants’ perceptions of Smart Neck Guard, a proposed wearable device designed to monitor neck angle and provide gentle haptic feedback, prolonged-use alerts, and break reminders. The survey assessed interest in the proposed device and preferred features; it did not evaluate a functional prototype.

Study Design and Setting

A cross-sectional, questionnaire-based study was conducted over five months among young adult smartphone users from Liaquat National School of Physiotherapy, Dow University of Health

Sciences, Jinnah Sindh Medical University, Quaid-i-Azam University, and Khyber Medical University. Participants were recruited through convenience sampling, and data were collected electronically using a structured Google Forms questionnaire.

Study Population and Sample Size

The study population comprised young adults who regularly used smartphones. Individuals were eligible to participate if they fell within the specified age range, used a smartphone, understood the purpose of the study, and voluntarily agreed to participate. Respondents who did not provide consent or submitted substantially incomplete questionnaires were excluded from the final analysis.

The required sample size was estimated using StatMate. A total of 185 eligible and consenting participants were included in the final analysis.

Sampling Technique

A non-probability convenience sampling technique was used. The questionnaire link was distributed electronically among eligible students and young adult smartphone users associated with the selected educational institutions. Participation was voluntary, and respondents completed the questionnaire independently.

Assessment Instrument

Data were collected using a structured questionnaire consisting of the following sections:

1. Demographic information
2. Smartphone-use patterns and daily exposure
3. Physical and visual symptoms
4. Posture, break-taking behavior, and environmental awareness
5. Smartphone Addiction Scale
6. Phubbing Scale
7. Phantom-phone phenomenon items
8. Exploratory digital-behavior items
9. Perceptions and preferred features of the proposed Smart Neck Guard

The demographic and smartphone-use sections collected information about participant characteristics, estimated daily smartphone use, scrolling habits, breaks, neck posture, neck stiffness, headache, visual fatigue, and awareness of the surrounding environment.

Smartphone Addiction Scale

Problematic smartphone-use behavior was assessed using the 33-item Smartphone Addiction Scale developed by Kwon et al. [3]. The scale evaluates different aspects of smartphone addiction, including disruption of daily activities, withdrawal, tolerance, overuse, and dependence on smartphone-mediated interactions. Responses were recorded using the response

categories included in the original questionnaire, with higher scores indicating greater problematic smartphone use.

Phubbing Scale

Phubbing behavior was assessed using the eight-item Phubbing Scale described by Karadağ et al. [15]. The scale measures the tendency to become occupied with a smartphone during face-to-face interactions and the extent to which smartphone use interferes with interpersonal communication. Higher scores represent more frequent phubbing behavior.

Phantom-Phone Phenomena

Eight questions assessed phantom-phone experiences, such as perceiving a vibration or notification sound when no notification had occurred, automatically checking the phone, and feeling an urge to check the device without receiving an alert. These items were analyzed as a separate group of smartphone-related sensory and checking experiences.

Exploratory Digital-Behavior Items

Eight study-specific questions were used to explore behavioral and awareness-related patterns associated with smartphone use. Four exploratory concepts were described:

- **Postural autopilot:** automatically adopting a compromised neck posture without consciously recognizing it.
- **Attention capture loop:** continued smartphone engagement resulting from repeated notifications, checking, and scrolling.
- **Digital proprioceptive drift:** reduced awareness of body and neck position during smartphone use.
- **Digital distraction blindness:** reduced awareness of the immediate surrounding environment while focused on a smartphone.

These concepts were treated as exploratory survey-based behavioral patterns and were not considered established clinical diagnoses or validated independent constructs.

Smart Neck Guard Perception

Participants were also asked about their perception of the proposed Smart Neck Guard and the features they would prefer in such a device. The proposed features included real-time neck-angle detection, gentle haptic feedback, prolonged-use alerts, break reminders, and combined posture monitoring. No physical prototype was tested during the study.

Data Collection Procedure

Data were collected electronically through a structured questionnaire developed using Google Forms. The survey link was distributed among young adult smartphone users associated with the selected educational institutions. Before accessing the questionnaire, prospective participants were provided with information explaining the purpose of the study, the voluntary nature of participation, the confidentiality of their responses, and their right to discontinue the survey at

any stage without providing a reason. Only participants who provided electronic informed consent were permitted to continue to the questionnaire.

The questionnaire was divided into sections covering demographic characteristics, daily smartphone-use patterns, physical and visual symptoms, postural habits, break-taking behavior, environmental awareness, smartphone addiction, phubbing, phantom-phone experiences, exploratory digital behaviors, and perceptions of the proposed Smart Neck Guard.

The study relied entirely on participant-reported information. No physical examination, cervical range-of-motion assessment, radiological investigation, direct postural observation, eye examination, or objective smartphone screen-time measurement was performed. Similarly, participants' walking behavior and environmental awareness were not observed directly. Therefore, the recorded outcomes represented participants' perceptions and experiences rather than clinically confirmed conditions.

Following completion of data collection, responses were exported from Google Forms into a spreadsheet. The records were reviewed for participant eligibility, consent, completeness, duplicate submissions, and coding accuracy. Eligible responses were assigned numerical codes according to the response categories used in the questionnaire. The cleaned dataset was subsequently prepared for descriptive, reliability, and correlation analyses. A total of 185 eligible participant records were included in the final analysis.

Statistical Analysis

Data were analyzed using descriptive and inferential statistical methods. Categorical variables were summarized using frequencies and percentages, whereas composite scale scores were summarized using the mean and standard deviation.

For the descriptive physical, visual, postural, and behavioral questions, the response categories **Sometimes**, **Often**, and **Always** were combined to calculate the percentage of participants who reported experiencing the relevant outcome. Participants selecting **Never** or the equivalent negative response were treated as not reporting that outcome.

Daily smartphone exposure was assessed using the questionnaire item concerning smartphone use for more than four hours per day. Based on the coding used in the study, participants selecting **Often** or **Always** were categorized as reporting prolonged daily smartphone use. This variable was used to describe the prevalence of prolonged exposure and to examine its association with the four questionnaire score groups.

Mean scores were calculated for the Smartphone Addiction Scale, Phubbing Scale, phantom-phone items, and exploratory digital-behavior items.

The internal consistency of each questionnaire section was assessed using Cronbach's alpha. Cronbach's alpha evaluates how consistently a group of questions measures the same general concept. A coefficient of at least 0.70 was considered acceptable, a value of at least 0.80 was considered good, and a value of at least 0.90 was interpreted as excellent internal consistency. High Cronbach's alpha values indicate that the items produced closely related responses within

the present sample, although internal consistency alone does not establish the validity or dimensional structure of a scale.

Spearman's rank correlation coefficient was used to examine the relationship between prolonged daily smartphone use and scores for smartphone addiction, phubbing, phantom-phone phenomena, and exploratory digital behaviors. Spearman's correlation was selected because the questionnaire generated ordinal response data and the analysis did not require the assumption of normally distributed scores.

A positive Spearman coefficient indicated that greater smartphone exposure was associated with a higher score on the relevant measure. Correlation coefficients closer to zero represented weaker relationships, while coefficients further from zero represented stronger relationships. All statistical tests were two-sided, and a p value below 0.05 was considered statistically significant.

The final analysis included 185 participants. Statistical findings were reported using the relevant coefficient, exact p value where available, and sample size.

Results

Participant Recruitment and Characteristics

A total of 185 eligible young adult smartphone users were included in the final analysis. Participants were recruited through convenience sampling from Liaquat National School of Physiotherapy, Dow University of Health Sciences, Jinnah Sindh Medical University, Quaid-i-Azam University, and Khyber Medical University.

The demographic characteristics of the participants should be summarized according to age, sex or gender, educational institution, academic level, and any other demographic variables included in the questionnaire. Continuous demographic variables, such as age, should be presented using the mean and standard deviation or the median and interquartile range, depending on their distribution. Categorical variables should be reported using frequencies and percentages.

Figure 1. Participant recruitment and inclusion flowchart

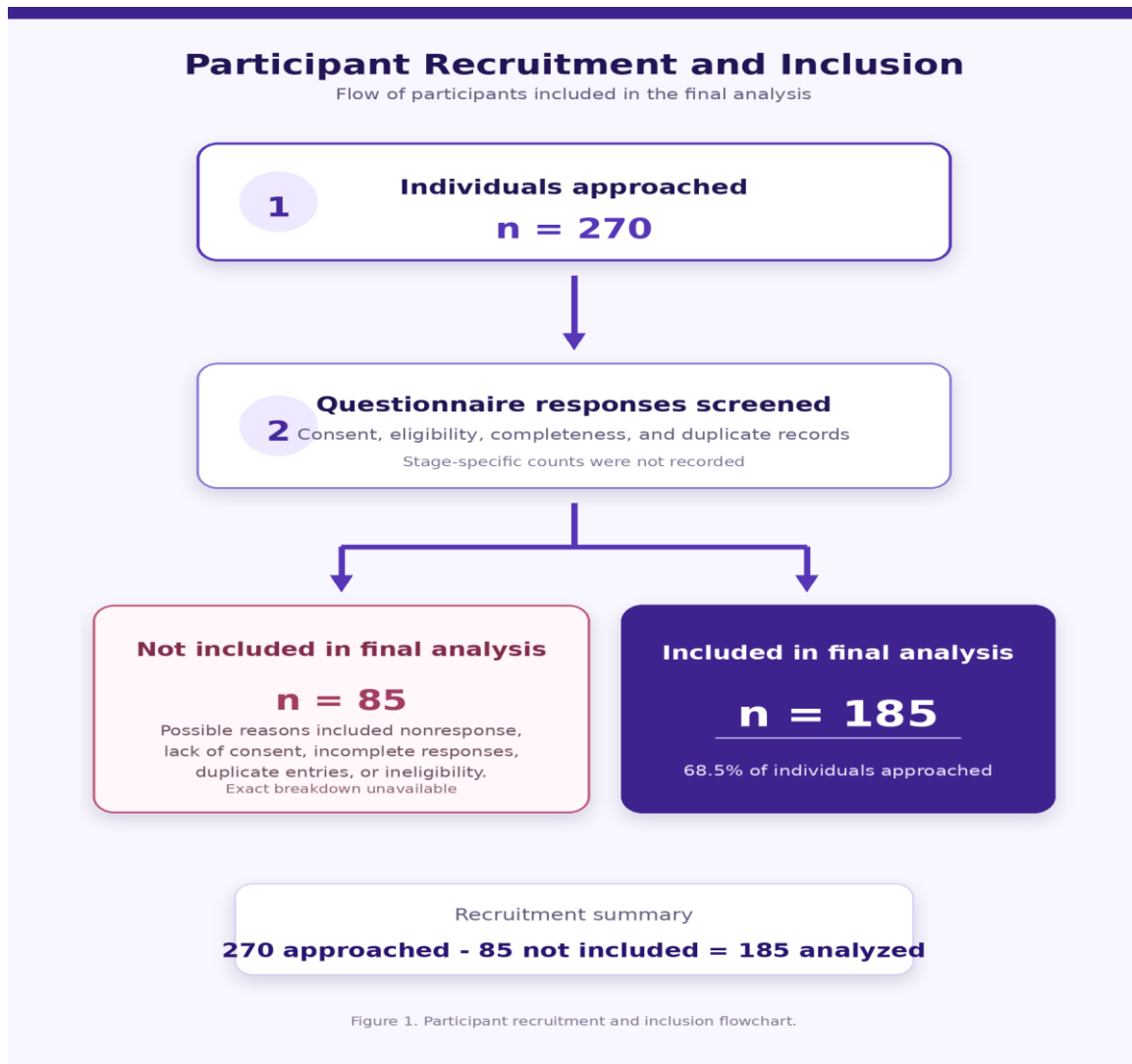


Table 1. Demographic Characteristics of Participants Included in the Final Analysis.

Variable	Category	Frequency (n)	Percentage (%)
Gender	Female	48	77.4
	Male	14	22.6
Age	17 years	1	1.6
	18 years	6	9.7
	19 years	20	32.3
	20 years	14	22.6
	21 years	15	24.2
	22 years	2	3.2
	23 years	2	3.2
	24 years	1	1.6
	26 years	1	1.6

Smartphone Exposure and Primary Reported Outcomes

Prolonged smartphone exposure was common among the study participants. Of the 185 respondents, 64.9% reported using a smartphone for more than four hours per day according to the predefined response threshold. This finding indicates that almost two-thirds of the sample regularly experienced prolonged daily smartphone exposure.

Unnecessary scrolling was the most frequently reported behavioral outcome, affecting 88.6% of participants. This was followed by tired eyes after prolonged smartphone use, reported by 85.7%, and forgetting to take regular breaks, reported by 84.9%.

Posture-related concerns were also frequently reported. A forward or slouched neck posture during smartphone use was endorsed by 80.0% of participants, while neck stiffness was reported by 71.1%. Headache following prolonged smartphone use was reported by 61.4%.

Reduced awareness of the surrounding environment was reported by 75.9% of participants. In addition, 78.4% agreed that smartphone overuse affected their physical health and ability to maintain focus.

Together, these findings show that prolonged smartphone use occurred alongside a high frequency of self-reported physical, visual, postural, and behavioral concerns. Because these outcomes were collected through a cross-sectional questionnaire, the percentages represent participant-reported experiences and do not establish a causal relationship between smartphone use and the reported outcomes.

Table 2. Prevalence of smartphone-use behaviors and self-reported outcomes

Responses were assessed using questionnaire frequency categories. S/O/A indicates "Sometimes / Often / Always".

Measure / Clinical Parameter	Prevalence (%)	Category Threshold
Unnecessary scrolling behavior	88.6%	S / O / A
Tired eyes after prolonged smartphone use	85.7%	S / O / A
Forgetting to take regular breaks	84.9%	S / O / A
Forward / slouched neck posture	80.0%	S / O / A
Believe smartphone overuse affects physical health & focus	78.4%	Agreed / Affirmative
Loss of environmental awareness	75.9%	S / O / A
Neck stiffness reported	71.1%	S / O / A
Daily smartphone usage >4 hours	64.9%	Often / Always
Headache after prolonged smartphone use	61.4%	S / O / A

Figure 2. Prevalence of smartphone-use behaviors and reported symptoms



Phantom-Phone Phenomena

Phantom-phone experiences were frequently reported in the sample. Continued smartphone use after checking a notification was reported by 74.6% of participants, while 72.4% reported an urge to check their phone despite not receiving a notification. Automatic checking because an alert was expected was reported by 71.9%.

Checking the phone after perceiving a vibration was reported by 68.1% of participants. The same percentage reported mistaking another sensory stimulus for a phone vibration and checking the phone after perceiving a notification sound that had not occurred. A false notification sensation was reported by 67.6%, while 62.7% reported feeling a tactile vibration despite the absence of an actual phone notification.

These findings indicate that automatic checking and incorrectly perceived phone signals were common within the study population. However, these experiences were self-reported and were not confirmed through direct observation or experimental testing.

Table 3. Reported phantom-phone experiences

Phantom-Phone Manifestation	Prevalence
Continued use after checking notification	74.6%
Urge to check phone without notification	72.4%
Automatic checking (expected alert)	71.9%
Checking after perceived vibration	68.1%
Mistaking sensory input for vibration	68.1%
Checking after perceived alert sound	68.1%
False notification sensation	67.6%
Feeling non-existent tactile vibration	62.7%

EXPLORATORY CONSTRUCTS

Postural Autopilot	74.6%
Automatic adoption of compromised neck angle	
Attention Capture Loop	73.5%
Unintentional habit loops prolonging session length	
Digital Proprioceptive Drift	71.4%
Loss of bodily posture awareness during screen time	
Digital Distraction Blindness	69.7%
Reduced situational awareness of immediate environment	

*Note: Exploratory constructs represent survey-based behavioral patterns, not clinical diagnoses.

Exploratory Digital-Behavior Findings

Four exploratory behavioral patterns were examined using study-specific questions. Postural autopilot was the most frequently reported pattern, affecting 74.6% of participants. This pattern referred to automatically adopting a compromised neck position during smartphone use without consciously recognizing the posture.

Attention capture loop was reported by 73.5% of participants. This concept described repeated or extended smartphone engagement driven by notifications, checking, scrolling, or other attention-capturing cues.

Digital proprioceptive drift was reported by 71.4%. This referred to reduced awareness of the position of the head, neck, or body while concentrating on a smartphone screen.

Digital distraction blindness was reported by 69.7% of participants and represented reduced awareness of the immediate environment while attention was directed toward the smartphone.

These labels were used to summarize specific questionnaire responses. They should be described as exploratory behavioral concepts because their validity and factor structure have not yet been independently established.

Scale Scores and Internal Consistency

The Smartphone Addiction Scale produced a reported mean score of 3.76 with a standard deviation of 1.06. The 33-item scale demonstrated excellent internal consistency, with a Cronbach's alpha of 0.982.

The eight-item Phubbing Scale had a reported mean score of 4.08 with a standard deviation of 1.53. Cronbach's alpha for the scale was 0.972, indicating excellent internal consistency in the present sample.

The eight phantom-phone items produced a reported mean score of 3.13 with a standard deviation of 0.89. The internal consistency coefficient was 0.950.

The eight exploratory digital-behavior items produced a reported mean score of 3.16 with a standard deviation of 0.89. Cronbach's alpha for this item group was 0.960.

All four coefficients exceeded 0.90, indicating that the items within each group produced highly consistent responses. The values for the phantom-phone and exploratory digital-behavior items demonstrate internal consistency within this dataset. Further psychometric evaluation would still

Table 5. Descriptive statistics and internal consistency of the questionnaire measures

Evaluated internal consistency across four grouped validated and exploratory scales. Cronbach's $\alpha \geq 0.90$ indicates excellent reliability.

Psychometric Measure	Items (K)	Mean $\pm$ SD	Cronbach's α	Internal Consistency Status
Smartphone Addiction Scale (SAS)	33	3.76 $\pm$ 1.06	0.982	Excellent Reliability
Phubbing Scale	8	4.08 $\pm$ 1.53	0.972	Excellent Reliability
Phantom-Phone Phenomena	8	3.13 $\pm$ 0.89	0.950	Excellent Reliability
Exploratory Digital-Behavior Items	8	3.16 $\pm$ 0.89	0.960	Excellent Reliability

Association Between Prolonged Smartphone Use and Questionnaire Scores

Spearman's rank correlation analysis identified statistically significant positive associations between prolonged daily smartphone use and all four questionnaire score groups.

The strongest association was observed between prolonged smartphone use and Smartphone Addiction Scale scores, with a Spearman correlation coefficient of $\rho = 0.355$ and $p < 0.001$. This indicated that participants reporting greater daily smartphone exposure generally had higher smartphone addiction scores.

Prolonged smartphone use was also positively associated with phantom-phone phenomena, with $\rho = 0.336$ and $p < 0.001$. This finding indicated that longer smartphone exposure was associated with more frequent reports of false notification sensations, perceived vibrations or sounds, and automatic phone-checking experiences.

A positive association was found between prolonged smartphone use and exploratory digital-behavior scores, with $\rho = 0.298$ and $p < 0.001$. Participants reporting prolonged use therefore tended to report more postural and attentional behaviors represented by the exploratory items.

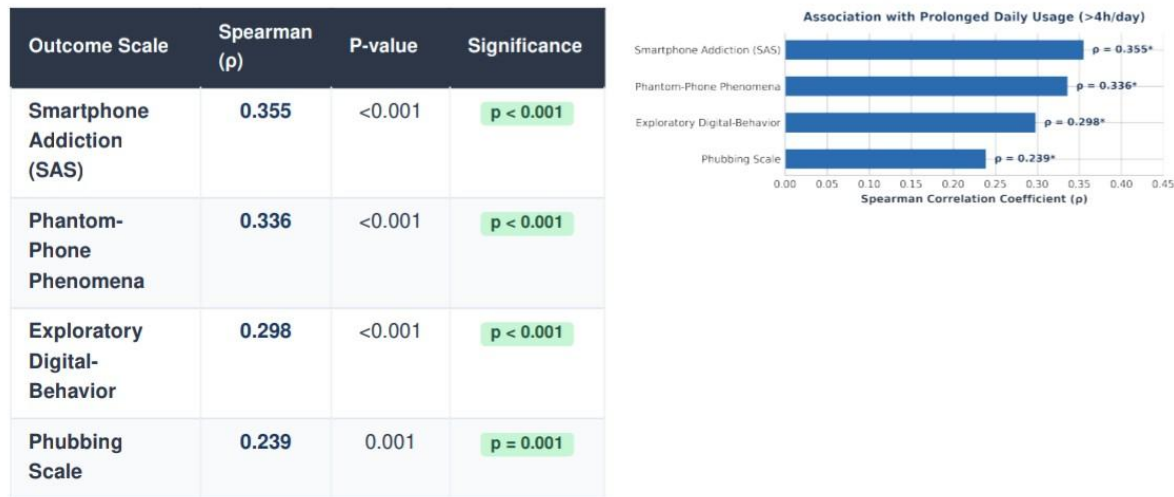
The weakest statistically significant relationship was found between prolonged smartphone use and phubbing, with $\rho = 0.239$ and $p = 0.001$. Although smaller than the other correlations, the

result indicated that prolonged use was associated with more frequent interference of smartphone use with face-to-face interaction.

The coefficients ranged from 0.239 to 0.355, indicating weak to moderate positive relationships. Statistical significance shows that the observed associations were unlikely to have occurred solely through random sampling variation under the null hypothesis. The cross-sectional design does not establish the direction of the relationships or demonstrate that prolonged use caused the measured behaviors.

Table 6. Correlations between prolonged smartphone use and questionnaire scores

Spearman rank correlation (ρ) evaluated associations between daily usage duration (>4 hours/day) and primary psychometric constructs.



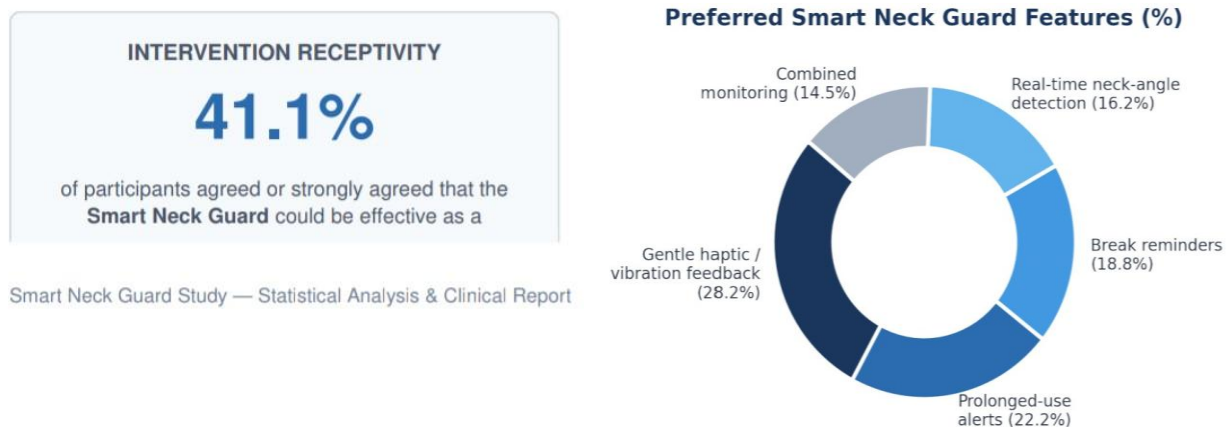
Perceptions of the Proposed Smart Neck Guard

Participants were asked whether the proposed Smart Neck Guard could be useful as an intervention for monitoring or improving smartphone-related posture. Overall, 41.1% agreed or strongly agreed that the proposed device could be effective.

Participants were also asked to select their preferred Smart Neck Guard feature. Gentle haptic or vibration feedback was the most frequently selected feature, chosen by 28.2% of participants. Prolonged-use alerts were preferred by 22.2%, while 18.8% selected break reminders. Real-time neck-angle detection was selected by 16.2%, and 14.5% preferred combined monitoring functions.

These responses indicate greater participant interest in immediate feedback and prolonged-use alerts than in passive monitoring alone. The findings represent preferences concerning a proposed device and do not provide evidence of its technical performance or clinical effectiveness.

Figure 6. Preferred features of the proposed Smart Neck Guard



Discussion

Principal Findings

The present study investigated the interconnected physical, visual, postural, behavioral, and attentional effects associated with smartphone use among young adults. The findings demonstrated a high frequency of prolonged smartphone exposure and several related concerns. Approximately 64.9% of participants reported using their smartphones for more than four hours per day. Unnecessary scrolling was the most frequently reported behavior at 88.6%, followed by tired eyes at 85.7%, failure to take regular breaks at 84.9%, forward or slouched neck posture at 80.0%, reduced environmental awareness at 75.9%, and neck stiffness at 71.1%.

Prolonged daily smartphone use was positively and significantly associated with smartphone addiction, phantom-phone experiences, exploratory digital behaviors, and phubbing. The strongest relationship was found with smartphone addiction scores, followed by phantom-phone phenomena, exploratory digital behaviors, and phubbing. Although these correlations were weak to moderate in magnitude, their consistent positive direction suggests that extended smartphone exposure may occur alongside a broader group of compulsive, sensory, social, postural, and attentional behaviors.

The findings support the central premise of the study that the consequences associated with smartphone use may extend beyond an isolated complaint such as neck discomfort. Participants simultaneously reported physical symptoms, visual fatigue, poor postural habits, missed breaks, compulsive scrolling, automatic checking, and reduced awareness of their surroundings. However, the cross-sectional design does not establish that prolonged smartphone use directly caused these outcomes.

Prolonged Smartphone Use and Problematic Use Patterns

Nearly two-thirds of participants reported using a smartphone for more than four hours per day. Prolonged exposure was positively associated with Smartphone Addiction Scale scores, with a Spearman correlation of $\rho = 0.355$ and $p < 0.001$. This was the strongest correlation identified in

the study. The result indicates that participants reporting greater daily exposure generally obtained higher scores for problematic smartphone-use behaviors.

The 33-item Smartphone Addiction Scale was originally developed to evaluate behavioral patterns such as disturbance of daily life, withdrawal, tolerance, overuse, and dependence on smartphone-mediated interaction [3]. The positive association found in the present study is therefore plausible because greater exposure provides more opportunities for repeated checking, compulsive scrolling, loss of control, and interference with daily activities.

Nevertheless, duration and addiction should not be treated as identical concepts. A person may use a smartphone for several hours for study, employment, communication, or navigation without demonstrating impaired control. Conversely, problematic use may occur in a person with a lower total duration if the behavior disrupts sleep, study, relationships, or daily responsibilities. The observed correlation should therefore be interpreted as an association between prolonged exposure and greater problematic-use scores rather than proof that all participants using smartphones for more than four hours were addicted.

The high prevalence of unnecessary scrolling, reported by 88.6% of respondents, provides further evidence that total screen time may include both purposeful and automatic use. Repeated scrolling may extend the duration of a smartphone session, delay breaks, and maintain visual and postural exposure. Future studies should distinguish between necessary use, recreational use, passive scrolling, social media use, gaming, and academic use. Objective screen-time records would also provide a more accurate exposure measurement than participant estimates.

Neck Posture, Neck Stiffness, and Musculoskeletal Findings

Forward or slouched neck posture was reported by 80.0% of participants, while 71.1% reported neck stiffness. These findings are consistent with previous research showing that smartphone use is frequently accompanied by substantial head and neck flexion.

Lee et al. found that smartphone users maintained median head flexion angles of approximately 33° to 45° from vertical and that flexion was greater while texting and while sitting [7]. Namwongsa et al. also demonstrated that cervical erector spinae activity increased with greater neck flexion during smartphone use. They found lower activity of relevant neck muscles when the neck remained within approximately 0° to 15° of flexion [8]. Biomechanical research has further shown that cervical flexion increases compressive and shear forces across the cervical spine compared with a neutral position [9,10]. These findings provide a biomechanical basis for examining prolonged flexed posture as a potentially modifiable exposure.

Previous studies of university populations have also reported associations between smartphone use and musculoskeletal symptoms. Mustafaoglu et al. found a high prevalence of upper-back, neck, and wrist or hand pain among university students and reported relationships between smartphone addiction scores and musculoskeletal complaints [4]. Ayhuallem et al. reported neck pain in 47.4% of university smartphone users. Smartphone use exceeding six hours per day and not taking breaks were among the factors associated with neck pain [5]. Al-Hadidi et al. similarly identified positive relationships between mobile-phone use duration and the duration or severity of neck pain [6].

The percentage of neck stiffness in the present study should not be directly compared with the prevalence of clinically assessed neck pain or disability. Neck stiffness, pain, discomfort, and functional limitation are related but distinct outcomes. The current questionnaire also relied on participants' perception of their posture. It did not objectively measure cervical flexion, muscle activity, pain intensity, cervical range of motion, or functional disability.

Published findings are also not completely consistent. Bertozzi et al. found that although approximately half of the young adults in their study reported neck pain, smartphone-use duration and objectively assessed posture were not significantly correlated with neck pain or disability [11]. This conflicting evidence suggests that smartphone exposure alone is unlikely to explain all neck symptoms. Physical activity, study posture, laptop use, previous injury, stress, sleep, ergonomic conditions, muscle endurance, and psychosocial factors may also contribute.

The present findings therefore support an association between smartphone use and self-reported postural or musculoskeletal concerns, while also indicating the need for objective measurements. Future studies should combine smartphone-use logs with cervical-angle measurements, standardized pain scales, the Neck Disability Index, physical examinations, and assessments of physical activity and other device use.

Break-Taking Behavior and Postural Exposure

Failure to take regular breaks was reported by 84.9% of participants. This was one of the most prevalent findings in the study and may be relevant to both visual and musculoskeletal complaints. Even when the degree of neck flexion is moderate, maintaining a relatively static posture for a prolonged period may contribute to muscle fatigue and discomfort.

Ayhuallem et al. reported that the absence of breaks during smartphone use was significantly associated with neck pain among university students [5]. Experimental work has also shown that pain and fatigue increase as continuous smartphone-use duration increases [12]. These findings suggest that exposure time and recovery opportunities should be considered together rather than treating posture as the only relevant factor.

Regular breaks may reduce continuous visual accommodation, static muscular loading, and uninterrupted behavioral engagement. Break reminders were preferred by 18.8% of participants, while 22.2% preferred prolonged-use alerts. These preferences suggest that participants recognized duration and missed breaks as relevant problems. Future intervention studies should determine the most acceptable break interval and evaluate whether reminders produce sustained changes rather than brief corrections immediately after an alert.

Visual Fatigue

Tired eyes following prolonged smartphone use were reported by 85.7% of participants, making visual fatigue the second most frequently reported outcome. This result is consistent with the wider literature on digital eye strain, which includes symptoms such as tired or aching eyes, dryness, irritation, blurred vision, headache, and difficulty refocusing after prolonged screen viewing.

Sheppard and Wolffsohn described digital eye strain as a common group of ocular and visual symptoms associated with digital-device use. Their review cited survey findings in which approximately 65% of adults reported digital eye-strain symptoms, although prevalence varied according to the population, exposure, and measurement method [13]. Proposed contributing factors include reduced or incomplete blinking, ocular surface dryness, sustained near focusing, small viewing distances, glare, screen characteristics, and prolonged uninterrupted viewing.

The higher percentage in the present study may reflect the young adult population, frequent smartphone exposure, the response threshold combining Sometimes, Often, and Always, or differences in the way visual fatigue was measured. Because no ophthalmological examination or validated diagnostic assessment was performed, the result should be described as self-reported tired eyes rather than a confirmed prevalence of computer vision syndrome or ocular disease.

The overlap between tired eyes, headache, and missed breaks may be clinically relevant. However, the cross-sectional questionnaire cannot determine whether participants experienced these symptoms simultaneously or whether one preceded another. Future studies could incorporate the Computer Vision Syndrome Questionnaire, viewing-distance measurements, blink-rate assessment, screen brightness, refractive status, and objective screen-time information.

Environmental Awareness and Distracted Walking

Reduced awareness of the surrounding environment was reported by 75.9% of participants. This finding supports the inclusion of attentional and environmental consequences within research on smartphone-related behavior.

The term “smartphone zombie” or “smombie” has previously been used in scientific literature to describe pedestrians who remain actively engaged with their smartphones while walking. Appel et al. examined smartphone use during walking in relation to fear of missing out [1]. Fernández et al. directly observed 3,301 pedestrians in Spain and classified 10.9% as smombies, while 29.7% displayed some form of smartphone use while walking [2].

The 75.9% reported in the present study is substantially higher than the directly observed smombie prevalence reported by Fernández et al. The two values measure different outcomes and should not be interpreted as contradictory. Fernández et al. counted pedestrians who were visibly interacting with smartphones at a particular time, whereas the current questionnaire asked whether participants experienced reduced environmental awareness. A participant could report occasional loss of awareness without being observed as a smombie during every walking episode.

Experimental evidence provides a mechanism for this finding. Lim et al. demonstrated that texting while walking interfered with situational awareness and gait stability, reflecting competition between the cognitive demands of smartphone interaction and environmental monitoring [14]. Other pedestrian research has shown that smartphone use can delay responses to roadside events and modify walking or crossing behavior.

The present study did not directly observe walking, street crossing, collisions, gait changes, or detection of environmental hazards. Therefore, reduced awareness should be interpreted as a self-reported attentional experience. A future study could use a standardized dual-task walking

protocol, obstacle course, virtual street-crossing task, eye tracking, or direct field observation to determine whether questionnaire reports predict measurable changes in environmental awareness and pedestrian safety.

Phubbing and Social Interference

Prolonged smartphone use showed a statistically significant positive association with phubbing scores, with $\rho = 0.239$ and $p = 0.001$. Although this was the weakest of the four reported correlations, it indicates that participants with greater smartphone exposure tended to report more smartphone interference during face-to-face interaction.

Karadağ et al. described phubbing as attending to a mobile phone during interpersonal interaction and withdrawing attention from the people who are physically present [15]. Their work linked phubbing with several forms of technology-related behavioral involvement, including mobile-phone, internet, social-media, messaging, and gaming behaviors.

The use of the PS-8 is also relevant to the setting of the current research. A later psychometric study examined the scale across Bangladesh, Iran, and Pakistan using confirmatory factor, network, and Rasch analyses [16]. This provides regional support for studying phubbing with this instrument, although the scoring and wording used in the present questionnaire should be checked against the validated version.

The modest correlation suggests that prolonged use contributes only part of the explanation for phubbing. Social context, fear of missing out, notification frequency, habits, expectations regarding phone availability, and the perceived acceptability of phone use during conversation may also influence the behavior. Longitudinal research would be needed to determine whether prolonged use precedes phubbing, whether phubbing encourages more frequent phone checking, or whether both arise from underlying problematic-use patterns.

Phantom-Phone Experiences

Phantom-phone experiences were also common. Individual item prevalence ranged from 62.7% to 74.6%, and prolonged smartphone exposure showed a positive association with the phantom-phone score, with $\rho = 0.336$ and $p < 0.001$.

Drouin et al. reported that 89% of 290 undergraduate participants had experienced phantom vibrations, although the experiences occurred approximately once every two weeks on average and few participants considered them highly bothersome [17]. Lin et al. also documented phantom vibration and ringing experiences among medical interns and found that their prevalence changed during the internship period [18]. These studies indicate that phantom-phone sensations can occur frequently among young and highly connected populations.

The current findings may reflect learned expectations created by repeated notifications and frequent checking. When a person repeatedly anticipates a vibration or alert, ordinary tactile sensations, muscle movement, clothing pressure, or environmental sounds may be interpreted as a phone signal. The association with prolonged use is consistent with greater exposure to phone notifications and more opportunities for this expectation to develop.

These findings should be interpreted carefully. Phantom vibrations and ringing are commonly reported experiences and should not automatically be treated as evidence of a psychiatric disorder or neurological disease. The present study measured self-reported experiences and did not evaluate their frequency, severity, distress, functional effect, or relationship with stress and sleep.

Future studies should distinguish between occasional, non-distressing phantom sensations and frequent experiences that interfere with concentration or well-being. Notification frequency, vibration-mode use, phone-carrying location, stress, sleep quality, and anxiety could also be examined as possible associated variables.

Exploratory Digital-Behavior Concepts

Four exploratory patterns were proposed: postural autopilot, attention capture loop, digital proprioceptive drift, and digital distraction blindness. These patterns were reported by 69.7% to 74.6% of participants.

Postural autopilot was reported by 74.6% and described the automatic adoption of a compromised neck posture without conscious recognition. This concept is consistent with the possibility that attention directed toward a screen reduces ongoing monitoring of body position. However, the present study did not measure proprioception or compare perceived posture with measured cervical angles.

Attention capture loop was reported by 73.5%. This pattern described a repeated sequence in which notifications, checking, scrolling, and continued engagement extend the smartphone session. The high prevalence of unnecessary scrolling and the association between prolonged use and smartphone addiction scores provide preliminary support for studying this pattern further.

Digital proprioceptive drift was reported by 71.4% and referred to reduced awareness of head, neck, or body position during screen use. This term remains hypothetical because no formal proprioceptive testing was performed. Digital distraction blindness was reported by 69.7% and described reduced awareness of the surrounding environment while attention was directed toward a smartphone. This idea overlaps conceptually with existing dual-task and distracted-walking research, but the proposed label itself has not been independently validated.

The eight exploratory items demonstrated a Cronbach's alpha of 0.960, while the phantom-phone items had an alpha of 0.950. These coefficients indicate strong internal consistency within the present dataset. However, a very high alpha may also occur when questions are highly similar or redundant. Cronbach's alpha does not establish content validity, construct validity, or the number of factors represented by the items [19].

The proposed concepts should therefore be described as exploratory survey-based patterns. Further development should involve expert review, cognitive interviews with participants, item reduction, exploratory factor analysis, and confirmatory factor analysis in an independent sample. Convergent and discriminant validity should then be examined against established measures of smartphone addiction, phubbing, body awareness, attentional control, and distracted walking.

Interpretation of the Correlation Findings

All four investigated relationships were positive and statistically significant:

- Smartphone addiction: $\rho = 0.355, p < 0.001$
- Phantom-phone phenomena: $\rho = 0.336, p < 0.001$
- Exploratory digital behaviors: $\rho = 0.298, p < 0.001$
- Phubbing: $\rho = 0.239, p = 0.001$

The coefficients indicate weak to moderate relationships. Prolonged smartphone use was most closely associated with smartphone addiction, followed by phantom-phone experiences. This pattern is understandable because both domains contain behaviors related to repeated engagement, expectations of notifications, and difficulty disengaging from the device.

The weaker association with phubbing may indicate that interpersonal smartphone behavior depends more heavily on context. A person may use a smartphone extensively while alone without using it during conversation. Similarly, another person may have a lower total duration but consistently check the phone during social interaction.

Statistical significance does not indicate that the relationships were strong, clinically important, or causal. With a sample of 185 participants, a relatively small association may reach statistical significance. The direction of the relationships also cannot be determined. Prolonged use could contribute to repeated checking behaviors, while existing compulsive checking or phubbing tendencies could also increase total use.

Shared method variance should also be considered because exposure and outcomes were measured in the same questionnaire at the same time. Participants who perceived their smartphone use negatively may have been more likely to endorse several negative outcomes. Objective smartphone-use data and prospective follow-up would strengthen future analyses.

Implications for the Smart Neck Guard

The Smart Neck Guard was proposed as a wearable system combining neck-angle monitoring, haptic feedback, screen-time monitoring, prolonged-use alerts, and break reminders. Participant responses showed that 41.1% agreed or strongly agreed that the device could be effective. Gentle haptic feedback was the most frequently preferred feature at 28.2%, followed by prolonged-use alerts at 22.2%, break reminders at 18.8%, real-time neck-angle detection at 16.2%, and combined monitoring at 14.5%.

Existing wearable research provides technical support for further development of this concept. Ailneni et al. reported that a wearable posture sensor reduced neck flexion angles and gravitational moments during office work [20]. Wang et al. developed a wearable cervical-posture monitoring system using a tri-axial accelerometer, demonstrating that inertial sensors can be applied to cervical-posture detection [21]. Harvey et al. also reported improvements in posture awareness and selected self-reported outcomes following training with a wearable posture-feedback device, although their study was small and used a different population and device [22].

These studies support the feasibility of posture monitoring and feedback, but they do not demonstrate that the proposed Smart Neck Guard is effective. A working prototype would

require technical and clinical validation. Sensor measurements should be compared with a reference method such as an optical motion-capture system, digital inclinometer, or validated cervical range-of-motion device.

The device would also require clearly defined thresholds for excessive flexion and sustained exposure. Immediate feedback for every brief movement could result in excessive alerts and poor acceptance. The system may need to consider both the degree and duration of cervical flexion before providing a reminder. User-adjustable feedback intensity, reminder intervals, comfort, device weight, battery life, data privacy, and the ability to temporarily silence alerts would also influence usability.

Testing should proceed in stages. Initial work should examine sensor accuracy and repeatability. Usability testing should then evaluate comfort, alert frequency, adherence, and participant acceptance. A pilot trial could subsequently compare the device with education alone. A larger controlled trial would be required to determine whether it improves objectively measured posture, reduces sustained flexion, increases break-taking, or changes symptoms over time.

Strengths of the Study

A major strength of this study was its multidimensional approach. Rather than examining smartphone addiction, neck symptoms, visual fatigue, phubbing, and environmental awareness separately, the questionnaire assessed these domains within the same sample.

The study also included established instruments for smartphone addiction and phubbing, alongside clearly identified exploratory items. Descriptive statistics were supplemented with reliability analysis and inferential correlation testing. This allowed the study to report the prevalence of individual experiences while also examining the relationship between prolonged exposure and broader behavioral scores.

The study additionally generated participant-centered information about the proposed Smart Neck Guard. Preferences for feedback, break reminders, prolonged-use alerts, and neck-angle monitoring may guide early prototype development.

Limitations

Several limitations should be considered. First, the cross-sectional design prevents conclusions about causality or temporal sequence. Second, convenience sampling may have produced a sample that differs from the wider population of young smartphone users. Participants interested in smartphone health effects may have been more likely to complete the questionnaire.

Third, the study relied on self-reported exposure and outcomes. Daily smartphone duration, posture, symptoms, breaks, environmental awareness, and phantom-phone experiences were not objectively verified. Recall bias and social desirability bias may therefore have influenced the responses.

Fourth, combining Sometimes, Often, and Always increased the proportion classified as reporting an outcome. This threshold captures any recurring experience but does not distinguish

occasional symptoms from persistent or severe problems. Future reports should provide the full distribution of response categories.

Fifth, neck posture was not measured directly, and neck stiffness was not confirmed through clinical examination. Visual fatigue was also not assessed using an eye examination or a complete validated diagnostic instrument. The study cannot determine whether symptoms were caused by smartphone use or by other activities and conditions.

Sixth, the exploratory behavioral concepts have not undergone full psychometric validation. Their high Cronbach's alpha values provide evidence of internal consistency only. Factor analysis and validation against established measures are required before treating them as independent constructs.

Finally, the Smart Neck Guard remained a proposed concept. Participants evaluated a description of the device rather than an operational prototype. The reported preferences therefore represent expected acceptability rather than actual use, adherence, accuracy, or therapeutic effectiveness.

Clinical and Research Implications

The findings suggest that health education for young smartphone users should address several modifiable behaviors, including prolonged uninterrupted use, missed breaks, sustained neck flexion, close viewing distance, automatic checking, and smartphone engagement while walking.

For physiotherapy and rehabilitation, smartphone-related complaints should be assessed within the broader context of the individual's study posture, physical activity, sleep, stress, laptop use, previous musculoskeletal symptoms, and overall screen exposure. Education may include positioning the device closer to eye level, changing posture regularly, taking planned breaks, and avoiding prolonged static flexion.

Future studies should use longitudinal designs to determine whether exposure precedes symptoms. Objective smartphone-use logs, cervical motion sensors, electromyography, gait analysis, eye tracking, and standardized clinical scales would strengthen measurement. The exploratory concepts should undergo separate psychometric validation, and the Smart Neck Guard should progress through prototype development, technical validation, usability testing, and controlled clinical evaluation.

Overall Interpretation

The present study identified a pattern of prolonged smartphone exposure accompanied by frequent self-reported visual fatigue, missed breaks, slouched posture, neck stiffness, automatic checking, phubbing, phantom-phone experiences, and reduced environmental awareness. The positive correlations with prolonged use suggest that these behaviors may occur as interconnected features of intensive smartphone engagement.

The findings provide a rationale for further investigation of integrated prevention strategies that address posture, exposure time, behavioral engagement, and environmental attention. They also support the development and evaluation of wearable feedback systems. However, the current evidence should be interpreted as observational and exploratory. It establishes the frequency and

association of participant-reported experiences within this sample and provides the foundation for more objective longitudinal and experimental research.

Conclusion

This study identified a high frequency of prolonged smartphone use and related physical, visual, postural, behavioral, and attentional concerns among young adults. Most participants reported unnecessary scrolling, tired eyes, missed breaks, forward or slouched neck posture, reduced environmental awareness, and neck stiffness. Prolonged daily smartphone use was significantly associated with higher smartphone addiction, phantom-phone, exploratory digital-behavior, and phubbing scores.

The findings suggest that intensive smartphone use should be understood as a multidimensional behavior involving more than screen time alone. Posture, uninterrupted exposure, compulsive checking, social interference, false notification sensations, and reduced awareness of the surrounding environment may occur together. However, because the study was cross-sectional and based on self-reported responses, it cannot establish causal relationships or confirm clinical disorders.

The exploratory concepts of postural autopilot, attention capture loop, digital proprioceptive drift, and digital distraction blindness provide possible directions for future investigation. These concepts require further psychometric validation through expert review, factor analysis, and testing in larger and more representative populations.

The proposed Smart Neck Guard offers a potential framework for real-time neck-angle monitoring, haptic feedback, prolonged-use alerts, and break reminders. Participants showed the greatest preference for gentle vibration feedback, indicating potential acceptance of an immediate and non-disruptive reminder system. Prototype development, sensor validation, usability testing, and controlled clinical studies are required before conclusions can be made about its effectiveness.

Overall, the study supports greater awareness of healthy smartphone-use practices, including regular breaks, reduced uninterrupted exposure, improved neck positioning, and greater attention to the surrounding environment. Future longitudinal and experimental research incorporating objective screen-time data, cervical motion measurements, clinical symptom scales, and direct assessment of walking behavior is needed to confirm these findings and evaluate preventive interventions.

Declarations

Ethics Approval and Consent to Participate

The study protocol was reviewed and approved by the Liaquat National School of Physiotherapy, on **14 September 2026** (approval/reference number: **[insert number]**). The approval decision was communicated by **Mr. Muhammad Ali, Vice Principal and Assistant Professor, Liaquat National School of Physiotherapy**, and **Dr. Nida Rizvi, DPT, Research Coordinator**.

The study involved minimal-risk, questionnaire-based research. Before accessing the questionnaire, prospective participants were provided with information explaining the purpose of the study, the voluntary nature of participation, the procedures involved, the intended use of the collected information, and the measures used to protect confidentiality. Electronic informed consent was obtained from all participants before they completed the questionnaire. Participants could decline participation or discontinue the survey at any time before submitting their responses without penalty.

The study was conducted in accordance with applicable institutional requirements and generally accepted ethical principles for research involving human participants, including respect for autonomy, privacy, confidentiality, and voluntary participation.

Confidentiality and Privacy

No direct personal identifiers were collected through the questionnaire. Participant responses were kept confidential, analyzed in aggregate form, and used solely for research purposes. Access to the research data was restricted to the researcher, and no individual participant's responses are presented in the manuscript.

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Competing Interests

The author declares no financial or commercial conflicts of interest concerning this research. The Smart Neck Guard described in the manuscript is a proposed design concept and was not manufactured, commercially evaluated, or tested as part of the present study.

Data Availability

The data supporting the findings of this study may be made available by the corresponding author upon reasonable request, subject to participant-consent provisions, institutional requirements, and appropriate safeguards for participant confidentiality. The questionnaire may also be shared where permitted by the licensing or usage conditions of the incorporated scales.

Author Contributions

The author conceived and designed the study, developed the methodology, conducted the literature review, designed and administered the survey, coordinated data collection, analyzed and interpreted the data, developed the Smart Neck Guard concept, prepared the tables and figures, drafted and critically revised the manuscript, and approved the final version for submission and publication.

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