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Relationship between Smartphone Addiction, Functional Neck Disability and Sleep Quality among University Students

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ABSTRACT

Aim of the Study: The widespread proliferation of smartphones has rendered them an integral component of contemporary life; however, their excessive and uncontrolled use has emerged as a global public health concern. While smartphones serve as valuable educational tools, their overuse has been associated with adverse outcomes, including sleep deprivation, anxiety, depression, and sleep-related disorders.

Methodology: A multi-university descriptive cross-sectional study was conducted among university students in Rawalpindi and Islamabad. A total of 11 universities within the twin cities were selected, and data were collected using online questionnaire. The survey instrument included sections on demographic characteristics, socioeconomic status, and smartphone usage patterns, and incorporated standardized measures such as the Smartphone Addiction Scale, the Neck Disability Index, and the Pittsburgh Sleep Quality Index (PSQI).

Findings: The findings indicated that smartphone addiction was significantly higher among female students compared to male students ($p = 0.0086$). The addiction scores ranged from 10 to 58, neck disability index scores ranged from 0 to 48, and PSQI scores ranged from 3 to 18. No significant association was observed between smartphone addiction and overall sleep quality. However, a strong positive correlation ($p = 0.000$) was identified between smartphone addiction and neck disability. Additionally, a statistically significant association ($p = 0.03$) was found between sleep quality and neck disability among participants.

Conclusion: In conclusion, although smartphone addiction did not significantly influence sleep quality in this sample, it was strongly associated with musculoskeletal discomfort, particularly neck disability. These findings highlight the need for amplified awareness and precautionary measures to mitigate the physical health consequences of excessive smartphone use among university students.

Keywords: SAS, Neck Disability, Sleep Quality, PSQI, Sleep Deprivation.

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1. INTRODUCTION

The popularity of electronic gadgets has drastically changed the modern way of life of all the age brackets, but smartphones have become the most popular portable electronic gadgets especially in young adults. The smartphones are becoming a communication, educational, and entertainment tool that is impossible to do without as their worldwide ownership has already surpassed 77 percent (Mohd et al., 2022). The uncontrolled and excessive use of smartphones despite their usefulness has resulted in the development of smartphone addiction otherwise known as pathological smartphone use or smartphone dependence. This state of affairs is theorized as a type of impulse control disorder where people become victims of the compulsive use of smartphones even despite the negative effects, such as the loss of functions and loss of control over themselves (Goktas et al., 2018). Even though the issue of smartphone addiction has not been a formal clinical diagnosis yet, an increasing body of research demonstrates its strong implication both on the physical and psychological health (Akbulut et al., 2018; Ladeira et al., 2023; Prithika et al., 2022; Safdar & Waseem, 2025; Khan et al., 2018). Although smartphones have significant educational roles, their excessive use has grown to become a worldwide public health issue since it has been linked to sleep deprivation and mental harmful effects like anxiety, depression, and sleeping problems (Zhang et al., 2021).

The most notable physical health effects of overuse of smartphones include musculoskeletal conditions, especially those of the cervical spine. Long time use of smartphones necessitates users to sustain neck flexions and awkward positions like the low-held position and forward-facing position of the arms. Such postures lead to the anterior displacement of the head, which puts strain on the cervical spine and muscles located on it (Goktas et al., 2018). Among the most prevalent postural deviations related to the use of a smartphone, one should single out forward head posture which is characterized by the fact that the head is positioned anterior to the center of gravity of the body (Li et al., 2021). This adaptive poor position adds to more strain on cervical structures, resulting in pain, loss of movement, and limits in the range of movement in the neck, such as flexion, extension and rotation. Long-term effects of this kind of repetitive strain can include chronic conditions, which are usually determined by such measures as the Neck Disability Index. Moreover, such poor posture as long-term bending over smartphones or computers can enhance cervical musculoskeletal disorders and be one of the causes of the early development of impairments in the neck (Akbulut et al., 2018).

In addition to the physical health-related effects, abuse of smartphones has been strongly linked to sleep quality disturbances and poor psychological consequences. Use of the device, especially at night, has been associated with sleep disorders, including insomnia, hypersomnia, and parasomnia, which eventually leads to poor sleep quality (Cagna et al., 2023). Smartphone lights emit blue light and inhibit the synthesis of melatonin, disrupting the sleeping-wake cycle, and changing circadian rhythms (Zhang et al., 2021). This disruption does not only shorten sleep time but also leads to a compromise in the quality of sleep which is vital to cognitive behavior, memory consolidation and physical performance. Sleep deprivation has also been linked to the risks of high blood pressure, disrupted encoding modalities, and reduced academic and work delivery (Zhang et al., 2021; Wah et al., 2022). Also, overuse of smartphone has been associated with various psychological disorders, such as anxiety, depression, stress, and emotional dysregulation. Neurobiological literature indicates that excessive use of a smartphone can change the brain activity, such as elevated concentrations of gamma-aminobutyric acid (GABA), which can negatively affect attention, impulse control, and cognitive processes (Aygar et al., 2019; Czepinska et al., 2023). In addition, people can start to use smartphones more as maladaptive coping strategies to address negative emotions, which can temporarily relieve the situation, only to deteriorate stress, social isolation, and depression symptoms in the long term (Liu et al., 2017; Wang et al., 2022; Achangwa et al., 2023). Longitudinal evidence also suggests that a lengthy period of smartphone use is linked to a higher degree of depression, which shows a worrying trend of psychological addiction (Prithika et al., 2022; Ammati et al., 2018).

University students are an exceptionally vulnerable group in terms of harmful effects of excessive use of smartphones. The academic setting requires the use of digital technologies in the process of learning, communication, and access to information on a vast scale, which frequently leads to spending a significant amount of time in front of the screens and becoming sedentary. Also, students are required to maintain the tight academic programs, which often result in a deteriorated posture, physical tension, and mental pressure (Prithika et al., 2022). Academic workload and the related stresses are the factors that lead to the high rates of anxiety and depression in this population, whereas irregular schedules tend to interfere with the regular sleeping patterns (Ladeira et al., 2023). Issues of sleep are very widespread with the students of the university as the academic needs often oppose the time frame needed to obtain sufficient physical and mental rest. Empirical data show that high use of smartphone in this group of people is linked to a decrease in the time of sleep, decreased energy levels, and poor academic results (Akbulut et al., 2018). Moreover, musculoskeletal symptoms are quite common among the young smartphone users, as up to 68% of users reported symptoms in the neck, and 46%-52% of users reported issues in the shoulders (Zhang et al., 2021). These risks have been further exacerbated by the COVID-19 pandemic, which has increased the number of people aged 20-34 years using their smartphones in remote learning and remote working (Paul et al., 2023; Sirajudeen et al., 2022).

Even though the connection between smartphone use and musculoskeletal and psychological outcomes is becoming increasingly recognized, the amount of research on the specific linkage between smartphone addiction, neck disability, and sleep quality amid modern global shifts in digital behavior is relatively limited, especially in terms of considering the study population, i.e., university students (Ting & Chen, 2020). Seeing that the present population is particularly susceptible to physical and psychological stressors, it is essential to explore these correlations to inform about the specific interventions and preventive measures designed to decrease the negative impact of excessive smartphone use.

1.1 Rationale

The addiction to smartphones has become a major concern of the contemporary world in terms of the general health of the population, especially young adults, because of the extensive use of smartphones in academic, social, and economic life (Mohd et al., 2022; Goktas et al., 2018). The available empirical data show that several negative consequences, such as physical, psychological, and sleep-related disruptions, are linked with overuse of smartphones (Akbulut et al., 2018; Ladeira et al., 2023).

Physically, due to prolonged use of a smartphone, musculoskeletal disorders, especially neck disability are one of the effects of repetitive neck flexion and forward head position, which can cause more load on the cervical spine (Goktas et al., 2018; Li et al., 2021). According to studies, neck and shoulder symptoms are high among smartphone users, and it is important to determine the level of functional impairment among this group of people (Zhang et al., 2021).

The high levels of using smartphones are also closely related to the low quality of sleep and psychological suffering. Exposure to blue light interferes with melatonin secretion and circadian rhythms and shortens sleep duration and affects the quality of sleep (Zhang et al., 2021; Wah et al., 2022). Also, anxiety, depression, and stress were identified as problematic smartphone use, which, in most cases, is a maladaptive coping strategy that increases the burden on the psyche (Liu et al., 2017; Wang et al., 2022; Achangwa et al., 2023).

Although there is a lot of literature on these associations that has been done all over the world; the same cannot be said about Pakistan university students. Instead, there is a dearth of literature in the research of the combined effect of smartphone addiction, neck disability, and sleep quality using standardized measures (Ting & Chen, 2020).

Consequently, the proposed research fill this gap by analyzing these interrelationships between university students in Rawalpindi and Islamabad, Pakistan. The results will be likely to present context-specific evidence that will be used to support intervention strategies to decrease excessive smartphone use,

enhance the quality of sleep, and limit the number of musculoskeletal complications among this high-risk group.

1.2 Research Question

What is the relationship between smartphone addiction, functional neck disability and sleep quality among university students?

1.3 Study Objectives

1.3.1 Primary Objective

To find the relationship between smartphone addiction, functional neck disability and sleep quality among university students.

1.3.2 Secondary Objective

- To find level of smartphone addiction across genders
- To find whether a student is having good or poor quality of sleep

1.4 Hypotheses

Null Hypothesis Ho: There is no significant relationship between smartphone addiction, functional neck disability, and sleep quality among university students.

Alternate Hypothesis H_1: There is a significant relationship between smartphone addiction, functional neck disability, and sleep quality among university students.

2. MATERIALS AND METHODS

2.1 Study Design

It was a descriptive multi-university cross sectional study carried out among students of 11 Universities of Rawalpindi and Islamabad, Pakistan. The selected Universities are Riphah International University (Ripha) Islamabad, International Islamic University (IIU) Islamabad, Rawalpindi Women University (RWU), Quaid-i-Azam University (QAU) Islamabad, National University of Sciences and Technology (NUST) Islamabad, Fatima Jinnah Women University (FJWU) Rawalpindi, Allama Iqbal Open University (AIOU) Islamabad, National University of Medical Sciences (NUMS) Rawalpindi, COMSATS University (CUI) Islamabad, Foundation University (FUI) Islamabad. Students were selected on the bases of history of at least six months smartphones usage and willing to participate in the study data was collected on a questionnaire designed on Google forms.

2.2 Data Collection

Nonprobability convenience sampling technique was used to collect the data through online questionnaire from all participants based on their demographic information socioeconomic status smartphone usage related information based on smartphone addiction scale questionnaire, neck disability index scale and The Pittsburgh Sleep Quality Index (PSQI). A brief statement of the consent form and summary of the research project was displayed on the front on the front page of the questionnaire. Sample size (n=343) was calculated by Slovin's Formula;

$$n = \frac{N}{1+Ne2}$$

- n = no. of samples collected from the setting
- N = Total population of the study setting
- e = Margin of error (0.05)

2.3 Operational Tools

Smartphone Addiction Scale (SAS): Selected participants were assessed for smartphone addiction using a self-reporting scale of SAS (Kwon et al., 2013). SAS was made up of 10 pre-qualified items rated in a six point Likert scale (1 – strongly disagree, 6 – strongly agree). This construct is comprised of six components: disruption in daily living, positive expectations, withdrawal, Internet based relationships, abuse and tolerance. The participants provided the depiction that most closely reflected their smartphone usage. Possible scores range from 10 to 60—with higher scores indicating more severe and problem behaviors with the smartphone. The Smartphone Addiction Scale Short Version (SAS-SV) had good validity and reliability when evaluating smartphone addiction.

Neck Disability Index (NDI): The Neck Disability Index (NDI) is a self-administered questionnaire that is employed to evaluate the degree to which neck discomfort affects the daily functioning of an individual. The purpose of this standardized instrument, which comprises ten items, is to assess the degree of disability that individuals endure as a result of neck discomfort. Every item is evaluated using a five-point scale, with zero denoting "no pain" and five representing the most excruciating pain conceivable; the maximum possible score is fifty. Indicating total disability are scores of 34 or higher, while 0 to 4 denotes no disability, 5 to 14 minor disability, 15 to 24 moderate disability, 25 to 34 severe disability, and 34 or higher total disability. Furthermore, it is possible to convert the cumulative score into a functional percentage. With intraclass correlations ranging from 0.50 to 0.98, the NDI demonstrates acceptable to moderate test-retest reliability among patients with mechanical neck pain and those with cervical radiculopathy. In addition, the NDI demonstrates strong construct validity. The instrument in question is widely acknowledged for its validity in evaluating neck pain and disability among patients suffering from acute or chronic ailments, musculoskeletal dysfunction, disorders associated with whiplash, and cervical radiculopathy.

The Pittsburgh Sleep Quality Index (PSQI): PSQI, a well-established and previously tested questionnaire (Kwon et al., 2013; Liu et al., 2017; Parlak et al., 2023; Rathakrishnan et al., 2021) that is use to assess the quality of sleep of participants. The Pittsburgh Sleep Quality Index (PSQI) consists of 19 items that are used to determine seven component scores and one composite score of various aspects of sleep. The above elements include daily operations and subjective sleep quality, sleep latency (time to fall asleep), sleep length, typical sleep efficiency (the percentage of time spent in bed), sleep disorders, hypnotic use and sleep disorders. Each item has a rating on a 3 point interval scale. Global PSQI score ranges from 0 to 21 and is the total of the ratings of the seven components. A smaller score indicates better sleep quality. Specifically, certain objects in the scale relate to the direction of the score of students. Seven components of the PSQI have a reliability coefficient (Cronbach's alpha) of 0.83, which indicates high internal consistency. Cross-sectional research using PSQI has been carried out in various populations of older adults from around the world, with the instrument demonstrating an outstanding level of validity and reliability in all populations.

2.4 Statistical Analysis

Collected data was analyzed using statistical software SPSS (version 25.0v). The collected data was entered into Excel spreadsheets. Data cleaning and validation were performed prior to statistical analysis. The normality of the data was determined using the Shapiro-Wilk test. To compare scores between groups, a variety of statistical tests were used, including frequency distribution, chi-square test, and ANOVA. Pearson's correlation test was used to investigate the correlations between several variables, including goniometer readings and neck disability scores. The significance level was set at <0.05.

2.5 Ethical Consideration

In consideration of the current ethical guidelines followed at Sutlan Idris Education University, this work is considered as the type of non-interventional quantitative research, and therefore no need for any formal

IRB approval with Dean office letter No. UPSI/FBK/D/242 dated: 9-3-2026. The study was carried out in accordance with the Declaration of Helsinki and all participants gave their informed consent, knowing the aim of the study and their right to withdraw from it, and the confidentiality procedures applied. The manuscript does not contain any identifying details. This type of research is exempt as per local practice.

3. RESULTS

The socio-demographic data in Table 1 provide a thorough overview of the characteristics of the participants that were chosen, making up a sample size of 343 people in total. It's noteworthy that participants' ages ranged from about 21 to almost exactly the same for both sexes, with men's average age being somewhat lower than women's. Significant morphological inequalities were also seen, with males frequently displaying larger weights and heights than females. Body mass index (BMI) calculations also revealed this, with men having a higher mean BMI than women. These socio-demographic subtleties are clarified by the data in Table 1, which also provide a strong basis for future study and actions. Precisely knowing the demographic composition of a population aids researchers in placing their findings in perspective, spotting potential confounding variables, and customising interventions to the particular requirements or difficulties encountered in various demographic groupings.

Table 1: *Socio-Demographic Characteristics of the selected participants (n=343)*

Characteristics	Mean ± SD (n = 343)		
	Male (n=152)	**Female (n=191)**	**Overall**
Age (years)	20.98 ± 2.07	21.29 ± 2.19	21.15 ± 2.14
Height (cm)	171.3 ± 11.6	159.6 ± 10.1	164.7 ± 11.8
Weight (Kg)	67.43 ± 12.42	52.88 ± 10.3	58.28 ± 14.5
BMI (Kg/m^2)	23.45 ± 5.71	20.71 ± 4.9	21.95 ± 5.41
Age group (frequency %)			
Less than 20	11.08%	13.99%	25.07%
20-25 years	31.78%	41.40%	73.18%
More than 25	1.46%	0.29%	1.75%
Study year (frequency %)			
1^{st} Year	23.91%	16.91%	40.82%
2^{nd} Year	7.58%	4.96%	12.54%
3^{rd} Year	10.20%	9.33%	19.53%
4^{th} Year	2.62%	24.49%	27.11%
University (frequency %)			
RWU	2.33%	25.36%	27.70%
UAAR	6.12%	4.08%	10.20%
QAU	3.79%	6.41%	10.20%
IIUI	0.29%	7.29%	7.58%
RIU	4.37%	2.04%	6.41%
AIOU	1.75%	4.08%	5.83%
NUST	1.17%	0.00%	1.17%
NUMS	12.24%	2.62%	14.87%
CUI	9.04%	2.33%	11.37%
FUI	1.75%	0.58%	2.33%
FJWUR	1.46%	0.87%	2.33%

RWU - Rawalpindi Women University, UAAR - University of Arid Agriculture Rawalpindi, QAU - Quaid-i-Azam University
IIUI - International Islamic University Islamabad, RIU - Riphah International University, AIOU - Allama Iqbal Open University
NUST - National University of Sciences and Technology, NUMS - National University of Medical Sciences
CUI - COMSATS University Islamabad, FUI –Foundation University, Islamabad, FJWUR - Fatima Jinnah Women University Rawalpindi

Upon analysing the age distribution within the sample, it was evident that a substantial proportion of the participants fell within the age range of 20 to 25 years. Moreover, analysis of the study years indicated a diverse distribution, with the majority of participants being enrolled in the first-year category. This demographic's prevalence might affect various aspects of research, such as the propensity to embrace intervention or behaviour modification and the chance of getting particular health conditions. According to the data it was observed that average age of male participants was 20.98 and average age of female participants was 21.29 years. It was also observed that the average BMI of all the participants was below the normal range of Asian people that is 20.71 to 23.45. Most of the participants word between 20 to 25 years of age group followed by less than 20 years of age group. Only approximately 2% of the total participants were more than 25 years old. Gender-wise distribution demonstrated representation of both male and female students across the selected universities analyzed both individually and collectively. Institutional distribution revealed that the largest proportion of data was obtained from RWU, followed by CUI, UAAR, and QAU. Overall, the sample reflects a diverse cohort of students drawn from multiple public and private sector universities in Islamabad and Rawalpindi, thereby enhancing the representativeness of the study population.

The study subjects were divided into groups of smartphone addicts, with and without neck disability, and with good or poor sleep quality, according to the data in Table 2. The results showed that female students were more addicted to smartphones than male students, but this was not statistically significant. However, the mean score for the overall level of university students' smartphone addiction was statistically significant ($p = 0.0086$).

With respect to musculoskeletal outcomes, the prevalence of neck disability was higher among female participants than males. The majority of participants exhibited mild neck disability, followed by those with no disability. Moderate neck disability was reported in 25% of male students and 20.9% of female students. Notably, approximately 28% of the participants experienced severe neck disability, while 6% were classified as having complete neck disability. These findings highlight a concerning prevalence of neck-related impairments among university students, potentially attributable to excessive smartphone use.

Regarding sleep quality, no statistically significant difference was observed between male and female students in overall PSQI scores. However, a substantial proportion of participants (86%) were found to have poor sleep quality. Furthermore, no significant association was identified between smartphone addiction and overall sleep-quality, although poor sleep quality was also prevalent among participants without smartphone addiction.

The range of scores observed in the study were as follows: smartphone addiction scores ranged from 10 to 58, neck disability index scores ranged from 0 to 48, and Pittsburgh Sleep Quality Index (PSQI) scores ranged from 3 to 18.

Table-2: *Frequency distribution of Smartphone addiction neck disability index and sleep quality of studied population*

Characteristics	**Male n(%)**	**Female n(%)**	**Total n(%)**
Smartphone addiction			
Not addicted	48(31.6%)	75(39.3%)	123(36%)
Addicted	104(68.4%)	116(60.7%)	220(64%)
Neck disability			
No disability	45(29.6%)	60(31.4%)	105(31%)
Mild disability	53(34.9%)	73(38.2%)	126(37%)
Moderate disability	38(25.0%)	40(20.9%)	78(23%)
Severe disability	12(7.9%)	16(8.4%)	28(8%)
Complete disability	4(2.6%)	2(1.0%)	6(2%)

Sleep Quality Index Conclusion			
Good sleep Quality	22(14.5%)	26(13.6%)	48(14%)
Poor sleep Quality	130(85.5%)	165(86.4%)	295(86%)

The overall association of smartphone usage patterns was also predicted with smartphone addiction score and sleep quality of the students' comparing the preferred position of using smartphone with smartphone addiction and sleep quality (Table 3). It was observed that most of the students who used their smartphone lying have more poor sleep quality (43.73%) as compared to those who use other positions. Results also showed that most of the addicted participants preferably used smartphones inlying position (34.11%) followed by inserting position (21.87%). Results showed that there is significant relationship of smartphone bold usage position bit sleep quality (p=0.001) and smartphone addiction (p=0.048). 51.60% of the students who are addicted to smartphone usage declare that they use smartphone for entertainment purposes and only 12% of the students clarify that they use smartphone for educational purposes. Comparing to purpose of smartphone usage data sleep quality of the participants, it was observed that 69% of the participants used smartphone for entertainment purposes as compared to 4.08% all the students who use smartphone for educational purposes have good sleep quality. Contrarily, there was no significant difference was observed in sleep quality index and purpose of smartphone usage. On the other hand, a significant association was observed in sleep quality and time spent using smartphones. Students who used smartphones three to five hours per day or more than are you off birthday showed poor sleep quality. Results are so short that students who are addicted to smartphone usage usually use their smartphones two to five hours per day or more than five hours per day. The overall sleep quality pattern showed a strong association between smartphone addiction and sleep quality index.

Table 3: *Association of pattern of smartphone usage with smartphones addiction score and sleep quality index.*

	Smartphone addiction		**Sleep Quality**	
	Not addicted	**Addicted**	**Good**	**Poor**
Preferred position for smartphone use				
Sitting	12.83%	21.87%	4.96%	29.74%
Lying	16.03%	34.11%	6.41%	43.73%
Any other	7.00%	8.16%	2.62%	12.54%
Purpose of smartphone use				
Entertainment purpose	27.41%	51.60%	9.91%	69.10%
Educational purpose	8.45%	12.54%	4.08%	16.91%
Time spent using smartphone				
> 5 hours per day	13.12%	24.49%	4.96%	32.65%
3-5 hours per day	16.33%	23.32%	4.37%	35.28%
< 3 hours per day	6.41%	16.33%	4.66%	18.08%

Median models were used to elucidate the overall association of smartphone addiction, sleep quality and neck disability bit of selected participants. Figure 1 shows the results of median models. The theoretical and hypothetical framework revealed it to be not fitting in the standard multivariate normal distribution patterns for ordinal SAS, NDI and PSQI scores, as was the partial median model. Thus, the path coefficient values of the following model were estimated using the robust weighted least square method: Smartphone addiction to sleep quality and smartphone addiction to the neck disability index, and sleep quality to the neck disability index. It was observed that smartphone addiction has no significant (p=0.165) relationship with sleep quality of the participants. The effect value of S as on sleep quality was -0.022. Negative sign is an indirect mediated effect between smartphone addiction and sleep quality. There was a good correlation between the variables of smartphone addiction and neck disability index (p=0.000). Likewise, significant association p=0.03) was found between sleep quality and neck disability index of the participants, however, a negative correlation was seen between the NDI and the sleep quality

of the participants. The relationship of these three parameters of the participants in total overall showed significant relationship (p=0.000) with a median value of 0.208. The bias-corrected bootstrap techniques resulted in all effect estimates' 95% confidence ranges being free of zero, which was a sign of statistical significance. To test the strength and reliability of the proposed mediation model, we also recalculated the path coefficients using the measurement variables as binary scores based on the specific thresholds.

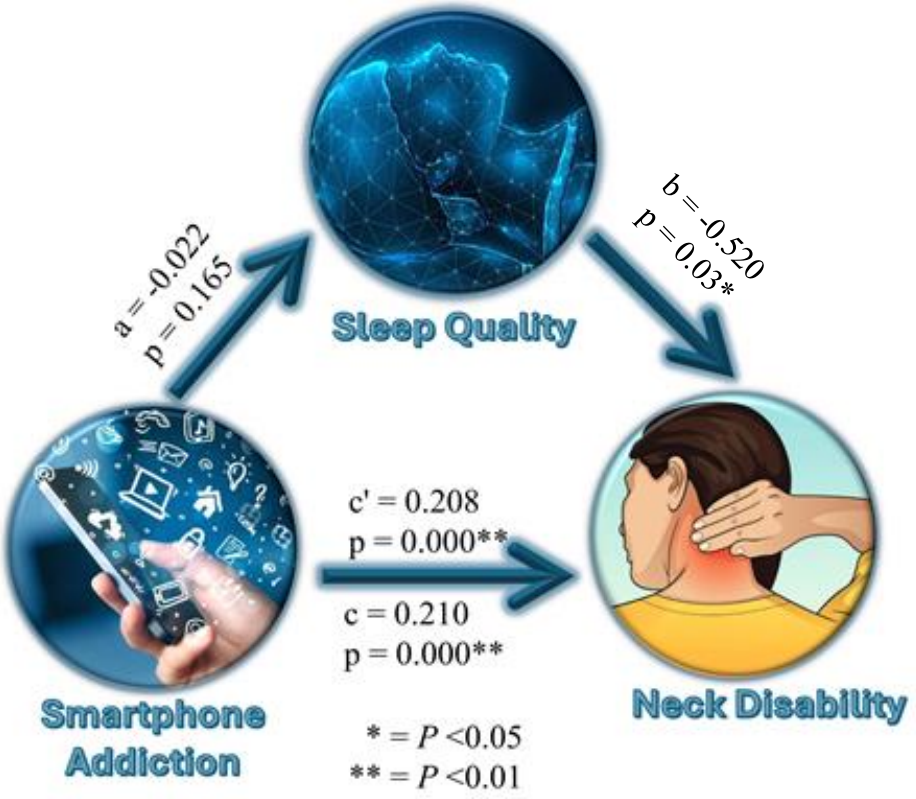

Figure 1: *Mediation models of smartphone addiction, sleep quality and neck disability.*

Frequency distribution association based on different categories of smartphone addiction, neck disability index and sleep quality was represented in table 4. It was noticed both addicted and not addicted students have poor sleep quality index which represents no significant relationship between SAS and PSQI. However addicted students have reported more neck disability index as compared to not addicted students. These do confirm the findings of median model analysis of the collected data.

Table 4: *Association of pattern of smartphones addiction score with Neck disability index and sleep quality index based on frequency distribution (%).*

		Smartphone Addiction		***p-value***
		Not addicted	**Addicted**	
Neck disability	No disability	14.87%	15.74%	0.003*
	Mild disability	11.66%	25.07%	
	Moderate disability	7.29%	15.45%	
	Severe disability	1.17%	7.00%	
	Complete disability	0.87%	0.87%	
Sleep Quality Index	Good sleep Quality	5.83%	8.16%	0.367
	Poor sleep Quality	30.03%	55.98%	

* Significant

Scattered plot analysis association of Total score of NDI and PSQI was depicted in Figure 2. The correlation graph also showed that there was a linear positive correlation between total SAS score and NDI score all of the selected participants. While there is linear negative correlation between SAS score and PSQI score.

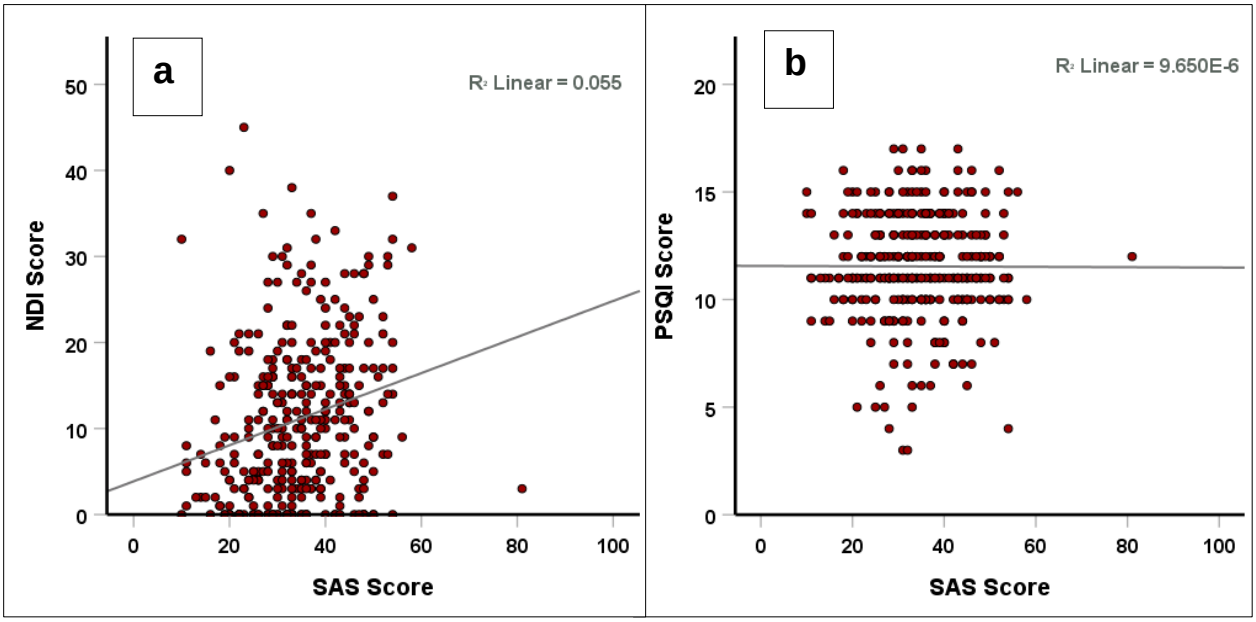

Figure 2: *Scatter-plot graph of the correlation between Smartphone Addiction Scale (SAS) score and Neck Disability Index (NDI) score (a) and Pittsburgh Sleep Quality Index (PSQI) score (b).*

It was theoretically observed that both in SAS sales and NDI it directly or indirectly affect the PSQI score of participants, then, 19 self -rated items of PSQI were summarized in 7 components score each with 0-3 point of difficulty. The total PSQI score actually was actually the sum of these seven components. The component scores consist of subjective sleep quality, sleep latency (i.e., how long it takes to fall asleep), sleep duration, habitual sleep efficiency (i.e., the percentage of time in bed that one is asleep), sleep disturbances, use of sleeping medication, and daytime dysfunction. The chi square test of the patterns of smartphone use and seven components of PSQI score compared to SAS by gender was presented in Table 5. Each of the 7 independent items of the PSQI scale failed to be significantly correlated with the score of smartphone addiction. Conclusively it is suggested that smartphone addiction does not directly affects the sleep quality of the participants however there is significant correlation between neck disability index and sleep quality.

Table 5: *Chi Square test of smartphone usage pattern and components of PSQI against Neck disability Index categorized on the bases of gender and smartphone addiction of all participants.*

	Male			**Female**		
	Not addicted	**Addicted**	**Total**	**Not addicted**	**Addicted**	**Total**
What is your preferred position for smartphone use	0.595	0.288	0.240	0.232	0.112	0.019
For what purpose are you mostly using your smartphone	0.711	0.303	0.483	0.418	0.100	**0.043**
How much time do you spend using smartphone per day	0.391	0.132	0.273	0.362	**0.005**	**0.004**
Subjective sleep quality	**0.015**	0.221	0.262	0.991	0.484	0.782
Sleep latency	0.391	0.126	**0.048**	0.531	0.056	0.548

Sleep duration	0.173	0.663	0.168	0.952	0.822	0.753
Habitual sleep efficiency	0.172	0.267	0.154	0.191	0.446	0.798
Sleep disturbance	0.540	0.584	0.590	0.995	0.137	0.307
Use of sleeping medication	0.015	0.221	0.262	0.991	0.254	0.582
Day time mis-functioning	0.626	0.310	0.306	0.671	0.255	0.652
Sleep quality index conclusion	**0.037**	0.241	0.163	0.862	**0.035**	0.587

4. DISCUSSION

The prevalence of smartphone usage continues to rise in recent decade and concerns have been raised about the potential health consequences of smartphone addiction among children and young adults. Smartphone addiction in children and youth has been shown to have a wide range of health impacts in numerous studies (Gabriel et al., 2023). The objective of this research endeavour was to evaluate the prevalence of smartphone addiction among university students, as well as the consequences it has on the quality of sleep and functional neck disability health (Mustafaoglu et al., 2021). There is not a consensus on the existing diagnostic criteria for smartphone addiction. On the other hand, a variety of self-administered scales have been presented in a number of scientific studies, such as the Smartphone Addiction Propensity Scale (Li et al., 2021; Göktaş et al., 2018), the Smartphone Addiction Inventory, the Smartphone Addiction Scale, and the Mobile Phone Addiction Scale. They are based on scales that involve scoring systems to assess an individual's pattern of using their smartphone. At first glance, these scales appear straightforward but much research has been conducted on the scales to establish their validity, reliability, and internal consistency (Mohd et al., 2022). The research team thus chose the Smartphone Addiction Scale (SAS). Smartphone addiction was deemed to be "high" for people with an SAS score of 58. Based on this, a cut-off point of 60 was found in the present study to identify teenage smartphone addiction (Aygar et al. 2019).

The demographic makeup of study participants greatly contributes to our understanding of participant characteristics, research design and possible implications of the intervention and health outcomes. Comprehending this particular demographic profile is crucial in order to appropriately construe study outcomes and devise interventions customised for particular subgroups (Lee & Oh, 2022). Firstly, the demographic distribution of the sample population can affect some of the study variables such as the chance of experiencing specific health problems, and the willingness to participate in interventions or change behaviour. One example is to provide the participants with information about their academic progress over several academic years, many of whom were first-year students in their programs. It also represents the diverse makeup of the sample population and gives light on the socio-demographic context. The presence of students from reputed institutes such as Rawalpindi Women University (RWU) and National University of Medical Sciences (NUMS) underlines the growing importance of these institutes and the diversity of student body. Given the diversity of backgrounds, experiences and perspectives among the participants, it is important to have a nuanced understanding of the sample. This type of diversity provides a higher quality of the study and increases the likelihood that various demographic groups would respond and act in different ways from each other. The information in Table 1 is quite comprehensive and contributes to further research and targeted intervention efforts. Further data analysis revealed that the mean age for males was 20.98 years, and for females was 21.29 years. Furthermore, it was observed that the average BMI of each participant was lower than that of the Asian population's standard. The bulk of participants were between the ages of 20 and 25, with a small minority being under 20.A minority of the participants exceeded the age of 25. With regard to their academic standing, the largest proportions of participants were in their inaugural year of graduation, with participants in their fourth year following suit. Based on the male and female participants at each of the universities, RWU was the main source of data, followed by CUI, UAAR, and QAU. This shows the variety of public and private schools in Rawalpindi and Islamabad in terms of affiliation to the universities. In conclusion, the demographic information provided provides a useful background to the findings of the research, the

possibility of identifying any confounding variables and interventions that are specifically designed for the needs of different demographic groups. It also provides the researchers with a critical insight into the traits of the research population.

In general, the more time that is spent using a smartphone, the more likely one is to become addicted to their smartphone. The students who used mobile phone for less than 3 hours had higher Smartphone Addiction Scale (SAS) scores than those who used mobile phone for more than 3 hours. This result is in line with research done on Korean high school students, which found that there was a positive relationship between phone usage frequency and SAS results. Neck pain can be caused by many factors, such as mechanical stress on the neck muscles. Recent studies have found a link between smart phone use and sore throat. When using the device, bad posture and repetitive hand and finger movements are to blame for this discomfort. The study evaluated the effect of long-term cell phone use on the strength of the cervical spine objectively and subjectively, with the help of tools such as goniometers, deep neck endurance tests, and Neck Disability Index (NDI) questionnaires. The NDI scale is an instrument to measure self-reported disability related to neck discomfort. Ten standardised components make up this system, which is based on the Oswestry Low Back Pain Failure Index (Kwon et al., 2013; Murugan et al., 2018). The maximum score for each item is 50 and the range is 0-5. To get a percentage score, multiply the total score. The NDI scale has become the universally accepted assessment of cervical impairment.

The Neck Disability Index (NDI) average for boys and girls was found to be 12.91 for males and 15.49 for girls in the study. The NDI scores between genders are statically significant (p-value 0.0016) with higher rates of neck involvement in girls than boys. These findings are supported by the studies of (Abdel-Azīem et al., 2023; Akbulut et al., 2018; Feng et al., 2022; Prithika et al., 2022; Rathakrishnan et al., 2021) that suggested that women are more at risk of developing cervical problems as compared to males. In addition, the researchers found that there was a significant difference in NDI scores between individuals with and without upper limb discomfort. The mean NDI score for the group of individuals who reported discomfort in the upper extremities (18.44) was higher than the group that did not report discomfort in the upper extremities (13.45). This difference highlights the importance of discomfort in the upper extremities in relation to neck involvement. The test revealed that pupils who used their smartphone for more than 3 hours (p-value = 0.002) achieved better scores on the NDI than those who used their smartphone for less time. This is consistent with findings from previous research by Gachon University students looking to demonstrate that the length of time spent using a smartphone is a correlation with how often neck pain occurs. The study found that people who use smart phones a lot can change their posture, leading to neck pain. In particular, Tamil Nadu's educational institutions prohibit the use of cell phones during class (Prithika et al., 2022). This means that the students are using their smartphones mainly in the evenings and at night, which creates the potential for extended use and neck issues (Czępińska et al., 2023).

Research has found that most Smartphone users are more active with their device in the evening than in the day. This is a significant risk factor for young adults' lower-quality sleep. A chronic decline in sleep quality has an immediate effect on cognition. For this reason, the purpose of this study was to assess the effect of smartphone addiction on sleep quality in college students (Parlak et al., 2023). In this study, the Pittsburgh Sleep Quality Index (PSQI) scale was used due to its high internal consistency and homogeneity and its validity. In addition, the PSQI is one of the most reliable tools to assess sleep quality in a wide range of populations in India, where it has been used by post-graduate students. The PSQI is a tool that is commonly used by neurologists and psychiatrists to assess patients' sleep. Higher scores on the PSQI mean that there is a sleep disturbance. The score range is from 0 to 21. More disruption of sleep patterns is associated with higher PSQI scores (Zhang et al., 2021). A PSQI score of five or more was present in almost two thirds of the study participants, indicating modest sleep disruptions. Similar findings were reported by (Achangwa et al., 2023; Ammati et al., 2018; Czępińska et al., 2023; Wah et al., 2022).

The mean PSQI value of males (5.75) was not significantly different from that of females (6.19). There was a significant difference between the students who used the smartphone less than 3 hours a day and more than 3 hours a day (p-value 0.002) when the PSQI scores were compared with the duration of daily cellphone use. From this, it can be inferred that students who use smart phones for more than 3 hours a day generally have better sleep quality than students who use their cell phones for less than 3 hours a day based on their PSQI scores. In a study done by Baitarani et al., which investigated the relationship between medical students' mobile phone usage and the quality of their sleep, similar results were found (Murugan et al., 2018; Rathakrishnan et al., 2021).

5. CONCLUSION

Smartphones have unquestionably made society much more convenient. However, using a smartphone excessively might have several negative health implications. The results of this study have confirmed the connection between smartphone addiction and the emergence of sleep disorders and neck-related problems, as have the results of several other research projects. All things considered, cellphones have advantages and disadvantages, and people need to use them responsibly. Utilising the benefits of smartphone use should be prioritised to reduce the risk of addiction. The majority of smartphone tasks require users to hold their arms out in front of them or to look down sharply at the screen. This causes the user's head to move forward, which puts stress on the cervical spine and neck muscles and causes an excessive anterior curve in the lower cervical vertebrae and an excessive posterior curve in the upper thoracic vertebrae to maintain balance. Reducing screen time and using cellphones sensibly are two measures that can be put into practice to help prevent long-term health issues like neck and sleep disorders. An increasing number of people are becoming concerned about smartphone addiction, especially college students. Community-based awareness campaigns could be a useful tool for helping people who are struggling with addiction change the way they think and behave.

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Data Availability

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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