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Prevalence of Forward Head Posture and Its Association with Smartphone Use among University Students

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ABSTRACT

A person exhibits forward head posture when their spine is out of neutral alignment with their head. Nowadays, smartphones are a necessary tool whose use is becoming increasingly significant. The side effect of smartphone use is forward head posture, which is most common among university students. **Objectives:** To determine the prevalence of forward head posture and its association with smartphone use among university students. **Methods:** This correlational study was conducted on university students with a sample size of 340. Both male and female students aged between 18-28 years, who use their smartphones for at least four hours and have no previous record of birth defects of cervical and lumber vertebrae were included. Whereas, any history of cervical surgery, or spinal abnormalities was excluded from the study. The goniometer and ruler method were used to measure the craniovertebral angle, and a smartphone addiction scale was used to screen the participants. **Results:** A positive correlation was found between craniovertebral angle and duration of smartphone usage with a correlation coefficient of r=0.084 and p=0.02. In contrast, a negative correlation was observed between the ruler method and the duration of smartphone usage with a correlation coefficient of r=0.54 and p=0.403. **Conclusions:** It was concluded that the prevalence of forward head posture was found to be 47.9% by the ruler method and 62.1% by the craniovertebral angle measurement. There is a correlation between craniovertebral angle and smartphone use and the duration of smartphone usage.

INTRODUCTION

A state of musculoskeletal equilibrium that places the least amount of strain and tension on the body is known as proper posture. Maintaining the angel wings or the retracted shoulder blades, together with the ears in line with the shoulders, are characteristics of proper posture. The most beneficial position for the spine is one that reduces spinal stress and is ideal for the spine [1]. The forward movement of the cervical vertebrae and hyperextension of the upper cervical region characterize a forward head position (FHP) and a bad head and neck posture [2]. Teenagers' widespread use of laptops, smartphones, and computers has caused a misalignment of their heads and neck. Most of their time was spent on smartphones, particularly during the COVID-19 pandemic, for things like playing games, social media friend talk, online classes, and searching for study materials [3]. Ergo, it was not recommended to keep the head lowered to stare at the screen for extended periods. This results in bad posture, including rounded shoulders, a head that protrudes with the chin pushed in, and Forward Head Posture (FHP) [4]. Forward head posture (FHP) has several other names such as text neck, scholar's neck, wearies neck, and reading neck etc., Smartphone addiction is characterized by compulsive smartphone use, a lack of control brought on by overindulgence, and behavioral addiction [2]. Users of smartphones typically have their

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heads tilted forward in their bodies. In that posture, the head naturally prefers to be in front to preserve the body's equilibrium because the spinal bones bend forward in that direction [5]. Long-term forward-facing head position can lead to musculoskeletal conditions like upper crossed syndrome, muscle shortening surrounding the articulation of the Atlantic-occipital, and increased pulling of the muscles surrounding the joints, resulting in persistent neck discomfort [6]. Forward head posture is 66% common between the 20 -30 age range with female more likely to exhibit it (24.1%) than male [1]. According to the studies, 70% of the physical therapy students and 85.5% of the dental staff members reported forward head posture [7, 8]. A survey among university students in Pakistan has revealed that 63.96% had a forward head posture [9]. It's characterized by the forward displacement of cervical vertebrae in association with hyperextension of the upper cervical region. This condition is caused by the combined weakening of deep cervical flexor muscles, mid-thoracic rhomboid muscles for shoulder retraction, and mid and lower trapezius muscles. Numerous factors such as sleeping with a head too high, use of computers and laptops for extended periods and weakening of back muscles, usually contribute to this condition [2]. This abnormal condition causes modification in cervical and thoracic vertebrae leading to muscle imbalance and thoracic limitation causing hindrance in rib cage expansion. As a result, lung volume is decreased. Therefore, these could be blamed for chronic respiratory and musculoskeletal issues compromising the patient's daily tasks [10]. Cervicogenic headaches, temporomandibular problems, neck pain, and post-concussive headache have all been linked to FHP [11]. Research has shown that when the cervical spine's lordotic curvature was straightened, the F-wave in the upper limb's median nerve was significantly reduced, indicating decreased motor-neuronal excitability. Only a few research studies have examined the connection between FHP and poor somatosensory and sensorimotor integration [12]. Fercho et al., determined the kinematic analysis of the frontal head body of smartphone users. They concluded that smartphones contribute more to frontal head injuries and maximum buckling occurred at C0-C1 vertebra [13]. Bomen et al., conducted an observational study to determine the high level of association between cell phone use and shoulder extension, forward bending, and thoracic kyphosis among students. The study concluded that the relationship between smartphone use and head and shoulder extension was not significant [14]. Janet et al., determined the impact of the smartphone on the front neck in physical therapy students and people who use smartphones for a long time. It was found that students with anterior neck stiffness had larger craniovertebral angles and range of motion compared to normal neck stiffness, and students with anterior neck stiffness also used smartphones for 5-6 hours a day [15]. Patel et al., conducted a cross-sectional study to identify factors associated with neck pain among student smartphone users. This study concluded that both personal factors of smoking and ergonomic aspects of neck flexion posture are associated with the occurrence of neck musculoskeletal problems in smartphone users [16]. To restore muscle balance between agonist and antagonist muscles, increase muscle strength and reduce muscle weakness. Exercise is effective in correcting postural disorders and maintaining the relationship between the head and shoulders. It is important to improve shoulder stability by simultaneously strengthening the scapular stabilizers while stretching the pectoralis minor muscle [17]. It is hypothesized that the prevalence of neck disorders among smartphone users may be associated with forward head posture and smartphone addiction or overuse.

This study aimed to determine the prevalence of forward head posture and its association with smartphone use among university students. The findings of this study may trigger an initiative for awareness and strategies to prevent the occurrence of neck pain among smartphone users. It will help students how to maintain good posture, reduce disabilities and adopt a healthy lifestyle.

METHODS

This correlational study was conducted on university students of Islamabad, Pakistan for a duration of 6 months from December 2023 to June 2024. The sample size was 340 which was calculated through the EPITOOL website by using the prevalence of FHP (0.67) [18]. Non-probability purposive sampling technique was used. Both male and female university students aged between 18-28 years, who use their smartphones for at least four hours and have no previous record of birth defects of cervical and lumber vertebrae were included in this study. Any history of cervical surgery, shoulder trauma, spinal abnormalities, pre-existing neck disorders such as polyarticular disease, spinal arthritis, inherited brain disease or neck torticollis were excluded from the study. The informed consent was signed by all the participants who fulfilled the inclusion criteria. The goniometer and ruler method was used to measure the forward head posture, and they had good reliability (ICC=0.830) [19], smartphone addiction scale (SAS-SV) questionnaire with the internal consistency and concurrent validity of SAS-SV were verified with a Cronbach's alpha of 0.911. Smartphone addiction scale (SAS-SV) is a 10-item measure of smartphone addiction. A 6-point Likert scale, with 1 representing strongly disagree and 6 representing strongly agree, is used to score each item. Because the SAS-SV was created especially for smartphones and excludes internet addiction, it is helpful. It was employed to evaluate the relationship between forward neck posture and cell phone use [20]. To check

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FHP by ruler method, encourage the students to stand up against the wall. Following an assessment, students showing forward neck position were measured using a ruler between the wall and structure located on the posterior surface of the occipital bone, at the level of the superior nuchal line. The forward neck posture is indicated if the measurement is more than three inches. Craniovertebral angle (CVA) was measured by goniometer, the participants were in a sitting position, the goniometer's axis was placed at the C7 spinous process, with the stable arm horizontally aligned at the C7 level and the movable arm at the ear's tragus, from where the angle is measured. The normal angle was 49.9 degrees and subjects with lower CVAs typically have higher FHP [21]. The IBM SPSS version 22.0 was used for data analysis. Descriptive data were analyzed through mean, standard deviation, frequency and percentages while association among two variables were analyzed by Pearson's correlation. The study has been approved by the Ethical Committee of the Institute of Health & Management Sciences, Islamabad, ref no: IHMS/DPT/SZABMU-2023/274, whereas informed consent was taken from all participants through a printed form in the English/local language. Every participant's privacy and sovereignty were respected and safeguarded.

RESULTS

This study involved 340 students, 130 of whom were male and 210 of whom were female (Figure 1).

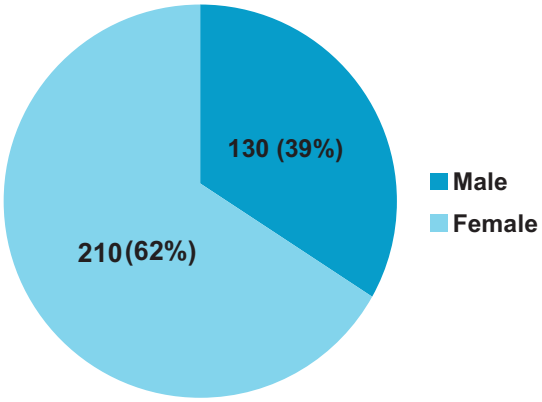

Figure 1: Gender distribution among study participants

The participants' average age was 21 ± 1.9 years, height was 5.4 ± 0.4 feet, weight was 58 ± 11 kg, and their average body mass index was 22 ± 4.8 kg/m2. The average time spent using a smartphone was 6.2 ± 3.4 years, with a screen size of 6.1 ± 0.6 cm and use of a smartphone 6.7 ± 3.6 hours per day. The average study hours at the university were 5.8 ± 2.2, whereas at home, they were 2.5 ± 1.7 (Table 1).

Table 1: Demographic Data of the study Participants

Variables	Mean ± SD
Age (Year)	21 ± 1.9
Height (Ft)	5.4 ± 0.4
Weight (kg)	58 ± 11
BMI (kg/m^2)	22 ± 4.8
Smartphone's Screen Size (cm)	6.1 ± 0.6
Duration of Smartphone Use Years	6.2 ± 3.4
Use of Smartphone Hours A Day	6.7 ± 3.6
University Study Hours	5.8 ± 2.2
Home Study Hours	2.5 ± 1.7

The majority of students utilize their right hand 178 (52.4%), students used their smartphones with their left hand 16 (5%), 144 (43%) used their smartphones with both hands and 282 (83%) students took notes on their smartphone (Table 2).

Table 2: Smartphone Usage of Students

Variables	Frequency (%)
Use of Hand During Smartphone	
Right	178 (52.4%)
Left	16 (4.7%)
Both	144 (43%)
Study Notes Took A Smartphone or Notebook	
Yes	282 (82.9%)
No	55 (17.1%)

The average craniovertebral angle was 47 ± 4.4 degrees, and the mean value of the ruler method was 3.3 ± 1.4 cm. The prevalence of forward head posture was found to be 47.9% by the ruler method and 62.1% by the craniovertebral angle measurement (Table 3).

Table 3: Methods for Measuring Forward Head Posture

Methods	Mean ± SD	n (%)
Ruler Measurement (cm)	3.3 ± 1.4	163 (47.9%)
CVA	47 ± 4.4	211 (62.1%)

The Smartphone Addiction Scale (SAS) indicates that 79 students, or 23.2%, out of 340 students, agree that using their smartphones prevented them from completing their assigned work. 100 people (29.4%) disagreed that they found it difficult to focus on class assignments when using a smartphone. While using a smartphone, 92 (27.1%) reported experiencing pain in the wrists or back of the neck; 88 (25.9%) disagreed that they would be unable to live without a smartphone. 73 (21.5%) strongly disagreed that they should keep their smartphone in mind even when they are not using it, and 80 (23.5%) disagreed that they should feel anxious and irritated when they are not holding their smartphone. 95 respondents (27.9%) disagreed that they would never stop using their smartphone, even if it was already hurting their daily lives. 78 respondents (22.9%) agreed that they constantly check their phones to make sure they don't miss other people's conversations on Facebook and Twitter. 96 respondents (28.1%) agreed that they had used their phone longer than they had intended. Finally, 66 respondents (19.4%) disagreed that others around them thought they were using their phones excessively (Table 4).

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Table 4: Smartphone Addiction Scale

Questions	Strongly Disagree n (%)	Disagree n (%)	Weakly Disagree n (%)	Weakly Agree n (%)	Agree n (%)	Strongly Agree n (%)
Missing planned work due to smartphone use	62 (18.2%)	60 (17.6%)	36 (10.6%)	44 (12.9%)	79 (23.2%)	59 (17.4%)
Having a hard time concentrating in class, while doing assignments, while working due to smartphone	38 (11.2%)	100 (29.4%)	51 (15.0%)	47 (13.8%)	68 (20%)	36 (10.6%)
Feeling pain in the wrists or at the back of the neck while using a smartphone	50 (14.7%)	61 (17.9%)	35 (10.3%)	51 (15.0%)	92 (27.1%)	51 (15.0%)
Will not be able to stand not having a smartphone	69 (20.3%)	88 (25.9%)	39 (11.5%)	40 (11.8%)	56 (16.5%)	48 (14.1%)
Feeling impatient and fretful when I am not holding my smartphone	56 (16.5%)	80 (23.5%)	50 (14.7%)	57 (16.8%)	70 (20.6%)	27 (7.9%)
Having my smartphone in my mind even when I am not using it	73 (21.5%)	71 (20.9%)	51 (15%)	57 (16.8%)	55 (16.2%)	33 (9.7%)
I will never give up using my smartphone even when my daily life is already greatly affected by it	61 (17.9%)	95 (27.9%)	42 (12.4%)	46 (13.5%)	68 (20%)	28 (8.2%)
Constantly check my smartphone so as not to miss conversations between other people on Twitter and Facebook	53 (15.6%)	69 (20.3%)	30 (8.8%)	60 (17.6%)	78 (22.9%)	50 (14.7%)
Using my smartphone longer than I had intended	32 (9.4%)	56 (16.5%)	51 (15%)	54 (15.9%)	96 (28.2%)	51 (15%)
The people around me tell me that I use my smartphone too much	54 (15.9%)	66 (19.4%)	41 (12.1%)	50 (14.7%)	65 (19.1%)	64 (18.8%)

The findings show that there is a relationship between smartphone use and CVA, r=0.067 and p=0.695, but no correlation between the ruler approach and smartphone use (r=0.058), p=0.557. The study's findings showed a significant positive correlation (r=0.084, p=0.002) between smartphone time and CVA. Conversely, there was a negative link between the length of time spent on a smartphone and the ruler approach, with a correlation coefficient of r=0.54 and p=0.403 (Table 5).

Table 5: Relationship among FHP with Smartphone Use

Methods	Duration of Smartphone	Use of Smartphone
Ruler		
Pearson Correlation	0.403	0.557
Sig. (2-Tailed)	0.54	0.058
CVA		
Pearson Correlation	0.002	0.695
Sig. (2-Tailed)	0.084	0.067

DISCUSSION

Forward head posture (FHP) is the forward movement of the cervical vertebrae and hyperextension of the upper cervical region characterize a forward head position and a bad head and neck posture. Smartphone addiction is characterized by compulsive smartphone use, a lack of control brought on by overindulgence, and behavioral addiction [2]. Users of smartphones typically have their heads tilted forward in their bodies. In that posture, the head naturally prefers to be in front to preserve the body's equilibrium because the spinal bones bend forward in that direction [5]. The purpose of this study was to determine the prevalence of forward head posture and its association with smartphone use among university students. Bomen *et al.*, precisely investigated to find out how college students' prolonged shoulder, head-forward position, and spinal kyphosis relate to their dependence on smartphones. The results of the investigation showed that there is no meaningful relationship between extended shoulders, thoracic kyphosis, or tilted heads and dependency on smartphones [14]. In the current study, the result suggests there was no correlation between the ruler method and the use of smartphones but in contrast, there was a correlation between CVA (craniovertebral angles) and the use of smartphones r=0.067, p=0.695. the outcome of this investigation concluded that the CVA angle was reduced in neck positioned upwards. The prevalence of forward head posture according to the ruler method was 47.9%, and according to craniovertebral angle measurement was 62.1%. Janet *et al.*, identified that across physical therapy students, advanced neck spot was prominent and that smartphones showed a detrimental effect and going on top head spot in widespread consumers of handsets. In a sample size of 100 students, who use smartphones for approximately four hours daily, a goniometer, craniovertebral angle and plumb line were used as outcome measures. The results of the study demonstrated that, with an average variance of 14.97 between the two student groups, there is a statistically significant difference between students with forward head positions and those in the group acting as a control. Smartphone addiction is more common among students' forward-leaning vertebral location [15]. In the current study, with a sample size of 340, the ruler method, goniometer and SAS questionnaire were used as outcome measures. The result concluded that CVA increased in students who used smartphones more than four hours per day. Among physical therapy learners, Patil *et al.*, evaluated a high incidence of reliance on smartphones and its association with erect gaze and spine damage. The objective of the study was to find how frequently learners contemplating reintegration are

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dependent on their cell phones as well as its relationship to neck dysfunction and forward head posture by using a craniovertebral angle. The neck disability index, the mobile phone obsession scale-SV, structured interview survey responses and the image-based biomechanical assessment of the head positioning orientation for forward head posture were used for data collection. When smartphone addiction was broken down by gender, it was shown that males were more prone to smartphone addiction than females. A significant correlation has been seen between smartphone habit and the corresponding neck disability index and forward head alignment (FHP). According to the study's findings, physiotherapy students were more likely to be addicted to smartphones, which can result in forward head posture and neck impairment [16]. In the current study, the ruler method, goniometer and SAS questionnaire were used. The current study's findings indicated a robust positive correlation between CVA (craniovertebral angles) and the duration of smartphones. In contrast, a negative correlation was observed between the Ruler method and the duration of the smartphone. Another longitudinal investigation to determine the precedence of forward head posture and pertaining hazards among university students. As stated by the results, the majority of individuals with forward head posture were between the ages of 18 and 21 and male participants had a somewhat higher extensiveness of front-facing orientation of the head than female participants. The results also showed that there is a direct link between front-facing skull position and computer and smartphone use [18]. A study was onducted to determine how common forward head posture is among college-bound students and how it relates to gender, BMI, and neck pain. The participants' average age was 19.8 ± 1.42 years. Female students were dominated by 60%. It was revealed that 63.3% had lowered CV angle and 36.7% had normal CV angle. CV angle and BMI were significantly correlated (p=0.003). There was no significant correlation between gender and neck discomfort and the CV angle (p>0.05) [1]. The majority of the students in the current study, who were 21 years old, were female. The length of smartphone usage had a positive link with CVA and a negative correlation with the ruler approach. The majority of the students had forward head position as evidenced by a decreased craniovertebral angle.

CONCLUSIONS

It was concluded that the prevalence of forward head posture was found to be 47.9% by the ruler method and 62.1% by the craniovertebral angle measurement. The current study indicates a significant association between CVA and smartphone use and there is no association between the ruler approach and smartphone use. According to the results, the duration of the smartphone and CVA also showed a strong favourable link. It is recommended that future research focus on the participants over an extended period of time, as the capacity to recognize the cervical angle may vary over time. Additionally, future studies should investigate the responsiveness of the WPD software in longitudinal research for more accurate and dependable results.

Authors Contribution

Conceptualization: AS[1]
Methodology: AS[1], AS[2], ML, RF, RK, SA
Formal analysis: NR, AR
Writing, review and editing: AS[1], AS[2], ML, RF, RK, NR

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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