

Smartphone Addiction among Undergraduate Medical Students: Its Relation with Neck Disability and Cervical Posture

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Abstract: *Background:* Smartphone addiction is a growing public health concern of 21st century. The commonly adopted forward head posture while using smartphone exerts stress on cervical spine. Increasing trend of smartphone usage among MBBS students raise concerns about it's potential impact on cervical posture and musculoskeletal health. *Aim:* To estimate the prevalence of Smartphone addiction by Smartphone Addiction Scale Short Version (SAS SV) and neck disability among undergraduate medical students & to find out it's association with neck disability & cervical posture. *Study Design and setting:* Descriptive cross-sectional study in a tertiary care hospital of West Bengal. *Methodology:* One Hundred sixteen subjects were included by simple random sampling and a predesigned pretested semi structured questionnaire was used to collect data. Postural variables were measured using Modified Universal Goniometer. Data analysis was done using MS Excel and SPSS16. *Results:* Prevalence of Smartphone addiction and neck disability were found 40.5% and 57.7%. Among smartphone addicted, mean Cranio-vertebral angle (CVA), Sagittal head angle (SHA), Forward head distance (FHD) were 48.59°, 16.49° and 10.61 cm respectively. Whereas among the non-addicted group, they were 48.14°, 16.48°, 10.4 cm respectively. Binary logistic regression identified age (OR=1.649) and screen time (OR=1.349) as significant predictors of Smartphone addiction Score, and Day scholars (OR=0.338) as significant predictors of Neck disability Index (NDI). *Conclusion:* Smartphone addiction is a predictor of self-reported neck disability among medical undergraduates. Addicted group has higher mean FHD and mean SHA. Males reported decreased CVA and increased FHD compared to females. Day schooling is protective factor of Neck Disability.

Keywords: Mobile Addiction, Neck Disability Index (NDI), Smartphone Addiction Scale (SAS), Cranio-vertebral Angle (CVA), Sagittal Head Angle (SHA), Forward Head Distance (FHD), Musculoskeletal Problem.

Key Message: Excessive Smartphone usage might lead to faulty cervical posture.

Introduction

Smartphone is undoubtedly the most popular electronic device of twenty-first century and it's use is increasing globally. Smartphone addiction, sometimes colloquially known as “nomophobia” (fear of being without a mobile phone), is an internet overuse problem or internet addiction disorder. It has similar effects like that of substance abuse including craving, withdrawal, tolerance, daily-life disturbance and preference of cyberspace-oriented relationship [1]. Due to smart phone addiction the student population

composed of the young adults are exposed to postural abnormalities. The commonly adopted smartphone user posture is Forward Head Posture (FHP), where the smartphone is held in one hand and head moves forward [2].

It causes an excessive anterior curve in the lower cervical vertebrae and posterior curve in the upper thoracic vertebrae to maintain balance. This exerts stress on the cervical spine, neck muscles and ligaments which may cause injury to any one of them leading to

neck pain [3]. The studies found that subjects with head, neck and shoulder discomfort are more likely to have a smaller cranio-vertebral angle (CVA) that indicates an FHP [4].

Recent meta-analysis reveals an alarming rise in smartphone addiction among Indian Medical Students [5]. Although smartphone addiction and neck-related musculoskeletal disorders have been studied independently, there is a clear dearth of studies examining their combined effects among Indian Medical students.

The aim of present study is not only to estimate the prevalence of smart phone addiction among undergraduate medical students of West Bengal using Smartphone Addiction Scale-Short Version (SAS-SV) [6] and neck disability using Neck Disability Index (NDI) scale [7] but also to find relationship between smart phone addiction, neck disability and cervical posture using the parameters like Craniovertebral Angle (CVA), Sagittal Head Angle (SHA) [8] and Forward Head Distance (FHD) [9]. If any association is found between them, appropriate exercise plan might be designed for sedentary college-going students who are using smartphone injudiciously.

Material and Methods

The descriptive, cross-sectional study was conducted in the department of Anatomy of a Government Medical college, Kolkata comprising Undergraduate Medical Students of age between 18 – 26 years. Sample size was calculated based on $n = Z^2pq/e^2$ where $Z=1.96$ (two tail) at 95% confidence interval, p = proportion of participants experiencing the outcome of interest (Smartphone addiction), q = complement of $p=100-p$, e =acceptable /allowable error around reported prevalence. As per literature [10], $p=43.9\%$, assuming $e=10$ (absolute), $n=94.6$. So, sample size was calculated to be 95 (approximately).

Considering, non-response rate 30%, final sample size was 125. Among them 9 students did not give consent for posture assessment, so finally data was collected from 116 subjects. Subjects were chosen by Simple Random Sampling using their roll numbers as sampling frame. Students with some pre-existing spinal musculoskeletal pathology were excluded from the study. 4th year students were not included due to ward duties. Study Tools were Computer assisted Self-

administered questionnaire and Modified universal Goniometer to measure the variables related to posture. The questionnaire was a predesigned, pretested, semi structured, anonymous questionnaire. Face validity, content validity and reliability of questionnaire were tested. The questionnaire comprised of three sections including:

- *Section 1:* General Information and demographic variables-6 items
- *Section 2:* Validated Smartphone Addiction Scale-Short Version (SAS-SV) - 10 items
- *Section 3:* Validated Neck Disability Index (NDI) scale - 10 items

Study variables were age, gender, SAS -SV score, NDI score and postural variables-CVA, SHA, FHD. Average daily Screen-time was self-reported by the participants from the data obtained from the Screen Time Application under 'Settings' Menu of their smart phones. (Figure-1 to 3).

Fig-1: Measurement of Sagittal head angle (SHA)



Fig-2: Measurement of Craniovertebral angle (CVA)



Fig-3: Measurement of Forward head distance (FHD)

This study was conducted after obtaining Ethical approval from the Institutional Ethics Committee (NRSMC/IEC/056/2025). During classroom survey, first the purpose of the study and the data collection technique was explained to all students of 1st, 2nd and 3rd year with information sheet and informed consent form was distributed. Those who gave consent, their roll number were noted. Based on their academic session and roll number a unified sampling frame was prepared with students of all the semester. From that sampling frame subjects were randomly selected by random numbers generated in MS-Excel. Willing participants were asked to fill up the self-administered questionnaire either through their smartphones, tablets, laptops or any other accessible devices.

In the next step the participants were requested to come to Department of Anatomy. Variables related to forward head posture were measured using a Modified Universal Goniometer after standardization of instrument [11]. Tool's reliability was determined by test-retest method. The participant had to stand in balance so that weight would be evenly distributed on both feet looking forward to the wall in front. Markers were used to locate the anatomical landmarks- C7 spinous process, outer canthus of eye and the tragus of the ear. All measurements were taken thrice by two independent examiners and average were taken to avoid intra and inter observer bias.

Collected data was compiled in MS Excel and codified for analysis in SPSS16. Data was summarized by estimating Mean, Standard deviation (SD), Median for continuous variable and frequency & percentage for categorical variable. Statistical test like Spearman/ Pearson

Correlation Coefficient for continuous variable and Chi Square test, Odds ratio with its 95% Confidence Interval (CI) for categorical variable were used for drawing inference between Independent Variables (IV) and Dependent Variables (DV). The unpaired *t*-test was applied to compare the mean values of continuous postural variables between two independent groups (males and females) and binary logistic regression analysis was performed separately to identify predictors of smartphone addiction and neck disability.

Statistical *p* value of <0.05 was considered significant. As per SAS-SV, the score of ≥ 31 and ≥ 33 denotes smartphone addiction/overuse among males and females respectively [6]. NDI score > 4 indicates neck disability with disability increasing with increasing score [7]. Craniovertebral angle less than 51 degrees in standing position considered as an indication of forward head disorder [12]. A lower value of SHA represents a lower FHP [8]. A higher FHD indicates a higher FHP [9].

Results

Among 116 study participants, 52.6% were male and 47.4% were female. The mean age of participants was 20.7 ± 1.37 years. The mean weight of the participants was 61.81 ± 10.9 kg. 52.5% the participants were hostel boarder and 47.41% of the participants were day scholars. Average daily screen-time was 5.8 ± 1.93 hours. The average smartphone addiction score (SAS) was 29.44 ± 10.16 . Based on the SAS, 40.5% was classified as addicted. Addicted group comprised of more males (65.9%) than females (34.04%). The mean Neck Disability Index (NDI) score was 5.90 ± 4.18 . The majority, 54.3% had mild neck disability and 3.4% had moderate neck disability [Table 1].

The mean Craniovertebral Angle (CVA) was 48.32 ± 7.16 degree, mean Forward Head Distance (FHD) was 10.48 ± 1.29 cm and mean Sagittal Head Angle was 16.48 ± 5.12 degree.

Females had a mean SAS of 27.6 ± 9.96 , mean NDI= 5.85 ± 4.16 , mean SHA 17.44 ± 5.89 degree, mean FHD 9.98 ± 1.13 cm, mean

CVA 49.35 ± 7.13 degree. Males had a mean SAS 31.1 ± 10.13 , mean NDI= 5.93 ± 4.23 , mean SHA 15.62 ± 4.18 degree, mean FHD $10.95 \pm$

1.27 cm, mean CVA 47.39 ± 7.12 degree [Table 2].

Table-1: Frequency table of Sex distribution, Smart phone addiction and NDI interpretation (N=116)			
Sex		Frequency	Percentage
	Male	61	52.6
	Female	55	47.4
Smart phone addiction	Addicted	47	40.5
	Non addicted	69	59.5
Neck Disability	No disability	49	42.2
	Mild disability	63	54.3
	Moderate disability	4	3.4
NDI=Neck Disability Index			

Table-2: Descriptive Statistics of Study Participants(n=116)						
Variables	Sex	Mean	SD	Round (LCI)	Round (UCI)	Mean (LCI-UCI)
AGE (in completed years)	Male	20.79	1.54	20.5	21.08	20.79(20.5-21.08)
	Female	20.6	1.16	20.38	20.82	20.6(20.38-20.82)
WEIGHT (in kg)	Male	66.63	11.44	64.51	68.75	66.63(64.51-68.75)
	Female	56.48	7.23	55.14	57.82	56.48(55.14-57.82)
SAS	Male	31.1	10.13	29.22	32.98	31.1(29.22-32.98)
	Female	27.6	9.96	25.75	29.45	27.6(25.75-29.45)
NDI	Male	5.93	4.23	5.14	6.72	5.93(5.14-6.72)
	Female	5.85	4.16	5.08	6.62	5.85(5.08-6.62)
FHD (cm)	Male	10.95	1.27	10.71	11.19	10.95(10.71-11.19)
	Female	9.98	1.13	9.77	10.19	9.98(9.77-10.19)
SHA (degree)	Male	15.62	4.18	14.84	16.4	15.62(14.84-16.4)
	Female	17.44	5.89	16.35	18.53	17.44(16.35-18.53)
CVA (degree)	Male	47.39	7.12	46.07	48.71	47.39(46.07-48.71)
	Female	49.35	7.13	48.03	50.67	49.35(48.03-50.67)
SAS= Smartphone Addiction Score, NDI=Neck Disability Index, FHD=Forward Head Distance, SHA=Sagittal Head Angle, CVA=Craniovertebral angle						

Among Smartphone addicted group, mean CVA, SHA, FHD were 48.59 ± 7.17 degree, 16.49 ± 4.82 degree, 10.61 ± 1.34 cm respectively. Among the non-addicted group, the mean CVA, SHA and FHD were 48.14 ± 7.21 degree, 16.48 ± 5.36 degree, 10.41 ± 1.27 cm. Chi-square analysis revealed significant associations between SAS and NDI ($\chi^2 = 17.86$, $p < 0.001$), and between sex and SAS ($\chi^2 = 5.67$, $p = 0.017$), while no significant associations were found with academic year and SAS and residence or sex versus NDI [Table 3].

According to unpaired t test, there is no significant difference between mean CVA of female and male ($p=0.14$) and mean SHA of female and male ($p=0.06$) whereas there is significant difference between mean FHD of female and male ($p<0.05$). Pearson correlation analysis showed a significant moderate positive relationship between SAS and NDI ($r = 0.442$, $p < 0.001$). A significant moderate negative correlation was observed between FHD and CVA ($r = -0.301$, $p = 0.001$).

Spearman's correlation further supported these observations. NDI had a weak positive correlation with SHA ($\rho = 0.119$, $p = 0.204$), though this was not statistically significant. A very weak negative correlation was observed between FHD and SHA

($\rho = -0.048$, $p = 0.605$), which also lacked statistical significance. Similar observations between NDI and FHD ($\rho = 0.001$, $p = 0.998$) and between FHD and SHA ($\rho = -0.048$, $p = 0.605$).

Table-3: Association between Smart Phone addiction and Neck Disability Index and with other demographic variables(n=116)			
	CHI Square Statistics	P-Value	Significance
SAS vs NDI	17.86	0.0001	Significant
SEX vs SAS	5.66	0.017	Significant
SEX vs NDI	0.21	0.897	Not significant
SAS vs academic year	2.89	0.234	Not significant
NDI vs Residence	3.22	.0727	Not significant
SAS= Smartphone addiction Score, NDI=Neck Disability Index			

Table-4: Predictors of Addiction (as per SAS score) in binary logistic regression (Nagelkerke's $r^2 = 0.264$) (n=116)				
Variables (Target Category)	p value	95% C.I. for aOR		
		aOR	Lower	Upper
Sex (Male)	.258	1.755	.663	4.649
Residence (day Scholar)	.199	1.908	.712	5.116
Year of study	.322	1.316	.764	2.270
Age	.015*	1.649	1.102	2.468
Number of devices	.301	.665	.306	1.442
ScreenTime	.013*	1.349	1.065	1.709
* = Significant predictors, SAS= Smartphone Addiction Scale				

Binary logistic regression identified age ($p=0.015$, $aOR=1.649$) and screen time ($p=0.013$, $aOR=1.349$) as significant predictors of SAS [Table 4]. Presence of smart phone addiction

($p<0.001$, $aOR= 7.942$) &day scholars ($p = 0.044$, $aOR =0.338$) were found to be significant predictors of NDI [Table 5].

Table-5: Predictors of Neck Disability (as per NDI score) in binary logistic regression (Nagelkerke's $r^2 = 0.322$). n=116				
Variables (Target Category)	p value	95% C.I. for aOR		
		aOR	Lower	Upper
Sex (Male)	.180	.375	.089	1.574
Residence (Day Scholar)	.044*	.338	.117	.970
Academic Year	.074#	1.698	.950	3.035
Age	.185	1.330	.872	2.027
Smart Phone Addiction (Addicted)	<.001*	7.942	2.793	22.589
FHD	.991	1.002	.691	1.454
SHA	.090#	1.085	.987	1.192
*= significant predictors at 0.05 level, #=significant predictors at 0.1 level, SAS= Smartphone addiction Score, NDI=Neck Disability Index, FHD=Forward Head Distance, SHA= Sagittal Head Angle				

Discussion

In the present study, the prevalence of smartphone addiction among Indian medical undergraduates was found to be 40.5%, which is higher than the 30.9% prevalence reported among medical undergraduates in Iran in earlier research [13]. However, a recent meta-analysis study done in India reveals a smartphone addiction of 60% among medical undergraduates, which is higher than the values in our cohort [5]. Similarly, mild to moderate neck disability was reported by 57.7% of the participants, exceeding the 42.9% prevalence documented among medical undergraduates outside India [13].

In the present study, age emerged as a significant predictor of smartphone addiction, along with screen time. This susceptibility may be attributed to increased engagement with smartphones for social interaction, entertainment, and academic purposes during the course of medical training. Prolonged screen time further reflects sustained exposure and habitual use, which may reinforce addictive behaviours.

As per Chi Square test, it is found that smartphone addiction was significantly associated with sex, male students being more frequently classified as addicted than females. Similar trends have been reported among Chinese medical undergraduates [14]. However, Binary logistic regression did not identify sex as a significant predictor of SAS. Similarly, evidence from an Indian meta-analysis indicates no significant difference in smartphone addiction prevalence between sexes [5]. No significant association was noted between sex and neck disability in our study.

A significant association was observed between smartphone addiction and neck disability in the present study, with binary logistic regression identifying the SAS as a significant predictor to the NDI. These findings are consistent with previous studies. Gustafsson et al [15] reported significant associations between frequent text messaging and neck, upper back, and upper-extremity symptoms in both men and women, while Hakala et al [16] observed increased neck and lower back pain among adolescents engaged in prolonged computer-related activities. In the present study CVA, SHA and FHD were used to

measure cervical posture. The mean CVA was 48.32°. This is low when compared to earlier studies done in healthy individuals who reported a CVA of approximately 52.7° [17]. This suggests a degree of postural deviation among medical students. CVA decreases with increasing age [18]. Since our cohort is closer to adolescent age group, significant changes in CVA to establish postural variations among smartphone addicted and non-addicted are yet to develop.

Guan et al. reported a remarkable decrease in neck angle (from 54.68° to 38.77°, $p = 0.000$) and significantly increased head shift (from 10.90 to 13.85 cm, $p = 0.000$) when viewing mobile phone [9]. We also observed a rise in mean FHD from 10.41 cm in non-addicted to 10.61 cm in smartphone addicted individuals. Similar findings were also noted by Torkamani et al. who concluded continuous and habitual smartphone usage by the addicted users may lead to development of an increased FHD and reduced CVA [19].

In our study the mean SHA of the addicted group was higher than the non-addicted group proving that the addicted group had a higher FHP than the non-addicted group. Similar findings were noted by Torkamani et al [19]. However, the males in our study reported a lower mean SHA than females which might be due to anatomical bone structure.

In this study, the mean CVA was lower and mean FHD was higher in males as compared to females. This reflects presence of postural deviation among males rising with smartphone addiction. Hakala et al [16] attributed that a higher CVA in females may be partly associated with psychosocial issues such as stress. Under normal circumstances, in paediatric population, boys showed a statistically significant greater mean CVA than girls [20]. However, Van et al [21], suggested that there is no difference in CVA of adolescents and pre-adolescent age groups irrespective of gender. In adult population stratified by age, linear regression analysis indicated a lower CVA in men compared to women with a difference of 2.46° and a 1.6° decrease in CVA per decade of increased age[18].

In the current study, Binary logistic regression identified day schooling as protective factor of NDI. This might be due to better ergonomic study environments at home, greater opportunities for physical activity, and reduced prolonged sedentary behaviour compared to hostel residents.

In our study, Spearman's correlation analysis revealed no statistically significant relationships between neck disability and postural variables, although neck disability showed a weak positive correlation with SHA ($\rho = 0.119$, $p = 0.204$). Binary Logistic regression established SHA as a contributing factor to Neck disability at $p = 0.1$ level. This might occur as correlation examines simple bivariate relationships but logistic regression accounts for confounding variables and may identify independent contributions of various parameters. Additionally, postural parameters such as SHA represents static measurements, whereas neck disability reflects a multifactorial and subjective outcome influenced by cumulative exposure, muscle fatigue, and individual pain perception.

The study provided a comprehensive assessment of smartphone addiction and neck disability with validated study tools like SAS and NDI that further enhances its reliability. Inclusion of postural assessment parameters – CVA, SHA, FHD provides a multidimensional understanding of musculoskeletal impact and multiple statistical tests adds robustness to data interpretation. However, Cross sectional nature of the study fails

to infer causal association between smartphone usage and neck disability. Limiting the study population to unicentric group of medical students restricts its representativeness to general population. Self-reported questionnaires may introduce reporting/ recall bias. Potential confounding factors such as physical activity, ergonomics, and psychological stress were not assessed.

Conclusion

Present study concludes that smartphone addiction is a significant predictor of neck disability among MBBS students. Additionally, demographic factors like age, male gender, residence are also significantly related to neck disability. Early detection of musculoskeletal symptoms will help to prevent further deterioration by life style modifications and designing appropriate exercise plan.

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