

Impact of Smartphone Usage on Forward Neck Posture and Function in College-Going Students

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Abstract

Objective: There is an increased usage of smartphones among college-going students, especially with an increase in online education system during the COVID pandemic. Long-term use of smartphones may lead to various health issues in an individual. The objective of this paper was to identify the impact of smartphone usage on the neck posture and disability in college-going students.

Methodology: The study recruited 50 students between the age group of 21 to 25 years. The weekly usage of smartphone in hours was documented from usage-tracking apps. Forward neck posture of the individuals was assessed by measuring Cranio-Vertebral (CV) angle using Photogrammetry method, and the disability using Neck Disability Index (NDI). Pearson correlation analysis was done to statistically analyze the data.

Results: The mean age of the study population was 23.3 ± 1.5 years and had 14 males and 36 females. There was a mean weekly smartphone usage of 36.45 ± 9.50 hours among the participants. The mean NDI score was 4.82 ± 3.76 , depicting mild disability among participants. A moderately positive correlation was identified between the weekly smartphone usage and NDI score and was statistically significant ($\rho = 0.309$, $p = 0.029$). The mean CV angle was 46.62 ± 4.71 degrees. The CV angle had a strong correlation of -0.811 ($p < 0.001$) with the weekly smartphone usage, denoting an increased forward neck posture with increased smartphone usage.

Conclusion: The study identified a mild disability in neck functions and an increased forward head posture in individuals who having increased weekly usage of smartphone. The results of the study call for actions in these patient population in order to prevent further worsening of situations by increasing awareness regarding the same.

Keywords: Smartphone; Forward Head Posture; Cranio-Vertebral Angle; Neck Disability Index

Introduction

The number of smartphone users has steadily increased over the last several years all across the world [1]. The COVID-19 pandemic has also influenced the increase in smartphone usage due to the implementation of social isolation and online education platforms [2]. Worries concerning musculoskeletal disorders related with prolonged smartphone use have also grown along with it. According to recent research, smartphone users report

pain in the neck, shoulder, and thumb, with the intensity of the symptoms increasing with an increased amount of time spent on smartphone [3]. Long-term use of a smartphone tends to cause forward neck position, slouched posture, and rounded shoulders [4]. Long-term forward neck posture can harm the cervical spine as well as the structures over the lumbar spine, mainly the spinal ligaments [5,6].

The excessive use of smartphone itself has found to cause detrimental effects in humans. The meta-analysis by Sohn, *et al.* reported poor mental health in children and young people, with an increased odds of depression, anxiety, perceived stress, and poor sleep quality [7]. Excessive smartphone can also cause poor concentration, increased distractibility, loneliness, and reduced social interaction in school-going children, influencing their personality and mood [8]. The incidence of mental illness induced by excessive smartphone usage was highly evident during the COVID-19 pandemic period among college-going students [9,10]. Smartphone usage was increased during the pandemic as a coping strategy to tackle social isolation measures but has led to a greater problematic smartphone use [11]. Measures have been implemented by various organizations in order to improve the mental wellbeing of the public through a digital detoxification and increased awareness regarding the situation [12,13].

To read the screen, most smartphone tasks require users to look down or hold their arms out in front of them, which causes the head to move forward and causes an excessive anterior curve in the lower cervical vertebrae and an excessive posterior curve in the upper thoracic vertebrae to maintain balance, putting strain on the cervical spine and neck muscles [3]. One of the common altered posture in the sagittal plane is forward head posture. This posture has been linked to the origin of neck and back pain disorders, as well as a subsequent loss of cervical spine extension [14]. A dynamic combination of daily life circumstances such as computer use can also lead to forward head posture [15]. Furthermore, because smartphone users in their teens and twenties use their phones more frequently than the elderly, they are more susceptible to severe musculoskeletal disorders, which can cause fatigue and pain in the upper extremities. The constant static position during the use of smartphone restricts blood circulation, reduces nutrients from reaching muscles, and creates minor weariness and soreness [4]. Fatigue arising out of bad postures can have consequences such as decreased physiological function, disturbance of the autonomic nervous system, effects on both the visual and musculoskeletal systems resulting in headaches and stress [16].

The existing literature available on the above-mentioned musculoskeletal problems in college-going students focused on the increased computer usage. Because smartphones are compact, portable, and accessible, many students now use them for longer amounts of time and more frequently than computers. However, a

paucity of evidence exist on the association between smartphone use and their impact on posture and function of the neck in college-going students. The current study intended to explore this relationship in order to identify the impact of smartphone use on neck posture and function in this population.

Materials and Methods

A cross-sectional study design was implemented for the research. Fifty college-going students between the ages of 21 to 25 years were recruited after procuring a signed informed consent form from them. The exclusion criteria included those with moderate to severe musculoskeletal or neurologic illness and undergoing treatment for the same. Those who were not willing to participate in the study were also excluded.

The weekly usage of smartphone was recorded in hours, using an android app (ActionDash: Screen Time Helper) which can track the usage time. The neck posture of the participants was assessed using photogrammetry method as explained in another study [17]. For this, a photo of the lateral view of the neck of the subject was obtained in standing after exposing and marking the C7 spinous process. The photo is then uploaded to offline ImageJ software [18]. The software allows to measure the Cranio-Vertebral (CV) angle formed between two lines, the line joining the tragus of the ear and the C7 spinous process to the horizontal line passing through the C7 spinous process. The functional disability of the participants with respect to the prolonged head posture were assessed using Neck Disability Index (NDI). It allows assessment of self-rated disability of participants and is found to be highly reliable and valid [19]. The total score of the NDI is 50, with higher scores representing severe disability. The Minimum Detectable Change of NDI is reported to be 5/50 in uncomplicated cases [20]. The collected data was analyzed using Pearson correlation analysis to identify the relationship between the outcome measures. The statistical analysis was done using Statistical Package for Social Sciences [SPSS] for Windows version 22.0 released 2013 Armonk, NY: IBM Corporation.

Results and Discussion

Among the fifty college-going students recruited to the study, 14 were males and 36 were females. The mean age of the study population was 23.3 ± 1.5 years. The mean weekly usage of smartphone was found to be 36.45 ± 9.50 hours among the participants. The mean CV angle was found to be 46.62 ± 4.71 degrees, and the mean NDI score was found to be 4.82 ± 3.76 .

The Pearson correlation analysis found a small to moderate statistically significant positive correlation ($\rho = 0.309$, $p = 0.029$) between weekly smartphone usage and NDI scores among the study participants. But the analysis between smartphone usage and CV angle found to have a significantly strong negative correlation ($\rho = -0.811$, $p < 0.001$).

According to the study by Macdermid, *et al.* a score of zero to four in NDI represents no disability and a score between four and fourteen represents mild disability [20]. We found a mild neck disability in the study population using NDI and found to have a moderate positive correlation with the weekly smartphone usage. This shows that with an increase in the duration of smartphone usage in college-going students, a mild neck disability as reported by NDI is observed.

The study by Fard, *et al.* reported normal mean CV angle in standing to be 52.7 ± 2.8 , and those with forward head posture had a mean CV angle of 43.4 ± 3.9 degrees [21]. They suggested assessment of CV angle to be done in standing rather than in sitting. Our study found a mean CV angle of 46.62 ± 4.71 degrees in the study population which was close to the range of a forward head posture. It was interesting to find that the negative relationship between CV angle and smartphone usage was significantly strong. Thus an increase in the duration of smartphone usage may tend to cause a decrease in the CV angle, suggesting a forward head posture in the individuals.

Our results were similar to the findings by Lee, *et al.* as they found only a small correlation between NDI and smartphone usage in their population ($n = 78$, $\rho = 0.24$, $p < 0.05$) [22]. The study by Alfaitouri, *et al.* reported an increase in neck flexion angle with the duration of smartphone usage, when the assessment was done over time at zero, five, ten, fifteen, and twenty minutes [23]. They concluded that smartphone use for a shorter duration of less than 20 minutes have an impact on neck flexion angle, with males demonstrating more change in posture than females. Evidence has reported increased activation of cervical erector spinae muscles in females with a static neck flexion for about 10 minutes, which is compensatory for the loss of passive viscoelastic stiffness of tissues leading to instability in continuous flexion [24]. The early activation of erector spinae provide stability of the cervical spine in the females, making males more prone for postural changes with prolonged flexed postures. Prolonged use of smartphone has also

found to influence the endurance of the neck muscles, leading to fatigue [25,26]. This in fact may be the influential factors leading to a poor neck function and posture in those who use smartphones for a prolonged period of time. There is a small to medium association between the stress and anxiety levels of individuals and the duration of smartphone use [27,28]. The induced psychosomatic symptoms due to this excessive usage may also have a detrimental effect on pain and function of the neck [29]. Studies suggest a 59% increase in the incidence of neck and shoulder pain in a span of 7 years with associated psychosomatic disorders [30]. Specific interventions at appropriate time are essential in order to prevent further worsening of the condition with poor postural adaptations. The meta-analysis by Sheikhhoseini, *et al.* identified a level 1a evidence for therapeutic exercises in improving craniovertebral angle, including strengthening, stretching, and corrective exercises [31]. Deep cervical flexor muscle training is reported to be effective in cervical postural correction along with other therapeutic exercises regimes [32,33].

The study pose various limitations. We could analyze the effect of smartphone usage on a small sample size limiting generalization of results. Further studies with larger population are required for better understanding of the situation. A follow-up evaluation of the study population may help in evaluating the chronicity of the situation and the need for planning strategies at an earlier stage in order to prevent worsening of the condition. This study could find significant effects of smartphone usage on neck posture and function in college-going students, the effects could be much more detrimental in older adults, warranting studies focusing on older adults.

Conclusion

The study identified a mild disability in neck functions and an increased forward head posture in college-going students who having increased weekly usage of smartphones. The results of the study call for actions in these population in order to prevent further worsening of situations by increasing awareness regarding the same.

Conflict of Interest

The authors declare no conflict of interest. There is no financial support/grant received for this study that could have influenced its outcome.

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