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The prevalence of cervical extension deficit among young adults: a cross-sectional observational study

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Abstract
Background: Prolong use of Smartphone leads to faulty posture causing soft-tissues adaptation and cervical vertebra joint dysfunction. Thus the structural change can results in reduction of the cervical range of motion.
Objective: The objective of the current study is to find out whether there is a cervical extension deficit and its prevalence among the current young adults.
Methodology: It is a cross-sectional study design. 436 subjects of both genders between age group 18-30 years were included. Cervical extension range of motion and numbers of years of smartphone usage and neck pain were assessed and correlated.
Results: Results showed that 167 of subjects had less than 60^0 extension in which 90 subjects showed 55^0-59^0 extension deficits, 60 subjects showed 50^0-54^0 extension deficits. Finally 14 subjects had less than 50^0 cervical extension deficits.
Conclusion: The results concluded that there is a moderate positive correlated between the numbers of years of Smartphone usage and cervical extension deficit with history of neck pain.

Keywords: Smartphone, cervical extension deficit, neck pain.

Introduction
The advancements in the field of technology have judicially made work easier, so as the advancements of Smart phones has made communication easier. But in return the younger generation has very severely addicted to the use of Smartphone. Many studies reported the increase in usage of computers, laptops and cell phones in young population [1, 2, 3, 4]. Computer use is very common among undergraduate students and some epidemiological studies have been published with regard to its relation to onset of neck pain. Undergraduate students involved in prolonged computer work and with high numbers of years of computer use more frequently reported upper extremity symptoms [5, 6, 7, 8]. However, little is known about relations between computer use-related factors and onset and persistence of neck pain among undergraduate students. According to the World Health Organization 50% of adults experience neck pain during their lifetime [9, 10]. Neck pain is a common condition which most people experience at some point in their lives, with self-reported incidence rates ranging from 15.5 to 213 per 1000 person years and 12-month prevalence rates around 30-50% [11, 12, 13]. Currently the smart phones usage is more to an extent that it has to be considered as a separate entity. A survey conducted by Global Digital Communication in 21 countries around the world, revealed that people aged 18-29 are more likely to use their mobile phones than those of 50 or older to access the internet on their mobile phone [1]. Theyspent many hours on texts messaging, social networking (facebook, twitter), chat applications (whatsapp, viber), playing video games, etc. as compared to voice calling [1, 2]. According to Jung-eon Mok (2014) *et al*; at the college level males have a higher addiction level to internet usage, however in terms of Smartphone users female addiction level was found to be higher [3, 4]. For all above mentioned smart phone usage activities, they have to forwardly lean their head for prolonged periods of time which can lead to a non-neutral neck position causing forward head position increasing cervical compression and stress [14, 15]. According to the analysis done by Dr. Kenneth Hansraj, stress on cervical spine increases up to 60 lbs during forward flexion than 10-12 lbs during upright position as far as the muscles in upper back and neck are concerned, because they have

to work that much harder to keep the head from dropping onto chest [16]. Cervical muscles activity is likely to vary according to the load demands induced by the position of the head and neck [17, 18]. Prolonged flexion at the cervical spine leads to consequent higher activity of cervical erector spinae and upper trapezius muscles, with a posture in which the trunk is slightly inclined backward [19]. This forwarded head posture reduces the average length of muscle fibers and increases stress on the ligaments, which contributes to extensor torque at the atlanto-occipital joint and it is possible that this shortening reduces the tension – generating capabilities of muscles [20, 21]. A study shows that a decreased cervical range of motion is associated with poor sitting postures, such as forwarded head posture (FHP) [22, 23]. Range of motion losses can occur from inactivity and structural changes of the tissues in the cervical spine and result in an increase in connective-tissue density, shortening of collagen tissues and muscle fibrosis [24, 25]. Thus it could indeed cause loss of joint play, tightness of neck muscles that would result in muscle imbalance and that in turn would aggravate the joint dysfunction [26, 27]. Studies on the effect of sustained force have indicated that a single posture should not be sustained for longer than one hour [28, 29]. Mc Grill and Brown have shown that twenty minutes in a position of sustained loading can induce creep in soft tissues, with recovery taking longer than forty minutes [30]. Sustained force produces time-dependent deformation and adaptations in soft-tissues. Short-duration stretching produces temporary deformation of soft tissues but one hour of stretching might be sufficient for long-term soft-term adaptationsx [31]. Therefore, a long-term habitual posture can result in abnormal loading of ligaments and muscles that might ultimately contribute to a reduction in the cervical range of motion and to the development of neck pain [32, 33, 34].

Methodology
A cross-sectional study to investigation the prevalence of cervical extensionrange deficit among young adults. 436 subjects were recruited according to the selection criteria from The Oxford Educational Institutions, Bangalore.
Selection Criteria:

Inclusion criteria
1. Young adults- 18 years to 30 years
2. Both genders
3. Subjects using Smartphone for more than 1 year.

Exclusion criteria
1. Whiplash injury
2. Disc pathology
3. Recent neck sprain and strain
4. Previous cervical surgery
5. Neurological disorder
6. Chronic diseases of the musculoskeletal system
7. Congenital neck condition

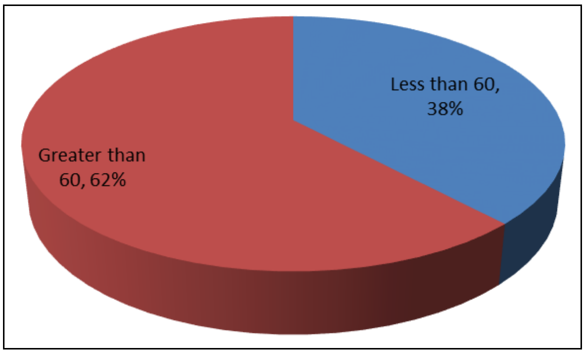
Procedure
Subjects were provided with a description of the studyandhistory of recent neck injuries, surgeries and congenital anomalies were excluded from the study. After getting consents, subjects willing to participate in the study were asked to fill the questionnaire titled as Questionnaire for Smartphone users. The questionnaire categorized the subjects and their Smartphone use. The subjects were made to sit on a chair with their back straight and hands rested on thighs. Knees were flexed to 90 degrees and ankles remained on the ground in a neutral position. The subjects were briefed about the procedure on how to move their head and neck. The range of motion was measured for cervical flexion and extension. Digital inclinometer was used to measure the range of motion of the above given movements. Three trails of each movement were taken and the researcher was assisted by an assistant who recorded the two movements of cervical range of motion. The measurements were taken in the following sequence: For cervical flexion the subjects were asked to touch their chest with their chin and measurement was taken. Command was "please try to touch your chest with your chin." For cervical extension the subjects were asked to look at the ceiling as much as possible and measurement was taken. Command was "please try to look at the ceiling as much as possible."

Results
Descriptive statistics and correlation was used to compare between various cervical extension deficits ranges. Results showed that predominant number of subjects had less than 60^0 extension deficit (167 subjects) following which 90 subjects showed 55^0-59^0 extension deficit, 60 subjects showed 50^0-54^0 extension deficit. Finally, 14 subjects had less than 50^0 cervical extension deficits. Coming to pain conversely subjects having less than 50^0 of cervical extension were more in number compared to the other sub-groups.

Table 1: Percentage of subjects having cervical extension deficit

S. No.	Extension ROM	No. of subjects	Percentage of Subjects
1	Less than 60^0	167	38%
2	Greater than 60^0	269	62%

Table 1 reveals 38% of total subjects (167) had less than 60^0 of cervical extension deficit, 21% (93) had deficit between 55^0-55^0, while 13% (60) had deficit between 50^0-54^0 and 3.2% (14) had less than 50^0 of cervical extension. 62% (269) shows no deficit.



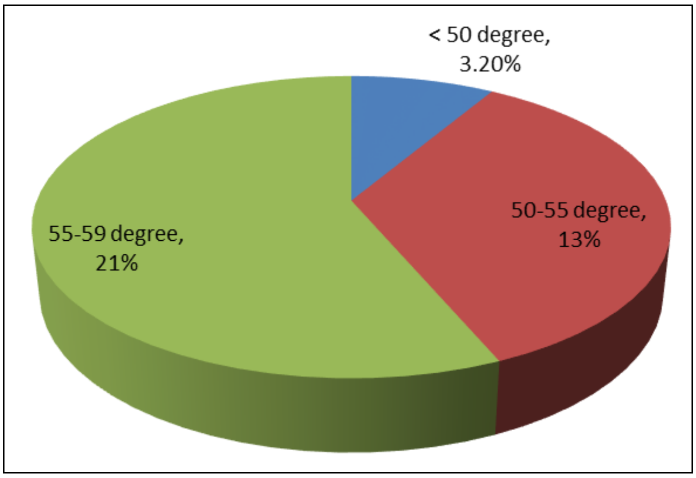
Graph 1: Percentage of subjects having cervical extension deficit

Graph 1 reveals 38% of total subjects (167) had less than 60^0 of cervical extension deficit and 62% (269) had no cervical extension deficit.

Table 2: Percentage of subjects having cervical extension deficit less than 60^0

S. No	Degree of Extension less than 60^0	Percentage
1	Less than 50^0	3.20%
2	50^0-55^0	13%
3	55^0-55^0	21%

Table 2 reveals percentage of subjects having cervical extension deficit less than 60^0



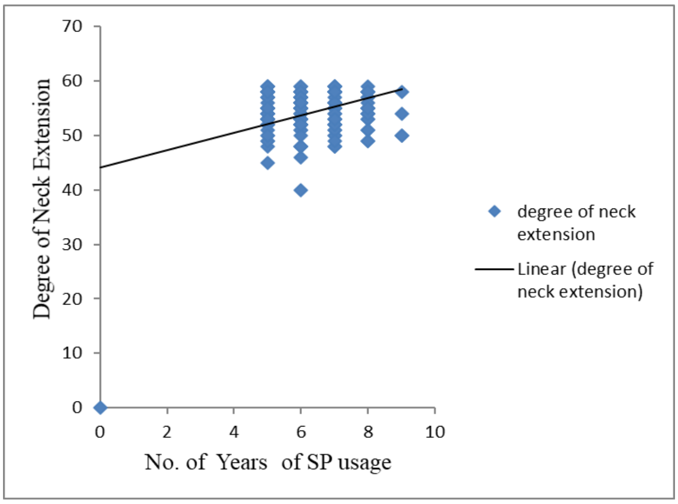
Graph 2: Percentage of subjects having cervical extension deficit below 60^0

Graph 2 reveals percentage of subjects having cervical extension deficit below 60^0.

Table 3: Mean and SD of degree of neck extension and number of years of smart phone usage

S. No	Degree		Mean	Standard deviation
1	Less than 60	Degree of extension	57.54	3.34
		No. of years of SP usage	6.32	1.05
2	55^0 - 59^0	Degree of extension	56.91	8.15
		No. of years of SP usage	6.11	0.91
3	50^0 - 54^0	Degree of extension	52.41	1.27
		No. of years of SP usage	6.8	1.05
4	Less than 50^0	Degree of extension	47.4	2.44
		No. of years of SP usage	6.42	1.22

Table 3 shows the comparison of mean and standard deviation of degree of cervical extension with the number of years of Smartphone usage. Subjects with less than 60^0 of cervical extension were found to have 54.50 $\pm$ 3.34 as mean and standard deviation who were using Smartphone for 6.32 $\pm$ 1.05 years. Subjects in between cervical extension ROM between 55^0-59^0were found to have mean and standard deviation of 56.91 $\pm$ 1.33 with Smartphone usage of 6.11 $\pm$ 0.91 as mean and standard deviation. While subjects having cervical extension between 50^0-54^0 had 52.41 $\pm$ 1.27 as mean and standard deviation and 6.8 $\pm$ 1.05 as mean and standard deviation of the numbers of Smartphone usage. And the subjects having cervical extension less than 50^0 were found to have 47.42 $\pm$ 2.44 as mean and standard deviation who were using Smartphone for 6.42 $\pm$ 1.22 years.

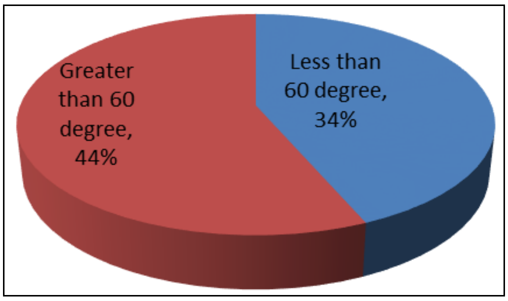


Graph 4: Correlation between number of years of smart phone usage and neck extension deficit (<60˚)

Table 5: Percentage of subjects with history of neck pain and cervical extension deficit

Sr. No.	Extension ROM	Percentage
1	Less than 60^0	34%
2	Greater than 60^0	44%

Table 5 shows that subjects having cervical extension deficit with history of neck pain. Subjects having cervical extension less than 60^0 show 34% of neck pain.



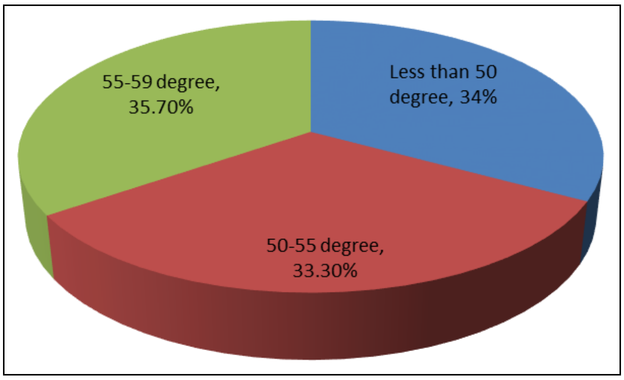
Graph 5: Percentage of subjects with history of neck pain and cervical extension deficit

Graph 5 reveals percentage of subjects with history of neck pain and cervical extension deficit

Table 6: Percentage of subjects having history of neck pain and cervical extension less than 60^0

S. No	Degree of cervical extension less than 60^0	Percentage
1	Less than 50^0	35.70%
2	50^0 - 54^0	33.30%
3	55^0 - 59^0	34.40%

Table 6 reveals the percentage of subjects having history of neck pain and cervical extension less than 60^0



Graph 6: Percentage of subjects having history of neck pain and cervical extension less than 60^0

Graph 6 reveals percentage of subjects having history of neck pain and cervical extension less than 60^0

Discussion

The aim of our study was to find the prevalence of cervical extension deficit among the smartphone users and to establish a correlation between the cervical extension deficit and the numbers of years of smartphone usage. The result shows that 38% of the subjects have cervical extension less than $60^{0.}$ These subjects have been categorized in 3 sub-groups as mild cervical extension deficit between 55^0 – 59^0, moderate cervical extension deficit ranging between 50^0-54^0, and severe deficit, less than 50^0 of cervical extension. 21% of subjects have mild cervical extension deficit, 13% have moderate and 3.2% have severe cervical extension deficit. The normal alignment of the cervical spine is the lordosis or concavity posterior. Any change in this alignment could alter the biomechanics of the entire spine. There can be a direct stress on the muscles, ligament, intravertebral disc, nerves, spinal cord and other structures causing further damages. Increase in cervical flexion or forward shift of the head leads to straightening of the spine as the body moves to counterbalance. Muscles of the upper back and neck begin to contract while holding the head in that position. This results in compression to the front of the vertebrae compressing the disc which starts a degenerative change to the disc and vertebrae. This also ultimately stresses the nervous system. Since holding a faulty posture i.e., forward head posture could lead to structural adaptation toward restricted cervical range of motion leading to extension deficit. The results of our study shows the there is no significant correlation between the numbers of years of smartphone usage with the cervical extension deficit, as statistically the p value is greater than 0.05. This was a contradictory to a study done by Yoon-jie So et, al. on young adults [15]. The study found that there is a significant correlation between the smartphone usage and cervical extension range of motion. The cervical range of motions was measures before and after 20-minutes of smartphone usage session. But in our study, there was no smartphone usage session before measuring the cervical range of motion. Another study conducted on the desktop and laptop users shows a significant restricted range of cervical extension due to prolong usage of desktops and laptops for prolonged period of time [17]. Our study also reveals that there is 34% of subjects having cervical extension deficit had a history of neck pain. Among them, subjects having extension less than 50 have the highest percentage of neck pain. Whereas 44% of the subjects had a history of neck pain having normal cervical extension ranges greater than 60^0. The result is similar with the above-mentioned study that continuous gazing on smartphone for long period of time could lead to further neck pain in smartphone users having pre-existing neck pain. But in our non-restriction group the prevalence percentage is 44% which is more than the restriction group. So, we believe that the neck pain is not associated with extension range restriction. But it is to do with the mobile usage. We believe the reason is as there is increase in muscle fatigue, thus damaging the muscles fibers in the long run. We considered in our study that it is possible that the constant use of smartphone in sustained flexed posture causes shortening of muscles. In sustained posture, individual not moving through a complete range of motion on a daily basis might cause adaptive changes in muscle length. The result of the study concluded that here is alarming prevalence percentage of subjects with cervical extension deficit.

Conclusion

The study was intended to check the prevalence of cervical extension deficit among the young adults due to overuse of Smartphone. The results shows 38% of subjects have cervical extension deficit less than 60^0, 21% subjects had deficit of 55^0 – 59^0, 13% showed deficit between 50^0 – 54^0 and finally 3.2% subjects had less than 50^0 extension deficit. Neck pain was shown in 34% of subjects who have extension deficit in contrast to 44% of subjects who have no cervical extension deficit.

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