Innovations

Assessment of Neck Muscle Endurance in Normal Healthy Individuals Using Electronic Devices: A Pilot Study

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Abstract:

Background: *For both industrialized and developing nations in the 21st Century, there is an increasing number of individuals are getting connected with electronic gadgets, including smart phones, tablets, laptops, and desktops, which are becoming more and more necessary for both daily life at home and at work. The manner in which that adults use their electronic devices varies. Increased internet accessibility and ownership have led to an increase in the amount of time that users of electronic devices spend using these devices. An increase in usage time of electronic devices is associated with an increased risk of developing musculoskeletal pain because there is a prolonged bending of the neck. Poor posture causes non-specific neck pain because it puts abnormal physiological loads on the neck over an extended period of time and reduces neck muscle strength as a result. 45 normal healthy adult students with age group between 18 to 30 years, from College of Physiotherapy, Sumandeep Vidyapeeth meeting the inclusion criteria, were included in this pilot study. Clinical tests were used to measure the neck flexor endurance, and neck extensor endurance to assess the neck flexor and neck extensor muscle endurance. Independent t test was done to compare the two group of neck pain and no neck pain individuals to know the effect of neck muscles endurance on neck pain. Results showed that smartphone was found to be the mostly used electronic device in the sitting position. 1/3 rd of the participants experienced neck pain with the use of the electronic device with 13.3% having regular experience of neck pain. On comparing the values of Neck Extensor endurance in subjects with and without neck pain and also for the values of Neck Flexor endurance, no significant difference was found (p values being 0.275 and 0.174 respectively). The pilot study results also showed that there were no significant result differences found for both groups.* ***Conclusion:*** *The findings of this pilot study demonstrated that normal individuals using electronic devices and suffering from neck pain did not have statistically significant lower neck flexor and extensor muscle endurance when compared to those without neck pain.*

Keywords: *Electronic device users, Forward head posture, neck pain, Neck flexor endurance test, Neck extensor endurance test*

Introduction

In 21st Century, in both industrialized and developing nations, an increasing number of individuals are getting connected with electronic gadgets, including phones, tablets, laptops, and desktops, which are becoming more and more necessary for both daily life at home and at work [1,2,3]. The usage of these gadgets has improved daily living and commerce in all societies. These devices are quickly rising to the top of the list of essential tools for reading and accessing any type of pertinent information [2]. The manner in which that adults use their electronic devices varies; younger adults (ages 18 to 29) are more likely to use a laptop than a tablet or desktop, while elderly persons (ages 50 to 64) are more likely to use a desktop. Increased internet

accessibility and ownership have led to an increase in the amount of time that users of electronic devices spend using these devices [1].

This extended use of electronic devices causes a prolonged bending of the neck, which leads to muscle weakness, forward head posture, adjustments in proprioception and text neck syndrome commonly affecting younger generation [3,4,5]. It happens when the flexed neck is subjected to excessive and repetitive tension. Soreness in the neck and shoulders are caused by it. If left untreated, this illness can lead to musculoskeletal problems like early onset arthritis, and overuse syndrome [3,4,6,7].

Laptops are more convenient to carry around because of light weight On Comparing desktop users, laptop users report experiencing pain in multiple body parts more frequently especially neck. Laptop users often adopt awkward postures when using them because of the device's inherent portability. Aches and pains experienced by laptop users are frequently caused by poor posture and repetitive motion [8]. An increase in usage time of electronic devices is associated with an increased risk of developing musculoskeletal pain [9].

In the list of Global Burden of Disease 2010 study, neck pain associated with sedentary work, an increase in activities such as the use of personal computers and the Internet, the use of motor vehicles, and changes in work type, ranks as the fourth largest contributor to global disability, having a significant impact on global health [10,11]. The overall one-year prevalence of neck pain is estimated to be as high as 87%, with a global point prevalence of 4.9% among the general population reporting neck pain [10,12]. Poor posture causes non-specific neck pain because it puts abnormal physiological loads on the neck over an extended period of time and reduces neck muscle strength as a result [7,13]. Neck Pain patients have deficits in their maximum strength, their ability to accurately position their heads during dynamic movements and repositioning, their contraction efficiency, and their muscle endurance [11]. Neck pain can lead to a reduction in working hours, a decrease in participation in recreational activities, and disruptions in sleep. It's noteworthy that a major factor in workforce attrition is neck pain [12].

Clinical tests were used to measure the forward head posture, neck flexor endurance, and neck extensor endurance of adolescents with neck pain and age-matched asymptomatic adolescents. Compared to adolescents without symptoms, those with neck pain exhibited notably lower forward head posture and lower neck flexor and extensor endurance [14]. When the head and cervical spine move, the deep neck flexor (DNF) muscles support the cervical spine. One crucial element of cervical spine function is deep neck flexor endurance (DNFE) [4,7]. Deep cervical flexor muscle endurance must be tested with ease and precision in order to confirm that the cervical spine is operating normally [7].

The osseoligamentous system provides the remaining 20% of the mechanical stability of the cervical spine, with the neck musculature accounting for the remaining 80%. Research has indicated that patients experiencing neck pain have diminished deep and superficial cervical flexor and extensor muscle strength and endurance [15]. Subjects with either resolved or ongoing neck pain showed a notable reduction in strength in the deep neck flexor muscles when compared to those without neck pain [16].

There is currently insufficient evidence to definitively establish a correlation between neck pain, neck posture, and neck muscle endurance. Grimmer did not discover a connection between complaints of neck pain and extreme cervical postures [13]. It has been suggested that neck muscle weakness plays a role in persistent neck pain. The hypothesised causal relationship between neck pain and neck muscle strength, however, is supported by inconsistent data [13]. Thus the need of this pilot study was to check the strength of the cervical musculature in normal healthy individuals using electronic devices.

Aim and Objectives

Aim:

The aim of this pilot study is to assess the neck muscle endurance in young healthy individuals using electronic devices.

Objectives:

- To Measure the neck flexors muscle endurance using neck flexors muscle endurance test.
- To Measure the neck extensors endurance through neck extensors endurance test.
- To Measure the neck pain if any in young healthy individual using electronic devices through VAS scale
- To see the effect of neck flexors & extensors muscle endurance on neck pain.

Alternate Hypothesis: Neck muscle endurance is affected in young healthy individuals using electronic devices.
Null Hypothesis: Neck muscle endurance is not affected in young healthy individual using electronic devices.

Methodology

Research design: Observational study
Population: Normal healthy adult's students age between 18 to 30 years.
Source of data: Participants taken from College of Physiotherapy, Sumandeep Vidyapeeth.
Sampling: Participants were selected from the population using convenient sampling.
Sample size: 45

Inclusion Criteria:

1. 18-30 years of age
2. Both genders
3. Those who use electronic devices

Exclusion Criteria:

1. Neck trauma or surgery or neck related musculoskeletal disorders.
2. Subjects who experience migraines, vertigo.
3. Subjects who having symptoms of covid -19, subjects who diagnosed as Covid-19 positive and subjects who had recovered from covid-19.
4. History of central or peripheral nervous system disorder.

Procedure:

After taking the Ethical approval was taken from Sumandeep Vidyapeeth Institutional Ethical Committee (SVIEC), data collection was started. Participants were recruited from College of Physiotherapy, Sumandeep Vidyapeeth on the basis of convenient sampling. The subject willing to participate in the study was requested for written informed consent form. Participant's information sheets were given to the participants. And then participants were screened as per assessment format; all those meeting in the inclusion criteria were explained in detail about the study procedure and protocol in their own language. Then the participants were assessed for their neck muscle endurance. Trial and explanation was given to all the participants to make them aware how the test will be performed. Neck flexors and extensors endurance test was done as described below procedure. The data thus obtained for neck muscles endurance was recorded.

1. Neck Flexors Endurance Test [16]: The participant was in supine lying position. (See fig. 1) The cervical spine should be in a neutral position. The pressure biofeedback device was inflated to a baseline of 20 mmHg and positioned between the plinth and the posterior part of the neck behind the occiput. Participant was reminded to relax the neck musculature and to concentrate on performing a gentle, nodding head movement. Participant was instructed to perform the cervical flexion movement at 5 different pressure levels (22, 24, 26, 28, and 30 mmHg) and to hold each level for 10 seconds. A 30-second rest period was provided between each level. The testing procedure was end when the participant was not be able to hold a specific pressure level for 10 seconds or if the maximum level of 30 mmHg was achieved. The highest level of pressure achieved by the participant was recorded.

Figure 1 shows neck flexors endurance test procedure

2. Neck Extensors Muscles Endurance Test [14]: The participant was in prone lying position with the head and neck over the edge of the bed. Participant was stabilized with the help of a stabilization belt at the level of T2. (See fig. 2) Participant was reminded to relax the neck musculature and was asked to perform chin tuck in than ask to performed neck extension and hold that position as long as they could. The time was recorded with the help of a stopwatch and the maximum time the participant is able to hold the position was recorded.

When to terminate the test –

1) When participant does not want to continue the test

2) When participant experiences neck pain and/or gets fatigue. The validity and reliability was 'very good' (k=0.800, SE of kappa = 0.109, 95% CI).

Figure 2 shows neck extensors endurance test procedure

Statistical Analysis

The data collected was entered in Microsoft excel sheet and descriptive statistic like mean, standard deviation after ensuring the normal distribution and analysis was done by using SPSS version 16 software with the help of a Biostatistician. Independent t test was done to compare the two group of neck pain and no neck pain individuals to know the effect of neck muscles endurance on neck pain.

Results:
Table 1 shows the demographic details and baseline assessment of the 45 normal healthy individuals enrolled in the study.
Table 2 shows the details of all the questionnaires assessed of all the participants as per the self developed questionnaire
Table 3 shows that there were no significant differences in results on comparing the strength of the neck flexors and neck extensors muscle strength in individuals with no neck pain to that who had neck pain.

Table 1 demographic data and assessment outcome
(Demographic data in which age, BMI, male and female, occupation)

	Total (n=45)
Age	23.20±1.254
Gender : male Female	25 20
Height (cm)	159.44±6.577
Weight (kg)	56.56 ± 8.250
BMI	22.17 ± 2.53
Occupation: Student Of Physiotherapy	45
NEE(sec)	173.33 ± 87.676
NFE(mm/hg)	28.27 ± 1.388
Duration (hours)	5.86 ±1.401

Discussion

In this pilot study, simple clinical tests which can be used in a clinical set up for neck flexors endurance (NFE) testing with the use of pressure biofeedback unit and neck extensors muscle endurance (NEE) test with a modification were used. Total of 45 physiotherapy student participants (25 males and 20 females) with mean duration of 5.86 ±1.401 hours of electronic devices were included. The mean height and weight of the participants were 159.44±6.577 cm and 56.56 ± 8.250 kg with a mean BMI of 22.17 ± 2.53. The mean NEE test measured the value of 173.33 ± 87.676 sec whereas the NFE measured to be 28.27 ± 1.388 mm/Hg.

Ana Carolina Oliveira et al. conducted another investigation which showed the assessment of neck muscles endurance using various methods of assessment, such as using functional magnetic resonance imaging had suggested some differences in the differential activation of the muscles, when comparing neck extensor muscles in neck pain sufferers to normal individuals, the results were found to be significant [7].

Table: 2 show the screening of subjects by screening questionnaire in frequency and percentage.

Screening questions	Frequency (total : n=45)	Percentage
Type of electronic device used **Smart phone** **Laptop**	45	100.0
Most preferred position **Sitting**	45	100
Experienced of neck pain while use of electronic device **Yes** **No**	 15 30	 33.4 66.7
Suffering from neck pain **Regularly** **Sometimes** **Never**	 6 16 23	 13.3 35.6 51.1
Affects sleeping pattern **No**	45	100
Comes under exclusion criteria **No**	45	100
Performed any warm up exercise **Yes** **No**	 5 40	 11.1 88.9
Pain affects ADLs **YES** **NO**	 4 41	 8.9 91.1
Exercise in daily routine **YES** **NO**	 11 34	 24.4 75.6

Table 3: shows comparison of neck musculature strength for subjects having no neck pain to those having neck pain.

	Experience of neck pain while using electronic device	**N**	**Mean**	**Std. Deviation**	**t-value**	**p-value**
Neck extensors endurance (sec)	Yes	15	152.93	93.02	-1.106	0.275
	No	30	183.53	84.629		
Neck flexors endurance (mm/Hg)	Yes	15	28.67	1.447	-1.381	0.174
	No	30	28.07	1.337		

Smartphone was found to be the mostly used electronic device in the sitting position. 1/3 rd of the participants experienced neck pain with the use of the electronic device with 13.3% having regular experience of neck pain. There was no affection with the sleep pattern, on the contrary, 8.9% of the subjects found to

have impaired activities of daily living (ADL's). Fewer participants had the habit of doing warm up (only 11.1% participants) during the use of the electronic device usage. On comparing the values of Neck Extensor endurance in subjects with and without neck pain and also for the values of Neck Flexor endurance, no significant difference was found (p values being 0.275 and 0.174 respectively).

These findings contradicted the findings in the study done by Ana Carolina Oliveira et al., it was shown that the multifidus /semispinalis cervicis activity was significantly reduced by inducing pain with the use of intramuscular injection in the upper trapezius muscles. A correlation between neck muscle endurance and age group was also pointed out by the author. They showed that there had been an altered neck extensors' EMG pattern during voluntary neck flexion and extension movement on comparing asymptomatic subjects with neck pain subjects with age 22 to 28 years [7].

The neck flexor and extensor endurance tests and forward head posture demonstrated moderate to nearly perfect intra-rater reliability, according to the results. Compared to adolescents without symptoms, those with neck pain exhibited notably lower forward head posture and lower neck flexor and extensor endurance [14]. The probable reason could be when using a electronic devices like smart phones, users typically keep their heads flexed between 33 and 45 degrees from vertical. Flexing the head forward to varying degrees puts a significant amount of weight on the spine; an adult head weighs 10 to 12 pounds in its neutral position. The force on the neck increase to 27, 40, 49 and 60 pounds at 15 degrees, 30 degrees, 45 degrees, and at 60 degrees respectively as the head tilts forward, changing the cervical spine posture and proprioception [5].

The study being a pilot study, lesser number of samples with convenient sampling method were included, was a major limitation of the study. Therefore studies with larger number of samples using random sampling method needs to be done in future which would give a better idea on the effects of pain on neck muscle endurance with the use of electronic devices in normal healthy individuals.

Conclusion

The findings of this pilot study demonstrated that normal individuals using electronic devices and suffering from neck pain did not have statistically significant lower neck flexor and extensor muscle endurance when compared to those without neck pain. Further studies need to be done in the future to see the association between neck muscle endurance and neck pain with large sample size.

Conflicts of Interest

The authors hereby state that we have no potential conflicts of interest to declare.

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