Measuring Neck Flexor and Extensor Muscle Endurance in Individuals Using Electronic Devices: An Observational Study Protocol

Dr. Noel Samuel Macwan [1*], Dr. Dixita Tandel [2]

[1]Assistant Professor, College of Physiotherapy, Sumandeep Vidyapeeth, Piparia, Waghodia, Vadodara, Gujarat, India 391760
[2*] PG Alumni, College of Physiotherapy, Sumandeep Vidyapeeth, Piparia, Waghodia, Vadodara, Gujarat, India 391760
Corresponding Author **Dr. Noel Samuel Macwan**

Abstract:
Background: Electronic gadgets are becoming more and more necessary for both daily life at home and at work as their use offer quick, convenient access to many of the same learning-enhancing capabilities. The more frequent use of the electronic devices on an average of ten hours a week causes a lengthy period of neck flexion which leads to higher chances of experiencing musculoskeletal pain. When using laptops compared to computers, users often adopt awkward postures due to the device's inherent portability and small weight. Neck strain experienced by laptop users is frequently caused by bad posture and repetitive motion. When it comes to smart phone addiction, university students are said to have the highest rates among users of all age categories. The cervical muscles' motor output is compromised in patients with neck pain. Muscle strength, endurance, and force stability all get declined. Poor postures exert abnormal physiological strain on the neck, which weaken the muscles in the neck. As of right now, there isn't enough proof to say that neck pain, posture, and neck muscle endurance are related. The purpose of the study is to evaluate neck muscle endurance in normal healthy individuals using electronic devices. **Outcome Measures:** Neck flexor muscle endurance, Neck extensor muscle endurance **Statistical Analysis:** Independent t test will be done to compare the two groups with neck pain and with no neck pain individuals to know the effect of neck muscles endurance on neck pain. One way ANOVA will be used to compare more than 3 groups. **Conclusion:** This observation study will be useful to check association if any of neck muscle endurance on neck pain in individuals using electronic devices. **Clinical Trial Registration:** The study is registered with Clinical Trials Registry- India (CTRI), with the registration number for the trial being CTRI/2021/06/034444.
Keywords: Electronic devices user, Neck muscle endurance, Neck pain, Forward head posture, Neck flexor endurance test, Neck Extensor endurance test

Introduction:

Electronic gadgets, including laptops, tablets, smart phones, and desktops, are becoming more and more necessary for both daily life at home and at work [1]. Their use offers quick, convenient access to many of the same learning-enhancing capabilities as a computer with an internet connection. This not only guarantee that we stay in contact with our loved ones, but they also take care of a lot of our work-related problems and save us from having to bring along a ton of paperwork [2].

The more frequent use of the electronic devices on an average of ten hours a week for texting, banking, social networking, emailing and surfing, online shopping and making phone calls causes a lengthy period of neck flexion which leads to higher chances of experiencing musculoskeletal pain [1, 3, 4]. However, given the number of cases of work-related neck discomfort has increased in percentage with the annual increase in computer use, epidemiological research implies that neck pain may be associated to poor posture when using electronic devices [5, 6]. Laptops are lighter as they are easier to take around, yet users have been linked to a higher risk of neck issues [5]. Laptop owners report more neck pain than desktop owners. When using laptops compared to computers, users often adopt awkward postures due to the device's inherent portability and small weight [7].

These positions involve placing the laptop on the lap, utilizing workstations not intended for laptop use, and lying down on the floor. Neck strain experienced by laptop users is frequently caused by bad posture and repetitive motion [7]. Sleep disturbances, a reduction in leisure activities, and a reduction in working hours can all be caused by neck pain. Notably, neck pain has a significant role in employee churn [8]. Constantly checking and/or using smart phone apps for extended periods of time is linked to a decline in wellbeing, stress, anxiety, withdrawal, and sleep disturbances as well as a decrease in physical activity and academic performance [9]. When it comes to smart phone addiction, university students are said to have the highest rates among users of all age categories. As a result, it is anticipated that university students might experience balance issues also [10].

Neck pain ranks as the fourth most common cause of disability worldwide, significantly affecting health [11]. It has been demonstrated that patients with neck pain have a wide range of sensory and motor abnormalities, including dysfunction of the neck muscles, proprioceptive deficits, elevated forward head posture, postural control deficiencies, and more [12]. The cervical muscles' motor output is compromised in patients with neck pain. Cervical muscles behave differently, with diminished deep postural muscle activity, directional specificity, delayed initiation of muscular responses, muscle fatigability, and greater neck muscle co-contraction. Muscle strength, endurance, and force stability have all declined [13]. Nonspecific neck pain is brought on by poor posture and results from the prolonged, abnormal physiological pressures that these postures exert on the neck, which weaken the muscles in the neck. As of right now, there isn't enough proof to say that neck pain, posture, and neck muscle endurance are related [14].

On the contrary it had been shown that neck pain patients who sought therapy had weaker neck muscles compared to healthy controls. Many things, including, deficiency in muscle strength and endurance, can lead to neck pain [11]. The function of the cervical spine is directly impacted by the strength of the flexor and extensor muscles of the neck. Any decrease in the amount of cervical spine flexor endurance may lead to pain, higher injury risk, tissue stressors, and cervical dysfunction [11]. This could be due to a lack of oxygen and nutrients, the patho-physiological changes occurring in active muscles cause micro trauma, overuse injury, and discomfort. The endurance of the neck muscles is lowered as a result [15].

The neck flexor endurance and neck extensor endurance of adolescents with neck pain and age-matched asymptomatic adolescents were measured using clinical procedures. Adolescents with neck discomfort showed noticeably decreased neck flexor and extensor endurance when compared to those without symptoms [16]. The deep neck flexor (DNF) muscles support the cervical spine during movements of the head and cervical spine. Deep neck flexor endurance is a vital component of cervical spine function (DNFE) [17, 18]. To verify that the cervical spine is functioning appropriately, it is necessary to easily and precisely assess the deep cervical flexor muscle endurance [17]. Studies have revealed that individuals with neck discomfort exhibit reduced strength and endurance in their deep and superficial cervical flexor and extensor muscles [19]. The deep neck flexor muscle strength was significantly lower in subjects with either resolved or persistent neck pain than in subjects without neck discomfort [20].

There is scanty of literature which shows the impact of neck muscular endurance on normal individuals using electronic gadgets. Therefore the purpose of the study is to evaluate neck muscle endurance in normal healthy individuals using electronic devices.

Objectives of the study are to:

- To assess neck pain using the Visual Analog Scale
- To measure neck flexors and extensors muscle endurance using the neck flexors muscle endurance test and neck extensors endurance test respectively.
- To check the effect of if any neck flexors & extensors muscle endurance on neck pain.

Hypothesis:

The null hypothesis is that neck muscle endurance is not affected in young healthy individual using electronic devices.

Ethical Approval:

All the procedures that will be involved in this trial had been taken approval from the Sumandeep Vidyapeeth Institutional Ethics Committee. The approval received from the Sumandeep Vidyapeeth Institutional Ethics Committee had the outward number, SVIEC/ON/Phys/BNPG20/D21006 dated on 08/05/2021.

Clinical Trial Registration:

The study is registered with Clinical Trials Registry- India (CTRI), with the registration number for the trial being CTRI/2021/06/034444.

Sample size calculation:

Sample size calculation was done using the following formula,

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Where n= Sample size,

Z = Z statistic for a level of confidence,

P= Expected prevalence of proportion

(If the expected prevalence is 20%, then P=0.2), and

d = Precision (If the precision is 5%, then d = 0.05)

After using the above formula for sample size calculation, the final sample size came to be 264 subjects.

Method:

In this observational study, normal healthy students from Constituents College's of Sumandeep Vidyapeeth will be approached and explained about the study.

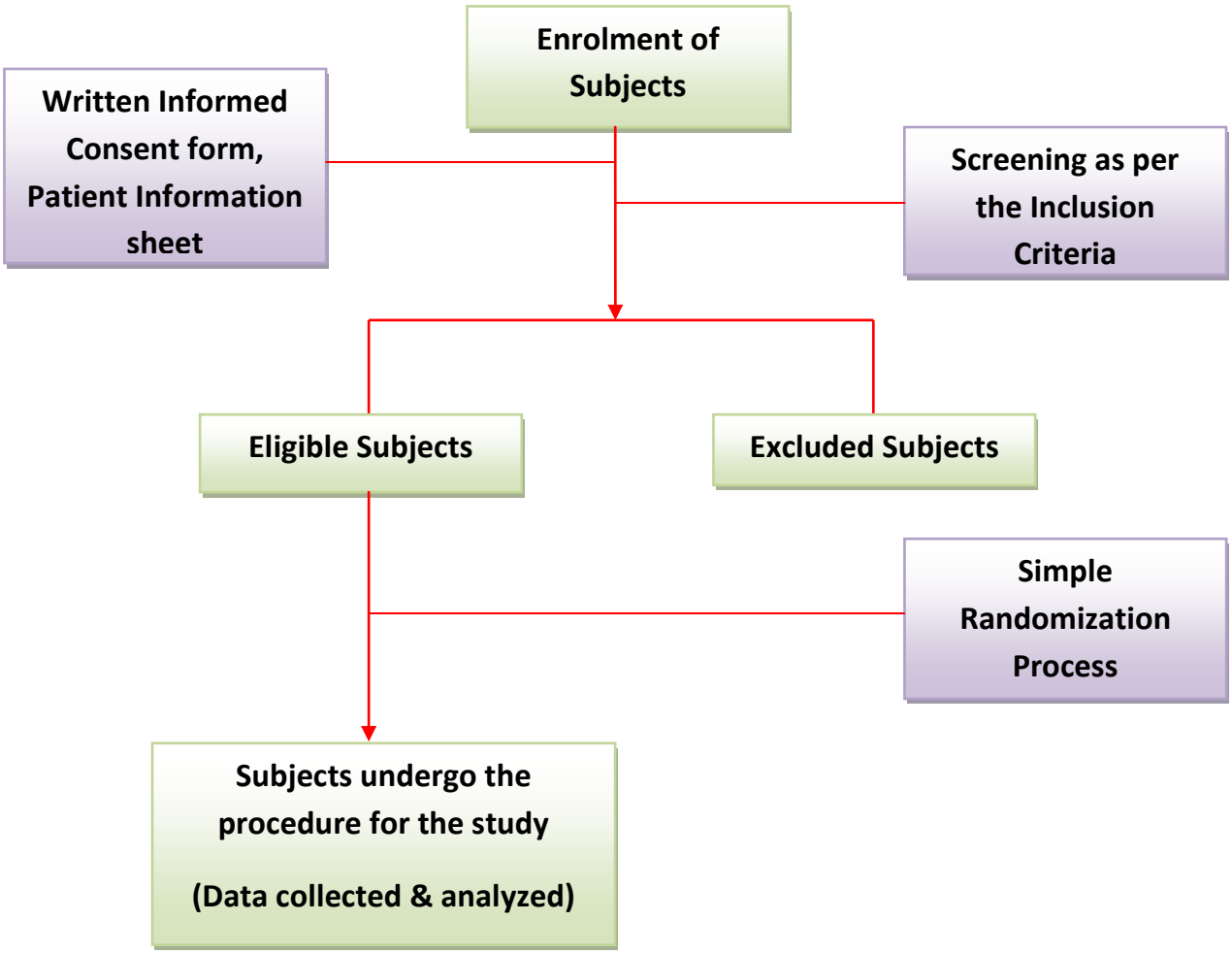
Inclusion Criteria:

1. Male and female subjects with 18-30 years of age
2. Subjects who use electronic devices

Exclusion Criteria:

1. Subjects who history of Neck trauma or surgery or neck related musculoskeletal disorders.
2. Subjects having migraines or vertigo.
3. Any subjects who had complains of the central or peripheral nervous systems involvement
4. Subjects who have symptoms of covid -19, subjects who diagnosed as Covid-19 positive and subjects who had recovered from covid-19.

Fig 1: Flowchart summarising the overall trial design



Those students who meet the inclusion criteria will be enrolled in the study. The subjects willing to participate in the study will be requested to fill up written informed consent form. Participants will be

selected from the population using simple randomization technique. A toss of coin method will be done to select either the student having odd enrollment number or even enrollment number from a class to avoid any form of bias. Participant's information sheets will be given to the participants. The participants will be screened as per the routine musculoskeletal assessment format. All the participants will be assessed for their neck muscle endurance. Trial and explanation will be given to all the participants to make them aware how the test will be performed. Neck flexors and extensors endurance test will be conducted with the procedure mentioned below.

Neck Flexors Endurance Test [19]:

The participant will be in supine lying position. The cervical spine should be in a neutral position. The pressure biofeedback device will be inflated to a baseline of 20 mmHg and positioned between the plinth and the posterior part of the neck behind the occiput. Participant will be reminded to relax the neck musculature and to concentrate on performing a gentle, nodding head movement. Participant will be instructed to perform the cervical flexion movement at 5 different pressure levels (22, 24, 26, 28, and 30 mmHg) and to hold at each level for 10 seconds. Rest time period of 30 second will be provided between each level. The testing procedure will be ended when the participant will not be able to hold a specific pressure level for 10 seconds or if the maximum level of 30 mm Hg will be achieved. The highest level of pressure achieved by the participant will be recorded.

Neck Extensors Muscles Endurance Test [20]**:**

The participant will be in prone lying position with the head and neck over the edge of the bed. Participant will stabilized with the help of a stabilization belt at the level of T2. Participant will be reminded to relax the neck musculature and will be asked to perform chin tuck in than will be asked to performed neck extension and hold that position as long as they

Fig 2

Fig 3

Figure 2 and 3 shows neck flexors endurance test procedure and neck extensors endurance test procedure respectively

Table 1: the schedule of enrolment, interventions and assessments in accordance with the Standard Protocol Items: Recommendation for Interventional Trials (SPIRIT) for the Observational Study

Time Point	Study Period			
		Enrolment	Day 1	Later if applicable
Enrolment	Eligibility Screen	×		
	Informed Consent	×		
	Patient Information Sheet	×		
Intervention	Intervention if any		Not applicable	
Assessments	Baseline	×		
	Neck Flexors Endurance Test		×	
	Neck Extensors Endurance Test		×	

can. The time will be recorded with the help of a stopwatch and the maximum time the participant will be able to hold the position will be recorded.

When will be the test terminated –

1) When participant does not want to continue the test

2) When participant experiences neck pain and/or gets fatigue.

After performing the above tests which are also going to be the outcome measures for this study, the obtained neck muscles endurance will be recorded.

Statistical Analysis:

The data will be collected and entered in Microsoft excel sheet and descriptive statistic like mean, standard deviation after ensuring the normal distribution and analysis will be done by using SPSS version 16 software taking the help of a Biostatistician. Independent t test will be done to compare the two groups with neck pain and with no neck pain individuals to know the effect of neck muscles endurance on neck pain. One way ANOVA will be used to compare more than 3 groups and if we will get any significant results in one way ANOVA than the Tukey's Post Hoc test will be done to know which group is more significant.

Discussion:

Number of research studies showing the effect of neck muscle endurance of subjects using various electronic devices like smart phones, laptops, tablets and personal computers are limited. Few of the studies shows that there is association between neck muscle endurance which leads to the increase in the forward head posture thereby putting strain on the neck muscles. As a result of the prolonged use of these electronic devices, neck pain gets developed as a musculoskeletal problem in these subjects.

To the best of our knowledge we did not find any systematic review which showed any association between the duration of use of the different electronic devices with the development of forward head posture thereby putting strain of the neck muscles leading to the weakness of this group of muscles. The results of this study therefore will be giving crucial information for the above association as the use of the electronic devices is getting higher and higher with the progression of the 21st Century.

The strength of this study protocol is that it follows the SPIRIT protocol. The study also follows all the recommendations for observational studies considered in the Strengthening the Reporting of Observational studies in Epidemiology (STROBE) statement.

Conclusion:

This observation study will be useful in understanding and interpretation of the effect and association if any of neck muscle endurance on neck pain in individuals using electronic devices.

Conflicts of Interest

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

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References:

1. Lee R, James C, Edwards S, Snodgrass SJ. Posture during the use of electronic devices in people with chronic neck pain: A 3D motion analysis project. Work. 2020 Sep 6(Preprint):1-5.
2. Haque AE, Sugathan S, Ali O, Islam MZ, Haque M. Use of electronic devices by the medical students of UniKL-RCMP, Malaysia, and its influence on academic performances. NJPPP. 2016;6(1):38-45.
3. Chaudary AA, Aslam F, Asghar AR, Bashir H, Awais A, Riaz CZ, Riaz B, Gen M, Ahmed C, Brig CA, Shahab A. Frequency of Text Neck Syndrome in Medical Students due to Excessive Usage of Electronic Devices. JPOA. 2019 Oct 30; 31(02):79-82.
4. Hakala PT, Saarni LA, Punamäki RL, Wallenius MA, Nygård CH, Rimpelä AH. Musculoskeletal symptoms and computer use among Finnish adolescents-pain intensity and inconvenience to everyday life: a cross-sectional study. BMC musculoskeletal disorders. 2012 Dec; 13(1):1-7.
5. Bucyana E, Jayavel A, Christian NC. Immediate Effect of Post Deep Neck Flexors Endurance Test on Neck Reposition Accuracy in Smartphone Addictors. Indian Journal of Public Health Research & Development. 2019; 10(10):476-80.
6. Lee H, Nicholson LL, Adams RD. Neck muscle endurance, self-report, and range of motion data from subjects with treated and untreated neck pain. JMPT. 2005 Jan 1; 28(1):25-32. 8
7. Namwongsa S, Puntumetakul R, Neubert MS, Boucaut R. Effect of neck flexion angles on neck muscle activity among smart phone users with and without neck pain. Ergonomics. 2019 Dec 2;62(12):1524-33
8. Oliveira AC, Silva AG. Neck muscle endurance and head posture: a comparison between adolescents with and without neck pain. Manual therapy. 2016 Apr 1; 22:62-7.
9. Alshahrani A, Samy Abdrabo M, Aly SM, Alshahrani MS, Alqhtani RS, Asiri F, Ahmad I. Effect of smartphone usage on neck muscle endurance, hand grip and pinch strength among healthy

college students: A cross-sectional study. International journal of environmental research and public health. 2021 Jun 10;18(12):6290.

10. Wah SW, Puntumetakul R, Boucaut R. Effects of proprioceptive and craniocervical flexor training on static balance in university student smartphone users with balance impairment: A randomized controlled trial. Journal of Pain Research. 2021 Jun 25:1935-47.
11. Berolo S, Wells RP, Amick III BC. Musculoskeletal symptoms among mobile hand-held device users and their relationship to device use: a preliminary study in a Canadian university population. Applied Ergonomics. 2011;42(2):371-8.
12. Lourenço AS, Lameiras C, Silva AG. Neck flexor and extensor muscle endurance in subclinical neck pain: intrarater reliability, standard error of measurement, minimal detectable change, and comparison with asymptomatic participants in a university student population. Journal of manipulative and physiological therapeutics. 2016 Jul 1;39(6):427-33.
13. Blomgren J, Strandell E, Jull G, Vikman I, Röijezon U. Effects of deep cervical flexor training on impaired physiological functions associated with chronic neck pain: a systematic review. BMC musculoskeletal disorders. 2018 Dec;19:1-7.
14. Lee SC, Lee YR, Yu SK, Seo DK. Deep neck flexor endurance in university students: normative data and reliability. Physical Therapy Rehabilitation Science. 2018 Dec 28;7(4):186-90.
15. Obembe AO, Johnson OE, Tanimowo TO, Onigbinde AT, Emechete AA. Musculoskeletal pain among undergraduate laptop users in a Nigerian University. JBMR. 2013 Jan 1;26(4):389-95.
16. Hoy D, March L, Woolf A, Blyth F, Brooks P, Smith E, et al. The global burden of neck pain: estimates from the global burden of disease 2010 study. Annals of the Rheumatic Diseases. 2014;73(7):1309-15
17. Parazza S, Vanti C, O'Reilly C, Villafañe JH, Moreno JM, De Miguel EE. The relationship between cervical flexor endurance, cervical extensor endurance, VAS, and disability in subjects with neck pain. Chiropractic & manual therapies. 2014 Dec 1; 22(1):10.
18. Chan LL, Wong AY, Wang MH, Cheung K, Samartzis D. The prevalence of neck pain and associated risk factors among undergraduate students: A large-scale cross-sectional study. International Journal of Industrial Ergonomics. 2020 Mar 1; 76:102934.
19. Wing Chiu TT, Hung Law EY, Fai Chiu TH. Performance of the craniocervical flexion test in subjects with and without chronic neck pain. Journal of Orthopaedic & Sports Physical Therapy. 2005 Sep;35(9):56.
20. Hudswell S, Von Mengersen M, Lucas N. The cranio-cervical flexion test using pressure biofeedback: A useful measure of cervical dysfunction in the clinical setting?. International journal of osteopathic medicine. 2005 Sep 1;8(3):98-105.