

# COMPARISON OF NECK MUSCLE FLEXIBILITY, STRENGTH, ENDURANCE AND PROPRIOCEPTION AMONG THE VIDEO DISPLAY TERMINAL USER'S IN COLLEGE STUDENTS WITH NECK PAIN AND WITHOUT NECK PAIN

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## ABSTRACT

**Background:** Neck pain is one of the main causes of those who use video display terminal devices. Prolonged period of work in an awkward posture would mainly lead to neck pain among the VDT users. Studies show the prevalence of neck pain among VDT users as 45.5%. It is essential to identify factors for preventing people from getting neck pain. Studies show that musculoskeletal disorders are related to physical fitness level. Many factors in physical fitness can predict the incident of musculoskeletal disorders. There are still studies which are specific to neck pain and physical fitness in office workers.

**The context and purpose of the study:** The main aim of the study is to compare the flexibility, strength, endurance and proprioception of neck among the VDT users in college students with neck pain and without neck pain.



**Results:** The main finding of this study was that the video display terminal device users who use more than 4 hours / day have significantly lower flexibility, endurance and proprioception among student with neck pain compared to without pain VDT devices students. But there is no significant difference in strength among both groups.

**Conclusion:** The majority of VDT user's students who have neck pain are more affected in range of motion, endurance and proprioception compare to without neck pain. But there is no significant difference in strength among both groups.

**Implication:** static posture without taking break in student who use VDT devices can be decrease in physical fitness of neck, so student are take break in between time to time and stretch their leg as well as arm ,neck.

**KEY WORDS:** VDT device, Neck pain, ROM of neck, endurance, proprioception, strength.

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## INTRODUCTION

Neck pain is a common disorder characterized by pain; ache or soreness experienced in a region between the inferior margin of the

occiput and T1 [1]. Increasing evidence suggests a high prevalence of musculoskeletal symptoms in the neck and upper extremity among undergraduate students, ranging at 48-78%. An

ideally aligned neck has a slight lordotic curvature and who use computer for longer period of time, sitting with rounded shoulders and faulty neck posture disturbs the normal lordotic curve of neck which leads to muscular imbalance and consequently neck pain [2-4].

Physical fitness is “the ability to carry out daily tasks with vigour and alertness, without undue fatigue and with ample energy to enjoy leisure-time pursuits and to meet unforeseen emergencies” [5].

A video display terminal (VDT) is defined as a device, either in the form of Cathode Ray Tube, Liquid Crystal Display or any other form of image projection technology that converts electrical signals into visual display. These video displays can be used for the purposes of relaying information in the form of images, photos, texts, and/or films. Examples of VDTs include computers, laptops, electronic notebooks, tablets, and a variety of portable cellular phones and devices (e.g., BlackBerrys, iPhones, and smartphones) [6,7]. VDT usage could cause consistent pressure on the upper quarter of body and musculoskeletal pain in the neck, shoulders, arms and hands [8]. Many studies suggested that neck pain problems result from prolonged poor posture, abnormal physiologic loads on the neck [9-11]. The loads compromise pain-sensitive structures and thereby affect the function of the cervical spine, causing a musculoskeletal imbalance in the upper quarter of the body. For example, a habitual excessively forward head posture has been suggested to be pain provoking, with a consequential reduction in muscle strength in cervical spine. However, neck muscle endurance was found to be lower for frequent neck pain individuals compared to persons with never or infrequent neck pain [12]. The association between the level of physical activity and musculoskeletal pain is contradictory. Many studies show a relation between a low level of physical activity and neck pain in adolescence and young adult [13-16].

Only few studies investigated on neck pain and flexibility, strength, endurance and cardiorespiratory fitness among office workers [17]. But there is no studies found on neck pain and flexibility, strength, endurance and proprioception among college student who use video display

terminal devices. Functioning in daily activity is considered the most important measure of health problem and it has been suggested that a self-evaluation may be more accurate than the clinical, biomechanical, or physiological indexes [18,19]. A study reported that heavy VDT users who complained frequent neck pain but were not necessarily under health professional services experienced difficulties in daily activities [16]. There are many studies that musculoskeletal disease and activities of daily living limited due to the use of VDT devices. Pain in the neck or upper limb is common in video display terminal users, and its use is high in the university student population [20]. Recent literatures shows that neck muscular performance can contribute to impaired physical measures in VDT users. Because of this it is needed to establish the comparison with physical fitness in college students who are prone to develop neck dysfunction due to technological advancements.

## MATERIALS AND METHODS

A cross-section study was conducted among college students in dakshina Kannada mangalore and duration of the study is December 2018 to July 2019. 40 students among video display terminal users' were recruited for the study from which 20 were neck pain and 20 were without neck pain. Both male and female with age group “between” 18-25 who are using video display terminal more than 4 hours per day were included. Students with any medical or musculoskeletal trauma of neck or cervical spine, past history of neurological involvement to neck, psychological illness and past surgical history of neck were excluded. Neck pain was assessed using standardized Nordic questionnaire, Flexibility of neck assessed by using universal goniometer, deep neck flexors endurance assessed by using deep neck flexor endurance test, proprioception of neck assessed by using digital inclinometer and biofeedback cranio-cervical flexion test for flexor strength of neck.

a) Body Picture from standardized Nordic questionnaire and the question asked “have you experienced any neck pain lasting > 24 hours during the past 3 months?” Criteria is adopted from reference article kanchanomai et al [22].

b) Cervical range of motion for flexion, extension, right and left side flexion, right and left rotation will be done in sitting, with thoracic & lumbar spine well supported by the back of the chair. Tongue depressor can be held between teeth for reference and shoulder girdle is stabilized to prevent flexion of thoracic & lumbar spine. For flexion and extension fulcrum is over the external auditory meatus, proximal arm was perpendicular to ground and distal arm parallel to longitudinal axis of tongue depressor. While doing Side flexion fulcrum will be on spinous process of c7, proximal arm on spinous processes of thoracic vertebrae so that arm is perpendicular to ground and distal arm over dorsal midline of head as a reference of occipital protuberance Rotation of cervical range of motion using goniometer centre over the cranial aspect of head, proximal arm parallel to imaginary line between the two acromion processes and distal arm with the tip of the nose. Ask patient to move actively as per direction of motion.

c) Deep Neck Flexor Endurance Test position performing in hook lying with patients tuck chin in and lift off table 1 inch. The examiner looks for substitution of the platysma or SCM muscle. Normal values for men 38.9 seconds, women are 29.4 seconds.

d) Biofeedback Cranio-Cervical Flexion Test subject in supine crook lying position with the neck in a neutral position visually determined by maintaining a horizontal face position between the forehead and chin and observing that a line bisecting the neck longitudinally is parallel to the treatment table. Before performing the test, an uninflated pressure sensor must be placed beneath the neck so that it abuts the occiput. The pressure sensor is inflated to a stable baseline pressure of 20 mm hg. Each 5 to 10 sec if subject able to hold then added 2 mm of hg pressure till 30 mm of hg.

e) Cervical proprioception Subjects sat upright on a chair with back support along hip and knee bent at approximately 90 degrees and feet placed firmly on the ground with strap the thoracic spine during the measurement of target head position and neck head position. To measure THP (target head position tests), subjects were required to adopt two positions one

in sitting position to measure THP into flexion, extension, side bending right and left and second with supine position to measure THP into rotation right and left. A digital inclinometer was placed on the side of the patient's head to measure THP into flexion and extension, while measure THP on side bending on right and left place inclinometer on the center of forehead and subject lying in supine position to measure THP into rotation right and left place inclinometer on the vertex of the head. To test THP, the examiner moved the subject's head slowly to the predetermined target position 50% of maximum range of motion. The head was maintained in the target position for three seconds, subjects were asked to remember that position, and then the head was brought back to the neutral position. When the subject reached the target position, relocation accuracy was measured in degrees. Subjects performed three trials in each movement direction (flexion, extension, side bending right and left, and rotation right and left). Only the absolute error was taken as a measurement because it represented the difference between the actual angle relative to the target angle, which had no directional bias compared to constant error or relative error.

## RESULTS

The results were expressed as mean  $\pm$  standard deviation (Mean  $\pm$  SD), frequency and percentage. SPSS version 16 was used as statistical software program.

In order to compare results, student t-test was used for quantitative variables. P-values less than 0.05 were considered significant.

**Table 1:** Descriptive statistics shows mean and standard deviation for VDT users in with neck pain and without neck pain.

| Outcome                                   | Subjects | Mean  | Standard deviation |
|---|----------|-------|--------------------|
| Flexion of neck                           | 20       | 45.15 | 13.74              |
| Extension of neck                         | 20       | 3.3   | 0.656              |
| Right Side flexion of neck                | 20       | 45.5  | 4.43               |
| Left side flexion of neck                 | 20       | 60.65 | 6.28               |
| Right rotation of neck                    | 20       | 39.95 | 3.73               |
| Left rotation of neck                     | 20       | 40.25 | 6.09               |
| Deep neck flexors endurance test          | 20       | 73.3  | 4.85               |
| Cranio cervical biofeedback test          | 20       | 71.95 | 5.81               |
| Proprioception of neck flexion            | 20       | 3.25  | 1.55               |
| Proprioception of neck extension          | 20       | 3.9   | 1.74               |
| Proprioception of neck right side flexion | 20       | 2.6   | 2.56               |
| Proprioception of neck left side flexion  | 20       | 3.15  | 1.18               |
| Proprioception of neck right rotation     | 20       | 3.8   | 1.93               |
| Proprioception of neck left rotation      | 20       | 2.8   | 2.14               |

**Table 2:** Descriptive statistics show mean and standard deviation of without neck pain among VDT users.

| Outcome                                   | Subjects | Mean  | Standard deviation |
|---|----------|-------|--------------------|
| Flexion of neck                           | 20       | 26.83 | 12.38              |
| Extension of neck                         | 20       | 2     | 1.21               |
| Right Side flexion of neck                | 20       | 39.95 | 7.05               |
| Left side flexion of neck                 | 20       | 46.35 | 9.2                |
| Right rotation of neck                    | 20       | 37.95 | 7.26               |
| Left rotation of neck                     | 20       | 36.4  | 7.41               |
| Deep neck flexors endurance test          | 20       | 68.35 | 9.39               |
| Cranio cervical biofeedback test          | 20       | 68.65 | 8.33               |
| Proprioception of neck flexion            | 20       | 5.1   | 2.91               |
| Proprioception of neck extension          | 20       | 5.05  | 2.37               |
| Proprioception of neck right side flexion | 20       | 4.75  | 2.04               |
| Proprioception of neck left side flexion  | 20       | 4.2   | 1.7                |
| Proprioception of neck right rotation     | 20       | 4.85  | 1.81               |
| Proprioception of neck left rotation      | 20       | 4.15  | 2.2                |

**Table 3:** Comparison between neck pain and without neck pain among VDT students.

| Students t test                           | t value | P value |
|---|---------|---------|
| Flexion of neck                           | 4.43    | 0       |
| Extension of neck                         | 4.21    | 0       |
| Right Side flexion of neck                | 2.73    | 0       |
| Left side flexion of neck                 | 5.73    | 0       |
| Right rotation of neck                    | 0.876   | 0.03    |
| Left rotation of neck                     | 1.79    | 0.08    |
| Deep neck flexors endurance test          | 2.09    | 0.04    |
| Cranio cervical biofeedback test          | 1.45    | 0.15    |
| Proprioception of neck flexion            | 2.5     | 0.01    |
| Proprioception of neck extension          | 1.74    | 0.09    |
| Proprioception of neck right side flexion | 2.93    | 0       |
| Proprioception of neck left side flexion  | 2.26    | 0.02    |
| Proprioception of neck right rotation     | 1.77    | 0.08    |
| Proprioception of neck left rotation      | 1.96    | 0.05    |

## DISCUSSION

The present study was done to find comparison of neck flexibility, strength, endurance and proprioception among VDT devices users in college students with neck pain and without neck pain. Student with neck pain among video display users have lower flexibility, endurance, and proprioception of neck.

Reduced cervical ROM can result from inactivity and structural changes in the tissues in the cervical spine, and the shortening of collagen tissue and muscle fibrosis results in an increased connective-tissue density [23]. The results of the present study showed that the cervical flexion, extension, right and left lateral flexion, and right rotation mean value are  $45.15 \pm 13.74$ ,  $3.30 \pm 0.65$ ,  $45.50 \pm 4.43$ ,  $60.65 \pm 6.28$ ,

$39.95 \pm 3.73$ ,  $40.25 \pm 6.09$  among VDT users with neck pain was compared with cervical range of motions flexion, extension, right and left lateral flexion, and right rotation of mean values are  $26.82 \pm 12.38$ ,  $2.0 \pm 1.21$ ,  $39.95 \pm 7.05$ ,  $46.35 \pm 9.20$ ,  $37.95 \pm 7.26$ ,  $36.40 \pm 7.41$  among VDT users without neck pain and  $p < 0.5$  but there is  $p > 0.8$ . Similar Study did by Yoo WG et al. On the relationship between the active cervical range of motion in VDT worker and result found cervical range of flexion is  $50.3 \pm 10.91$ , extension is  $42.6 \pm 14.25$ , right lateral flexion is  $40.7 \pm 10.18$ , left lateral flexion is  $39.1 \pm 11.32$ , right rotation is  $57.0 \pm 9.76$ , left rotation is  $58.3 \pm 10.47$  and  $p < 0.05$  for all except flexion of neck ROM. The flexion relaxation ratio obtained by dividing the maximal muscle activation during the re-extension phase by activation during the relaxation phase was most highly associated with the cervical active ROM, which was considered a major clinical feature of the anticipatory dysfunction and neck posture in the previous studies [24].

In recent society, computer work is clearly the most threatening element that causes neck and shoulder pain for young computer users. Although it is difficult to classify them as chronic patients given their ages, they may show tendencies of being chronic in terms of neck pain because they have been exposed to computers since childhood. This study was conducted to prepare for the possibility those young generations students could easily develop chronic neck pain.

The results of the present study showed that the deep neck flexors endurance test mean values are  $73.30 \pm 4.85$  among VDT users with neck pain when it compared with the neck endurance mean values are  $68 \pm 9.39$  among VDT users without neck pain and  $p < 0.05$  which is statistically significant. In the studies of Domenech et al. [24] and Jarman et al. [25] the clinicians had an average of 23 years and 13.5 years of experience, respectively. In this study, however, three third-year junior students assessed inter-rater reliability. Therefore, DNFET is a highly reliable tool that can be used to assess patients by evaluators with minimal clinical experience. The average DNFET results of Korean college students without neck pain

were measured to be approximately 52% lower than the DNFET results of American subjects. In a study conducted by Domenech et al. [24] mean DNFET values for men and women without neck pain between 20 and 40 years were 38.4 and 23.1 seconds respectively. Because students spend prolonged periods of time sitting at their desk while study independently every night starting from adolescence. In addition, physical education classes are recognized as insignificant and are often replaced by in-class or other important lessons [26,27]. Patients with FHP may have less muscle activation of Longus Colli compared to healthy adults, and FHP may have a negative effect on neck endurance.<sup>28</sup> In an American study, studies conducted by Domenech et al. [24] reported a significant difference in DNFET outcome according to gender but not in Jarman et al. [25] studies. In Korean college students, gender affected DNFET results as well as the results of Domenech et al. [24].

Differences in physical activity between men and women can also contribute to the DNFET results. In a study investigating physical activity for Korean college students, the average sitting time per day for male college students and female college students was approximately 784 minutes and 937 minutes, respectively. In addition, 42.5% of male college students and 66.5% of female college students responded that they lacked physical activities [29,30].

Cranio-cervical flexion test [CCFT] represents the action of the longus capitis in synergy with the longus colli, which causes a reduction of the cervical lordosis. The pressure biofeedback unit, which was placed behind the neck, monitored the flattening of the cervical spine as the deep neck flexors were activated. The results of our study revealed that the highest pressure level successfully achieved during the CCFT and the mean values are  $71.95 \pm 5.81$  in the subjects with neck pain is when compared to the asymptomatic group with mean are  $68.65 \pm 8.33$  among video display terminal users and  $p > 0.05$ . However similar study done by Juul .T. which showed the mean is  $27.67 \pm 3.2$  in the subjects with neck pain when it compared to the asymptomatic group with mean are  $24.32 \pm 3.0$  among video display terminal users and  $p < 0.05$  [31]. Individuals in the chronic neck pain group had

difficulty achieving the higher pressure levels associated with the CCFT. The results may suggest that those patients with neck pain may tend to develop severe chronic neck pain which in turn an increased cervical lordotic posture associated with a forward head posture [32].

Neck endurance and proprioception have been investigated to some extent [33]. The results of this study agree with Van Blommestein et al. [34] who demonstrated excellent intra-rater reliability of the inclinometer, with a reported ICC of 0.96. A systematic review of the literature identified only six studies that assessed reliability in patients with cervical disorders, and of these, only two studies had more than 30 subjects. Out of these six studies, very few used ICC statistics to establish reliability [35].

Further, although many studies claim that range of motion devices are reliable, most have not been properly tested for reliability in terms of statistical techniques and sample size adequacy [36]. Swait et al. [35] concluded that the test-retest reliability was obtained with five or more trials using intraclass correlation coefficients (0.73–0.84) and cervico-cephalic kinesthesia (ICC: 0.90–0.97) tests. In the current study, the joint position sense tests showed significantly larger errors in students with neck pain. mean values for flexion is  $5.10 \pm 2.91$ , side bending right is  $4.75 \pm 2.04$ , side bending left is  $4.20 \pm 1.70$ , rotation left is  $4.15 \pm 2.20$  among group with neck pain when compared mean of without neck pain for flexion is  $3.25 \pm 1.55$ , side bending right is  $2.60 \pm 2.56$ , side bending left is  $3.15 \pm 1.18$ , rotation left is  $2.80 \pm 2.14$  and there p value is  $< 0.05$ . When compared for extension and right rotation of neck proprioception p value is  $> 0.05$ . There is some evidence that patients with chronic neck pain have neck muscle weakness compared to healthy control subjects [36]. Treleaven et al. [37] have reported significantly larger errors in extension and right rotation in subjects with whiplash compared to controls. This study presented similar finding subjects with neck pain had significantly larger errors in extension and right rotation compared to healthy individuals [39]. In contrast, two recent studies failed to show any significant differences between healthy subjects and patients with cervicogenic

headache or non-traumatic neck pain in terms of kinesthetic acuity [40,41].

However, the limitation of this study is that it is difficult to generalize the results of the study because only college students from one university were selected. The numbers of participants in this study were small. Some factors of physical fitness include range of neck extension and neck rotation failed to describe the difference between healthy participants and those with neck pain. Moreover, amount of participants in this study was insufficient for statistical analysis. Further studies with adequate amount of participants should be explored.

## CONCLUSION

A present study showed significant decrease in flexibility, endurance, proprioception in neck pain that is used VDT devices among college students. There was no significant difference in strength of neck among neck pain and without neck pain in VDT users. Further research is required to expand the relationship of current study.

## ABBREVIATIONS

- VDT** - Video display terminal  
**SCM** - Sternocleidomastoid muscle  
**THP** - Target head position  
**ROM** - Range of motion  
**DNFET** - Deep neck flexor endurance test  
**CCFT** - Cranio-cervical flexor test

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