“EVALUATION OF CERVICAL ROM, PROPRIOCEPTION AND CVA IN HEAVY COMPUTER USERS: A COMPARATIVE STUDY BETWEEN SEDENTARY VS NON-SEDENTARY COMPUTER USERS”

A Dissertation

Submitted

In Partial Fulfillment of the Requirements

for the Degree of

MASTER OF PHYSIOTHERAPY

In

Neurology

Submitted by

Niyati

Under the Supervision of

Prof. (Dr). Abdur Raheem Khan

Department of Physiotherapy

Faculty of Medical Sciences

INTEGRAL UNIVERSITY, LUCKNOW,

INDIA

June 2022

CERTIFICATE

This is to certify that **Miss. Niyati** (Enroll. No-150002994) has carried out the research work presented in the thesis titled **"Evaluation of cervical ROM, Proprioception and CVA in heavy computer users: a comparative study between sedentary vs non-sedentary computer users"** submitted for partial fulfillment for the award of the **Degree of Master of Physiotherapy in Neurology** from **Integral University, Lucknow** under my supervision.

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Associate Professor

Integral University

Lucknow

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I certainly owe my gratitude to my PARENTS, & my BROTHER, for their never-ending love and support and being there as a strong and unshakable force now and forever this work is dedicated to them.

Date:
Place: Lucknow
Niyati

TABLE OF CONTENTS

LIST OF TABLES

.

LIST OF FIGURES

.

LIST OF SYMBOL AND ABBREVIATIONS

ABBREVIATIONS	DESCRIPTION
VDT:	Visual display terminal
MET:	Metabolic equivalent task
RMR:	Resting metabolic rate
FHP:	Forward head posture
CROM:	Cervical range of motion
C/O:	Complain of
ROM:	Range of motion
CVA:	Cranio- vertebral angle
JPA:	Joint position error test
IPAQ:	International physical activity questionnaire
GRP:	Group
F:	Flexion
E:	Extension
RR:	Right rotation
LR:	Left rotation
LF:	Left flexion
RF:	Right flexion
SD:	Standard deviation

ABSTRACT

BACKGROUND: Nowadays, individuals are utilizing computer for different tasks and the impact of prolonged usage can be hazardous for musculoskeletal health. It is crucial to identify health impairment in persons with a very long duration of computer use because it is spreading explosively among every generation. prolonged computer use can put constant stress on musculature of head and neck area which can lead to forward head posture (FHP) and detoriation in balancing ability. All these in combination might results in musculoskeletal problem including pain, headache, visual problem. So far, these variables were not combined for study hence the purpose of this study was to correlate whether there is positive effect of active lifestyle on neck posture in heavy computer users and to identify changes if any in cervical range, FHP, and proprioception than those who is living sedentary lifestyle.

METHODS: 30 adult desktop users were recruited for the study. The subjects were classified into two groups: sedentary (n=15) and non-sedentary (n=15). Neck proprioception were assessed by joint position error test ,6 trials were performed, and the mean value were calculated in cm and converted into degree for analysis, range of motion was assessed by universal goniometer and CVA was measured through photogrammetric method and then assessed by Apecs app.

RESULTS: There is no significant difference between group A and B for proprioception, FHP, and flexion range of motion. However, there is non-significant changes in extension (limited for sedentary with a mean value of 42.06 for grp B, 37.53 for grp A). The side flexions were significantly higher for Grp B (non-sedentary) with p value0.004 for left flexion and 0.01 for right flexion. Rotations were significantly higher for Grp A with p value 0.043 for RR and 0.008 for LR.

CONCLUSION: The between group differences noted shows stastical significant difference in both groups in,side flexions and no difference in proprioception and CVA range. Based on the finding of this study handheld goniometer is not considered reliable for measurement of rotation because of the chances of manual error as rotation is a coupled movement.

Keywords: - Heavy computer users, CVA, CROM, Proprioception, Sedentary and Non-sedentary.

DEDICATION

This research is wholeheartedly dedicated to my parents, my guide Dr. Abdur Raheem khan who have been my constant source of inspiration and given me the drive and discipline to tackle the task. I also dedicate my work to my brother and friends who have supported and encourage me throughout the process.

And lastly, this whole research id dedicated to the Almighty GOD for guidance, strength, power, and skills.

CHAPTER-1

INTRODUCTION

Now a day's use of computers and other electronic gadgets has increased worldwide rapidly. The use of computer for both work and amusement activity which involves processing a large amount of data maintaining a global database, checking social media, games, using a computer. Constant computer work requires sustained tension of the musculature of head and neck region and can easily result in adaption of a forward head posture.

Among effects of using computer for prolonged duration, keeping a posture of staring at a monitor, locate below height of eyesight, makes the head move forward, which cause increased anterior curve in lower cervical vertebra and increased posterior curve in upper thoracic vertebrae to compensate for balance. Szeto et al stated that maintaining the head forward for long duration may cause musculoskeletal disorders such as upper crossed syndrome which involves reduced lordosis of lower cervical with kyphosis of upper thoracic vertebra. Such posture causes constant stress on cervical spine joints due to FHP hence results in disturbing signals to the brain that might cause decrease neck proprioception and balance ability because of pain and inflammation. [1].

A FHP also limits the normal rotation and gliding movement when joints move which further limits functional movement. This posture is improper, with extension in lower cervical and flexion in upper cervical thus it is considered that FHP influences postural changes in sagittal plane movements but not in horizontal plane(rotation) [2].

Some advance studies have showed that one of the main problems in patients with neck pain is impairment in their cervical proprioception, which further leads to cervical sensorimotor control disturbances. Cervical sensorimotor control involves central integration and processing of all afferent information including (visual, vestibular, and cervical proprioceptive inputs), and execution of the motor program through the cervical muscles, contributing to the maintenance of head posture and balance as well as the stability of cervical joints. Based on the available evidence, it is recommended that patients with neck pain must be assessed and managed for cervical proprioceptive impairment. [3]

According to THE TIMES OF INDIA the average office worker spends almost ,1700 hours a year in front of computer. A recent study in 2021 conducted by the "workspace and Ergonomics research cell at Godrej Interior group suggested that 72% of workers in India spend more than 9 hours a day in front of computer/laptop to get their work done on time and 86% of them complained about muscle disorders. This percentage has increased also due to the outburst of pandemic.

Computer have replaced huge amounts of files, paperwork and men power which has led to increase in productivity and efficiency but also introduced VDT (visual display terminal) syndrome, with complaints of musculoskeletal pain, headache, visual problems. Among these complaints, musculoskeletal problems are the most common. Regarding this, the World Health Organization defines Work-related musculoskeletal disorders as 'injuries in muscles, tendons, peripheral nerves, and vessels possibly caused by continuous use of a body part.

Sedentary lifestyles are diffusing globally because of a lack of sufficient spaces for exercise, increased occupational sedentary behavior demands such as office work, and the increased penetration of television and video devices. We all are familiar that insufficient physical activity has a deleterious effect on our health. Physical inactivity is the fourth leading risk factor for global mortality, accounting for 6% of global mortality.Around 31% of the global population age 15-30 years engages in insufficient physical activity according to Jung Ha Park, et al. [2020]. [4]. Approx. 20% of Indian population are in inactive category, 36.9% are mild active ,27.8 % are moderately active and 15% are vigorously active, according to Vivek podder et al. [2020]. [5].

Sedentary behavior can be explained as any waking behavior such as sitting or leaning with an energy expenditure of 1.5 metabolic equivalent task (MET) or less. Based on a study conducted in 2011 Compendium of Physical Activities, MET is expressed as the ratio of work metabolic rate to the standard resting metabolic rate (RMR) of 1 kcal/(kg/h). One MET defined as RMR or energy cost for a person at rest. When we classify it based on their intensities, physical activity can be classified into 1.0–1.5 METs (sedentary behavior), 1.6–2.9 METs (light intensity), 3–5.9 (moderate intensity), and ≥6 METs (vigorous intensity). [4]

Adults [18-40] should do at least 150 mints of moderate physical activity and 75 mints of vigorous activity with muscle strengthening activities to maintain non-sedentary behavior. If anyone do less activities, consider as sedentary behavior. Low physical activity level is leading risk factor for cardiac diseases, diabetes as well as mental stress. [6]

According to Janice Cheung, more than 50% of workers reported a relationship between their occupation and neck pain, while 14% experienced activity limitations due to neck pain each year. [7]. Physical activity is a common management strategy for chronic musculoskeletal pain. Strengthening and fitness exercises have shown to be effective at preventing neck pain and reducing its severity. Workers participating in general exercise and sport activities were more likely to experience relief in their neck pain [8]. Computer use affect habitual postures indirectly, via physical activity or pain. High levels of computer use may lead to reduced physical activity, and subsequent reduction in muscle endurance that affect habitual posture.

BACKGROUND AND PURPOSE:

So far this type of study is not previously conducted thus, this study tried to correlate whether there is positive effect of active lifestyle on neck posture and to identify changes if any in cervical range, CVA and proprioception than those who is living sedentary lifestyle , also we consider that it is crucial to identify health impairment in persons with a very long duration of computer use because an increasingly computer use is spreading explosively among every generation causing not only physiological but also psychological hazards. The results might be helpful in creating awareness about the normal duration of computer use and to promote good posture and role of exercises to prevent upcoming dysfunctions.

STATEMENT OF QUESTION:

This study tried to investigate the differences between the impact of physical activity and sedentary lifestyle on computer-based workers and to examine the variation in cervical range, proprioception, and forward head posture between both the groups.

OBJECTIVE:

1. To determine whether the range, CVA and proprioception of neck was different between participants with active and sedentary lifestyle in heavy computer users.
2. To find out the effects of sedentary lifestyle on neck range, posture, and balance ability in heavy computer users.
3. To find out the effects of non-sedentary lifestyle on neck range, posture, and balance ability in heavy computer users.

HYPOTHESIS:

ALTERNATE: There will be significant difference between variables of both groups.

NULL: There will be no significant difference in variables of both groups.

OPERATIONAL DEFINITIONS

Heavy computer user: - Based on information regarding the history of computer use, the daily computer usage of ≥ 6 hours is categorized as heavy desktop usage. Time spent using computer adversely affect health and development in adolescent as well as adults. It displaces the vigorous physical activities and give rise to musculoskeletal problems.

Sedentary Lifestyle: - Sedentary behavior is defined as any waking behavior such as sitting or leaning with an energy expenditure of 1.5 metabolic equivalent task (MET) or less. When classified quantitatively based on their intensities, physical activities can be classified into 1.0–1.5 METs (sedentary behavior), 1.6–2.9 METs (light intensity), 3–5.9 (moderate intensity), and ≥6 METs (vigorous intensity) [4].

Non-sedentary Lifestyle: - A daily physical activity level of greater than 39 MET-hr. was considered as non-sedentary [4]. It generally includes light activities such as occasional standing from sitting or walking, it also includes regular exercise in form of stretching or strengthening or doing aerobics. Non-sedentary lifestyle decreases the chances of disease also promote psychological well-being.

Cervical joint position error test: - The JPE tests one's ability to relocate the head back to center after maximal or submaximal rotation in transverse and sagittal planes. This test was developed by Michel Revel hence also known as Rebel's Test, according to which a repositioning error of 3cm or more in any direction is abnormal, indicative of poor head repositioning ability. [9]

Cranio-vertebral angle (CVA): - It is the angle formed between a horizontal line drawn through the spinous process of the seventh cervical (C7) vertebra and a line joining the spinous process of C7 vertebra with the tragus of the ear. Normal value in standing is 49.9° degree [10]. The smaller CVA indicates greater FHP and a CVA less than 48°-50° is defined as FHP [11].

Forward head posture (FHP): -it is the most common cervical postural fault in sagittal plane. It can be visually assessed as placement of external auditory meatus anterior to clavicle. Mann Heimer discusses two different types of FHP; one in which posterior cranial rotation occurs, and one without posterior cranial rotation. In FHP with posterior cranial rotation, the head is placed anterior to the shoulders and the upper cervical spine is positioned in slight extension. In FHP without posterior cranial rotation, the head is anteriorly placed but without extension of the upper cervical spine [12]. It can be explained as extension of upper cervical region and flexion of lower cervical region, which further requires sustained activation of cervical erector spinae at c4 level.

Cervical range of motion (CROM): - displacement from one extreme to the other extreme of the physiological range of translation or rotation of a joint, for each of its six degrees of freedom.

Flexion: -Motion occur in sagittal plane in medial lateral axis. Normal value is 40°.

Extension: -Motion occurs in the sagittal plane around a medial-lateral axis. Mean cervical extension is 50°.

Rotation: -Motion occurs in the transverse plane around a vertical axis. Normal value is 49° left side, 51° right.

Lateral flexion: - Motion occurs in the frontal plane around an anterior-posterior axis. Mean value is 22° each side [13]

CHAPTER-2

REVIEW OF LITERATURE

CERVICAL SPINE:

As the superior portion of the vertebral column, cervical spine lies between the cranium and the thoracic vertebrae, cervical region is the sole bony support for the head. Originating from the relatively stiff thoracic region (characterized by rib attachment points), it allows a greater degree of flexibility than any other portion of the spine.

Exceptional demands are placed on the central nervous system in providing postural stability and motor control in the presence of this great mobility. Also, because the cervical spine has the responsibility of maintaining position of the sense organs for sight, sound, balance, and olfaction, proper function of the cervical spine is essential for effective interaction with the environment. Finally, activity of muscles throughout the trunk and extremities is affected by events that occur in the cervical spine.

The cervical spine is generally separated into two distinct functional parts: the upper cervical spine (CO-C2) and the lower cervical spine (C3-C7). The directions of rotation that spinal joints undergo are, in common language, expressed as flexion, extension, lateral flexion, and rotation. Translations are expressed as anterior, posterior, and left and right lateral translation.

UPPER CERVICAL SPINE

The upper cervical spine is comprised of CO-Cl and CI-C2, this is the most dynamic area of spine. The first cervical vertebra, the atlas, arguably does not belong to the cervical spine. It has more in common with the occiput than with the rest of the neck. It is designed to cradle the occiput and to transmit forces from the head to the cervical spine. According to Panjabi et all, the CO-Cl joint acts as a pivot upon which flexion and extension can occur, and it is this pivot upon which occipital nodding occurs. The ROM for flexion and extension is approximately 25 degrees. The CI-C2 segment contributes almost equally to cervical flexion and extension, with approximately 20 degrees of range.

Axial rotation in the upper cervical spine occurs primarily at CI-C2. In fact, approximately 50 to 60 percent of the rotation ROM of the entire cervical spine takes place at this level. The range is approximately 23 to 39 degrees to each side. Lateral flexion in the upper cervical spine is limited to approximately 5 degrees at each of the CO-Cl and CI-C2 segments. Translation movements in the upper cervical spine are minimal. Normal translation in this direction is measured as 2 to 3 mm, Excessive translation at this level suggests the presence of gross instability due to inadequacy of the transverse ligament.

Axial rotation about a vertical axis is not a true physiological movement of the atlanto-occipital joint. Axial rotation requires anterior translation of the contralateral occipital condyle. These movements are essentially prevented by the respective anterior and posterior wall of the atlantal sockets.

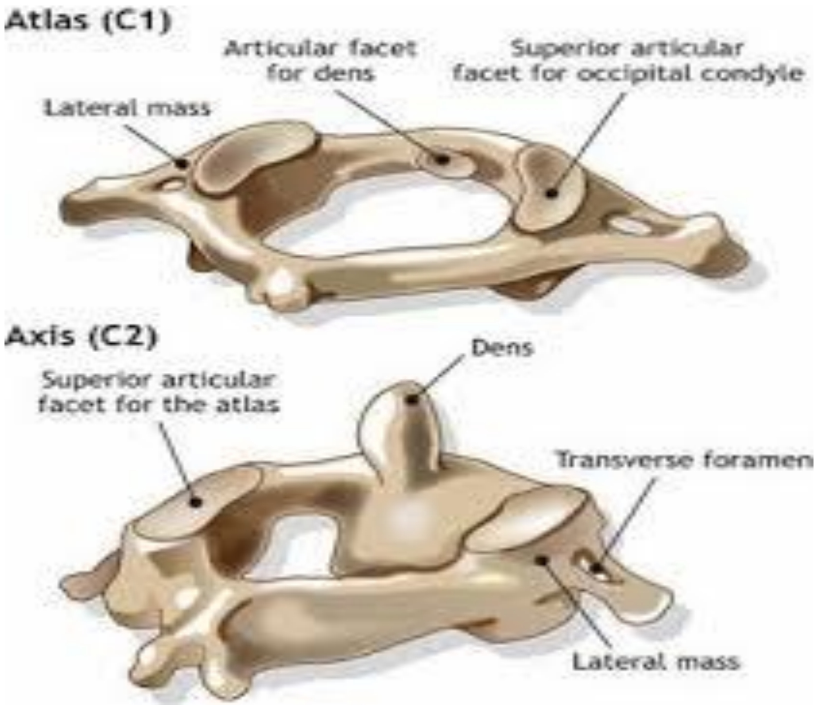


Figure 2.1. A typical upper cervical vertebra (C1-C2)

LOWER CERVICAL SPINE

The lower cervical spine consists of the segments C2-C3 through C7-Tl. For flexion and extension, the segments of the lower cervical spine have an ROM of between 10 and 20 degrees, with the greatest ROM occurring at the levels C4-C5 and C5-C6. For lateral flexion, approximately 5 to 10 degrees occurs at each segment, with the greatest amount occurring at the C3-C4 and C4-C5. Axial rotation is approximately 3 to 7 degrees at each segment from C2-C3 to C7-Tl.

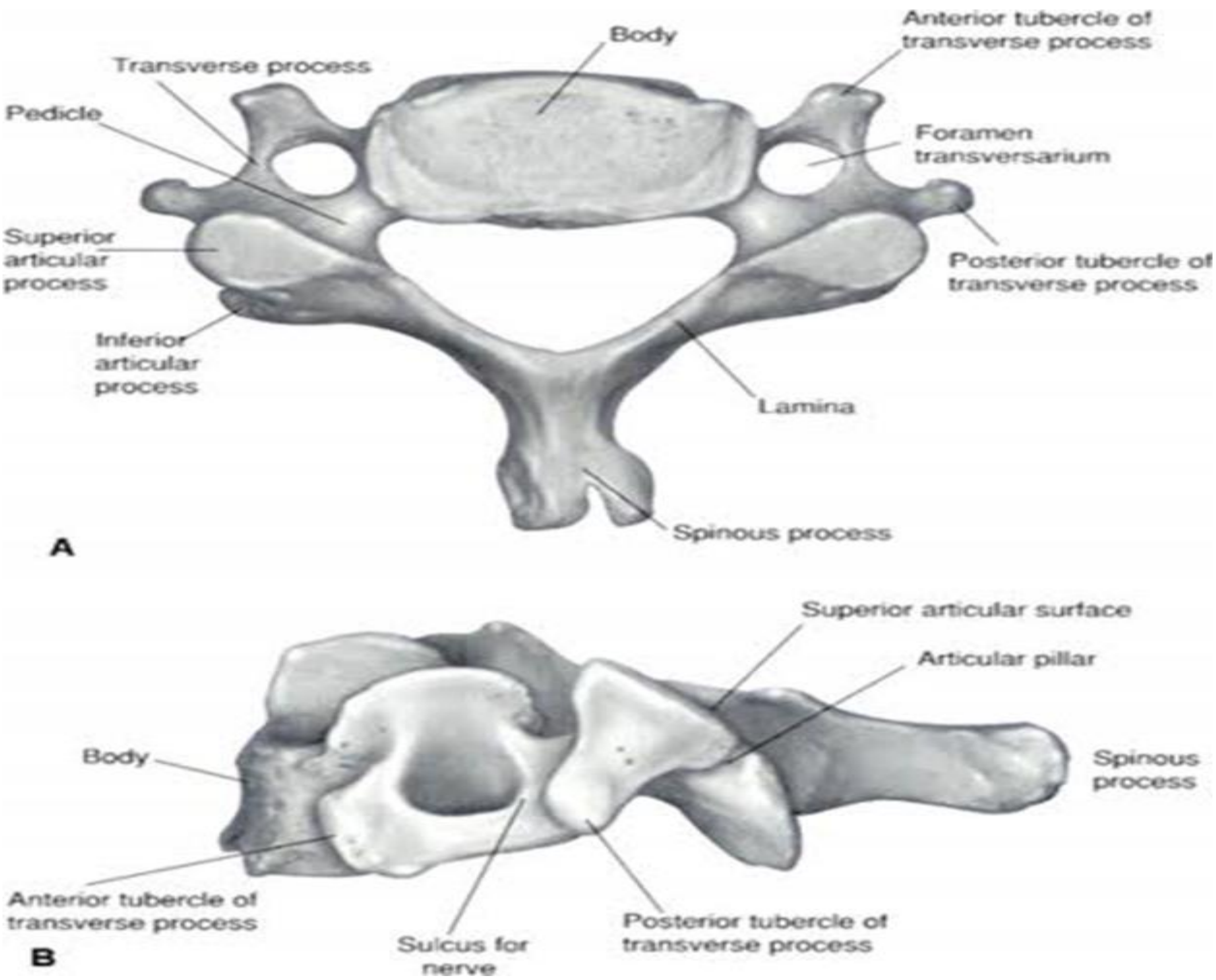


Figure 2.2. A typical lower-cervical vertebra, showing superior (A) and lateral (B) views

RANGE OF MOTION:

For flexion and extension, the segments of the lower cervical spine have an ROM of between 10 and 20 degrees, with the greatest ROM occurring at the levels C4-C5 and C5-C6. Axial rotation of the cervical spine, as stated earlier, takes place primarily at CI-C2. There being very little axial rotation taking place at CO-C1, the remaining total axial rotation in the cervical spine is somewhat evenly distributed among the lower cervical spine segments. This adds up to approximately 3 to 7 degrees at each segment from C2-C3 to C7-Tl. It should be noted that there is a wide individual variability of ROM in rotation in the lower cervical spine. II For lateral flexion, approximately 5 to 10 degrees occurs at each segment, with the greatest amount occurring at the C3-C4 and C4-C5 segments. Figure 2-8 provides graphic representation of the representative ROMs at each level of the cervical spine.

MOBILITY

COUPLED MOTION:

In the locomotor system, no movement occurs in isolation. Even at the spinal intersegmental level, when a joint move through rotation about a certain axis, it will inevitably rotate or translate about or along another axis. In the upper cervical spine, rotation to one side is coupled with lateral flexion to the opposite side; that is, when the C1-C2 segment goes through rotation there occurs a coupled rotation. As will be seen, the opposite coupling pattern occurs in the lower cervical spine, and these opposing coupled patterns allow the head to remain neutral during cervical spine movements.

There also occurs a translation during axial rotation of the C1-C2 segment. In addition, as Penning and Wilminkll have shown, the atlas translates laterally (along the x axis) during rotation of the upper cervical spine. This translation occurs in the opposite direction as rotation; that is, with right rotation of the upper cervical spinethe atlas translates to the left.

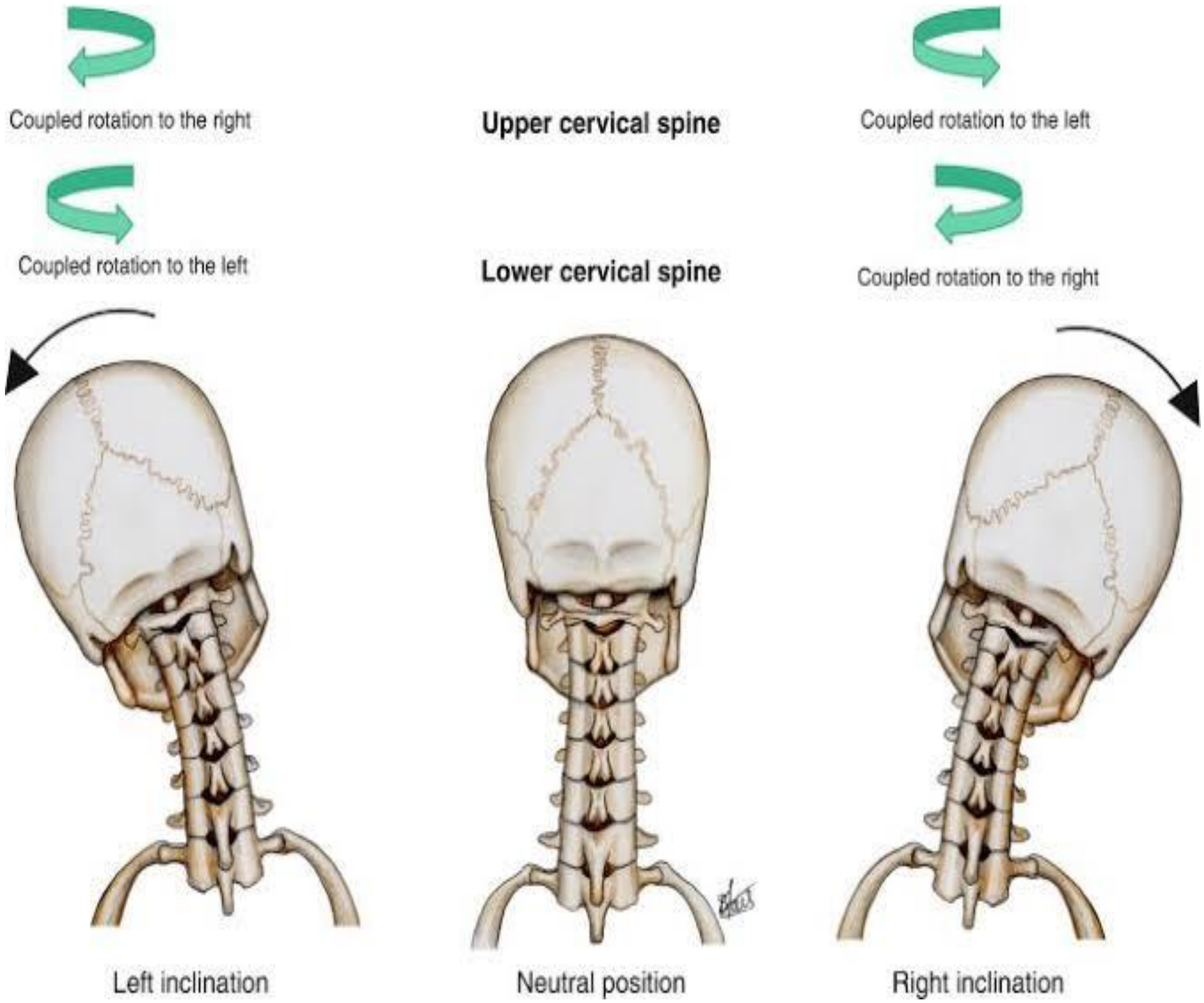


Figure 2.3. Coupled motion of lateral flexion with rotation to the same side, such that the spinous processes move toward the convexity of the curve.

MUSCLE FUNCTION

FLEXION:

The head-neck system consists of approximately 30 to 32 muscles. Studies showed that the greatest contribution to cervical flexion was provided by the sternocleidomastoid muscle (SCM) and the deep neck flexors (longus capitis and colli), as measured by the cross-sectional area. Fountain et al. studied using copper wire electromyogram (EMG), showed activity in the longus colli during flexion against resistance that increased in intensity with increased resistance. Interestingly, they showed that the longissimus cervicis, typically thought of as a “cervical extensor," was active during cervical flexion against resistance and its activity increased markedly as resistance increased.

These findings demonstrate the absence of reciprocal inhibition in the cervical spine and show the complex interaction between cervical muscles for the purpose of maintaining stability and smooth movement. The contraction of the SCM and the deep neck flexors is synchronous and coordinated and proper balance of this synchronization is essential to proper function of the flexion movement pattern. The longus colli assists in flexion of the cervical spine. The SCM, if the flexors of the upper cervical spine are not active, creates flexion of the lower cervical spine along with extension of the upper cervical spine.

The scalene are capable of flattening the lordosis (this is not to be confused with their alleged role in causing loss or reversal of lordosis after trauma), but when the lordosis is extenuated, they act merely to flex the cervical spine on the thoracic spine while maintaining cervical lordosis. This action makes the scalene the cervical analogue to the iliopsoas. So, the movement of flexion of the cervical spine is complex and cannot be reduced to simplified terms.

EXTENSION:

Extension of the upper cervical spine is primarily carried out by the semispinalis capitis, splenius capitis, sub occipital group (except the obliquus capitis posterior), and SCM. The SCM is generally considered a flexor of the cervical spine, but it must not be overlooked that when it contracts concentrically, in addition to causing the lower cervical spine to flex, it causes the upper cervical spine to extend. This action is probably not prominent when a heavy load is being moved, but it does become important during common movements of the head in the upright position. In addition to these muscles, the upper trapezius contributes to extension of the upper cervical spine.

The most important extensors of the lower cervical spine are the semispinalis cervicis, multifidiare, and longissimus cervicis. The extensors of the cervical spine, in general, are bulkier and powerful than the flexors. The semispinalis muscles are powerful extensors and, along with the multifidi is, are important stabilizers of the lower cervical spine and, in the case of the semispinalis cervicis, the upper thoracic spine. In the lower cervical and upper thoracic spine, the semispinalis cervicis is assisted by the spinalis cervicis, longissimus cervicis, and iliocostalis cervicis, all part of the erector spinae group.

ROTATION:

Rotation of the cervical spine involves activity by a wide variety of muscles. This is because of the importance of fine motor control of this movement during functional movements involving rotation, such as smooth pursuit movements of gaze and normal rotational head movements while talking, especially to a group. Rough, uncontrolled movement of the cervical spine in these situations would be functionally inefficient and disturbing to the normal carrying out of these everyday activities.

The movement of the head and neck into rotation is primarily carried out by the ipsilateral splenius capitis, contralateral SCM, and ipsilateral semispinalis capitis. In the upper cervical spine, the obliquus capitis inferior and rectus capitis posterior major also play an important role. In the lower cervical spine, the splenius cervicis contributes. In addition to these muscles, the contralateral upper trapezius, ipsilateral levator scapulae, and ipsilateral longissimus capitis and cervicis are important rotators (although the upper trapezius and levator scapulae only perform this function in the presence of upper limb activity). On an intersegmental level, the multifidi and rotators are the prime mover.

The SCMs are of particular importance in maintaining the smooth, even cervical movement during rotation. when head rotation is performed in response to a stimulus, both SCMs contract, with the muscle on the side opposite the direction of rotation contracting earlier and concentrically to create the movement and that on the same side as the movement displaying a slightly delayed onset of eccentric contraction for control. This action is also seen in the semispinalis and splenius capitis muscles.

In the case of these muscles, concentric contraction on the side to which rotation occurs is seen while eccentric contraction on the side opposite takes place simultaneously. Other muscles are active as well in controlling cervical movement, most likely to prevent unnecessary flexion, extension, and lateral flexion movements during rotation. These include the anterior and middle scalene, semispinalis cervicis, and the longus capitis and coli.

Lateral flexion is a less important and less well-studied movement in the cervical spine. SCM shows the greatest activity with this movement, with substantial contribution from the levator scapulae, longissimus capitis and cervicis, and scalene. The iliocostalis cervicis and upper trapezius also make substantial contributions. On an intersegmental level, the obliquus capitis superior and inferior in the upper cervical spine and the intertransversarii and multifidi in the lower cervical spine are the prime movers. As most of the muscles involved in lateral flexion of the cervical spine are also extensors, the longus capitis and colli are active in preventing flexion during this movement.

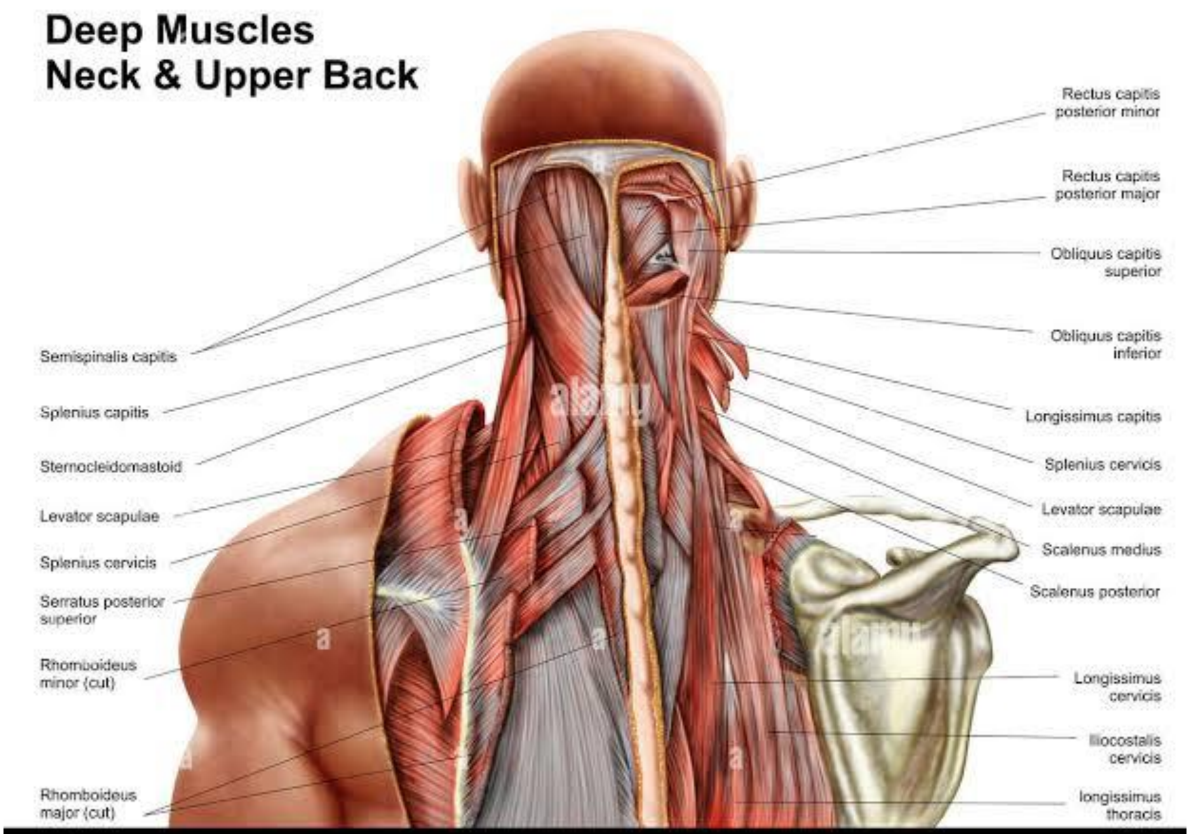


Figure 2.4. Representing the deep neck muscles.

LIGAMENTS:

Ligaments feature a typical composition of approximately 70% water, with the main structural integrity contributed by type I collagen and elastin. The posterior portions of the vertebrae are connected by the ligamentum flavum (LF) and the comparatively minor interspinous (ISL) ligaments. The LF serves as a posterior wall for the spinal canal, as well as a shock-absorbing tether to prevent hyper flexion. At the posterior margin of the anterior column, the posterior longitudinal ligament (PLL) tightly adheres to both the anterior column and the intervertebral discs.

Opposite the anterior column is the anterior longitudinal ligament (ALL), which is very similar to the PLL in appearance and mechanical characteristics. Primary resistance to hyper-rotation is provided by the alar ligaments, ATL is constructed of a stiff fibro cartilaginous tissue. Beyond its role in the atlanto-axial joint, the ATL possesses superior and inferior cruciform elements, which bridge the main structure of the ATL to the 12 occiput and inferior portion of the dens, respectively. The TM provides stiffness to the cervical spine, intimately attaches to the dura mater (outer sheath) of the spinal cord and prevents the tip of the dens from protruding into the spinal canal.

Several other ligaments of more minor mechanical function are found within the cervical spine. These ligaments are often absent from the cervical spine or have been found to provide very little mechanical support. The more commonly acknowledged of these ligaments include the accessory axial-occipital, atlanto-dental, lateral atlantal-occipital, intertransverse, ligamentum nuchae, supraspinous, transverse-occipital, and Barkow ligaments.

BIOMECHANICS OF FHP:

Faulty posture not only affects specific tissues by placing increased strain on them during the maintenance of the posture, it also disturbs the postural set from which movement patterns will be derived. In the case of the forward head posture, for example, there will be positional relationships that affect the afferentation from the tissues involved (influencing somatosensory) input as well as the moment arms of the muscles that are required to produce the response.

Forward head posture produces a destabilizing effect on the cervical spine in part because, extension of the upper cervical spine increases the moment arm of the SCM for upper cervical extension, and flexion of the lower cervical spine increases the moment arm of the SCM for lower cervical flexion. This alteration in moment arms gives the SCM a greater mechanical advantage, at the expense of the deep cervical flexors and lower cervical/upper thoracic extensors. Because the SCM is a long muscle, it is not adequately suited for producing stabilizing responses, thus leading to a destabilizing response in cervical spine.

The effect of postural set on stability responses can easily be demonstrated by analyzing a person stand in a faulty postural set with the chin jutted forward, and hyperextension of the upper cervical spine, and hyper kyphosis of the thoracic spine-and gently but firmly apply a push to his or her upper thoracic area from behind, the magnitude of movement of the cervical spine in a mild "whiplash" fashion. Then place the individual in an optimum postural set with elevation of the postero superior portion of the head, elongated cervical spine, and chin slightly tucked-and introduce another push of the same magnitude to the same area. The marked difference in the resultant movement illustrates why someone who is struck from behind in a motor vehicle accident will incur far greater injury if he/she is sitting in a faulty postural set as opposed to a correct postural set.

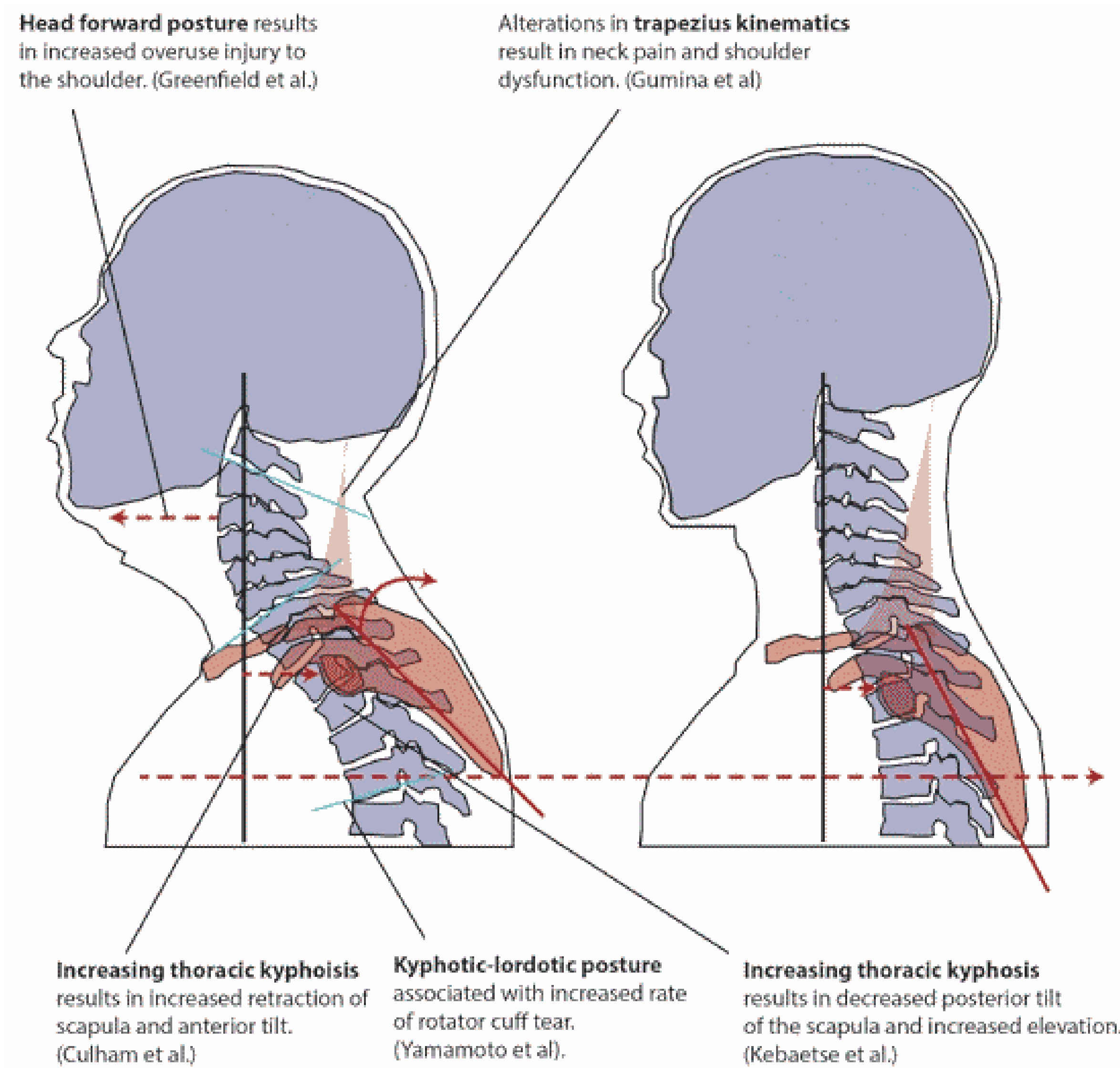


Figure 2.5. Demonstrating the altered neck biomechanics due to Forward head posture.

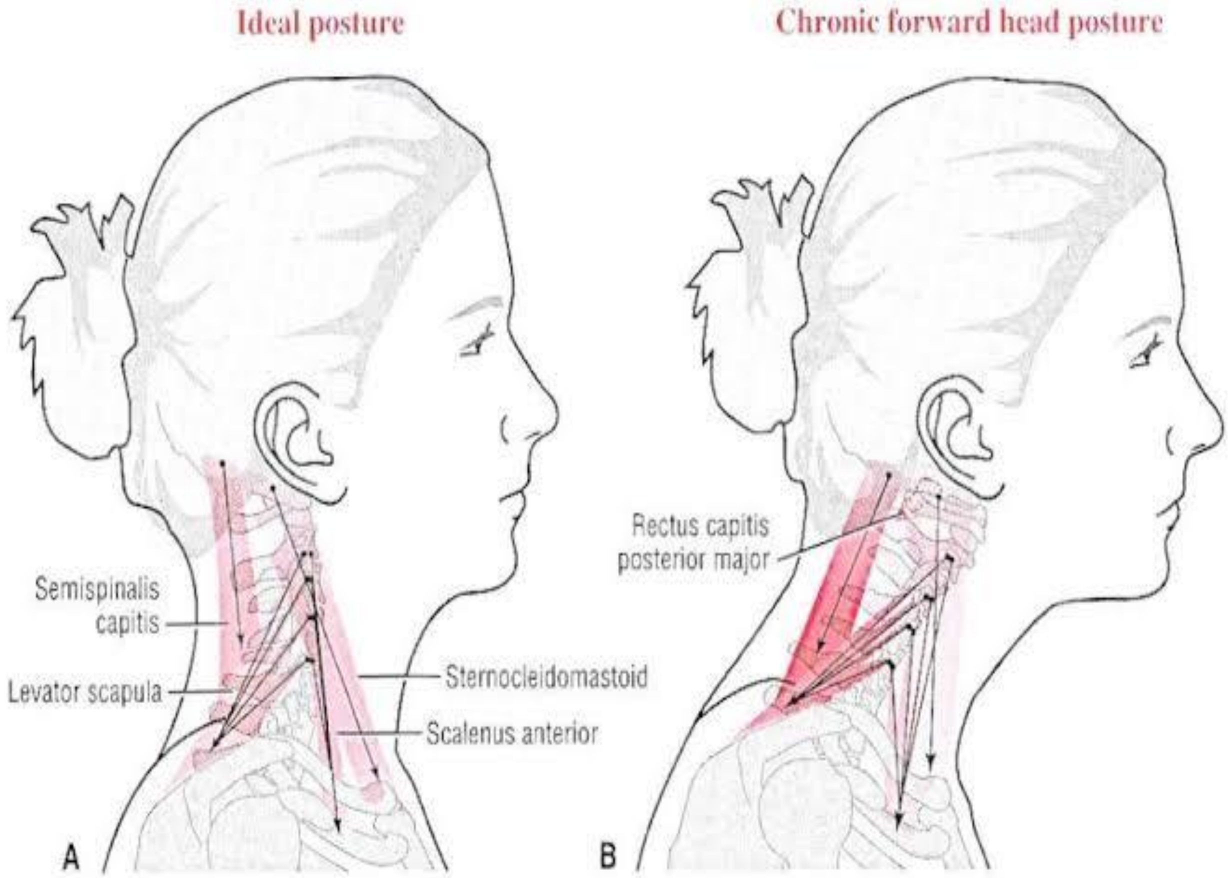


Figure 2.6. Illustrating the altered muscle load due to chronic forward head posture.

MECHANISM OF DISTURBED PROPIOCEPTION:

Disturbance of eye-head-neck coordination and oculomotor reflexes resulting from cervical trauma is well documented. It has been shown to be present in patients with "tension-type headaches" as well. The most common oculomotor reflexes affected are saccades and smooth pursuit, although sympathetic-related eye functions have also been shown to be involved. It is generally thought that this eye motility dysfunction, particularly smooth pursuit, and saccades, relates to disruption in the normal afferentation from the mechanoreceptors in the cervical muscles as a result of trauma and muscle dysfunction.

Hypertonicity of certain muscles in the cervical spine, particularly the cervical rotators (SCM, upper trapezius, splenius capitis, obliquus capitis inferior) causes an increase in the afferent input from these muscles, whereas any muscles that may be inhibited produce decreased afferentation. This imbalanced input conflicts with afferent input from other sensory structures and creates alteration in the reflex processes that control these eye movements. In addition, disturbance in the velocity of saccades is caused by the disruption of attentional processing. Coordination of head and neck movements is closely related to that of eye movements and can also be disturbed by cervical spine dysfunction.

The relationship between cervical spine dysfunction and coordination of head and neck movements was first shown by Revel et al, who found a significantly decreased ability to reproduce head position in patients with chronic neck pain.

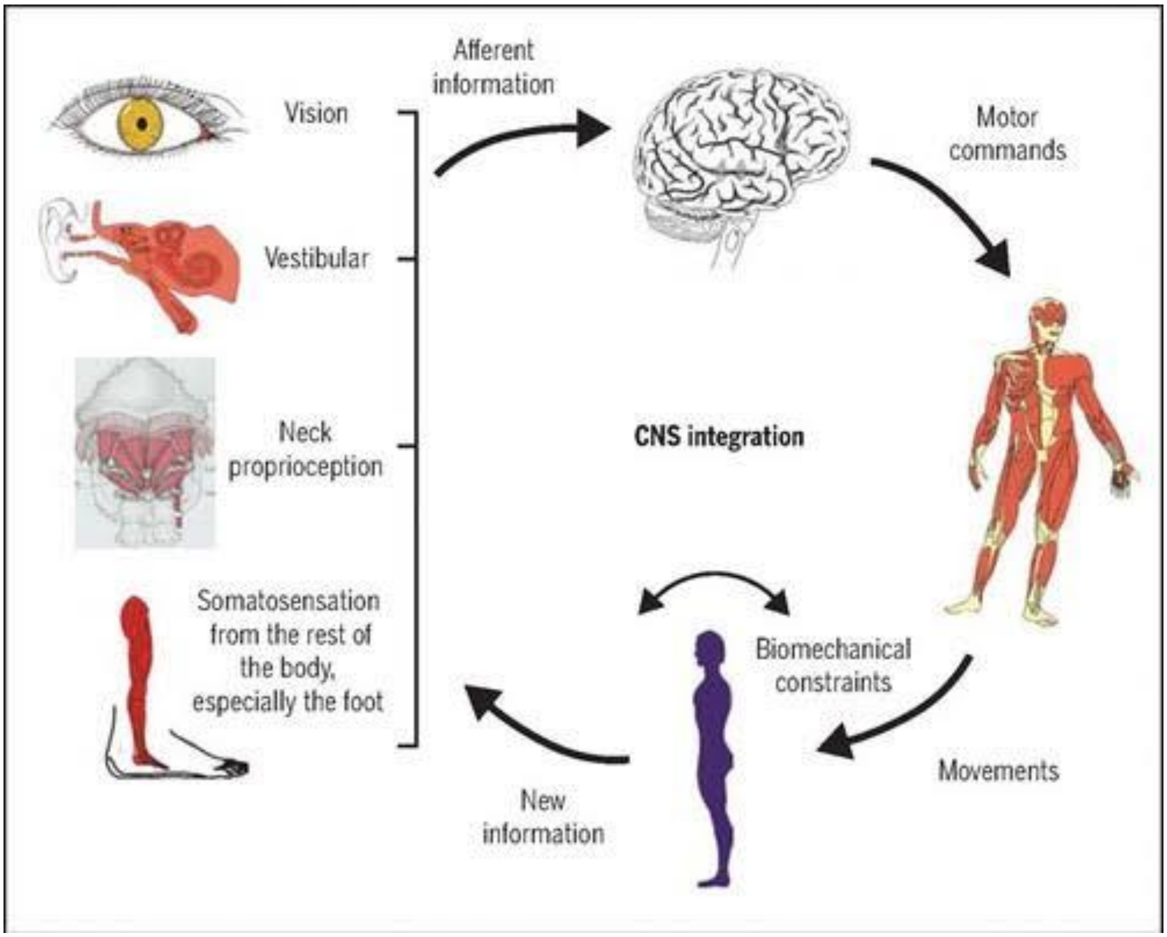


Figure 2.7. Representing sensorimotor function and dizziness in neck pain

CERVICAL SPINE DYSFUNCTIONS:

In individual with nonimpaired necks, the apparent range of motion on one day may differ from that on another day. Measuring range of motion from flexion to extension and from extension to flexion may present different value, in patients with neck pain, dysfunction can occur at one level and reflect symptoms on another. These oddities indicate that clinicians should appreciate and assess the cervical spine not as a homogeneous unit, but as a series of separate, yet linked segments that may contribute to symptoms and signs in a variety of complex ways.

The upper cervical spine frequently manifests symptoms above it, as headaches, whereas the lower cervical spine is associated with lower neck and upper extremity pain syndromes. The mid-cervical region (C3-5) commonly displays localized facet joint pain but can refer pain either above or below it [14].

Non-specific neck pain is defined as pain with a postural or mechanical basis and affects about two third of people at some stage. Neck pain often occurs in combination with limited movement and poorly defined neurological symptoms affecting the upper limbs. Acute neck pain can resolve within days or weeks but becomes chronic in 10% of population. The pain can be severe and can occur with radiculopathy or myelopathy. Prevalence is highest in middle age, with women being affected more than men.

The etiology of uncomplicated neck pain is unclear. Most uncomplicated neck pain is associated with poor posture, anxiety and depression, neck strain, occupational injuries, or sporting injuries [15]. The inability to stabilize the intersegmental joint in the presence of perturbations is one mechanism by which people with significant cervical dysfunction often have pain with common, everyday movements

BIOMECHANICS OF SITTING POSTURE WHEN USING DESKTOP:

Computer use might affect habitual postures directly, with transient postural changes during computer use leading to more permanent changes in habitual postures through adaptive neuromusculoskeletal changes. Degree of such adaptations depend on the total duration of the stimulus; it might explain the mainly linear relationship observed between hours of use and some habitual postures.

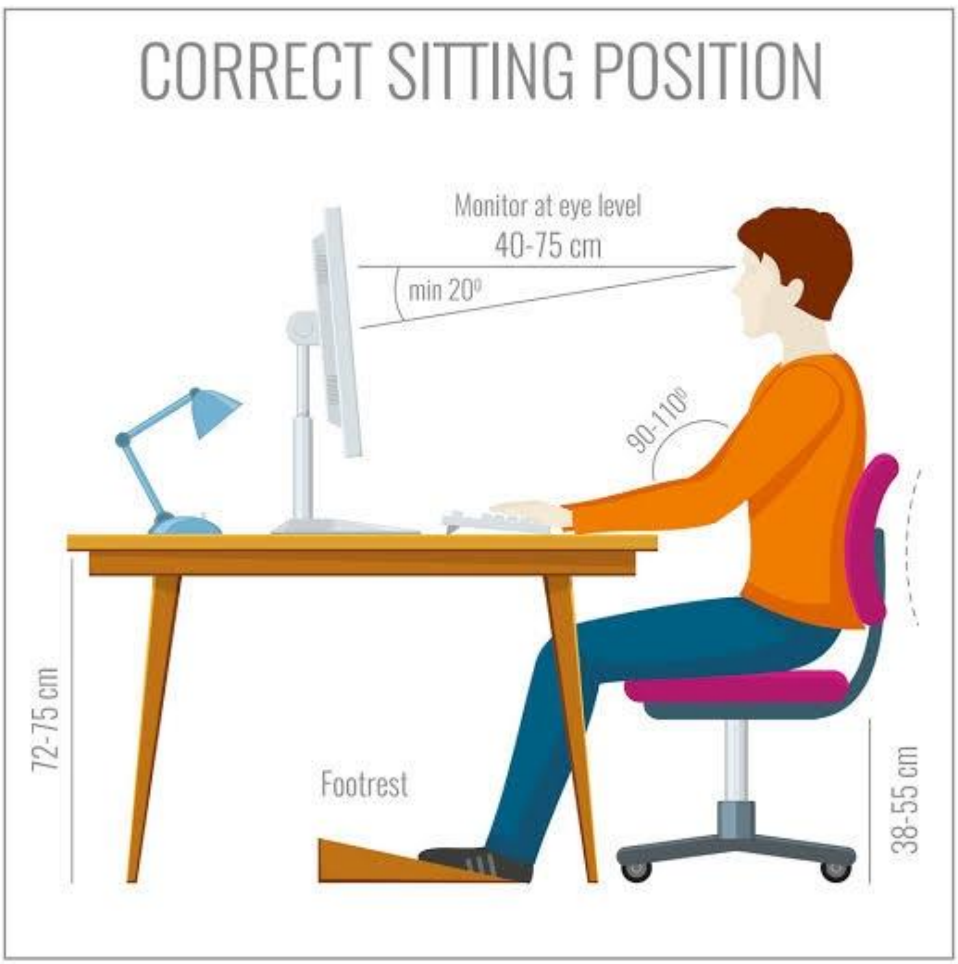


Figure 2.8. Demonstrating ideal sitting posture with appropriate distances while sitting on desktop to avoid biomechanical imbalances.

The sitting position routinely used for performing tasks increases the potential of developing forward head posture, considered abnormal and frequently observed in medical practice. Forward head posture is linked with chronic musculoskeletal and functional disorders in the craniofacial region, neck, and shoulders. In a study conducted by Kang et al., group of individuals who remained seated at a computer for six or more hours a day for over ten years exhibited forward head posture, there is a forward shift in body's center of gravity, and reduced balance and postural control. Sitting position is generally influenced by several factors, including design of chair, its ergonomic adaptation to the individual and the task to be performed.

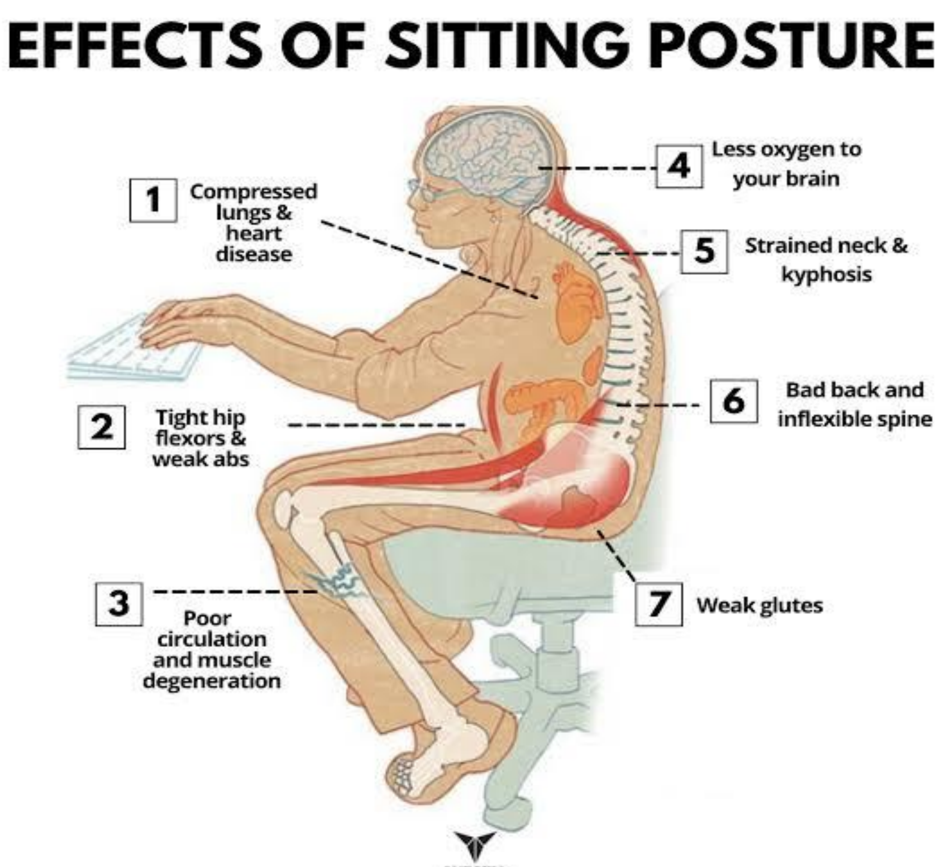


Figure 2.9. Diagram representing overall effect on body due to relaxed sitting

When sitting without a backrest, the pelvis tilts backwards and lumbar curvature is reduced or reversed, converting lordosis into kyphosis. Pressure on the intervertebral disc in this position (no backrest), measured at the level of L3, was 40% greater than that recorded with the subject standing. In the erect sitting position, the forward tilt of the pelvis preserves the concavity of lordosis, promoting a reduction in the load on this vertebral segment. However, this erect posture without a backrest puts excess strain on the muscles, making it unsuitable for performing tasks over prolonged periods. As such, the chair should allow for postural adjustments to reduce pressure on the intervertebral disc.

A relaxed sitting posture with the pelvis in a neutral position and a relaxed thoracic column showed a significant increase in flexion and forward head posture, in addition to a significant rise in the electrical activity of extensor muscles in the neck and thoracic column at T4, flexion moment is balanced by passive connective tissue structures such as capsules and ligaments.

Thus, studies show that the load on the neck is related to the trunk and the position of the head. The load moment is balanced by muscle force and the traction of passive connective tissue. The moment arm and corresponding muscle force are 50% higher at a forward head angle of 30° when compared to values obtained with zero tilt. Load on the C7-T1 segment is 3 to 4 times greater with full head flexion.

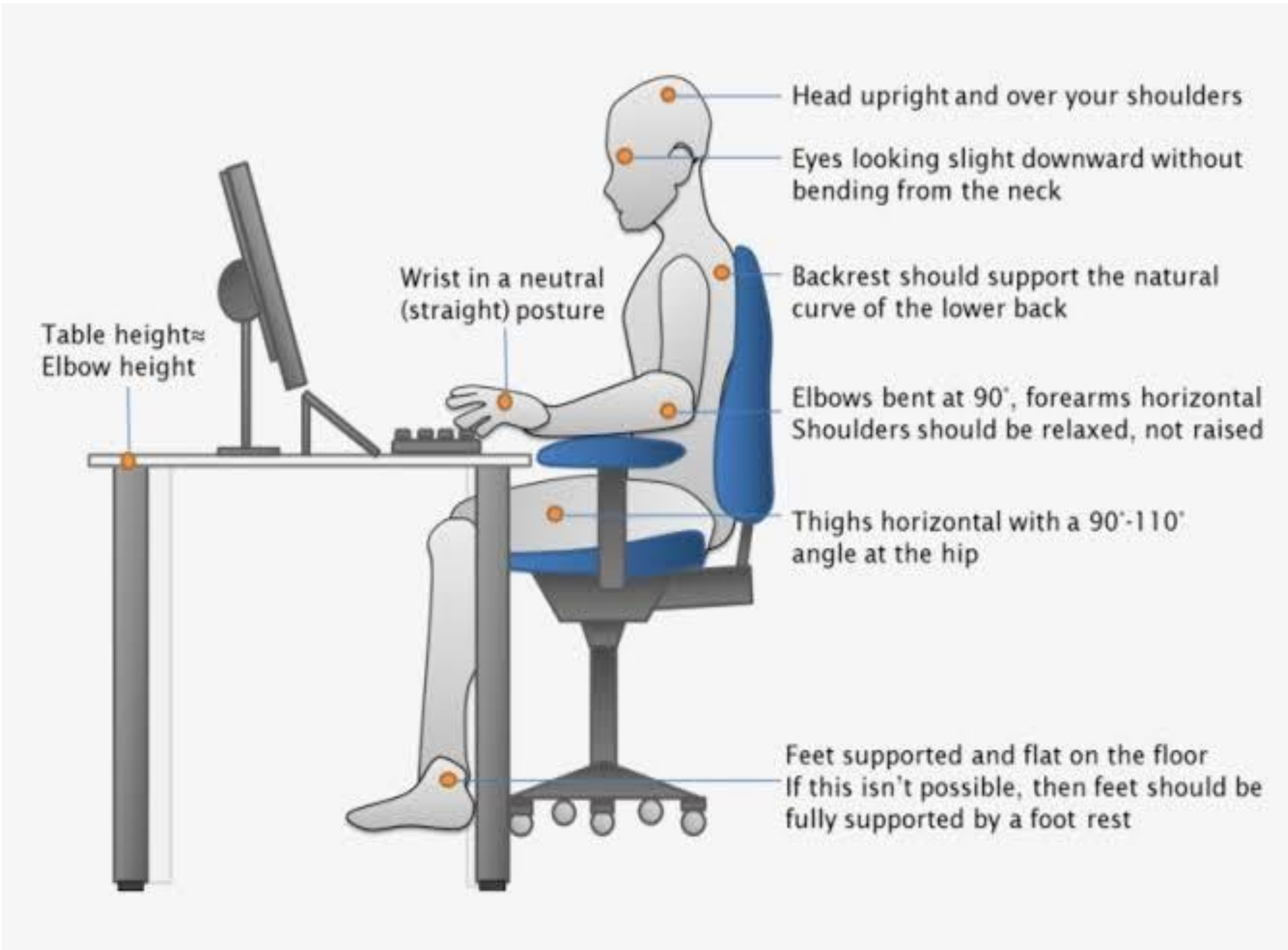


Figure 2.10. Explaining the correct adjustments in sitting posture while using desktop.

PROPIOCEPTION

Bagan Peng et.al, [2021], conducted a study and result of study reveals that neck pain is common cause of disability but the basic pathology is unclear. He stated that main problem with patient with neck pain is the altered proprioception which leads to disturbance of cervical sensorimotor control. The overall recommended clinical evaluation and management of sensorimotor control disturbances are based on currently evidence, he mentioned that this is an emerging field that requires more extensive study to determine evaluation and treatment [3]

Pramod Kumar Saho, Neha Chauhan et al., [2020]conducted a study and result of study reveals that -" the prolonged usage of computer (more than 4 hours) could negatively affect cervical proprioception and dynamic balance ability even in healthy adults. He also emphasizes on importance of developing programs for good postural education and awareness about normal duration of computer usage [16]

Oberoi Mugdha, Jani Kotecha Dhara et al., [2015], conducted a study and result of study reveals that cervical joint position sense is found altered in individuals having chronic neck pain, didn't have any relation with age and gender. He also emphasizes on the importance of assessment of sensorimotor functions in patients with chronic neck pain and included treatment oriented towards sensorimotor rehabilitation [17]

Jung ho kang, Kae young park et al., [2011] studied the effect of FHP on postural balance in heavy computer users suggested that FHP may contribute to some disturbances in balance ability in healthy adults [1]

Revel M, Andre-Deshays C, Minguet M. Cervicocephalic, [1991],conducted a study and result of study reveals that patient. with neck pain were less accurate in repositioning head to neutral from flexed, rotate or bend, positions [18]

CVA ANGLE

Apurva Nitin Warlike et.al., [2019] conducted a study and result of study revels, that- "there is no significant correlation between FHP and pain and FHP and rom of cervical spine in desktop users [9]

Daae-Hyun Kim, Chang-Ju Kim et al., [2018] conducted a study and result of study reveals that decreased CVA, and cervical flexion range are prognostic factors for occurrence of pain in cervical region thus assessment of the CVA and flexion joint range of motion in cervical area can be used clinically as a reference to prevent future occurrence. [2]

Aliaa Rehan Youssef, PhD, [2016], conducted a study and result of study reveals that photogrammetric quantification of FHP by measuring craniovertebral angle may differ across sides in patients having mechanical neck pain [19]

B. Shaghayegh Fard, Amir Ahmadi, et al., [2016], concluded that CVA was increased in sitting position thus he introduced the standing position to be more reliable for measuring forward head posture [10]

Jung-Ho Kang, Rae-Young Park, et al., [2012], conducted a study and result of study reveals that heavy computer users are more prone to forward head posture and, he emphasizes on the importance of good posture education and stretching exercises while using a computer and common VDT's such as mobile, tablets [4]

Anabela G Silva, T. David Punt et al., [2009], conducted a study and result of study reveals that forward head posture was seen more in people aged 50 yrs. Or below who have no traumatic chronic neck pain compared to people who are pain-free. He also suggested that further study is required which focus on head posture with patient having pain and age should be considered [20]

Grace P.Y Szeto, Leon Straker, et al., [2001], conducted a study and result of study reveals conducted a study and result of study reveals that the computer users who had neck pain showed increased head tilt and neck flexion postures also they tend to have protracted acromion compared to those who are pain-free. All desktop users showed 10% increase in FHP from their relaxed sitting posture while working with computer display, but there were no significant changes in posture because of time -at-work [21]

Szeto GP, Straker L et al., [2002] conducted a study and result of study reveals that maintaining head forward for longer durations causes musculoskeletal disorders which includes decrease cervical lordosis [1]

CERVICAL ROM

Muhammad Nazim Farooq, Mohammad A. Mohseni Bandepi et al., [2016], conducted a study and result of study reveals that universal goniometer is a reliable tool for the assessment of cervical range of motion in healthy subjects [22]

Se-Yeon Park, Won-GYU YOO [2014], conducted a study and result of study reveals that sustained computer work affects cervical flexion range especially in upper cervical region after computer work also the result showed that upper cervical flexion and its relationship to total cervical flexion were significantly reduced [23]

PHYSICAL ACTIVITY

Jung Ha Park, Ji Hyun Moon et al., [2020] conducted a study and result of study reveals that – "the total daily sedentary time cannot be reduced for unavoidable reasons, it is good to do sufficient exercise equivalent to or more than 150-300 minutes of MPA per week, the studies reveal that physical activity could counterbalance the adverse effects of sedentary behavior in population. If enough exercise cannot be performed by anyone, person should at least perform light physical activity, to cover or match the total time of exercise. the person should further try to increase their physical activity levels as their situations permit for good health [4]

Vivek Poddar, Raghuram Nagarathna, Akshay Anand et al., [2020], conducted a study and result of study reveals that – "current prevalence estimates that 20 and 37 % of population in India are mildly active and 57 % of population did not match the WHO regimen for physical activity [5]

Akindutire Isaac Olusola, Olanipekun Johnson Adewunmi, et al., [2017], conducted a study which conducted a study and result of study revels examined the reasons for sedentary lifestyle and physical inactivity. and the risks of sedentary behavior. The results show that Physical inactivity leads to sedentary behavior [24]

Sepal deep Singh Dhaliwal, Parveen Kalra, et al., [2015], studied that there is lack of awareness of prolonged sitting or sedentary behavior in Indian employees and students. The results show that the large population takes lesser breaks during continuous sitting. There is a misconception that physical activity can balance the effect of sitting [25]

Mathew Stults –Kolehmainen, Rajitha Sinha, Yale [2014], conducted a study and result of study reveals that experience of stress impairs physical activity and suggested that future study should center on the development of theory explaining the mechanism underlying the multifarious influences on physical activity behaviors [6].

Janice Cheung, et.al [2013], conducted a study and result of study reveals that participants having neck pain, and who reported mild level of disability, and pain free controls, and reported no previous injury and recent neck pain for 3 months did not differ in the amount of subjective and objective measured whole body physical activity, as determined by RAPA scores and accelerometry data. He also stated in his study that perceived activity level might be relate to the pain threshold and tolerance at local neck muscle sites, whereas measured activity may be related to pain measures at the tibialis anterior, which reflects generalized pain sensitivity [7]

CHAPTER-3

MATERIALS AND METHODS

PARTICIPANTS:

Healthy participants were recruited from a sample of convenience at the INTEGRAL UNIVERSITY, Lucknow based on inclusion and exclusion criteria. Twenty-four male and six female aged between 25-45 volunteered for the study after providing the consent. Participants were then divided into 2 groups; 15 participants who were physically active and another 15 who were sedentary. All subjects were fully briefed about study purpose, benefits, and risk prior to taking consent.

STUDY DESIGN: -

It was a group comparative cross-sectional study and subject were selected based on the sample of convenience.

STUDY DURATION:

6 Months

VARIABLES:

DEPENDENT- Proprioception, CROM, CVA, IPAQ score

INDEPENDENT- Age, weight, Height, Computer users

INCLUSION CRITERIA:

1)Computer users (≥6 hrs.)

2)Both genders

3)Age-25 to 45 yrs.

4)Sedentary lifestyle computer users

5)Active lifestyle computer users

6)Pain free population

EXCLUSION CRITERIA:

1) Traumatic neck injury

2) Age >45 and <25

3) Work duration<6 hrs.

4) Taking any treatment for neck.

5) Recent surgery near neck area

6) Subject not willing to take part in study.

7) C/o neck pain

8) Pain with or without radiculopathy

PROTOCOL

Based on inclusion and exclusion criteria

Heavy computer users

Sedentary users(n=15) | Non sedentary users(n=15)

Group A | Group B

PROPIOCEPTION | PROPIOCEPTION

ROM | ROM

CVA | CVA

Data analysis

Comparison of results

Conclusion

MEASURING TOOLS: -

1)PROPIOCEPTION

6 trails for each side head rotation and cervical flexion were done through head mounted LED light in each patient and marked on a TRACKER chart. Mean value was calculated for each patient.

2)ROM

Cervical flexion, extension, lateral flexion, and rotation range was taken through universal goniometer.

3)CVA

CVA was calculated by measuring horizontal distance from c7 vertebra to tragus of ear (Cranio-vertebral angle measurement) through photogrammetric method and further analyzed by APECS app.

4)To classify sedentary and non-sedentary lifestyle

International physical activity questionnaire (IPAQ) [26]

MEASUREMENT OF PROPIOCEPTION

The cervical joint position sense was measured using Joint position error test (JPE)/Rebel's test. This method has shown good test-reset reliability [27]. Three cervical spine movements (flexion, right and left rotation) were assessed through JPE test. This was assessed by using a laser pointer hooked on lightweight headband on participant's head and a circular target was placed on the wall which was 40 cm in diameter and has 8 Concentric circles with 1 cm gap in each. Each subject was seated straight at 90 cm from the target, thighs were horizontal, and knees flexed at 90°. Subjects were asked to close their eyes and to focus on self-perceived neutral head position, target was then adjusted accordingly (laser pointer focused on the center of target).

Participants were then instructed to move the neck one by one nearly half the normal range to avoid any end range pain or stretch provocation in all three directions slowly [28]. At first subjects were asked to perform 2 trials in each direction with eyes open to understand the procedure. Each cervical movement was then performed 6 times with closed eyes, after each movement head was repositioned to neutral by examiner manually and averaged. Average of 6 trials was measured in cm by scale ruler and then converted into degrees for data analysis by the formula: -

$$\Theta = tan^{-1}\left[\frac{error distance}{90}\right] cm$$

Figure 3.1. Sitting position for JPE test.

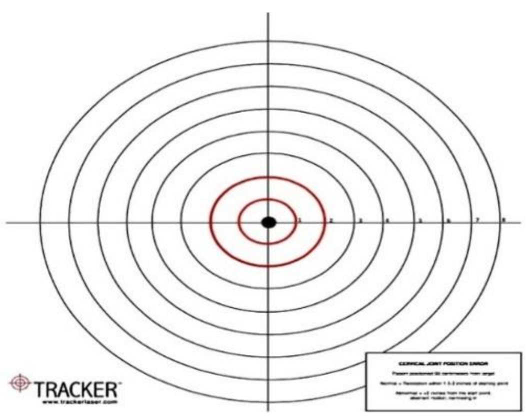


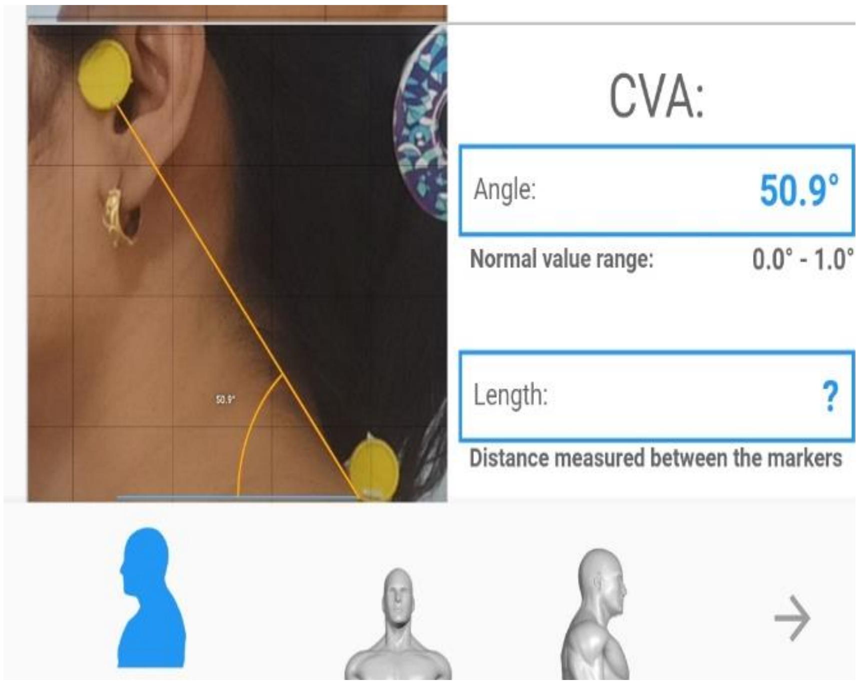
Figure 3.2. Target for JPE test

MEASUREMENT OF CVA

With a view to accurately measure the degree of CVA, photogrammetry method was used, which is recommended as a method that is clinically feasible, cost-effective, time-efficient, and non-invasive with no exposure to ionizing irradiation [20]. This was measured as the angle between an imaginary line extending from c7 through the tragus and the horizontal line. The value of CVA indicates the position of head relative to trunk. Ludo token was used as a marker and was placed on tragus of ear and c7 vertebra with the help of double-sided tape.

A graph paper was fixed on wall according to subject's height and subjects were asked to stand straight. Lateral picture from right side was taken through android phone fixed on a tripod at 150 cm from subject and camera was fixed at the shoulder level in standing position. All the pictures were then assessed by Apecs app to measure the exact angle.

[a]



[b]

Figure 3.3. A Profile photography method showing measurement of craniovertebral angle.

[a]-represents the position of marker placed

[b]-showing angle measured by Apecs software.

MESUREMENT OF ACTIVE CERVICAL RANGE OF MOTION

The range of motion was measured by universal goniometer. Subjects were first introduced with all the movement which needs to be assessed. All the participants were asked to sit straight with back supported and then perform movement one by one. The position of fulcrum, movable and stable arm is demonstrated in the table below: - [29]

Table 3.1. Illustrating the placement of goniometer for measurement of range of motion.

Movement	**Position of Fulcrum**	**Position of stable arm**	**Position of movable arm**
Flexion	External auditory meatus	Perpendicular to ground.	Base of nares.
Extension	External auditory meatus	Perpendicular to ground.	Base of nares.
Rotation	Center of cranial aspect of head	Parallel to imaginary line between two acromion process.	Tip of nose.
Lateral flexion	Spinous process of C7 vertebra	Spinous process of thoracic vertebra.	Midline of head (in line with occipital protuberance).

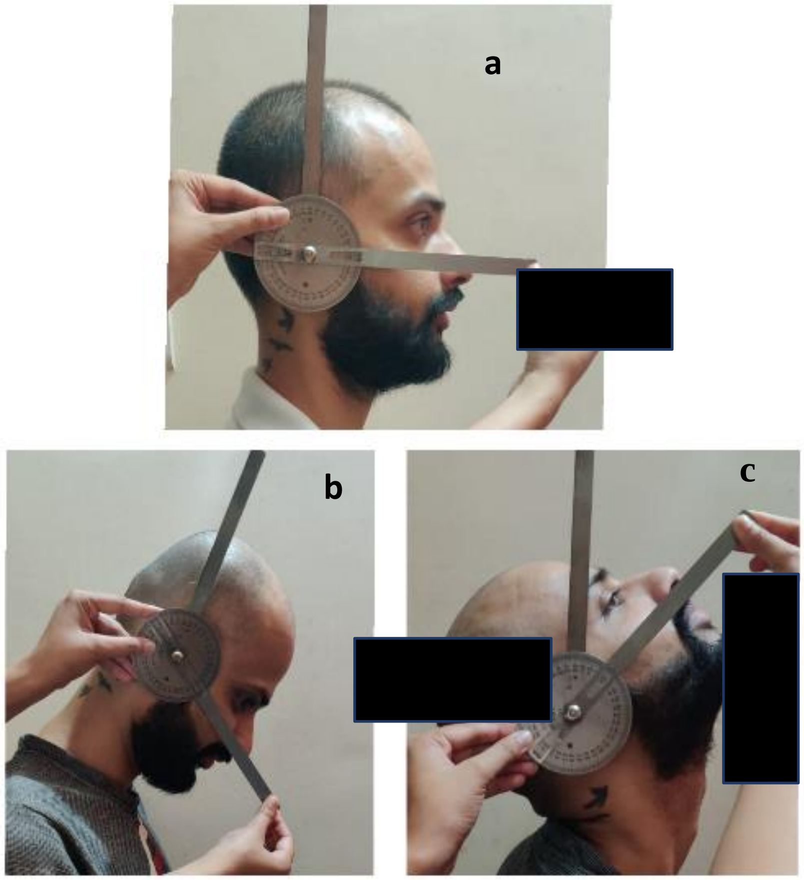


Figure 3.4. Represents neck position for measurement of flexion and extension with goniometer.

[a]- represents starting position for flexion and extension (starting position assumed at 90° in goniometer)

[b]- represents end position for flexion

[c]- represents end position for extension (examiner holds the proximal arm at external auditory meatus while the distal arm was aligned at base of nares)

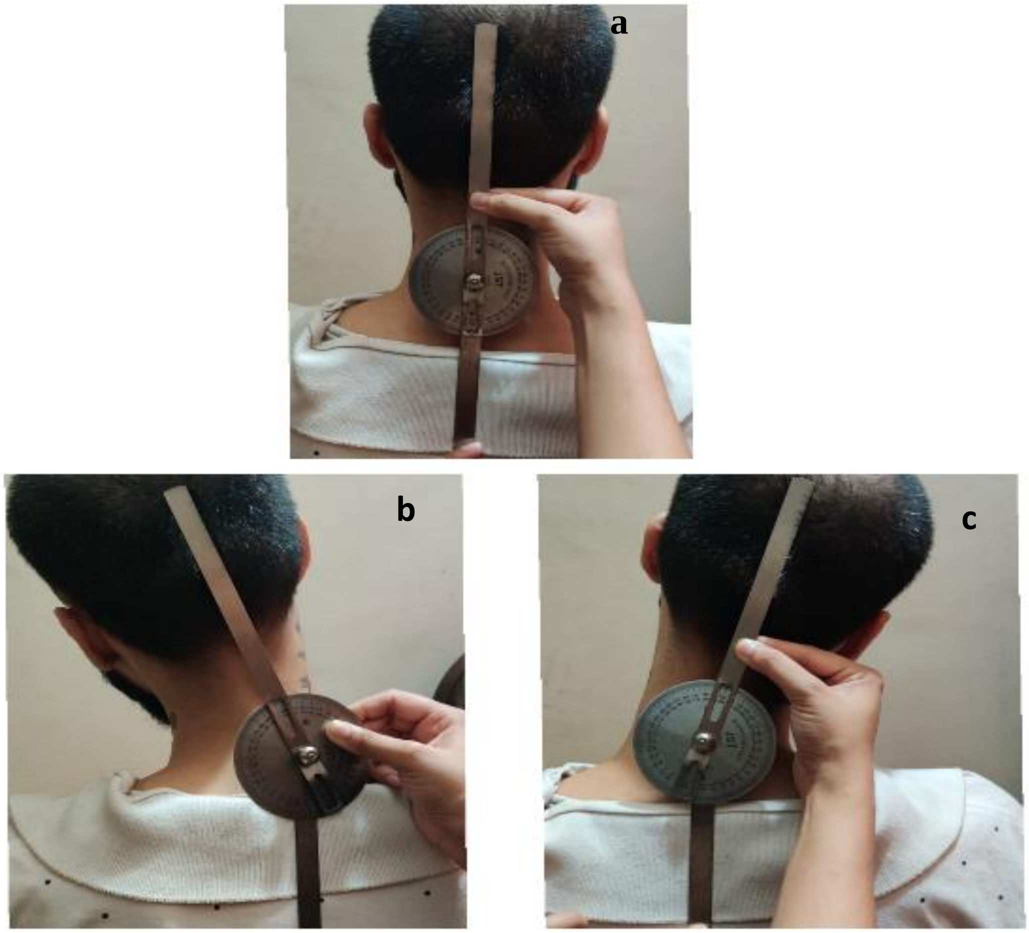


Figure 3.5. Represents neck position for measurement of lateral bending

[a]- represents starting position for lateral bending (starting position assumed at 180° in goniometer)

[b]- represents end position for left lateral bending

[c]- represents end position for right lateral bending

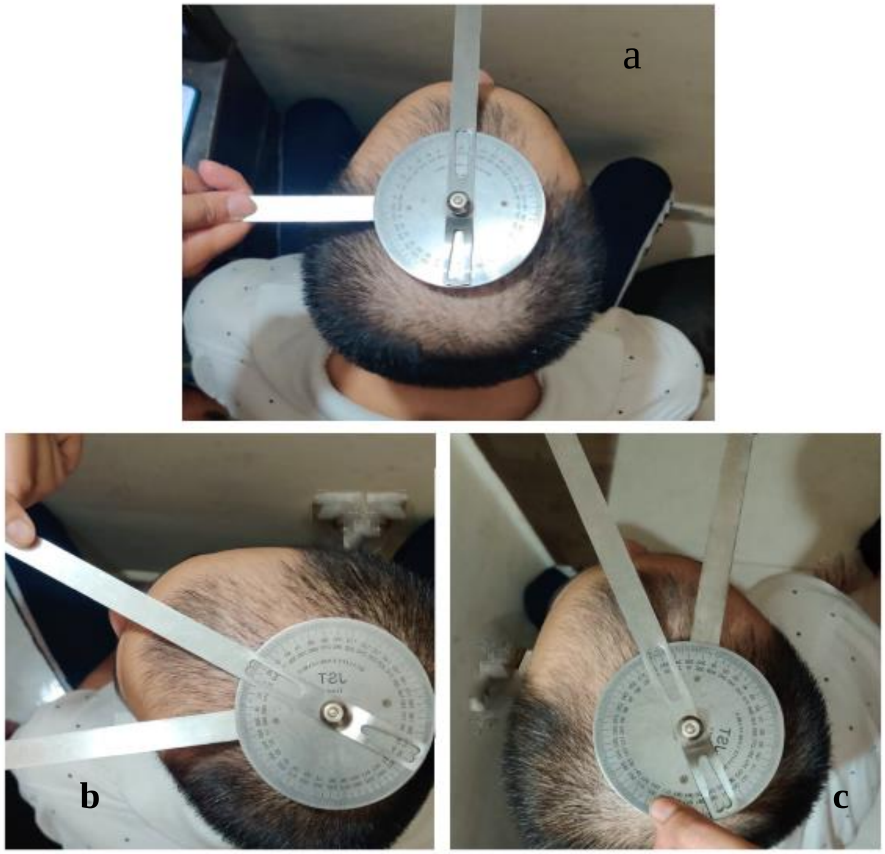


Figure 3.6. Represents neck position for rotation

[a]- represents starting position for rotation (starting position assumed at 90° in goniometer

[b]- represents end position for left rotation

[c]- represents end position for right rotation (at the end one of the examiner's hands maintains alignment of distal arm with the tip of subject's nose, proximal hand should be parallel to imaginary between acromion process.

DETERMINATION OF SEDENTARY AND NON-SEDENTRY BEHAVIOUR

The international physical activity questionnaire [IPAQ] comprises a set of 4 questionnaires. long [5 activity domains asked independently] and short [4 generic items] versions for use by either telephone or self- administered methods are available. The purpose of IPAQ is to provide common instruments that can be used to obtain internationally comparable data on health – related physical activity. The development of an international measures for physical activity commenced in Geneva in 1998, was followed by extensive reliability and validity testing undertaken across 12countries [14 sites] during 2000.

The results suggest that these measures have acceptable measurement properties for use in many settings and different languages and are suitable for national population – based prevalence studies of participation in physical activity. Intended population – is 18 – 69 years. [30,31]

Scale was first explained to participants and then asked to fill the same with more accurate results, All the scoring was then put in IPAQ-EXCEL sheet which determine the energy expenditure in each section of scale and classified the overall activity as low, moderate, and high. Low was categorized as sedentary and moderate and high were put under non-sedentary group.

DATA ANALYSIS: -

All statistical data were analyzed by the professional Statesian. Descriptive statistics (mean, standard deviation, frequency counts) were carried out using EXCEL 2010 data analysis tool Pak and excel analysis tool pack 2019 (Microsoft corporation). The independent and dependent variable for the participant's demographic information including age, weight, height, and gender were summarized by mean, standard deviation,). The averages of all six trails of proprioception were used for the reliability and between-group differences analyses.

To assess the between group differences for range of motion, proprioception, and CVA, a two-sample t-tests with unequal variance and two-tailed test were utilized to determine the significant associations between all the variables in groups. Alpha value kept at 0.05 hence p-value below 0.05 is considered as statically significant. Mean, SD, p, and t value are used in this study.

CHAPTER – 4

RESULTS

Among the 30 participants in our study 6 were females and 24 were male hence making this study male dominant. Mean age for participants of grp A and B was 33.93 ± 5.48 and 30.8 ± 5.50 SD. Mean height of grp A and B was 65.6 ± 3.68 and 65.3 ± 2.69 SD, Mean weight for grp A and B was 72.33 ± 12.56 and 66.06 ± 8.78(table 3.1). There was no significant difference between the age, height, weight in both groups hence it does not influence any aspect of the study as they had similar age, height, and weight.

Table 4.1. Statistical value of participant's demographic data (Mean ± SD)

Group	AGE	Weight	Height
A	33.93 ± 5.48	72.33 ± 12.56	65.6 ± 3.68
B	30.8 ± 5.50	66.06 ± 8.78	65.3 ± 2.69

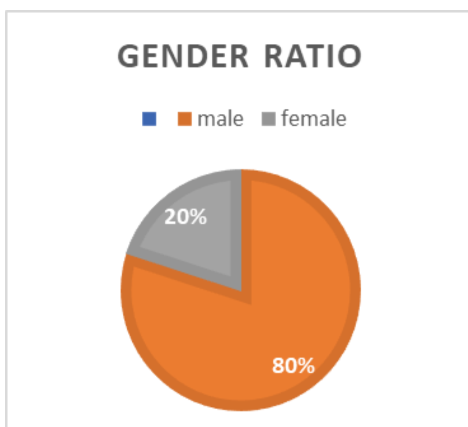


Figure 4.1. Representing gender ratio in study population.

The two-sample t-test revealed there were no significant difference between group A and B for proprioception (table 4.2) with a mean and SD (3.30 ± 1.996) for grp A flexion, (3.32 ± 1.334) for grp B, p value for flexion is 0.974. For LR the mean and SD (3.84 ± 1.919) for grp A, (3.74 ± 1.052) for grp B, p value 0.861. For RR the mean and SD (3.99 ± 2.117) for grp A, (3.9 ± 1.282) for grp B, p value 0.885. P value for all three movements is >0.005 hence statically insignificant.

Table 4.2. Statistical Mean ± SD values for cervical proprioception for both groups.

Proprioception				
	Gr A (in °) Mean ± SD	**Gr B (in °) Mean ± SD**	**p-value**	**t-value**
Flexion	3.30 ± 1.996	3.32 ± 1.334	0.974	2.063
LR	3.84 ± 1.919	3.74 ± 1.052	0.861	2.073
RR	3.99 ± 2.117	3.9 ± 1.282	0.885	2.068

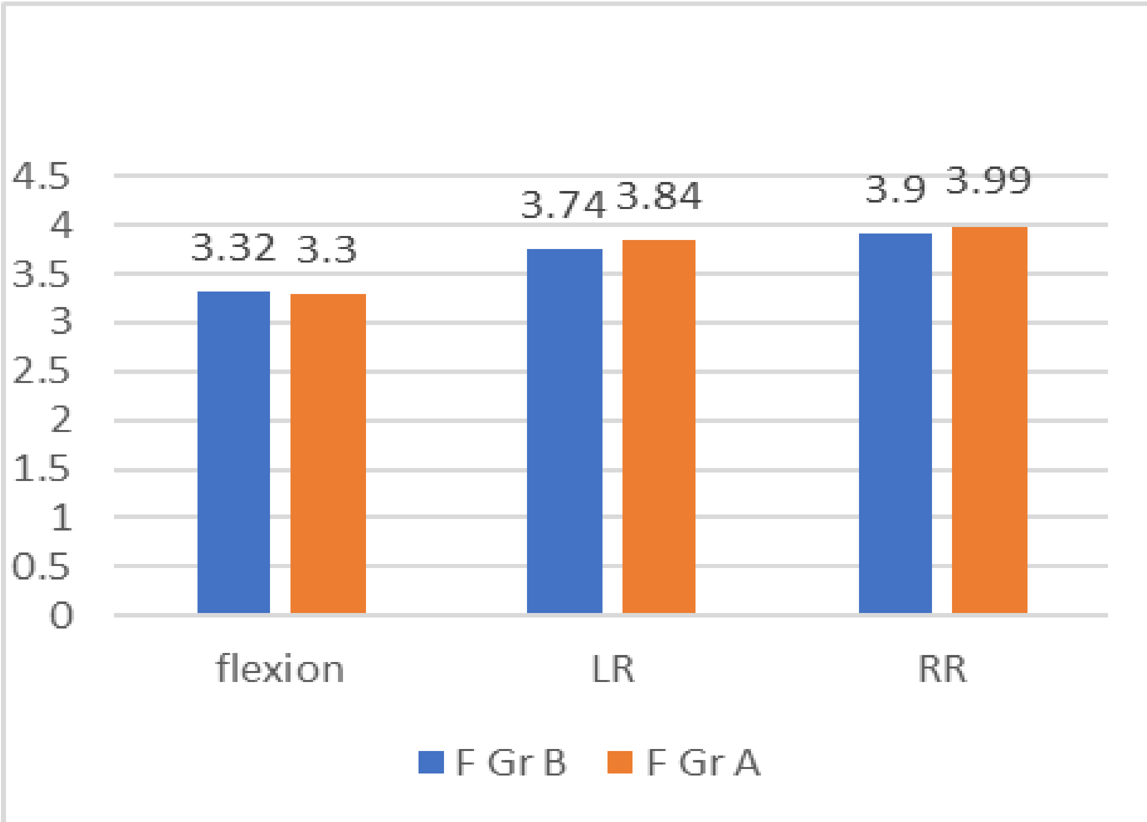


Figure 4.2 Graph representing the non-significant difference in proprioception of both groups.

The result of study manifests that there is no significant difference between CVA in both groups with a mean and SD of (48.04 ± 4.596) for grp A and (48.90 ± 5.258) for grp B, p value (0.635). Even being insignificant the CVA values for both groups were at the borderline compared to normal range and slightly less in sedentary which somehow explains the effects of sedentary lifestyle accompanied with lack of mobility.

Table 4.3. Statistical Mean ± SD values for CVA in both groups.

	Gr A (in °) **Mean ± SD**	**Gr B (in °)** **Mean ± SD**	**t-value**	**p-value**
CVA	48.04 ± 4.596	48.90 ± 5.258	2.051	0.635

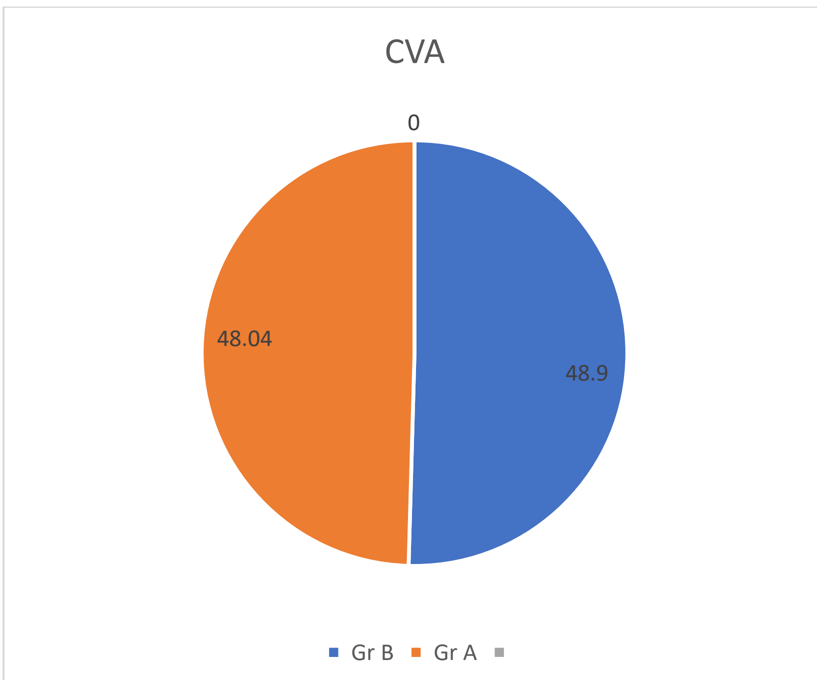


Figure 4.3. Pie chart representing the non-significant value of CVA in both groups.

Data reveals that there is no significant difference between flexion in both groups however, there is non-significant changes in extension mean ± SD for grp A 37.53 ± 5.962 and grp B 42.06 ± 7.694 (limited for sedentary) with a value p= 0.082(>0.05), t= 2.055 respectively. The side flexions were significantly higher for Grp B, with RF=33.8 ± 6.930 for grp B, 27.53 ± 5.617 for grp A, p=0.011(>0.005), t=2.051, LF= 33.3 ± 6.368 for grp B, 26.6 ± 5.068 for grp A, p=0.004(<0.005), t=2.051 but rotations were significantly higher for Grp A, RR=50.2 ± 10.523 for grp A, RR= 43.6 ± 5.539 for grp B, p=0.434, t=2.079. LR=53.33 ± 8.607 for grp A, LR= 45.86 ± 5.069 for grp B, p=0.008, t=2.068 (table 4.4).

Table 4.4. Summary of statistical data for cervical range of motion in both groups.

CROM	**Grp A (in °)** **Mean ± SD**	**Grp B (in °)** **Mean ± SD**	**p-value**	**t-value**
Flexion	36.6 ± 8.902	35.06 ± 6.408	0.593	2.059
Extension	37.53 ± 5.962	42.06 ± 7.694	0.082	2.055
RR	50.2 ± 10.523	43.6 ± 5.539	0.434	2.079
LR	53.33 ± 8.607	45.86 ± 5.069	0.008	2.068
RF	27.53 ± 5.617	33.8 ± 6.930	0.011	2.051
LF	26.6 ± 5.068	33.3 ± 6.368	0.004	2.051

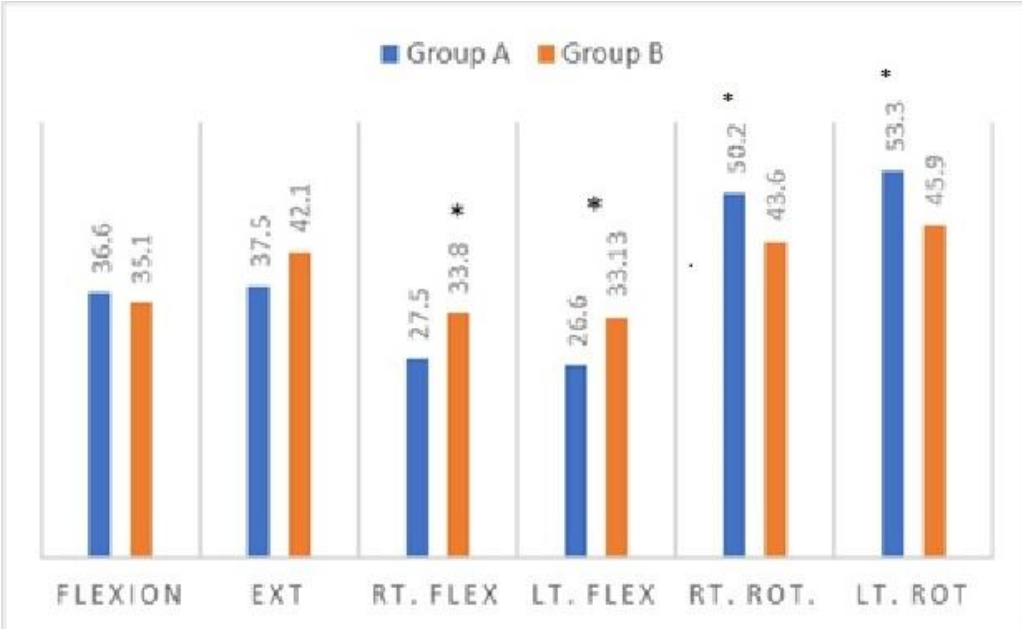


Figure.4.4. Graph representing the cervical range of motion in both groups.

*- represents the statistically significant difference in groups.

CHAPTER-5

DISCUSSION

This is a comparative cross-sectional study. The purpose of this study was to compare the effect of prolonged computer use on cervical proprioception, range of motion, CVA in sedentary and non-sedentary healthy population. The main outcome measure of the study is difference between side flexion and rotation range in both groups.

The result of the study showed that (table and graph 4.1) there is no significant difference in proprioception between group but the mean value of proprioception (Flexion- 3.30 grp A, 3.32 grp B), (RR- 3.99 grp A, 3.9 grp B), (LR- 3.84 grp A, 3.74 grp B). p value 0.974. 0.861, 0.885 respectively for F, LR, and RR showing no significant importance However, both groups were found to be deviated from the normal value.

In the above study participants were asked to return to neutral from a mid-range to avoid end range feedback in respective movement directions [31]. Swait et al. (2007) reported that at least six trials were needed to optimize the stability and reliability of the cervical JPE measurement. (Revel et al., 1991; Heikkila€ and Wenngren, 1998; Rix and Bagust, 2001; Chen and Treleaven, 2013), in which the mean JPE was calculated over six or more trials, showed significantly higher joint position errors trials there by reducing the standard error of the mean. This stresses the importance of calculating the joint position error over at least six trials. These studies used a laser pointer as a JPE testing device [32]. Normal range for proprioception in this study is 3cm (1.90°). According to Michel Revel a repositioning error of 3 cm or more in any direction is abnormal; this is indicative of poor head repositioning related to faulty afferent input from the cervical muscles. Repositioning of the head requires, first, spatial awareness of the position of the head at rest. This is determined by integration of the signals arising from the spindles of the cervical muscles along with the vestibular apparatus and vision.

This integration takes places in the parieto-insular vestibular cortex. The most important of these inputs is that from the cervical muscles. when the head is rotated, stretch signals arising from the cervical muscles (both agonists and antagonists) are altered accordingly. The length-tension levels are recorded at each posmon, and memory of the length tension relationship in the original position is stored. For this to occur accurately, appropriate length tension information must arise from the muscles. If this information is altered because of dysfunction, the ability to return the head from a fully rotated, flexed, or extended position [11].It is also proposed that alterations in neck posture such as forward head posture will sequentially lead to proprioception acuity diminution.

This study focused on difference in active ROM between groups. Results shows that there is no significant difference in flexion range between groups though the range is slightly higher in sedentary group but within the normal range used in this study, this difference was probably because of lack of mobility also the greater flexion angle is related to lower vertical height of screen [33]. The nature of our participants was that of a pain-free population, we believe that this difference would be represented more obviously within a symptomatic population. There was statically significant difference between side flexions in both groups, rt. and left side flexions were limited in sedentary group with a mean and SD (27.53 ± 5.617) for RF in grp A and (33.8 ± 6.930) for grp B, p value 0.011, For LF mean and SD (26.6 ± 5.068) for grp A, (33.3 ± 6.368) for grp B, p value 0.004. This might be due to the altered activation of sternoclenimastoid muscles due to changes in neck muscle because of maintaining of fault neck and head posture. Thus because of stiff neck people uses contralateral muscle instead of local muscle. Thus, excessive activation of Sternocleidomastoid causes decreased efficiency of local muscles to perform movement [34]

For rotation range there was a statically significant difference between groups, both side rotation was higher in sedentary group with mean and SD (50.2 ± 10.52) RR for grp A, (43.6± 5.539) for grp B, p value 0.434, LR for grp A (53.33 ± 8.607), (45.86 ± 5.069) for grp B, p value 0.008. This can be justified by a study according to which goniometer has poor reliability for measurement of cervical rotation because handheld goniometer could not respond to the changing centers of multisegmented movement. Hence supporting the result of our study [35]. The influence of neck length has not been considered in the study which might have given the more accurate data.

Results for CVA shows no significant difference in both groups but the values were at the borderline compared to normal range (48-50°) [11] used in this study. Grp A mean angle is 48.04 and Grp B 48.90 which is very close to the deviated posture, although the data between group didn't show much difference but it is clear to predict that desktop users are very much prone to assume fault posture, if the duration of desktop use was considered then data must have reflected the larger deviation in such population. The task of using computer for prolonged duration leads to flex posture in cervical spine with higher activity in cervical erector spinae muscle and upper trapezius, with a posture in which the trunk slightly aligns posteriorly adopted as fixed postural habits.

FUTURE PERSPECTIVE AND LIMITATIONS: -

The present study had certain limitation to be considered, study did not undertake the neck length and girth into consideration further study can be conducted making allowance for this missing assessment. Despite the use of clear landmark for assessment of movement in horizontal plane (right and left rotation) of cervical the handheld goniometer could not respond in changing center as it is a multisegmented movement hence digital goniometer/inclinometer should be used instead of handheld goniometer to reduce the chance of error. Also, further diagnostic research is required including the population of different age group to compare the severity hence analyzing the treatment plan.

RELEVANCE TO CLINICAL PRACTISE: -

In subjects with prolonged usage of desktop (>4-6hrs/day) there is dysfunction in cervical proprioception, range, and balancing ability which needs appropriate guidance and intervention to prevent the progression of symptoms. Furthermore, suggestion should be given to such population to reduce the computer exposure time and to take break from screen at a regular interval. Also, the awareness should be created regarding good posture while working because prolonged working in fault posture leads to decreased CVA. Also more emphasize should be paid on the importance of adequate level of physical activity specially focusing on neck exercises which will help alleviating symptoms if any or to prevent any upcoming deformities.

CHAPTER-6

CONCLUSION

The study suggests that there are no significant differences in proprioception and CVA between both the groups however data for both the groups reflects deviation from normal range. Hence, we can conclude that general physical activity has no specific effect on neck balancing ability and posture. For range of motion the study results imply that there is no statically significant difference in flexion and extension range between group, but extension range is higher in non- sedentary group indicating clinical significance of data. Data for side flexion suggests the statically significant difference in groups, sedentary participants have less range than non- sedentary hence acknowledging the importance of physical activity.

Therefore, these can be used with 95% confidence in clinical practice with the least measurement error. The data for rotation range shows significant difference in groups, sedentary groups have more rotation range which might be the result of poor reliability of hand-held goniometer for rotation measurement. Hence it can be concluded that if we had used digital goniometer/inclinometer for rotation the results might have been more accurate.

CHAPTER 7

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CHAPTER- 8

APPENDICES

APPENDIX- I

INTERNATIONAL PHYSICAL ACTIVITY QUESTIONNAIRE

READ: - We are interested in finding out about the kinds of physical activities that people do as part of their everyday lives. The questions will ask you about the time you spent being physically active in the last 7 days. Please answer each question even if you do not consider yourself to be an active person. Please think about the activities you do at work, as part of your house and yard work, to get from place to place, and in your spare time for recreation, exercise, or sport.

READ: -Think about all the vigorous activities that you did in the last 7 days. Vigorous physical activities refer to activities that take hard physical effort and make you breathe much harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

1. During the last 7 days, on how many days did you do vigorous physical activities like heavy lifting, digging, aerobics, or fast bicycling?

_____ days per week

☐ No vigorous physical activities ➡ Skip to question 3

2. How much time did you usually spend doing vigorous physical activities on one of those days?

_____ hours per day

_____ minutes per day

☐ Don’t know/Not sure

Think about all the moderate activities that you did in the last 7 days. Moderate activities refer to activities that take moderate physical effort and make you breathe somewhat harder than normal. Think only about those physical activities that you did for at least 10 minutes at a time.

3. During the last 7 days, on how many days did you do moderate physical activities like carrying light loads, bicycling at a regular pace, or doubles tennis? Do not include walking.

_____ days per week

☐ No moderate physical activities ➡ Skip to question 5

4. How much time did you usually spend doing moderate physical activities on one of those days?

_____ hours per day

_____ minutes per day

☐ Don't know/Not sure

Think about the time you spent walking in the last 7 days. This includes at work and at home, walking to travel from place to place, and any other walking that you have done solely for recreation, sport, exercise, or leisure.

5. During the last 7 days, on how many days did you walk for at least 10 minutes at a time?

_____ days per week

☐ No walking ➡ Skip to question 7

6. How much time did you usually spend walking on one of those days?

_____ hours per day

_____ minutes per day

☐ Don’t know/Not sure

The last question is about the time you spent sitting on weekdays during the last 7 days. Include time spent at work, at home, while doing course work and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

7. During the last 7 days, how much time did you spend sitting on a weekday?

_____ hours per day

_____ minutes per day

☐ Don’t know/Not sure

This is the end of the questionnaire, thank you for participating.

APPENDIX- II

INFORMED CONSTENT

I…………………………………………………………...……Age…………..…Gender……..

hereby consent to participate as requested for the study on **"Measurement of cervical rom, proprioception & CVA in heavy desktop users -a comparative study between sedentary lifestyle & non-sedentary lifestyle computer users."**

●Purpose of study: -to determine whether active lifestyle has any effect on neck posture and range in heavy desktop users compared to sedentary lifestyle users.

●Risk-I have been explained that the procedure that I must undergo will not pose any risk of failure &. The details of procedures and any risk have been explained to my satisfaction.

●Benefits: - above study will help to determine the positive effects of active lifestyle on neck posture and musculature thus helping to prevent from upcoming neck pathologies.

I do understand and appreciate that the information gained in this study will be published as it is. I will not be identified, and individual information will remain confidential, hence I grant permission and consent for utilizing my data in future report/article.

I am free to withdraw from the study at any time and I am free to decline to question.

Participant's signature……………… Researcher's signature………………

Date- Place-

APPENDIX- III

MASTER CHART

S/N	GROUP	AGE (yrs.)	GENDER	HEIGHT (In inch)	WEIGHT (In kg)	IPAQ	CVA (in °)	PROPIOCEPTION (in degree) °			CROM (in degree) °					
								F	RR	LR	F	E	RF	LF	LR	RR
1	B	28	F	62	52	High	47.1	4.3	5	4.3	35	45	40	38	45	40
2	B	25	M	63	62	Moderate	50.7	4.3	5.3	4.3	28	40	24	25	35	42
3	B	27	M	69	76	High	49.5	3.4	3.9	3.9	35	50	35	40	45	45
4	B	26	M	69	65	Moderate	52.0	1.4	2.2	2.6	36	40	35	30	42	40
5	B	27	M	66	62	Moderate	58.8	4.4	2.9	4.3	50	48	38	45	45	40
6	B	32	M	66	75	Moderate	43.6	4	3.9	3.4	38	40	38	30	44	48
7	B	42	F	59	62	Moderate	40.5	4.1	5.1	4.1	32	48	35	35	42	42
8	B	28	M	64	60	Moderate	44.2	5.1	4.9	4.8	42	48	22	22	50	52
9	B	40	M	67	65	Moderate	52.4	5	5.2	6.5	35	38	38	32	45	35
10	B	30	M	63	57	High	56.1	1.6	4.5	2.5	30	34	25	30	44	42
11	B	28	M	64	64	Moderate	47.4	2.2	4	2.6	30	40	46	40	55	50
12	B	37	M	67	70	Moderate	40.3	1.7	4.7	3.2	32	34	40	36	50	45
13	B	37	M	66	60	Moderate	52.0	1.4	2.4	3.1	28	34	30	28	46	40
14	B	26	M	67	75	Moderate	50.3	3	3.5	2.9	30	32	26	28	55	55
15	B	29	M	68	86	Moderate	48.7	4	1	3.7	45	60	35	38	45	38
16	A	35	F	60	67	LOW	49.7	7.1	6.9	7.2	38	30	30	28	55	55
17	A	36	F	66	85	LOW	54.9	6.5	5.9	5.6	30	40	35	30	40	35
18	A	39	M	64	60	LOW	48.0	3.8	6.1	4.1	48	35	30	25	45	40
19	A	26	M	64	82	LOW	43.0	2.9	3.3	3.9	32	38	25	24	50	50
20	A	28	M	72	65	LOW	52.1	1.9	3.6	2.3	40	36	28	25	54	52
21	A	37	M	67	79	LOW	53.1	2	2	2.1	35	34	25	20	52	52
22	A	30	F	63	64	LOW	47.7	0.8	1.5	2.9	30	52	30	32	45	38
23	A	38	M	68	67	LOW	49.0	2	6.3	6.7	34	40	30	34	65	58
24	A	28	M	69	68	LOW	45.0	1.7	0.7	0.8	40	35	25	30	60	50
25	A	25	M	63	60	LOW	53.9	3.4	4.4	4.7	35	45	15	20	62	62
26	A	41	F	64	63	LOW	50.9	0.6	1.1	0.8	30	34	36	35	50	46
27	A	34	M	60	70	LOW	39.6	4.5	5.7	4.1	30	45	22	25	48	40
28	A	32	M	72	99	LOW	41.0	2.7	3.1	2.8	34	32	32	28	44	40
29	A	38	M	63	64	LOW	48	3.7	2.9	4.5	55	35	30	25	70	70
30	A	42	M	69	92	LOW	45.8	6	6.4	5.2	28	32	20	18	60	65

APPENDIX- IV

DATA COLLECTION FORM

Name- Date: -

Age/Gender-

Height-

Weight-

Group-

IPAQ-

PROPIOCEPTION							
Movement	R1	R2	R3	R4	R5	R6	Mean (in degree)
Flexion							
Rt. rotation							
Lt. rotation							

ROM	
MOVEMENT	Value (in degree)
Flexion	
Extension	
Lateral flexion(right)	
Lateral flexion(left)	
Left rotation	
Rt. rotation	

CVA: -

APPENDIX - V

DATA OUTPUT SHEET

GROUP- A

AGE A(yrs.)	WEIGHT_ A (in kg)	CVA Gr A (in °)	Prop. (in °) F Gr A	Prop. RR Gr A	Prop. LR Gr A	ROM F Gr A	ROM E Gr A	ROM RF Gr A	ROM LF Gr A	ROM LR Gr A	ROM RR Gr A
35	67	49.7	7.1	6.9	7.2	38.0	30.0	30.0	28.0	55.0	55.0
36	85	54.9	6.5	5.9	5.6	30.0	40.0	35.0	30.0	40.0	35.0
39	60	48.0	3.8	6.1	4.1	58.0	35.0	30.0	25.0	45.0	40.0
26	82	43.0	2.9	3.3	3.9	32.0	38.0	25.0	24.0	50.0	50.0
28	58	52.1	1.9	3.6	2.3	40.0	36.0	28.0	25.0	54.0	52.0
37	79	53.1	2.0	2.0	2.1	35.0	34.0	25.0	20.0	52.0	52.0
30	64	47.7	0.8	1.5	2.9	30.0	52.0	30.0	32.0	45.0	38.0
38	67	49.0	2.0	6.3	6.7	34.0	40.0	30.0	34.0	65.0	58.0
28	68	45.0	1.7	0.7	0.8	40.0	35.0	25.0	30.0	60.0	50.0
25	60	53.9	3.4	4.4	4.7	35.0	45.0	15.0	20.0	62.0	62.0
41	63	50.9	0.6	1.1	0.8	30.0	34.0	36.0	35.0	50.0	46.0
34	70	39.6	4.5	5.7	4.1	30.0	45.0	22.0	25.0	48.0	40.0
32	99	41.0	2.7	3.1	2.8	34.0	32.0	32.0	28.0	44.0	40.0
38	64	48.0	3.7	2.9	4.5	55.0	35.0	30.0	25.0	70.0	70.0
42	92	45.8	6.0	6.4	5.2	28.0	32.0	20.0	18.0	60.0	65.0

GROUP- B

AGE B(yrs.)	WEIGHT B (in kg)	CVA Gr B (in °)	Prop. F Gr B (in °)	Prop. RR Gr B	Prop. LR Gr B	ROM (in °) F Gr B	ROM E Gr B	ROM RF Gr B	ROM LF Gr B	ROM LR Gr B	ROM RR Gr B
28	52	47.1	4.3	5.0	4.3	35.0	45.0	40.0	38.0	45.0	40.0
25	62	50.7	4.3	5.3	4.3	28.0	40.0	24.0	25.0	35.0	42.0
27	76	49.5	3.4	3.9	3.9	35.0	50.0	35.0	40.0	45.0	45.0
26	65	52.0	1.4	2.2	2.6	36.0	40.0	35.0	30.0	42.0	40.0
27	62	58.8	4.4	2.9	4.3	50.0	48.0	38.0	45.0	45.0	40.0
32	75	43.6	4.0	3.9	3.4	38.0	40.0	38.0	30.0	44.0	48.0
42	62	40.5	4.1	5.1	4.1	32.0	48.0	35.0	35.0	42.0	42.0
28	60	44.2	5.1	4.9	4.8	42.0	48.0	22.0	22.0	50.0	52.0
40	65	52.4	5.0	5.2	6.5	35.0	38.0	38.0	32.0	45.0	35.0
30	57	56.1	1.6	4.5	2.5	30.0	34.0	25.0	30.0	44.0	42.0
28	64	47.4	2.2	4.0	2.6	30.0	40.0	46.0	40.0	55.0	50.0
37	70	40.3	1.7	4.7	3.2	32.0	34.0	40.0	36.0	50.0	45.0
37	60	52.0	1.4	2.4	3.1	28.0	34.0	30.0	28.0	46.0	40.0
26	75	50.3	3.0	3.5	2.9	30.0	32.0	26.0	28.0	55.0	55.0
29	86	48.7	4.0	1.0	3.7	45.0	60.0	35.0	38.0	45.0	38.0

APPENDIX-VI

MANUSCRIPT FORMAT

EVALUATION OF CERVICAL ROM, PROPRIOCEPTION AND CVA IN HEAVY COMPUTER USERS: A COMPARATIVE STUDY BETWEEN SEDENTARY VS NON-SEDENTARY COMPUTER USERS

Niyati, Prof(Dr.) Abdur Raheem Khan, Dr. Neeraj Maurya, Prof (Dr.) Ashfaq Khan, Fatima Saeed, Akeel quraishi
Department of Physiotherapy, Integral University-Lucknow.

ABSTRACT

Background/Aims: Nowadays, individuals are utilizing computer for different tasks and the impact of prolonged usage can be hazardous for musculoskeletal health. It is crucial to identify health impairment in persons with a very long duration of computer use because it is spreading explosively among every generation. prolonged computer use can put constant stress on musculature of head and neck area which can lead to forward head posture (FHP) and detoriation in balancing ability. All these in combination might results in musculoskeletal problem including pain, headache, and visual problem. So far, these variables were not combined for study hence the purpose of this study was to correlate whether there is positive effect of active lifestyle on neck posture in heavy computer users and to identify changes if any in cervical range, FHP, and proprioception than those who is living sedentary lifestyle.
METHODS: 30 adult desktop users were recruited for the study. The subjects were classified into two groups: sedentary (n=15) and non-sedentary (n=15). Neck proprioception were assessed by joint position error test ,6 trials were performed, and the mean value were calculated in cm and converted into degree for analysis, range of motion was assessed by universal goniometer and CVA was measured through photogrammetric method and then assessed by Apecs app.
RESULTS: There is no significant difference between group A and B for proprioception, FHP, and flexion range of motion. However, there are non-significant changes in extension (limited for sedentary with a mean value of 42.06 for grp B, 37.53 for grp A). The side flexions were significantly higher for Grp B (non-sedentary) with p value0.004 for left flexion and 0.01 for right flexion. Rotations were significantly higher for Grp A with p value 0.043 for RR and 0.008 for LR.
CONCLUSION: The between group differences noted shows statically significant difference in both groups in,side flexions and no difference in proprioception and CVA range. Based on the finding of this study handheld goniometer is not considered reliable for measurement of rotation because of the chances of manual error as rotation is a coupled movement.

Keywords: - Heavy computer users, CVA, CROM, Proprioception, Sedentary and Non- sedentary.

INTRODUCTION:

Now a day's use of computers and other electronic gadgets has increased worldwide rapidly. Among effects of using computer for prolonged duration, keeping a posture of staring at a monitor, locate below height of eyesight, makes the head move forward, which cause increased anterior curve in lower cervical vertebra and increased posterior curve in upper thoracic vertebrae to compensate for balance. Szeto et al stated that maintaining the head forward for long duration may cause musculoskeletal disorders such as upper crossed syndrome which involves reduced lordosis of lower cervical with kyphosis of upper thoracic vertebra. Such posture causes constant stress on cervical spine joints due to FHP hence results in disturbing signals to the brain that might cause decrease neck proprioception and balance ability because of pain and inflammation. [1].

A FHP also limits the normal rotation and gliding movement when joints move which further limits functional movement. These posture is improper, with extension in lower cervical and flexion in upper cervical thus it is considered that FHP influences postural changes in sagittal plane movements but not in horizontal plane (rotation) [2].

Some advance studies have showed that one of the main problems in patients with neck pain is impairment in their cervical proprioception, which further leads to cervical sensorimotor control disturbances. Cervical sensorimotor control involves central integration and processing of all afferent information including (visual, vestibular, and cervical proprioceptive inputs), and execution of the motor program through the cervical muscles, contributing to the maintenance of head posture and balance as well as the stability of cervical joints. Based on the available evidence, it is recommended that patients with neck pain must be assessed and managed for cervical proprioceptive impairment. [3]

A recent study in 2021 conducted by the "workspace and Ergonomics research cell at Godrej Interior group suggested that 72% of workers in India spend more than 9 hours a day in front of computer/laptop to get their work done on time and 86% of them complained about muscle disorders.

Computer have replaced huge amounts of files, paperwork and men power which has led to increase in productivity and efficiency but also introduced VDT (visual display terminal) syndrome, with complaints of musculoskeletal pain, headache, visual problems. Regarding this, the World Health Organization defines Work-related musculoskeletal disorders as 'injuries in muscles, tendons, peripheral nerves, and vessels possibly caused by continuous use of a body part.

Sedentary lifestyles are diffusing globally because of a lack of sufficient spaces for exercise, increased occupational sedentary behavior demands such as office work, and the increased penetration of television and video devices. Around 31% of the global population age 15-30 years engages in insufficient physical activity according to Jung Ha Park, et al. [2020]. [4]. Approx. 20% of Indian population are in inactive category, 36.9% are mild active ,27.8 % are moderately active and 15% are vigorously active, according to Vivek podder et al. [2020]. [5].

Based on a study conducted in 2011 Compendium of Physical Activities, MET is expressed as the ratio of work metabolic rate to the standard resting metabolic rate (RMR) of 1 kcal/(kg/h). One MET defined as RMR or energy cost for a person at rest. When we classify it based on their intensities, physical activity can be classified into 1.0–1.5 METs (sedentary behavior), 1.6–2.9 METs (light intensity), 3–5.9 (moderate intensity), and ≥6 METs (vigorous intensity). [4]

Adults [18-40] should do at least 150 mints of moderate physical activity and 75 mints of vigorous activity with muscle strengthening activities to maintain non-sedentary behavior. Low physical activity level is leading risk factor for cardiac diseases, diabetes as well as mental stress. [6]

According to Janice Cheung, more than 50% of workers reported a relationship between their occupation and neck pain, while 14% experienced activity limitations due to neck pain each year. [7]. Strengthening and fitness exercises have shown to be effective at preventing neck pain and reducing its severity. Workers participating in general exercise and sport activities were more likely to experience relief in their neck pain [8]. High levels of computer use may lead to reduced physical activity, and subsequent reduction in muscle endurance that affect habitual posture.

So far this type of study is not previously conducted thus, this study tried to correlate whether there is positive effect of active lifestyle on neck posture and to identify changes if any in cervical range, CVA and proprioception than those who is living sedentary lifestyle , also we consider that it is crucial to identify health impairment in persons with a very long duration of computer use because an increasingly computer use is spreading explosively among every generation causing not only physiological but also psychological hazards.

AIM:

This study tried to investigate the differences between the impact of physical activity and sedentary lifestyle on computer-based workers and to examine the variation in cervical range, proprioception, and forward head posture between both the groups.

OBJECTIVE:

1. To determine whether the range, CVA and proprioception of neck was different between participants with active and sedentary lifestyle in heavy computer users.
2. To find out the effects of sedentary lifestyle on neck range, posture, and balance ability in heavy computer users.
3. To find out the effects of non-sedentary lifestyle on neck range, posture, and balance ability in heavy computer users.

HYPOTHESIS:

ALTERNATE HYPOTHESIS: There will be significant difference between variables of both groups.

NULL HYPOTHESIS: There will be no significant difference in variables of both groups.

METHODOLOGY:

PARTICIPANTS:

Healthy participants were recruited from a sample of convenience at the INTEGRAL UNIVERSITY, Lucknow based on inclusion and exclusion criteria. Twenty-four male and six female aged between 25-45 volunteered for the study after providing the consent. Participants were then divided into 2 groups; 15 participants who were physically active and another 15 who were sedentary. All subjects were fully briefed about study purpose, benefits, and risk prior to taking consent.

STUDY DESIGN: -

It was a group comparative cross-sectional study and subject were selected based on the sample of convenience.

STUDY DURATION:

6 Months

VARIABLES:

DEPENDENT- Proprioception, CROM, CVA, IPAQ score

INDEPENDENT- Age, weight, Height, Computer users

INCLUSION CRITERIA:

1) Computer users (≥6 hrs.)
2) Both genders
3) Age-25 to 45 yrs.
4) Sedentary lifestyle computer users
5) Active lifestyle computer users
6) Pain free population

EXCLUSION CRITERIA:

1) Traumatic neck injury
2)Work duration<6 hrs.
3) Taking any treatment for neck.
4) Recent surgery near neck area
5) Subject not willing to take part in study.
6) C/o neck pain
7) Pain with or without radiculopathy

RESULTS:

Among the 30 participants in our study 6 were females and 24 were male hence making this study male dominant. Mean age for participants of grp A and B was 33.93 ± 5.48 and 30.8 ± 5.50 SD. Mean height of grp A and B was 65.6 ± 3.68 and 65.3 ± 2.69 SD, Mean weight for grp A and B was 72.33 ± 12.56 and 66.06 ± 8.78(table 3.1). There was no significant difference between the age, height, weight in both groups hence it does not influence any aspect of the study as they had similar age, height, and weight.

Table 4.1. Statistical value of participant's demographic data (Mean ± SD)

Group	AGE	Weight	Height
A	33.93 ± 5.48	72.33 ± 12.56	65.6 ± 3.68
B	30.8 ± 5.50	66.06 ± 8.78	65.3 ± 2.69

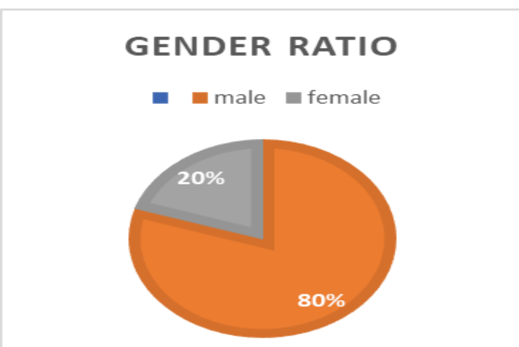

Figure 4.1. Representing gender ratio in study population.

The two-sample t-test revealed there were no significant difference between group A and B for proprioception (table 4.2) with a mean and SD (3.30 ± 1.996) for grp A flexion, (3.32 ± 1.334) for grp B, p value for flexion is 0.974. For LR the mean and SD (3.84 ± 1.919) for grp A, (3.74 ± 1.052) for grp B, p value 0.861. For RR the Mean and SD (3.99 ± 2.117) for grp A, (3.9 ± 1.282) for grp B, p value 0.885. P value for all three movements is >0.005 hence statically insignificant.

Proprioception				
	Grp A (in °) Mean ± SD	**Grp B (in °) Mean ± SD**	**p-value**	**t-value**
Flexion	3.30 ± 1.996	3.32 ± 1.334	0.974	2.063
LR	3.84 ± 1.919	3.74 ± 1.052	0.861	2.073
RR	3.99 ± 2.117	3.9 ± 1.282	0.885	2.068

Table 4.2. Statistical Mean ± SD values for cervical proprioception for both groups.

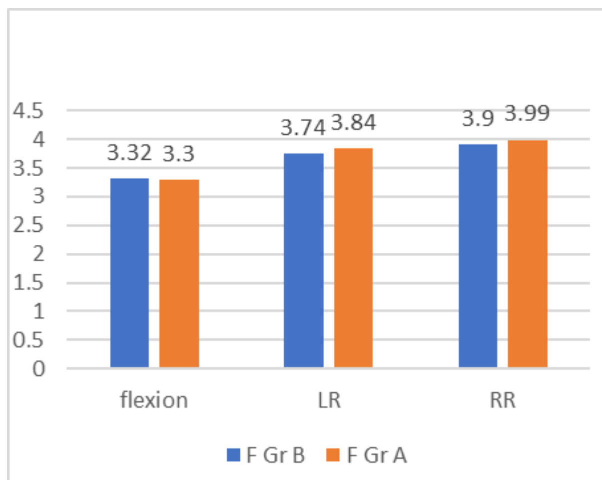

Figure 4.2 Graph representing the non-significant difference in proprioception of both groups.

The result of study manifests that there is no significant difference between CVA in both groups with a mean and SD of (48.04 ± 4.596) for grp A and (48.90 ± 5.258) for grp B, p, value (0.635). Even being insignificant the CVA values for both groups were at the borderline compared to normal range and slightly less in sedentary which somehow explains the effects of sedentary lifestyle accompanied with lack of mobility.

Table 4.3. Statistical Mean ± SD values for CVA in both groups

	Grp A (in °) Mean ± SD	Grp B (in °) Mean ± SD	t-value	p-value
CVA	48.04 ± 4.596	48.90 ± 5.258	2.051	0.635

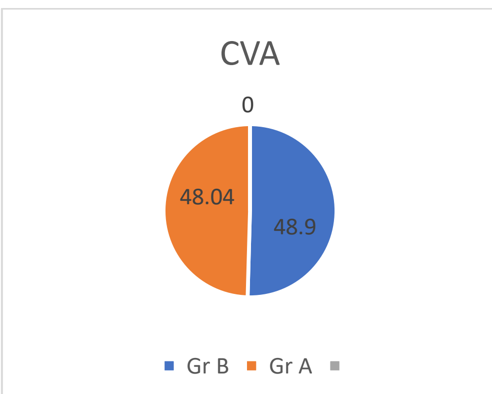

Figure 4.3. Pie chart representing the non-significant value of CVA in both groups.

Data reveals that there is no significant difference between flexion in both groups however, there is non-significant changes in extension mean ± Sd for grp A 37.53 ± 5.962 and grp B 42.06 ± 7.694 (limited for sedentary) with a value p= 0.082(>0.05), t= 2.055 respectively.

The side flexions were significantly higher for Grp B, with RF=33.8 ± 6.930 for grp B, 27.53 ± 5.617 for grp A, p=0.011(>0.005), t=2.051, LF= 33.3 ± 6.368 for grp B, 26.6 ± 5.068 for grp A, p=0.004(<0.005), t=2.051 but rotations were significantly higher for Grp A, RR=50.2 ± 10.523 for grp A, RR= 43.6 ± 5.539 for grp B, p=0.434, t=2.079. LR=53.33 ± 8.607 for grp A, LR= 45.86 ± 5.069 for grp B, p=0.008, t=2.068 (table 4.4).

Table 4.4. Summary of statistical data for cervical range of motion in both groups.

CROM	Grp A (in °) Mean ± SD	Grp B (in °) Mean ± SD	p-value	t-value
Flexion	36.6 ± 8.902	35.06 ± 6.408	0.593	2.059
Extension	37.53 ± 5.962	42.06 ± 7.694	0.082	2.055
RR	50.2 ± 10.523	43.6 ± 5.539	0.434	2.079
LR	53.33 ± 8.607	45.86 ± 5.069	0.008	2.068
RF	27.53 ± 5.617	33.8 ± 6.930	0.011	2.051
LF	26.6 ± 5.068	33.3 ± 6.368	0.004	2.051

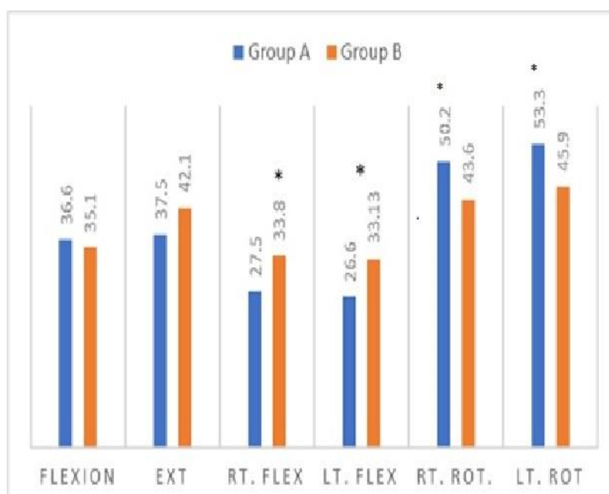

Figure.4.4. Graph representing the cervical range of motion in both groups. *- represents the statistically significant difference in groups.

DISCUSSION:

This is a comparative cross-sectional study. The purpose of this study was to compare the effect of prolonged computer use on cervical proprioception, range of motion, CVA in sedentary and non-sedentary healthy population. The main outcome measure of the study is difference between side flexion and rotation range in both groups.

The result of the study showed that (table and graph 4.1) there is no significant difference in proprioception between group but the mean value of proprioception (Flexion- 3.30 grp A, 3.32 grp B), (RR- 3.99 grp A, 3.9 grp B), (LR- 3.84 grp A, 3.74 grp B). p value 0.974. 0.861, 0.885 respectively for F, LR, and RR showing no significant importance However, both groups were found to be deviated from the normal value.

In the above study participants were asked to return to neutral from a mid-range to avoid end range feedback in respective movement directions [31]. Swait et al. (2007) reported that at least six trials were needed to optimize the stability and reliability of the cervical JPE measurement. (Revel et al., 1991; Heikkila- and Wenngren, 1998; Rix and Bagust, 2001; Chen and Treleaven, 2013), in which the mean JPE was calculated over six or more trials, showed significantly higher joint position errors trials there by reducing the standard error of the mean. This stresses the importance of calculating the joint position error over at least six trials. These studies used a laser pointer as a JPE testing device [32]. Normal range for proprioception in this study is 3cm (1.90°). According to Michel Revel a repositioning error of 3 cm or more in any direction is abnormal; this is indicative of poor head repositioning related to faulty afferent input from the cervical muscles. Repositioning of the head requires, first, spatial awareness of the position of the head at rest. This is determined by integration of the signals arising from the spindles of the cervical muscles along with the vestibular apparatus and vision. This integration takes places in the parieto-insular vestibular cortex. The most important of these inputs is that from the cervical muscles. when the head is rotated, stretch signals arising from the cervical muscles (both agonists and antagonists) are altered accordingly. The length-tension levels are recorded at each posmon, and memory of the length tension relationship in the original position is stored. For this to occur accurately, appropriate length tension information must arise from the muscles. If this information is altered because of dysfunction, the ability to return the head from a fully rotated, flexed, or extended position [11]. It is also proposed that alterations in neck posture such as forward head posture will sequentially lead to proprioception acuity diminution.

This study focused on difference in active ROM between groups. Results shows that there is no significant difference in flexion range between groups though the range is slightly higher in sedentary group but within the normal range used in this study, this difference was probably because of lack of mobility also the greater flexion angle is related to lower vertical height of screen [33]. The nature of our participants was that of a pain-free population, we believe that this difference would be represented more obviously within a symptomatic population. There was statically significant difference between side flexions in both groups, rt. and left side flexions were limited in sedentary group with a mean and SD (27.53 ± 5.617) for RF in grp A and (33.8 ± 6.930) for grp B, p value 0.011, For LF mean and SD (26.6 ± 5.068) for grp A, (33.3 ± 6.368) for grp B, p value 0.004. This might be due to the altered activation of sternoclenimastoid muscles due to changes in neck muscle because of maintaining of fault neck and head posture. Thus because of stiff neck people uses contralateral muscle instead of local muscle. Thus, excessive activation of Sternocleidomastoid causes decreased efficiency of local muscles to perform movement [23]

For rotation range there was a statically significant difference between groups, both side rotation was higher in sedentary group with mean and SD (50.2 ± 10.52) RR for grp A, (43.6± 5.539) for grp B, p value 0.434, LR for grp A (53.33 ± 8.607), (45.86 ± 5.069) for grp B, p value 0.008. This can be justified by a study according to which goniometer has poor reliability for measurement of cervical rotation because handheld goniometer could not respond to the changing centers of multisegmented movement. Hence supporting the result of our study [24]. The influence of neck length has not been considered in the study which might have given the more accurate data.

Results for CVA shows no significant difference in both groups but the values were at the borderline compared to normal range (48-50°) [11] used in this study. Grp A mean angle is 48.04 and Grp B 48.90 which is very close to the deviated posture, although the data between group didn't show much difference but it is clear to predict that desktop users are very much prone to assume fault posture, if the duration of desktop use was considered then data must have reflected the larger deviation in such population. The task of using computer for prolonged duration leads to flex posture in cervical spine with higher activity in cervical erector spinae muscle and upper trapezius, with a posture in which the trunk slightly aligns posteriorly adopted as fixed postural habits.

FUTURE PERSPECTIVE AND LIMITATIONS: -

The present study had certain limitation to be considered, study did not undertake the neck length and girth into consideration further study can be conducted making allowance for this missing assessment. Despite the use of clear landmark for assessment of movement in horizontal plane (right and left rotation) of cervical the handheld goniometer could not respond in changing center as it is a multisegmented movement hence digital goniometer/inclinometer should be used instead of handheld goniometer to reduce the chance of error. Also, further diagnostic research is required including the population of different age group to compare the severity hence analyzing the treatment plan.

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RELEVANCE TO CLINICAL PRACTISE:

In subjects with prolonged usage of desktop (>4-6hrs/day) there is dysfunction in cervical proprioception, range, and balancing ability which needs appropriate guidance and intervention to prevent the progression of symptoms. Furthermore, suggestion should be given to such population to reduce the computer exposure time and to take break from screen at a regular interval. Also, the awareness should be created regarding good posture while working because prolonged working in fault posture leads to decreased CVA. Also more emphasize should be paid on the importance of adequate level of physical activity specially focusing on neck exercises which will help alleviating symptoms if any or to prevent any upcoming deformities.

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