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RESEARCH ARTICLE

CORRELATION BETWEEN STRESS AND DISCOMFORT WITH BIOMECHANICAL POSTURE IN CHRONIC COMPUTER USERS

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Manuscript Info Abstract

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Cervical angle, thoracic angle, pelvic tilt, stress, discomfort.

Background: The presence of musculoskeletal disorders is a wide spread problem among the computer users. There are many evidences that supports the association between prolong use of computer in awkward posture and the development of musculoskeletal disorder. The purpose of the present study was to find out correlation of cervical angle, thoracic angle and pelvic tilt with stress, discomfort score and discomfort severity score.

Method: Fifty subjects were recruited aged 20-40 years and thorough explanation was given about the procedure to all subjects. Perceived stress scale and Boston University Computer & Health Survey Questionnaire were filled by subjects. Cervical angle and thoracic angle were measured through Photography method. Pelvic tilt was measured with the help of pelvic tilt instrument.

Results: The data was analyzed using statistical test which was performed using SPSS 17 software package. Karl Pearson coefficient of correlation was used to analyze the relation of cervical angle, thoracic angle and pelvic tilt with stress, discomfort score and discomfort severity score.

Conclusion: There is significant correlation between craniovertebral angle with stress and discomfort in subjects who are chronic computer users

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Introduction

Work-related musculoskeletal disorders (WRMDs) have become a major concern in many industrialized countries. Work-related musculoskeletal disorders causes muscles, tendons and nerves at the joints of the neck, shoulder, elbow, wrist, finger, back, legs, etc. to be stressed and traumatized due to excessive or repetitive exertive force, awkward body posture, less resting time, cold working environment, vibration and so on. WRMDs are also referred as cumulative trauma disorders (CTD), repetitive strain injury (RSI), occupational overuse syndrome (OOS) (Winkel and Westgaard 1992⁴⁰, Hagberg et al. 1995¹⁹).

Organizational factors such as long working hours, the duration of computer use per day, psychosocial factors such as stress (Smith & Carayon, 1996)³⁸ & visual factors also associated with musculoskeletal disorders amongst computer users (Aaras et al 1998² & Aaras et al. 2001³). Physical risk factors associated with computer users include awkward working postures, the repetitiveness of computer task & the force with which the keys are depressed.

Studies have documented biomechanical & epidemiological evidence that supports the association between prolonged use of computer displays, (Burgers-Limerick et al. 1998⁸, Jaschinski et al. 1998²⁴) & data entry devices, (Gerry et al. 2004)¹⁷ in awkward postures & the development of musculoskeletal disorders or discomfort of the neck, shoulder, upper extremity & back of personal computer / laptop users of various ages. Epidemiological studies

in the literature confirmed that the work which is related with computer use brings higher risk for the development of musculoskeletal symptoms. **Evans and Patterson (2000)**¹³ tested the hypothesis that poor typing skill, hours of computer use, tension score and poor workstation setup are associated with neck and shoulder complaints, and they found out that tension score and gender were the only factors to predict neck and shoulder. **Jensen et al. (2002)**²⁵ found that the duration of computer work is associated with neck and shoulder symptoms in women, and hand symptoms in men. Additionally, the use of mouse was observed to have an increase in hand/wrist and shoulder region symptoms among the intensive users of computer.

Peper et al. (2003)³⁴ reviewed the ergonomic and psychosocial factors that affect musculoskeletal disorders at the workstation, and their results showed that there was a significant difference in right forearm extensor-flexor muscle tension and in right middle trapezius muscle tension between type tasks and rest.

The presence of musculoskeletal disorders is a wide spread problem among the operators of visual display terminals (VDTS). Sustained non neutral postures during computer use, such as neck rotation, shoulder abduction are defined as risk factors leading to onset of symptoms in the neck and shoulder areas (**Bergqvist U et al. 1995**)⁶. Studies have shown that neck and shoulder discomfort exist even when working in an ergonomically correct position. The possible reason suggested was that this discomfort was due to the limited number of postures available when sitting at a computer (**Winkel J, 1992**)⁴⁰. But with an appropriate ergonomics intervention based on the use of armrests, the postural load diminished, as did physical discomfort & neck pain (**Aaras A. et al; 1998**)².

Nowadays with the development of technology and the sedentary lifestyle there is more of work with prolonged sitting hours which decrease physical activity and puts further strain on the muscles that maintain posture. As there is more utilization of one side of the body while using mouse, so further straining the back muscles and also working for long hours can cause slouched posture which cause undue stress on ligaments and cause back pain. Another common postural problem is a forward tilt of pelvis causing anterior weight bearing, an increase in lumbar lordosis and associated muscle weakness¹⁰.

Methods

Participants:

On the basis of inclusion and exclusion criteria 50 subjects were selected randomly for the study. Prior the study permission was taken from institutional ethical review committee and informed consent were taken from them. All the subjects with age of 20-40 years who works with computer for more than 4 to 6 hours per day were included in the study. Any history of spinal deformity, spinal surgery, history of trauma and signs of radiculopathy were excluded from the study. All the subjects were given thorough explanation of the procedure performed. Craniovertebral angle and thoracic angle were measured with the help of photographic method & the pelvic tilt is measured with the help of inclinometer immediately after Stress and discomfort questionnaire were filled by the subject.

Procedure

Measurement of Stress(Perceived stress scale)

Questionnaire is given to the subject & he/she asked to read it. Whole questionnaire is thoroughly described to the subject. After reading each question the subject is consider how often you felt or thought that way over the past month. It consists of 10 questions and subject had to rating each questions as like (Never: 0, Almost never: 1, Sometimes: 2, Fairly often: 3, Very often: 4). To get the numerical grade from each response questions of these no (1,2,3,6,9,10) where grading were measured in ascending order and question of those no (4,5,7,8) the grading were measured in reversed order & lastly summed up all the 10 items.

Measurement of Discomfort(Boston university computer & health survey questionnaire)

After reading each question the subject was consider how often he/she felt his discomfort over the past 2 weeks. It consists of 2 sections: A & B. In section A, in question 1&3 the grading should be done in NO or YES where NO indicates 0 and YES indicates 1. In question 4 the grading should be done in numerical form 0,1,2,3,4 (No difficulty: 0, Mild difficulty: 1, Moderate: 2, Severe difficulty: 3, So difficult I cannot do at all: 4). In section B, it consist of 5 question then grading should be done in numerical form 0,1,2,3,4. Scoring was done by the formula

$$\frac{\text{Individual Score}}{10} \times 100$$

Total Score

Measurement of cervical and thoracic angle

The subjects were asked to sit comfortably as if in normal sitting posture on the chair, knees flexed to 90 degrees and feet flat on the floor. Tragus of the Ear was identified and marked. To locate the spinous process of C7,

subject is asked to flex and extend the neck and the C7 spinous process becomes more prominent, whereas the C6 spinous process is absent in palpation when the neck is extended. Clay was put on C7 spinous process so that it would become visible on photograph. Nikon digital camera was mounted on a tripod stand and kept 2 meters away from the chair. The camera was placed at the level of shoulder height of the subject with the spirit level of tripod stand was maintained in centre for leveling. Then lateral view of photograph was taken with neck in neutral position and the measurements of craniovertebral angle were done using COREL DRAW 12 software.

Similarly to measure the thoracic angle, the Subjects were asked to sit comfortably as if in normal sitting posture on the chair, knees flexed to 90 degrees and feet flat on the floor. Superior border of manubrium and spinous process of C7 were identified and clay was put on it. Subject was asked to flex the elbow, brought it back to retract the scapula so that inferior angle of scapula was palpated. Horizontally from there, T7 spinous process was palpated. Below it palpate the spinous process of T8 and clay was put on it so that it would become visible on photograph.

Measurement of pelvic tilt

Pelvic tilt was measured by pelvic tilt instrument made up of wood having a base, a vertical stand, and two horizontal arms. Arms were adjusted with the help of screws. At the level of the horizontal arms, wooden plate was attached with it and Inclinometer was put over it for reading of pelvic tilt. Subject was asked to stand in front of pelvic tilt instrument. Now the ASIS and PSIS were exposed, palpated and marked with a black dot over the apices. Once the dots were marked, then pointed ends of both the arms of the instrument were adjusted over the ASIS & PSIS. Reading was taken through the inclinometer.

Data Analysis

The data was analyzed using SPSS 17.0 software package. Karl Pearson Coefficient of Correlation was used to find correlation between CVA, Thoracic Angle & Pelvic Tilt with PSS, Discomfort Score and Discomfort Severity Score. Level of significance was 0.05.

Results

The results of this study shows that there is a significant correlation between CVA with PSS, discomfort score and discomfort severity score and also stated that there is non-significant correlation between thoracic angle with PSS, discomfort score and discomfort severity score. Correlation between pelvic tilt and discomfort severity score was also showed significant.

TABLE 1

VARIABLES	PEARSON CORRELATION COEFFICIENT (r)	P VALUE
CVA & PSS	-.440	.001
CVA & Discomfort score	-.839	.000
CVA & Discomfort severity score	-.773	.0001
Thoracic angle & PSS	.069	.634
Thoracic angle & Discomfort score	-.058	.691
Thoracic angle & Discomfort severity score	.056	.698
Pelvic tilt & PSS	.134	.354
Pelvic tilt & Discomfort score	-.278	.051
Pelvic tilt & Discomfort severity score	.432	.002
PSS & Discomfort score	-.321	.023
PSS & Discomfort Severity score	.333	.018

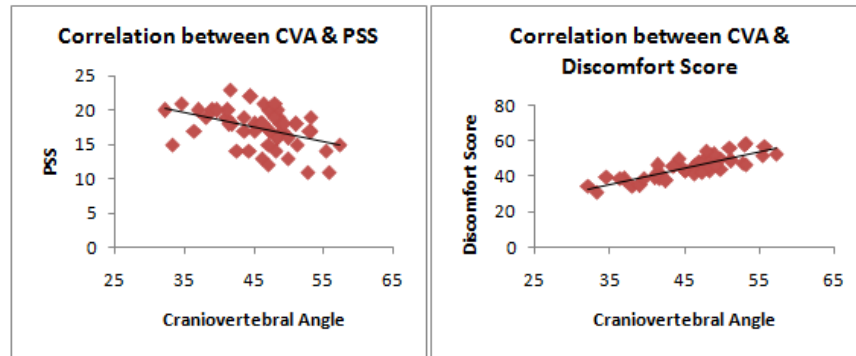


Fig.1 Correlation between CVA with PSS and Discomfort score

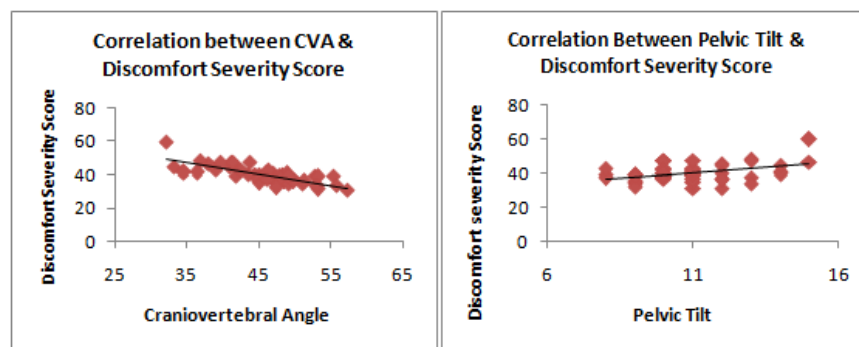


Fig. 2 Correlation between CVA and Thoracic angle with Discomfort severity score

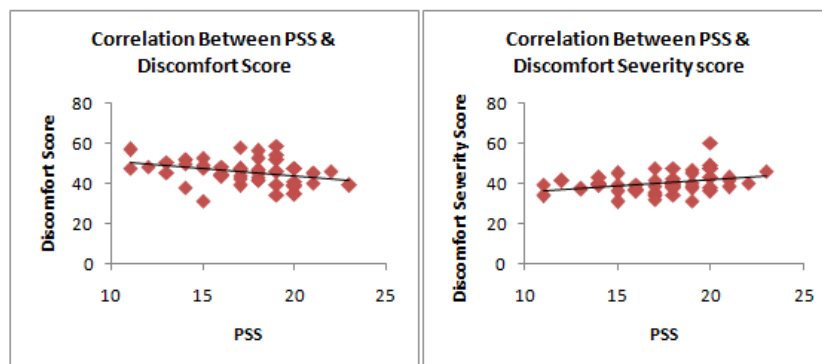


Fig.3 Correlation between PSS with Discomfort score and Discomfort severity score

Discussion

In recent time, use of computer, laptop, mobiles is increasing day by day. Computer users have to maintain their posture for longer periods of time which might cause future musculoskeletal stress and discomfort. **Ijmer S et al. (2006)**²³ confirmed an incidence of work related musculoskeletal disorder in different body parts of office workers due to their long time exposure to the computers but none of the study found correlation between different postural angles with stress and discomfort. Thus aim of present study was to see whether there is any correlation of Craniovertebral Angle, Thoracic Angle and Pelvic Tilt with the Stress and discomfort.

Craniovertebral angle, stress and discomfort

Results of the present study showed that the correlation of craniovertebral angle with stress and discomfort was significant in computer users. **Ariens G.A.M. et al. (2001)**⁴ found that increased forward neck flexion may result in increased tension in posture stabilizing muscles as well as increased compressive forces in the articulations of cervical spine resulting in a higher risk of work related musculoskeletal disorders. Persistent forward head posture was found to be the major cause for many musculoskeletal disorder around neck and shoulder region in adults (**Yip CH, Chiu TT, 2008**)⁴¹. Lesser craniovertebral or forward head posture as been associated with greater neck disability (**Yip CH, 2008**)⁴¹, tension type headache (**Fernandez CDLP, 2006**)¹⁴, syndromes of the neck (**Choudhary BS, 2000**)⁹, TMJ disorder (**Lee WY, 1995**)³¹, increased incidence of cervical and interscapular pain and headache (**Griegel- Morris P, 1992**)¹⁸ etc. There significant alterations in postural angles may cause or precipitate pain related musculoskeletal dysfunction (**Korovessis P, 2005**)³⁰, significant changes in respiratory parameters (**Jing XL, 2004**)²⁶ and metabolic cost measures (**Hong Y, 2000**)²². **Yip CH, (2008)**⁴¹ studies demonstrated that association exist among forward head posture, neck pain and disability. **Fredrikson et al. (2002)**¹⁵ reported that neck and shoulder pain was associated with computer work in both men and women.

Salam Rahmatalla, (2011)³⁵ found that relevance of the proposed predictive discomfort with the subjective reported discomfort was more with different non-neutral head postures. **Szeto et al. (2002)**³⁹ found that individuals increase their forward head posture during computer work, which involves an excessive anterior position of the head in relation to the theoretical plumb line perpendicular to the body's center of gravity and can be considered similar to a protracted position of the cervical spine in which the lower cervical vertebrae are flexed in a forward glide and the upper cervical vertebrae are extended (**Hanten WP, 1991**)²⁰. This causes a shortening of the posterior cervical and sub-occipital muscles, lengthening and weakness of the anterior neck muscles, weakness of the scapula retractor muscles and increased stress on the ligaments. The imbalances created by this position decrease muscular efficiency and extra muscular action are needed to hold the head and neck in the stable position (**Garrett TR, 1993**)¹⁶.

In the forward head posture, decreased activation of the thoracic extensors is associated with a significant increase in cervical extensors activity. The increased activation in the cervical extensors, which have a smaller cross-sectional area compared to the extensors with a thoracic origin (**Elliott et al. 2007**)¹², may result in decreased oxygenation and decreased force output in the low threshold motor units of this muscles (**Kallenberg et al. 2007**)²⁹. Activation of higher threshold motor units may help off-set this fatigue response in the short-term (**HodsonTole, Wakeling 2009**)²¹ and may explain the higher level of muscle activity associated with low load task observed in some individuals with posture related neck pain (**Johnston et al. 2008**)²⁷. However, the higher levels of muscle activity would contribute to elevated levels of muscle strain and loading of cervical spine structures increasing the potential for the development of pain.

Thoracic angle, stress and discomfort

The statistical analysis indicates that the correlation of thoracic angle with stress and discomfort was non-significant. The thoracic angle showed very little change in the angle between postures because the thoracic region is the most inflexible region of the vertebral column (**Sjan- Mari van et al. 2008**)³⁷ because of the limitations imposed by the structural elements such as the rib cage, spinous process, zygoapophyseal joint capsules, the ligamentumflavum and the dimensions of the vertebral bodies.

Reason for no correlation might be that musculoskeletal symptoms of computer users are believed to have a multifactorial aetiology. It is not like that change in thoracic angle causes stress and discomfort. Other contributing factors are non- neutral wrist, arm and neck postures, the work station design and the duration of computer work as well as psychological and social factors, such as time pressure and high perceived work load, are believed to interact in the development of these symptoms (**Bongers PM, 1993**)⁷. Alteration in thoracic angle might occur after a long period of sitting posture. The present study have done posture analysis of thoracic angle but not taken into consideration that he or she had worked for a longer period due to time availability of subjects.

Pelvic tilt, stress and discomfort

The pelvis is considered the base of the spine and its antero-posterior orientation affects the sagittal curves of the spine (**Levine and Whittle, 1996**)²⁸. Stable pelvis is necessary to avoid related problems of vertebral curve. The statistical analysis indicates that the correlation of pelvic tilt with stress is non- significant and the correlation of pelvic tilt with discomfort is significant.

One of the most common causes of poor biomechanics of the low back is due to the anterior pelvic tilt. Due to anterior pelvic tilt, a patient will generally have tight hip flexors (illioipsoas) and tight low back muscles (lumbarparaspinals). These tight muscles create added stress on the low back joints and spine causing pain, inflammation, spasm and tenderness. The greater lumbar lordosis in subjects with a high anterior pelvic tilt and the excessive curvature can create pain and discomfort at the low back, (**Barrey et al. 2007**)⁵.

Schwab et al.(2009)³⁶, found that muscle imbalance can be caused by the sedentary lifestyles. Those who participate regularly in an activity that takes the body unevenly will develop muscle imbalances. Those who spend long periods of time sitting also develops imbalances as the sitting position shortens the psoas and weakens the gluteal muscles. The cause of anterior pelvic tilt is usually due to extended periods of time spent in a seated or bent position at the hip. The seated position shortens the hip flexors and can cause the lower back to generate an excessive curvature. Sitting in a slumped posture may contribute to the development of musculoskeletal disorder as low back pain and neck pain. Prolonged sitting may slacken the abdominal muscles and slump the spine. This increases the strain of the spinal ligaments and stretches the back muscles. If this posture adopted over time, fatigue and back pain may be reported. This slumped posture increases the vertebral disc pressure, again presenting as back pain and may eventually lead to disc herniation. Sitting position may aggravates the discogenic low back pain, (**A Gandavadi, JRE Ramsay, 2007**)¹

Posture as a whole

Studies of the effect of sustained forces have indicated that a single posture should not be sustained for longer than 1 hr, (**Light KE, 1984**)³².**Mc Gill and Brown, (1992)**³³ have shown that 20 minute in a position of sustained loading can induce creep in soft tissues, with recovery taking longer than 40 min. Sustained forces produces time dependent deformation and adaptations in soft tissues. Short duration stretching produces temporary deformation of soft tissues but 1 hour of stretching might be sufficient for long term soft tissues adaptations (**Light KE, 1984**)³². Therefore, a long term habitual posture can results in abnormal loading of the ligaments and muscles that might ultimately contribute to a reduction in the range of motion and to the development of the pain (**Edmondston SJ, 2005**)¹¹. **Yoo et al. (2008)**⁴² suggested that it is necessary to frequently change the sitting posture when performing long term computer work. So to avoid problems occurring due to long term computer work, one should be advised that he/she should change posture whenever possible.

The limitation of the study, firstly as during the Methods section, a strong attempt was made to minimize the potential for bias during the measurement of cervical angle, thoracic angle and pelvic tilt. Despite these efforts, it is possible that subjects did not adopt their habitual posture during data collection, as one difficulty founded in the present study was that the precise localization of the bone prominences under the skin tissue. Secondly, the short duration of posture analysis limits the extrapolation of these results to muscular responses to postures sustained over longer period of time and posing of subjects for this may also alter the faults that exist. Thirdly, the markers were placed manually on the C7 and T8 spinous processes of the spine and reliability of the manual placement of these markers were not tested.

The future scope of the study, firstly it can be done on subjects with anthropometric measures. Secondly equal no. of male and female population can be taken. Thirdly mental stress can be added along with the physical stress. Fourthly as photography method was used during data collection, video method can also be used for this.

Conclusion

The study conclude that there is significant correlation between craniovertebral angle with stress and discomfort in subjects who are chronic computer users

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