*Available online at* **www.ijmrhs.com**

**ISSN No: 2319-5886**

**International Journal of Medical Research & Health Sciences, 2017, 6(6): 77-81**

# Effect of Ergonomic Advice on Neck Pain among Engineering Students of Belagavi City, Karnataka: An Observational Study

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## ABSTRACT

***Background and aim:*** *Neck pain is a common health problem experienced by engineering students. Majority of the times, neck pain is due to poor workstation posture, improper workstation structure. Thus, the aim of the study was to analyze the effect of ergonomic advice on neck pain among engineering students of Belagavi.* ***Materials and methodology:*** *An observational study was carried out among engineering students of all academic levels in local engineering institutes of Belagavi. Data of study was collected in academic year 2016-2017 using Neck pain and disability scale from 331 students. Initially, a baseline data was collected and then booklet consisting of ergonomic advice was given and follow-up was done after 4 weeks by using same questionnaire.* ***Results:*** *Overall 33.96% of reduction in neck pain was seen after ergonomic advice. In accordance with movements associated with neck pain, there was significant pain reduction in relation to up-down movement.* ***Conclusion:*** *Ergonomic advice is effective in terms of reducing neck pain among engineering students and it should be adopted for prevention of neck pain.*

**Keywords:** Neck pain, neck pain and disability scale, ergonomics

## INTRODUCTION

As said by Bernardini Ramazzini, (Italian physician and father of occupational medicines), in 18th century- "Diseases arise from three causes: First, constant sitting; Second, Perpetual motion of the hand in the same manner and Third, attentional application of the mind" [1].

Neck pain is defined as pain experienced from the base of the skull (occiput) to upper part of the back and extending laterally to the outer and superior bounds of the shoulder blade (scapula) [2].

Neck pain is a common health problem experienced by general population and workers. It is a major factor contributing to sick leave. Almost everyone in some point in their life experience neck pain. Considerable discomfort can occur due to neck pain. It may affect work due to pain, disability, and impaired quality of life. Each year around 11% to 14.1% people limit their activities due to neck pain [3]. Every week 15% of males and 25% of females report to the hospital with this disabling cause [4].

Musculoskeletal pain can occur due to repetitive strain, overuse, and work-related factors. Abnormal biomechanics of body movement due to inadequate muscle strength, endurance and joint mobility can result into abnormal physical load to various tissues leading more prone for musculoskeletal injuries. There are many causative factors of neck pain. Few of the factors associated are related to individual, physical attributes and psychosocial factors. Individual risk factors are sex (females are more prone than males), age, frequency and type of exercise, comorbid conditions [5]. Muscular or ligamentous factors related to posture (forward head posture, rounded shoulders, and trapezius spasm), poor ergonomics (improper workstation height, prolonged slouch sitting, and keyboard far away from user), stress and/or chronic muscle fatigue can result into neck pain. Risk factors associated with neck pain are previous muscle pain, high quantitative job demands, and low social support at work, job insecurity, low physical capacity, work posture, sedentary work position, repetitive work and precision work [6].

Many studies report that, increase duration of computer use and incomplete work- rest cycle control leads to neck pain and also other musculoskeletal disorders. Postural stress caused by poor workstation ergonomics, which can be due to inappropriate location of computer screen, keyboard, or mouse; any deviation in viewing distance; sustained non-neutral position of neck and shoulder is a primary source of pain in shoulder, craniovertebral junction or temporomandibular joint which can also develop neck pain [7]. Work environment is also an important aspect for development of musculoskeletal problems; lighting conditions, temperature, quality of air, size of working room, as well as acoustic conditions play important role to determine individual's health. Psychosocial risk factors include mental stress, mental strain, depression, domestic environment, and activities (in relation with duration and frequency), any recreational activity [5]. All these factors play an important role in determining susceptibility to develop musculoskeletal disorder especially neck pain.

Ergonomics is the science of studying people at work and then designing tasks, jobs, information, tools, equipment, facilities, and the working environment so people can be safe and healthy, effective, productive, and comfortable [8]. Normal ergonomic guidelines for computer users suggest that viewing distance should be 19-24", screen viewing angle should be 0° to 60°,eyes should be at the level of screen, head and neck should be straight, there should be lumbar support for lower back, elbow should be in 90° flexion, wrist should be straight, seat-back angle should be 90°, knees should be in 90° flexion, there should be adjustable seat height, feet should be supported on floor and there should be foot rest for shorter people [9]. Any variation in this posture leads to musculoskeletal pain.

Despite extensive literature search, there is dearth of literature available on studies conducted on prevalence of neck pain in engineering college going students. Hence, this study is intended to find the prevalence of neck pain among engineering students of Belagavi city, Karnataka.

## MATERIALS AND METHODS

### Study Setting and Design

An observational study conducted from November and December 2016 of academic year 2016-17 in Belagavi City, Karnataka.

### Ethics

This study was reviewed and approved by Institutional Research Ethics Committee-KLES Institute of Physiotherapy, Belagavi.

### Inclusion Criteria

• Engineering students who work on computer for at least 3 hours/day or 15 hours/day

• Engineering students who are working on computer for at least past 6 months

• Participants willing to participate in the study.

### Exclusion Criteria

• Subjects who have neck pain due to fracture, malignancy, infection, or other non-mechanical causes

• Subjects who have progressive neurological deficit, myelopathy, herniated nucleus pulposus

• Subjects who have serious co-existing disease

• Subjects who are non-co-operative.

### Sample Size

As this is observational study, there is no specific sample size.

### Data Collection Methods and Instruments

The approval for the study was obtained from the institutional ethical committee. After random selection of colleges, the colleges were approached personally to get permission. The purpose of the study was explained and written informed consent was obtained from all the participated students. All the subjects were screened based on the inclusion and exclusion criteria prior to their enrolment into the study. A brief demographic data was noted from the subjects.

All the subjects were asked if they are having neck pain and was noted in the data sheet. Subjects were asked to fill the 'neck pain and disability scale' and a booklet consisting of ergonomic advice was given. All the data was then collected and analyzed for the study. Neck pain and disability scale is a comprehensive measure of neck pain which is more reliable and valid than neck disability index. It comprises 20 items which measures neck problems, intensity of pain, its inference with activities of daily living and extent of associated emotional factors. Target population is patients with neck pain. Subjects will be asked to mark along 10 cm scale for each item. Score ranges from 0-5 in quarter point increments. For each item mark on the vertical grid indicates whole point and the one on dotted lines indicates half point increments. If the subject marks the space between the vertical grids a quarter point is added to the score. The total score is the sum of the item scores. It is a self-administered questionnaire. Time for completion is less than 5 minutes. After four weeks, follow-up was done with same questionnaire, all the data was collected and then analyzed.

**Statistical Analysis**

Statistical analysis for the present study was done manually as well as using statistical package of social science version 16 in order to verify the results obtained. For this purpose, the values of the study were entered in an excel sheet where the data was tabulated and subjected to various statistical analysis. Statistical measures such as mean, standard deviation and tests of significance such as Chi-square test, paired and unpaired t-test, were utilized for all the scores in all the participants. Probability values less than 0.05 were considered statistically significant and probability values less than 0.001 were considered highly statistically significant (Table 1).

**Table 1 Distribution of patients by ages, gender, causes and duration**

| Factors | No of patients | % of patients |
|---|---|---|
| **Age** | | |
| 18 yrs. | 34 | 10.27 |
| 19 yrs. | 56 | 16.92 |
| 20 yrs. | 91 | 27.49 |
| 21 yrs. | 117 | 35.35 |
| 22 yrs. | 33 | 9.97 |
| **Sex** | | |
| Male | 192 | 58.01 |
| Female | 139 | 41.99 |
| **Causes** | | |
| None | 186 | 56.19 |
| Computer use | 110 | 33.23 |
| Prolong sitting | 35 | 10.57 |
| **Duration** | | |
| None | 186 | 56.19 |
| Acute | 109 | 32.93 |
| Chronic | 36 | 10.88 |
| **Total** | 331 | 100 |

Outcome measure used was neck pain and disability scale. There was significant reduction in neck pain. Mean score on pre-test was 19.26 and post-test was 12.27. mean difference of pre- and post-scores was 6.54.

There was 33.96% of reduction in neck pain after ergonomic advice. t and p value was found to be 12.2862 and 0.0001 respectively, which is statistically significant.

In terms of pain reduction in accordance with movements associated with neck pain, there was significant pain reduction in relation to up-down movement. Mean score on pre-test was 1.04 and post-test was 0.69. mean difference between pre- and post-test was 0.36. There was 34.16% of change in neck pain associated with up-down movement. t value was 7.8690 and p value was 0.0001, which is highly significant.

But, in terms of rotatory movements and overhead activities, reduction in pain was 19.36% and 14.03% respectively p value for the same was 0.0729 and 0.5089, which was not significant (Table 2).

**Table 2 Comparison of pre-test and post-test of NPAD and its component scores by paired t test**

| Variables | Time | Mean | SD | Mean Diff. | SD Diff. | % of change | Paired t | P-value |
|---|---|---|---|---|---|---|---|---|
| NPAD | Pre-test | 19.26 | 15.25 | 6.54 | 9.69 | 33.96 | 12.2862 | 0.0001* |
| | Post-test | 12.72 | 12.02 | | | | | |
| Rotation | Pre-test | 1.07 | 1.01 | 0.21 | 2.1 | 19.36 | 1.7992 | 0.0729 |
| | Post-test | 0.86 | 2.05 | | | | | |
| Up-down movement | Pre-test | 1.04 | 1.03 | 0.36 | 0.82 | 34.16 | 7.869 | 0.0001* |
| | Post-test | 0.69 | 0.79 | | | | | |
| Overhead | Pre-test | 1.18 | 1.68 | 0.17 | 4.57 | 14.03 | 0.6613 | 0.5089 |
| | Post-test | 1.02 | 4.36 | | | | | |
| *p<0.05; NPAD= Neck pain and disability scale | | | | | | | | |

Pre-test and post-test comparison scores showed significant improvement in accordance with pain intensity, pain at rest, pain on activity, pain during ADL and psychosocial aspect among electronic faculty students then mechanical students, then computer science students than civil dept. students. After ergonomic advice, there was 28.13% of change in pain intensity, 34.65% change in pain at rest, 39.54% change in pain on activity, 31.52% change in pain during ADL and 37.09% change in psychological aspect. (p=0.0001) (Table 3).

**Table 3 Comparison of pre-test and post-test scores of pain intensity, pain at rest, pain on activity, pain during ADL and psychological aspect scores by Wilcoxon matched pairs test**

| Variables | Time | Mean | SD | Median | Mean Dif. | SD Dif. | % of Change | Z Value | p Value |
|---|---|---|---|---|---|---|---|---|---|
| Pain Intensity | Pre-test | 3.33 | 3.1 | 2.5 | 0.94 | 2 | 28.13 | 8.6281 | 0.0001* |
| | Post-test | 2.4 | 2.46 | 1.75 | | | | | |
| Pain at Rest | Pre-test | 1.07 | 1.18 | 0.75 | 0.37 | 1.04 | 34.65 | 8.6683 | 0.0001* |
| | Post-test | 0.7 | 0.92 | 0.25 | | | | | |
| Pain on Activity | Pre-test | 5.59 | 4.88 | 4.5 | 2.21 | 3.07 | 39.54 | 12.0766 | 0.0001* |
| | Post-test | 3.38 | 3.48 | 2 | | | | | |
| Pain During ADL | Pre-test | 0.88 | 0.93 | 0.5 | 0.28 | 0.58 | 31.52 | 8.4639 | 0.0001* |
| | Post-test | 0.6 | 0.67 | 0.25 | | | | | |
| Psychological Aspect | Pre-test | 3.23 | 3.11 | 2.5 | 1.2 | 2.23 | 37.09 | 9.9878 | 0.0001* |
| | Post-test | 2.03 | 1.98 | 1.5 | | | | | |
| *p<0.05; ADL=Activities of Daily Living | | | | | | | | | |

## DISCUSSION

Ergonomics is science of studying people at work and then designing tasks, jobs, information, tools, equipment, facilities and working environment. So, people can be safe, healthy, effective, productive, and comfortable [8].

Neck pain is a common problem among engineering students. Academics of engineering students expect them to use computer for more than 3 hours a day, total institutional hours a day (on average) are 8-9 hours working in a day with 1 hour break in whole session, thus giving rise to requirement of prolonged sitting.

Prolonged slumped sitting gives rise to increased tension and muscle tightness around shoulder and neck [10].

Forward head posture and trunk flexion are major factors related to development of neck pain. Due to spine flexion in case of slumped sitting, improper height of chair or in absence of backrest gives rise to higher activity in cervical erector spinae, trapezius and thoracic erector spinae muscles thus giving rise to neck pain [10].

Ergonomics is an important aspect of preventing any musculoskeletal disorder. Mainer times, pain results due abnormal posture during work, improper workstation design etc.

Booklet which was given to subjects consisted of difference between good posture and poor posture in which each body component was highlighted through picture describing ideal position. Also, there was explanation about seating arrangement, work surface, handling of mouse, keyboard, personal habits, position of monitor and guidelines during usage of accessories. It was explained that, chair should be of optimal height providing proper back support, armrest to maintain elbows in 90° of flexion. Work surface area should be arranged in terms of distribution with regard to usual work area, occasional and non-working, usual work area being closer. It was also explained that during reaching for mouse or keyboard movement should be from wrist, even about ideal distance between monitor and person's eyes, so that by minimizing neck strain. Along with this, they were advised to take short breaks after sitting for prolonged time.

A study done by Niamh Kilroy and Sara Dockrell in 2000 showed that advice relating to postural changes and reduction of risk factors, resulted in decreased musculoskeletal symptoms [11].

Previous study done by Akshay Bansode and Deepali Hande showed that, ergonomic advice is significant in reduction of neck pain in accordance with numerical rating scale (p=0.0001) [12].

The ergonomic guidelines given to subjects must be contributed to reduction of neck pain by reducing strain on upper as well as lower back. This study showed that, there was significant pain reduction with up-down movements of neck (according to neck pain and disability scale) (p=0.0001). Reason for this would be decrease in strain of erector spinae (cervical and thoracic) and trapezius muscles which are major extensors of neck.

In present study, pre-test and post-test comparison scores showed significant improvement in accordance with pain intensity, pain at rest, pain on activity, pain during ADL and psychosocial aspect among electronic faculty students, mechanical students, computer science students and civil department students.

## CONCLUSION

Ergonomic advice is effective in terms of reducing neck pain among engineering students and it should be adopted for prevention of neck pain.

## ACKNOLEDGEMENT

The authors of this study would like to acknowledge Principal Dr. Sanjiv Kumar and all teaching staff for their help rendered to the study.

## CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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