



## ASSOCIATION OF WORK-RELATED MUSCULOSKELETAL DISCOMFORTS AND ERGONOMIC RISK FACTORS AT WORKPLACE AMONG INDIAN AND AMERICAN IT PROFESSIONALS- A CORRELATIONAL STUDY

### Physiotherapy

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### ABSTRACT

**OBJECTIVE:** Purpose of the research was to find out the correlation between work related musculoskeletal problems and ergonomic risk factor at workplace setting as well as to compare the ergonomics setting between Indian and American IT companies.

**METHOD:** Pearson correlation coefficient was used to find the relationship between work related musculoskeletal problems and workplace ergonomics risk factors. Musculoskeletal problems have been assessed by using Standard Nordic Questionnaire (SNQ) and ergonomics risk factors by Rapid Office Strain Assessment scale (ROSA).

**RESULT:** 120 participants were assessed with their ergonomic settings using ROSA for IT workers in India and USA in which only 23.33% out of 60 people working in USA depicted higher risk (with score 5 and above) however in India 80% people were at higher risk ergonomic setting. The grand total ROSA score between Indian and American IT professionals companies also showed a significant difference in mean value from being as low as of  $4.12 \pm 1.03$  in American IT companies and in Indian IT companies being a higher value of  $5.43 \pm 1.29$ .

**CONCLUSION:** The results of the current study confirmed some of these relationships wherein ergonomics setting affect the occurrence of certain musculoskeletal discomfort. The office workers participating in this research in India were found to have a high level of both MSDs and ergonomic risks. These findings can be further used to guide MSD prevention efforts for office workers in India.

### KEYWORDS

Musculoskeletal Problems, Ergonomic Risk Factors, It Professionals

#### INTRODUCTION

Work-related musculoskeletal disorders are a major concern for people in IT sector, leading to temporary and permanent disability whether being from long duration wrong sitting postures in front of computers resulting in positional deformities to constant pressing of palmer aspect of forearm and wrist while coding leading to nerve damage.[1] Risks of occupational health hazards are common in IT sector and are escalating and substantial in a way that they are associated with high costs of workers absenteeism, lost productivity with financial and economical implications of IT companies leading to increase in health care, disability, and worker's compensation costs.[2][3][4][5]

While financial cost as well as number of people getting these injuries are significant therefore a structured and correctly designed workstation is very important.[6]

Revamping workplace stations in a systematized ergonomic manner are suggestive of not only downsizing but also eliminating various musculoskeletal problems among office workers [7] and aims to establish safe, commodious and productive workspaces by spawning human abilities and limitation into the design of a workplace, that incorporates individual's body size, strength, skill, speed, sensory abilities (vision, hearing) and even attitudes.[8] Nordic musculoskeletal questionnaire is most widely used questionnaire to assess the prevalence of self reporting musculoskeletal disorders. It covers different body regions using the body map from illustration. [9][10]

Rapid office strain assessment (ROSA) a picture based posture checklist designed to quantify exposure to risk factors in an office work environment for the musculoskeletal problems. Studies have been carried out with a significant connection that linked musculoskeletal discomfort with final ROSA score.[11] Office workstations self-assessments using the present ROSA online application demonstrate a satisfactory response in terms of workers reduction of the risk factors of surrounding workplace to reduce musculoskeletal discomforts.

#### Objectives :

To identify musculoskeletal disorder among computer professionals among IT professionals working in India and Unites States of America.

To assess the ergonomic risk factor in computer professionals of the same.

To find the correlation between different musculoskeletal problems with the ergonomic risk factors at workplace.

Comparison of the workplace ergonomic setting between India and United States of America.

#### MATERIAL AND METHOD:

Sample Size of 120 engineers working in IT companies at least 7 hours per day in front of computer were taken for study from IT companies of India and United States of America as per inclusion and exclusion criteria. Standardised Nordic questionnaires and Rapid Office Strain Assessment scale were used as instruments for evaluation of musculoskeletal problems.

#### Procedure

The study was conducted in different IT Companies of India and USA and informed consent was taken from each person. The subjects were selected on the basis of inclusion and exclusion criteria. Data was collected in the form of questionnaires for musculoskeletal disorders a Nordic musculoskeletal questionnaire and for the ergonomics part of assessment Rapid Office Assessment scale was used. A Google document form was designed with all the respective scales and distributed to people working in IT sector. The population was chosen randomly. A general questionnaire was about the personal demographic details and company they are currently working in which was followed by the standardized Nordic questionnaire (SNQ) to assess musculoskeletal disorders in nine different areas of the body for a duration of past 12 months and the past 7 days and pain has affected work in those last 12 months in which yes =1, no=0. Rapid office strain assessment scale (ROSA) a quick picture based survey method to assess workplace setting, provides a guide to the risks associated with work-related musculoskeletal injuries and covers different sections separately for example section A-chair height and pan depth, section B- armrest and back support, section C- monitor and telephone and section D- mouse and keyboard. All scores for ROSA were later calculated separately combination of these scores produced a grand score that was used to determine the proper calculation of ergonomics risk factors at the workplace. The data were then statistically analysed using the Pearson Product Moment Correlation between the musculoskeletal disorders and ergonomics settings.

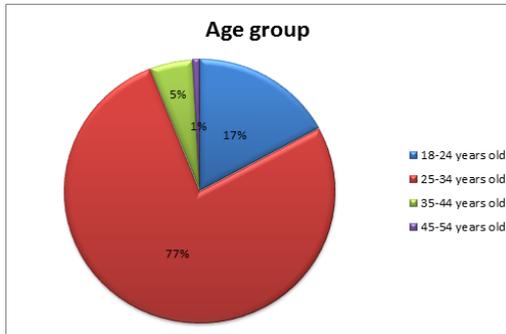
#### DATA ANALYSIS

##### Statistical analysis

To determine the relationship of levels of discomfort in the upper limb and lower limb between ROSA total scores and the standard Nordic questionnaire, the Pearson Product Moment Correlation was employed. The value of a correlation coefficient ranges between -1 and 1. The greater the absolute value of a correlation coefficient, the stronger the linear relationship. In this study, the values of r between 0.5-1.0 as strong significant relationship, 0.3-0.5 as moderate significant relationship, 0.1-0.3 as weak significant relationship and 0.1-0 as none or very weak relationship.

**Demographics**

120 subjects filled the questionnaire which includes 72 (60%) males and 48(40%) females. The population was randomly distributed with 50-50 ratio that is 60 were IT professionals working in United states of America and other 60 consisted of IT professionals working in India with age selected range from 25-45yrs, who spend at least 7 hours in front of a computer each day and with at least 1-year working experience.



**Figure 5.1 Different age groups found in study conducted**

In the study conducted the tables 1 & 2 shows higher percentage of people were suffering with discomfort in last 12 months among Indian IT professionals compared to IT professionals working in USA mainly in the upper limb covering areas of upper back, neck and shoulder also in lower limb mainly in lower back, hips and thighs.

This higher percentage of people with musculoskeletal problems found in people who are working in India also relates to the fact that ergonomic settings were also found in poor settings that were requiring immediate change as shown in table 3 and 4.

**Table 5.1-Prevalence of musculoskeletal discomfort in upper limb in the last 12 months among IT professionals working in India and United States of America**

Country	Neck	Shoulder	Upper back	Elbows	Wrist and hand
India	70%	50%	68.33%	23.33%	35%
United states of America	30%	18.33%	28.33%	8.33%	18.33%

**Table 5.2- Prevalence of musculoskeletal disorder in lower limb in the last 12 months among IT professionals working in India and United States of America**

Country	Lower back	Hips/thighs/buttocks	Knees	Ankles and feet
India	65%	45%	31.66%	15%
United states of America	26.66%	16.66%	8.33%	3.33%

The grand ROSA total score between Indian and American IT professionals company also showed also showed significant difference in mean value as shown in table 3&4 from being as low as of 4.12±1.03 in American IT companies and in Indian IT companies being a higher value of 5.43±1.29.

Grand score mean value of 4 and below usually doesn't require any change of the current workplace design setting whereas a value of 5 and above require immediate attention to re evaluate and correct the workplace setting design to avoid any further problems.

**Table 5.3- Result for ROSA at workplace setting in India**

ROSA Score	Mean±SD	Mode
Section A	4.20±1.30	3
Section B	4.38±1.32	4
Section C	3.73±1.27	3
Section D	3.57±1.27	3
Grand Score	5.43±1.29	6

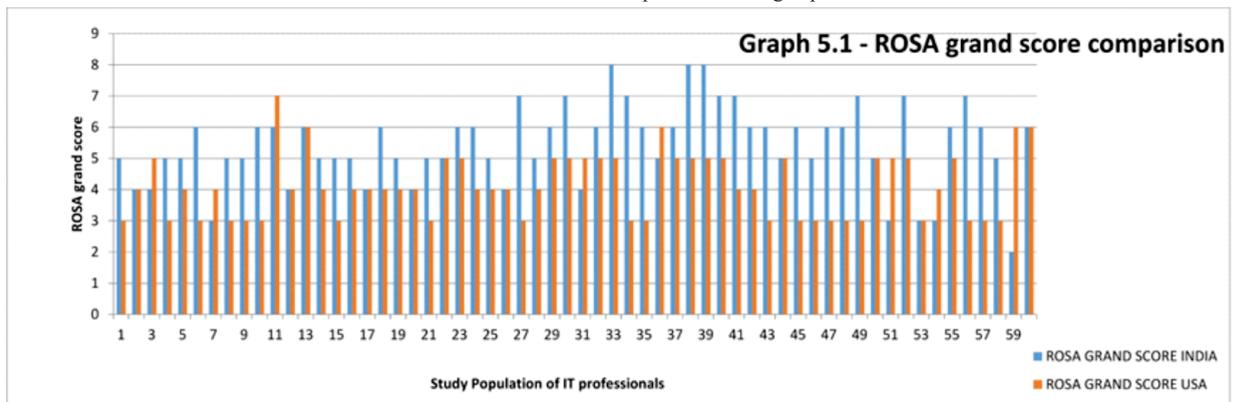
**Table 5.4- Result for ROSA at workplace setting in USA**

ROSA Score	Mean±SD	Mode
Section A	3.57±1.09	3
Section B	3.22±0.83	3
Section C	3.20±1.02	3
Section D	3.37±0.88	3
Grand Score	4.12±1.03	3

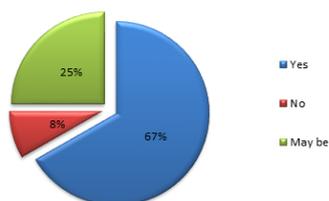
**Comparison of ergonomic setting at workplace between Indian and American IT companies in terms of ergonomic ROSA grand score**

The bar graph illustrates the grand ROSA score values found between the population working in India and in USA. The red bars shows the IT professionals working in India and the blue one demonstrates the IT professionals working in USA. The graph further portrays the variation of scores with highs and lows of the ROSA grand score value in entire study of population selected from different companies.

It can be seen that ROSA grand score values were of lesser value in the population working in USA whereas in the population working in India showed significantly higher values which depicts that workplace settings are better with less risk factors in USA compared to India where risk factors are high and thus causing more musculoskeletal problems among IT professionals.

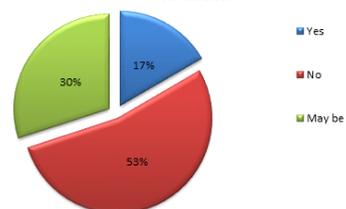


**Ergonomics department at workplace in USA**



**Figure 5.2-Awareness of ergonomics department in population working in USA**

**Ergonomics department at workplace in India**



**Figure 5.3- Awareness of ergonomics department among people working in India**

The following pie chart in figure 3 depicts maximum number of people were aware of the ergonomics department out of 60 people working in USA and very few percentage of people selected that they didn't have any ergonomics department in their respective companies. However in India as depicted in figure 4 more than 50% of total population were unaware of the ergonomics department in the office and only 17% said they had a separate ergonomics department at their workplace.

**Concurrent validity**

**Relationships between total scores of discomfort in neck**

ROSA total scores and Standardised Nordic questionnaire remark Neck score I (12 months any pain reported )found moderate significance of value of  $r=0.436919$  whereas a strong significant correlation was found between Neck II (last 7 days of pain reported) and ROSA total scores value  $r=0.58902$ .

**Relationships between total scores of discomfort in shoulder**

ROSA total scores and Standardised Nordic questionnaire remark with shoulder score I (12 months any pain reported)found moderate significance of value of  $r=0.42711$  whereas a strong significant correlation was found between Neck II (last 7 days of pain reported) and ROSA total scores value  $r=0.501$ .

**Relationships between total scores of discomfort in upper back**

ROSA total scores and Standardised Nordic questionnaires remark with both upper back I and II score found strong correlation with value of  $r$  being 0.616047 in Upper back I and 0.64505 in upper back II.

**Relationships between total scores of discomfort in elbows**

ROSA total scores and Standardised Nordic questionnaires showed weak relationship with value for elbows I with  $r=0.24244$  and elbows II with  $r=0.26368$ .

**Relationships between total scores of discomfort in wrist and hand**

ROSA total scores and Standardised Nordic questionnaires showed weak relationship with wrist and hand value  $r=0.260747$  and a moderate relationship with wrist and hand II with  $r=0.4949$ .

**Relationships between total scores of discomfort in lower back**

ROSA total scores and Standardised Nordic questionnaires showed moderate relationship with lower back I with  $r= 0.551459$  and lower back II with  $r=0.455944$ .

**Relationships between total scores of discomfort in Hips and thighs**

ROSA total scores and Standardised Nordic questionnaires showed moderate relationship with hips , thighs and buttocks I with  $r= 0.531267$  and hips thighs and buttocks II with  $r=0.49209$ .

**Relationships between total scores of discomfort in Knee**

ROSA total scores and Standardised Nordic questionnaires showed weak relationship with knee I with  $r= 0.270717$  and knee II with  $r= 0.397426$ .

**Relationships between total scores of discomfort in Ankle**

ROSA total scores and Standardised Nordic questionnaires showed very weak relationship with ankle I with  $r= 0.16057$  and ankle II with  $r= 0.082759$ .

**Table 5.5- Correlation values of Grand score ROSA with respective musculoskeletal discomfort in different areas**

	Grand Score Pearson Correlation Value (r)
Neck I	0.43
Neck II	0.58*
Shoulder I	0.42
Shoulder II	0.50*
Upper Back I	0.61*
Upper Back II	0.64*
Elbows I	0.24
Elbows II	0.26
Lower back I	0.55*
Lower back II	0.45
Hips/ Thighs/ Buttocks I	0.53*
Hips/ Thighs/ Buttocks II	0.49
Knees I	0.27
Knees II	0.39
Ankles and feet I	0.16
Ankles and feet II	0.08

\*shows strong significant correlation

**DISCUSSION**

This study aimed to find the correlation between different musculoskeletal disorders with the ergonomic risk factors at workplace and comparing workplace ergonomic setting between IT companies of India and United States of America.

According to the findings of all subsections and final scores in the rapid office strain assessment scale, the scores as filled by the workers showed a significant correlation. Moreover, ROSA scores were considerably but not highly related to those of discomfort and thus exhibited an intermediate validity. A significant relationship was found between discomfort and ROSA scores with neck, upper back, lower back and hip thighs and buttocks. These results are comparable in magnitude with the magnitude of the link between ROSA final score and whole body discomfort which ranged from  $r=0.40$  to  $r=0.70$ .

In the population of people working in in India during the chair assessment, most of the workers had the chair height with the knees approximately angled too low and the pan depth at about approximately 3 inches but it was not adjustable. At the level of the armrests, many workers reported the issue either it was too high which caused the shoulders to shrug or were present and again not adjustable which consequently causes the increase in the tension of the neck ( $r=0.58$ ) and shoulder muscles ( $r=0.50$ ) and further causes musculoskeletal pains. Our study supports the findings of Gonçalves et al (2017) [12] by providing evidence that supported forearm on the work surface increases the comfort as well as further reduce muscular load in the neck and shoulder. As for the lumbar support, few workers reported absence of lumbar support in chair or being angled to far back and if the support was present it was not adjustable, with the increase trunk forward bending at work for long hours also contributes to increase in the activity of lumbar and thoracic muscles and thus causing musculoskeletal pain in upper back ( $r=0.61$ ) lower back ( $r=0.55$ ) in Standard Nordic questionnaire. The time period reported by every IT professional was more than 4 hours, so the score was assigned 1 to each section being the highest value. Maintaining a posture of sitting during long hours in static postures and sometimes inadequate. This constant maintenance of erect and incorrect posture activity contributes to causing muscle fatigue as reported by Hunting et al (1981) thus making IT professionals more sensitive to suffer from WRMSD[1]. The results of this study also showed that ROSA section A score that is chair height and pan depth was significantly positively related with lower back symptoms and correspondingly the scores for lower back were of higher value among IT professionals in India compared to that of USA..

The scores assigned to the monitor are related to the positioning of the head in relation to the same ,in the computer screen and telephone section mostly the level of the computer screen was at eye level and only few reported a higher or lower level and those people suffer from neck pains from past 12 months. A lot of people reported that hand held telephones were still in practice with people that used telephone on average 4 and above hours and very few reported headset option being available to them where as in USA most of the IT companies provide a headset to their worker.

The studies of musculoskeletal disorders among people working India and USA showed massive variability in terms of 70% of people reported neck discomfort in India whereas 30% in USA which also shows higher scores in ROSA section B that relates with monitor and telephone thus indicating the rise in discomfort due to lack of correct ergonomics setting at workplaces hence, forcing wrong postures and movements at cervical spine. People working in the Unites states in all subsections of ROSA scale most people showed appropriate settings the only thing most people selected was nonadjustable back rest and non-adjustable working platform. The scores obtained from mouse and keyboard analysis ( $3.57\pm 1.27$ ) were related to the fact that many workers working in India often do not have their shoulder aligned with the mouse which further forces the shoulder in an obligatory postures and these non-neutral postures of the shoulder being in constant abduction and flexion have been found to be associated with musculoskeletal symptoms of the neck and upper limbs as supported by Cook et al (2017) [13]. However both population reported that there wrist were in extended position which is a contributing factor to people developing carpal tunnel syndrome.

IT companies in India have their most occurring score (mode value) in ROSA grand score 6 for compared to the IT companies in USA with

grand score 3, which shows people working in India have higher ergonomic risk factors at workplace which is suggestive that inadequate workstation conditions, specifically the monitor height, chair height and pan depth, shoulder/forearm support and back rest are contributing to musculoskeletal discomfort in computer office workers.

It is essential that ergonomic programs for the IT workers in the study population in India need to be put into corrective action immediately and for those with high symptomatic level and risk should be provided further with appropriate treatment.

The study further depicts that in India maximum number of people are either unaware about ergonomics department in their respective companies or they don't have any while only few out of 60 answered yes. This lack of knowledge further supports the above facts.

#### LIMITATION

The correlational study primarily focused on the effect of ergonomic risk factors at workplace on the work related musculoskeletal problems encountered by IT professionals. The study was limited to a small sample size, shorter time duration and uneven gender ratio.

#### CONCLUSION

The study has been concluded that only 23.33% out of 60 people working in USA depicted higher risk (with score 5 and above) however in India 80% people were at higher risk ergonomic settings. Although the effect of etiological mechanisms on occurrence of these Musculoskeletal disorders (MSDs) is not fully apprehended, the study conducted provides significant evidence that environmental factors influence the occurrence of MSDs. The results of the current study confirmed some of these relationships wherein ergonomics setting affect the occurrence of certain musculoskeletal discomfort. The office workers participating in this research in India were found to have a high level of both MSDs and ergonomic risks.

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