Effect of ergonomics training in work related musculoskeletal pain and posture among auto rickshaw drivers an experimental study

Dr. Samiya Shaikh, Dr. Shrikant Mhase and Dr. Sucheta Golhar

Abstract
Objectives: Aims to find the effect of ergonomics training in work related musculoskeletal pain and working posture among auto rickshaw drivers.

Methods: Study had begun with the presentation of synopsis to the ethical committee in PES MCOP. An approval was granted from the ethical committee various rickshaw stops were visited in and around the city. 35 subjects were selected on the basis of their inclusion and exclusion criteria. Pre score action method OWAS analysis was done Pre NPRS score was analyzed. Intervention for 3 weeks every alternate day was given Post OWAS and NPRS were analyzed. Data entered and analyzed.

Results: there was significant effect of pain and posture on pain and posture p value <0.0001.

Conclusion: This study concluded that there was positive effect of pain and posture on auto rickshaw drivers.

Keywords: ergonomics, pain, posture, musculoskeletal disorder, rickshaw drivers

1. Introduction
People working in transport sector spend more than 8-10hrs a day in traffic [4]. Professional drivers (bus, auto rickshaw, and taxi and truck drivers) have a lifestyle that is not conductive to good health [4]. They are at risk of developing number of health problems as a direct result of occupational environment in the form of exposure to poor posture, and other work related stress factors [4]. Driving as a task involves prolonged sitting, a fixed posture and vibrations, any of which could directly lead to musculoskeletal trouble [4].

Sitting in the driving position exerts considerable forces on the spine and cause a number of problems with the musculoskeletal system especially backaches, neck problems, pulled muscles and general stiffness [4]. About 68.15% of the auto drivers reported presence of one or more musculoskeletal symptoms [2]. The major impairments of musculoskeletal system found out were in shoulder (50.6%), neck (42%) and in lower back (40.7%) [2]. This observation point in the direction of impact of poor posture and faulty ergonomics [2].

2. Need of study
1. This study aims to find the effect of ergonomics training in work related musculoskeletal pain and working posture among auto rickshaw drivers.
2. The study is mainly focused ergonomic training and risk factors modification which is helpful for drivers to maintain the correct posture during the work process.

3. Aim
To study the effect of ergonomic training in work related musculoskeletal pain and posture among auto rickshaw drivers.

4. Objective
To study the effect of ergonomic training in work related musculoskeletal pain and posture among auto rickshaw drivers.
5. Hypothesis

Null Hypothesis
There will be no significant difference in work related musculoskeletal disorders (pain) and posture when treated with ergonomic training.

Alternate Hypothesis
There will be significant difference in work related musculoskeletal disorders (pain) and posture when treated with ergonomic training.

6. Methodology

Study population - Auto rickshaw driver’s Male
Study setting - Pune city
Study duration - 6 months
Study design – Quasi experimental study
Sample size - 35
Sampling method - convenient sampling

7. Materials
screening form
Participants informed consent form
OWAS Scale
Numerical pain rating scale NPRS

8. Criteria

Inclusion criteria
1. Participants with work related musculoskeletal disorders and pain
2. age group 25-55yrs old
3. only male drivers’
4. experience - drives since 2yrs or more
5. Working hrs. - Equal or more than 4 hrs.
6. 5 days or more

Exclusion criteria
1. Participants with previous history of trauma or surgery
2. Participants with congenital deformity
3. Participants with systemic illness like rheumatoid arthritis

9. Materials
Screening form, Participants informed consent form, OWAS Scale, Numerical pain rating scale NPRS, Data collection sheet, Pen, Paper

10. Procedure

Study had begun with the presentation of synopsis to the ethical committee in PES MCOP. An approval was granted from the ethical committee. Various rickshaw stops were visited in and around the city.

The subjects were selected on the basis of their inclusion and exclusion criteria.

The subjects were explained about the study before starting the procedure. Consent was taken from the subjects who wish to participate.

Baseline data was obtained. Pre score action method OWAS analysis was done. Pre NPRS score was analyzed. Intervention for 3 weeks every alternate day was given. Post OWAS and NPRS were analyzed. Data entered and analyzed. Training intervention - Training intervention included the basic principles of ergonomics, ergonomic training, with workplace modifications.

In ergonomics training basic exercises were taught such as shoulder rolls, neck rotations, chin tucks, back exercises, knee raises, calf raises, and finger exercises. Basic stretching was also taught that took almost 30 mins in each session. Job modifications, changes in their sitting postures, changes in seats, cushioning, foot rests, height of the seat, back support. Rest intervals were advised. Small distance walk was advised.

11. Procedure for assessing working posture

In this study working posture was evaluated with the help of ovako working posture analysis system (OWAS). OWAS posture system is classified in main four postures trunk, upper extremity, lower extremity and neck posture. Trunk posture is categorized in four categories and Upper extremity posture is categorized in three categories, lower extremity posture is categorized in seven postures, neck and head posture is categorized in five postures. According to this method assessment of the working posture among auto rickshaw drivers was done and coding system of OWAS was used to know at what level the working level is and who needs posture correction.
**Coding system**

1. Normal posture – No intervention required (Code 1)
2. Slightly harmful- Correction action should be taken during next regular review work method (code2)
3. Distinctly harmful- Correction action should be taken as soon as possible (code3)
4. Extremely harmful- Correction action should be taken immediately (code4)

**Fig 2: Owas interpretation**

<table>
<thead>
<tr>
<th>Action</th>
<th>Digit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td></td>
</tr>
<tr>
<td>Straight</td>
<td>1</td>
</tr>
<tr>
<td>Bent</td>
<td>2</td>
</tr>
<tr>
<td>Twisted</td>
<td>3</td>
</tr>
<tr>
<td>Bent and twisted</td>
<td>4</td>
</tr>
<tr>
<td>Arms</td>
<td></td>
</tr>
<tr>
<td>Both arms below shoulder level</td>
<td>1</td>
</tr>
<tr>
<td>One arm at or above shoulder level</td>
<td>2</td>
</tr>
<tr>
<td>Both arms at or above shoulder level</td>
<td>3</td>
</tr>
<tr>
<td>Legs</td>
<td></td>
</tr>
<tr>
<td>Sitting</td>
<td>1</td>
</tr>
<tr>
<td>Standing on two straight legs</td>
<td>2</td>
</tr>
<tr>
<td>Standing on one straight leg</td>
<td>3</td>
</tr>
<tr>
<td>Standing or squatting on two bent legs</td>
<td>4</td>
</tr>
<tr>
<td>Standing or squatting on one bent leg</td>
<td>5</td>
</tr>
<tr>
<td>Kneeling</td>
<td>6</td>
</tr>
<tr>
<td>Walking</td>
<td>7</td>
</tr>
<tr>
<td>Load</td>
<td></td>
</tr>
<tr>
<td>Less or equal to 10 Kg</td>
<td>1</td>
</tr>
<tr>
<td>Greater than 10 Kg and less or equal to 20 Kg</td>
<td>2</td>
</tr>
<tr>
<td>Greater than 20 Kg</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Back</th>
<th>Arms</th>
<th>Load</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**Interpretation of the result**

1. No action required
2. Corrective actions required in the near future
3. Corrective actions should be done as soon as possible
4. Corrective actions for improvement required immediately
**Ergonomics — ME 502**

**OWAS method**

by Palitha Pushpa Kumara

1/04/02

---

**OWAS**

(The **Ovako Working posture Analysis System**)

- Created in the mid-1970s by Ovako Oy, a private steel company in Finland
- Developed as a joint effort between Ovako Oy and the Finnish Institute for Occupational Health
- Basic concepts have been incorporated into other posture analysis systems (e.g., RUJA, REBA, Univ. of Michigan, etc.)

---

**Why We Measure Posture?**

- Job evaluation and redesign
  - Determine if current postural demands are acceptable
  - Establish baseline to evaluate effectiveness of interventions
  - Identify job attributes associated with awkward postures
  - Evaluate intervention effectiveness by comparing to baseline
- Epidemiology / Research
  - Measure exposure for dose-response models

---

**Using OWAS**

- Standard postures for the trunk, arms, lower body, and neck
- User makes a series of instantaneous observations to record posture at these four joints
- Percentage of time in each pre-defined category is computed
- Results compared to benchmarks

---

**Trunk Posture**

Four Categories

1. Straight/upright (“neutral”)
2. Bent forward (“pure” flexion)
3. Straight and twisted (“pure” axial twisting)
4. Bent and twisted (combination of flexion, lateral bending, and/or twisting)

---

**Dept. of Mechanical Engineering**

---

Fig 3: Owas scale 1
Fig 4: Owas scale 2
Using OWAS

Example: In a 25-observation study, the following trunk posture categories were observed:

- Neutral: 13 (52%)
- Bent: 9 (36%)
- Twisted: 1 (4%)
- Bent & Twisted: 2 (8%)

Trunk Posture Action Levels

Results

Look up action level for each category:

- Neutral: 52% (Acceptable)
- Bent: 36% (Slightly harmful)
- Twisted: 4% (Acceptable)
- Bent & Twisted: 8% (Slightly harmful)

For the trunk, this job would be rated “Slightly harmful”

OWAS Summary

Advantages

- Relatively easy to learn and use
- Results can be compared against benchmarks to establish intervention priority
- Scores at each body part can be used for “before” and “after” comparisons to evaluate intervention effectiveness
- Scores at each body part can be used in epidemiological studies
- Relatively easy to customize system to specific user needs

Weaknesses

- Posture categories are rather broad for the trunk and shoulders
- No information on duration of postures
- Method does not separate left and right arms
- Method gives no information for the elbow or wrist

THE END

Dept. of Mechanical Engineering
12. Data analysis and Results
The pre and post values of nprs and owas were analysed. The data was entered in excel spreadsheet, tabulated and subjected to statistical analysis. Instat graphpad prism v-9.1.0 was used for checking the effectiveness of ergonomics training among auto rickshaw drivers.

Comparison of NPRS score before and after intervention in neck pain

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t value</th>
<th>Mean difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>5.37</td>
<td>0.9727</td>
<td>10.047</td>
<td>1.371</td>
<td>(p &lt; 0.001)</td>
</tr>
<tr>
<td>Post</td>
<td>4</td>
<td>0.9393</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Fig 6: NPRS for neck pain](image)

![Fig 7: NPRS graph for neck pain](image)

Comparison of NPRS score before and after treatment in shoulder pain

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t value</th>
<th>Mean difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>4.6</td>
<td>1.215</td>
<td>5.850</td>
<td>1.486</td>
<td>(p &lt; 0.001)</td>
</tr>
<tr>
<td>Post</td>
<td>3.14</td>
<td>1.192</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Fig 8: NPRS for shoulder](image)

![Fig 9: NPRS for shoulder pain](image)

Comparison of NPRS score before and after intervention in Elbow pain

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t value</th>
<th>Mean difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>4.3</td>
<td>1.345</td>
<td>0.233</td>
<td>1.6</td>
<td>(p &lt; 0.001)</td>
</tr>
<tr>
<td>Post</td>
<td>2.7</td>
<td>1.363</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Fig 10: NPRS graph for elbow](image)

![Fig 11: NPRS elbow pain](image)

Comparison of NPRS score before and after intervention in Wrist pain

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t value</th>
<th>Mean difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>4.7</td>
<td>1.146</td>
<td>7.990</td>
<td>1.514</td>
<td>(p &lt; 0.001)</td>
</tr>
<tr>
<td>Post</td>
<td>3.2</td>
<td>1.114</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Fig 12: NPRS for wrist](image)

![Fig 13: NPRS graph for wrist](image)

Comparison of NPRS score before and after intervention in Low back pain

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>t value</th>
<th>Mean difference</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>3.62</td>
<td>1.190</td>
<td>0.233</td>
<td>1.6</td>
<td>(p &lt; 0.001)</td>
</tr>
<tr>
<td>Post</td>
<td>2.05</td>
<td>1.349</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Fig 14: NPRS for low back pain](image)
Fig 15: NPRS graph low back pain

<table>
<thead>
<tr>
<th>Action category/code</th>
<th>Pre percentages</th>
<th>Post Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.43</td>
<td>37.14</td>
</tr>
<tr>
<td>2</td>
<td>2.1</td>
<td>31.4</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>8.57</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
<td>11.43</td>
</tr>
</tbody>
</table>

Fig 20: Trunk owas graph

<table>
<thead>
<tr>
<th>Action category/code</th>
<th>Pre percentages</th>
<th>Post Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.43</td>
<td>48.57</td>
</tr>
<tr>
<td>2</td>
<td>31.43</td>
<td>25.71</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>14.29</td>
</tr>
</tbody>
</table>

Fig 21: Upper extremity owas score

<table>
<thead>
<tr>
<th>Action category/code</th>
<th>Pre percentages</th>
<th>Post Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.43</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>25.71</td>
<td>14.29</td>
</tr>
<tr>
<td>3</td>
<td>22.86</td>
<td>8.57</td>
</tr>
</tbody>
</table>

Fig 22: Upper extremity owas graph

Fig 16: NPRS for knee graph

Fig 17: NPRS for ankle

Fig 18: NPRS graph

Fig 19: Trunk owas score

Fig 23: Lower extremity owas score

<table>
<thead>
<tr>
<th>Category</th>
<th>Pre Percentage</th>
<th>Post Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>25.71</td>
<td>40</td>
</tr>
<tr>
<td>2</td>
<td>17.14</td>
<td>25.71</td>
</tr>
<tr>
<td>3</td>
<td>22.86</td>
<td>14.29</td>
</tr>
<tr>
<td>4</td>
<td>22.86</td>
<td>8.57</td>
</tr>
</tbody>
</table>

Fig 24: Lower extremity owas graph
13. Discussion
The current study showed that the ergonomic intervention were effective in terms reduction in pain in auto rickshaw drivers and some working posture were appropriate for working and some posture needs correction with the help of modified work place designs and educating the drivers about the ergonomics and how to apply during driving.
Frequency of musculoskeletal pain was found to be reduced in auto rickshaw 2drivers receiving the ergonomic intervention. The result was highly significant for ergonomic intervention (p<0.001).
Amick et al. Assessed this effect after changing the chairs in an office environment and found considerable results. Some studies have shown that installing ergonomic programs based on training, or workplace exercises are also effective in reducing of WMSDs.
Also, the work of Borle et al. (2012) conducted study among M.S.R.T.C. bus drivers reported about similar prevalence of Musculoskeletal Disorder MSD. The findings also relate to the work of Agarwal et al., (2017), which shows the 12 months prevalence of LBP is 63.66%.
One of the reasons for auto-rickshaw drivers to exhibit a high prevalence could be that they tend to sit in awkward postures resulting in musculoskeletal disorders while driving.
A study conducted on ergonomic intervention workplace exercises and musculoskeletal complaints comparative study. Musculoskeletal disorders are the most prevalent occupational disorders in different jobs. Some interventions such as ergonomic modifications and workplaces exercises are introduced as the methods for alleviating these disorders. In this study they compared the ergonomic modifications and workplace exercises on musculoskeletal pain and discomfort in a group of drivers.
In the current study Ergonomic intervention in the form of workplace exercises and activity modification, and job modification was useful in correcting working posture. There was significant improvement in action category 3(code 3) and action category 4 (code 4) working posture among trunk also improvement in action category 3(code 3) in upper extremity and improvement in code 3 and 4 in lower extremity.

14. Conclusion
The result of this study shows ergonomic training is effective in reducing work related musculoskeletal pain and working posture in auto rickshaw drivers.

This study also shows that because of awkward working posture drivers are prone to musculoskeletal injuries affecting economy and workers quality of life.

15. Implication in practice
In the present study, participants benefited from ergonomic training, as it showed significant results in 3 weeks of intervention. All participants had better reduction in work related musculoskeletal pain and all participants got aware at what risk there working posture are. Regular visits of physiotherapist can be arranged at various rickshaw stops.

Limitations
1. In present study, the duration of the intervention was short.
2. Activities of daily living and recreational activities of participants were not taken into account.
3. Home exercise program was not given.
4. Sample size of the study was limited.
5. Duration of pain was not considered

16. Future scope
- Future study should expand the sample size to represent the entire population of rickshaw drivers in Maharashtra.
- The same protocol could be implemented in different populations.
- Further research can be carried out extending the duration of protocol.
- Other components such as height of the driver and the seat can also be considered.
- and duration of pain can be also considered in further studies.
16. References
4. IOSR Journal of dental and medical sciences (IOSR-JDMS) prevalence and risk factors of musculoskeletal impairments among auto rickshaw drivers in a city of central India.
5. Ibrahim H. Garbie. An experimental study on assembly workstation on considering ergonomically issues.