

Ergonomic Risk Analysis of Auto Rickshaw Drivers Using RULA and REBA

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Abstract—The aim of this research is to determine the ergonomic risks and the musculo skeletal disorders that are associated with the Indian auto-rickshaw drivers during driving and suggest the necessary modifications and improvements that can be implemented for the development of a new auto-rickshaw that is better suited ergonomically for the drivers. The ergonomic risk is measured by analysing the different postures attained by the drivers. The main tools that I have used for this purpose are RULA (Rapid Upper Limb Assessment) and REBA (Rapid Entire Body Assessment). A total of 20 auto-rickshaw drivers were interviewed and questions were asked about the problems that they were facing during driving. A questionnaire was prepared to collect data on their demographics, work history and musculoskeletal pain history. A REBA score of 6-7 considering the different postures of the drivers signifies that there is a medium risk of developing a musculoskeletal disorder, further investigation is needed and the changes may be applied as soon as possible. Assessment of ergonomic risks using the method RULA gave a score of 5-6 considering different postures which suggests that necessary changes must be implemented immediately. The analysis of the work related musculo skeletal disorders (WMDs) using the RULA and REBA shows that the workers are under threats of musculo-skeletal disorders and there is a need to implement necessary changes as soon as possible in order to prevent the musculo-skeletal disorders.

Keywords—Working Postures, Musculo-Skeletal Disorders, RULA, REBA Method, Auto Riksha Drivers.

I. INTRODUCTION

Ergonomic Assessments can also be referred to as workspace assessments which safeguards that a worker's workplace is ergonomically so designed that it minimizes the musculoskeletal disorders related to that particular work with the help of the ergonomic analysis tools such as RULA and REBA etc. The musculoskeletal disorders (MSDs) which are associated to work consists of conditions such as pain, inflammation, tingling, numbness, etc. that involves the tendons, muscles, nerves, cartilage, ligaments, and joints. The auto rickshaw is nothing but a modified version of the conventional cycle rickshaw or pulled rickshaw. Most commonly seen in the form of a three-wheeled vehicle that is available for hire. The vehicle is formed of a small cabin like structure comprising of a driver seat in the front and a seat for commuters in the back., Generally, it is seen in a yellow, black or green colour while covered with a canopy on the top.

The design may vary from place to place. There are two categories of auto rickshaws in India. In conventional versions, the engines were below the driver's seat, while in the modern versions the engines are in the back. They normally run on petrol, CNG, or diesel. Currently CNG auto rickshaws are used widely because they are less responsible to pollution.It

was first developed by Bajaj in 1959, inspired from the design of the Vespa two wheeler vehicle. The design of the handle-bar of the auto rickshaw is such that it is bound to provide some discomfort to the drivers, especially while operating the auto rickshaw at higher gears. Thus, the objective of this paper is to investigate the ergonomic risks that the auto-drivers are subjected to during driving. For the evaluation of the musculoskeletal disorders, I have chosen two very well-known ergonomic analysis tools namely Rapid Entire Body Assessment (REBA) and Rapid Upper Limb Assessment (RULA). Both of these above methods have been utilized extensively in the field of ergonomics for determining whether a particular posture or process or design is advantageous or disadvantageous ergonomically. Important works that are related to the ergonomic evaluation of the muscular skeletal disorders where RULA and REBA were employed consists of the study of the musculoskeletal disorders pertaining to drivers of buses and trucks etc.

II. RULA, REBA AND MSD

A. RULA

The RULA (Rapid Upper Limb Assessment) method utilizes a systematic process to investigate the upper extremity posture related musculoskeletal disorders and the risk factors associated with daily activity at workplace. The body parts under consideration in RULA assessment are neck, trunk and upper extremities. Like in REBA, RULA also utilizes a single worksheet in order to investigate the body posture under consideration.

B. REBA

The REBA (Rapid Entire Body Assessment) method utilizes a well-structured process to investigate the entire body posture related musculoskeletal disorders and the risk factors associated with specific daily activity at workplace. A single page assessment worksheet is utilized in REBA tool in order to study the selected body postures, and other associated risk factors like forceful exertion, repetitive movement, etc.

C. MSD

Musculoskeletal disorder (MSD) is a term that includes various injuries that are created due to unbalanced developments which are repeated regularly after some time. Musculoskeletal Disorders can happen to the ligaments, tendons, joints, muscles, nerves, shoulders, neck and arms and so on. Many work-related MSDs create after some time and then are brought about either by the representatives working condition or by the work itself. Other disturbing components contains poor stances, a very bad outlined workstation, poor instrument plan, and work stress. Musculoskeletal Disorders are additionally referred to as industry related cumulative trauma disorder, overuse disorders and repetitive stress injuries. Commonly, MSDs fundamentally influence the back,

neck, shoulders and upper appendages; be that as it may, they likewise influence the lower appendages.

III. DIFFERENT TYPES OF MUSCULO-SKELETAL DISORDERS

A. Nerve and Circulation Disorder-

Whenever inflammation or friction causes swelling, arteries and nerves both can be packed thus limit the stream of blood flow to the muscles. This can bring about an injury called as thoracic outlet syndrome. The manifestations of the issue are torment in the whole arm, coldness, insensibility and shortcoming in the fingers, arm and hand. Indications incorporate excruciating affectability, shivering, coldness, numbness, and whiteness in the fingers. It can influence one or both hands.

B. Repetitive Strain Injury (RSI)-

It is a common word which is utilized to portray the drawn-out agony experienced in arms or hands or shoulders or neck. It is the normal word utilized for alluding the sorts of soft tissue wounds like the trigger finger, nerve fits and carpal tunnel disorder. Repetitive Strain Injury happens whenever the mobile parts of the appendages are harmed. It is for the most part because of repetitive undertakings, wrong stance, stress and terrible ergonomics. For the most part it causes insensibility, shivering, shortcoming, swelling, and stiffing and even nerve harm.

C. Muscle and Tendon Disorders-

Tendons associate muscles to bones. They can sit next to no in the method for extending and are inclined to damage when abused. Exhausting a ligament can bring about little tears in it. These tears can wind up noticeably kindled and cause extreme agony. This phenomenon is known as tendinitis, and it happens in the shoulder muscles, lower arm tendinitis causes torment in wrist, muscles, and fingers in the highest point of the hand.

IV. METHOD AND ANALYSIS

The common postures which are to be considered while designing any product and while doing any research that involves human interaction are as follows

- Standing
- Moving
- Sitting
- Reaching

The methods which are employed in the analysis of the ergonomic risk factors are the Rapid Upper Limb Assessment (RULA) method and the Rapid Entire Body Assessment (REBA) method.

RULA ANALYSIS

RULA is a screening tool that estimates the biomechanical and postural load requirements of the work or the task on the neck, trunk and upper limbs of the body. In RULA analysis, a single page worksheet is used (which contains different sorts of body postures attained by the workers during their tasks) for assessment of the required body postures, force, and repetitions. It contains two sections i.e., section A for arm and wrist analysis and section B for neck, trunk and leg analysis. Depending upon the different body postures mentioned in the RULA sheet, scores are entered for each body region in section A for the arm and wrist, and section B for the neck and trunk. When the data for each data is evaluated and scored then tables on the form are used to compile the risk factor, variables,

generating a single, score that represents the level of the Muscular Skeletal Disorder risk.

The steps that are taken while using the RULA analysis are as follows:

- Step 1: Observing and selecting the postures to evaluate.
- Step 2: Scoring and recording the posture.
- Step 3: Action level.

Table 1: Shows RULA score, level of risk and necessary actions

SCORE	Level of MSD risk and action
1-2	Negligible risk, no action required
3-4	Low risk, change may be needed
5-6	Medium risk, further investigation, change soon
6+	Very high risk, implement change immediately

The final RULA score comes out to be 5 which indicates that further investigation is needed as soon a risk of s possible and change may be implemented immediately in order to avoid the avoid the risk of MSDs.

REBA ANALYSIS

REBA is a screening tool that estimates the biomechanical and postural load requirements of the work or the task on the body. Like RULA, in REBA also a single page worksheet is used (which contains different sorts of body postures attained by the workers during their tasks) for assessment of the required body postures,

It contains two sections i.e., section A for neck, trunk and leg analysis and section B for arm and wrist analysis. Depending upon the different body postures mentioned in the REBA sheet, scores are entered for each body region in section A for the neck, trunk and leg and section B for the arm and wrist. This ergonomic assessment tool uses a systematic process to evaluate whole body postural MSD and risks associated with job tasks. The REBA was designed for easy use without need for an advanced degree in ergonomics or expensive equipment. You only need the worksheet and a pencil. Using the REBA worksheet, a score will be assigned for each of the body regions such as wrists, forearms, elbows, shoulders, neck, trunk, back, legs and kneesforce, and repetitions.

After the data for each region is collected, scored, and compiled the risk factor variables, generating a single score that represents the level of MSD risk using the Reba table.

Table 2: Shows REBA score, level of risk and necessary actions

SCORE	LEVEL OF MSD RISK
1	Negligible risk, no action required
2-3	Low risk, change may be needed
4-7	Medium risk, further investigation, change soon
8-10	High risk, investigate and implement change
11+	Very high risk, implement change immediately

The final REBA score comes out to be 5 which replicates that there is a medium risk of developing Musculoskeletal Disorder among the auto rickshaw driver, further investigation is needed as soon as possible and the changes should be implemented soon.

V. RESULT

RULA and REBA scores were computed by analyzing postures of auto-rickshaw drivers while applying different gears and also while taking a turn under the different postures. The most

commonly affected body regions were lower back (80%), neck (85%), shoulder (55%), upper back (80%), thigh/hip (40%) and knee (25%). RULA score comes out to be 5 or 6 for each of the evaluated positions which suggest that the ergonomic condition of the job is very poor and should be changed immediately. Further, a score of 6-7 is achieved in case of REBA while evaluating different postures thereby signifying that the drivers have a very high risk of developing a musculoskeletal disorder and therefore necessary modifications should be implemented within a short span of time. The scope for improvement in the present state can be approached from the following two directions.

1. Improvements in the design of driver's seat.
2. Improvements in the design of handle bar by suggesting an alternative solution.

CONCLUSION

Prior to proposing modifications in the design of auto-rickshaws, a thorough investigation of the working postures of drivers has been carried out using ergonomic evaluation techniques of RULA and REBA. The final scores of both these methods indicate the same conclusion, that is, the drivers have a very high risk of developing a musculo-skeletal disorder and hence the working posture should be changed immediately. In the current study, an attempt has been made to lower the associated ergonomic risks by suggesting improvements in the design of driver's seat and handle-bar. These changes may allow the driver to attain a comfortable and convenient posture while driving. Secondly, the traditional handle bar was suggested to be replaced by a steering wheel which may allow a more ergonomic posture. The advantages rendered by the said modifications were to be further studies by generating a model of the steering wheel for the handle. Hence, there is a tremendous scope for carrying out future research work in this field, the primary reason being the involvement of a large workforce who is extremely prone to occupational hazard.

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