International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 09 Issue: 01 | Jan 2022 www.irjet.net p-ISSN: 2395-0072

STUDY ON POSTURAL ANALYSIS ON THE TRUCK BODY MAKING INDUSTRIAL WORKERS

Siva Ranjith S[1], Jishin JayanT[2]

[1]PG Scholar, M.E Industrial Safety Engineering, Department of Mechanical Engineering, Bannari Amman Institute of Technology, Sathyamangalam, Erode, India
[2]Assistant Professor, M.E Industrial Safety Engineering, Department of Mechanical Engineering, Bannari Amman Institute of Technology, Sathyamangalam, Erode, India

---

Abstract – *Work-related muscular-skeletal disorder (WMSDs) is the most common problem in manual work in small-scale industries. The present study was focused on the posture analysis on the truck body making industrial workers in different industries. The study was conducted on the workers engaged in various operations namely hammering, cutting, drilling, and grinding, and welding. The study includes administering a questionnaire to determine the level of risk during the operations. The workers are subjected to awkward positions link bending, twisting, etc. The survey was carried out by the different workers in the truck body-making industries. The activities will be making videos and taking photographs for postural analysis. Evaluation of these posture analyses carried out the tools like Rapid Upper Limb Assessment (RULA), Rapid Entire Body Assessment (REPA), and Quick Exposure Check (QEC). The study suggests improving the working posture by using engineering controls and administrative controls to provide a sit-stand chair for proper sitting position and ergonomic tables, and an adjustable ladder for working truck body and rubber material grip for hammering handle.*

Key Words: Posture Analysis, Truck Body Making, Small Scale Industries, Proper sitting position and Rubber material.

1. INTRODUCTION

Singh et al (2012) have studied in the small-scale forging industries with around 102 workers taken for analysis using the RULA method. The videos will take the different activities and images will use for analysis. The result will show that 20.33% of workers were high-risk level immediate changes required 42.32% of workers were low-risk level 34.33% of the workers were a medium level risk. They recommended that give proper awareness of the ergonomics and give training of the workers [6]. Hussain, M.M et al (2019) have reported that Digital Human Modeling (DHM) is a CAD representation process for human body form, it will stimulate the workplace and give a solution for ergonomics. The study aimed to analyze the working postures in small-scale industries using RULA Assessment and CATIA V5R20 software. The workers will take the stone cutting and polishing industry workers they will work in awkward postures while heavy manual lifting, bending, twisting, and turning of a truck. The postures will show a score range of 7. So, they suggest improving the work postures. The manual lifting was assessed using the NIOSH equation for origin and destination. The safe limit will be manual lifting will be 1.79 to 0.98. The result shows minimize the injuries using ergonomic interventions [3]. Qutubuddin, S. M. et al (2013) have conducted the study in automotive coach manufacturing unit workers using RULA, REBA, and QEC Assessment Tools. The result of REBA shows 26.32 % of the workers exposed to high-level risk corresponding to RULA shows 31.57% of the workers exposed to high-level risk.QEC Assessment around 34.21 % of workers exposed to high-level risk. It will conclude that without proper planning and implementation will lead to health problems. It will be recommended to give proper awareness of the workers about ergonomics and proper training of the workers [7]. Kumar et al (2012) have studied was adapted on cast house operations, workers will work awkward postures. The workers will be observed and analyzed through photographic analysis, line diagram techniques, and Ovako Working Posture Analysis System (OWAS). Awkward postures will lead to serious health problems like injuries and illness of workers. Working postures and anthropometric measurements will be collected for analyzing and improving working conditions. The computer-aided ergonomics assessment platform JACK 5.1 was developed for the workstation stimulation. To suggest changes in work procedure, work norms, ergonomic interventions, and sit-stand chair for workers sitting comfort position [5]. Halim, I. et al (2005) have reported that musculoskeletal disorder is lead to serious health problem in the manufacturing industry. The study was conducted under Malaysian small-scale and medium-scale industries. Each work station will be carried out a manual material handling process. Rapid Upper Limb Assessment (RULA) associated with CATIA software and Nordic Questionnaire was used for analyzing assessment. From RULA assessment found awkward posture of working position and Nordic Questionnaire was used for lower back in Malaysian stamping industry [2]. Agrawal, D. N.et al (2011) have studied was conducted in a tractor-trolley manufacturing unit in small-scale industries. Data will be collected from various in the different industries and analyzed through the RULA Method. The turn table is suggested as the ergonomic manufacturing unit. Ergonomic considerations and actual practices on the workstations will be prescribed the proper design method [1]. Jagadish R et al (2018) have studied that the work posture analysis in small-scale industries.

Randomly the workers will be selected in the different operations such as cutting, polishing, saw mills, brick making, and Dall mill. The study will be conducted using questionnaires for the health level of the workers, RULA and REBA Assessment tool. According to 32 % of the workers exposed to high-level risk at RULA Assessment and 36 % of the workers exposed to high-level risk at REBA Assessment. Suggest improving ergonomic control and interventions, encouraging the workers to use PPE [4].

1.1 Objective of the Study

The extensive literature surveys the presence of work-related musculoskeletal disorders among the workers involved in manual works in the truck body-making industry. It can be identified that the maximum number of musculoskeletal problems are related to the awkward posture line bending, twisting, etc. Moreover, mostly this problem is still faced in small-scale industries application of ergonomic problems and even safe working positions are negligible. Hence the present study's main objective is to identify and assess the Work-Related Musculoskeletal Disorder due to unnatural/awkward posture by RULA, REBA, and QEC.

2. MATERIALS AND METHODOLOGY

The present study assessing the ergonomic risks in working postures used tools like RULA, REBA and QEC.

2.1 Rapid Upper Limb Assessment (RULA)

RULA – Rapid Upper Limb Assessment was first developed earlier by McAtamney and Corlett. The survey method was developed for ergonomics assessment in the workplace, where workers faced musculoskeletal problems. RULA assesses the workers working posture, force or weight level of the working equipment, and movement associated with workers' sedentary tasks. The assessment does not require any particular equipment for providing scores for neck, trunk, and upper limbs along with muscle function and external loads experienced by the worker's life. RULA was used to generate the coding system for indicating the level of risk and intervention required. Briefly evaluated and the score is given each body part of each section include upper arm, lower arm, and Wrist postures. The risk level and action required are shown in the table 1.

Table -1: Classification of Risk According to RULA

RULA Score	Action Required
1-2	Acceptable posture
3-4	Change may be needed
5-6	Change soon
7	Implement Change

2.2 Rapid Entire Body Assessment (REBA)

REBA – Rapid Entire Body Assessment was first developed by Hignett, s and McAtamney, L. in the year 2000. The posture assessment tool provides a quick observational analysis of the whole-body parts activities (static and dynamic giving musculoskeletal risk action level). REBA also gives the score level of each position body part indicating the urgency for changing the worker's body postures. The development of REBA aimed to divide into body segments group A and group B. Group A consists of truck, neck, and legs. Group B consists of the upper and lower arm and wrists. Other items are included load-handled couplings with the load and physical activity is specified in the assessment tool. The risk level and action required are shown in the table 2.

Table -2: Classification of Risk According to REBA

REBA Score	Action Required
1	Acceptable posture
2-3	Change may be needed
4-7	Change soon
8-10	Implement change
11-15	Change immediately

2.3 Quick Exposure Check (QEC)

QEC – Quick Exposure Check is an observational method that was first developed by Li and Buckle in the year of 1998 and enhanced by David et al. in the year of 2003. The method will assess the body parts like the back, shoulder, upper arm, wrist, hand, and neck concerning working postures and working movement. Additional information was also provided such as maximum weight handled, time spent for the specific task, level of hand force, types of vibrating tools used, visual demand of the task, the stressfulness of the working time. The survey method was used to analyze the level of exposure faced by the workers and ergonomic risks. The assessment tools include questions that need to be answered by both users and workers. The questions are developed to identify the risk level for four major areas of the body parts shoulder, arm, wrist, and neck. Finally, QEC achieve the overall score obtained for the four body parts are added divided by the maximum possible score i.e., 172 for manual material handling tasks and 162 for other tasks. The risk level and action required are shown in the table 3.

Table -3:

QEC Score (%)	Action Required
<40%	Acceptable
41-50%	Change may be needed
51-70%	change soon
>70%	change immediately

Classification of Risk According to QEC

2.4 Methodology

The present study was carried out analyses the ergonomic risk involved in the truck body building making industrial workers ,19 workers will be analyzed. The different types of truck body building will make depend upon their customer stratification. In industries workers were performing hammering, cutting, grinding, drilling, and welding operations. At the time of these operations working with daily 5-6 hours. The awkward postures like bending, twisting etc., lead to serious health problems such as neck pain, shoulder pain, etc., The entire truck body making works and awkward postures adapted by the workers are shown in fig 1.

Fig -1: Awkward postures

At the time of the survey, all the jobs were thoroughly observed before starting the work and detailed information will be collected from the workers to ensure the completion of ergonomic risk. A video recording and photographs were taken in the different operations such as hammering, cutting, surface grinding, drilling, and welding to record the different movements of workers and working postures. The photographs are used to analyze to fill the scores like REPA and RULA. To evaluate the risk assessment of a job or task use RULA, REBA, and QEC.

The RULA assessment scores mainly focus on the upper limbs, neck, trunk, arms, and wrist of posture. The range of workers' body movement posture will be divided into different body sections. The score of body sections will be given to assigning score is 1 work posture risk level will be maintained minimum. To assign body score will be high work posture risk level is an extreme risk factor. The score is categorized into different levels such as negligible, low risk, medium risk, and high risk. Medium risk and High risk they addressed urgently to reduce the exposure levels.

The REBA assessment tool used for analyzing such activities such as whole body and motion of limbs. Similar to RULA in REBA also body parts will be divided into different segments and each part can be analyzed to the risk level scores will be assigned. In such body parts, high scores are allocated the postures will have more risk factors, and low scores are allocated the posture will have low-risk factors. The score is categorized into different levels such as negligible, low risk, medium risk, high risk, and very high risk.

3. RESULT AND DISCUSSION

3.1 Rapid Upper Limb Assessment

The result of the RULA assessment are shown in chart 1. According to this posture analysis technique 52.6 % of the workers working with medium risk levels and required corrective action as soon as possible. Around 47.3% of the workers working with high risk and need corrective action immediately. The overall process-wise distribution of the REBA Score is show in table 4. The workers are involved in hammering operations are shows in very high-risk level and immediate changes required. The reaming operations including cutting, grinding, drilling, welding workers are worked with awkward positions, the RULA score is medium to high-level risks, and required changes as soon as possible.

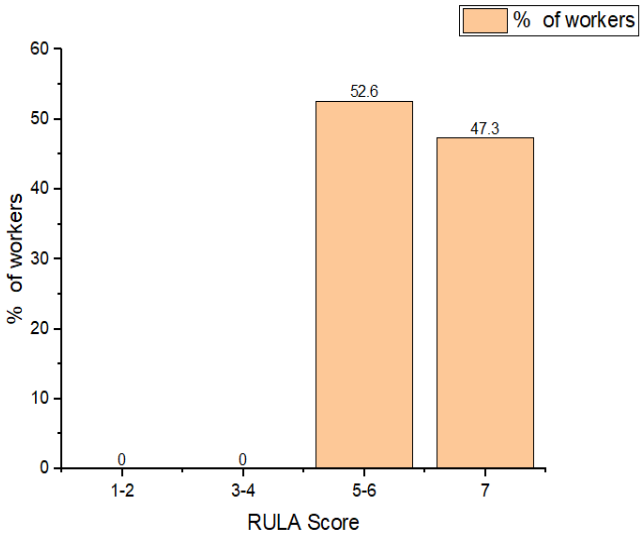

Chart -1: Percentage level of RULA Assessment

Table -4: Overall process wise distribution of RULA Score

Job Description		RULA Score			Total (n=19)
	1-2	3-4	5-6	7	
Hammering	-	-	-	2	2
Cutting	-	-	4	3	7
Grinding	-	-	2	2	4
Drilling	-	-	1	1	2
Welding	-	-	3	1	4
Total			10	9	19

3.2 Rapid Entire Body Assessment

The result obtained from the REBA assessment work are shown in chart 2. Around 22.2% of the workers are at medium risk and need some necessary changes, whereas 44.3% of the workers are at a high-risk level and make changes as soon as possible. Around 33.3 % of the workers are at a very high-risk level and immediate changes will be needed. The overall process-wise distribution of the REBA Score is show in table 5. The workers involved in cutting operations are at medium risk. The workers are involved in grinding operations are at high to very high-level risk and immediate change required. The workers involved in the drilling operations are at a high-risk level and as soon as possible changes. The workers involved in the welding operations are at medium level risk and very high-level risk and necessary changes will be needed. The main reason for workers working with high-level risk is due to manual involvement of the work.

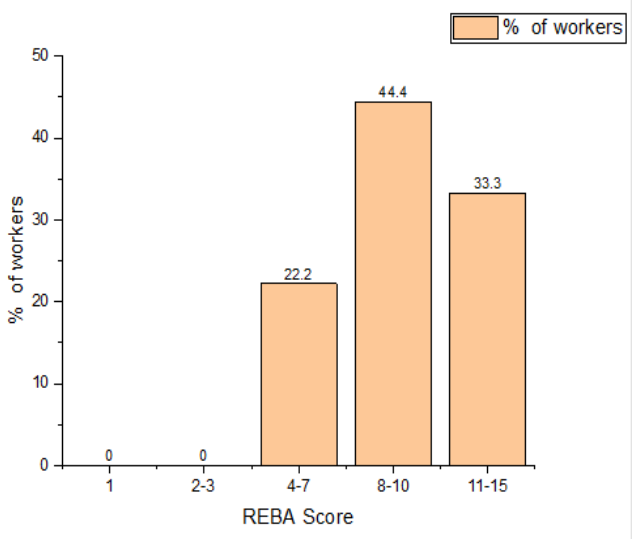

Chart -2: Percentage level of REBA Assessment

Table -5: Overall Process wise distribution of REBA Score

Job Description			REBA Score			Total (n=9)
	1	2-3	4-7	8-10	11-15	
Hammering	-	-	-	-	-	-
Cutting	-	-	1	-	-	1
Grinding	-	-		2	2	4
Drilling	-	-	-	2	-	2
Welding	-	-	1	-	1	2
Total			2	4	3	9

3.3 Quick Check Exposure

The exposure level of (E) is calculated as a percentage of the total exposure score X and the maximum possible total Xmax.
For manual handling task, Xmax=176

For other tasks, Xmax=162

The Exposure level E (%) = X/Xmax * 100%

The result obtained from the QEC assessment work are shown in chart 3. It is observed that about 31.5% of the postures are at a high-risk level and further investigation and need changes as soon as possible. Around 68.4 % of the workers are at a very high-risk level and an immediate investigation will be needed and changes will need immediately. The overall process-wise distribution QEC score will show in the table 6. The workers involved in the hammering operations are at very high risk and immediate changes will be required. In remaining operations include cutting, grinding, drilling, welding is at a high-level risk to very high-level risk, and as soon as possible immediate changes will be required.

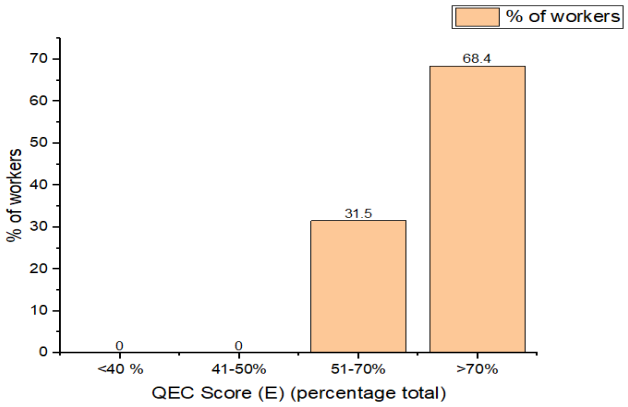

Chart -3: Percentage level of QEC Assessment

Table -6: Overall Process wise distribution of QEC Score

Job Description	QEC Score				Total (n=19)
	<40 %	41-50%	51-70%	>70 %	
Hammering	-	-	-	2	2
Cutting	-	-	2	5	7
Grinding	-	-	1	3	4
Drilling	-	-	1	1	2
Welding			2	2	4
Total			6	13	19

The Chart 4 shows the overall percentage of three assessments. According to RULA Assessment, the graph shows cutting, grinding, drilling, welding (55 – 65%) of the workers exposed to the medium risk and changes needed as soon as possible. Only hammering operations (70%) of the workers are exposed to very high risk and immediate changes will be required. Similar to the hammering REBA Assessment shows the grinding, drilling, and welding (85% - 98%) of the workers will expose high-level risk only cutting operations (70%) of the workers will expose medium risk and changes needed as soon as possible. Compare to the other two assessments shows workers will be faced medium to high-level risk but QEC Assessments shows all operations workers will be faced (70%-81%) of the very high-level risk and immediate changes will be required.

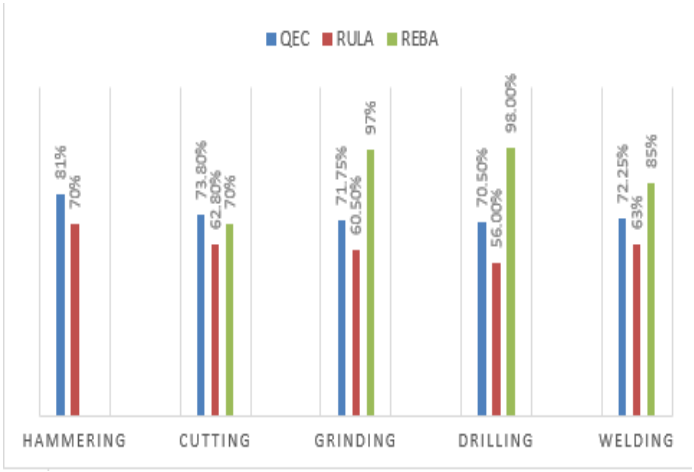

Chart -4: Over all Percentage of three Assessments

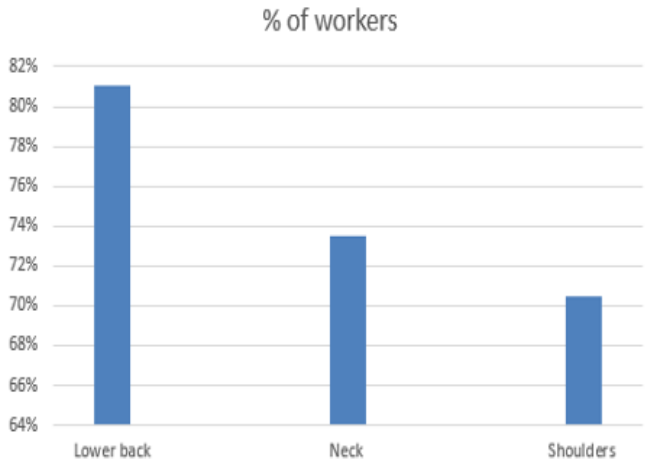

Chart -5: Over all Discomfort Level of Workers

The chart 5 indicates the overall discomfort and pain at the lower back, neck, and shoulders. According to the questionnaire survey about (81%) of the workers will be reported as the lower back pain. Mostly hammering operations workers will be reported. Around (73.50%) of the workers will be reported are neck pain. Usually, the neck will occur in all operations. Around (71%) of the workers will be reported as the shoulder usually occurs in the cutting, grinding operations mostly workers used in the hand motion.

4. CONCLUSSION

The majority of the truck body-making industrial workers are affected by Work-related muscular-skeletal disorder (WMSDs) according to the study. It revealed that the major cause of WMSDs is lack of ergonomics and working in an awkward position. The average QEC is >70% indicating a high level of risk. It is concluded that certain risk factors cause muscular-skeletal disorder problems and stress. So, it is essential to redesign the workstation. Workers must get technical training in the area of ergonomic safety, risk factors, and working positions. As far as possible

to provide mechanical handling assist like site standing chair, ergonomic table and Lifting ladder to be used. A health check-up program must be intimated at regular intervals and the work period must be intimated to include frequent rest breaks, which could improve the working ability.

REFERENCES

[1] Agrawal, D. N., T. A. Madankar, and M. S. Jibhakate. "Study and validation of body postures of workers working in small scale industry through RULA." International journal of Engineering science and technology 3, no. 10 (2011).

[2] Halim, I., A. R. Omar, and N. H. Saad. "Ergonomic assessment for assessing work-related musculoskeletal disorders in Malaysian Metal Stamping Industry." In Conference: 8th SEAES conference and 12th IPS congress. 2005.

[3] Hussain, M. Manzoor, S. M. Qutubuddin, KaturuPhani Raja Kumar, and ChKesava Reddy. "Digital human modeling in ergonomic risk assessment of working postures using RULA." In Proceedings of the International Conference on Industrial Engineering and Operations Management Bangkok, Thailand. 2019.

[4] Jagadish R, Asif Ansari, Sameer Quraishi, Ayesha Sultana and Qutubuddin S.M "Ergonomic Risk Assessment of Working Postures in Small Scale Industries" Grenze International Journal of Engineering and Technology (2018).

[5] Kumar, GundeSatish, and Abhishek Das. "Analysis and ergonomic improvement of working postures in cast house work station using JACK modelling." International Journal of Human Factors Modelling and Simulation 3, no. 1 (2012): 16-31.

[6] Singh, Jaspreet, HarvinderLal, and Gautam Kocher. "Musculoskeletal disorder risk assessment in small scale forging industry by using RULA method." International Journal of Engineering and Advanced Technology 1, no. 5 (2012): 513-518.

[7] Qutubuddin, S. M., S. S. Hebbal, and A. C. S. Kumar. "Ergonomic risk assessment using postural analysis tools in a bus body building unit." Industrial Engineering Letters 3, no. 8 (2013): 10-20.