Vol. 02, No. 02 (2024) 77-82, doi:10.61552/JEMIT.2024.02.004 - http://jemit.aspur.rs

INVESTIGATE THE FUNCTIONING OF THE POWER-LOOM INDUSTRY THROUGH RULA AND REBA

Dr. Somnath G. Kolgiri[1]
Dr. Madhavrao G. Jadhav

Received 09.10.2023.
Revised 29.11.2023.
Accepted 21.12.2023.

Keywords:

Musculoskeletal disorders (MSDs), RULA, REBA, SSIs, Ergonomics.

Original research

A B S T R A C T

Employees in India frequently complain about musculoskeletal issues. Currently, manual labor is a common component of power loom industries, making the problems of job-related musculoskeletal ailments and injuries at various body sites of important importance. To measure job processes, workload assessment, and work stress in the current study, video was taken. The Rapid Upper Limb Assessment (RULA) method was utilized to quantify the risk variables connected to upper extremity problems. While the physical issues were measured with the Rapid Entire Body Assessment (REBA). This ergonomic study sheds light on the analysis of worker posture in the power loom sector. The study's participants were the 15 power-loom industry employees at MIDC Solapur (Maharashtra, India).Then, using a video clip that showed the workers' various tasks, images were taken for analysis. It was concluded as a result that the power loom industry is not ergonomics aware or aware. According to RULA and REBA's examination of the problem utilising postural analysis, the staff is working more than is safe. The vast majority of workers are stooped over. Since there is a moderate to high risk of musculoskeletal issues among the workforce, many interventions are employed to avoid WMSDs or their symptoms, such as training, ergonomic adjustments, rest relief, and exercises..

© 2024 Journal of Engineering, Management and Information Technology

1. INTRODUCTION

Given that it employs the great majority of industrial employees, the textile sector is crucial to the development of countries like India. The majority of employees in India experience musculoskeletal problems, which are the most common work-related problem. In these industries, the bulk of the work is still done by hand and while standing up, therefore problems with occupational musculoskeletal illnesses and accidents involving different body parts continue to be a major concern (Metgud et al.,2008; Kolgiri & Hiremath 2019). Rapid Upper Limb Assessment, or RULA, is a survey technique that was created for use in workplace ergonomics assessments when work-related upper limb concerns are discovered (McAtamney & Corlett, 1993). The REBA is a postural analysis tool that examines the working postures prevalent in the service sectors of the health care and other industries while taking into account the potential risks to the musculoskeletal system in a variety of vocations (McAtamney & Corlett 1993; Kolgiri et al., 2021). Prolonged standing at work has been associated to musculoskeletal disorders related to the workplace, chronic venous insufficiency, premature birth and spontaneous abortion, carotid atherosclerosis, and other health effects. However, those injuries can be decreased by utilizing engineering and administrative measures (Halim et al.,2011). Workers in the industries where labor is done have been identified to lack ergonomics knowledge. Musculoskeletal problems in the knelt-position welding process show that different body positions are required (Agrawal et al., 2011). Although, applying ergonomic concepts to machines would increase their productivity and

[1]Corresponding author: Dr. Somnath G. Kolgiri
Email: sgkolgiri@gmail.com

efficiency, it would largely benefit human operators by making them feel secure and at ease (Maldonado-Macias et al. 2009). Workers work under difficult conditions to complete the essential task. Workers who work in these stressful environments frequently have different musculoskeletal issues. As a result of frequent lifting, different lifting heights, environmental conditions, etc., these issues manifest in the worker's body (Sachdeva et al., 2011). The significance of ergonomics in workplace design, its impact on industrial workstation design, its interdisciplinary nature, and its repercussions for the practice of industrial engineering (Iqbal et al., 2011). According to the study's first findings (Parimalam et al., 2006), there were a number of shortcomings in the available tools, equipment, and working conditions. Ergonomic approaches and processes can help reduce or eliminate workplace risks while also improving the organization's productivity and quality standards (McAtamney & Corlett, 1993). Uncomfortable posture, lifting, forceful movement, and hastily completed manual work are all contributors to musculoskeletal diseases. The primary objective of the current study is to evaluate the work posture of individuals who are involved in various casting procedures (Fuller et al., 2005). Although using ergonomic principles would boost the productivity and efficiency of machines, it would mostly benefit human operators by putting them at rest. (Beevis & Slade, 2003). The small-scale forging industry was found to lack ergonomics planning and practices. A significant portion of the workforce is hunching over while at work. According to the study, it is urgently necessary to perform ergonomics interventions with enough worker awareness (Colim et al., 2020). The results of the study show that an ergonomic workstation design can significantly improve the physiological performance of the operators (Gualtieri et al., 2020). All body parts were less likely to experience discomfort regularly and to a lesser extent, according to the overall finding. Not all standing workers found this to be true (Côté et al., 2008), despite the fact that combining a static and dynamic standing working system and altering your leg posture when standing can aid to minimize the discomfort of working while standing. A design technique for preventive ergonomics and comfort assessments of Human-Machine-Interface (HMI) is what this work aims to do (Peruzzini et al., 2020).

2. LITERATURE REVIEW

Metgudet al. (2008), conducted anErgonomic Study of women workers in a woolen textile factory for identification of health-related problems.

Kolgiri and Hiremath (2019), did a comparative study of Sustainable Postural Research for Women Workers from Power-Loom Industry Solapur City, Maharashtra, India.

McAtamney et al. (1993), conducted a survey method for the investigation of world-related upper limb Disorders

Hignett and McAtamney (2000), conducted aSurvey Method for the Investigation of Work-Related Upper Limb Disorders Ergonomic Study of women workers in a woolen textile factory for identification of health-related problems.

Halim et al. (2011), conducted aReview on Health Effects Associated with Prolonged Standing in The Industrial Workplaces.

Norman and Wells (1998), conducted aErgonomic interventions for reducing musculoskeletal disorders: an overview, related issues and future directions", for the institute for work & health to the royal commission on worker's compensation in British Columbia

Kolgiri and Hiremath (2019), performed a comparative study work related musculoskeletal disorders among power-loom industry women workers from Solapur City, Maharashtra, India.

3. METHODOLOGY

This investigation was conducted at the MIDC Solapur power-loom industry (Maharashtra). For the study, 60 workers with an average age of 31.81 years + 3.83 S.D., an average experience of 11.6 years + 4.2 S.D., and an M/F Ratio of 9:1 were used. The average stature for men was 166.52 cm + 2.47 S.D., and the average weight was 61.9 kilograms + 3.01 S.D. The average stature for women was 155.45 cm + 2.42 S.D., and the average. When doing tasks for the threading department, the low back, neck, shoulders, and trunk are evaluated using the RULA and REBA methods. The workers' postures and movements during work were documented on film. The video was cropped after it was recorded to obtain still images for the worker's posture analysis. While they were at work, 60 employees were photographed. Using the analysis of the images, score sheets for RULA and REBA were created (appendix).



Figure 1. The positions taken while working. (Threading depart.)

Figure 1 shows the selected photos of factory workers going about their daily tasks. Investigations on the gathered films and observational data have been done in-depth. The RULA and REBA scores were computed using the ErgoMasterTM programme, and the computation for Figure 1 is displayed here as an illustration.



Figure 2. How the RULA Score is assigned based on the position of the body component. (Source: ErgoMasterTM Software.)

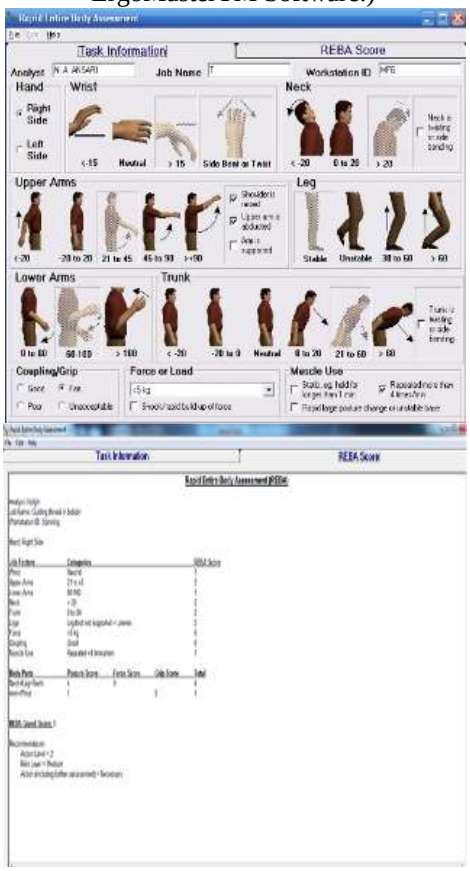


Figure 3. REBA Score assignment based on body component position (Source: ErgoMasterTM Software.)

The output and input screen shots of the ErgoMasterTM programme are shown in figures 2 and 3, respectively, and were used to check the results. Then, by looking at the data using this instrument, risk factors for ergonomic injury were identified.

The posture of the upper limbs was assessed using the RULA score sheet, which divides the range of motion for each body location into portions. The arm and wrist posture were evaluated the most. A score of 1 is assigned to the range of motion or working position that has the fewest risk concerns. Scores are greater in mobility range locations with more severe postures, indicating a higher frequency of risk factors that put stress on the structures of the affected body part. The RULA exposure scores of 0, 1, and 3 were used to generate the 4 exposure classes of negligible, low, medium, and high. High-risk and medium-risk acts require immediate attention in order to reduce the level of exposure to risk factors. When evaluating the motion of the complete body and limbs during an activity, the REBA approach, which is also a pen-and-paper method, was used. According to its range of motion, each body part is divided into sections and given a score in REBA. Higher ratings are assigned to body parts with more risk factors, while lower ratings are given to those with less risk factors. The REBA scores were divided into five categories: negligible, low, medium, high, and extremely high (0, 1, 2, 3, and 4). To avoid any musculoskeletal issues, prompt care was necessary at levels of medium, high, and extremely high.

4. RESULTS AND DISCUSSION

The RULA worksheet assessment is included in the appendix. The various risk level groups that were discovered during posture analysis are shown in Table 1. Figure 4 showed that 41% of the workforce is at high risk and needs immediate examination, while 46% was deemed to be at medium risk and needs more research and adjustment in the near future. Investigate is a company that employs about 12% of the workforce. Table 1 displays the outcomes of the posture analysis performed using RULA. These results demonstrate that job postures encompass all risk level groups. According to the table, 41% of the workers' postures while performing activities are high-risk. These workers were told to do more research and start changing things right now. Furthermore, the evidence shows that no worker is exposed to a level of negligible risk.The study's participants, who represented a variety of industry sectors, had their behaviors divided into numerous categories.

Table 1. Classification in RULA Level of Thread Formation tasks performed by employees in Power-Loom Industry

RULA Action Level				
Body parts with more risk factors are given higher ratings, while those with fewer risk factors are given lower ratings.	**The span of RULA score**	**Description**	**RULA risk grade**	**Percentage of employee**
0	1-2	The job is of almost safe	Negligible	-
1	3-4	The job is of reasonably safe	Low	12
2	5-6	The job is of risky	Medium	46
3	7	The job is of highly risky	High	41

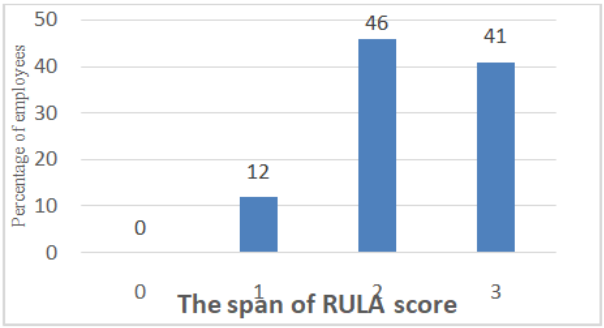


Figure 4. Percentage of employee in RULA Level

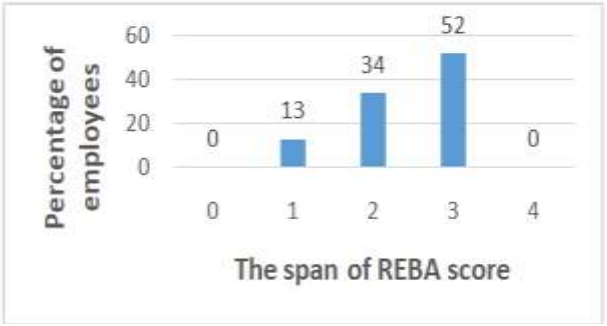


Figure 5. Percentage of employee in REBA Leve

The posture analysis was finished by performing these exercises in the same order as RULA and REBA (Ansari & Sheikh, 2014). Using the REBA analytical approach, it was discovered that the majority of the employees were working in positions that were high risk and unsatisfactory.

Table 2: Classification in REBA Level of Thread Formation tasks performed by employeein Power-Loom Industry

REBA Action Level				
REBA Level	**The span of REBA score**	**Description**	**REBA risk grade**	**Percentage of employee**
0	1	The job is of almost safe	Negligible	-
1	2-3	The job is of reasonably safe	Low	13
2	4-7	The job is of medium safe	Medium	34
3	8-10	The job is of highly risky	High	52
4	11-15	The job is of very highly risky	Very High	-

Figure 5 and Table 2 showed that somewhat more than 52% of the workforce were working in hazardous occupations. It was discovered that the workers would soon develop wrist, neck, and back MSDs if they maintained their existing posture. It was urged that we immediately start the required corrective action. Although more female thread formation employees than male workers were observed to be working in a proper posture, a REBA study of these units revealed that they might need to adapt. Nearly 52% of the workers' necks, trunks, and wrists had experienced significant physical stress and needed immediate assistance. Nearly 34% of the workers needed a change and were in a career that was at medium risk. Average RULA and REBA scores are displayed in Figure 6 and Table 3

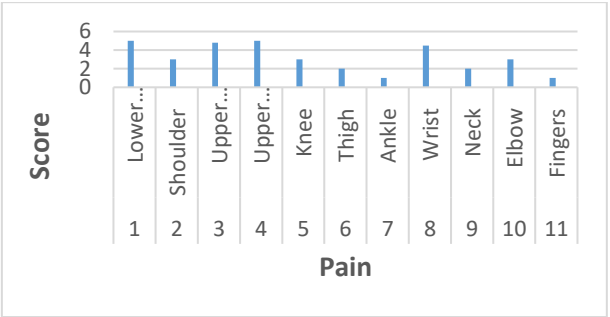


Figure 6. Average RULA and REBA Scores

Many of the workers doing tasks involving tread formation were working under intense strain on their upper arms, and some of them were bending their trunks improperly. The operator was told to maintain a straight

trunk while working. A change was necessary because some jobs required more trunk bending than others, which was unpleasant. Despite the fact that they may have required to accomplish anything, the workers had good posture for the other tasks.

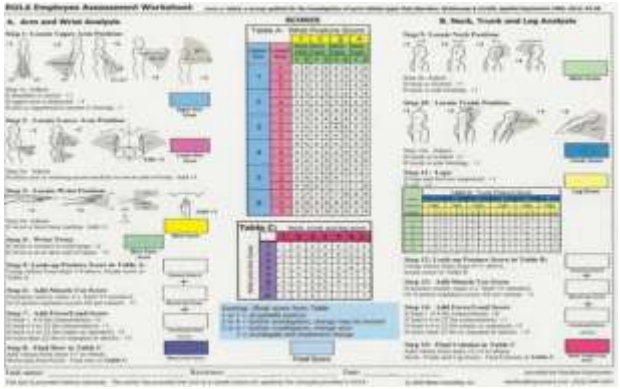
Table 3: Average RULA and REBA Scores of Thread Formation tasks performed by employee in Power-Loom Industry

Sr. No.	Pain	RULA and REBA Score
1	Lower Back	5
2	Shoulder	3
3	Upper Arm	408
4	Upper Back	5
5	Knee	3
6	Thigh	2
7	Ankle	1
8	Wrist	4.5
9	Neck	2
10	Elbow	3
11	Fingers	1

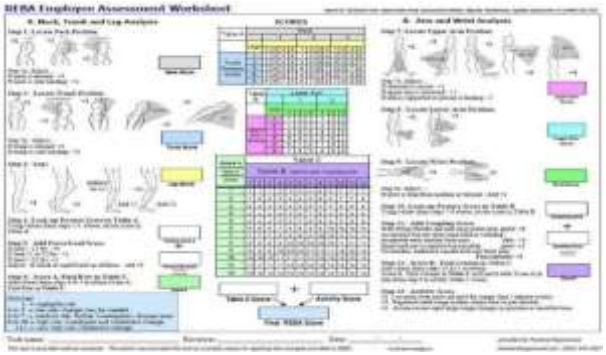
5. CONCLUSION

The body posture for this specific thread production power loom unit has been assessed by RULA and REBA tools. The results of the investigations indicate that a significant portion of the workforce is probably in painful and uncomfortable working situations. This is due to the lack of knowledge and awareness of ergonomics in the power-loom industry. These employees have a moderate to high risk of developing musculoskeletal issues, using the REBA and RULA risk classifications. Since the workforce is at a moderate to high risk of developing musculoskeletal problems, numerous interventions are used to prevent WMSDs or their symptoms, including training, ergonomic changes, rest relief, and exercises. This study recommends that ergonomic solutions be put into place immediately away together with health education on typical postural alterations and the right worker comprehension. To reduce morbidity from musculoskeletal problems, it is advocated that legislation be implemented and enforced across industries.

Appendix



Source: McAtamney & Corlett 1993



Source: Hignett and McAtamney 2000

References:

Agrawal, D. N., et al. (2011). Study and Validation of Body Postures of Workers Working in Small Scale Industry through Rula. *International Journal of Engineering Science and Technology*, 3(10).

Ansari, N. A., & Sheikh, M. J. (2014). Evaluation of work Posture by RULA and REBA: A Case Study. *IOSR Journal of Mechanical and Civil Engineering*, 11(4), 18-23.

Beevis, D., & Slade, I. M. (2003). Ergonomics—costs and benefits. *Applied ergonomics*, 34(5), 413-418.

Colim, A., Sousa, N., Carneiro, P., Costa, N., Arezes, P., & Cardoso, A. (2020). Ergonomic intervention on a packing workstation with robotic aid–case study at a furniture manufacturing industry. *Work*, 66(1), 229-237.

Côté, P., van der Velde, G., Cassidy, J. D., Carroll, L. J., Hogg-Johnson, S., Holm, L. W., ... & Peloso, P. M. (2008). The burden and determinants of neck pain in workers: results of the Bone and Joint Decade 2000–2010 Task Force on Neck Pain and Its Associated Disorders. *Spine*, 33(4S), S60-S74.

Fuller, A., Hodkinson, H., Hodkinson, P., & Unwin, L. (2005). Learning as peripheral participation in communities of practice: a reassessment of key concepts in workplace learning. *British educational research journal*, 31(1), 49-68.

Gualtieri, L., Palomba, I., Merati, F. A., Rauch, E., & Vidoni, R. (2020). Design of human-centered collaborative assembly workstations for the improvement of operators' physical ergonomics and production efficiency: A case study. *Sustainability*, 12(9), 3606.

Halim, I., Omar, A. R., Saman, A. M., & Othman, I. (2011). A review on health effects associated with prolonged standing in the industrial workplaces. *International Journal of Research and Reviews in Applied Sciences*, 8(1), 14-21.

Hignett, S., & McAtamney, L. (2000). Rapid entire body assessment (REBA). *Applied ergonomics*, *31*(2), 201-205.

Iqbal, M., et al. (2011). Ergonomics and Design. International Conference on Industrial Engineering and Operations Management Kuala Lumpur, Malaysia. (IEOM) IEOM Society Proceeding IEOM ID 665

Kolgiri, S., & Hiremath, R. (2019). Sustainable Postural Research for Women Workers from Power-Loom Industry Solapur City, Maharashtra, India. *International Journal of Innovative Technology and Exploring Engineering*, 8(11s), 377-382.

Kolgiri, S., Hiremath, R., & Kolgiri, V. (2021). Ergonomic Analysis Tools for Power-Loom Industry. In: Pawar, P.M., Balasubramaniam, R., Ronge, B.P., Salunkhe, S.B., Vibhute, A.S., Melinamath, B. (eds) Techno-Societal 2020, 2, 623–636. Springer, Cham.

Maldonado-Macias, A., Ramírez, M. G., García, J. L., Díaz, J. J., & Noriega, S. (2009). Ergonomic evaluation of work stations related with the operation of advanced manufacturing technology equipment: Two cases of study. In XV Congreso Internacional de ergonomia SEMAC.

McAtamney, L., & Corlett, E. N. (1993). RULA: a survey method for the investigation of work-related upper limb disorders. *Applied ergonomics*, 24(2), 91-99.

Metgud, D. C., Khatri, S., Mokashi, M. G., & Saha, P. N. (2008). An ergonomic study of women workers in a woolen textile factory for identification of health-related problems. *Indian Journal of Occupational and Environmental Medicine*, 2(1), 14-19.

Norman, R. W., & Wells, R. (1998). Ergonomic interventions for reducing musculoskeletal disorders: an overview, related issues and future directions. Royal Commission on Workers' Compensation in British Columbia.

Peruzzini, M., Grandi, F., & Pellicciari, M. (2020). Exploring the potential of Operator 4.0 interface and monitoring. *Computers & Industrial Engineering*, 139, 105600.

Parimalam, P., Kamalamma, N., & Ganguli, A. K. (2006). Ergonomic interventions to improve work environment in garment manufacturing units. *Indian Journal of Occupational and Environmental Medicine*, 10(2), 74-77.

Sachdeva, A., Gupta, B. D., & Anand, S. (2011). Minimizing musculoskeletal disorders in lathe machine workers. *International Journal of Ergonomics*, 1(2), 20-28.

Somnath G. Kolgiri
SPPU Pune, P. G. Moze College of Engineering, Pune,
India.
sgkolgiri@gmail.com
ORCID: 0000-0003-0432-0370

Madhavrao G. Jadhav
SPPU Pune, P. G. Moze College of Engineering, Pune,
India.
drmgjadhav@gmail.com