

# Ergonomic Evaluation of Body Posture of Workers in Small Scale Forging Industries: A Case Study

Das Suman<sup>a</sup>, Banerjee Debamalya<sup>b</sup>, Mukherjee Shankarasish<sup>c</sup>

<sup>a</sup> Department of Production Engineering, Jadavpur University, Kolkata, W.B, India, sd\_suman@yahoo.co.in

<sup>b</sup> Department of Production Engineering, Jadavpur University, Kolkata, W.B, India, debamalya\_banerjee@rediffmail.com

<sup>c</sup> Department of Physiology, University College of Science and Technology, Kolkata, W.B, India, msasish@yahoo.co.in

**Abstract:** Manufacturing is the backbone of any industrialized nation. Forging is one of the most significant activities in manufacturing sector in West Bengal. Work related musculoskeletal disorders (WRMSD) are very common health problem in this area. Assessment of exposure levels to WRMSD risk factors can be suitable for planning and implementing interventional ergonomics programs in the work station. This paper focused on posture analysis of the workers working in forging industries at south twenty four parganas in West Bengal. Work related musculoskeletal disorders are very painful and these happen in different muscles, tendons, nerves and joints. Heavy physical workload may create high frequency muscular disorders of human body. The aim of the present research work is to evaluate the work related musculoskeletal disorder (WRMSD) of workers engaged in Small scale forging industries. The present study is conducted on 26 workers engaged in four different small scale forging industries in south twenty four parganas in West Bengal. The tool REBA is used for analyzing body posture of number of workers working in this sector. The different work activities of the workers are taken with help of snapshot for postural analysis. The results of REBA shows that immediate change of body posture of workers are required to avoid different chronic pain in the muscles and so many health diseases which they are not realize now a day. This paper suggests that the proper awareness and appropriate ergonomics trainings are required. The appropriate ergonomic training should include the elements in any WRMSD management programmes like injury & illness record keeping, early recognition and reporting of WRMSD symptoms. This training and awareness programme also give guide lines like minimizing the distance between the load and the body, lift loads from knuckle height, keep the travel distance less than 10 feet, minimize body twisting in jobs requiring manual handling to improve the efficiency of the workers and quality of work.

**Key words:** Forging, Musculoskeletal disorders, Postural Analysis, REBA

## 1 Introduction

The method of ergonomics plays a significant role in the area of design of work places, production of jobs, healthy working environment and safety at work and also personal safety. It also helps to reduce muscular fatigue, stress and strain of human body, improve internal strength and efficiency, simplification of work and to improve the quality of product and services. It is observed that method of ergonomic is not considered while manufacturing



the products in small and medium scale industries. These are the places where postural analysis of workers is highly neglected. Most of the works are involved and also worked in very bad body postures in forging industries. Repetitive processes and manual material handling are the major problems in these areas. The objective of this paper is to analysis the working postures of workers engaged in various processes of small scale forging industry in west Bengal. Therefore, musculoskeletal disorders (WRMSDs) are associated to such high repetitive processes due to working in very bad posture. Thus, to improve the working efficiency of the workers, their body posture need to be assessed and corrective measures should be adopted to avoid the musculoskeletal disorders.

Assessment tool REBA is used in the present research work that recommends the changes to be made in the body posture of workers while working in forging industries. This tool requires no special equipment or attachment in providing a quick assessment of postures of the neck, trunk and upper limbs, lower limbs, legs along with muscle function and the external loads experienced by the body. Hignett, S. and McAtamney, L. 2000, developed the tool REBA to provide a quick and easy observational postural analysis for whole body activities (static and dynamic) [1]

The development of REBA is aimed to divide the body into segments to be coded individually with reference to movement planes. It provides a scoring system for muscle activity caused by static, dynamic, rapid changing or unstable postures. It reflects that coupling is important in handling of the loads but may not always be via the hands. On assessment of health related problems and work related musculoskeletal disorders (WRMSD) various studies have been conducted from the last few decades [2] [3]. There has been an increasing effort in recent years to investigate the causes of musculoskeletal disorders (MSDs) and also to take action to prevent them. A strong relationship exists between factors within the working environment and the development of MSDs and that these conditions result in significant sickness absence and reduced productivity.

Musculoskeletal Disorders (MSD) that directly affecting muscles, tendons, ligaments and nerves. They are sometimes called Repetitive Strain Injuries (RSI), Cumulative Trauma Disorders (CTD) and Repetitive Motion Injuries (RMI). MSD develop due to the effects of repetitive and forceful work which results Low Back Strain, Neck Strain, Tendonitis, Carpal Tunnel Syndrome (CTS) Rotator Cuff Joints, ligaments and other soft tissues. The Work Related Musculoskeletal Disorders are major problem in almost all countries and are important causes of work incapacity and loss of work days. The aim the studies is evaluation of WRMSDs symptoms among the workers by using Nordic Musculoskeletal Questionnaire (NMQ) and determination of WMSDs risk factors by application of OWAS. The OWAS methods can be used to identify any possible correction in working posture that leads to a better and less harmful posture [4]. Proper equipment design, working environments and factors affecting individual workers can minimize the musculoskeletal disorder of the workers [5] [6].

The most affected body parts of the workers are back, neck, elbow and wrist [7]. The highest prevalence are reported in lower back, knees and upper back and recommendations are made for elimination of awkward postures and manual material handling [8][9]. Musculoskeletal disorders have proved to be a major problem for modern industrialized countries can generate short term advantages such as cost reduction and productivity improvement as well as long term benefits from increased employee motivation and reduced staff turnover, reduced absence due to sickness and reduced insurance costs [10][11].

OWAS method of postural analysis classifies that the postures adopted by the workers while performing the tasks of casting and grinding are very awkward. The frequency of load lifting in these workers is much more and thus it further puts the workers into more stressed conditions of work [12] [13].

Proper ergonomics guidance and consciousness programmes to the workers are essential to overcome work related musculoskeletal disorders and painful disorders of muscles tendons and nerves and that will help to recover health of workers and finally the quality of work.

## 2 Methodology

The present research work has been done in small scale forging unit in south 24 parganas in West Bengal. The snapshots of worker working in different body postures in forging unit are taken to analysis and it shows the different movements of the workers during their different work activities inside shop floor. The snapshots are analyzed and REBA score is obtained from that. High risk jobs are numbered higher and less risk are numbered lower as per working method. Instant corrective actions and essential changes are recommended as well as recommended for higher activities numbered to avoid any musculoskeletal disorders, body fatigue and risk.

**2.1 Reba Method:** REBA Method is a quick and easy to use observational postural analysis tool for whole body activities and giving a musculoskeletal risk action level. The method is similar to RULA tool where the assessor assigns scores to postures and body alignment based on body part diagram. Load, Force and coupling scores are added to calculation for the body and then final score for both groups are summated to form the final action score. The REBA method evaluate the ergonomics risk factor by observation the posture of employees while they working at their workstation directly (Hignett, S. and McAtamney, L.2000). Postural and biomechanical loading was assessed on the entire body by valid REBA method.

The scores evaluate the posture of different body parts Neck, Trunk and Legs give posture score A with the help of standard Table and Upper Arm, Lower Arm, Wrist, and Wrist twist give the posture score B with the help of standard Table. The loading or coupling scores were added to posture scores A and posture score B to obtain scores A and B, respectively. Combination of scores A and score B give the Grand score with the use of standard Table and table score C is obtained. After this the activity score is added in the table score C to get the final REBA score. The range of Grand scores varies from 1 to 11 and reflects the musculoskeletal loading associated with the worker's posture. Low score 1 indicates that the work posture is acceptable if not maintained or repeated for long period of time. Further investigation is needed and changes may be necessary when risk level is low and REBA score is in between 2 to 3. Investigation and changes are required for scores of 4 to 7. Investigation and changes are required soon for REBA score of 8 to 10. Further investigation and the changes required immediately for the REBA score of 11 and onward.

**2.1.1 REBA Clarification:** REBA suggests the total job measurement and also gives the instructions for modifying body posture to reduce the possibility of musculoskeletal hazards at work places. REBA is a simple analytical tool which allows surveying different



tasks connecting the whole body of the workers at work places. This method focuses on the postural analysis of workers when posture is static, dynamic, rapidly changing or inanimate loads are being handled either frequently or in frequently.

**Table 1** Background information of the EG participants

Parameters	EG
Age (years)	38.2 ± 6.89
Stature (cm)	164.6 ± 7.36
Body Weight (kg)	61.8 ± 13.22

### 3 Observation and Case Study

It has been observed that details investigations of MSD and occupational health of workers are required in small scale forging industries at south 24 parganas in West Bengal. For finding the severity of the problems body postures and muscular fatigues are evaluated with the REBA method. The figures give details the different postures of the workers body in the forging industries. For investigation of arm, wrist, neck, trunk and limbs the whole body is divided into part- A and part- B respectively. The body postures of the workers and the angles at which they work inside the shop floor are recorded with the help of different snapshots. The posture scores of arm, leg, body, trunk etc. can be measured through REBA method.

Using the scoring sheet of REBA, the score of respective body parts can be obtained. In fig- 1 the trunk angle (T) is 400, giving a score of 3. The neck posture (N) angle is greater than 200, with a score of 2. The leg score (L) is in two parts: weight is taken on both feet, giving a score of 1; the knee is bent greater than 60°, giving score + 1. The load/force score is between 5 and 10 kg, giving a score of 1.



Using REBA assessment score table for group A (trunk, neck, and legs), the three posture scores are entered to produce a score of 5. This is added to the load/force score of 1 to produce a score- A equal to 7. Only the right arm is visible in Fig -2, so this is the limb that has been scored. It is likely that the left arm was in a similar posture.

The upper arm (UA) is in a posture between 45 and 90°, giving a score of 2, while the lower arm (LA) is between 0 and 60°, giving a score of 2. Fig-3 shows the wrist position was recorded when the photograph was taken. The wrist (W) was extended with the fingers gripping the sheet, giving a score of 2. The coupling is fair, giving a score of 1. The upper arms, lower arms, and wrist posture scores can be calculated. This gives a score of 3, which

is added to the coupling score (1) to produce a score B of 4. Score- A (6) and score B (4) are entered to calculate score C (8). The activity score (1) is added to score C. The final REBA score is 9. The action level is confirmed as a high risk level.

### 3 Results and Discussion

It has been observed by the REBA assessment results that most of the workers engaged in different operations in forging units are high risk level zone and needs an urgent change in body posture for reducing their WRMSD, stress and body fatigue. The final REBA score is 9 which is under the action level "3". This result shows the importance of considering workers health and occupational condition to prevent WRMSDs and related risks. Proper sitting arrangement and proper arrangement of machinery may reduce the risk level of workers. All workers should aware about the correct posture while working in different section in forging industry.

Table: 2 REBA Scoring Sheet

### 4 Conclusion

**Table 2** Hand anthropometric measures and hand grip strength of EG individuals

Parameters	EG
<b>Anthropometric Measures</b>	
Hand Length (cm)	17.8 ± 0.73
Palm Length (cm)	10.1 ± 0.58
<b>Hand grip strength</b>	
RH (kg)	46.8 ± 8.35
LH (kg)	39.5 ± 5.52
AM ± SD	

There is a lack of ergonomic planning and methods in small scale forging industries in West Bengal. Most of the workers are unable to select their desirable posture while doing the work in side the shop floor due to improper design of work station. This may cause



musculoskeletal injuries and other health problems. Work place may be redesign by using ergonomic methods and principle to accommodate individual worker in their ergonomically correct and comfortable zone.

## 5 References

1. Hignett, S. and McAtamney, L.2000. Rapid Entire Body assessment (REBA). *Applied Ergonomics*, 31, 201-205.
2. Jafry T, O'Neill DH. The application of ergonomics in rural development: a review. *Applied Ergonomics* 2000;31:263–8.
3. Wearsted M, Westgaard RH. Working hours as a risk factor in the development of musculoskeletal complaints. *Ergonomics* 1991;34(3):265–76.
4. Aarås A, Westgaard RH, Stranden E. Postural angles as an indicator of postural load and muscular injury in occupational work situations. *Ergonomics* 1988;31(6): 915–33.
5. Clark DR. Workstation evaluation and design. In: Bhattacharya, A, Mc Glothlin JD, editors. *Occupational Ergonomics: theory and practice*. New York, NY, USA: Dekker; 1996. p. 279–301.
6. Mital A, Pennathur A,R.L.Huston, D.Thompson, M.Pittman, GMarkle. (1999) "The need for workers training in advanced manufacturing technology (ATM) environments: A white paper *International Journal of Industrial Ergonomics*, 24, 173–184.
7. Buckle P, Devereux J. *Work Related Neck and Upper Limb Musculoskeletal Disorders*. Bilbao, Spain: European Agency for Safety and Health at Work (1999)
8. Markku Mattila, Waldemar Karwowski & Mika Vilkki. Analysis of working postures in hammering tasks on building construction sites using the computerized OWAS method. *Applied Ergonomic*, 24(6): 405-412 (1993)
9. L P Singh. Work posture assessment in forging industry: an exploratory study in India *International Journal of Advanced Engineering Technology* Oct.-Dec.,(2010)
10. Choobineh Alireza, et.al., "Musculoskeletal problems among workers of an Iranian communication company",
11. *Indian Journal of Occupational and Environmental medicine*-April 2007-volume 11-issue 7.
12. Varmazyar Sakineh,et.al., "Evaluation Working posture and Musculoskeletal Disorders Prevalence in Pharmacy packaging Workers", *European Journal of Scientific research* ISSN 1450-216X vol.29 No. 1(2009),pp82-88
13. Jaspreet Singh et al., "Musculoskeletal Disorder risk Assessment in small scale forging Industry by using REBA Method," *International Journal of Engineering and Advanced Technology*, Volume-1, Issue-5, June 2012.