Jr. of Industrial Pollution Control 31(1)(2015) pp 159-162
© EM International
Printed in India. All rights reserved
www.envirobiotechjournals.com

ERGONOMIC RISK ASSESSMENT OF ASSEMBLY WORKERS OF INDIAN AUTOMOBILE INDUSTRY BY USING POSTURAL ANALYSIS TOOL

PRAGYA OJHA[1]* AND DEEPA VINAY[2]

Department of Family Resource Management, College of Home Science,
GB Pant University of Agriculture & Technology, Pantnagar 263 145, Uttarakhand, India

(Received 10 March, 2015; accepted 15 June, 2015)

Key words: Automobile industry, Assembly workers, RULA, Occupational, Postural analysis, Industrial safety.

ABSTRACT

Work related musculoskeletal disorders have become a major risk in automobile industry due to lack of ergonomically designed work stations and the wrong work postures occupied by the workers. This paper presents a study on various working postures occupied in two wheeler automobile industry of State Infrastructure & Industrial Development Corporation of Uttarakhand Limited, Pantnagar. The automobile industrial sector have major role in Indian economy and it is the place where work posture analysis is mostly neglected. The study was conducted on 111 workers engaged in various process of assembling of bikes. Posture analysis tool Rapid Upper Limb Assessment was used. The different activities of the workers were recorded by video and still photography, and these images were used for analysis. The final scores of Rapid Upper Limb Assessment during various working activities were found to be high. The findings revealed that there are ergonomic deficiencies in the planning and work methods. A significant proportion of the workers are working in high risk postures. Thus the workers are under moderate to high risk of work-related musculoskeletal disorders. The study recommended a proper implementation of ergonomics interventions program with awareness and training among workers to reduce the risks of WMSD.

INTRODUCTION

Musculoskeletal disorders (MSDs) are a common health problem and major cause of disability throughout the world. The economic loss due to such disorders affects not only the individual but also the organization and the society as a whole (Kemmlert, 1994). Kumar *et al.*, (2012) reported that musculoskeletal disorder is a worldwide concern and distributed among both industrialized countries (ICs) and Industrially Developing Countries (IDCs). In IDCs, the problems of workplace injuries are extremely serious. Poor working conditions and absence of an effective work injury program in IDCs has resulted in high rate of MSD (Jafry *et al*., 2000). It has been widely accepted that awkward and constrained postures result in musculoskeletal stress on different body regions and the major factor in the development of musculoskeletal dis-

*** Corresponding author's email :** ojha.pragya063@gmail.com; deepasharma1416@rediffmail.com
[1]Research Scholar and [2]Professor & Head

orders (Li *et al.*, 1995). Poor postures have also been found to be associated with decreased efficiency of performance, an important cause of which are recognized to be the body discomfort resulting from the restricted postures (Haslegrave, 1994). The aim of the workstation design is to minimize the harmful postures and the design imposed stresses on users. An obstacle in the implementation of ergonomic recommendations in a real world design situations which will optimally fit in diverse anthropometry of the users and satisfy their task demands (Kemmlert, 1994). The objective of this investigation is to provide a systematic ergonomic approach to the design of an industrial workstation to reduce the postural discomfort of assembly workers.

MATERIALS AND METHODS

Selection of sample

Total 111 assembly workers were selected from two wheeler automobile industry of State Infrastructure and Industrial Development Corpo- ration of Uttarakhand Limited (SIIDCUL), Pantnagar. Assembly workers were selected from two production department, i.e. vehicle assembly and paint shop. This cross-sectional study was conducted in order to investigate the ergonomic risks involved in the automobile manufacturing industry. All the jobs were observed before start of the study and detailed job information was collected to ensure the completion of ergonomic risk assessment tools. A video recording and photographs were taken in different sections of assembling of parts of bikes.

Postural Analysis

For the study used assessment tools namely RULA (Rapid Upper Limb Assessment) to assess the working postures and recommend the changes to be made. The Rapid Upper Limb Assessment (RULA) was developed earlier by Mc Atamney and Corlett (1993), to provide a rapid objective measure of musculoskeletal risk caused by mainly sedentary tasks where upper body demands were high and where work related upper limb disorders are reported. RULA assesses the posture, force and movement associated with sedentary tasks; such tasks include computer tasks, manufacturing or retail tasks where the worker is seated or standing without moving about. The use of RULA results in a risk score from one to seven, where higher scores signify greater levels of apparent risk (McAtamney *et al*., 1993). This tool requires no special equipment in providing a quick assessment of postures of the neck, trunk and upper limbs along with muscle function and the external loads experienced by the body. A coding system is used to generate an action list which indicates the level of intervention required to reduce the risks of injury due to physical loading on the operator. Briefly, the upper arm, lower arm, and wrists postures are evaluated and scores are given for each body part posture. Then, the scores are combined (using a specially developed scoring table) to generate the upper limb posture score. Similarly, the neck, trunk, and legs postures are evaluated and scores are also given. They are combined to generate the neck-trunk-legs score. For both combined scores, scores for muscle use and force are added. Finally, the grand score is determined and action to be taken is recommended. The RULA score sheet was used to assess the upper limbs mainly arms and wrist of posture; each body part is divided into sections depending on the range of movement and these sections are numbered so that the number 1 is assigned to the range of movement or working posture where minimal risk is involved. Higher numbers are assigned to parts of the movement range with more extreme postures indicating an increasing presence of risk factors causing load on the structures of the body segment. The exposure scores according to RULA were divided into four risk categories negligible, low, medium and high. Medium and high risk actions should be urgently addressed to reduce the level of exposure of risk factors (Qutubuddin *et al*., 2013).

Table 1. Classification of Risks according to Scores of Assessment Tools

RULA Score	Action Required
1-2	Acceptable
3-4	Change may be Necessary
5-6	Change necessary soon
7	Change Immediately

RESULTS

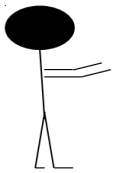
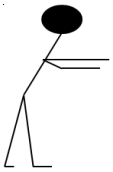
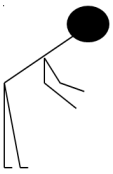
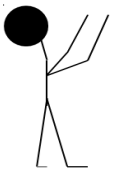
Physical characteristics of the subjects

Physical characteristics of the subjects selected for the study are depicted in Table 2. The mean age of the respondents was 25.01 ± 3.567 years and ranged from 20-30 years and the range of height of the respondents was 147-189cm and average value of height was 168.69±6.16 cm. The mean body weight was 64.52 ±

Table 2. Physiological characteristics of the assembly workers

Physical characteristics of subjects	Range	Mean± S.D.
Age	20-30	25.01±3.567
Weight	41-94	64.52±9.093
Height	147-189	168.69±6.16
BMI	15.57-32.95	22.27±2.44
VO2	1.28-3.05	2.28±0.216
HR rest, beats/min	72.95-81.35	76.56±6.89
Blood pressure (Sys/Dias), mmHg/mmHg	120/72- 143/95	129.75/84.36±10.68/3.58

Table 3. Postural analysis of the assembly workers

Code of Postures	Line Diagram of body postures	Name of the body Postures	Scores of RULA	Action Category
1.		One hand above the shoulder	7	Investigate and change immediately
2.		Standing Upright	4	Investigate further
3.		Stooping 30^0	7	Investigate and change immediately
4.		Stooping 60^0	7	Investigate and change immediately
5.		Twisted to preferred side	6	Investigate and change soon
6.		Overhead working posture	7	Investigate and change immediately

9.093 kg. The mean body mass index (BMI) was 22.27±2.44 kg/m2 with the range as 15.57-32.95 kg/m2 that indicated that all the subjects were in normal health as per the classification given by WHO (2000). The mean blood pressure of the respondents was 129.75/84.36±10.68/3.58 mmHg which is normal in Indian population. The resting heart rate (HR work) of the subjects ranged from 72.95-81.35 beats/min with a mean value of 76.56±6.89 beats/min.

Postural Analysis

The video was cropped every 27 seconds to get snapshots of the workers and these snapshots were analyzed to fill the scores in RULA worksheet. Later on stick diagrams were drawn from freezed frame video records and eventually subjected to analysis. The most frequent postures adopted by the workers were taken into consideration. The results of the RULA assessment of the workers are shown in Table 3. The posture codes of the RULA indicate that, working postures of workers of automobile industry in different assembling activities represents that usually assembly workers adopt stressful and awkward postures during maximum activities which demand corrective measures immediately. Thus it is clear that due to adoption of awkward postures at work for a prolonged period of time, the assembly workers suffer from high rate of work related musculoskeletal disorders.

DISCUSSION

From the analysis of results and scores obtained by RULA postural assessment techniques it can be concluded that there is a lack of awareness and knowledge about ergonomics practices and principles in the working methods in the two wheeler automobile manufacturing industries. The workers adopt awkward postures involving frequent twisting, bending, and over-reaching, which are a result of poorly designed workplace and working methods. These actions force them into a non-neutral position that increases the overall discomfort and pain at the lower back, neck, and shoulders (Qutubuddin *et al*., 2013). Almost one third of the study populations claimed to feel uncomfortable to their upper and lower extremities. Thus the workers are under moderate to high risk and in some postures at a very high risk of Work-related Musculoskeletal disorders (WMSDs). Application of ergonomic principles, biomechanical and engineering principles can be effective in reducing the risks and occurrence of WMSD. The present study recommended that there is dire need of implementation of ergonomics interventions with proper awareness and training among the assembly workers to improve the work station designing and minimize safety hazards. This study also proposed that various ergonomic approaches and models could be used as a guide for designing and modifying assembling equipment and tools suiting to human strength capabilities and limitations and to reduce the level of fatigue and discomfort of male and female assembly workers. It is suggested that such extensive surveys for other assembling units in various industries should be carried out in different regions of the country in order to generate region specific design database for safe and efficient design / modification of industrial tools and equipments.

ACKNOWLEDGMENT

The authors wish to acknowledge the University Grant Commission, India and GB Pant University of Agriculture and technology, Pantnagar, U.S. Nagar, Uttarakhand, India for providing funds and facility for the conduct of the research.

REFERENCES

Haslegrave, C.M. 1994. What do we mean by a working posture? *Ergonomics.* 37 : 781-799.

Jafry, T. and O'Neill, D.H. 2000. The application of ergonomics in rural development: A review. *Applied Ergonomics.* 31 : 263- 268.

Kemmlert, K. 1994. Labour inspectorate investigation for the prevention of occupational musculoskeletal injuries (licentiate thesis). Solna, Sweden: *National Institute of Occupational Health.*

Kumar, M.W., Kumar, R.A. and Gnanaraj, D. 2012. RULA analysis of workers assembly workstation. Humanizing work and work environment. *Ergo: Safety for All*. 290-295.

Li, G., Haslegrave, C.M. and Corlett, E.N. 1995. Factors affecting posture for machine sewing tasks: The need for changes in sewing machine design. *Applied Ergonomics.* 25 : 35-46.

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

Qutubuddin, S.M., Hebbal, S.S. and Kumar, A.C.S. 2013. An ergonomic study of work related musculoskeletal disorder risks in Indian Saw Mills. *Journal of Mechanical and Civil Engineering*. 7 (5) : 7-13.

World Health Organization. 2000. Obesity: preventing