International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-1 Issue-5, June 2012

Musculoskeletal Disorder Risk Assessment in small scale forging Industry by using RULA METHOD

Jaspreet Singh, Harvinder Lal, Gautam Kocher

***Abstract*--Musculoskeletal disorders (MSDs) are common health problem throughout the world. Work related musculoskeletal disorders are group of painful disorders of muscles, tendons and nerves. The low back, or lumber area, serves a number of important functions for the men in working area many occupational tasks in industrial are still associated with strenuous working postures and movement. Combined with a heavy physical workload, they result in a high frequency of work-related musculoskeletal disorders. The present study was aimed to evaluate the musculoskeletal disorder (MSD) of workers engaged in Small scale forging industries. Study was conducted on 102 workers of a forging industry using the posture analysis tool RULA Method. A video showing the different activities of the workers was shot and then images were cropped from it for the analysis. The results of RULA showed that about 20.33% of the workers were under high risk levels and required immediate change. About 45.32% of the workers were at lower risk levels and 34.33% of the workers were at medium risk levels. The present Study recommended the awareness and proper ergonomics training to the workers.**

***Keywords*: Musculoskeletal disorders, men, forging industry, RULA.**

I. INTRODUCTION

There has been an increasing effort in recent years to investigate the causes of musculoskeletal disorders (MSDs) and to take action to prevent them. This has led to increasing recognition from workers, employers and government agencies that 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 [1]. Musculoskeletal Disorders (MSD) are injuries 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, forceful or awkward movements on joints, ligaments and other soft tissues.

Manuscript published on 30 June 2012.
***** Correspondence Author (s)
Jaspreet singh, Department of Mechanical engineering, CT group of institutions, Jalandhar, India,.
Harvinder lal, Department of Mechanical engineering, RIET, Phagwara, India,.
Gautam kocher, Department of Mechanical engineering, RIET, Phagwara, India,.

Some MSD injuries include Low Back Strain, Neck Strain, Tendonitis, Carpal Tunnel Syndrome (CTS), Rotator Cuff Syndrome, and Tennis Elbow. There has been an increasing effort in recent years to investigate Musculoskeletal disorders (MSDs) and to take action to prevent them.

This has led to increasing recognition from workers, employers and government agencies that a strong relationship exists between factors with in the working environment and the development of MSDs, and these conditions result in significant sickness absence and reduced productivity. The objective of this study is to analyse the working postures of workers engaged in various processes of small scale forging industry .The study used assessment tool RULA (Rapid Upper Limb Assessment), RULA was developed earlier by McAtamney and Corlett, 1993, to provide a rapid objective measure of musculoskeletal risk caused by mainly sedentary tasks where upper body demands were high; where work related upper limb disorders are reported [2]. J.N.Saraji et al. (2004) were evaluation of WMSDs risk factors among the crew of the Iranian Ports and shipping organization's vessels. This paper clarify the WMSDs are major problem in almost all countries and are important causes of work incapacity and loss of work days. The aim of their studies is evaluation of WMSDs symptoms among the workers by using Nordic Musculoskeletal Questionnaire (NMQ) and determination of WMSDs risk factors by application of OWAS. After determination of risk factors, the OWAS methods can be used to identify any possible correction in working posture that leads to a better and less harmful posture [3] In an anthropometric survey was carried out for female agricultural workers from north-eastern India, it appeared that most body dimensions are higher in the middle age group and lower with higher age groups and hence, there is a great scope of improving the agricultural tools [4]. Cleaning is associated with high physical and psychosocial workloads and musculoskeletal disorders related to it were studied. A few studies concern equipment design, working environments and factors affecting individual workers. A need to conduct research on cleaning tools and equipment, working environments and individual risk factors is apparent [5].

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

The relationship between the subjective ride comfort in a vehicle seat and whole-body vibration can be modeled using frequency weightings and rms averaging. For the results obtained in this study, it was clear that the alternative approach could give superior predictions of comfort than the method used in ISO 2631-1 [6]. 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. There are many researcher studies on the discomfort working postures by using different methods [7]

II. MATERIAL AND METHODS

The study was done in small scale forging units in Ludhiana and Jalandhar Region. A video of different sections like forging, punching, Trimming Furnace, broaching and grinding etc. showing different movements of the workers during an activity was recorded. Snapshots of 102 workers working in different sections were obtained. The snapshots were analyzed to fill the scores in RULA.

A. RULA Method

The RULA method evaluate the ergonomics risk factor by observation the posture of employees while they working at their workstation directly (McAtamney and Corlett 1993). Postural and biomechanical loading were assessing on the upper limbs by valid RULA method. We used several score in this method with the help of RULA score sheet, that the scores evaluate the posture of different body parts Upper Arm, Lower Arm, Wrist, and Wrist twist give the posture score A with the help of standard Table and Neck, Trunk and Legs give posture score B with the help of standard Table. Score 1 indicated the ‘‘best’’ or most natural posture and score 4 shows the worst position. Muscle score for forging workers is acquired a score of 0 to 1. At the stage of static posture or highly repetitive in job task we used 1 score for muscle score and if it is not static or not repetitive we considered 0 score. Force exerted gained score 0 to 3. if the is less than 2 kg and no resistance we use 0 score and if the load is vary from 2 to 10 kg with intermittent load we considered score 1. If the load is static or repeated and vary from 2 to 10 kg we considered score 2. If load is more than 10 kg and load is static, repeated or jerk forcely than the score is considered 3. These scores are added to posture scores A and posture score B to obtain scores A and B, respectively (McAtamney and Corlett 1993). Combination of scores A and score B give the Grand score with the use of standard Table. The range of Grand scores 1 to 7 and reflects the musculoskeletal loading associated with the worker’s posture. Whereas low grand scores (of 1 or 2) indicate that the work posture is acceptable if not maintained or repeated for long time (action level 1), For grand score of 3 or 4, further investigation is needed and changes may be required (action level 2). Investigation and changes are required soon for scores of 5 or 6 (action level 3). Further investigation and changes are required immediately for grand score of 7 (action level 4) (Massaccesi et al. 2003, Choobineh et al. 2004). RULA action level are shown in Table -1. RULA score 1 to 2 shows the negligible risk level, RULA score 3 to 4 shows the low level risk, RULA score 5 to 6 shows the medium level risk, RULA score 7 shows the high level risk. Figure 2 to 6 shows the work of worker at different processes in awkward posture like shearing, furnace unloading, forging process, grinding process and picking or placing.

RULA Score with Action Level

Table-1 RULA Score with Action Level.

RULA SCORE	ACTION LEVEL
1 to 2	**Posture is acceptable if not maintained or repeated for long time**
3 to 4	**Further investigation is needed and changes may be required**
5 to 6	**Investigation and changes are required soon**
7	**Investigation and changes are required immediately**

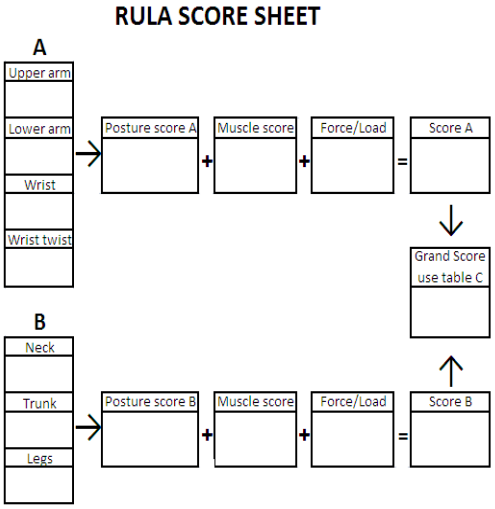

Figure-1 RULA Score Sheet

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

Figure-2 Odd posture in shearing process

Figure -3 Odd posture in furnace unloading

Figure -4 Odd posture in forging process

Figure -5 Odd posture in grinding process

Figure -6 Odd postures in picking & placing

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

III. RESULTS

The results of the RULA assessment of the Workers are shown in Table 2, 3. According to this technique of posture analysis 45.4% of workers are working in Low Risk Level Posture and requires further investigation and changes may be required. About 34.33 % workers were found be at medium level and require Investigation and changes soon as possible. Around 20.33% workers are working in posture of high risk level and require corrective action immediately. These results reveal that all categories of the risk levels exist in jobs postures from left to right positions. In first category i.e. Blanking, Cutting and Shearing as shown in table 3. 25% of this category is of low level risk in which investigation is required and changes are to be done. 41% of this category is calculated to be as medium level risk and rest 34% is of high level risk, Investigations are to be done immediately and changes are needed as soon as possible. Next category in the table no.3 is of Furnace Loading in this category 23% of the postures fall under low level risk, 40% comes under medium risk and 37 % fall under High level risk. Investigations are required for all level of risks and changes are to be done according to the need. Third category of the table is Hammering, Hammering is the main operation of the forging as the power hammer is dropped and the shape and size of the product is changed, so by the calculations 52 % of the postures are in the low level risks , 44% are in the medium level risks and rest 4% is under high risk. Investigations are required for all level of risks and changes are to be done according to the need.

Further comes the process of the Punching and Trimming as from the table is that 59% is of low level risks, 35% is of medium risks and remaining 6% is high risk. Next is Grinding and Drilling 81% is low level, 14% is medium risks and 5% is high risks, scope of improvement is always there so changes are to be made. Whereas in the next category broaching, chamfering and heat treatment there is only 80% of low level and 20% of medium risks as there is no high risks in these processes. Inspection is the most important aspect of any field which determines the quality of the product. but during there is always posture failures as 18% is of low level, 28% is of medium level and 54% is of high risks. Then comes the material handling or Picking and placing, in this category postures calculations are 43% of low level risks, 27% of medium and 30% of high risks. Investigations are to be made for better material handling methods. Last category of the table is Lathe and Welding. In this processes there is also scope of improvement as calculated as 40% of low level risks and 60% of medium risks are involved. As mentioned in the above processes examinations are to be made to check whether the methods can be improved to reduce the load on the worker and he could perform his duties with full efforts. Table-2 shows the No. of posture with RULA score in each section and. No. of posture left hand and right hand with percentage and risk level shown in Table-3

Process	RULA SCORE											
	1 to 2			3 to 4			5 to 6			7		
	L	R	T	L	R	T	L	R	T	L	R	T
Blanking, Cutting, Shearing	0	0	0	5	6	11	12	6	18	8	7	15
Furnace loading	0	0	0	9	8	17	15	15	30	8	20	28
Hammering	0	0	0	7	18	25	11	10	21	2	0	2
Punching & Trimming	0	0	0	20	12	32	7	12	19	0	3	3
Grinding & Drilling	0	0	0	17	17	34	3	3	6	1	1	2
Broaching, Chamfering &Heat Treatment	0	0	0	8	4	12	2	1	3	0	0	0
Inspection	0	0	0	1	1	2	3	0	3	3	3	6
Picking & Placing	0	0	0	13	13	26	7	9	16	11	7	18
Lathe & Welding	0	0	0	1	5	6	5	4	9	0	0	0
TOTAL	0	0	0	81	84	165	65	60	125	33	41	74

Table.2 No. of posture with RULA score in each section and Abbreviations are L=Left, R=Right & T=Total

RULA score	Risk level	No. of worker's posture		%age of worker's posture	
		Left	Right	Left	Right
1--2	Negligible	0	0	0	0
3--4	Low level	81	84	45.3	45.4
5--6	Medium level	65	60	36.3	32.44
7	High level	33	41	18.4	22.16
	Total	179	185		

Table.3 No. of posture left hand and right hand with percentage and risk level

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)

IV. DISCUSSIONS

After visiting various small scale industries, It was observed that in the small scale industries the ergonomics is hardly given preferences as the space in the industries are very less and the space for the worker provided is not appropriate. Workers are performing the operations under great difficulties and bearing stress on their bodies. This is due to several reasons as justified by the photographs taken of the workers performing the operations. By using RULA method, it was observed that in every category of processes taken into consideration, every worker is under muscular stress. This is justified by the percentage calculated from the RULA Score Sheet which was made by the posture analysis of the worker taken from the photograph of the workers from different small scale industries. There is sense of urgent improvement in the industries for the betterment of the workers to perform their operations with minimum load and stress on their bodies. During the calculations of the postures it was observed that in the different processes the worker is subjected to different Muscular disorders. In the blanking, cutting and shearing operations the worker has to pick the heavy loads and to hold them for certain time while operation is to be performed. While like in the furnace operation the worker is subjected to bending as the stress is observed on the back and neck. Similarly like in every operations scope of improvement is must. The owners of the industries must concentrate on the ergonomics. Then only they can increase the productivity of the worker as well as their profits.

V. CONCLUSION

RULA methods of postural analysis closely correlate with the awkward postures adopted by the male workers. According to RULA Method the postures adopted by workers in these small scale forging industries have been categorizes as having high to very high risk level. Blanking, Cutting, Shearing, Picking and placing or furnace loading workers are at very high risk of musculoskeletal disorders hence the ergonomically interventions are required in these sections. Proper training of workers and awareness may reduce the risk of musculoskeletal disorders. The results show that the operators are working in an inadequate working environment with awkward postures the results are supported by the subjective assessment of discomfort.

REFERENCES

[1] Buckle P, Devereux J. Work Related Neck and Upper Limb Musculoskeletal Disorders. Bilbao, Spain: European Agency for Safety and Health at Work (1999)

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

[3] J.N.Saraji, M.A.hassanzadeh, M.Pourmahabadian & S.J.Shahtaheri. Evaluation of Musculoskeletal Disorders Risk Factors among the Crew of the Iranian Ports and Shipping Organication's Vessels. Acta Medica Iranica, 42(5): 350-354 (2004)

[4]. Aarås, A, G. Horgen, M. Helland. Can visual discomfort influence on muscle pain for visual display unit (VDU) workers. (2007)

[5]. Christine Brulin, Karl-Axel Angquist, Margareta Barnekow-Bergkvist and Ulrika Aasa. Relationships between work-related factors and disorders in the neck-shoulder and low-back region among female and male Ambulance Personnel. (2003)

[6]. Dan Anton, John C Rosecrance, Linda A Merlino and Thomas M Cook. Method for quantitatively assessing physical risk factors during variable non cyclic work. (2003)

[7] 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)

[8] Sakineh varmazyar, Ali safari varyani, Isa Mohammadi Zeidi, Hasan Jahani Hashemi Evaluation Working Posture and Musculoskeletal Disorders Prevalence in Pharmacy Packaging Workers European Journal of Scientific Research ISSN 1450-216X Vol.29 No.1 (2009)

[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] A. R. Ismail, M. L Yeo, M.H.M. Haniff, R. Zulkifli, B.M. Deros. Assessment of Postural Loading among the Assembly Operators: A Case Study at Malaysian Automotive Industry Euro Journals Publishing, Inc. (2009)

[11] M. Massaccesi, A. Pagnotta, A. Soccetti, M. Masali, C. Masiero, F. Greco Investigation of work-related disorders in truck drivers using RULA method Applied Ergonomics Received 1 January 2002; accepted 21 March 2003

[12] *S Sahu, M Sett*, Ergonomic evaluation of tasks performed by female workers in the unorganized sectors of the manual brick manufacturing units in India Ergonomics. (2010)

[13] www.dcmsme.gov

[14] www.vassarstat.com

[15] www.indianforging.com

Er. Jaspreet singh. I have done my B-Tech in Mechanical Engineering from CT group of institution shahpur jalandhar, under Punjab Technical University Jalandhar INDIA. Currently I am pursuing M.Tech from RIET Phagwara under Punjab Technical University Jalandhar INDIA. From last four year I am lecturer in CT group of Institute shahpur Jalandhar. In 2008 made a 800cc bike.
Qualification: B.Tech in Mechanical engineering, Post Graduation Diploma in Business Management and Post Graduation Diploma in Personal Management and Industrial Relations.

Er. Harvinder Lal I have done my B.E in Mechanical Engineering from G.Z.S.C.E.T. Bathinda, Punjab, INDIA. And I had completed my M.Tech in Industrial engineering from Dr. Ambedkar National Institute of Technology. Now I m Asst. Prof. in RIET Phagwara. I have seven year experience in teaching field.
Qualification: B.E in Mechanical engineering, M.Tech in Industrial engineering.

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

Gautam Kocher I have done my B.E in Production engineering from PEC, Chandigarh Punjab, INDIA. And I had completed my M.Tech in Industrial engineering and Pursuing PhD from Dr. Ambedkar National Institute of Technology Now I m Head of Department in RIET Phagwara. I have nine year experience in teaching field.
Qualification: B.E in Production engineering, M.Tech in Industrial engineering. Pursuing PhD.

.

Published By:
Blue Eyes Intelligence Engineering
and Sciences Publication (BEIESP)