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Research Paper

Work posture analysis of activities performed by blacksmiths engaged in hand tools manufacturing units

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■ **ABSTRACT :** Repetitive processes and manual material handling are the major problems in hand tool manufacturing units. The presents study is focused on posture analysis of the workers working in hand tools manufacturing units of Jorhat district of Assam. For the purpose RULA (Rapid Upper Limb Assessment) was used to assess specific body postures of the workers and recommend the changes to be made in the body postures while working. The impact of posture was studied by using eye hand co-ordination and motor speed of the workers, which was measured by using Grooved Pegboard test. The prevalence of WMSDs was studied by using NMQ. The study was conducted on 30 blacksmiths engaged in various processes during manufacturing of hand tools. The photographs of different sections like preparing sheet, molding, hammering, sharpening of tools etc. showing different movements of the workers during performance of activities was observed and both side of the body was assessed. The results of RULA showed that majority of the (75 %) blacksmiths were working in medium risk level which requires further investigation and changes to be made soon in work postures for improving their health and wellbeing. About 25 per cent of the workers were found in high risk level that requires changes to be brought immediately for the benefit of the workers after proper investigation. The postural assessment of the workers at different stages observed that the neck, trunk at flexion; upper arm at flexion and extension; lower arm at pronation and wrist in neutral position. Changes were observed in Grooved Pegboard test before and after the activities. Proper rest periods were recommended to avoid WMSDs of the workers in the future.

■ **KEY WORDS:** Posture analysis, RULA**,** Risk levels, WMSDs, NMQ

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In developing countries, where labour is cheap, proper cheap, proper occupational hygiene and posture analysis methods are often neglected. Proper sitting arrangements and work environment are seldom provided. The workers, being economic migrants, accept adverse conditions as a part of the job and mostly work in bad posture. The small and medium scale enterprises (SMEs) are much greater in number in Indian economy and these are the places where work posture analysis is mostly neglected. Repetitive processes and manual material handling (MMH) are the major problems in the hand tool manufacturing. Therefore, work related

musculoskeletal disorders (WMSDs) are related to such high repetitive processes and working in bad posture. The subjects had experienced shoulder and wrist pain which could be due to the repetitive nature of the job (Cumulative Trauma Disorder-CTD) and the poor design of the hand tools. Thus, to improve the efficiency of the workers their posture needed to be assessed and corrective measures should be adopted to avoid the work related musculoskeletal disorders. RULA (Rapid Upper Limb Assessment) is a tool to assess specific body postures of the workers and recommend the changes to be made in the body postures while working (McAtamney and Corlett, 1993). It provides a rapid objective measure of musculoskeletal risk caused by mainly sedentary tasks where upper body demands were high and work related upper limb disorders occurs. 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 (Karhu *et al*., 1977). 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. The presents study is focused on posture analysis of the workers, the prevalence of WMSDs and the impact of posture of the workers of blacksmiths engaged in hand tools manufacturing units of Jorhat district of Assam.

■ RESEARCH METHODS

The study was conducted on 30 workers various processes of blacksmiths engaged in hand tools manufacturing unit of Jorhat district of Assam. The photograph of different sections likes preparing sheet, molding, hammering and sharpening of tools showing different movements of the workers during the activity was observed and both side of the body was assessed. After observing, the postures of the worker were analyzed. The postures were analyzed to fill the scores in RULA score sheets. The upper limbs mainly arms and wrist of (both the sides; left and right) posture was assessed using RULA score sheet; the range of movement for each body part is divided into sections. These sections are numbered so that the number 1 is given to the range of movement or working posture where the risk factors present are minimal. Higher numbers are allocated 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 exposure categories: negligible, low, medium and high. Medium and high risk actions should be urgently addressed to reduce the level of exposure of risk factors. The prevalence of work related musculoskeletal disorders (WMSDs) was studied by using Nordic Musculoskeletal Questionnaire (NMQ). Nordic Musculoskeletal Questionnaire (NMQ) was used to determine the prevalence of WMSDs symptoms. NMQ comprises information about work experience and problems on the whole body and body part-specific questions (neck, shoulders and lower back). A body "map" was also used to make it easier for workers to pinpoint their problems in each body area. The impact of posture was studied by using eye hand co-ordination and motor speed of the workers, which was measured by using grooved pegboard test. The grooved pegboard is a manipulative dexterity test. This unit consists of 25 holes with randomly positioned slots. Pegs, which have a key along one side, must be rotated to match the hole before and after completion of the activities. This test requires more complex visual-motor coordination than most pegboards.

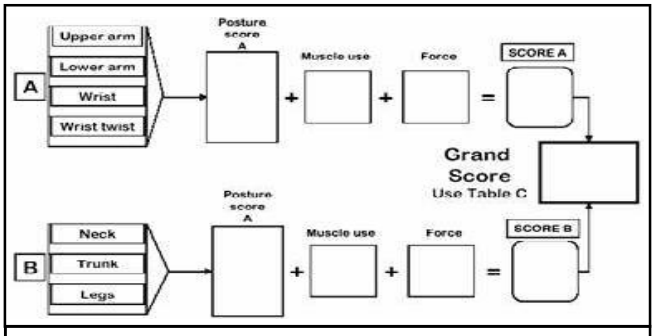


Fig. A : RULA score sheet

The RULA action categories for evaluation of working postures.

RULA score	Risk level	Action
1-2	Negligible	Acceptable
3-4	Low	Investigate further
5-6	Medium	Investigate further and change soon
7	High	Investigate and change immediately

■ RESEARCH FINDINGS AND DISCUSSION

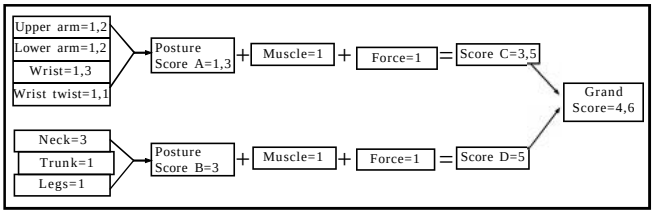
The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Details of study :

Blacksmiths is a hand tools manufacturing units where workers engaged in activities with poor work posture and performed in a sitting position. Poor work posture constitute one of the main risk factor for Musculoskeletal Disorders (MSDs), ranging from minor back problems to severe handicapping. The effect of poor posture will continue unless proactive steps are taken to evaluate the problem. The activities performed by blacksmiths workers in hand tools manufacturing units is divided in to four different types such as preparing sheet, molding, hammering and sharpening of hand tools. All the activities used only the upper body parts and the job was performed by workers while sitting on a '*Pihri*'. The movements of different upper body parts of the workers are as follows.

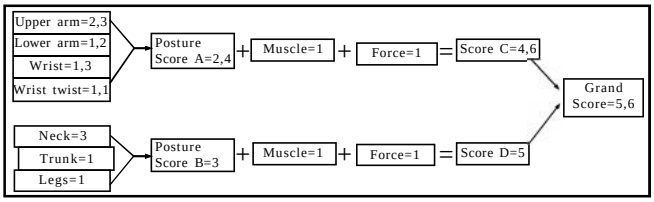
Preparing sheet :

The postural assessment of the workers at preparing sheet found that the movement of upper arm was flexion and extension, lower arm at pronation, and wrist in a neutral position. The neck and trunk were flexion and legs in a position of body weight are evenly distributed over both feet.



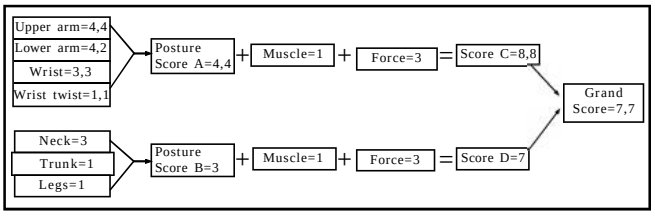
Molding :

The postural assessment of the workers at molding step found that the movement of upper arm at flexion, lower arm at pronation, and wrist in neutral position. The neck and trunk were flexion and legs in a position of body weight are evenly distributed over both feet.



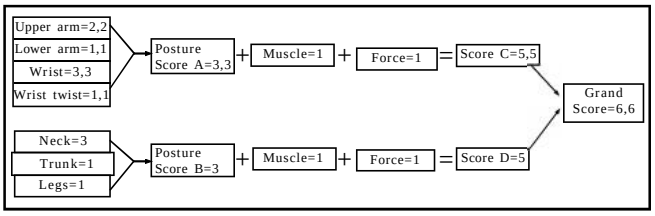
Hammering :

The postural assessment of the workers at hammering step observed that the upper arm at flexion, lower arm at pronation, and wrist in neutral position. The neck and trunk were flexion and legs in a position of body weight are evenly distributed over both feet.



Sharpening :

The postural assessment of the workers at sharpening stage observed that the upper arm at flexion and extension lower arm at pronation, and wrist in neutral position. The neck and trunk were flexion and leg in a position of body weight is evenly distributed over both feet.



The Table 1 showed that none of the worker was at negligible risk level. The study was done on workers engaged in different sections of the Black smithy- a hand tool manufacturing units and their activities were divided into different categories like preparing sheets, molding, hammering, and sharpening of hand tools. The postural analysis was done according to these activities using the same sequence of RULA. The study according to RULA showed that majority of the (77 %) workers were working in medium risk level and requires investigate further and change soon the work posture of the workers for improving health and wellbeing and reducing postural load (Table 1). It was observed from the Table 1 that 27 per cent of the workers under the low risk level and action requirement is investigate further. About 23 per cent of the workers were high risk level and requires investigation and change immediately for the benefit of the workers.

These results revealed that all categories of the risk levels exist in jobs postures except negligible risk level in

Fig. 1 : Workers in odd postures in preparing sheets, molding, hammering and sharpening tools

Table 1 : Overall distribution of RULA score

RULA score	Risk level	Action	No. of workers		Percentage of workers	
			L	R	L	R
1-2	Negligible	Acceptable	-	-	-	-
3-4	Low	Investigate further	8	-	27	-
5-6	Medium	Investigate further and change soon	15	23	50	77
7	High	Investigate and change immediately	7	7	23	23

activities performed by Black smithy workers engaged in hand tool manufacturing unit. The Table 2 shows that both left side and right side of 27 per cent workers who used in performing the activity of hammering were at high risk levels. A further investigation with an immediate change was recommended to these workers.

The observations of the posture analysis showed that while preparing the sheet the right hand was used for using for hammer and left hand was using for holding the sheet, so the both hand were belonging to the two different risk levels categories. Around 27 per cent of the hammering workers were working at high risk levels and an immediate change for them was recommended. Proper sitting arrangement and proper machinery arrangement was suggested to reduce the risk levels. The reasons for the problem were lack of proper sitting

Table 2 : Process wise distribution of RULA score

Job description		RULA Score				Total
		1-2	3-4	5-6	7	
Preparing Sheet	L	-	3	-	-	8
	R	-	-	8	-	8
Molding	L	-	-	8	-	8
	R	-	-	8	-	8
Hammering	L	-	-	-	8	8
	R	-	-	-	8	8
Sharpening	L	-	-	8	-	8
	R	-	-	8	-	8

arrangement for the workers and lack of proper arrangement of the machines. It was suggested that proper sitting arrangement for the workers, proper arrangement for the machinery to adjust their level and proper rest periods for the workers could solve the problems. Therefore, proper rest periods were recommended to avoid any WMSD in the future. Also, all the workers were made aware about the correct posture while working in different sections of the blacksmiths hand tool manufacturing units.

Prevalence of Musculoskeletal disorders of the respondents :

Prevalence of Musculoskeletal disorders of the respondents was assessed by using NMQ method. The highest prevalence of WMSDs symptoms among the workers were related to body regions such as, neck, low back, ankle, elbow, foot, hand and wrist. The results showed that the highest prevalence of work related musculoskeletal disorders (WMSDs) were in shoulder (72.2 %), elbow (63.3 %), knee (55.2 %) and foot (47.7 %), hand and wrist (36.8 %), legs (33.3 %), back (29.6 %), neck (23.9 %), and low-back (22.9 %). Sarajil *et al.* (2004) found that the highest prevalence was reported in lower back, knees and upper back and recommendations were made for elimination of awkward postures and manual material handling.

The impact of posture of the workers of blacksmiths engaged in hand tools manufacturing units :

Seated workers were required to fill all 25 peg holes on the board with pegs starting from the top row of holes in the board (moving from left to right) and working down, as fast as possible. Performance time, in seconds, was recorded, beginning when the participant started the task until the last peg was laced in the board. Performance was measured as the time elapsing between placement of the first and last pegs. Changes were observed in grooved pegboard test before and after the activities. Percentage change of the workers before and after the activities was 18 per cent (Table 3) (Metgud *et al*., 2008 and Hignett and McAtamney, 2000).

Table 3 : Performance of peg board test

Workers engaged in blacksmiths hand tool manufacturing unit (n=30)	
Before activity	1.15 minutes
After activity	1.36 minutes
Percentage change	18 per cent

Grooved Pegboard

Performing Peg board test

Conclusion :

On the basis of analysis of results and scores obtained by RULA method, it can be concluded that, there is a lack of ergonomics planning and methods in work station of Blacksmiths hand tool manufacturing units. The workers are working in very bad postures where seventy five per cent of workers are under medium risk of work related musculoskeletal disorders (WMSDs) particularly in right hand side and require further investigation and changes is required as soon as possible for wellbeing of the workers. The workers should be rotating among jobs and revision of work rest should be provided.

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