Identification of ergonomic risk factors among the workers of a paint manufacturing company

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Abstract. A prospective study was conducted to identify ergonomic risk factors among the workers of a paint manufacturing company. Three different departments of the company were evaluated separately. Rapid entire body assessment (REBA), Muscle Fatigue Assessment and Key Indicator Method- Manual Handling Operations (KIM-MHO) were used to assess the risk factors. A total of 55 tasks were evaluated. The commonest body parts that were found to be at risk were the lower back, neck and shoulder. The commonest risk factors were awkward posture, high levels of exertion and repetitive movements.

Keywords. Paint company, REBA,MFA, ergonomics

1. Introduction

Work related musculoskeletal disorders (WRMSDs) are the most costly occupational problems, and cause significant human suffering and economic burdens for employers, workplaces, workers and society. The accurate measurement of workers' exposure to the factors that may contribute to the development of WRMSDs has been of vital importance to both epidemiologists and ergonomists conducting research studies.

WRMSD are diseases related and/or aggravated by work that can affect the upper limb extremities, the lower back area, and the lower limbs. WRMSD can be defined by impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves, bones and the localized blood circulation system, caused or aggravated primarily by work itself or by the work environment (Nunes2009a).The ageing of the workforce are also a contribution to the widespread of WRMSD , since the propensity for developing a WRMSD is related more to the difference between the demands of work and the worker's physical work capacity that decreases with age (Okunribido& Wynn 2010).

WRMSD have also heavy economic costs to companies and to healthcare systems. The costs are due to loss of productivity, training of new workers and compensation costs (Isabel Nunes & Pamela McCauley 2008). (Kourinka et al 1987) reported ergonomic factors such as awkward working postures, static load and task invariability to be some of the most important factors contributing to occurrence of musculoskeletal symptoms. WRMSD are caused by many factors, including awkward postures (e.g. bending, stretching, twisting), repetitive movements, using force and manual handling (lifting and carrying) working hours, static postures and repetitive nature of work were identified as some of the risk factors leading to pain and discomfort.

An ergonomically deficient workplace can cause physical and emotional stress, low productivity and poor quality of work. Assessment of exposure levels to WRMSD risk factors can be an appropriate base for planning and implementing interventional ergonomics programs in the workplace.

2. Methods

2.1 Aim

The aim of this study was to identify tasks with high risk of causing WRMSD among the workers of a paint manufacturing company.

2.2 Study design and settings

A prospective study was conducted to identify risky tasks and ergonomic risk factors among the workers of a paint manufacturing company, In which 55 task were selected for detailed assessment. The company is a 103 year old industry and is one among India's largest paint manufacturing industry. The company manufactures coatings and chemicals, that it is a global leader in decorative paints and the largest manufacturer of performance coatings. It also makes a variety of specialty chemicals. Assessment of exposure levels to WRMSD risk factors can be an appropriate base for planning and implementing interventional ergonomics programs in the workplace. In this study workstation of a Paint manufacturing industry is analyzed by a team of experts. Initially there was a shop floor visit by the experts to identify tasks that might be considered to predispose WRMSD.

A video recording and photographs were taken in different sections like powder manufacturing; Tank washing-Equipment Conditioning, UV production Area, Palletizing, Closing the container using hammer , Packing of powder from shifter etc. to record different movements and postures of the workers during work.

To evaluate the ergonomic risk of the task REBA, OWAS, Muscle Fatigue assessment scale and physical over load over the worker is assessed with KIM-MHO scale.

Workers of the entire problem tasks worked for 8 hours a day. They all felt that the tasks were physically demanding and puts a tremendous load on their back, shoulders and hands. Intermittent break time is subjective and highly depends on process requirements. The workers were not aware of proper lifting and carrying techniques

2.3 Assessment tools

2.3.1 REBA

REBA (Rapid Entire Body Assessment) was developed (Hignett, S. and McAtamney, L. 2000), to provide a quick and easy observational postural analysis tool for whole body activities (static and dynamic giving musculoskeletal risk action level. The development of REBA is aimed to divide the body into segments to be coded individually with reference to movement planes. The design of REBA is very similar to that of RULA method and special attention is devoted to the external load acting on trunk, neck, and legs and to the worker–load coupling using the upper limbs. Postures of individual body parts are observed and postural scores increase when postures diverge from the neutral position. Group A includes trunk, neck, and legs, while group B includes upper and lower arms and wrists. Other items including the load handled, couplings with the load, and physical activity are specifically scored and then processed into a single combined risk score using a table provided. These scores are summed up to give one score for each observation, which can then be compared to tables stating risk at five levels, leading to the necessity of actions. Unlike RULA, REBA provides five action levels for estimating the risk level. REBA combines two scores, one for body (Score A for Group A) and a second for hand/arm posture (Score B for Group B). These are then amalgamated to give an overall score, which provides a risk assessment for the posture. These risk levels starting from 1 to 15 are corresponding to negligible, low, moderate, high and very high risk level

2.3.2 Key Indicator Method

Key Indicator Method - Manual Handling Operations (KIM-MHO). In accordance with the principle of the KIMs, it contains an objective requirement and load description, and identifies potential threats to physical overload. The KIM-MHO includes job characteristics and their interaction. The key indicators to be considered in the KIM-MHO are:

• Daily duration of manual work processes,
• Type, duration, and frequency of executing forces,
• Body posture during manual work processes,
• Hand-arm posture during manual work processes,
• Work organization, and
• Work conditions.

The key indicators are classified in different scales. The scales correspond to conditions in practice and Range from a minimum/optimum to maximum/poor. The classification of these scales indicates potential bottlenecks for each category/indicator. By multiplying the scale value of the daily duration of activity with the sum of the other scale scores, a total value can be calculated. This calculated sum score can be used as a risk score. This score can be allocated to a risk range.

2.3.3 MFA

Rodger's Muscle Fatigue Assessment scale is used to provide a method of evaluating the physiological demands of a task against published criteria of acceptable levels of oxygen consumption for whole body or upper bodywork. This scale will cover Body Regions like Neck, shoulder, hand, wrist, arm, back, legs, elbow, and knee. And this Scale is appropriate for jobs that require high frequency and duration, and have awkward postures

3. Result and Discussion

Out of 55 tasks selected 26 tasks were assessed using REBA. Since the work involves more of static loading over the workers whole body. The results obtained from the REBA assessment worksheet are shown in Table 3 and reveals the different categories of the risk levels. Around 27% of the workers are at low risk level and changes may be needed, whereas 42.33 % workers were found at medium risk levels and needs a necessary action. Around 7.6 % of the workers were at high risk level and needs a necessary change soon whereas 23.07 % of the workers were found at very high risk action needs to be done very urgently.

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

REBA			KIM		
Action level (Risk level)	REBA Score	Corrective Measure	Risk Range	Risk Score	Corrective Measure
0 (Negligible)	1	None necessary	1	<10	Low load situation, physical overload unlikely to appear
1 (Low)	2-3	May be necessary	2	10 bis <25	Increased load situation, physical overload also possible for normal person. For that group redesign of
2 (Medium)	4-7	Necessary	3	25bis <50	Highly increased load situation, physical overload also possible for normal person, redesign of workplace
3 (High)	8-10	Necessary soon	4	>50	Highly load situation, physical overload is likely to appear. Workplace redesign is necessary.
4 (Very High)	11-15	Necessary NOW			

Table-2 REBA Score distribution

REBA Score	No. of Task	Percentage of Task
1	0	-
2-3	7	27%
4-7	13	42.33%
8-10	2	7.6%
11-15	6	23.07%

Out of 55 task evaluated 18 tasks were assessed using MFA as task involves body Regions like Neck, shoulder, hand, wrist, arm, back, legs, elbow, and knee. And this Scale is appropriate for jobs that require high frequency and duration, and have awkward postures among the assessed 18 tasks.

Table 3: Distribution of MFA Score

Total Number of Task Assessed =18	Area / Scores	Neck	Shoulder Left	Shoulder Right	Back	Arms/Elbow Left	Arms/Elbow Right	Wrist/Fingers Left	Wrist/Fingers Right	Leg/Knee Left	Leg/Knee Right	Ankle/Feet/Toe Left	Ankle/Feet/Toe Right
	Very High	3	6	6	7	3	3	0	0	2	2	2	2
	High	3	9	9	8	9	8	3	3	3	6	3	3
	Moderate	9	1	1	2	4	5	8	8	4	6	6	6
	Low	3	2	2	1	2	2	7	7	9	4	7	7

Out of the 55 task assessed 8 task were assessed using KIM were work involves push / pull and lifting/carrying activities the outcome score reveals about 62.5% of the task is at Increased load situation, physical overload also possible for normal person. For that group redesign of workplace is helpful and rest 37.5% is at highly increased load situation, physical overload also possible for normal person, redesign of workplace is recommended.

Table 4: Distribution of KIM-MHO Score

KIM-MHO				
Risk Range	Risk Score	Corrective Measure	No. of Task	Percentage of Task
1	<10	Low load situation, physical overload unlikely to appear	0	-
2	10 bis <25	Increased load situation, physical overload also possible for normal person. For that group redesign of workplace is helpful	5	62.5%
3	25bis <50	Highly increased load situation, physical overload also possible for normal person, redesign of workplace is recommended.	3	37.5%
4	>50	Highly load situation, physical overload is likely to appear. Workplace redesign is necessary.	0	-

4. Conclusion

From the analysis of results and scores obtained by all the four tools it can be concluded that almost half of the tasks performed by the workers of the paint manufacturing company has moderate to high risk of predisposing WRMSD, irrespective of the department and type of task done. Necessary recommendations to reduce the risk should include environmental, workstation modification, training, job redesign, application of ergonomic principles, biomechanical and engineering principles.

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