Ergonomics Evaluation of Body Posture of Worker In SSI

[1]Prof. R. D. Vaidya, [2]Prof. K.G. Sontakke, [3]Prof. N. A. Ansari
[1]Asst. Prof., [2] Asst. Prof., [3] Asst. Prof.
[1]Mechanical Engineering,
[1]DMIETR, Wardha, India

Abstract— The working at shop floor is multifunctional and complex tasks with a great responsibility. Working for the long period of time causes higher risk of musculoskeletal disorders. The workers suffer from the high risk and gives poor performance because of inappropriate match between anthropometry and work station.

Musculoskeletal disorders (MSDs) are surrounded by the most common work-related problem in India. In an Indian manufacturing industry most of the work is still carried out manually hence issues of work related musculoskeletal disorders and injury in different sites of the body are prominent. Postural analysis using Rapid entire body assessment (REBA), Rapid upper limb assessment (RULA) indicates that the workers are working above the secure limit. The presents study is focused on posture analysis of the workers working in small scale manufacturing industry. The study was conducted on 15 workers engaged in small scale manufacturing industry Wardha (Maharashtra, India). Video tape on different activities of the workers was done and then images were cropped from it for the analysis.

It was concluded that; there is a lack of ergonomics social contact and understanding in small scale manufacturing industries (SSMIs). Postural analysis using REBA, RULA indicates that the workers are working above the secure limit. A major quantity of the workers is working in awkward postures. Thus the workers are under moderate to high risk of Musculoskeletal disorders (MSDs).

Keywords- Ergonomics, Musculoskeletal disorders (MSDs), REBA, RULA, SSMIs.

I. INTRODUCTION

During survey in various industries at MIDC Wardha, it is observed that workers are highly exposed to fatigue due to work related health problem. The workers are suffering from various problems like severe back pain, heavy legs, discomfort in buttocks etc. Low back pain is found to be major cause of sick leave among various factories. These problems are probably due to adoption of unstable and unhealthy posture resulting from improper design of components. This may be due to lack of ergonomic considerations in design of components and insufficient & obsolete anthropometric data for Indian population. Many researchers have recommended the development of anthropometric data set. The fabrication industry strongly encourages research in the field of objective comfort assessment especially dedicated to related posture. A great deal of literature is available which suggests ergonomic evaluation of workstation. The aim of this study is to identify and resolve the various problems faced by workers.

Most of the researchers recommended the ergonomic evaluation of working posture. The basic philosophy of ergonomics is to design workstations which are comfortable, convenient and productive to work. Ergonomics is a multidisciplinary subject which can be applied to the study and design of the human component of work system. The term ergonomics had been coined in late 1949 by K.F.H Morrel, who derived it from Greek word 'ergo' which means work and effort & 'nomous' which means law and rules. Ergonomics was formally accepted as the name of new society at its council meeting on February 16, 1950.

II. AIMS AND OBJECTIVES

The various aims and objectives of the project are as follows.

- To identify the critical anthropometric variable in the machine section.
- To measure linear and angular anthropometric dimensions.
- To evaluate workers posture based on anthropometric data.
- To suggest working posture to reduce fatigue.

III. LITURATURE SURVEY

Isa Halim & Abdul Rahman Omar [1], that performing jobs in prolonged standing has contributed numerous health effects such as work-related musculoskeletal disorders, chronic venous insufficiency, preterm birth and spontaneous abortion, and carotid atherosclerosis. However, those injuries can be minimized through application of engineering and administrative controls. D. N. Agrawal et al. [2], musculoskeletal disorders are there in the welding process where workers are working in kneeling posture and it shows that there is need to change the body postures. Aide Maldonado-Macias et al. [3], The application of ergonomic principles would help to increase machine performance and productivity, but mostly help human operator to be comfortable and secure. Jaspreet Singh et al. [4], Musculoskeletal disorders (MSDs) are common health problem throughout the world. Work related

musculoskeletal disorders are group of painful disorders of muscles, tendons and nerves and suggested that the present Study recommended the awareness and proper ergonomics training to the workers.

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. Asim Zaheer et al. [5], Engineering control is used to modify the design of the work place, tools and equipment according to the workers‟ comfort level, so that risk and hazards are permanently eliminated from the work place. On the other hand, administrative controls such as job rotations are temporary solutions that are employed to reduce the workers‟ exposure to risks and hazards. Krishnamurthy Muthukumar et al. [6], The present study aimed to investigate the extent of postural discomfort in CNC machine operators, and the relationship of this discomfort to the display and control panel height, with a view to validate the anthropometric recommendation for the location of the display and control panel in CNC machines and conclude that Discomfort increased with the progress of the day and was highest at the end of a shift; subject age had no effect on patient tendency to experience discomfort levels.

Lakhwinder Pal singh. [16], Awkward posture, lifting, forceful movement and manual work at rapid rate contribute to musculoskeletal disorder. Present study is focused on assessing the work posture of worker engaged in different activities of casting. A Naddeo et al. [18], the aim of this work consists in developing a design methodology for preventive ergonomics and comfort analyses of Human-Machine-Interface (HMI). Lynn McAtamney et al. [17], RULA (rapid upper limb assessment) is a survey method developed for use in ergonomics investigations of workplaces where work-related upper limb disorders are reported.

IV. METHODOLOGY AND DESCRIPTION OF OPERATION

This project is exploratory in nature in which the opinions of workers on design and location of the body posture are collected. The workers participation would be voluntary. The population under consideration is smaller than 5% and larger than 95% are excluded. The inclusion criterion for the questionnaire assessment would be a minimum of six month in present job or total of one year continuous working experience at machine.

The purpose of this study was to analyze the manufacturing at Company Yashashree to determine the magnitude of ergonomic risk factors that were present. Employees in this process were being exposed to ergonomic risks that could cause musculoskeletal injuries. The operation of the lathe initiates when the operator walk to grasps a metallic plate, then he attaches it to the machine, and fastens it with tools and clamps involving considerable effort. Longitudinal and transverse movements begin to make the turning. Both hands in this action are always on the levers and the operator is simultaneously watching the visual display or the work piece, this requires high levels of control and coordination.

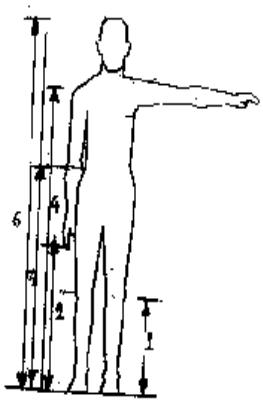
Figure1- Working postures

V. ANTROPOMETRY DATA COLLECTION

The fifteen workers were chosen from industry. The criterion for survey participation was a minimum of two years in present job or total of five years continuous manufacturing work in working experience. After collecting the required data from the sample, we can now apply the statistical method to all the anthropometric variables. The workers workstation has critical important in work station design. The analysis helped us in the determination of body dimension of the smallest i.e. 5th percentile and largest i.e. 95th percentile worker. The observations of critical body dimensions Tibial Height, Knuckle Height, Elbow Height, Shoulder Height, Shoulder Pivot Width, and Stature etc. are illustrated in Table.

The body dimension selection and measurement of body dimensions are made according to a standardized procedure. The procedure of the measurement is in accordance with a written protocol which are reviewed and modified before executing. It is decided to measure anthropometric data of 15 linear dimensions and 15 angular dimensions are collected by measurement. Further it is decided to calculate the critical body dimension related to 5th, 50th, and 95th percentile workers. The critical linear anthropometric parameters identified from literature reviewed are tabulated below. Structural Anthropometric measure the various measurement of body parts of subject in static or fixed position are the structural anthropometric measure.

Table 1- Antropometry data

	Sr. No	Anthropometric Variables	Notation
	1	Tibial height	L1
	2	Knuckle height	L2
	3	Elbow height	L3
	4	Shoulder height	L4
	5	Shoulder pivot width	L5
	6	Stature	L6
	7	Functional forw. Reach	L7
	8	Humeral length (upper arm)	L8
	9	Fore arm length	L9
	10	Shoe length	L10
	11	Shoe width	L11
	12	Horizontal distance (X dir) of operator from reference point	H1
	13	Horizontal distance (Z dir) of operator from reference point	H2
	14	Height of Machine	H3

The questionnaire asked the information regarding demographic and performance characteristics of the workers. The frequency curve showed that these characteristics follow the normal distribution characterized by mean and standard deviation. The primary data for demographic and performance characteristics was collected for fifteen workers at industry. Table illustrates information regarding workers individual characteristics. Table also provides the mean, standard deviation, minimum and maximum of demographic and performance characteristics like age, weight etc.

Table 1- Sample calculation for Age

Cell boundary	Cell mid point	Frequency	d	fd	fd2	k
21-30	25.5	7	-10	-70	700	45.5
31-40	35.5	4	-5	-20	100	45.5
41-50	45.5	1	0	0	0	45.5
51-60	55.4	2	5	10	50	45.5
61-70	65.5	1	10	10	100	45.5
		15		-70	950	

VI. RESULT AND DISCUSSION

This chapter presents the findings of the questionnaire assessed and the inference from the statistical analyses. The first part of result concerned with the evaluation of posture. This was done by REBA analysis. The findings of posture evaluation helped us to understand the problems that workers were facing in their working hours. Further the posture evaluation is also carried out by RULA analysis in the next part. The findings of posture evaluation helped us to understand the problems that workers were facing in their working hours. The second part of this chapter deals with the comfort assessment based on five parameters.

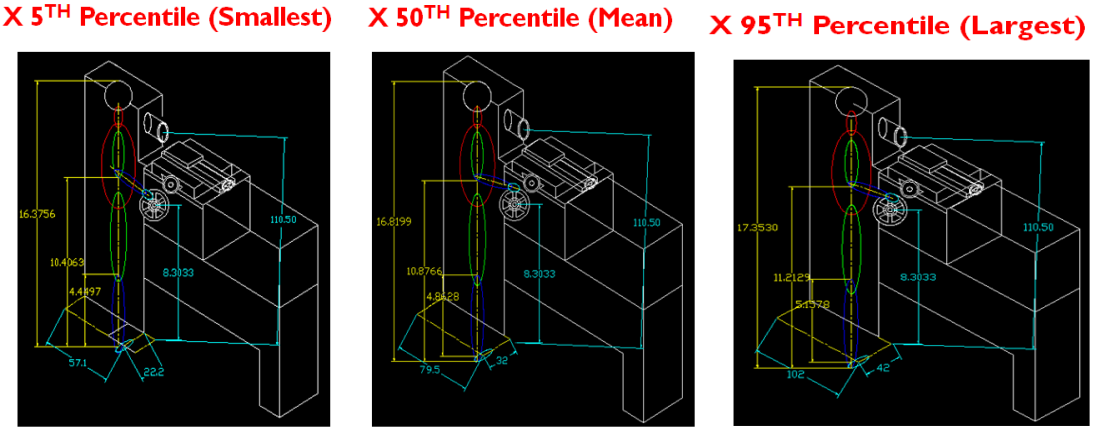


Figure2- Standard body posture by AutoCAD Software

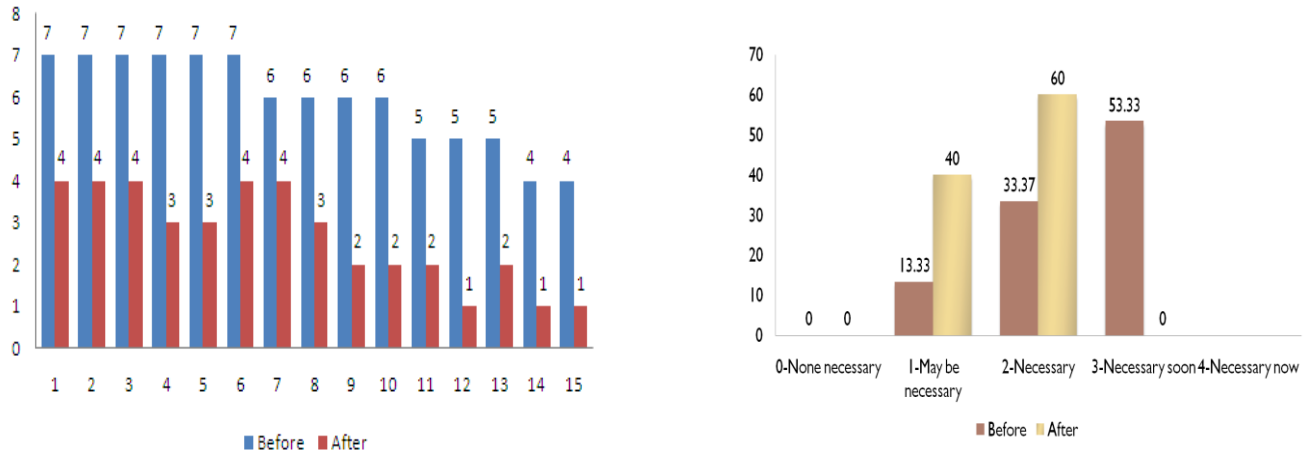


Figure3- REBA and RULA score

From the figure 3 it is found that the effect of the scores and level of the RULA which directly depend on the proper standing position from the reference point of the machine. Before implementation Reba levels was 53.33% in level 3 which risk level is high and action given change body posture necessary soon , i.e. the worker works in this condition is under high risk of the health. About 33.33% under medium risk level and action necessary, change and 13.33% was under low risk level and action level may be necessary. After implementation it is found 44%, 60% under low and medium level respectively of REBA level and which is acceptable for body posture. The distance far away from the work station is greatly affecting the body posture and which directly affect the healthy work.

VII. CONCLUSION AND FUTURE SCOPE

From the study of project the following conclusions appear to be justified.

1. The posture evaluation using REBA and RULA methods categorized posture and represents the worker's risk and indicates possible action to avoid or minimized the risks1evel.
2. Most of the workers are unable to select their desirable and comfortable postures. The adoption of unhealthy postures is because of improper workstation design. This inconvenient posture may lead to musculoskeletal injuries and other symptoms. Therefore, the workstation can be redesigned using the ergonomic principles to accommodate individuals ranging from 5th percentile to 95th percentile Indian population.
3. It is found that assessment of comfort is a complex process due to involvement of large number of factors. However ergonomic evaluation provides the root cause analysis to find out the sites of discomfort.
4. This project would be a very useful tool for the workers working in small scale industries suggesting the desirable posture with respect to anthropometry.

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