Postural and musculoskeletal disorder risk assessment in bakery industry using Rula method

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ABSTRACT

Ergonomics assessment of women workers were carried out on a sample of purposively selected 30 respondents in normal health who were engaged in packaging activities in a Bakery industry, Jorhat. An attempt was made to identify the working postures and musculoskeletal disorders prevailing among the women workers in the industry. RULA method was applied to analyze the working postures and musculoskeletal pain scale was developed to observe acuteness of pain among the workers in bakery Industry. From the observation and analysis of the result it was concluded that the women workers were highly affected by adopting awkward body posture while performing the activities. Twisting, bending and static repetitive tasks are the resultant of poorly designed workstation. These actions force them into a non-neutral position that increases the overall discomfort and pains at the knees, feet, legs, arms and shoulders. Moreover, lack of proper illumination and ventilation at work site also exerts an additional adverse effect on the performance of the workers.

INTRODUCTION

In India a good number of women workers are engaged in small scale industries. Small scale industries not only play a crucial role in the development of Indian economy but also have a great contribution in the development of women employees in India. There are a huge number of women employees engaged in small scale industries performing different type of jobs at different level. Small enterprise performs a vital role in development and in many countries like India, they play an important role in employing the majority of the industrial workers. India today engages more than 4.5 crores of women workers employed in the industrial work. Such industries in which the workers are engaged demand various working postures which may be adopted repeatedly during a day and continuing for many years which are expected to affect the musculoskeletal harmony of the individual. The workers complaints about discomfort and pain, come most of the time, from inadequate postures during work activities. Being a bio-mechanic nature factor, the skeletal-muscular lesions can be better understood after an analysis of the work postures (Fernanda *et al.*, 2006). In different occupations women are engaged in various activities with high postural load due to constraints of work method and working conditions. They perform the activities by assuming varieties of postures. To maintain a few Corlett and Bishop (1988) investigation

of repetitive operation revealed that particular posture were required in order to do the work and these postures were maintained over many hours with small period of relaxation.WMSDs are a group of disorders affecting the bones, muscles, ligaments and tendons of the human body. There are certain risk factors like awkward posture, force, repetitive activities and inadequate rest (Mukhopadhyay *et al*., 2007). Presence of all these factors sets the stage for WMSDs. This eventually leads to a decline in the productivity and quality of the work. Moreover, work organization and work environmental factor also affects work performance such as long period of work duration, no rest break, no job rotation and too hot or cold temperature which may lead to fatigue and decreased performance in workers and resulting in development of WMSD.

One of the fastest growing trends in the world over the past two decades the increase in the number of women fully employed outside the home. In the future years women will account for one half of the work force and two thirds of the labour force growth. There is a strong need to study women in stress at work. In packaging industry mostly women workers are involved in different activities related to pre-packaging and packaging. While performing the activities they are required to maintain different static postures for a long period of time which may cause damage to the health. Women labourer are the main working force in any industry, so to increase the productivity of industries, it is very essential to improve their working conditions as well as their health problems so that they can performs their activities more efficiently. Many researchers found that long term standing has been the cause of pain and discomfort to body parts, increasing over time starting from the one near to the standing in floor to the upper body parts (Kamalinia *et al*., 2008 and Deros *et al*., 2010).

Thus realizing the importance of women workers in packaging industry relating to their working conditions and health problems, the present study was undertaken with the following objectives:

– To analyze the working postures of the female workers engaged in packaging of bakery products.

– To determine the prevalence of work related musculoskeletal problems among women workers.

– To study the relationship between RULA scores with work related musculoskeletal problems of the workers.

MATERIAL AND METHODS

In the present study, RULA method was used for postural analysis. The RULA method is a tool to evaluate the exposure of individual workers to risk factors associated with work-related upper limb disorders : postures adopted, repetitive motions, forces required, static activity of the muscle skeleton system.

RULA divides the body into two segments which form two distinct groups. Group A includes the upper limbs (upper arms, lower arms and wrists), while Group B, includes legs, trunk and the neck. Posture scores for each of the group A and B are calculated by means of a table into which the individual posture scores for each body part (legs, wrists, arms, trunk) are entered.

The posture scores for each body part are obtained from measuring the angles formed by the operator's different body parts. This method applies a different procedure to each part of the body depending on its angle measurements.

The global posture scores for groups A and B are calculated and lastly a final score is obtained from the modification of such global values.

The requirements for action into which the grand scores are divided are summarized into Action levels as follows:

Action level 1 :
A score of 1 or 2 indicates that posture is acceptable if it is not maintained or repeated for long periods.

Action level 2 :
A score of 3 or 4 indicates that further investigation is needed and changes may be required.

Action level 3 :
A score of 5 or 6 indicates that investigation and changes are required soon.

Action level 4 :
A score of 7 indicates that investigation and changes are required immediately.

Musculoskeletal problems :
Musculoskeletal problems are associated with static muscles and skeletal efforts which may produce painful fatigue symptoms in muscles concerned. If the static efforts is repeated daily over a long period more or less

permanent aches will appear and involve not only the muscles but also joints tendons and other tissues.MSD was categorized as mild pain, moderate pain, continuous pain and Severe pain with scores ranging from 1, 2, 3, 4, respectively.

Statistical analysis:

Frequency, percentage, mean and standard deviations were computed to elicit information according to the objectives of the study. Karl Pearson's Co-efficient of Correlation and t test were used to find out the relationship between independent variables and dependent variables

OBSERVATIONS AND ANALYSIS

In one process of packaging, the packed biscuit packets delivered from the outlet of the machine were collected by the workers and stored in the cartoons for marketing to distant places. This is a highly repetitive task and daily performed packaging activity.

Working posture of the female workers engaged in packaging of Bakery products :

The female workers are involved in performance of various activities in bakery industry for packaging of the end products. While performing various packaging activities the workers assume different postures which were studied by observation and the still photography technique, where from postures were analyzed.

The data revealed that cent per cent of the respondents assumed standing posture while performing activities in industry. The activities were performed both manually and by using machines. The work place *i.e.* the machines were above the ground level for which the female workers adopted different awkward static postures by using both the extremities.

RULA scores obtained by the respondents in packaging activity :

RULA method was applied to analyze each postures adopted in packaging activities. RULA scores are presented and analyzed according to the age, years of involvement in job and to the height of the respondents.

From the Table 1 it reveals that maximum percentage of respondents *i.e.* 40 per cent of the respondents age group of 15-25 years followed by 20 per cent of the respondents in the age group of 25-35

years obtained a score of 5 and 6, while less percentage *i.e.*13.33 per cent of the respondents in the age group of 35-45years obtained scores of 5 and 6 (Table 1). This indicates that further investigation and change is required soon. On the other hand 20 per cent in the age group of 25-35 years and nearly 7 per cent belonging to older age groups obtained RULA scores of 3 and 4, indicating that change may be required.

Table 1 : RULA scores obtained by the respondents in packaging according to the age

Age (in years)	RULA scores	
	3 or 4 (%)	5 or 6 (%)
15-25 yrs	-	40.00
25-35 yrs	20.00	20.00
35-45 yrs	6.66	13.33

Analysis of RULA scores according to years of involvement depicted (Table 2) that maximum respondents (33.33%) with job exposure less than 2 years, followed by 26.66 per cent of the respondents with 2-4 years of involvement obtained scores of 5and 6. Only 13.33 per cent of the respondents with total 6-8 years of service obtained scores of 5 and 6. Thus, it indicated that further investigation and change in required soon in work position and work station in industry. On the other hand 13.33 per cent of the respondents involved in this activity for longer years of exposure *i.e.* 4-6 years obtained less scores of 3 and 4 (Table 2).

Table 2 : RULA scores obtained by the respondents in packaging activity according to years of involvement

Years of involvement (in years)	RULA scores	
	3 or 4 (%)	5 or 6 (%)
Less than 2 years	6.66	33.33
2-4 years	-	26.66
4-6 years	13.33	-
6-8 years	6.66	13.33

From the above analysis it can be inferred that the respondents with less years of involvement obtained higher RULA scores than the respondents with more years of involvement in packaging activity. This may be attributed to the fact that the respondents with less years of involvement in industry had less skill in performance of packaging activity and adopted improper postures leading to high RULA scores.

For analysis of data, heights were categorized into two groups, *i.e.* less than 5ft 3inch and more than 5ft

3inch. Results of Table 3 represents that maximum percentage *i.e.* 66.66 per cent of the respondents with height less than 5ft 3inch and nearly 27 per cent respondents in the taller group obtained scores of 5 and 6, indicating that further investigation and change is required soon in work place and work positions. Only, 6.66 per cent of the respondents with height more than 5ft 3inch obtained a score of 3 and 4, indicating that further investigation and change may be required. The scores are obtained by analyzing various body segments of the respondents in two different body heights.

It was clear from the results (Table 3) that majority of the short height respondents obtained high RULA scores than the taller respondents which depicts that short height respondents adopted highly awkward repetitive postures while working in the existing work station of packaging.

Table 3 : RULA scores obtained by the respondents in packaging activity according to the height		
Height (inch)	RULA scores	
	3 or 4 (%)	5 or 6 (%)
Less than 5'3"	-	66.66
More than 5'3"	6.66	26.66

Musculoskeletal problems prevailing among the female workers :

An awkward and static posture has been recognized as a risk factor for work related musculoskeletal problem (Borah, 2009). Keeping the importance of musculoskeletal problems faced by the workers in mind an attempt has been made to ascertain the musculoskeletal problems faced by the women workers in performance of different activities in industry.

Musculoskeletal pain was analyzed according to age, years of involvement and height of the respondents.

Findings revealed that maximum per cent of respondents *i.e.* 76.66 per cent of the respondents had pain in their legs, followed by 60 per cent of the respondents with pain in their feet (Table 4). The musculoskeletal problems were found to be abundantly present with pain among the respondents. It was observed that the respondents had severe pain in the lower extremities. Since they had to perform their work in static posture by standing for long hours, they felt pain in their legs and feet. High repetitiveness, prolonged work activity and remaining in static posture for a prolong period of time may be regarded as the causative factors in the occurrence of musculoskeletal disorder (Gangopadhyay *et al.*, 2003).

Further, 53.33 per cent respondents suffered from shoulder pain because pre-packaging and packaging were highly repetitive tasks. Rosecrance and Cook (1998) also reported that several work-related risk factors such as awkward postures, high repetition rates have been associated with the increased prevalence of MSDs. Fifty per cent of the respondents had pain in their knees because they had to work by standing in one place and had to give much effort in their legs. It was followed by 43.33 per cent of the respondents who had pain in their neck because they had to bend and twist their neck while performing the tasks in the bakery industry (Table 4). An equal percentage of respondents *i.e.* 40 per cent suffered from back and arms pain. Only 26.66 per cent of the respondents had pain in their wrists.

From the above interpretation, we can conclude that maximum percentage of respondents had pain in their lower segment of the body because they maintained a static posture with high motion repetitiveness. Similar findings were reported by Chee and Rampal (2004) who found that highest prevalence's of pain were found in the lower limbs, neck/shoulders, and upper back due to highest

Table 4 : Intensity of the body pain felt by respondents					
Body parts	Intensity				Total (%)
	Mild pain (%)	Moderate pain (%)	Continuous pain (%)	Severe pain (%)	
Neck	53.84	-	7.70	38.46	43.33
Shoulder	37.50	6.25	6.25	50.00	53.33
Back	25.00	8.33	8.33	58.33	40.00
Arms	41.66	8.66	8.66	41.66	40.00
Knees	33.33	6.66	6.66	53.84	50.00
Wrist	50.00	-	-	50.00	26.66
Leg	30.43	4.34	13.04	52.17	76.66
Feet	27.77	5.55	11.11	55.56	60.00

Figures in parentheses indicate percentage

exposures to prolonged hand/wrist movement and standing positions.

Musculoskeletal problems faced according to different age group of the respondents :

Further analysis of data reveals that the respondents from the young age group (between 15-25 years) felt continuous pain in different body parts as compared to middle and old age groups. Young respondents reported mild to continuous pain in legs, feet, shoulder and back. Less number of respondents in middle age group had suffered from body pains, while least number of respondents in older age group reported pain in body parts (Fig. 1).

An attempt was made to assess the musculoskeletal problem faced by respondents according to their years

Table 5 : Musculoskeletal problems faced according to years of involvement								
Years of involvement (in years)	Musculoskeletal pain							
	Neck	Shoulder	Back	Arms	Knee	Wrist	Leg	Foot
0-2	57.14	28.57	28.57	28.57	85.71	57.14	85.70	87.51
2-4	18.75	18.75	25.00	18.75	37.50	18.75	37.50	37.50
4-6	21.42	50.00	14.28	28.75	7.12	14.28	42.84	28.75
6-8	18.75	25.00	25.00	18.75	12.50	12.50	31.25	12.50

Figures in parentheses indicate percentage

Table 6 : Problems faced by the respondents regarding work place and work environment		(n = 30)
Problems faced	Pre-packaging (%)	Packaging (%)
Work place too high	40.00	26.66
Work place too low	13.33	40.00
Work place is congested	73.00	46.66
Improper lighting	66.60	60.00
Improper ventilation	86.60	86.60
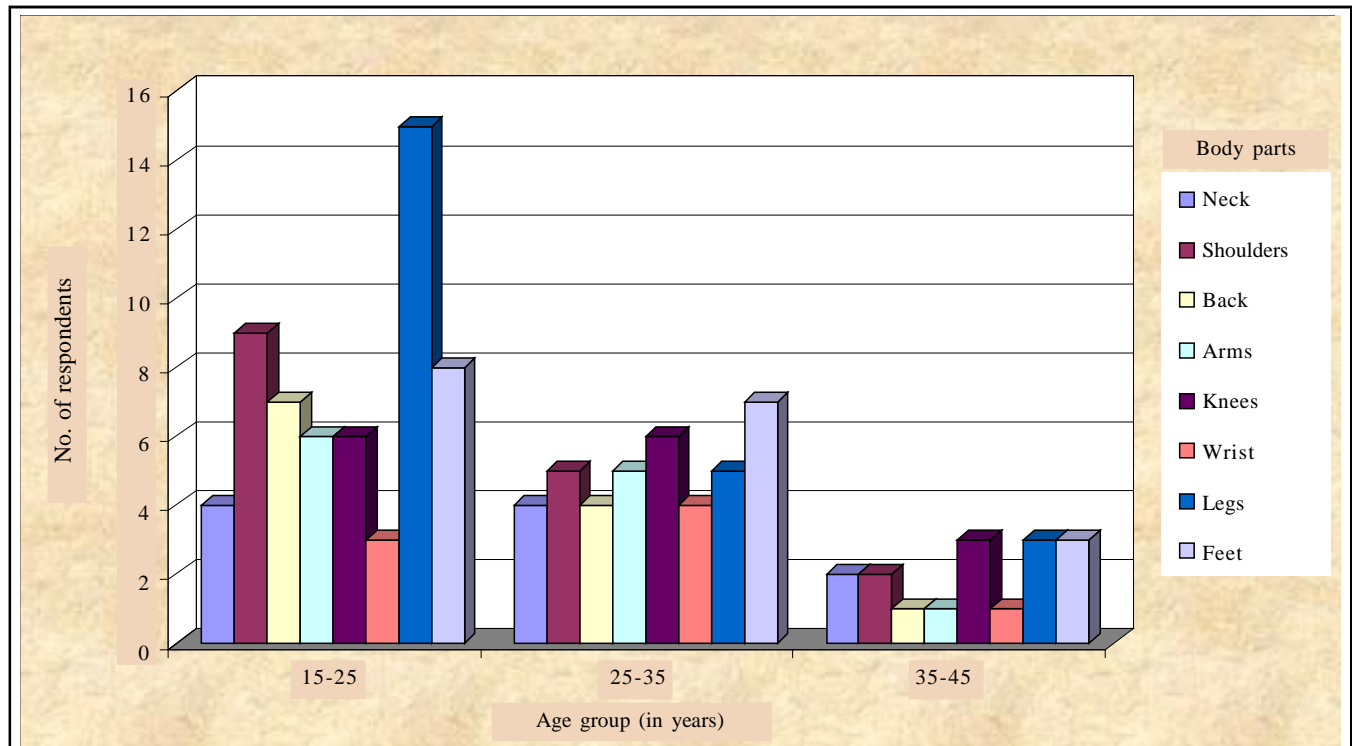
Fig. 1 : Musculoskeletal pain in different age groups of respondents

of involvement (Fig. 2). It was revealed from the Table 5 that most of the respondents engaged for less years of involvement in job faced more work related musculoskeletal problems compared to respondents with more years of job exposure. It was observed that the stress of repetitive work has a cumulative effect on the pathogenesis of diverse health problems. An association between musculoskeletal disorders and work related physical factors when there are long exposures in combination with physical factors such as repetitiveness force level and awkward disorders were reported in almost every joint of the upper limbs (Farooq and Khan, 2009). In the present study it was found that various activities that take place in industry were repetitive in nature. This may probably lead to the fact that young respondents with less years of involvement suffered more musculoskeletal pains.

**Problems faced by the woman workers regarding work place and work environment :**

Work environment is the sum of the interrelationship that exists within the employees and between the employees and the environment in which the employees

work. An attempt was made to identify the problems faced by the women workers in their work place and work environment.

Findings indicated (Table 6) that majority of the workers who performed pre packing activities found the work place too high and congested while performing there activities.

Majority of the respondents expressed discomfort in performing pre-packaging (66.6%) activity and packaging activity (60%) due to improper illumination. The lighting level in working areas of pre-packaging and packaging was observed to be 103 lux and 134 lux, respectively which was found to be less than recommended illumination level (200 lux in packaging industry).

There existed a significant negative correlation between age of the respondents, height of the respondents with RULA scores and musculoskeletal problems. Thus it can be inferred that short height respondents and younger respondents obtained higher RULA scores and faced more musculoskeletal problems. Further, there existed a significant positive relationship between RULA scores and musculoskeletal pain.
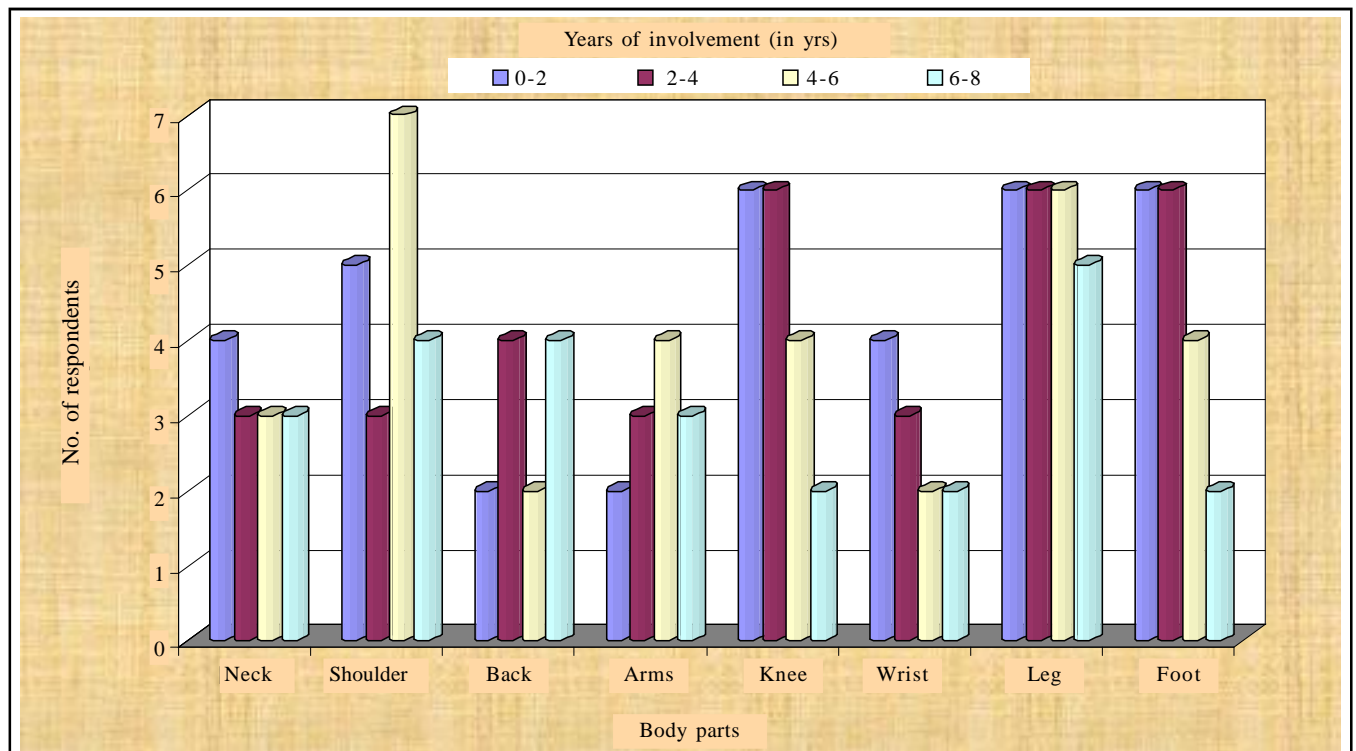
Fig. 2 :   Musculoskeletal problems according to years of involvement

Conclusion:

From the above discussion it can be inferred that women workers were the main working force in industrial activities. While performing packaging activities, women adopted different awkward postures with high motion repetitiveness as depicted by high RULA scores. Hence, there is a need to change the working conditions *i.e.* workstation and work method, so that women workers could avoid awkward postures in their work place. Musculoskeletal problems were very pronounced among the women workers as evidence by the acute incidence of shoulders pain, pain in legs, knee pain and pain in neck. The poor working posture was responsible for such health problems. Moreover, it is desirable that the activities should be carried out with breaks to give relief to the workers from undesirable physiological strain and fatigue. There is a lack of ergonomics planning and methods in small scale industry. Hence, for improving efficiency of the workers, there is a dire need of implementation of ergonomics interventions with the objective of providing maximum comfort to the women workers for promotion of their health and well being.

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