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Musculoskeletal Problems Among Workers of An Indian Sugar - Producing Factory

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Abstract **- Assessment of the level of exposure to work-related musculoskeletal disorders (WMSDs) risk factors can be an appropriate basis for planning and implementing an interventional ergonomics program in the workplace. This study was conducted among workers of an Indian sugar-producing factory to determine WMSD prevalence rate among production workers and to assess the level of exposure to WMSD risks. In total, 83 workers were randomly selected from production workshops and included in this study. The musculoskeletal questionnaire was used to study the prevalence of WMSDs and a quick exposure checks (QEC) was used to assess the physical exposure to risks. Required data were videotaped. Most workers (83.1%) suffered from some kind of MSD symptoms for 6 months prior to the study. The highest prevalence was reported in knees (58.6%) and the lower back (54.3%). The level exposure to MSD risks established with QEC was high and very high for about 99.1% of the workers. Awkward postures, manual material handling and long hours of standing were the major ergonomics problems. There was a high rate of WMSDs in this factory. The level of exposure to WMSD risk factors was high and corrective measures for reducing risk level were essential.**

Keywords: Musculoskeletal disorders, QEC, sugar industry

1. INTRODUCTION

Musculoskeletal disorders (MSDs) and symptoms in the working population are common, occurring predominantly in the low back, neck and upper limbs [1, 2, 3]. It is indicated that MSDs are an important cause of worker disability and absenteeism in many occupational groups [4]. These disorders include a large number of inflammatory and degenerative conditions affecting muscles, tendons, ligaments, joints, peripheral nerves and blood vessels. It is stated that MSDs are a common health problem and a major cause of disability [5]. A range of physical, individual and psychosocial risk factors are associated with the development of MSDs [6] .The physical risk factors include the physical demands imposed by performing the task such as posture adopted, force applied, frequency and repetition of movement, task duration and vibration experienced [7].

Musculoskeletal disorders (MSDs) are associated with parts of body such as muscles, joints, tendons, ligaments, nerves, bones and the localized blood circulation system. The disorders developed in the above mentioned organs are mainly because of poor fit of workers to the job they are doing. Individuals have different physical capabilities due to height, weight, age and level of fitness. In Indian sugar-producing factories, workers are directly involved in the production process where physical activities such as manual material handling (e.g., heavy load lifting, lowering, carrying, pulling and pushing) and awkward working postures are very common. In this situation, a high rate of MSD is expected. The sugar plant has used old technology to produce sugar for over 50 years. The production process is very labor intensive and workers are exposed to MSD risk factors. According to the workers' medical records 22.75 % of all occupational illnesses were related to the musculoskeletal system.

Study was carried out with the objectives of (a) determining WMSD prevalence rate among workers in a sugar-producing factory and (b) to assess the level of workers exposure to WMSD risks. The results of this study should be an appropriate basis for planning and implementing an interventional ergonomics program in the workplace and for improving workers' health in the sugar-producing industry.

2. MATERIALS AND METHODS

2.1. Examined Population

This cross-sectional study was conducted from June to august 2019 among the production workshops of an Indian sugar-producing factory. This plant employed 500 workers, divided into three shifts and four groups. Eighty three workers with at least one-year job tenure were randomly selected for this study. Workers with background diseases or accidents affecting their musculoskeletal system were excluded from this study.

2.2. Questionnaire

Data were collected via anonymous questionnaires, which covered (a) personal details (including age, weight, height, job tenure, education, health and medical background); and (b) musculoskeletal problems in different body regions. The general Nordic questionnaire of musculoskeletal symptoms [8] was used to examine reported cases of MSDs among the study population. Reported MSD symptoms were limited to the 6 months prior to the study. All workshops were visited; the questionnaires were completed on the basis of an interview with each worker.

2.3. Ergonomics Assessment

Physical exposure to musculoskeletal risks was assessed with a pen-and-paper observation method called a quick exposure check (QEC) [9, 10]. QEC is a sensitive method for assessing physical exposure to musculoskeletal risks in the workplace with fair inter- and intra observer reliability [11]. This technique includes their position and

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repetitive movement for an assessment of the back, shoulder/arm, wrist/hand and neck. In QEC, the required data are obtained from the worker for task duration, maximum weight handled, hand force exertion, vibration, visual demand of the task and subjective responses to work. The magnitude of each item is classified into exposure levels and the combined exposure between different risk factors for each body part is calculated with a score table. Up to five pairs of combinations are considered to obtain exposure scores of the four body regions, i.e., posture versus force, movement versus force, duration versus force, posture versus duration, and movement versus duration. The total score for each body area is determined from the interactions between the exposure levels for the relevant risk factors and their subsequent addition. The exposure scores for the back, shoulder/arm, wrist/hand, and neck are categorized into four exposure categories: low, moderate, high, and very high. Moderate, high, and very high scores should be urgently addressed to reduce the level of exposure to risk factors. To obtain an overall exposure score, total scores for body parts are added and the result is divided by the highest possible score for the whole body, i.e., 176 for manual handling tasks and 162 for other tasks. Low overall exposure scores (<40%) indicate acceptable musculoskeletal loading (low risk). For overall exposure scores of 41–50%, further investigation is needed and changes may be required (moderate risk). Prompt investigation and changes are required soon for overall exposure scores of 51–70% (high risk); and immediate investigation and changes are required for overall exposure scores over 70% (very high risk).

To find the most awkward postures with QEC, all workers were videotaped during their routine job activities for nearly 20 min. The tapes were then reviewed in a laboratory and the QEC score was calculated.

2.4. Data Analysis

Upon completion of the field survey, data were transferred into a computer for statistical analyses (SPSS version 22.0) for windows (IBM., corp., Armonk, NY,USA). An independent *t* test and $\chi 2$ were used to assess the relationship between personal and work variables with reported MSD symptoms.

3. RESULTS

Nineteen percent of workers who participated in the study were illiterate, and 40.5% each had primary and secondary education. Table 1 summarizes other personal details. Table 2 presents the prevalence of MSD symptoms in different body regions during the 6 months prior to the study; the workers' knees, lower back, shoulders and upper back were most commonly affected.

TABLE 1. Personal Characteristics of the Workers in this Study (*n* = 83).

Characteristics	**M(SD)**	**Range**
Age (years)	43.1(9.70)	18-60
Weight(kg)	68.3(10.29)	45-102
Height(cm)	170.6(11.54)	150-195
Tenure(years)	9.4(5.47)	1-25

TABLE 2. Frequency of Reported Musculoskeletal Disorder Symptoms in Different Body Regions in the 6 Months Prior to the Study (*n* = 83).

Body Regions	**No. of cases**	**%**
Neck	25	30.6
Shoulders	40	48.5
Elbows	26	31.2
Wrists/Hands	37	44.5
Upper back	38	46.0
Lower back	45	54.1
Thighs	27	32.0
Knees	48	58.6
Legs/feet	26	31.8

Table 3 shows the relationship between some demographic variables and reported MSD problems in at least one region. The means of age and job tenure among workers who reported MSD symptoms were significantly higher than those of workers without any symptoms ($P < .05$).

TABLE 3. Relation of Some Demographic Variables and Musculoskeletal Disorder (MSD) Problems Among the Workers in this Study (*n* = 83)

	MSD Problems				
	Reported		**Not Reported**		
Variables	**M**	**SD**	**M**	**SD**	**P Value***
Age (years)	42.83	9.05	34.63	11.06	0.02
Weight(kg)	67.91	10.33	68.45	10.25	0.82
Height(cm)	168.97	12.14	170.35	6.35	0.63
Tenure(years)	9.75	5.36	6.75	5.54	0.03

Notes. *-independent sample *t* test

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Table 4 presents the frequency of sick leave due to musculoskeletal problems in different body regions during the 6 months prior to the study. Problems of the lower back, knees, upper back, and shoulders caused the highest rate of sick leave. Table 5 shows the results of assessment of physical exposure to work-related musculoskeletal risks.

TABLE 4. Frequency of Sick Leave (%) Due to Reported Musculoskeletal Disorder Problems in Different Body Regions in the 6 Months Prior to the Study (n = 83)

Body Regions	**Sick Leave**	
	No. of cases	**%**
Neck	9	11.0
Shoulders	15	18.3
Elbows	10	12.5
Wrists/Hands	13	15.3
Upper back	16	20.2
Lower back	18	22.1
Thighs	11	13.6
Knees	20	23.8
Legs/feet	12	13.9

TABLE 5. The Results of the Quick Exposure Check (QEC) for Work-Related Musculoskeletal Risks (WRMR)Among the Workers in this Study (n = 116)

Risk level	**Calculated exposure to WRMR (%)**	**No. of cases**	**%**
Low	≤40	0	0.0
Moderate	41-50	1	0.8
High	51-70	19	22.7
Very high	>70	63	76.5

Table 6 demonstrates the prevalence rate of reported symptoms in different levels of risk exposure among the workers. When risk increased, the prevalence rate increased. The $\chi 2$ test revealed a significant relationship between the QEC risk level and the prevalence rate of reported musculoskeletal problems (P < .034).The prevalence rate of MSD symptoms among workers with high and very high risk levels was significantly higher than for those with a moderate risk level.

TABLE 6. The Prevalence Rate of Reported Musculoskeletal Disorder (MSD) Symptoms at Different Levels of Risk Exposure Among the Workers in this Study

Risk level	**MSD symptoms**				**Total**	
	Reported		**Not Reported**			
	n	**%**	**n**	**%**	**n**	**%**
Low*	0	0	0	0	0	0
Moderate	0	0	1	0.8	1	0.8
High	16	19.27	3	3.61	19	22.7
Very high	53	63.85	10	12.04	63	76.5
Total	69	83.12	14	16.45	83	100

Notes. P <.034; *- the low risk group was excluded from statistical analysis.

4. DISCUSSION

The questionnaire showed that MSD symptoms were common among the workers in the sugar producing factory. Most of the study population (83.1%) had experienced some form of MDS symptoms during the 6 months prior to the study. This indicated that the problem of MSDs in this factory was serious and required due attention. Symptoms from the knees, back, and shoulders were found to be the most prevalent problems. This could be attributable to awkward working postures, manual material handling and prolonged standing, which were common in almost all work stations and job activities observed. Moreover, the results revealed that symptoms from the knees, back, and shoulders caused the highest rate of sick leave. This implies that any interventional program for preventing or reducing MSD problems among workers in a sugar-producing factory should focus on reducing physical exposure to the MSDs risk factors of these regions.

The results of physical exposure to work related musculoskeletal risk assessment showed that the level of exposure for about 99.1% of the workers was high and very high. This indicates that the jobs and working conditions in the production workshops of the plant were conducive for developing WMSDs. Therefore, ergonomics interventions to improve working conditions and to decrease exposure level were necessary. The results demonstrated that there

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was an association between the QEC risk level and the prevalence rate of the reported symptoms (Table 6). This implies that QEC was an appropriate method to determine the level of exposure to musculoskeletal risks in this industry and provides reliable results. Our observations showed that awkward working posture, manual material handling of heavy loads and prolonged standing was major risk factors of the workers encountered. Thus, the following general corrective measures were recommended for reducing exposure level and consequently preventing WMSDs in this sugar factory.

• Using mechanical devices such as conveyer belts to carry sugar casts and bags;
• Reducing the weight of sugar bags which had to be handled manually;
• Repairing rails for transport wagons containing sugar casts;
• Using sewing machines to sew the heads of filled sugar bags (instead of sewing them manually);
• Designing sitting–standing workstations in the production workshops;
• Revising an appropriate work–rest cycle.

5. CONCLUSION

The results led to the conclusion that there was a high rate of WMSDs in this factory. Workers' level of exposure to WMSDs risks was high. . The musculoskeletal questionnaire was used to study prevalence of WMSDs and a quick exposure checks (QEC) was used to assess physical exposure to risks. Most workers (83.1%) suffered from some kind of MSD symptoms during the 6 months prior to the study. The highest prevalence was reported in knees (58.6%) and the lower back (54.3%). The level exposure to MSD risks established with QEC was high and very high of about 99.1% of the workers,. Awkward postures, manual material handling and long hours of standing were the major ergonomics problems**.** There was a high rate of WMSDs in this factory.

Taking corrective measures to reduce the level of risk was essential. Any ergonomics intervention program in the workplace should focus on eliminating awkward postures and manual handling of heavy loads, and designing sitting– standing workstations in the production line.

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