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A Study on Ergonomic Awareness among Workers Performing Manual Material Handling Activities

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Abstract

Manual material handling (MMH) is the most common cause of musculoskeletal disorders (MSDs) and low back pain (LBP). It involves manual lifting, lowering, carrying, pushing and pulling loads. This study has three main objectives, first: to identify ergonomics awareness towards MMH activities amongst the workers; second, to identify the body discomfort or body pain of the workers using Body Parts Symptom Survey (BPSS); and third to study the LBP and MSDs risk exposure in reference to MMH practiced by the workers using RULA. The respondents for the study were selected from the production area. There were 32 respondents who answered questionnaires regarding ergonomics awareness and reported their body pains through Body Parts Symptom Survey (BPSS) included in the 5-scale Likert questionnaires. Based on the self-reported survey, 7 subjects were chosen to be observed through Rapid Upper Limb Assessment (RULA). Evaluation of ergonomic awareness on MMH amongst workers on research area shows that they possess a moderate ergonomics awareness level (mean score 2.97). The BPSS used in this research provides the insight of discomfort issue amongst workers. Nine workers who are working at loading and collection bay were detected to have LBP and MSD problem symptoms. Based on RULA observations on work stations and MMH motions, it was found that the MMH methods used is on level 4. This means that the current method employed should be investigated and immediate changes should be applied. It is recommended that the management should put more effort to increase workers ergonomics awareness especially during MMH activities, to re-examine the MMH activities and redesign the work flow or the workstations.

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Keywords: awareness; ergonomic; MSDs; LBP, MMH, RULA

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1. Introduction

Human contribution as manual work resource is still dominant in current manufacturing activities. The term used to describe the activities is Manual Material Handling (MMH) activities. MMH usage was preferred over machineries due to high flexibility and being relatively low in cost. MMH holds advantage in its flexibility to maneuver during simple and light material transfer, if compared to performing the same activity using mechanical aids. However, repetitive MMH activities, wrong transfer position and method as well as heavy loads could risk the workers of a serious case of Lower Back Pain (LBP). This will intensify should it occurs continuously and in a long period of time. Incorrect MMH activities are possible risks on LBP as well as other Musculoskeletal disorders (MSD) (Nag, 2000). In addition, a study conducted by Durishah et al. (2004) found that staff ergonomic awareness with respect to safety and health at workplace was still very low level.

2. Literature Review

From ergonomics perspective, manual material transfer is a high risk activity that could cause spinal injuries. From physiology aspect, manual material transfer requires high amount of energy and strength. Hence, all activities, if carried out incorrectly, could cause inflammation at the nerves and muscles (Muslimah et al., 2006). MMH activities that involve high physical demands, continuous bending, crouching and hip twisting could disrupt the musculoskeletal system (Deros et al. 2010a; Deros et al. 2010b; Deros et al. 2011; Ismail et al. 2009). The main source of this problem is the bearing of static loads repeatedly in a long period of time, which causes tensions or disruptions on the joints, tendons and ligaments. This is known as Musculoskeletal Disorders (MSD).

This research looks on the ergonomic and MMH awareness in a steelwork company, Company A. According to the statistics released by the management, 20% of reported health issues were LBP (RHSC 2010). Besides that, 60% of the accidents reported were due to incorrect MMH method and dangerous surrounding factor. There were increases in accident cases in 2009 (9.2%) and 4.3% in 2010. The total of increase from 2008 until 2010 is 13.5% (RHSC 2010). This statistics is in an alert state due to the increase for each year. The effects of this were company losses in term of work source and medical expenditures. Productivity and motivation are well affected as well due to limitation caused by health issues, which affects the quality of life as well. This matter has to be attended to avoid accidents and injuries to occur amongst workers.

3. Methodology

3.1. Research Goal

Three main objectives of this research are: to identify ergonomic awareness towards MMH activities amongst the workers; to identify the discomfort or body pain of the workers using Body Parts Symptom Survey; to study the LBP and MSD risk exposure in reference to MMH practiced by the workers using RULA.

3.2 Sample and Data Collection

This study was focused on the workers from the manufacturing department only. The 36 subjects of the selected workers are those who work double shift, eight hours per day. They were chosen based on their daily task that involved mainly MMH. The main data were obtained through questionnaire distributed to the workers. Respondents filled their details voluntarily after being briefed by the researcher on the objectives and the items in the questionnaire.

The development of items in the questionnaire were based on the contents of literature studies as well as modification from Deros et al. (2010), Shaliza et al. (2009) and Azhar (2009). The questionnaire was divided into three sections A, B and C. Section A is about demographic questions such as age, gender, education level, position and body mass index (BMI). Section B asks about knowledge and understanding of MMH, work station evaluation, work environment evaluation as well as attitude and commitment evaluation. In this study, the Likert scale used is from 1 to 5 with 1 being strongly disagree and 5 being strongly agree. Section C asks on the comfort level experienced at respondent's body parts using BPSS.

The data was analysed using SPSS Statistic 17.0. Data obtained from the workers were divided into two parts; frequency and percentage table. Descriptive analysis was used to explain the respondent's demographics. Besides that, questions involving worker's knowledge on ergonomics, work station evaluation and BPSS has multiple choice answers. For both parts; mean score and standard variable was determined. This method was used to understand the level of awareness of the workers. The outcome of the data allows researcher to continue with the next step.

Rapid Upper Limb Assessment (RULA) was used on selected workers based on the result from BPSS. Those who reported through the BPSS 'very uncomfortable' on their body parts were selected to be monitored. The body parts that are found as very uncomfortable in this study are; neck, upper shoulder, hip, arm, wrist, thigh and calf.

At the end of the research, observation were given on the operation as a whole including environment factor, equipment, workers, work station design and integration of ergonomics. Observation was given on these features which affects the worker's activities especially their MMH motions. The environment factor was focused on work station aspect suitability towards the MMH activities. The equipment was observed to understand its sustainability, as well as the ergonomic features on the other factors.

4. Analysis of Results

From the 36 sets of questionnaire distributed to workers within the manufacturing department, only 32 were returned (i.e.89% response rate). It was found out that 71.9% were aware and have little knowledge of ergonomics in their daily work. However, only 9.4% of the total respondents ever attended official briefings on matters regarding ergonomics. Besides that, only 18.8% of the workers realize the bad consequence of neglecting ergonomics. Table 1 shows the distribution of the responses regarding awareness on ergonomics.

Table 1. Percentage of workers' perception on ergonomic general knowledge and MMH

Question item	Yes	No
Ergonomic knowledge	71.9	28.1
Attended ergonomic seminar	9.4	90.6
Knowing the effects of neglecting ergonomics	18.8	81.2
Knows the function of MMH	12.5	87.5

Analysis on work stations shows that the workers perception towards their work station is at medium level with mean score of 2.81 and standard deviation of 0.959. The result as shown in Table 2 is responses to questions on clean, comfortable & safe environment, suitable space for routine activities, ease of movement in workspace and MMH equipment provision.

Table 2. Work station evaluation (percentage)

Question item	1	2	3	4	5	μ /σ
Clean, comfortable and safe environment	0.0	84.4	0.00	15.6	0.0	2.31/0.738
Suitable space for routine activities	6.3	21.9	0.0	53.1	18.8	3.56/1.216
Ease of movement in work space	18.8	6.3	3.1	46.9	25	3.53/1.436
MMH aid equipement provided	18.8	78.1	3.1	0.0	0.0	1.84/0.448
Overall mean						2.81/0.959

Overall perception towards work environment factor was rated based on items as shown in Table 3 with mean result is at 3.358 and standard deviation of 0.533. Fifty three percent of the respondents disagree with the current state of air ventilation system, with 3.1% being neutral about it. Fifty percent felt comfortable with the current condition of the temperature, while 15.6% disagree. 50% of the respondents agrees with the current lighting condition with 25% (disagree) and 3.1% (extremely disagree). Majority of the workers agree that the noise level is high (90.6%), with 6.3% chose to be neutral.

Table 3. Work environment evaluation

Question item	1	2	3	4	5	μ /σ
Good ventilation	15.6	53.1	3.1	28.1	0.0	2.44/1.076
Comfortable temperature	1.3	15.6	1.3	50	28.1	3.06/0.246
Good lighting	1.3	25	15.6	50	6.3	3.09/0.296
Too noisy	0.0	0.0	6.3	3.1	90.6	4.84/0.515
Overall Mean						3.358/0.533

Analysis on worker's commitment and attitude towards ergonomics application at work shows a mean score of 2.735 (SD = 0.626) (please refer Table 4). From this result, 62.5% agree with priority of safety and health aspects while on duty. In the aspects of whether they applied the correct MMH, majority (75%) of the respondents disagree. Furthermore, majority of them (68.8%) also disagree with the aspect of sharing information on the correct MMH to colleagues. It seems also that the respondents really lack of the awareness and knowledge of ergonomics and MMH as majority (75%) also disagree with giving explanation to colleagues on effects of MMH. The mean score for correct MMH application is moderate (2.50 SD = 0.88). The aspect of sharing and explaining of MMH knowledge is low (mean at 1.78 (SD= 0.61) and 2.28 (SD=0.52) respectively). The overall mean score of this segment is moderate (mean at 2.735 SD=0.626).

Table 4. Workers commitment and attitude evaluation

Question item	1	2	3	4	5	μ /σ
Safety and health always first	0.0	0.0	0.0	62.5	37.5	4.38/0.492
Executing MMH correctly	0.0	75	0.0	25	0.0	2.50/0.880
Spreading the right MMH method	28.1	68.8	0.0	3.1	0.0	1.78/0.608
Explaining the effects of MMH to	0.0	75	21.9	3.1	0.0	2.28/0.523

colleagues	
Overall Mean	2.735/0.626

Body Parts Symptom Study (BPSS)

BPSS was used to identify MMH system issues as practiced by the workers. The workers chose to describe their discomfort by choosing the options given to body parts from eye, neck, shoulder, upper back, elbow, lower back, arm, wrist, thigh, knee, calf and ankle. Table 5 shows the percentage of body parts discomfort for uncomfortable and very comfortable amongst the workers.

Table 5. Body parts comfort level among the workers

Body parts	Very uncomfortable (%/No. of workers)	Uncomfortable (%/No. of workers)
Upper back	12.5 / 4	15.6 / 5
Lower back	9.4 / 3	18.8 / 6
Arm	15.6 / 5	12.5 / 4
Wrist	12.5 / 4	15.6 / 5

To identify the cause of LBP from MMH activities, body parts evaluation using RULA was performed. The motion due to MMH activities was observed. The focus to this evaluation is workers whose duty is on the loading bay of materials to be melted. This is based on the outcome of BPSS, which was filled by the workers themselves. Analysis was done on lifting and loading of raw materials into the reservoir activity. The selection was done by placing worker's number on the questionnaire. This is to detect workers who are experiencing discomfort on their body parts. RULA was used to evaluate the observation done on the research site as shown in Table 6.

Table 6. RULA method according to workers number

Workers number	Arm and wrist score	Neck, body frame and leg score	Schedule C score	Final score	Level
24	7	6	7	7	4
25	8	9	7	7	4
26	7	11	7	7	4
28	8	8	7	7	4
30	8	10	7	7	4
32	7	6	7	7	4
27	8	7	7	7	4

RULA evaluation was used to prove the statement of 7 workers out of 9 that claims to be having LBP and MMH. RULA final result indicates that all MMH method used while lifting materials achieves a score of 7 for all workers. Based on arm and wrist evaluation score, all workers have an evaluation score ranging from 7 to 8. This value indicates high risk on arms and wrist.

5. Discussions

The study showed that the workers were lack of knowledge in regards of ergonomics and MMH. There was no particular safety and health program conducted at their work place. Besides that, most programs organized were less effective and does not give an impact towards the workers. It is a company's responsibility to provide safety and health requirement to the workers in the form of information, seminar, exhibition amongst others (Noriah, 2010). In terms of lighting, the work environment was gloomy, as the main lighting was natural light that comes through the

wall of the warehouse. The lights were turned on only on specific condition, such as during rain or cloudy days. Besides that, the greasy environment as depicted in Figure 1 makes the viewpoints of the warehouse to become dreary. The noise aspect gave a direct impact towards the workers. This was indicated by the perception towards the noise level on work place with a high mean score at 4.84. This is due to the environment, which was exposed with scrap cutting activities and material loading using machineries. Observation also shows that the workers does not wear any ear muff for protection during work (refer Figure 2). This neglect clearly is causing health and safety problem to the workers.

Figure 1. First work station

Figure 2. Second work station

BPSS was used to identify discomfort on workers body parts. The use of BPSS method allows the workers to clearly indicate on their discomfort. The result confirms that these workers are experiencing LBP. However, the extent of the LBP faced by these workers will be determined. Based on observations, the discomfort problems arise from the MMH method practiced by the workers, as well as discomfort on upper and lower back for those working at the loading bay. According to Ghaffari et al. (2006), repeated MMH activities, even if performed while in sitting

position could potentially cause LBP and MSD. This shows that the MMH performed is hazardous and high risk to LBP.

RULA evaluation indicates that all MMH methods used while lifting the materials achieves a score of 7 for all workers. This final result is based on two main score values; arm and wrist for the first one and neck, posture and legs for the second score. High values shown on arms and wrist (7 to 8 range) which indicates a high risk. Range for neck, posture and legs were 6 to 11. This shows that it is high risk for MSD problems and can be clearly observed from the task they do as illustrated in Figure 3. Combination of values of upper and lower muscles as well as postures in the MMH activities gave a value of seven, which is in level 4. This means that the current MMH method is required to be investigated and changes are required as soon as possible. This result proves that the information on LBP and MSD problems obtained from BPSS have a clear and direct connection with the MMH activities performed.

Figure 3. An example of worker performing MMH

The work station factor also contributes to LBP problems. Both stations carry out the same functions; loading works and raw material collection. Workers on both stations performed the same tasks. Should both stations are combined with a single loading and collection bay, MMH activities can be minimized. Loading aids such as cranes, conveyors, trollies etc. can be used to replace the MMH tasks that were carried out by the workers. This could prove to lower the risk of LBP and MSD amongst the workers.

6. CONCLUSION

Evaluation of ergonomic awareness on MMH amongst workers on research area shows that they possess a moderate awareness level. This can be seen by the overall mean score, which shows a moderate awareness level at 3.68. Mean score obtained from ergonomics awareness through three factors; the ergonomics application at workstation 2.81, work environment 3.36 and workers commitment 2.74. Hence, the management should take full responsibility to increase the workers awareness level on a higher level. This is important to ensure the workers possess appropriate awareness level as well as practising the correct MMH methods, and further lowering the risk of LBP and MSD amongst workers.

The BPSS used in this research provides the insight of discomfort issue amongst workers. This method was used to understand the tendency of discomfort which specifies on specific body parts. Nine workers who work on loading and collection bay were detected to have LBP and MSD problem symptoms.

Based on RULA observations on work stations and MMH motions, it was found that the MMH methods used is on level 4. This means that the current method employed should be investigated and immediate changes should be applied. Should this method is continued, a higher risk of LBP and MSD could occur. The management should emphasize on the design of the work stations as well. A good design should minimize the requirement of MMH activities that consumes high amount of energy, such as the implementation of conveyors and rails to transport raw material to the furnace.

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