HEALTH RELATED PROBLEMS OF LIFTING TASKS IN AN OIL PALM FACTORY IN MALAYSIA

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Abstract: Work-related health problems among 25 workers in an oil palm factory was investigated using questionnaires and observations of the tasks conducted. The workers were required to stand, bend, carry heavy load and in some instances reaching and tilting their bodies. Fatigue, backache, pressure, headache, shoulder and leg pain were reported as health problems occurring during and after work. The problems were mainly contributed to the heavy load lifted, the workplace design, wrong posture, and prolonged standing. Using the NIOSH lifting equation for three tasks showed that the recommended weight limits (RWL) of each task were below the actual weight of load lifted and the lifting index (LI) for all tasks is greater than 1.0. This indicates that the lifting tasks pose some hazards to the workers such as low back pains. The tasks need to be redesigned to make it safer, healthier, and more comfortable for the workers.

Keywords: musculoskeletal diseases, NIOSH lifting equation, oil palm factory, Malaysia

1. INTRODUCTION

MSDs can cause a number of conditions, including pain, numbness, tingling stiff joints, difficulty moving, muscle loss and sometimes paralysis. The conditions that are likely to cause MSD problems are exerting excessive force, excessive repetition of movements that can irritate tendons and increase pressure on nerves, awkward postures or unsupported positions, static postures or positions that a worker must hold for long periods of time. These risk factors either alone or in combination can subject workers shoulders, arms, hands, wrists, backs and legs to thousands of repetitive twisting, forceful or flexing motions during a typical workday (U.S Department of Labor, 2000). Parts of the body affected by MSDs are arms, hands, fingers, neck, back, wrists, legs and shoulders. Musculoskeletal impairments ranked number one in chronic impairments in the United States, and chronic musculoskeletal pain is reported in surveys by 1 in 4 people in less and more developed countries’ (White and Harth cited in Anthony D. Woolf and Kristina Akesson, 2001). Musculoskeletal disorders (MSDs) are among the leading causes of occupational injury and disability, with back pain the most common reason for the filing of workers’ compensation claims.

Back pain accounts for about one fourth of all claims and for about 40 percent of absences from work. In the United States, in 1990, the cost of back pain was estimated to be between $50 billion and $100 billion (Saporta, 2000). The seriousness of the lower back injury is reflected in the large number of claims under the US Worker’s Compensation Act of 1970 (Fernandez, 1995). Low back pain and injuries attributed to frequent awkward postures in manual lifting activities have an enormous and growing impact in industries. The debilitating effect of low back pain on the worker results in absenteeism, high turnover and high compensation costs for the company. Thus, solutions or preventions are required in industries to minimize its occurrence. Evaluating a task ergonomically using the 1991 revised NIOSH lifting equation can help identify the risk factors causing musculoskeletal disorders and thereby facilitate to redesign of the tasks toward eliminating/reducing the risk factors (Chung and Kee, 2000).

Manual handling and lifting are major causes of work-related low back pains (LBP) and impairments (Waters et al, 1993). Manual handling jobs involving lifting, lowering, pushing, pulling and holding and body movements with frequent bending, twisting and sudden movements have a significant potential for producing low back pain (Garg and Moore, 1992). There is strong evidence of an association between
musculoskeletal disorders and workplace physical factors, such as heavy physical work, lifting and forceful movements, awkward postures, whole-body vibration, and static work postures. Static work postures of prolonged standing, sitting, and sedentary work are isometric positions where very little movement takes place. These postures are typically cramped or inactive and cause static loading on the muscles (NIOSH, 1997).

Low back injuries, often due to improper manual handling of materials, form the largest subset of musculoskeletal injuries. The risk factors for low back injuries include force and amount of weight lifted, frequency of lifting, location and size of load, starting and ending point of lift, stability of the load, handles, twisting, geometry of the workplace and environmental conditions (Fernandez, 1995).

The workplace risk factors typically associated with low back pain identified by most researchers include handling heavy loads, task repetitiveness, extreme postures of the back (twisting, bending, stretching, and reaching), static postures, whole body vibration, prolonged sitting, direct trauma to the back (striking or being struck by an object), slips, trips and falls, and work-related stress. Bending, twisting, kneeling, reaching, and stretching in particular are stressors on the low back and influence how the worker feel after finishing a taxing task.

Since the workers in an oil palm factory are exposed to these risk factors, a study was conducted to investigate the prevalence of MSDs among them. Three tasks were analysed using the NIOSH revised lifting equation of 1991 to establish the recommended weight limits (RWL) and the lifting index (LI). The recommended weight limit (RWL) is the principal product of the revised NIOSH lifting equation and is defined for a specific set of task conditions as the weight of the load that nearly all healthy workers could perform over substantial period of time (e.g., up to 8 hours) without an increased risk of developing lifting-related LBP. Healthy workers are workers who are free of adverse health conditions that would increase their risk of musculoskeletal injury. The LI is a term that provides a relative estimate of the level of physical stress associated with a particular manual lifting task. The estimate of the level of physical stress is defined by the relationship of the weight of the load lifted and the recommended weight limit. (Waters et al., 1993, Waters et al., 1993a). The 1991 revised NIOSH equation is an expansion of the 1981 equation which has been developed to assist ergonomists and occupational safety and health practitioners analyze lifting demands on the low back (NIOSH, 1981).

2. METHODOLOGY

This study was carried out at Felda Palm Industries (FPISB) that has 76 oil palm factories in Malaysia. The Oil Palm Factory in Felda Trolak is one of them that processed the oil palm to produce the raw oil and kernel for international markets. The factory had been operating since 1976 and can produce and process 500 tonnes of oil per day. The factory is managed by a manager and helped by 2 assistant managers and a station leader. The factory has 46 workers and most of them were paid based on their number of working days.

Health related problems of the workers were identified using a questionnaire form distributed to the workers. The workers were asked on their predominant work posture, tasks and experiences of pain during and after work. Since most of the work requires some lifting and carrying of loads in the mill, the 1991 NIOSH lifting equation was used to evaluate the degree of severity of some of the tasks.

2.1 Questionnaire

The questionnaire was designed to capture the health problems and identify the working postures of the workers. It was analysed by counting the frequencies of occurrence for each question. It is not the intention of this work to provide rigorous statistical analysis of the data or an in-depth medical analysis of the health problems. The questionnaire serves only as a guide to identify whether health related problems occurred in the tasks carried out and actions are necessary identified subjectively by the workers.

2.2 Task analysis and Measurement
Based on the questionnaire results, three tasks were observed and measured. The 1991 revised NIOSH lifting equation was used to calculate the recommended weight limits (RWL) based on a multiplicative model that provides a weighting factor for each lifting job-related problem and in reducing the risk factors by redesigning the jobs. A job worksheet was used for each of the task. The RWL and LI were calculated at the origin and destination of the task.

The equation consists of six multiplicative factors (horizontal, vertical, distance, frequency, asymmetry and coupling). The horizontal (H), vertical (V) and carrying (D) distances of the load have to be measured to determine the values of the multipliers. The values of the multipliers can be determined by using the formulae given for horizontal, distance, asymmetric and vertical multipliers and using the tables for frequency and coupling multipliers (Waters et al. 1993a; Wickens et al., 1997). The RWL is defined as:

\[
\text{RWL} = \text{LC} \times \text{HM} \times \text{VM} \times \text{DM} \times \text{AM} \times \text{FM} \times \text{CM}
\]

where if measured using the metric system,

- \(\text{LC}\) = load constant =23 kg
- \(\text{HM}\) = horizontal multiplier = 25/H
- \(\text{VM}\) = vertical multiplier = \((1-0.003|V-75|)\)
- \(\text{DM}\) = distance multiplier = \((0.82 +4.5/D)\)
- \(\text{AM}\) = asymmetric multiplier
- \(\text{FM}\) = frequency multiplier
- \(\text{CM}\) = coupling multiplier

The LI or lifting index is the ratio between the actual load and the RWL.

3. RESULTS AND DISCUSSION

3.1 Respondents’ background

There are altogether 8 workstations at the oil palm mill. However, the respondents for the questionnaire came from the loading ramp station, sterilizer, capstan, nut, press and ash store workstations. All the 25 respondents were male. They were asked with regard to their work posture, work related health problems they experience and the reasons for the cause of these health problems.

Table 1 showed that all the respondents (25) indicated that the work required them to stand most of the time, followed by carrying heavy load (16), reaching (15) and bending forward (13). The health problems while and after working (Table 2) were quite consistent with fatigue, leg, shoulder, back, waist and joint pains as most frequent. It seemed that the effect on the body parts were slightly higher after work than during work except for fatigue.

Table 1. Predominant work posture

<table>
<thead>
<tr>
<th>Work posture</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standing</td>
<td>25</td>
</tr>
<tr>
<td>Carrying heavy load</td>
<td>16</td>
</tr>
<tr>
<td>Reaching</td>
<td>15</td>
</tr>
<tr>
<td>Bending Forward</td>
<td>13</td>
</tr>
</tbody>
</table>

Table 2. Work-Related Health Problems

<table>
<thead>
<tr>
<th>Problems</th>
<th>No. of Respondents</th>
<th>During Work</th>
<th>After work</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue</td>
<td>20</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>Leg Pains</td>
<td>14</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Shoulder pain</td>
<td>13</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Backache</td>
<td>13</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Waist ache</td>
<td>11</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>Joint ache</td>
<td>10</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>
The workers were asked on the probable cause of these health problems. Twenty-two of the workers blamed it on the prolonged standing followed by posture (17), bending and carrying heavy load (13 each), workplace design (12) and machine design (10).

Based on the results, the workers have associated their work-health problems to the working postures that they have to assume when working. Prolonged standing, bending, reaching and carrying loads exceeding the capabilities of the workers are the risk factors identified by several researchers (Garg and Moore, 1992 and NIOSH, 1997) as positive contributors to MSDs.

3.2 Task analysis and Measurement

Since the majority of the workers indicated having work-health related problems, three tasks have been identified as potential risks for the workers have been analysed using the NIOSH lifting equation.

3.2.1 Lifting the oil palm fruits to put into a carriage

This task requires the worker to pick the fruit bunches from the ground, grabbing the ends with both hands, lifts and carries the fruit bunches before unloading them into the carriages. The fruit bunches usually weighs between 6-15 kg. The horizontal and vertical distance at the origin and destinations were measured as shown in Figure 1. The measured and corresponding multiplier values have been summarized in Table 3.
For recommended weight limit (RWL);

\[
\text{RWL}_{\text{origin}} = 23 \times 0.66 \times 0.81 \times 0.85 \times 1.0 \times 1.0 \times 0.95 = 9.93 \text{ kg}
\]

\[
\text{RWL}_{\text{destination}} = 23 \times 0.60 \times 0.75 \times 0.85 \times 1.0 \times 1.0 \times 0.95 = 8.36 \text{ kg}
\]

For lifting index (LI);

\[
\text{LI}_{\text{origin}} = \frac{15 \text{ kg}}{9.93 \text{ kg}} = 1.51
\]

\[
\text{LI}_{\text{destination}} = \frac{15 \text{ kg}}{8.36 \text{ kg}} = 1.79
\]

The recommended weight limits (RWL) for lifting at both origin and destination were less than the actual weight of oil palm fruit bunch. The weight of the oil palm bunch is about 15 kg. A lifting index greater than one indicates that this lift would be hazardous for a majority of healthy workers.

3.2.2 Lifting the bag of cement to put into a clay water tank

The job requires the worker to lift the bag of cement that is usually placed on the floor. The worker has to grab the bag with both hands and lift it to the clay water tank (figure 2). The bag of cement weighs 25 kg. Since the RWL under ideal conditions is only 23 kg, it is obvious that this task will pose severe health problems. The measured values and corresponding multiplier for this task has been summarized in Table 4.
Table 4: The measured variables and corresponding multiplier values for lifting the cement bag

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
<th>Multiplier, M</th>
</tr>
</thead>
<tbody>
<tr>
<td>The actual weight</td>
<td>25 kg</td>
<td>-</td>
</tr>
<tr>
<td>(H_{\text{origin}})</td>
<td>40 cm</td>
<td>0.63</td>
</tr>
<tr>
<td>(V_{\text{origin}})</td>
<td>20 cm</td>
<td>0.84</td>
</tr>
<tr>
<td>(H_{\text{destination}})</td>
<td>50 cm</td>
<td>0.50</td>
</tr>
<tr>
<td>(V_{\text{destination}})</td>
<td>104 cm</td>
<td>0.92</td>
</tr>
<tr>
<td>Vertical distance, D</td>
<td>84 cm</td>
<td>0.87</td>
</tr>
<tr>
<td>(AM_{\text{origin}})</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>(AM_{\text{destination}})</td>
<td>0</td>
<td>1.0</td>
</tr>
<tr>
<td>Frequency, F</td>
<td>&lt; 0.2</td>
<td>1.0</td>
</tr>
<tr>
<td>Duration, Hour</td>
<td>&lt; 1</td>
<td>-</td>
</tr>
<tr>
<td>Object coupling</td>
<td>Fair</td>
<td>0.95</td>
</tr>
</tbody>
</table>

For recommended weight limit (RWL):

\[
\text{RWL}_{\text{origin}} = 23 \times 0.63 \times 0.84 \times 0.87 \times 1.0 \times 1.0 \times 0.95 = 10.05 \text{ kg}
\]

\[
\text{RWL}_{\text{destination}} = 23 \times 0.50 \times 0.92 \times 0.87 \times 1.0 \times 1.0 \times 0.95 = 8.74 \text{ kg}
\]

For lifting index (LI):

\[
\text{LI}_{\text{origin}} = \frac{25 \text{ kg}}{10.05 \text{ kg}} = 2.49
\]

\[
\text{LI}_{\text{destination}} = \frac{25 \text{ kg}}{8.74 \text{ kg}} = 2.86
\]

The RWL for this task at the origin is 10.05 kg and destination is 8.55 kg. The lifting index (LI) showed that this task is physically stressful for the workers in this factory.

3.2.3 Lifting the sack of ash to put into lorry

The ash is initially collected and filled into a sack. The filled sack has to be lifted and put into a lorry to be sent to other factory or customer. The procedure of the task is the same like lifting a bag of cement. The weight of the sack is also about 25 kg. See Figure 3.
The data for the task is shown in table 5.

Table 5: The data for lifting the sack of ash to put into a lorry

<table>
<thead>
<tr>
<th>Value</th>
<th>Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>The actual weight</td>
<td>25 kg</td>
</tr>
<tr>
<td>H&lt;sub&gt;origin&lt;/sub&gt;</td>
<td>40 cm</td>
</tr>
<tr>
<td>V&lt;sub&gt;origin&lt;/sub&gt;</td>
<td>18 cm</td>
</tr>
<tr>
<td>H&lt;sub&gt;destination&lt;/sub&gt;</td>
<td>50 cm</td>
</tr>
<tr>
<td>V&lt;sub&gt;destination&lt;/sub&gt;</td>
<td>160 cm</td>
</tr>
<tr>
<td>Vertical distance, D</td>
<td>142 cm</td>
</tr>
<tr>
<td>AM&lt;sub&gt;origin&lt;/sub&gt;</td>
<td>0</td>
</tr>
<tr>
<td>AM&lt;sub&gt;destination&lt;/sub&gt;</td>
<td>0</td>
</tr>
<tr>
<td>Frequency, F</td>
<td>&lt;0.2</td>
</tr>
<tr>
<td>Duration, Hour</td>
<td>&lt;1</td>
</tr>
<tr>
<td>Object coupling</td>
<td>Fair</td>
</tr>
</tbody>
</table>

For recommended weight limit (RWL):

\[
RWL_{\text{origin}} = 23 \times 0.63 \times 0.81 \times 0.86 \times 1.0 \times 1.0 \times 0.95 = 9.58 \text{ kg}
\]

\[
RWL_{\text{destination}} = 23 \times 0.50 \times 0.75 \times 0.86 \times 1.0 \times 1.0 \times 0.95 = 7.05 \text{ kg}
\]

For lifting index (LI):

\[
LI_{\text{origin}} = \frac{25 \text{ kg}}{9.58 \text{ kg}} = 2.609
\]

\[
LI_{\text{destination}} = \frac{25 \text{ kg}}{7.05 \text{ kg}} = 3.534
\]

Since the weight to be lifted is higher than load constant of 23kg under ideal conditions, this task will also present substantial risk to the workers. The RWL for this task at the origin and destination is only 9.58 kg and 7.05 kg, respectively. The lifting index indicates that the risks are substantial.

For all the three tasks being analysed, the recommended weight limit exceeded the actual weight being lifted. This has resulted in the lifting index to be greater than 1. From the NIOSH perspective, lifting tasks with \( LI >1 \) are likely to pose an increased risk from some workers. However, when \( LI \geq 3 \), many or most workers are at a high risk of developing low back pain and injury (Wickens et al., 1997). The LI can also be used for the purpose of evaluating and redesigning the lifting tasks (Waters et al., 1993). Thus, by analyzing the lifting tasks using the NIOSH lifting equation, the multiplier values can be manipulated to reach ideal conditions. In all three cases, the multiplier value at \( H_{\text{destination}} \) (0.63, 0.50, 0.50) is the lowest. By decreasing the distance of load from the body, a higher multiplier value (closer to 1) can increase the RWL. This is so for all other multiplier values. The task designer should be able to identify the problem areas and modify them, if possible. Though the tasks are not frequent, do not require twisting of the body and showed relatively good coupling, there are other risk factors posed by these tasks, such as the horizontal distance of the load from the body, the distance of lifting and the originating heights of the lifts.

4. CONCLUSION AND RECOMMENDATION

The results of the study showed that the workers are faced with the potential risks of MSDs. The occurrence of fatigue and the reported work related health problems require actions to be taken by management to improve the job design. The cause of these problems such as prolonged standing, posture and carrying heavy loads should be minimized.

The lifting tasks clearly showed that the workers involved are prone to low back pains and other related health problems. The tasks can be redesigned by increasing the multiplier values, wherever possible. As the multiplier values approaches 1, the RWL can also be increased. Otherwise, administrative interventions are required. Load weights exceeding 23kg, should be lifted and carried by at least two workers or mechanical devices should be in place.
5. REFERENCES


U.S Department of Labor, (2000). *Occupational Safety and Health Administration OSHA 3125 (Revised)*


