Ergonomic Hazard Identification on Musculoskeletal Discomfort among Electronic Workers in Thailand

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ABSTRACT

Musculoskeletal disorders (MSDs) are considered to be a major occupational health problem and also affecting quality of work life, medical costs, efficiency at work and productivity in most workplaces. Industrial workers have been identified as high risk for developing MSDs. The purposes of this study were to determine the prevalence and to identify the potential risk hazards on musculoskeletal discomfort occurrence among electronic workers in Thailand. A cross-sectional survey was completed by 321 electronic workers in all departments in a large electronic factory. Data were collected using questionnaires including demographical-occupational data and self-reported musculoskeletal discomfort. Descriptive and binary logistic regression statistics were used to identify ergonomic hazards of reported musculoskeletal discomfort.

Most workers were men (71.40%) with average age of 32.09 years (S.D. = 8.38), and had experience in this factory for 7.76 years (S.D. = 8.20). 76.80% of electronic workers self-reported work-related musculoskeletal discomforts in at least one body part. The most three high prevalence were found at low back (51.4%), followed by lower leg (50%) and shoulder (44%). The workers reported usually working time in a standing posture (74.15%) with average 52.06 minute (S.D. = 2.64). It has been also found that manual material handling was a common task (86.90%) with average weight 8.33 kg. (S.D. = 7.13). Binary logistic regression showed that standing posture (OR=3.75; 95% CI 1.84 to 16.66) was significantly associated with musculoskeletal discomfort (p<0.05).

The prevalence of MSDs among workers in this study is found high. The study revealed that prolonged standing has led to musculoskeletal discomfort among electronics workers, especially in the lower back and lower leg regions. Therefore, work re-design should provide short breaks every hour and muscular stretching to reduce MSDs. Improvement of working condition is recommended in the study to prevent high risk activities at specific complained body parts.

Keywords: Discomfort; Standing posture; Workplace design; Thailand; Ergonomics

1. Introduction

The electronics industry is one of the major industries in Thailand (The Thailand Board of Investment, 2015). This industry trend is expected to crucial to the growth of manufactured exports. As the production increases, the demand for labor also rises. The occupational health of the employees in the electronics industry needs to be addressed (Lu et al., 2016). Packaging and assembly are two common processes in electronics industry (Koh et al., 2004). These tasks may be exposed to the health hazards during performing activities. Musculoskeletal disorders (MSDs) are considered to be a major occupational health problem and also affecting quality of work life, medical costs, efficiency at work and productivity in most workplaces (Health and Safety Executive, 2015). Industrial workers have been identified as high risk of developing MSDs (Aziz et al., 2015; Chandrasakaran et al., 2003; Chee et al., 2004; Tissot et al., 2009). Lu et al (2016) reported that manufacturing operators in Taiwan for the prevalence of MSDs was 31.8%. Among the various body parts, the highest prevalence of MSDs was found in neck and shoulders (20.4%) and also found that MSDs tends to be affected by both work factors and operator factors. According to the study by Chee et al (2004), Workers in the assembly of electronic components in the semiconductor industry in Malaysia, carrying out repetitive tasks with hands and fingers, and standing in awkward postures had high pain prevalence in the neck/shoulders.
(61.5%), arms (38.5%), low back (35.0%), and hands/wrists (30.8%). Potential various hazards may be present in electronics work. Repetitive assembly line work or manual handling and prolonged visual inspection work may lead to cumulative trauma disorders of the musculoskeletal system (Koh et al., 2004). It is important for occupational health and safety practitioners to be aware of the work processes in this industry, to recognize possible hazards, and to implement appropriate control measures to protect the health of its employees. Therefore, the purposes of this study were to determine the prevalence and to identify the potential risk hazards on musculoskeletal discomfort occurrence among electronic workers in Thailand.

2. Method

A cross-sectional survey was completed by 321 electronic workers. All the participants are general workings involved in packaging and assembly process. Data were collected using questionnaires including demographical-occupational data, work characteristics, prolonged postures and movement, and self-reported musculoskeletal discomfort. A self-report consists of a body map with 10 body parts on which they were expected to identify body parts where they experience discomfort or pain in the past 12 months that had been modified from the Nordic Musculoskeletal Questionnaires (Kuorinka et al., 1987). The participants were asked to circle the sites of discomfort on the body map by the question: In the past 12 months, have you had any significant discomfort or pain in any of following body parts which interfered with your usual activities? The participants took about 30-45 minutes to fill in the questionnaire. The identification of ergonomic hazards was based on accidental sampling in all departments in a large electronic factory (7 departments), Navanakorn Industrial Estate, Thailand from 3 December 2015 to 13 March 2016. This study was conducted in agreement with the management of the company and the participants took part in a voluntary manner. there were assured that the data collected would be handled confidentially. Descriptive and binary logistic regression statistics were used to identify ergonomic hazards of reported musculoskeletal discomfort. Odd ratios (OR) were also reported with the 95% confidence interval (95% CI). The level of significance was set at 0.05.

3. Results

Demographic characteristics of the participants are presented in Table 1. The majority were men (71.40%) with average age of 32.09 years (S.D. = 8.38). These workers had been working in the present electronic factory for an average of 7.76 years (S.D. = 8.20). Majority of the workers had been training related health and safety (95.01%). Work characteristics, highlights the workers reported usually working time in a standing posture (74.15%), followed by sitting posture (25.85%), and prolonged working time average of 52.06 minute (S.D. = 2.64). It has been also found that manual material handling was a common task (86.90%) with average weight 8.33 kg. (S.D. = 7.13).

3.1 Prevalence of musculoskeletal discomforts among Electronic Workers

The prevalence of musculoskeletal discomforts in the past 12 months at least one body part was 76.80%. The most three high prevalence were found at low back (51.40%), followed by lower leg (50%) and shoulder (44%) in Table 2

3.2 Identification of ergonomic hazards on musculoskeletal discomfort among electronic workers.

The major ergonomic hazards exposure in this study found that standing posture was significantly associated with the occurrence of musculoskeletal discomfort (OR=3.75; 95% CI = 1.84-16.66, p<0.05). However, no significant association was found between the demographic factors, another work characteristics and musculoskeletal discomfort in Table 3.
### Table 1 Demographic and work characteristics of the electronic workers (n=321)

| Variables | Frequency | Percentage |
|-----------|-----------|------------|
| Gender    |           |            |
| Men       | 229       | 71.40      |
| Women     | 92        | 28.60      |
| Age (Years) |         |          |
| < 30      | 91        | 28.40      |
| 30-40     | 171       | 53.20      |
| > 40      | 59        | 18.40      |
| Age, Mean ± SD | 32.09 ± 8.38 years |
| Work experience |       |          |
| 1-2       | 145       | 45.20      |
| > 2-5     | 43        | 13.40      |
| > 5-10    | 45        | 14.00      |
| > 10      | 88        | 27.40      |
| Work experience, Mean ± SD | 7.76 ± 8.20 years |
| Training |           |            |
| Yes       | 305       | 95.01      |
| No        | 16        | 4.99       |
| Work characteristics |       |          |
| Manual material handling (MMH) |       |          |
| Yes       | 279       | 86.90      |
| No        | 42        | 13.10      |
| MMH, Mean ± SD | 8.33 ± 7.13 kg. |
| Prolonged working time (minute) |       |          |
| Mean ± SD | 52.06 ± 2.64 minute |

### Table 2 Prevalence of musculoskeletal discomfort in the past 12 months among electronic workers (n=321)

| Body parts | Prevalence |
|------------|------------|
| Whole body |            |
| Yes        | 247        | 76.80      |
| No         | 74         | 23.20      |
| 1. Neck    | 38         | 11.83      |
| 2. Shoulder| 141        | 44.00      |
| 3. Upper arm | 15    | 4.80       |
| 4. Upper Back | 48     | 15.00      |
| 5. Lower back | 164   | 51.40      |
| 6. Lower arm | 126     | 39.30      |
| 7. Wrist/Hand/Finger | 15     | 4.80       |
| 8. Upper leg | 65      | 20.50      |
| 9. Lower leg | 160     | 50.00      |
| 10. Ankle/ Foot/Toes | 34    | 10.70      |

### Table 3 Identification of ergonomic hazards on musculoskeletal discomfort among electronic workers (n=321)

| Ergonomic hazards      | Musculoskeletal discomfort |
|------------------------|---------------------------|
| Work experience (yr)   | Adjusted Odd Ratios       | 95% CI       |
| 1-2                    | 1                         | 1            |
| > 2-5                  | 0.30                      | 0.03-2.74    |
| > 5-10                 | 2.20                      | 0.30-3.80    |
| > 10                   | 0.22                      | 0.18-2.80    |
| Training               | 0.90                      | 0.83-0.96    |
| Manual material handling | 0.94                    | 0.10-8.49    |
| Standing               | 3.75                      | 1.84-16.66*  |
| Sitting                | 1.13                      | 0.63-2.08    |

* Significant at p<0.05, Age, gender, alcohol, smoking, and exercise were used as confounders in the logistics regression analysis
4. Conclusion

It can be concluded from the study that the prevalence of MSDs among electronic workers is found high. The study revealed that prolonged standing has led to musculoskeletal discomfort among electronics workers, especially in the lower back and lower leg regions. Therefore, work re-design should provide short breaks every hour and muscular stretching to reduce MSDs. Improvement of working condition is recommended in the study to prevent high risk activities at specific complained body parts.

The results of this study revealed high prevalence on musculoskeletal discomforts when operating electronic tasks. These prevalence rates are similar to some studies have demonstrated that electronic workers were at risk of MSDs (Aziz et al., 2015; Chandrasakaran et al., 2003; Lu et al., 2016). The current study illustrated that the majority of the workers had lower back, followed by lower leg and shoulder regions discomfort. Prolonged standing has been identified as an ergonomic risk factor for body discomfort among electronic workers in this study. This has also been revealed by previous studies (Chandrasakaran et al., 2003; Chee et al., 2004; Tissot et al., 2009). Therefore, working process and posture of workers in part packaging and assembly should be investigated for related musculoskeletal discomfort. Prolonged tasks duration at static posture has been identified as major risk factors. It can be recommended that introduction of regular break of short duration after an hour will introduce flexibility into operations and alter working postures, thereby reducing the possibility of musculoskeletal disorders or injuries occurring. Although this interruption might reduce active time, the reduction in fatigue occurrence will lead to increased productivity and save cost associated with treatment of MSDs and loss man-hour (Aziz et al., 2015). Although there are no associated between worker characteristics, work duration, manual material handling, and musculoskeletal discomfort but several studies reported that these factors have been identified as one of the potential hazards in industrial sectors which create an inherent risk for musculoskeletal injuries (Chandrasakaran et al., 2003; Chee et al., 2004; Sarkar et al., 2016).

For this reason, the current study suggested that tasks involving prolonged standing need to be evaluated and resigned so as to minimize the risk of MSDs. Ergonomic risk assessments should be conducted in order to reduce the prevalence of musculoskeletal problems in their workplace. Ergonomic improvements can be in consideration.

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