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MUSCULOSKELETAL DISCOMFORT AMONG WORKERS IN MOULD MAKING MANUFACTURING INDUSTRY

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ABSTRACT

Mould making industry is a manufacturer and designer for various kinds of mould such as commodity mould, packaging mould and furniture mould for other manufacturing processes. Due to the mould manufacturing process, a workers are exposed to the risks of upper limb disorders such as repetitive tasks, uncomfortable work postures and carry out work for long periods without break. Therefore, the main objective of this study was to identify the prevalence of work-related musculoskeletal disorders among the employee at mould making manufacturing industry. Structured interview using Cornell Musculoskeletal Discomfort Questionnaires (CMDQ) were conducted over 35 workers in mould making industry in which the age range was from 23 to 38 years (mean 28.54 ± 4.22 years) while working experience ranges from 1 to 11 years (mean 4.31 years ± 3:09). The results shows that workers in the mould making industry were exposed to ergonomic risk of experiencing discomfort in the upper part of the body such as neck, back body, forearm and wrists that involves an iterative process on a regular basis and work in awkward postures. As a conclusion, this study can be a useful references to ergonomists, researchers, OSH practitioners and others concerned to identify the prevalence of work-related musculoskeletal disorders in the workplace, especially in the mould making industry and other manufacturing industries.

Keywords: musculoskeletal disorders, discomfort, mould manufacturing industry.

INTRODUCTION

Mould making industry is a manufacturer and designer for various kinds of mould such as commodity mould, packaging mould and furniture mould for other manufacturing processes (Canis, 2012). Mould is a commonly term used to describe the equipment for producing plastic parts in the mould (Taylan *et al*. 2001). In addition, mould is indispensable tool in mass production because it represents a vital link in the chain of production of discrete parts for various industries (Lyu *et al*. 2006).

Mould manufacturer by two main methods: conventional machining and modern machining. Conventional machining processes is the process by using several types of machines such as lathe machine, milling machines and grinding machines Modern machining process refers to machining via Electrical Discharge Machine (EDM) and Computer Numerical Control (CNC) (Amorim & Weingaretner, 2004).

Due to the mould manufacturing process, a worker can expose to the risk of Upper Limb Disorders (ULDs) (Pourmahabadian *et al*. 2006). It was found that the risk of ULDs are associated with various risk factors such as repetitive tasks, uncomfortable work postures and carry out work for long periods without breaks (Graves *et al*. 2004). Work that requires activities involved repetitive movements of the upper limbs such as shoulder, neck, and arms is common in the manufacturing sector (Solidaki *et al*. 2010). This type of activity involved the upper limb is called repetitive work or work cycles consisting of a sequence of tasks (Danuta *et al*. 2004). Therefore, the main objective of this study was to identify the prevalence of work-related musculoskeletal disorders (WRMDs) among the employee at mould making industry.

MATERIALS AND METHODS

Questionnaire Survey

The questionnaire is a "tool" used to gather and obtain information on knowledge, specific issues of importance by respondents (Bird, 2009). It should always have a purpose related to the objectives (Hawkes & Rowe, 2008). This study was using the Cornell Musculoskeletal Discomfort Questionnaires (CMDQ) (Hedge, 1999). It consists of three parts, namely personal information, job tasks and other information as well as the body discomfort checklist. Part 1 is about the personal information of respondents who participated in this study and it is a general questions related to the age, sex, weight and height.

In Part 2 discussed the common activities performed by workers involving repetitive processes, the type of task being performed, breaks and other information such as awareness of health and safety rules as well as environmental factors. This section focuses on student opinions and proposals in the workplace. The purpose of this section is to suggest how to improve performance in the workplace and it is an open-ended questions. Part 3 is used to study the discomfort assessment of symptoms or discomfort experienced by workers. CMDQ can be used to make assessments of musculoskeletal disorders. The purpose of this questionnaire is to document whether there is a trend in discomfort, pain and injury among workers in mould making industries (Janson *et al*., 2010).

Data collection

Questionnaire were distributed to employees in the mould making industry during a site visit. Interviews were conducted with the respondents to obtain feedback on the frequency of discomfort following a liker scale from 0 (no) to 10 (several times a day) and the level of discomfort from 1 (little uncomfortable) to 3 (very uncomfortable). In addition, the level of discomfort affect the work from 1 (no interference) to 3 (significant interference with the work). Total score discomfort calculated using the formula: Score = frequency of discomfort × level of discomfort caused disruption to the work (Jansen *et al*., 2012). The format of the questionnaire for this study was a combination of open-ended questions (Reja *et al*., 2003). Respondents would give their comments on both positive and negative aspects of their works in the workplace. They are also encouraged to give some recommendations to resolve any problems encountered. Figure-1 shows the flow chart of the questionnaire survey.

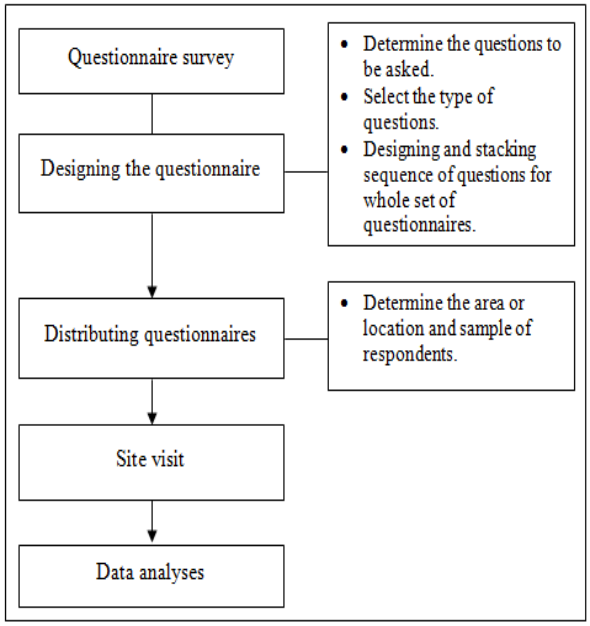


Figure-1. Flow chart of questionnaire survey.

Data analysis

After collecting data through questionnaires, the results of CMDQ were analyzed using Statistical Package for Social Sciences (SPSS) Version 16. Descriptive statistics were obtained and the frequency distribution, mean and standard deviation were also be calculated.

RESULTS AND DISCUSSION

Personal information

The sample of this study consisted of all men and the age range was from 23 to 38 years (mean 28.54 ± 4.22 years) while working experience ranges from 1 to 11 years (mean 4.31 years ± 3:09). Mean (± Standard Deviation) height and weight of the study was 168.15 ± 4.2 cm, 65.85 ± 8.31 kg. Range for height was 163 to 173 and the weight was from 53 to 78. Table-1 shows the personal information of respondents in the mould making industry involved in the survey.

Table-1. Personal information of respondents in mould making industry.

Personal Details	Mean	SD	Range
Age (years)	28.54	4.22	23-38
Working Experience (years)	4.31	3.09	1-11
Height (cm)	168.15	4.2	163-173
Weight (kg)	65.58	8.31	53-78

Job tasks and others information

A total of 76.9% of respondents doing the same job for a long while 10.23% did not carry out work on the long term. In addition, 100% of respondents said that the work done involves an iterative process. 84.62% of respondents said that much of their work at the same place and 15.38% of the respondents are not. Four different tasks such as boring process, tapping process, grinding process and milling process were selected in this study (Figure-2).

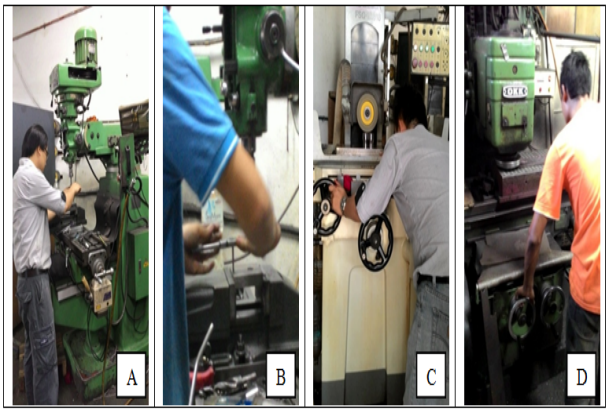


Figure-2. Different tasks in moulding manufacturing industry; (a) boring process; (b) tapping process; (c) grinding process and (d) milling process.

The results obtained from this study show that a total of 13 (100%) of respondents would carry on the work interminable threaded screws, 11 (84.62%) respondents for grinding work, 8 (61.53%) to work bore and 3 (23.08%) for grinding work. Table-2 shows the analysis of questionnaires for work assignments and others information.

Table-2. Job tasks and others information.

No.	Questions	Category	No. Respondents	Percentage (%)
1	Break time	1 time	13	100
		2 times	0	0
		> 2 times	0	0
2	Resting time	30 min	0	0
		1 hours	13	100
		> 1 hours	0	0
3	Do you carry out the same work for a long period	Yes	10	76.90
		No	3	23.10
4	Do you carry your work mostly at the same workplace	Yes	11	84.62
		No	2	15.38
5	Does the work rotate between you and your colleagues	Yes	0	0
		No	13	100
6	Does your work involve mainly repetitive task many times a minute	Yes	13	100
		No	0	0
7	Are you going back to work after a break	Yes	0	0
		No	13	100
8	Do you find your current workplace safe and secured	Yes	13	100
		No	0	0
9	As a worker, do you know and understand about safety & health rules and guidelines	Yes	13	100
		No	0	0
10	Does your workplace have enough space for easy movement and emergency exit	Yes	13	100
		No	0	0
11	Are there any environment factors that affect your work productive	Temperature	13	100
		Noise	9	69.23
		Humidity	5	38.46
		Wind	8	61.54
12	Job tasks	Boring	8	61.53
		Tapping	13	100
		Grinding process	11	84.62
		Milling process	3	23.08
		Turning process	0	0

Musculoskeletal discomfort survey for task 1

Task 1 known as a boring process. Boring process is a reamer operations that have been drilled in advance. Based on the total score of the discomfort from CMDQ (Figure-2), it was found that workers in the mould making industry are exposed to discomfort in the upper part of the body, especially in the wrist (21.22%), forearm (12.42%), upper arm (2.38%), neck (4.21%) and shoulder (3.06%). A total of 11.06% of respondents felt uncomfortable in the lower back and 2.67% on the upper back. Meanwhile, only a little amount of discomfort in the lower limbs such as the thigh (1.88%), knee (0.03%) and leg (0.03%).

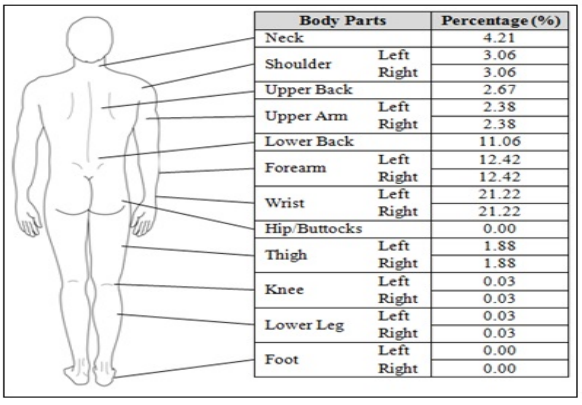


Figure-2. Musculoskeletal discomfort survey for Task 1.

Musculoskeletal discomfort survey for task 2

The second task often carried out in the mould making industry known as a tapping process. Tap is a type of hand tools used to create threads in a threaded screw holes drilled as an example nut (Hardik *et al*., 2012). The total score discomfort for Task 2 was shown in Figure-3, where about 19.55% of respondents feel uncomfortable or pain in the wrists and 13.67% on the forearm when carrying out this process. 12.42% of respondents felt uncomfortable at the lower back the rear and 8.71% in the neck. In addition, only 1.63% of respondents reported discomfort in the shoulder and 1.64% on the upper arm. Discomfort in the lower part of the body is little where only 1.74% in the thigh, knee (0.06%) and lower leg (0.17%).

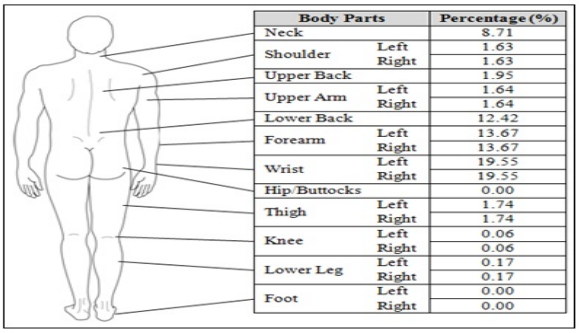


Figure-3. Musculoskeletal discomfort survey for Task 2.

Musculoskeletal discomfort survey for task 3

Task 3 known as a grinding process. This process is often carried out after machining or boring process to obtain a finishing or smooth surface. The scores of discomfort from Task 3 (Figure-4) shows that 97.22% of respondents reported discomfort in the upper part of the body such as the wrists (23.70%), forearm (11.80%), neck (7.98%) and lower back (9.92 %). A small amount of discomfort reported in the shoulder (1.20%), upper back (2.01%) and upper arm (1.96%). In addition, respondents also felt a little discomfort in the thigh (0.85%), knee (0.27%), leg (0.15%) and foot (0.12%) when performed the grinding process.

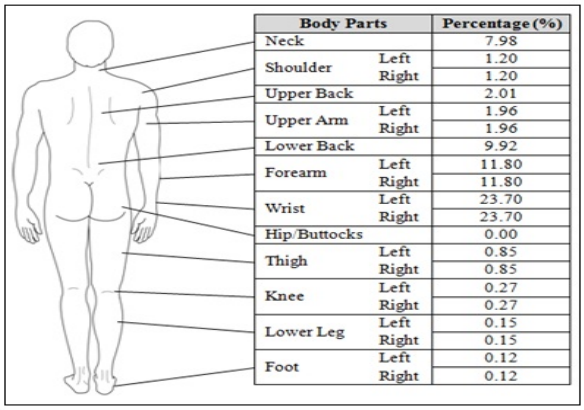
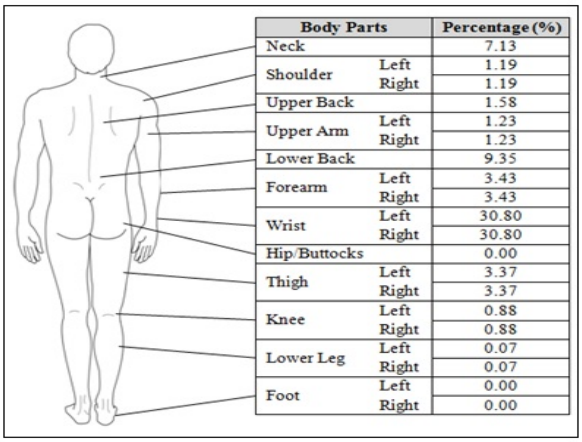


Figure-4. Musculoskeletal discomfort survey for Task 3.

Musculoskeletal discomfort survey for task 4

Task 4 known as a milling process. Milling is the process in which various forms of metal machined to the desired shape or to get a flat surface (Mennig & Stoeckhert, 2013). From the Figure-5, about 30.8% of respondents felt uncomfortable at wrists and 9.35% on lower back. In addition, a slight discomfort in the neck (7.13%), forearm (3.37%), upper arm (1.23%) and shoulder (1.19%) were reported for the milling process. A total of 8.62% discomfort reported at the lower part of the body such as thigh (3.37%), knee (0.88%), and leg (0.07%) during the milling process.



Body Parts		Percentage (%)
Neck		7.13
Shoulder	Left	1.19
	Right	1.19
Upper Back		1.58
Upper Arm	Left	1.23
	Right	1.23
Lower Back		9.35
Forearm	Left	3.43
	Right	3.43
Wrist	Left	30.80
	Right	30.80
Hip/Buttocks		0.00
Thigh	Left	3.37
	Right	3.37
Knee	Left	0.88
	Right	0.88
Lower Leg	Left	0.07
	Right	0.07
Foot	Left	0.00
	Right	0.00

Figure-5. Musculoskeletal discomfort survey for Task 4.

Study limitations

Since this study design was case study, the small sample size among 35 workers in mould making manufacturing industry have been conducted. This sample size is considered to be adequate according to Diem (2012) for such survey. Therefore a larger sample size is needed for the cross sectional study and others that related to compare between industry sectors.

CONCLUSIONS

These results shows that workers in the mould making industry exposure to ergonomic risks of experiencing discomfort in the upper part of the body such as neck, back body, forearm and wrists that involves an iterative process on a regular basis and work in awkward postures. The results obtained from this study can be a useful references to ergonomists, researchers, OSH practitioners and others concerned in order to identify prevalence of work-related musculoskeletal disorders in the workplace, especially in the mould making industry and other manufacturing industries.

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