WORK-RELATED MUSCULOSKELETAL DISORDERS (WMSDs) COMPLAINTS AMONG WORKERS AT ALUMINIUM SMELTING COMPANY AT BUKIT RAJA, KLANG

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OPEN UNIVERSITY MALAYSIA

2018

ABSTRACT

The main objective of this study is to know WMSDs complaints among workers at Daiki Aluminium Industry (M) Sdn. Bhd. in various body regions. The data were obtained from Nordic Questionnaire distributed among the staffs and self-construct demographic questionnaires. It was carried out in 2 months from early June 2018 until end of July 2018 at Daiki Aluminium Industry (M) Sdn. Bhd. Out of total 84 staffs, the questionnaires were distributed to only 35 – 50 respondents and received from 40 respondents. The prevalence of musculoskeletal disorder in 14 anatomical areas of the body regions (lower back, upper back, neck, hands and wrist, shoulders, upper arms, elbow and forearm, stomach, chest, upper legs, knees, lower legs, ankles and feet) were evaluated. This study found that 38 out of 40 respondents (95%) had experiences WMSDs in at least one body region. The most common areas generally are at lower back (52.5%), upper back (47.5%) and feet (37.5%). As a conclusion, this study confirmed that workers of Daiki Aluminium Industry (Malaysia) Sdn. Bhd. suffered from various types of WMSDs due to ergonomic risk factors such as repetitive, force, awkward posture, long duration exposure, vibration and workstation design. Therefore, improvement plan need to develop at the workplace to reduce the WMSDs symptoms and effects towards the workers and to be a better workplace. Indirectly can improve productivity and reduce medical cost of the company.

ABSTRAK

Objektif utama penyelidikan ini adalah untuk mengetahui tentang aduan yang berkaitan dengan WMSDs di kalangan pekerja di Daiki Aluminium Industry (M) Sdn. Bhd. di beberapa bahagian badan mereka. Dapatan maklumat adalah daripada Nordic Questionnaire dan demographic questionnaire yang direka sendiri dan diedarkan dikalangan pekerja-pekerja. Penyelidikan ini dibuat dalam tempoh masa 2 bulan iaitu daripada Jun 2018 sehingga Julai 2018 di Daiki Aluminium Industry (M) Sdn. Bhd. Daripada sejumlah 84 pekerja, soalan kaji selidik telah diedarkan kepada 35 – 50 orang responden dan mendapat pulangan semula daripada 40 responden sahaja. Penilaian telah dilakukan di kelaziman gangguan musculoskeletal pada 14 bahagian anatomi badan (bawah belakang, atas belakang, leher, tangan, bahu, lengan, siku, perut, dada, kaki atas, lutut, kaki bawah, buku lali dan kaki). Penyelidikan ini mendapati dari 40 responden, 38 daripadanya menghadapi WMSDs pada sekurang-kurangnya satu bahagian badan. Bahagian badan yang biasa menghadapi WMSDs dikalangan pekerja adalah bahagian bawah belakang badan (52.5%), bahagian atas belakang badan (4.5%) dan kaki (37.5%). Kesimpulannya, penyelidakan ini mengesahkan bahawa pekerja di Daiki Aluminium Industry (Malaysia) Sdn. Bhd. menderita dengan beberapa jenis WMSDs disebabkan oleh faktor risiko ergonomic seperti kerja yang berulang, paksaan, postur badan yang janggal, pendedahan yang terlalu lama, getaran dan juga rekabentuk tempat kerja. Oleh sebab itu, pelan penambahbaikan perlu dilakukan untuk mengurangkan gejala WMSDs dan kesannya kepada pekerja serta memastikan tempat kerja yang lebih baik. Secara tidak langsung, dapat meningkat produktiviti dan mengurangkan kos perubatan yang dihadapi oleh pihak syarikat.

ACKNOWLEDGEMENT

I would like to express my deepest appreciation to all those who provided me the possibility to complete this project paper.

A special gratitude and appreciation to my supervisor, Mr. Safial Eqbal Bin Zakaria for his guidance, encouragement, helped and invaluable advice to me throughout this project.

Furthermore I also would like to acknowledge with much appreciation to my family especially my father Amir Husin Bin Mat Ali, my mother Siti Jaleha Binti Ahmad, my beloved wife Noorlelawati Binti Zakariya, my daughters Damia, Delisya and Dafynah for their endless support and invaluable assistances and co-operation.

Not forget a special thanks to my Managing Director at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. Mr. Shogo Izu and all fellow colleagues for their co-operation and support to answer and give feedbacks on the questionnaire distributed to them.

Finally many thanks to friends for their support and assistance whenever I face problems. Without the mentioned parties, it is impossible for me to complete this project report successfully.

THANK YOU.

MOHD. ROSLI BIN AMIR HUSIN

Aug, 2018

TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 Background of the Study

Work-related musculoskeletal disorders (WMSDs) can considered as work related when aches and pains in the body region such as neck, shoulders, back, arms etc. are associated with physical strain in these body areas during the course of work and at the same time no other visible sign of general illness is affecting the musculoskeletal system.

Work-related musculoskeletal disorders (WMSDs) statistics in Great Britain for year 2017 shows 507,000 workers suffering from WMSDs and it is equal to 8.9 million working days lost due to this in 2016/2017. The major affected area is upper limbs or neck which is 229,000 workers and equal to 45%. The next affected area is backs by 194,000 workers which is 38% out of total affected area and lastly is lower limbs area which is 17% contribution and equal to 84,000 workers. The most contribution industry is come from construction industry and followed by agriculture, forestry and fishing industry. Musculoskeletal disorders can affect muscles, joints and tendons in all parts of the body. They can be episodic or chronic in duration and can also result from injury sustained in a work-related accident. These disorders are seldom life threatening but they impair the quality of life of a large proportion of the adult population. WMSDs are associated with work patterns including fixed or constrained body positions, continual repetition of movements, force concentrated on small parts of the body such as hand and wrist and a pace of work that does not allow sufficient recovery between movements. Psychosocial factors such as organizational culture, the health and safety climate and human factors may also create the conditions for WMSDs to occur (HSE, 2017).

Musculoskeletal conditions comprise more than 150 diagnoses that affect the locomotor system including muscles, bones, joints and associated tissues such as tendons and ligaments. They range from those that arise suddenly and are short-lived such as fractures, sprains and strains; to lifelong conditions associated with ongoing pain and disability (WHO, 2018). Musculoskeletal conditions are typically characterized by pain and limitations in mobility, dexterity and functional ability, reducing people's ability to work and participate in

social roles with associated impacts on mental wellbeing, and at a broader level impact on the prosperity of communities. The most common and disabling musculoskeletal conditions are back pain, neck pain, muscle pain and fractures associated with bone fragility.

According Canadian Centre for Occupational Health and Safety (2014), WMSDs are a group of painful disorders of muscles, tendons, and nerves. Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome are the examples. In 1997, the Centers for Disease Control and Prevention's (CDC) National Institute for Occupational Safety and Health (NIOSH) released a review of evidence for WMSDs. Example of work conditions that may lead to WMSDs include routine lifting of heavy objects, daily exposure to whole body vibration, routine overhead work, work with the neck in chronic flexion position, or performing repetitive forceful tasks.

1.2 Problem Statement

Work-related musculoskeletal disorders are one of the major concerns among employers not only because of the health effects on the employees but also because of their business performances and costs. In United State WMSDs are the single largest categories of workplace injuries and are responsible for almost 30% of all workers' compensation costs and United State companies spent 50 billion dollars on direct costs on WMSDs in 2011 (Matt Middlesworth, 2016). MSDs are reported by persons in the U.S more than any other health problems. In 2004, the estimated total cost of treatment and lost wages related with MSDs was $849 billion which is equal to 7.7% of the gross domestic product of U.S. (Accurate Ergonomics, 2013).

Standing and sitting are common work postures. Usually, manufacturing industry prefer standing posture due to mobility of legs and large degree of freedom (Tissot et al., 2005). Tissot et al. also mentioned that working posture is a determinant of musculoskeletal and vascular health. WMSDs may be caused by mechanical (physical) exposure at work while psychosocial factors at work may in themselves cause pain or modify the perceived pain level caused by the mechanical exposure (Winkel et al., 2008).

In industrialized countries, about one-third of all health-related absences from work are due to musculoskeletal disorders of which pain in lower back, neck, shoulder and knee regions accounted for the largest proportion of the problem (Treaster and Burr, 2004).
Continuous exposure to a combination of ergonomic risks can lead to WMSDs, decreased productivity, increased job stress and absenteeism (Torma et al., 2008).

The statistical report of health and safety at work in Europe stated that WMSDs problems encountered for 60% of work-related health problems in 2007. WMSDs accounted for 33% of all workplace injuries and illness requiring days away from work in the USA in 2011 (USA Dept. Of Labor, 2012). Annual report from the National Institute for Occupational Health in South Africa proposes that WMSDs are among the most commonly reported illness in the working population (NIOSH,2008).

In Malaysia, according to accident statistics reported by the Social Security Organization (SOCSO), the number of accidents related to musculoskeletal diseases increased from 961 cases in 2010 to 1719 cases in 2016. These are for both number of invalidity and survivors' cases reported to SOCSO. Industries suffer from tangible and intangible losses because of increased medication costs, decreased productivity, work quality and decreased worker morale.

Daiki Aluminium Industry (Malaysia) Sdn. Bhd. is a company that manufacturing and marketing of secondary aluminum alloy ingots and supplies it to Japanese company and others in Malaysia and also ASEAN countries. It was established in November 1988. This is Japanese company that based in Osaka, Japan. It is located and Kawasan Perindustrian Bukit Raja, Klang. As a company that produces secondary aluminum alloy ingots, Daiki Aluminium Industry (Malaysia) Sdn. Bhd. received a lot of complaints regarding WMSDs among the workers. So many reports received among workers regarding ergonomic problems that bordering them and affect their health and also productivity. Most of the activities at factory are about heat, lifting heavy and huge scrap items, stacking the finished goods and driving forklift. Manual tasks are a major source of hazards and problems for worker at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. Tasks which are performed manually constitute a considerable proportion of work done in this company. In year 2017, medical cost for the employees raised up to RM120,000 per year. Summary received from Human Resource Department, most of the illnesses reported are back pain, muscles pain, body pain, ligaments and tendons problem etc. and it is mostly related with ergonomic or musculoskeletal disorders.

Major working areas at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. are working at furnace, sorting and packing area. Other areas are quality and office department. It involves a wide range of tasks such as carrying and loading scrap material to a furnace by using forklift, stirring the molten metal etc. These tasks are repetitive and the furnace is used daily for 22 to 24 hours. The furnace temperature is about 650 ~ 850°C. Workers also lift the

scrap material and stir it into molten metal by using forklift which involve with high vibration continuously.

Sorting area involve of task that need workers to loading and carrying the scrap material manually. They have to sort many types of scrap material and segregate it according to correct type. This task involve of combined with twist, bend and awkward posture that can contributing to WMSDs and also force to carry huge scrap material manually.

While at packing area, workers need to do the same movement repetitively to tie the finished goods which is aluminum ingots. At the same times, workers also need to bend their body due to height of finished goods only 700mm from the ground which is lower than their hands level. Workers need to tie the ingots from bottom to top for each edge of ingot bundle for one round and this process also require workers to bend their body.

For Quality department, the workers task mainly operating a lathe machine to cut aluminium sample from furnace and check it at spectrometer machine. The process need the workers to standing in long duration and need to bend their body forward. As for office staff, they need to climb stairs for at least one floor up to go to the main office. They also need to travel from main office to production office which located at different building.

1.3 Research Objective

The objectives of the study are:

1. To investigate the symptoms of WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
2. To determine relationship between age and WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
3. To determine relationship between gender and WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
4. To determine relationship between working area and WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
5. To propose effective action plan, improvement and also training.

1.4 Research Questions

The framework of this study is based on the research questions below:

1. What is the relationship between symptoms of WMSDs and Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers?

2. What is the relationship between WMSDs and age among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers?
3. What is the relationship between WMSDs and gender among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers?
4. What is the relationship between WMSDs working area among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers?

1.5 Hypothesis

Null Hypothesis:

1. There is no relationship between age of workers with the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
2. There is no relationship between gender of workers with the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
3. There is no relationship between working area with the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.

1.6 Scope of Study

The scope of study involved employees of Daiki Aluminium Industry (Malaysia) Sdn. Bhd. The study conducted among 84 people of Daiki Aluminium Industry (Malaysia) Sdn. Bhd. employees. The job ranking of employees to examine is between level operators up to General Manager. The research area covers all including furnace, sorting, maintenance, quality, packing and as well as office areas. This study will gather information from the activities conducted by employees at all locations and to be done through questionnaires.

1.7 Significance of Study

Rapid increase in WMSDs accidents among employees all over the world and especially in Malaysia are the major concern to all employers and as well as for employees. Not only because of health effects to the employees but also because of economic impact to the businesses and industries. This study will benefit the employer, workers and also community. It can be as a reference to make an adjustment and improvement in order to reduce or eliminate WMSDs.

No study has been conducted at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. related with WMSDs before. Therefore this study will beneficial to management of Daiki Aluminium Industry (Malaysia) Sdn. Bhd. and also all employees as a guideline for them to

facilitate the best for employees in order to reduce or eliminate WMSDs. The study also can find the gaps which can improve current process flow to fully comply with company policy and procedure.

Ergonomic is important to practice at workplace to ensure quality, productivity and also health among the employees. If ergonomic culture is apply at workplace, it can decrease number of accidents, injuries, illnesses and also medical cost. It can be beneficial for both parties at one company which are the employers and employees. This research purposely is to identify daily tasks or activities that raise WMSDs problems among employees at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. What type of tasks that bordering them much until can cause WMSDs. And to find the better solutions to prevent the problems from happen again.

1.8 Definitions of Terms

Work-Related Musculoskeletal Disorders (WMSDs)

WMSDs are a group of painful disorders of muscles, tendons, and nerves. Carpal tunnel syndrome, tendonitis, thoracic outlet syndrome, and tension neck syndrome are examples. (Canadian Centre for OSHA, 2018).

Ergonomic Risk Factor

The risk factors for WMSDs are work postures and movements, repetitiveness, force of movements, vibration, temperature, lack of influence or control over one's job, increase pressure, lack of poor communication, monotonous tasks and perception of low support (Canadian Centre for Occupational Health & Safety, 2018). Risk factor related with WMSDs include awkward posture, repetition, material handling, force, mechanical compression, vibration, temperature extremes, glare, inadequate lighting and duration of exposure (Centers for Disease Control and Prevention, 2016)

CHAPTER 2

LITERATURE REVIEW

2.1 Previous Study

Every year workers' low-back, hand, and arm problems lead to time away from jobs and reduce the nation's economic productivity. The connection of these problems to workplace activities-from carrying boxes to lifting patients to pounding computer keyboards-is the subject of major disagreements among workers, employers, advocacy groups, and researchers. Musculoskeletal Disorders and the workplace examine the scientific basis for connecting musculoskeletal disorders with the workplace, considering people, job tasks, and work environments (National Research Council (U.S.), 2001). WHO recognizing the impact of WMSDs diseases, has characterized WMSDs as a multifactorial, indicating that a number of risk factors contribute to and exacerbate these maladies (Sauter et al. 1993). The presence of these risk factors produced increases in the occurrence of these injuries of the soft tissues are referred to by many names, including WMSDs, repetitive strain injuries (RSI), repetitive motion injuries (RMI), and cumulative trauma disorders (CTDs) (McCauley Bush, 2011). WMSDs are diseases related and/or aggravated by work that can affect the upper limb extremities, the lower back area, and the lower limbs. WMSDs can be defined by impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves, bones and the localized blood circulation system, caused or aggravated primarily by work itself or by the work environment (Nunes, 2009). Some disorders were identified by names related with the professions where they mainly occurred, for instance ‘carpenter’s elbow’, ‘seamstress’, ‘wrist’ or ‘bricklayer’s shoulder’, ‘washer woman’s sprain,’ ‘gamekeeper’s thumb,’ ‘drummer’s palsy,’ ‘pipe fitter’s thumb,’ ‘reedmaker’s elbow,’ ‘pizza cutter’s palsy,’ and ‘flute player’s hand’ (Putz-Anderson, 1988) (Mandel, 2003). WMSDs are defined as impairments of bodily structures such as muscles, joints, tendons, ligaments, nerves, bones or a localized blood circulation system that are caused or aggravated primarily by the performance of work and by the effects of the immediate environment where work is carried out (Zinta et al, 2008).

2.2 WMSDs Related With Furnace / Foundry Workers

Workers handling casting, hot core and molten metal suffer from traumatic injuries and burns because of inadequate personal protective equipment and poor work practices (Zakaria, 2005). The reasons of a high prevalence of WMSDs among the foundry workers are awkward work postures, lifting heavy loads and carrying loads for a long distance. The foundry industry operates by processes that combine strictly manual activities and pro-semi-automated processes, rare in the production line. There is a large share of manual labor in the processing of parts. Many of these activities are extremely repetitive, monotonous and performed in intense rhythms. These are activities carried out under extremely painful, which explain the high incidence of repetitive strain injury (RSI) (Arthur et al. 2012). The study done by Rohit Sharma and Ranjit Singh (2015), showed a high prevalence of WMSDs among foundry workers. The male workers were more prone to pain in neck while the female workers were more prone to WMSDs in upper back and shoulders. From the result proved that the work-related WMSDs are the results of interaction of multiple stressors associated with work and work environment and other personal factors.

2.3 WMSDs Related With Gender

WMSDs occur in relation to ergonomic exposures both in men and women. More research is needed to elucidate whether MSD risk varies between women and men in jobs with the same occupational exposures, and whether WMSDs have the same outcomes in women and men. Women often report WMSDs more frequently than men; however, this difference appears to be less marked for low back disorders and when men and women are compared within homogenous job groups. However, some studies suggest that men may have higher risk than women with increasing exposure to physical stressors, although women have a higher background risk. This may mean that other factors have a greater effect on women in low-exposure jobs and are less important when there is high physical loading, or because women with higher occupational exposures are more likely than men to leave employment or change jobs due to WMSDs (Marlene et. al, 2000). Some studies have found a higher significant of some WMSDs in women (Bernard et al. 1994; Hales et al. 1994; Johansson 1994; Chiang et al. 1993). A male to female ration of 1:3 was described for carpal tunnel syndrome (CTS) in a population study in which occupation was not evaluated (Stevens et al. 1988). Hagberg and Wegman (1987) reported that neck and shoulder muscular pain is more common among females than males, both in the general population and among industrial workers. According to European Agency for Safety and Health at Work (2010), more male

workers appear to be affected by WMSDs compared with female workers. 20% of absenteeism among men was due to WMSDs. Similarly, WMSDs caused 27.9% of lost working days among men as opposed to 23.5% among women. Jose Miquel Cabecas (2006), Male workers have a risk 1.3 times higher to new medico-legal MSD diseases than female workers. Women and men are exposed to different physical hazards due to gender segregation that occurs in many sectors of job (Eurofound, 2007). This study reveals that 33% of men but only 10% women are regularly exposed to vibrations, while 42% of men and 24% of women carry heavy loads. However, according to Silverstein (1985) study of CTS among industrial workers, no gender difference could be seen after controlling for work exposure. Franklin et al. (1991) also found no gender difference in workers compensation claims for CTS. As well as Burt et al. (1990) found no gender difference in reporting neck or upper extremity MSD symptoms among newspaper employees using video display terminals.

2.4 WMSDs Related With Age

The prevalence of WMSDs increases as people enter their working years. By the age of 35, most people have had their first episode of back pain (Guo et al. 1995; Chaffin 1979). According to Buckwalter et al. (1993) musculoskeletal impairments are among the most prevalent and symptomatic health problems of middle and old age. Normally age groups with the highest rates of compensable back pain and strains are between 20 to 24 age group of men and 30 to 34 age group for women. In addition to decreases in musculoskeletal function due to the development of age-related degenerative disorders, loss of tissue strength with age may increase the probability or severity of soft tissue damage from a given insult. The European Union (EU) Agency for Safety and Health (OSHA) describe age as one of the factors that can lead to MSD. An exception to this are diseases that affect the muscles and bones, such as arthritis, which are generally age related and some occupations may exacerbate these conditions or increase the likelihood of their early onset (Olsson et al. 2004). The jobs the ageing of the workforce are also a contribution to the widespread of WMSD , since the propensity for developing a WMSD is related more to the difference between the demands of work and the worker's physical work capacity that decreases with age (Okunribido & Wynn 2010). Studied from Prasuna (2013), age of respondents showed significant positive correlation with WMSDs. As age of the respondents increased the WMSDs in the women engaged in packing activities of pharmaceutical industries increased. The young women were rarely experiencing WMSDs symptoms. The middle and old aged women were sometimes feeling the neck, shoulder, upper limb, back and over all body symptoms.

2.5 WMSDs Related With Ergonomic Risk Factors

According to NIOSH (1997) in a critical review reported that monotony, repetition, awkward posture, static posture, long duration of exposure, force, vibration, workstation design are the major workplace factors responsible for the development of WMSDs.

Repetition: A cycle time less than 30 seconds or as more than 50% of the cycle time spends performing the same fundamental motion considered as repetitive activity (Silverstein, 1985). Studies have established an association between different musculoskeletal discomfort / disorders and the repetitions of any particular task (Waters et al. 2007; Melzer et al. 2010). A study done in Germany found that MSDs due to repetitive work were common in manufacturing industries and possibly caused by ergonomic risk factor of the work environment (Spallek et al, 2010). At Daiki Aluminium Industry (Malaysia) Sdn. Bhd. repetition ergonomic risk factor can be found at Packing Department (Refer Figure 1 and 2).

Figure 1: Repetition as a risk factor

Figure 2: Repetition as a risk factor

Awkward posture: It is refer to the positions of the body (limbs, joint, back) that deviate substantially from the neutral position while tasks are being performed. Considerable

deviations from neutral posture may adversely affect muscle efficiency and predispose individuals to musculoskeletal or neurological pathologic conditions (Novak et al. 1997). Awkward posture can enhance the risk of the development of musculoskeletal disorders and are positively correlated with WMSDs (Marcus et al. 2002; Ramadan et al. 2006; Ismail et al. 2009). Awkward posture demand greater force and the greater the force required to complete a task, the greater the stress impact on muscles and tendons, resulting in musculoskeletal injuries Acutt j et al., 2011). For awkward posture situation can be found at Sorting Department at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. Refer Figure 3 and 4 for details pictures.

Figure 3: Awkward posture as a risk factor

Figure 4: Awkward posture as a risk factor

Long duration exposure: While performing the pipetting activity, the complaints of hand increased gradually with exposure time. The long hours of working showed more hand complaints (David et al. 1997). Gerr et al. (2002) observed that the computer users who had used computer for more than 15 hours per week developed more musculoskeletal symptoms in comparison to the population who were using computer for less than 15 hours per week.

According to Costa, Sarton and Akerstedt (2006) long working hours (over 8 hours) and long job duration (over 10 years) had a positive impact on the occurrence of WMSDs among women. Long duration exposure is related with Furnace Department workers at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. There are exposing to heat and standing for almost all their working times a day (Refer Figure 5).

Figure 5: Long duration exposure as a risk factor

Force: Studies have shown that exertion of high force along with some other risk factors lead to the development of musculoskeletal disorders in different body parts (Moussavi et al. 2007). Force risk factor is related with workers at Sorting Department as well at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. (Refer Figure 6 and 7).

Figure 6: Force as a risk factor

Figure 7: Force as a risk factor

Vibration: Whole body vibration (WBV) is an occupational health problem (Griffin, 2006). Musculoskeletal discomfort occurs when driving for a long duration sitting on a vibrating sit or travelling in any vibrating mode (Anderson et al. 1992; Krause et al. 1998; Chen et al. 2005: Ismail et al. 2010). Studies also shown that apart from whole body vibration, the hand arm vibration is also an important causal factor for increasing the hand arm syndrome in different activities (Mattioli et al. 2011). At Daiki Aluminium Industry (Malaysia) Sdn. Bhd. vibration risk factor directly refers to forklift driver at Furnace Department as they are using the forklift most of the times during working hours. (Refer Figure 8 for details).

Figure 8: Vibration as a risk factor

Workstation design: Studies have shown that there is a correlation between the workstation design and the musculoskeletal discomfort (Furlow, 2002; Margarita et al. 2002; Singh et al. 2006). Studies have also shown that an improvement in the workstation design can improve the output of the users (Pheasant, 1991). Workstation design directly related

with office staff and Quality Department at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. (Figure 9)

Figure 9: Workstation design as a risk factor

2.6 Theoretical Framework

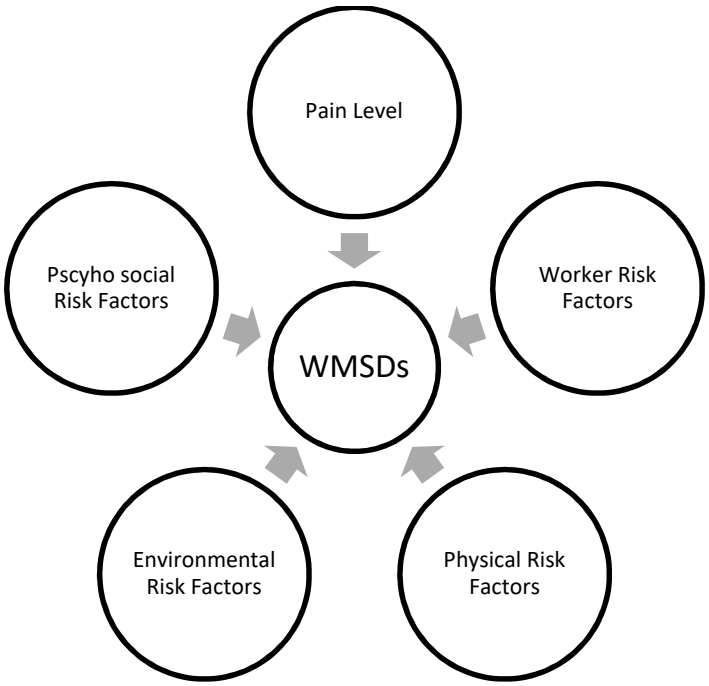

Figure 10: Theoretical Framework of WMSDs (Carlos Ignacio P. Lugay, 2017)

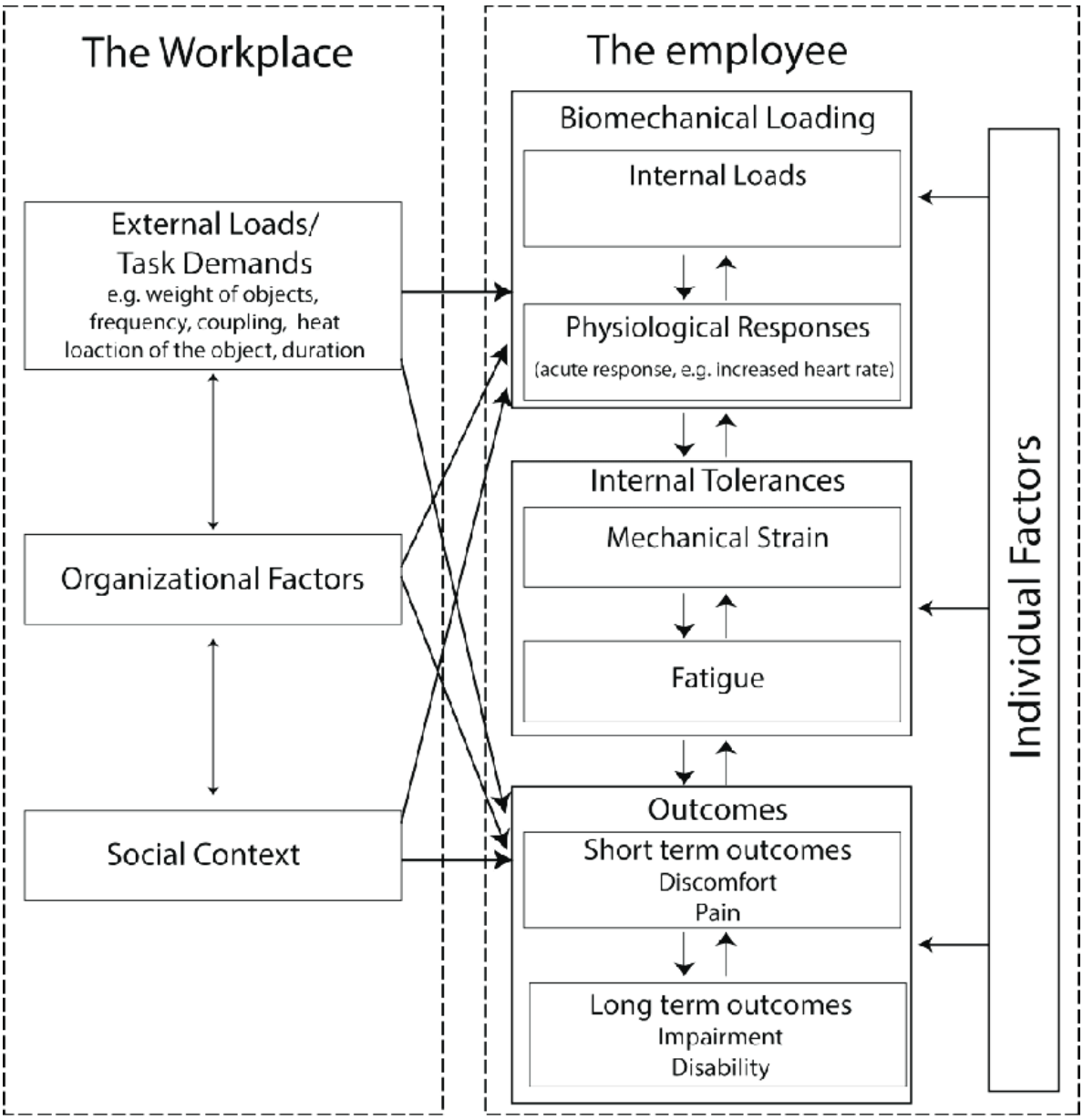

Figure 11: Theoretical model displaying the relationship between external loads and development of pain, discomfort and WMSDs (Carl Lind, 2017)

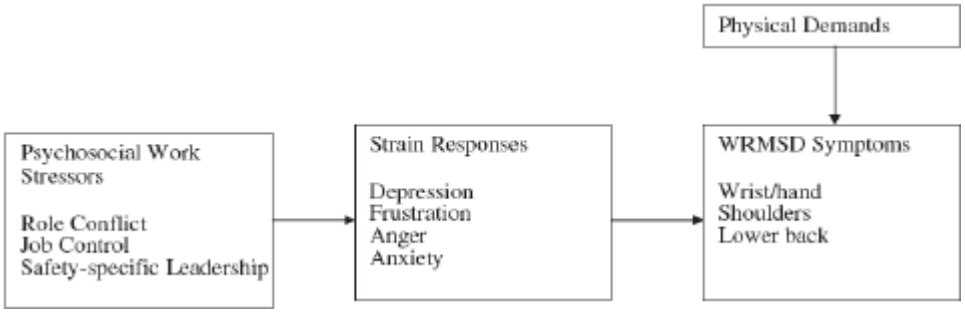

Figure 12: Theoretical model related to the association between psychosocial work factors and WRMSDs (Eatough, 2011)

2.7 Conceptual Framework

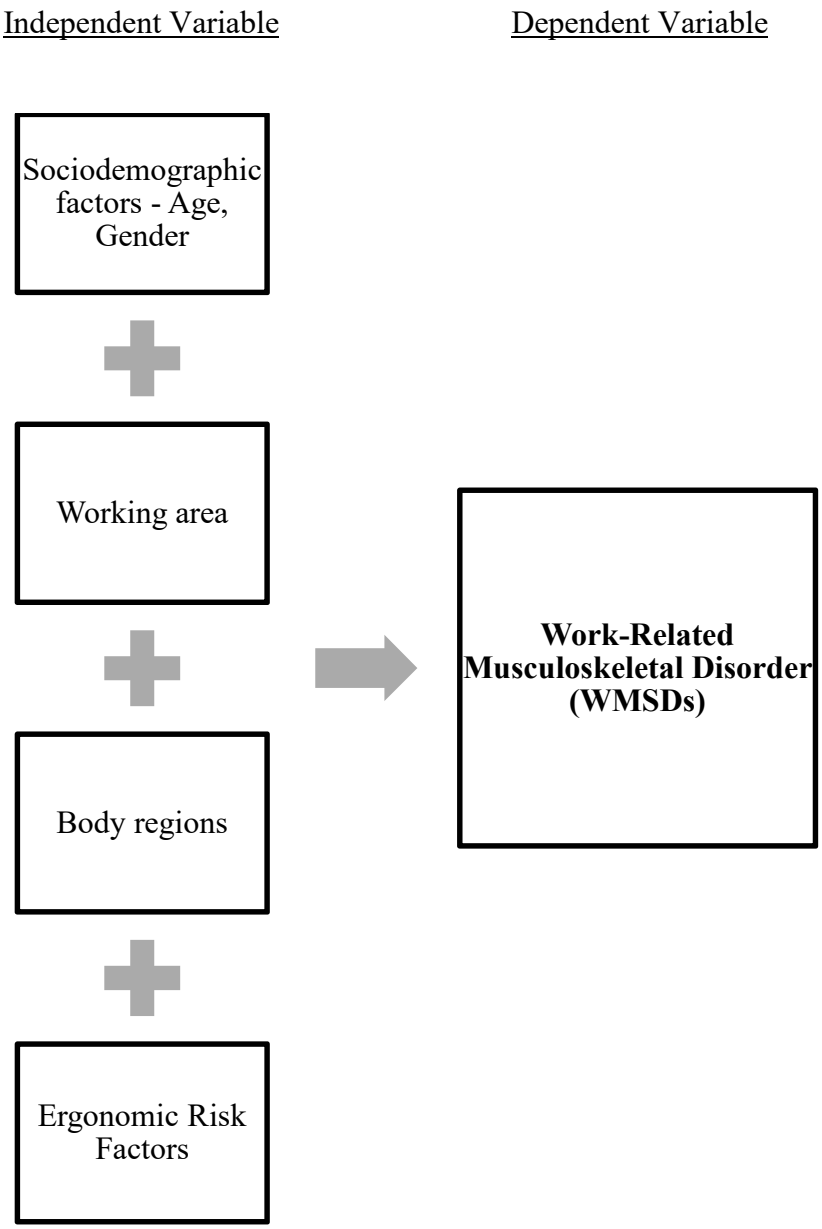

Figure 13: Conceptual Framework

CHAPTER 3

METHODOLOGY

3.1 Research Design

This research is a Cross Sectional study. Cross sectional study is a type of observational study design. In a cross sectional study, the researcher measures outcome and the exposures in the study participants at the same time. Participants in a cross sectional study just selected based on the inclusion and exclusion criteria set for the study. Once the participants have been selected, the researcher follows the study to assess the exposure and the outcomes (Indian J Dermatol, 2016). The data collected through questionnaires distributed among the 84 Daiki Aluminium Industry (Malaysia) Sdn. Bhd. employees According to the literatures mentioned in the Chapter 2, found that age, gender and working area being a risk factors towards of getting WMSDs. Therefore, these 3 risk factors will be a co-founder in this study to meet the hypothesis as follow:

1. Gender of workers does have relationship to the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
2. Age of workers does have relationship to the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.
3. Working area does have relationship to the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers.

3.2 Data Sampling

Daiki Aluminium Industry (Malaysia) Sdn. Bhd. has 84 staffs including management and foreign workers. The sample size needs to identify before this study start. According to (Nunnaly & Bernstein, 1994) that was stated in Hertzog (2007) suggested a minimum acceptable number of pilot study is 30 respondents. Therefore for this study, the questionnaires were distributed to 50 respondents out of 84 Daiki Aluminium Industry (Malaysia) Sdn. Bhd. employees but only get the feedback from 40 respondents.

3.3 Research Instrument

The main tool use for data collection in this study is questionnaire. Questionnaire is a research instrument consisting of a series of questions for the purpose of gathering information from respondents. The selected respondents were contacted and informed of this study, what are the main purpose of this study and the target.

This questionnaire has two sections. The first section included questions related with respondents' background (gender, age, marital status, race, working experience and working area) also known as demographic questions and closed type of questions are choose for better analysis. In the questionnaire, the respondents were divided into four marital status groups which are single, married, divorced and widowed. While for age also divided into four groups (20-30 years old, 31-40 years old, 41-50 years old and 51-60 years old). 3 main races in Malaysia are Malay, Chinese and Indian. While for foreign workers, they need to specify their races. Working experience was categorized under four groups (less than 1 year, 1-5 years, 6-10 years and ≥ 10 years). Working area was categorized into furnace, sorting, maintenance, packing, quality and office.

The second section of this questionnaire is the section to assess the information related with musculoskeletal discomfort. For this purpose Nordic Musculoskeletal Questionnaire (NMQ) was used. The most studied questionnaire is the Nordic Musculoskeletal Questionnaire, first designed by Kuorinka et al. (1987), developed the NMQ with the support of the Nordic Council of Ministers and for use in epidemiological research. Cronbach's alpha coefficient (α) (Cronbach, 1951) was used to evaluate the internal consistency or reliability of the NMQ. The Cronbach's alpha coefficient is an estimate of the correlation between all the included items and all of the included items and the construct (Cronbach, 1951), and the coefficient varies in value between zero and one. The Cronbach's alpha for NMQ was 0.8, which demonstrated good reliability.

This second section of questionnaire consists of 2 parts. The first part refers to aided of a body map to indicate WMSDs symptoms at 22 parts of the body. The second part refers to degree of discomfort that respondents feel at 14 areas which are lower back, upper back, neck, hands and wrist, shoulders, upper arms, elbows and forearm, stomach, chest, upper legs, knees, lower legs, ankles and feet.

3.4 Data Analysis

The data of this study were analyzed quantitatively by using the Statistical Package for the Social Sciences (SPSS) version 25 for Windows® named as IBM SPSS Statistics. The

result received will present through graph and tables. Few photos related with working area at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. also taken to give better understand and view about the activities related with WMSDs at Daiki Aluminium Industry (Malaysia) Sdn. Bhd.

An index was created based on Nordic questionnaire to represent the severity of symptoms for each anatomic region with ranging scores from 0 to 2. A score of 0 represent absence of musculoskeletal discomfort symptoms (no discomfort). Score 1 consider as moderate musculoskeletal discomfort symptoms (some discomfort). Score 2 considers that the respondent has severe musculoskeletal discomfort symptoms (considerable pain).

CHAPTER 4

DATA ANALYSIS AND RESULT

4.1 Demographic Profile

The majority of respondents were male workers with 33 respondents (82.5%) and the balance 7 respondents (17.5%) were female workers. It is because most of the workers working at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. are male workers. 35% of respondents are at age of 20-30 years old and followed by 30% are between 31-40 years old, 25% within the range of 41-50 years old, 10% within the range of 51-60 years old and none of the respondents' age more than 60 years old. Comparatively larger proportions of the sample (75%) are married and the balance 25% still single.

For the race, most of the respondents are foreigners from two different countries which are Bangladesh (15%) and Nepal (37.5%) it is about 52.5% of them. The balances 30% are Malay, 12.5% are Indian and very few respondents is about 5% among the total respondents are Chinese. 40% of the respondents are having more than 10 years working experiences, 12.5% of them working between 6-10 years, 45% having 1-5 years of working experiences and only 2.5% having less than 1 year working experiences. Most of the respondents come from Furnace department with 30% of them. Sorting department is about 17.5%, Maintenance department is 10%, Packing department is 12.5%, Quality department 10%, and 20% from Office staffs. The demographic data details as shown in Table 1.

Demographic Data		Frequency	Percentage (%)
Gender	Male	33	82.5
	Female	7	17.5
Age	20-30 years old	14	35
	31-40 years old	12	30
	41-50 years old	10	25
	51-60 years old	4	10
	>60 years old	0	0

Marital Status	Single	10	25
	Married	30	75
	Divorced / Separated	0	0
	Widowed	0	0
Race	Malay	12	30
	Chinese	2	5
	Indian	5	12.5
	Nepal	15	37.5
	Bangladesh	6	15
Year of employment	Less than 1 year	1	2.5
	1-5 years	18	45
	6-10 years	5	12.5
	>10 years	16	40
Section / Department (Working Area)	Furnace	12	30
	Sorting	7	17.5
	Maintenance	4	10
	Packing	5	12.5
	Quality	4	10
	Office	8	20

Table 1: Demographic Profile

4.2 WMSDs Symptoms

95% from total respondents which is 38 respondents had experiences WMSDs in at least one body region. From the total of this 95%, majority 77.5% of the respondents who had experiences WMSDs was male respondents. In term of age range, there is a balance result within age 20-30 years old and 31-40 years old with 32.5% respectively, 25% within age 41-50 years old, and 10% for age 51-60 years old. Among these 95% respondents, majority of them are married (70%), and the balance 25% still single. Foreign workers from Bangladesh and Nepal are the most having WMSDs symptoms compared to others with 47.5% of them. Balance 32.5% is from Malay respondents, 12.5% from Indian and only 5% from Chinese respondents.

There were 42.5% of the respondents who had WMSDs symptoms were working between 1-5 years, 40% of respondents who had WMSDs symptoms were working for more

than 10 years and the less than 1 year working experience had experiences less WMSDs symptoms (2.5%). The most workers that had experiences WMSDs symptoms are come from Furnace Department (27.5%), for others Sorting (17.5%), Maintenance (10%), Sorting (10%), Quality (10%) and Office (20%). Details for related with WMSDs symptoms can refer to Table 2 below. Meanwhile, Table 3 presents the prevalence of experiencing work-related musculoskeletal symptoms with respect to 14 body regions. The highest percentage of body regions that prevalence of experiencing WMSDs among the respondents are at lower back area (52.5%), followed by upper back (47.5%) and feet (37.5%).

Demographic Data		**WMSDs**	
		Yes	**No**
Gender	Male	31 (77.5%)	2 (5%)
	Female	7 (17.5%)	0 (0%)
Age	20-30 years old	12 (32.5%)	2 (5%)
	31-40 years old	12 (32.5%)	0 (0%)
	41-50 years old	10 (25%)	0 (0%)
	51-60 years old	4 (10%)	0 (0%)
	>60 years old	0 (0%)	0 (0%)
Marital Status	Single	10 (25%)	0 (0%)
	Married	28 (70%)	2 (5%)
	Divorced / Separated	0 (0%)	0 (0%)
	Widowed	0 (0%)	0 (0%)
Race	Malay	12 (32.5%)	0 (0%)
	Chinese	2 (5%)	0 (0%)
	Indian	5 (12.5%)	0 (0%)
	Others	19 (47.5%)	2 (5%)
Year of employment	Less than 1 year	1 (2.5%)	0 (0%)
	1-5 years	17 (42.5%)	1 (2.5%)
	6-10 years	4 (10%)	1 (2.5%)
	>10 years	16 (40%)	0 (0%)

Section / Department (Working Area)	Furnace	11 (27.5%)	1 (2.5%)
	Sorting	7 (17.5%)	0 (0%)
	Maintenance	4 (10%)	0 (0%)
	Packing	4 (10%)	1 (2.5%)
	Quality	4 (10%)	0 (0%)
	Office	8 (20%)	0 (0%)

Table 2: Work-Related Musculoskeletal Disorders symptoms

Body Region	**Percentage (%)**
Lower back	52.5%
Upper back	47.5%
Neck	20%
Hands and wrist	25%
Shoulders	25%
Upper arms	2.5%
Elbow and forearm	2.5%
Stomach	2.5%
Chest	10%
Upper legs	12.5%
Knees	25%
Lower legs	15%
Ankles	17.5%
Feet	37.5%

Table 3: Prevalence of work-related musculoskeletal symptoms in 14 body regions

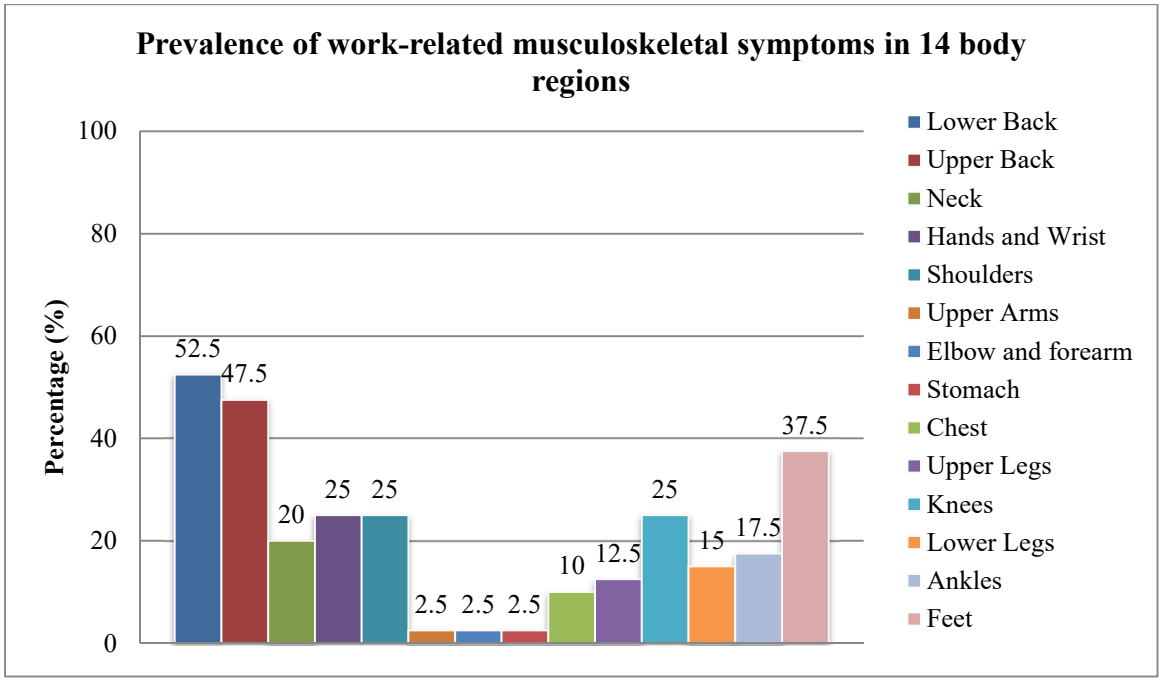

Figure 14: Prevalence of work-related musculoskeletal symptoms in 14 body regions

4.3 Age Factor and WMSDs

As shown in table 2, most of the respondents who had experiences WMSDs symptoms are age within 20-30 years old (n=12) and 31-40 years old (n=12). These age groups of respondents reported high WMSDs symptoms in upper back for group of 31-40 years old (66.7%), lower back (50%) each for group 20-30 years old and 31-40 years old, followed by feet with 42.9% for group of 20-30 years old and 50% for group of 31-40 years old. Others than that, group of 20-30 years old having experience of WMSDs for lower legs with 35.7%. For age 41-50 years old (n=10) reported to have upper back pain (60%) and shoulders pain with 50% and followed by lower back (40%). For group age of 51-60 years old, there is 100% WMSDs symptoms for lower back and followed by knees (75%). From table 3, it shows a result that most of respondents having experienced with lower back, upper back and also feet pain. Details comparison between age factors is shown in Table 4 and Figure 11.

Body Region	Age				
	20-30 years old (n=14)	31-40 years old (n=12)	41-50 years old (n=10)	51-60 years old (n=4)	>60 years old
Lower back	7 (50%)	6 (50%)	4 (40%)	4 (100%)	0
Upper back	4 (28.6%)	8 (66.7%)	6 (60%)	1 (25%)	0
Neck	0	5 (41.7%)	2 (20%)	1 (25%)	0
Hands and wrist	4 (28.6%)	2 (16.7%)	2 (20%)	2 (50%)	0
Shoulders	1 (7.1%)	3 (25%)	5 (50%)	1 (25%)	0
Upper arms	0	0	1 (10%)	0	0
Elbow and forearm	1 (7.1%)	0	0	0	0
Stomach	0	0	1 (10%)	0	0
Chest	1 (7.1%)	1 (8.3%)	1 (10%)	1 (25%)	0
Upper legs	1 (7.1%)	3 (25%)	0	1 (25%)	0
Knees	3 (21.4%)	1 (8.3%)	3 (30%)	3 (75%)	0
Lower legs	5 (35.7%)	0	1 (10%)	0	0
Ankles	1 (7.1%)	1 (8.3%)	3 (30%)	2 (50%)	0
Feet	6 (42.9%)	6 (50%)	2 (20%)	1 (25%)	0

Table 4: Comparison Musculoskeletal symptoms between age group

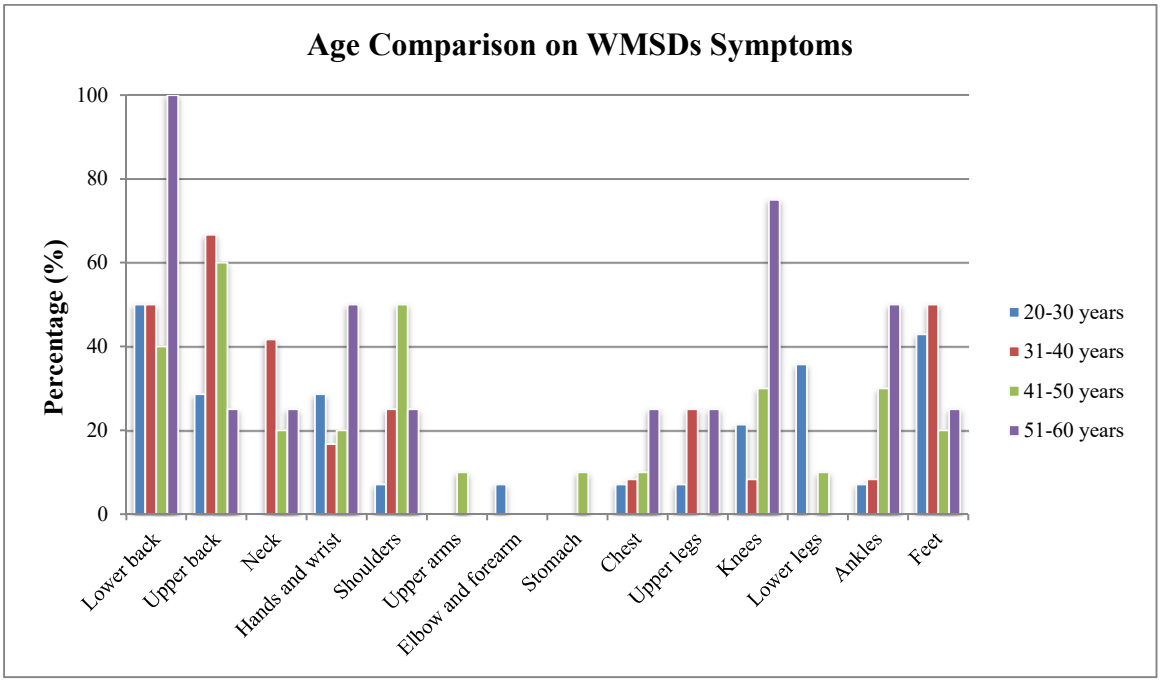

Figure 15: Age Comparison on WMSDs Symptoms

4.4 Gender Factor and WMSDs

As shown in table 2, male respondents experienced higher WMSDs symptoms than female. It is because most of the respondents were male. But if refers to respective gender, male respondents experienced more WMSDs symptoms in lower back (55%), upper back (52%) and feet (36.4%). While for female respondents, they experienced more WMSDs symptoms in knees (85.7%) and lower back and feet with 43% respectively. Male respondents are having fewer symptoms in upper arms and for female fewer symptoms in stomach and elbow and forearm area. For details please refer to Table 5 and Figure 12.

Body Region	Gender	
	Male (n=33)	Female (n=7)
Lower back	18 (55%)	3 (43%)
Upper back	17 (52%)	2 (29%)
Neck	6 (18.2%)	2 (29%)
Hands and wrist	8 (24.2%)	2 (29%)
Shoulders	8 (24.2%)	2 (29%)
Upper arms	0	1 (14.3%)
Elbow and forearm	1 (3%)	0
Stomach	1 (3%)	0
Chest	3 (9.1%)	1 (14.3%)
Upper legs	4 (12.1%)	1 (14.3%)
Knees	4 (12.1%)	6 (85.7%)
Lower legs	5 (15.2%)	1 (14.3%)
Ankles	5 (15.2%)	2 (29%)
Feet	12 (36.4%)	3 (43%)

Table 5: Comparison Musculoskeletal symptoms with Gender

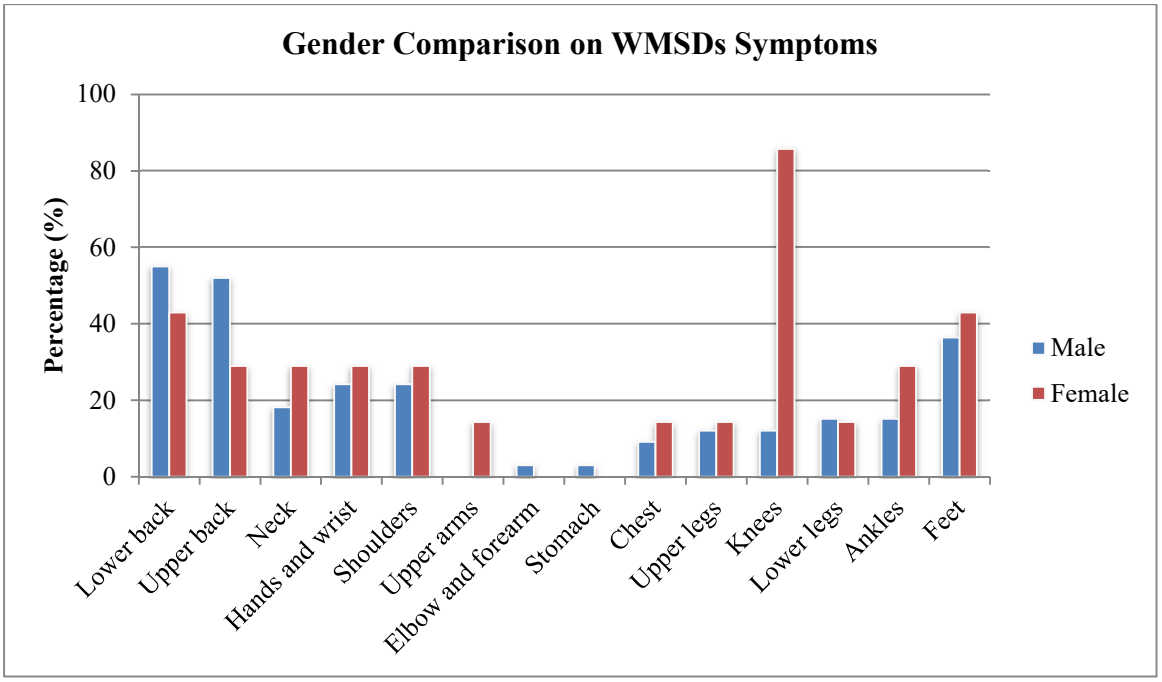

Figure 16: Gender Comparison on WMSDs Symptoms

4.5 Working Area and WMSDs

There are 6 mains departments at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. which are Furnace, Sorting, Maintenance, Packing, Quality and Office. From the total of respondents from Furnace Department (n=12), 5 of them (41.7%) had experienced with WMSDs symptoms at feet area due to long working hours required for them to work especially standing up for the whole working hours, followed by 33.3% at upper back, neck and shoulder area respectively might due to whole body vibration for forklift driver working at Furnace Department.

While for Sorting Department (n=7), most of the respondents had problem with upper back (85.7%), followed by lower back (71.4%) and at hands and wrist, lower legs and feet area with 28.6% respectively. As per mentioned earlier, Sorting Department task is to sort up the scrap material manually therefore all related area mentioned (upper back, lower back, hand and wrist, lower legs and feet) are directly related with that activity. All manual tasks done related with awkward posture and also force.

Respondents from Maintenance Department (n=4) all of them had bad experienced with their lower back, upper back and upper legs (75%) respectively. While for Packing Department (n=5), about 60% of the respondents had experienced WMSDs symptoms at lower back area (60%) and upper back, shoulder and feet with 40% respectively. For Quality

Department with total 4 respondents and the most bothered areas are lower back, shoulders and feet.

Staff from Office (n=8) had experienced 75% at knees area, and followed by lower back pain (62.5%). For office staffs, they experienced more knees symptoms might be due to their working area are at 1st and 2nd floor of the office building. They have to climb up the stairs daily and frequently. One more factor might be due to their age. Most of the respondents from office staffs are from age 41-60 years old (88.9%). Other than that, the lower back pain symptoms might be related with works with computer. Most of the office staff are using computer in their daily routine task. Therefore the workstation design is most important to make sure the office staff experience minimal WMSDs symptoms.

Body Region	**Section / Department**					
	Furnace (n=12)	**Sorting (n=7)**	**Maintenance (n=4)**	**Packing (n=5)**	**Quality (n=4)**	**Office (n=8)**
Lower back	3 (25%)	5 (71.4%)	3 (75%)	3 (60%)	2 (50%)	5 (62.5%)
Upper back	4 (33.3%)	6 (85.7%)	3 (75%)	2 (40%)	1 (25%)	3 (37.5%)
Neck	4 (33.3%)	0	1 (25%)	0	0	3 (37.5%)
Hands and wrist	2 (16.7%)	2 (28.6%)	1 (25%)	1 (20%)	1 (25%)	3 (37.5%)
Shoulders	3 (33.3%)	1 (14.3%)	0	2 (40%)	2 (50%)	2 (25%)
Upper arms	0	0	0	0	0	1 (12.5%)
Elbow and forearm	0	0	0	1 (20%)	0	0
Stomach	0	1 (14.3%)	0	0	0	0
Chest	1 (8.3%)	1 (14.3%)	0	0	1 (25%)	1 (12.5%)
Upper legs	1 (8.3%)	0	3 (75%)	0	0	1 (12.5%)
Knees	0	1 (14.3%)	2 (50%)	0	1 (25%)	6 (75%)
Lower legs	2 (16.7%)	2 (28.6%)	1 (25%)	0	0	1 (12.5%)
Ankles	0	1 (14.3%)	1 (25%)	1 (20%)	1 (25%)	3 (37.5%)
Feet	5 (41.7%)	2 (28.6%)	2 (50%)	2 (40%)	2 (50%)	2 (25%)

Table 6: Comparison Musculoskeletal symptoms with Working Area

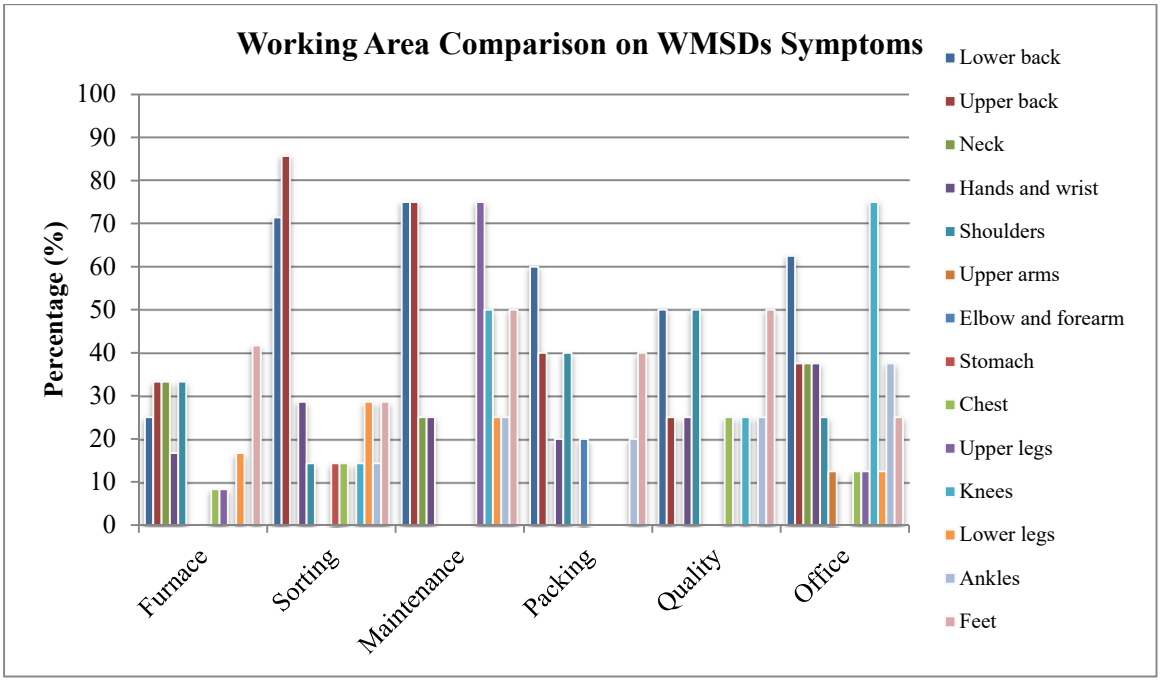

Figure 17: Working Area Comparison on WMSDs Symptoms

CHAPTER 5

DISCUSSION AND CONCLUSION

5.1 Summary of Main Findings

The response rate to the questionnaire among respondents from Daiki Aluminium Industry (Malaysia) Sdn. Bhd. was 80% (40/50). 10 more questionnaires not return back from respondents due to missed place and unknown reason. The time taken to complete the questionnaire was 10 to 15 minutes per person. The process of questionnaire distribution and collection take about 2 weeks to complete.

A foundry or furnace is a site where castings are made from molten metal according to customer specifications. Numerous potential hazards including ergonomics are present in a foundry or furnace working environment (OSHA, 2012). Study done by H. Mohammadi et al (2013), showed that most casting workers had experienced WMSDs symptoms in the past 12 months (84%). This rate of prevalence of WMSDs could contribute to handling of exceed load, force exertion, awkward postures, repetitive tasks and inappropriate workstation design. ILO (2003) and NIOSH (1985) studies on foundry workers confirmed the prevalence of MSDs among the workers. Studied from Rohit and Ranjit (2014), found out the main reason of a high prevalence of MSDs among the foundry workers are awkward work postures, lifting heavy loads and carrying loads for a long distance. It is about the same findings with this study which is most of the respondents (95%) experienced WMSDs symptoms. According to OSHA, foundry workers are most often exposed to physical hazards such as ergonomic-related risks which is MSDs. This is due to manual handling of heavy objects, repetitive tasks, awkward or static posture and vibration. The OSHA mentioned that injuries to the lower back and upper limbs are common among foundry workers and may arise from doing work repetitively without enough rest times and exerting excessive force to move or grip objects. (OSHA, 2012).

Welch et al. (2008), found that increasing age was associated with reduced physical functioning independent of the presence of medical conditions or MSDs. Changes in physical abilities that are encountered with ageing are however influenced by individual genetics, lifestyles and environment in which the person work and live (Bucham et al., 2007: Kenny et

al., 2008). Therefore, highly trained older person may be able to outperform compare to younger than them.

According to Rohit and Ranjit (2014), gender differences in the prevalence and occupational consequences of MSDs are consistently found in epidemiological studies. The major complaint from female nurses was hip/thigh pain (60%), followed by ankle/feet (55%) and knees (53%) (Sandul et al., 2014). Studied from Tsekoura et al. (2017), the most frequent areas of pain or discomfort for female participants were the low back area.

Study from Mohammad Didar Hossain et al (2018) found that lower back and neck were the most affected areas among readymade garment workers. Lower back pain, neck pain and other MSDs are the leading causes of years lived with disability (Vos T et al, 2013). Lower back ranked the highest in terms of years lived disability and sixth in terms of disability-adjusted life years in Global Burden of Disease 2010 study (Hoy D et al, 2014). Injuries at low back and upper limb are common MSDs among foundry workers. These may be caused from doing work repetitively or for prolonged time periods, exerting force to move or grip objects, or using vibrating tools and machinery (OSHA, 2012). Deros B., et al. (2010) studied that lifting posture contributed the highest percentage of upper extremities back pain (45%) and lower extremities back pain (80%). Any tasks that involve heavy labor or manual material handling may be in a high-risk category of injury to the back (Triano and Selby, 2006).

In South Australia, injury in the lower back was the most common claim about 38% among the body parts during year 2008-2009 (WorkCoverSA, 2010). The 12-month musculoskeletal complaints of studied found out most common reported at lower back (43.7%), followed by neck (42.3%), shoulder (37.8%) and upper back (29%) (Y.J., Wang R.S., 2006). Studied from Nurhidayah Rani et al. (2016), showed that the overall prevalence of musculoskeletal symptoms was 87%. Approximately 80% of the workers complained of WMSDs in 2 to 5 of their body area. The most affected body part was lower back (64.8%), feet and ankles (53.7%) and knee (52.8%). Low back pain is one of the most common health problems faced by working adults. It can affect workers of all age of groups and most common from age 35 to 55 years old (Waddell, G et al., 2001). Studied by Burdof A. et al. (2006), found the connection between low back pain and ergonomic risk factors such as working environment, exposure to physical hazards, awkward posture and forceful activities. Studied done by H. Abdul Hadi (2016), showed a high prevalence of low back pain among tea plantation workers which was 64.2% in the last 12 months duration. This could be due to their daily work activities that exposed them to ergonomic risk factors involving frequent

manual material handling. A study by Nizam J. (2002), among oil palm plantation workers in Selangor showed prevalence rate of 82.6%. WMSDs at lower back (64.8%) was most prevalent among workers and feet and ankle area was the second highest prevalence of symptoms (53.7%) (Ng et al., 2014).

Fazilah Abdul Aziz et al., (2017), found there are four body parts with the highest MSDs symptoms were lower back (75.4%), right shoulder (61.4%), right wrist (60%) and upper back (63.2%). Akrouf et al. (2010), studied on MSDs among bank office workers reported that the most affected body parts were the neck (53.5%), lower back (51.1%), shoulders (49.2%) and upper back (38.4%). Studied from P de Beer et al. (2016) found all 38 participants from the studied experienced MSDs and back pain was the most common. All participants were exposed to repetitive movements, poor ergonomics and hazards. This finding is comparable to research done in Eurpe that showed that about one in three workers suffer from lower back pain (Quadrello T et al., 2009). The most common problem among Europe workers in 200 were reported to be back pain (29.5%). According to Mc Cauley Bush (2011), the back is the most frequently injured part of the body (22% of 1.7 million injuries) with overexertion being the most common cause of these injuries. Many back injuries develop over a long period of time by a repetitive loading of the disc caused by improper lifting methods or other exertions.

5.2 Conclusion

This study conclude that workers at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. suffered from various types of ergonomic risk factors due to their nature of work such as working with awkward posture and force to carry heavy scrap items manually at sorting area, long duration of exposure to heat and also vibration during driving the forklift for furnace workers, repetitive process at packing area to tie and pack aluminium ingot before send it to customer and also working at improper work station for office and lab staffs.

The most vulnerable areas of discomfort are lower back, upper back, knees and feet among the workers. This finding is consistent with findings of past studies by Choobineh A. et al. (2007) and Punnet L. et al. (2004), common risk factors of WMSDs are awkward postures, prolonged static work, repetitive movements, manual material handling, forceful exertions and vibration. More male workers than female were participated in this study. Gender of the workers does have relationship to the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers. Male workers were identified to have high risk of getting WMSDs among them in the area of lower back, upper back, knees and

feet. This result is supported by other research that stated male workers more potential to get WMSDs (European Agency for Safety and Health at Work, 2010), and Jose Miquel Cabecas (2006). Age of the workers also have relationship to the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers at their lower back, upper back & feet. Most of them are at middle age workers (31 – 50 years old) who most suffer with WMSDs symptoms. Working area does have relationship to the risk of getting WMSDs among Daiki Aluminium Industry (Malaysia) Sdn. Bhd. workers as well at lower back, upper back and feet areas. As a conclusion, this study found out that WMSDs are common ergonomic problems among workers of Daiki Aluminium Industry (Malaysia) Sdn. Bhd. at lower back (52.5%), upper back (47.5%), and feet (37.5%) area.

5.4 Recommendations

As a recommendation, the company can do some improvement and also corrective actions to reduce or eliminate the WMSDs in the workplace such as re-plan the production shifts from two shift system to three shift systems to reduce the long duration exposure among the workers. The company also can implement the working area rotation system among the workers by keep on changing their working area for every 6 months to reduce all the related ergonomic risk factors such as vibration, repetitive, force, long duration exposure etc. Other than that, company also can provide the workers with correct tools and equipment and do some improvement at work station design such as provide chair with arm rest and add a proper platform at packing area so that the workers no need to bend their body to low during packing process. Training to all employees also can be done to create awareness among them related with ergonomic and WMSDs.

5.3 Limitation of the Study

This study was conducted at Daiki Aluminium Industry (Malaysia) Sdn. Bhd. which is a single organization only with small number of workers (84 staffs including top management) and not include all staff. Due to small sample size, the result cannot be generalized to other foundries but still can be beneficial to industries that depend on manual handling labor as they might increase the awareness related with MSDs. Other than that is language barrier. About half of the total respondents are foreign workers from Bangladesh and Nepal. They have low education background and limitation to understand Bahasa Malaysia and English. Received help from other workers to translate to their own language in order for better understanding and can answer the questionnaires correctly and smoothly.

5.4 Implication of the Study

The result of this study can be useful for company Daiki Aluminium Industry (Malaysia) Sdn. Bhd. as a guideline to come out with ergonomic planning and implementation in order to reduce or eliminate WMSDs in the work place. From the result can help the company to decide what improvement need to be done and at which area that the most contribution to this problem among their workers and also to identify the main risk factor of WMSDs symptoms among their workers. Other than that, absenteeism and hospitalization cost or medical cost related with WMSDs problem among their workers can be reduced and it can benefit the company in term of productivity and expenses. This study also can be useful to other researchers as their reference.

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APPENDICES

Appendix 1: Questionnaires

BAHAGIAN A: SOSIODEMOGRAFI

Arahan: Sila isi pada tempat yang berkenaan dan tandakan (✓) pada maklumat yang sesuai

1) **Nama:** _____

2) **Jantina:** ☐ Lelaki ☐ Perempuan

3) **Umur:**

☐ 20 – 30 tahun ☐ 31 – 40 tahun ☐ 41 – 50 tahun

☐ 51 – 60 tahun ☐ > 60 tahun

4) **Taraf perkahwinan:**

☐ Bujang ☐ Berkahwin ☐ Bercerai ☐ Balu

5) **Kaum:**

☐ Melayu ☐ Cina ☐ India ☐ lain-lain _____ (Nyatakan)

6) **Tahun Berkhidmat:**

☐ Kurang daripada setahun ☐ 1 – 5 tahun

☐ 6 – 10 tahun ☐ Lebih daripada 10 tahun

7) **Bahagian / Jabatan:**

☐ Furnace ☐ Sorting ☐ Maintenance ☐ Packing ☐ Quality ☐ Office

SECTION A: SOCIODEMOGRAPHIC

Instruction: Please fill in your answer in the each blank provided below & (✓) at the suitable information.

1) **Name:** _____

2) **Gender:** ☐ Male ☐ Female

3) **Age:**

☐ 20 – 30 years old ☐ 31 – 40 years old ☐ 41 – 50 years old

☐ 51 – 60 years old ☐ > 60 years old

4) **Marital Status:**

☐ Single ☐ Married ☐ Divorced / Separated ☐ Widowed

5) **Race:**

☐ Malay ☐ Chinese ☐ Indian ☐ Others _____ (Please state)

6) **Year of employement:**

☐ Less than 1 year ☐ 1 – 5 years

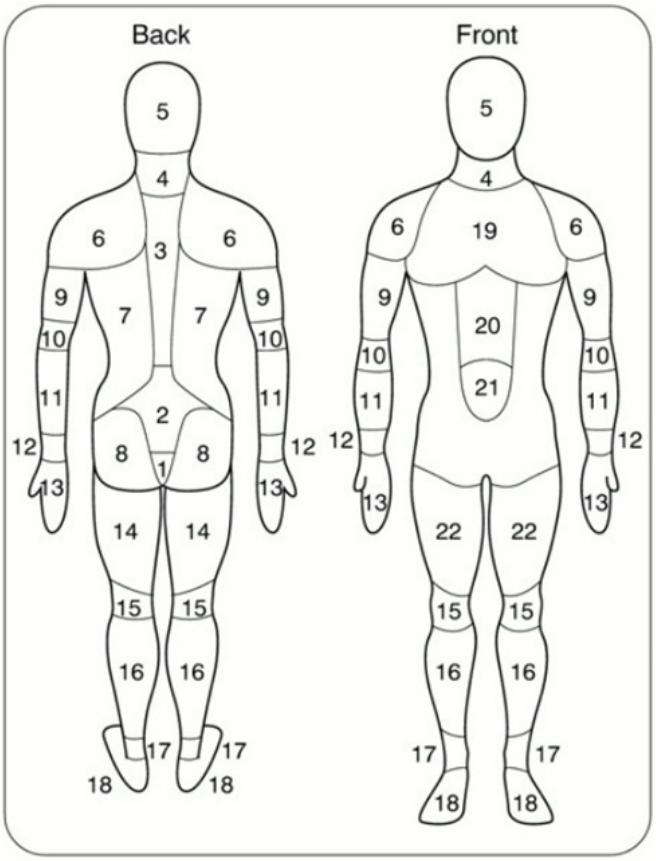
☐ 6 – 10 years ☐ More than 10 years

7) **Section / Department:**

☐ Furnace ☐ Sorting ☐ Maintenance ☐ Packing ☐ Quality ☐ Office

BAHAGIAN B: Nordic Musculoskeletal Questionnaire (NMQ) - 1987

1. Using the diagram below, please circle any areas of pain aching or discomfort you feel



2. Please tick the *degree of* discomfort you feel in each of these areas

	No discomfort	Some discomfort	Considerable pain
Lower back			
Upper back			
Neck			
Hands and wrist			
Shoulders			
Upper arms			
Elbows and forearm			
Stomach			
Chest			
Upper legs			
Knees			
Lower legs			
Ankles			
Feet			

Appendix 2: SPSS Data Analysis: Demographic Frequency

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	33	82.5	82.5	82.5
	Female	7	17.5	17.5	100.0
	Total	40	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20-30 yo	14	35.0	35.0	35.0
	31-40 yo	12	30.0	30.0	65.0
	41-50 yo	10	25.0	25.0	90.0
	51-60 yo	4	10.0	10.0	100.0
	Total	40	100.0	100.0	

Marital Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single	10	25.0	25.0	25.0
	Married	30	75.0	75.0	100.0
	Total	40	100.0	100.0	

Race

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Malay	12	30.0	30.0	30.0
	Chinese	2	5.0	5.0	35.0
	Indian	5	12.5	12.5	47.5
	Others	21	52.5	52.5	100.0
	Total	40	100.0	100.0	

Others_race

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid		19	47.5	47.5	47.5
	Bangladesh	6	15.0	15.0	62.5
	Nepal	15	37.5	37.5	100.0
	Total	40	100.0	100.0	

Working Experience

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< 1yr	1	2.5	2.5	2.5
	1-5 yrs	18	45.0	45.0	47.5
	6-10 yrs	5	12.5	12.5	60.0
	> 10yrs	16	40.0	40.0	100.0
	Total	40	100.0	100.0	

Department

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Furnace	12	30.0	30.0	30.0
	Sorting	7	17.5	17.5	47.5
	Maintenance	4	10.0	10.0	57.5
	Packing	5	12.5	12.5	70.0
	Quality	4	10.0	10.0	80.0
	Office	8	20.0	20.0	100.0
	Total	40	100.0	100.0	

Appendix 3: SPSS Data Analysis: Frequency Risk of 14 Body Regions

Lower_back

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	19	47.5	47.5	47.5
	Some discomfort	20	50.0	50.0	97.5
	Considerable pain	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

Upper_back

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	21	52.5	52.5	52.5
	Some discomfort	19	47.5	47.5	100.0
	Total	40	100.0	100.0	

Neck

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	32	80.0	80.0	80.0
	Some discomfort	8	20.0	20.0	100.0
	Total	40	100.0	100.0	

Hands_and_wrist

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	30	75.0	75.0	75.0
	Some discomfort	10	25.0	25.0	100.0
	Total	40	100.0	100.0	

Shoulders

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	30	75.0	75.0	75.0
	Some discomfort	10	25.0	25.0	100.0
	Total	40	100.0	100.0	

Upper_arms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	39	97.5	97.5	97.5
	Some discomfort	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

Elbow_and_forearm

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	39	97.5	97.5	97.5
	Some discomfort	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

Stomach

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	39	97.5	97.5	97.5
	Some discomfort	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

Chest

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	36	90.0	90.0	90.0
	Some discomfort	4	10.0	10.0	100.0
	Total	40	100.0	100.0	

Upper_legs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	35	87.5	87.5	87.5
	Some discomfort	5	12.5	12.5	100.0
	Total	40	100.0	100.0	

Knees

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	30	75.0	75.0	75.0
	Some discomfort	8	20.0	20.0	95.0
	Considerable pain	2	5.0	5.0	100.0
	Total	40	100.0	100.0	

Lower_legs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	34	85.0	85.0	85.0
	Some discomfort	6	15.0	15.0	100.0
	Total	40	100.0	100.0	

Ankles

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	33	82.5	82.5	82.5
	Some discomfort	6	15.0	15.0	97.5
	Considerable pain	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

Feet

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No discomfort	25	62.5	62.5	62.5
	Some discomfort	14	35.0	35.0	97.5
	Considerable pain	1	2.5	2.5	100.0
	Total	40	100.0	100.0	

Appendix 4: ANOVA

ANOVA: Significant between Risk factor and Lower Back

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.067	2	.034	.217	.806
	Within Groups	5.708	37	.154		
	Total	5.775	39			
Age	Between Groups	.903	2	.451	.432	.653
	Within Groups	38.697	37	1.046		
	Total	39.600	39			
Department	Between Groups	8.616	2	4.308	1.151	.327
	Within Groups	138.484	37	3.743		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Upper Back

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.176	1	.176	1.195	.281
	Within Groups	5.599	38	.147		
	Total	5.775	39			
Age	Between Groups	.442	1	.442	.429	.516
	Within Groups	39.158	38	1.030		
	Total	39.600	39			
Department	Between Groups	1.486	1	1.486	.388	.537
	Within Groups	145.614	38	3.832		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Neck

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.056	1	.056	.374	.545
	Within Groups	5.719	38	.150		
	Total	5.775	39			
Age	Between Groups	1.600	1	1.600	1.600	.214
	Within Groups	38.000	38	1.000		
	Total	39.600	39			
Department	Between Groups	.006	1	.006	.002	.968
	Within Groups	147.094	38	3.871		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Hands and Wrist

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.008	1	.008	.055	.816
	Within Groups	5.767	38	.152		
	Total	5.775	39			
Age	Between Groups	.133	1	.133	.128	.722
	Within Groups	39.467	38	1.039		
	Total	39.600	39			
Department	Between Groups	2.700	1	2.700	.711	.405
	Within Groups	144.400	38	3.800		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Shoulders

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.008	1	.008	.055	.816
	Within Groups	5.767	38	.152		
	Total	5.775	39			
Age	Between Groups	3.333	1	3.333	3.493	.069
	Within Groups	36.267	38	.954		
	Total	39.600	39			
Department	Between Groups	1.633	1	1.633	.427	.518
	Within Groups	145.467	38	3.828		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Upper Arms

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.698	1	.698	5.225	.028
	Within Groups	5.077	38	.134		
	Total	5.775	39			
Age	Between Groups	.831	1	.831	.814	.373
	Within Groups	38.769	38	1.020		
	Total	39.600	39			
Department	Between Groups	11.683	1	11.683	3.047	.089
	Within Groups	145.692	38	3.834		
	Total	157.375	39			

ANOVA: Significant between Risk factor and Elbow and Forearm

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.031	1	.031	.208	.651
	Within Groups	5.744	38	.151		
	Total	5.775	39			
Age	Between Groups	1.241	1	1.241	1.229	.274
	Within Groups	38.359	38	1.009		
	Total	39.600	39			
Department	Between Groups	.741	1	.741	.192	.663
	Within Groups	146.359	38	3.852		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Stomach

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.031	1	.031	.208	.651
	Within Groups	5.744	38	.151		
	Total	5.775	39			
Age	Between Groups	.831	1	.831	.814	.373
	Within Groups	38.769	38	1.020		
	Total	39.600	39			
Department	Between Groups	1.356	1	1.356	.354	.556
	Within Groups	145.744	38	3.835		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Chest

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.025	1	.025	.165	.687
	Within Groups	5.750	38	.151		
	Total	5.775	39			
Age	Between Groups	.711	1	.711	.695	.410
	Within Groups	38.889	38	1.023		
	Total	39.600	39			
Department	Between Groups	.544	1	.544	.141	.709
	Within Groups	146.556	38	3.857		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Upper Legs

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.004	1	.004	.024	.879
	Within Groups	5.771	38	.152		
	Total	5.775	39			
Age	Between Groups	.057	1	.057	.055	.816
	Within Groups	39.543	38	1.041		
	Total	39.600	39			
Department	Between Groups	.014	1	.014	.004	.952
	Within Groups	147.086	38	3.871		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Knees

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	2.433	2	1.217	13.471	.000
	Within Groups	3.342	37	.090		
	Total	5.775	39			
Age	Between Groups	3.358	2	1.679	1.714	.194
	Within Groups	36.242	37	.980		
	Total	39.600	39			
Department	Between Groups	42.858	2	21.429	7.606	.002
	Within Groups	104.242	37	2.817		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Lower Legs

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.000	1	.000	.003	.955
	Within Groups	5.775	38	.152		
	Total	5.775	39			
Age	Between Groups	4.149	1	4.149	4.447	.042
	Within Groups	35.451	38	.933		
	Total	39.600	39			
Department	Between Groups	2.982	1	2.982	.786	.381
	Within Groups	144.118	38	3.793		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Ankles

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.699	2	.350	2.549	.092
	Within Groups	5.076	37	.137		
	Total	5.775	39			
Age	Between Groups	6.388	2	3.194	3.558	.039
	Within Groups	33.212	37	.898		
	Total	39.600	39			
Department	Between Groups	19.524	2	9.762	2.831	.072
	Within Groups	127.576	37	3.448		
	Total	147.100	39			

ANOVA: Significant between Risk factor and Feet

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Gender	Between Groups	.701	2	.350	2.555	.091
	Within Groups	5.074	37	.137		
	Total	5.775	39			
Age	Between Groups	6.183	2	3.091	3.423	.043
	Within Groups	33.417	37	.903		
	Total	39.600	39			
Department	Between Groups	10.183	2	5.091	1.376	.265
	Within Groups	136.917	37	3.700		
	Total	147.100	39			