

A Survey on Work-Related Musculoskeletal Disorders Among Construction Trades

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Abstract: Work-related musculoskeletal disorders (WMSDs) are the common health problem among workers in a construction site. Construction workers tend to experience neck pain, lower back pain, knee pain, leg fatigue and feet discomfort due to the occupation they performed. This study aims to investigate the issue related to musculoskeletal disorders among construction workers while performing construction works. Field observation was conducted at four construction sites in Perak Tengah district in order to identify the types of trades who exposed to musculoskeletal disorders. Next, a survey form was developed by modifying the existing Nordic Musculoskeletal Questionnaire (NMQ) in determining the symptoms of WMSDs. Surveys were carried out on 100 construction workers at the selected four construction sites to identify the area and causes of pain and discomfort, types of treatment received by the workers and recovery duration for pain and discomfort. Based on the survey, shoulder, wrists/hands and low back were the common area of pain or discomfort after and while performing works. The main causes of pain and discomfort were mostly from repetitive works, awkward working postures and manipulation of heavy load. Types of treatment received by workers were taking a medicine and rest, while the recovery duration for pain or discomfort was around a week. Interviews with panels of expert regarding the strategies or best practice to minimize the WMSDs among construction workers revealed that the most preferable practice is the contractor of the construction project should follow the safety and health regulation, particularly in managing WMSDs, such as implementing medical surveillance for workers. This study will help construction stakeholders, especially contractors to discover the type of occupations that are majorly impacted with WMSDs and further provide the best strategies or control measures to reduce the effect of WMSDs to their employees while performing work.

Keywords: Work-related musculoskeletal disorders (WMSDs), ergonomic, health hazards in construction

1. Introduction

The construction industry is perceived as on the largest industry in every state in the world as in every day there are so many construction works that are ongoing [1]. Type of trades or occupations that involve in this industry are masons, carpenters, electricians, sheet metal workers, roofers, ironworkers, and plumbers. These trades are exposed to the hazardous environment in their daily works as is known that the construction industry has been categorized as one of the most hazardous industry in the world [2].

Construction works often involved forceful exertions such as heavy manual lifting, awkward body postures,

pressure from hard surfaces and vibration from tools and machinery [1]. These factors have a significant impact on workers health, safety, comfort, performance, and productivity like work-related musculoskeletal disorder (WMSDs) as their risk of the musculoskeletal injury is much higher than the workers in other industry who perform less heavy work [3].

In Malaysia, based on the Social Security Organization (SOCSSO) annual report 1997-2009, the number of work-related ill against construction workers increases year by year. It is believed that the lack of workers' health awareness among construction contractors about this issue has contributed to the problem. Therefore, it is essential for a study to be

carried out which focuses on the WMSDs among construction workers so that the findings can provide awareness on the current state of worker's health (particularly due to MSDs).

2. Literature Review

2.1 Overview of construction safety

Construction industry has the highest industrial accident rate in the world because construction workers are lack in job safety while performing their works. Construction workers have to face constant change in the nature of work, the location of work and the mix of workers. Apart from that, the workers always work with heavy materials and machinery and exposed to hazardous environmental risk factors such as noise, dust and heat stress. This will reduce their productivity, increases their irritability and loss of their enthusiasm for work [4].

Most of previous study has revealed the bad performance of construction industry by emphasizing on the safety risks only. Meanwhile, the literature on the effect of health hazards to workers are rarely mentioned or studied because their risks are considered as delayed-type of effect. However, addressing the health hazards is also important because it is employer's responsibility to ensure safety, health and welfare of the workers at the workplace, besides there are also some fatalities and permanent disabilities recorded. For example, there are workers' fatalities and permanent disabilities recorded in Department of Occupational Safety and Health (DOSH) statistics between the year 2002-2009 specifically due to health hazards, under the categories of 'over-exertion or strenuous movements' and 'exposure to or contact with harmful substances and radiation' [5-7].

More recently, between years 2014-2016, the number of occupational diseases and poisoning reported to DOSH has increased from 2648 in 2014 to 7820 in 2016 [9]. Even though, the numbers represent all types of industry covered by the DOSH, there is an urgent need to address the problems related to occupational diseases and poisoning, particularly MSDs-related injuries, as it will affect the performance of construction productivity. Occupational diseases such as MSDs are related to illness of the workers where workers affected by it are usually absent from work. This further could affect the productivity of construction.

2.2 Ergonomics in construction industry

Ergonomics can be identified with human and their occupation. Ergonomics looks at human behavioral, mental, and physiological capacities. Workplaces must be design based on the human condition for make sure there are comfortable while perform their jobs next to minimize the hazards [9].

In construction industry, there are several risk factor for every type of occupation that workers involved. Risk factors are actions or conditions that increase the likelihood of injury to the human body so there have three categories of this factor which biochemical exposures, psychosocial stressors, and individual risk factors. Ergonomics Risk Factors (ERF) are circumstances that

exist or made deliberately or accidentally that could or may add to comes about contradict or against the standards or logic of ergonomics that could or may harmful to the well-being of workers after work. The examples of ERF are awkward postures, force, repetition, vibration, static loading, contact stress and extreme temperature [9].

2.3 Work-related Musculoskeletal Disorders (WMSDs)

Many construction work tasks are physically very strenuous and the incidence of WMSDs among construction workers is considerably higher than those in most other occupations. WMSDs are injuries and disorders of the soft tissues such as muscles, tendons, ligament, joints, and cartilage that can affect nearly all tissues including the nerves and tendons that involve arms and back [9].

Table 1 shows the work-related musculoskeletal problems among construction workers according to the categories of occupation or trade [1]. There are several types of occupation which are commonly exposed to WMSDs-related risks, such as carpenters, masons, electricians, sheet metal workers, roofers, iron workers and plumbers that have their own task condition. Working patterns among construction workers are the cause of musculoskeletal disorders such as fixed or constrained body positions, continual repetition of movements, force concentrated on small parts of the body and a pace work that does not allow sufficient recovery between movements. WMSDs occur in these different types of occupation which affect the construction workers' body parts such as back, neck, shoulders and hands.

Construction workers are exposed to various WMSDs effect activities from the works they are performing, and the affected body parts include neck, shoulder, low back, wrist, hand, knee, and leg. Modified Nordic Musculoskeletal Questionnaire (NMQ) used to acquire responses regarding MSDs that the workers had experienced [4]. However, their study limits in that the data obtained were general for construction workers, which did not specifically address certain construction occupations or trades.

Therefore, using the same tool as carried out in their study [4], this study seeks to identify the WMSDs among construction trades during construction works and discuss the cause of disorders, while proposing the best practice in minimizing it among construction workers.

3. Methodology

This study involved three main stages in order to attain the aim of the study, which are field observation, workers' survey and interviews with experts.

3.1 Field observation

This study involved a walkthrough observation at the construction sites to identify which activity involved in

construction that can cause WMSDs to workers. The importance of this method is to confirm the findings from existing literature about the types of risk factors and potential WMSDs that workers are exposed to. Four construction sites were selected in which all sites were located at Perak Tengah, Perak Darul Ridzuan. From field observation and literature review, nine (9) trades or

occupations were selected to proceed with survey which are: i) masons, ii) carpenter, iii) bar bender, iv) concrete worker, v) plastering worker, vi) skim coat worker, vii) electrician, viii) plumber, and ix) others.

Table 1 WMSDs risks and body parts affected according to workers' occupation or trade

Occupation/ Trade	Task conditions	WMSDs Risks	Body Parts Affected
Carpenters	<ul style="list-style-type: none"> Overhead work Ground/Floor –level work Hand-intensive work Manual material handling 	<ul style="list-style-type: none"> Forceful exertion Awkward body postures Pressure/pinch points Hot/cold temperatures 	<ul style="list-style-type: none"> Back Neck Shoulders Fingers/Hands, Wrists Knees
Masons	<ul style="list-style-type: none"> Ground/Floor-level work Manual material handling 	<ul style="list-style-type: none"> Force Awkward postures Work in static position Pressure/pinch points Hot/cold temperatures 	<ul style="list-style-type: none"> Back (low back) Legs/knees Neck Shoulders
Electricians	<ul style="list-style-type: none"> Overhead work Ground/floor-level work Hand-intensive work Manual material handling 	<ul style="list-style-type: none"> Force (pushing/pulling wires, bending conduits) Awkward body postures Pressure/pinch points Hot/Cold temperatures 	<ul style="list-style-type: none"> Back Neck/Shoulders Wrists/hand
Sheet metal workers	<ul style="list-style-type: none"> Overhead work Ground/floor-level work Hand-intensive work Manual material handling 	<ul style="list-style-type: none"> Force Awkward postures Work in static position Pressure/pinch point Hot/cold temperatures 	<ul style="list-style-type: none"> Back Wrists/hands Knees Neck/shoulders
Roofers	<ul style="list-style-type: none"> Sloped/ elevated-level work Manual material handling 	<ul style="list-style-type: none"> Force Awkward body postures Pressure/pinch points Hot/cold temperatures Vibration 	<ul style="list-style-type: none"> Back Neck/shoulders Fingers/hands/wrists Knees Ankles/feet
Ironworkers	<ul style="list-style-type: none"> Ground/floor-level work Hand-intensive work Manual material handling 	<ul style="list-style-type: none"> Awkward body postures Force Work in static position Hot/cold temperatures 	<ul style="list-style-type: none"> Back Neck/shoulders Elbows Wrists/hands Knees
Plumbers, pipefitters, steamfitters	<ul style="list-style-type: none"> Ground/floor-level work Overhead work Hand-intensive work Manual material handling 	<ul style="list-style-type: none"> Force (upper extremities) Awkward postures Work in same (static) position Pressure/pinch points Hot/cold temperatures 	<ul style="list-style-type: none"> Back Neck/Shoulders Elbows Wrists/hands Knees

3.2 Survey

There are two types of questionnaires which are a general questionnaire and specific questionnaires used for this study. General questions are designed to determine the common problem like parts of the body that experience MSDs. For example, Fig. 1 shows the back view of human body that is divided into nine (9) regions. The respondent need to select the region that they experienced MSDs symptoms. On the other hand,

specific questionnaire consists of special questions that can analyze the severity of the symptoms in depth. The questionnaires provide useful information that helps in decision making for MSDs preventive measures.

The author brought the survey forms to the selected construction sites and directly interviewed the workers to acquire their responses in the survey form. A total of 100

workers from the selected occupations participated in this survey. The answers were analyzed based on their occupation categories.

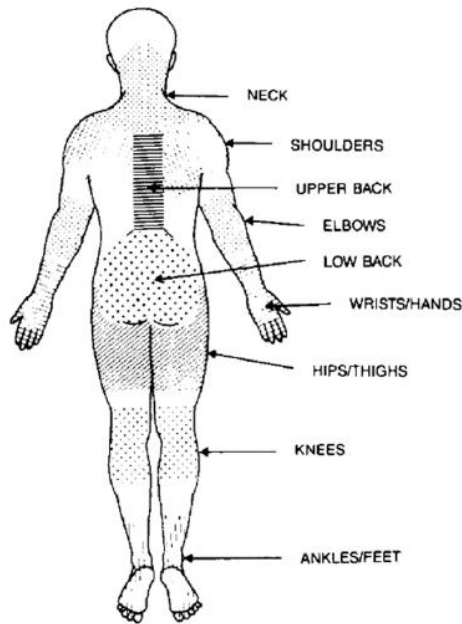


Fig. 1 Human body parts [8]

3.3 Interview with panels of expert

Once the results of the questionnaire survey were analyzed, interviews with panels of expert were conducted to obtain their opinion on the best practice in minimizing the WMSDs among workers. The panels of expert selected for this study were those who have more than five (5) years experiences in managing safety and health in construction projects and those who have experience in handling the WMSDs. Interviews were

conducted separately for each panel at their working premises.

4. Results and Discussion

4.1 Analysis of survey

The survey form consisted two parts, which are: i) part A - background of respondent; and ii) part B - WMSDs among construction workers.

4.2.1 Background of respondents

There were nine (9) types of selected occupations for this study. Table 2 shows the distribution of construction workers participated in the survey.. Carpenter, masons and skim coater are the top 3 occupations participate in the survey, while the least occupation comes from plumber. The 'others' category consists of various types of occupation which cannot be assigned to any trade, for example workers who install the lintel for window and those who scrap the floor for tiling. It is to be noted that the workers for this category

are solely doing the job task, which does not fall under the other 8 types of occupation categories.

Meanwhile, Table 3 denotes the working experience of respondents according to their ages. It could be seen that majority of the respondents aged between 34 to 41 years old and possessed 6 to 10 years working experience.

Table 2 Number of respondents according to their occupation

No.	Occupation	Number of workers
1.	Masons	12
2.	Carpenter	16
3.	Bar bender	9
4.	Concrete worker	15
5.	Plastering worker	10
6.	Skim coat worker	12
7.	Electrician	9
8.	Plumber	6
9.	Others	11
Total		100

Table 3 Respondents' working experience

Age (years old)	Working experience (years)				
	1-5	6-10	11-15	16-20	> 20
18-25	15	1	-	-	-
26-33	12	19	1	-	-
34-41	8	21	6	-	3
42-49	2	4	4	-	1
> 50	2	1	-	-	-
Total	39	46	11	-	4

4.2.2 Area of pain or discomfort after performing works

Workers in every occupation or trades experienced MSDs after performing their works. Fig. 2 shows the number of complaints on area of pain or discomfort after performing works for all respondents. From the survey carried out towards 100 respondents, the total number of complaints received were 226 cases. It can be seen that most respondents experienced pain or discomfort on shoulders, wrists/hands and low back area of the body after performing works. Meanwhile body parts like neck, elbows, upper back, hips/thighs, knees and ankles/feet received minor complaints only.

Table 4 depicts the complaints received (in percentage per number of total worker of the trade or occupation) for the area of pain or discomfort experienced by the workers after performing their works. The light-red coloured cells indicate the major complaints (percentage more than 50) of pain or discomfort experienced by workers for each trade.

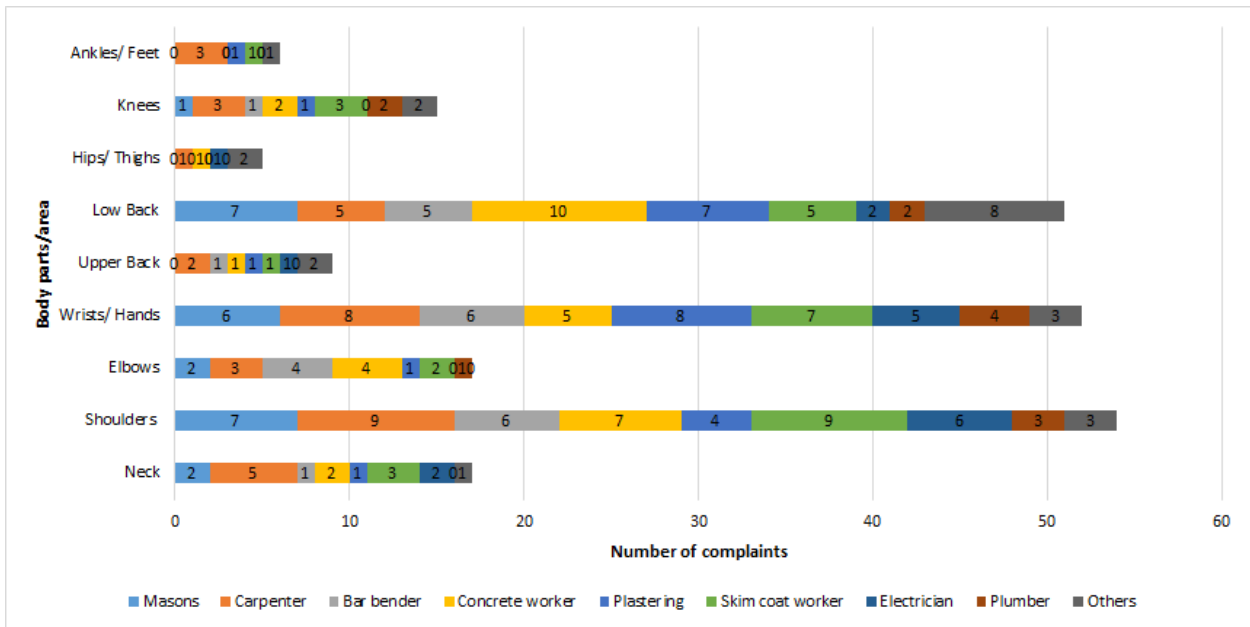


Fig. 2 Number of complaints for area of pain or discomfort after performing works

It can be seen that the highest percentage of complaints was from plastering worker trade (80%), in which most of the respondents experienced pain or discomfort on wrists/hands. This may be due to their working nature which involve extensive use of hands movement to do plastering in vertical position and at the same time, holding the harling trowel which contains the cement mixture. Constant movement of hand and wrist while doing the work could eventually cause pain on these body parts. Most of the plastering workers surveyed also

experienced low back pain or discomfort (70%). The reason to this is may be due to the constant stooping while scooping the cement mixture onto the harling trowel before continue to the plastering work, as observed during the time of survey. Other than that, most of the skim coat workers had experienced pain or discomfort on the shoulder. The findings are quite similar with the results from previous study, they found that lower back, shoulder, and leg were the most area of pain or discomfort experienced by construction workers [4].

Table 4 Complaints received (in percentage per number of total worker of the trade or occupation) for the area of pain or discomfort experienced by the workers after performing their works

Trades	Number of workers	Neck	Shoulders	Elbows	Wrists/ Hands	Upper Back	Low Back	Hips/ Thighs	Knees	Ankles/ Feet
Masons	12	17	58	17	50	0	58	0	8	0
Carpenter	16	31	56	19	50	13	31	6	19	19
Bar bender	9	11	67	44	67	11	56	0	11	0
Concrete worker	15	13	47	27	33	7	67	7	13	0
Plastering	10	10	40	10	80	10	70	0	10	10
Skim coat worker	12	25	75	17	58	8	42	0	25	8
Electrician	9	22	67	0	56	11	22	11	0	0
Plumber	6	0	50	17	67	0	33	0	33	0
Others	11	9	27	0	27	18	73	18	18	9
Total number of complaints = 266 cases							Major respondents' complaints (in percentage) on area of pain or discomfort			

4.2.3 Major pain or discomfort while performing works

This section discusses the highest frequency of major pain or discomfort on body parts for all respondents while performing their works. The results of the top three (3) of the most frequent complaints on body parts or area of pain or discomfort are found similar to the findings from precious section. Shoulders, low back and

wrists/hands were the major area of pain or discomfort among respondents, while hips/thighs received zero complaint.

In this part, the respondents are required to select one area of body that they experienced major pain or discomfort while performing works. Fig. 3 shows the major area of pain or discomfort for all trades while performing works.

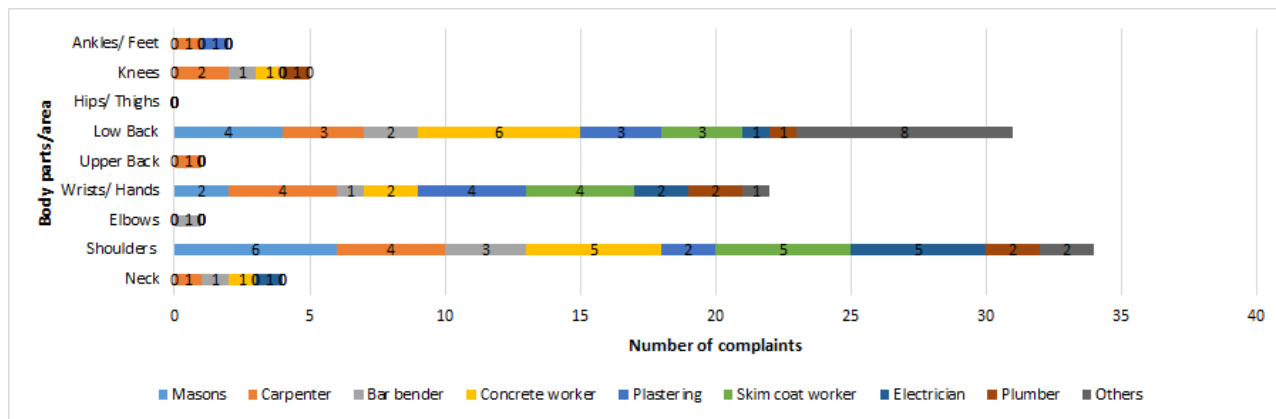


Fig. 3 Major pain or discomfort while performing works

Table 5 describes in detailed about major pain or discomfort while performing works where the major percentage are coloured in red. While performing their works, majority of the respondents from electricians (56%) and masons (50%) experienced pain or discomfort

on their shoulders. This is differs from previous study [4] where they found that upper back, lower back, and biceps were the major areas pain or discomfort while performing work.

Table 5 Complaints received (in percentage per number of total worker of the trade or occupation) for the area of pain or discomfort experienced by the workers while performing their works

Trades	Number of workers	Neck	Shoulders	Elbows	Wrists/ Hands	Upper Back	Low Back	Hips/ Thighs	Knees	Ankles/ Feet
Masons	12	0	50	0	17	0	33	0	0	0
Carpenter	16	6	25	0	25	6	19	0	13	6
Bar bender	9	11	33	11	11	0	22	0	11	0
Concrete worker	15	7	33	0	13	0	40	0	7	0
Plastering	10	0	20	0	40	0	30	0	0	10
Skim coat worker	12	0	42	0	33	0	25	0	0	0
Electrician	9	11	56	0	22	0	11	0	0	0
Plumber	6	0	33	0	33	0	17	0	17	0
Others	11	0	18	0	9	0	73	0	0	0
Total number of complaints = 266 cases						Major respondents' complaints (in percentage) on area of pain or discomfort				

4.2.4 Causes of pain or discomfort

Fig. 4 shows the causes of pain or discomfort among construction trades. The findings of this study indicated the highest frequency of causes of pain or discomfort for each construction trades.

The results show that most respondents from skim coat worker, plastering worker, carpenter, masons, plumber and electrician trades reported that repetitive works were the main reason that caused them pain or discomfort. Awkward working postures and static loading were the most causes of pain and discomfort among the respondents from bar bender, while the electrician also stated that awkward working postures were the cause of their pain and discomfort on their body parts. For concreting workers, the respondents from this trade perceived that awkward postures were the causes of pain or discomfort on their body parts. Very less workers

stated that manipulation of heavy load, high exertion and static loading are the main causes of pain or discomfort.

The results are quite different from previous study [3], in which they found that manipulation of the heavy load was the highest cause reported followed by awkward working postures, high force exertion, static loading and repetitive work. This may be due to that the previous study generalized the sampling of respondents, while this study focused categorized the workers according to their occupation or trades. The trades chosen for this study are undertaking more repetitive work while performing their works.

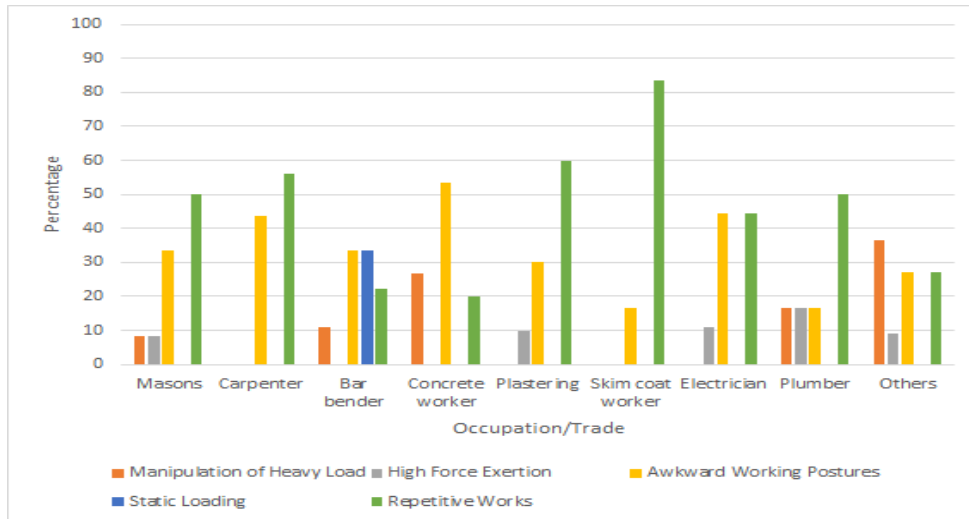


Fig. 4 Causes of pain or discomfort on body parts or area (in percentage)

4.2.5 Types of treatment for pain or discomfort

Fig. 5 shows the types of treatment on pain or discomfort among construction trades. The findings of

this study indicated the highest frequency in percentage of treatment that used among construction trades.

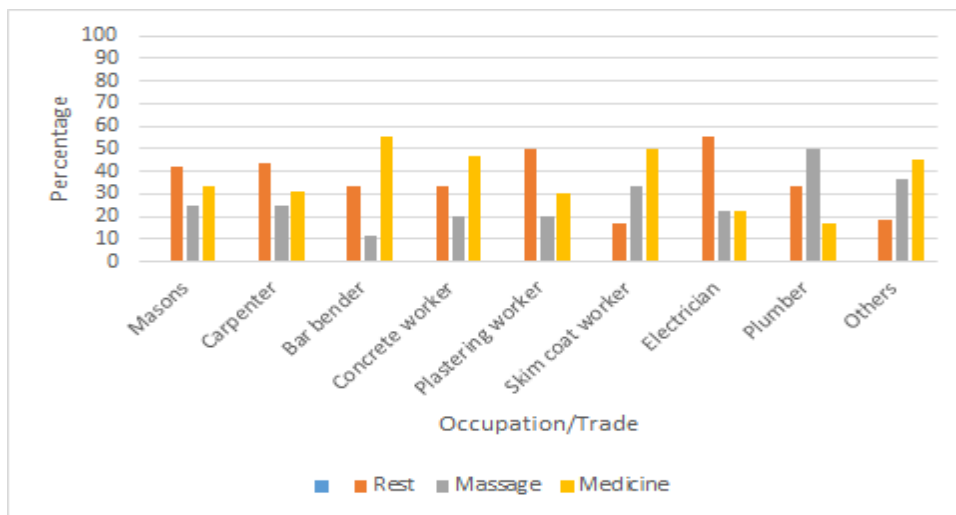


Fig. 5 Types of treatment for pain or discomfort

Fig. 5 shows that ‘rest’ treatment was chosen by most of the respondents from electrician, plastering worker, carpenter and masons trades as their preferable treatment to reduce MSDs. Next, most of the respondents from plumber trade chose ‘massage’ treatment to reduce pain or discomfort due to WMSDs. For other workers, concrete worker, skim coat worker and bar bender, majority of the respondents from these trades prefer to choose medicine because taking a medicine can heal pain or discomfort faster.

In a larger view, ‘rest’ and ‘medicine’ were the preferable type of treatment to reduce pain or discomfort

with 36% respondents chose rest and 37% respondents chose medicine, while the rest chose ‘massage’ as their treatment. The analysis also found that there are respondents who mixed the types of treatment to reduce pain or discomfort better and faster. The results of this study is in-line with the previous study that medicine is the most preferred choice of treatment [4]. This might be due to the types of treatment provided by the company, in which the workers tend to use medicine because it is provided and accessible at workplace. If there is no medicine provided, the workers might just rest to recover from pain or discomfort.

4.2.6 Recovery duration for pain or discomfort

This study also identified the frequency of recovery duration (in percentage) that every trades or occupations takes to recover from pain and discomfort, whether 0 day,

1-7 days or 8-30 days. Zero days means the workers take less than 24 hours to recover from musculoskeletal disorder while 1-7 days means the workers take about less than a week to recover from the musculoskeletal disorders. The recovery duration on pain or discomfort among respondents is shown in Fig. 6.

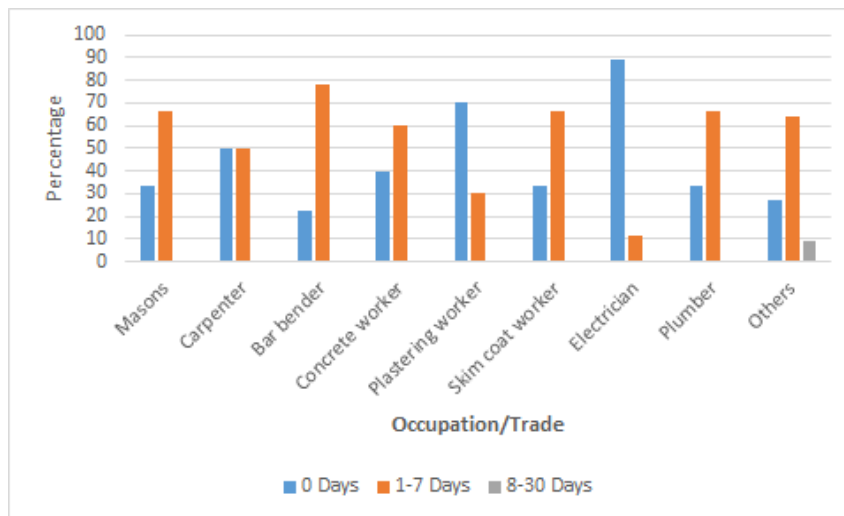


Fig. 6 Recovery duration for pain or discomfort

Out of all occupations, only carpenter has similar distribution for each recovery duration, with 8 respondents (50%) recover in 0 days and another 8 recover in 1-7 days. Majority of the respondents from electrician and plasterer take zero day to recover from pain or discomfort. This may be due to the works carried out by these trades are mostly involved wrist or hands. Whilst, majority of the respondents from masons, bar bender, concreting worker, skim coat workers and plumber took 1-7 days to recover from pain or discomfort. Most of the activities carried out by these trades has a potential to affect shoulder and lower back of the body, in which the pain or discomfort in this area is likely takes time to recover. Only 1 respondent from 'others' category responded more than 8 days to recover.

4.3 Analysis of interview

The interview sessions were conducted with eight (8) individuals who are capable to give opinion on the best practice to minimize MSDs among construction workers. The interviews involved four (4) Occupational Health Doctor (OHD), one (1) Safety Manager, two (2) Safety and Health Officer (SHO) and one (1) Site Safety Supervisor (SSS).

In their opinion about the WMSDs among construction workers, all of the interviewees agreed that WMSDs was very common, prevalent and majority of the cases were under report. There is also lack of awareness among both employers and employees that lead to worsen the MSDs effects. One of the panels also highlighted that there is no specific regulation to address WMSDs, especially for a foreign worker. Meanwhile, one of the

panels said that providing equipment and tools to reduce MSDs may incur high cost.

Next, supplied with the data of survey analysis results, the panels were asked about their opinions on the best practice to minimize WMSDs among construction workers. About six (6) out of eight (8) panels emphasized that the contractor of the project must follow the regulation related to safety and health, for example provide means for medical surveillance for their workers. This is in agreement with Abdul-Tharim et al. [8] in which better communication and management control will enhance ergonomics implementation in the workplace.

Half of the panels suggested that the employer and employees must follow Standard Operative Procedure (SOP) provided at construction site because it can help maximizing safety and health, despite operational efficiency. Other suggestions include providing construction workers with training on safe or correct handling of materials, besides just providing the right Personnel Protective Equipment (PPE) to them. All of these suggested control measures are in agreement with suggestions highlighted by previous researchers such as Abdul-Tharim et al. [9], Ahankoob and Charehzehi [11] and Kumar et al. [12].

5. Summary

Work-related musculoskeletal disorders (WMSDs) is undoubtedly a serious and widespread problem in the construction industry. Even though the effect of WMSDs may only takes place after a long period of time, the period might be reduced if the workers are performing

multiple works concurrently or exposed to the works for a longer period of time every day. In this study, a survey was conducted and the area of pain or discomfort among workers in every trades or occupations were identified. The parts of body that received complaints on pain or discomfort are shoulder, low back and wrist or hands. These body parts were the major parts that move others body. The shoulders were functioned to move the hands and waists were functions to move the upper and low body. Based on these judgements, body parts or area like shoulders, low back and wrist or hands received the major musculoskeletal disorders by the respondents. Meanwhile, the causes of this problem were due to the repetitive works as the most popular causes, followed by awkward working postures. Several strategies of best practice to minimize the WMSDs are also highlighted and discussed in this paper. The findings of the study serves as a basis for or a stepping stone towards an in-depth study on the WMSDs among construction workers.

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