

# **A Study Of Ergonomic Awareness Of Musculoskeletal Disorder (Msd) For Workers In Casting Line In Ceramic Factory**

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## **Abstract**

Workers in casting line continuously standing and squatting in order to move the ceramic mold. Awareness among those workers about these movements and its relation to Musculoskeletal Disorder (MSD) is still low. It is observed that those workers worked continuously in the same position continuously and later they suffered discomfort on their body part. The aim of this research is to identify the perception of 55 workers in Casting Line at CeramTec Innovative Ceramic Engineering (M) Sdn. Bhd. on factors that may cause MSD. Two aspects have been identified which are the workstation and MSD symptom. The findings of this research were analyzed using SPSS (Statistical Packages for Social Science) system, version 16.0. The result shows that employees who suffer MSD are considerably high. However, there were some area that were at the average level and necessary improvements are needed to minimise the risk of MSD among the workers.

**Keywords:** Ergonomic, Musculoskeletal Disorder (MSD)

## **1.0 Introduction**

According to Merriam-webster's Medical Dictionary, ergonomics is defined as “an applied science concerned with designing and arranging things people use so that the people and things interact most efficiently and safely”. Ergonomics is the science, technology and art of people at work to improve the quality of working, domestic and leisure life (Sen, 1984). Thus, ergonomics seeks to adapt tasks, working conditions, work methods, tools, machines, etc. to make them suitable for people. It is a way of looking at the overall organization of the design of tasks, tools, equipment, workplace layouts, work methods, etc. to fit the jobs to the workers, but not the other way round. (Maccollum, D.V. ,1995).

Ergonomics is concerned with making the workplace as efficient, safe and comfortable as possible (Amit B, James D. M., 1999). Effective application of ergonomics in work system design can achieve a balance between worker characteristics and task demands (Mc A. L & Corlett N.,1993). This can enhance operator productivity, provide worker safety,

physical and mental well-being and also job satisfaction. Many research studies have shown positive effects in applying ergonomic principles at the workplace which are the design of the machine, tool, environment and facilities (Tsuyoshi Kawakami, 1996).

Ergonomic injuries are those injuries caused by the presence of ergonomic risk factors, including:

- Awkward or sustained postures
- Forceful exertion or strain
- Contact pressure
- Exposure to vibration
- Exposure to heat or cold (Heinrich H. W. ,1959).

Ergonomic injuries may be referred to as Repetitive Stress Injuries (RSIs), Repetitive Motion Injuries (RMIs), Musculoskeletal Disorders (MSDs), Cumulative Trauma Disorders (CTDs), or Cumulative Trauma Injuries (CTIs). OSHA and NIOSH typically use the term MSD or Musculoskeletal Disorder (Tirthankar.G., et. al, 2010).

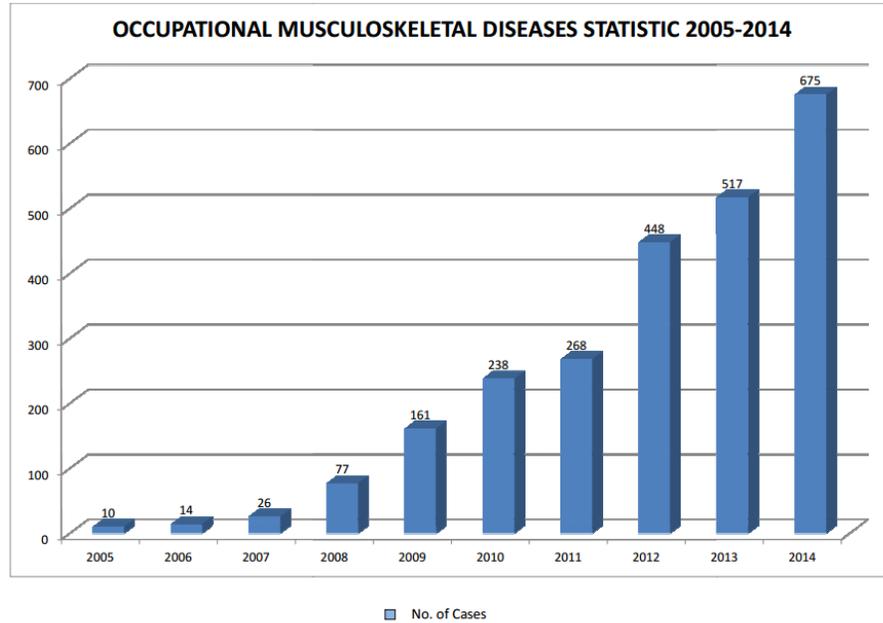
## **2.0 Background of study**

OSHA has issued an ergonomics standard to reduce MSDs developed by workers whose jobs involve repetitive motions, force, awkward postures, contact stress and vibration. The principle behind ergonomics is that fitting the job to the worker through adjusting a workstation, rotating between jobs or using mechanical assists, MSDs can be reduced and ultimately eliminated. (DOSH, 2014).

Work related MSDs are among the most frequently reported causes of lost or restricted work time. In 2011, the Bureau of Labor Statistics (BLS) reported that industries with the highest MSD rates include health care, transportation and warehousing, retail and wholesale trade and construction. According to BLS, the 387,820 MSD cases accounted for 33% of all worker injury and illness cases in 2011.

Based on the annual reports (2005-2014) that received by DOSH Seremban shows the increasing number of occupational musculoskeletal diseases. Most of the diseases caused by ergonomics factor. The study found that occupational safety and health committee is necessary for the role and responsibilities of occupational health and safety besides that it is also to ensure continued progress in addressing the issue of health. The committee is also responsible for making the study and research on the level of occupational safety and health. (Heinrich H. W. ,1959).

The reports of occupational musculoskeletal diseases are recorded as in Figure 2.1. (SOSCO, 2014).



Source: SOCSO Annual Report

Source: SOCSO Annual Report (2005-2014)

**Figure 2.1:** Statistics of occupational musculoskeletal disease

Investigation conducted by DOSH Seremban show the statistic of diseases and poisoning occupational by sector as shown in Table 2.1.

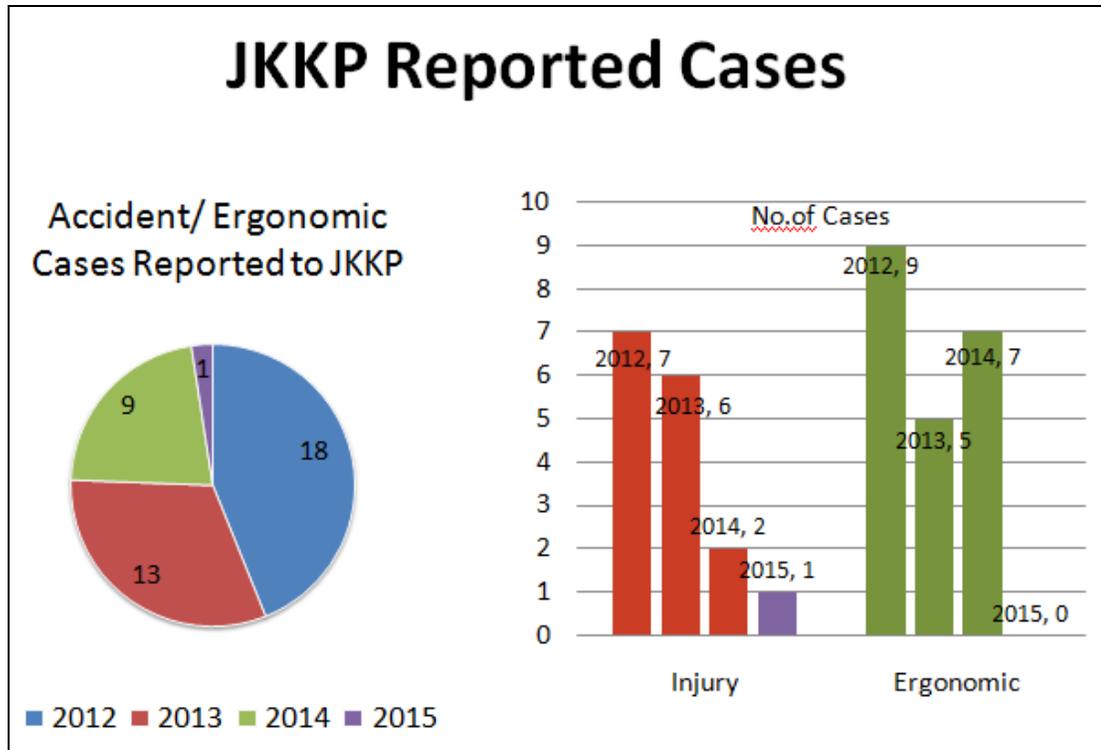
**Table 2.1:** Statistic of diseases and poisoning occupational by sector

STATISTICS OF DISEASES AND POISONING OCCUPATIONAL BY SECTOR INVESTIGATED FOR THE YEAR 2014						
	Manufacturing	Quarry/Mine	Plantation	Facility	Financial Services	Public Service
Occupational Lung Diseases (OLD)	3	2	0	1	2	20
Occupational Skin Diseases (OSD)	2	0	0	0	0	2
Occupational Noise Induced Hearing Loss (NIHL)	786	10	27	42	3	3
Occupational Muscular - Skeletal Disorders (OMD)	42	0	0	3	13	2
Occupational Poisoning	4	0	2	0	2	0
Disease cause by Physical Agent	0	0	0	0	0	0
Disease cause by Biological Agent	0	0	2	1	1	5
Occupational Cancer	0	0	0	0	0	0
Psychosocial Problem	0	0	0	0	0	0
Other Types of Occupational Diseases	1	0	0	0	0	5
Non Occupational Diseases	1	0	1	1	2	0

Occupational Health Division,  
Department of Occupational Safety & Health, Malaysia

Source: DOSH Seremban (2014)

According to the table, the highest problem occurred in manufacturing industry were Occupational Noise Induced Hearing Loss (NIHL) and Occupational Muscular - Skeletal Disorders (OMD/ MSD). Based on a report received from CeramTec Innovative Ceramic Engineering (M) Sdn. Bhd.(2012-2015), it showed the increasing number of problem regarding ergonomics in years 2013 to 2014. The reports of the ergonomic injury are recorded as in Figure 2.2. (JKKP,2014)



**Figure 2.2:** Accident or ergonomic cases reported since 2012 -2014

## 2.1 Problem statement

Yeow and Sen (2002) stated that the awareness of ergonomics in Malaysia is still low, although Kogi and Kawakami (1997) indicated that these awareness were rising in the Asia-pacific region. Thus, the objective of this survey is to identify the level of awareness among workers in casting line production on MSD which could influence their safety, health, skill and productivity. Decreasing productivity and performance are also related to MSD. The equipment, workplace and environment need to be designed according to the ergonomic specification (Kroemer and Grandjean,1997). The second objective is to produce designs or recommend appropriate ergonomic equipment in order to improve and reduce MSD among workers in casting line.

### 3.0 Methodology

According to figures obtained, the total number of population (N) is 55 people. Therefore, based on the statistical table's Krejeie and Morgan, 1970, the sample size is about 48 people. The number and sample of the population in the casting process is shown in the table 3.1 on the next page (Krejeie, R. V. and Morgan ,1970)

**Table 3.1:** Total population and sample in casting process

Department	Population	Sample
Casting Process	55	48

Source: CeramTec Innovative Ceramic Engineering (M) Sdn. Bhd.

### 3.1 Sample Selection Method

The method of sample selection made by the researchers in this study was using simple random selection method by distributing questionnaire to each employee in the casting line.

### 3.2 Research Instruments

The main instrument in this study wa a set of questionnaire that was distributed to the respondents (employees). The respondents were asked about condition of the workstation and any problem about musculoskeletal disorder. Likert scale used in this survey are as follows: (1) "Strongly Disagree", (2) "Disagree", (3) "Neutral" (4) "Agree", (5) "Strongly Agree". The questionnaire among workers was divided into two parts:

- i) Respondent demographics
- ii) Perception of the employee on the factors causing problem of musculoskeletal disorder.

The first part of this questionnaire is a tool for researchers to know the differences in the level of MSD problem by all items that have been expressed. The second part of this questionnaire was to seek employee opinion on factors that cause MSD. This section contained 30 items based on two (2) dependent variables:

- i) Workstation
- ii) Musculoskeletal disorder

Variables identified in this section are based on the Occupational Safety and Health Act 1994, the annual report of Department of Occupational Safety and Health (DOSH). Summary of distributions in the second part of this item are shown in Table 2 below:

**Table 3.2:** Schedule of items according to dependent variable

No.	Dimension Of Variable	Item Number
1.	Workstation	1 - 15
2.	Musculoskeletal disorder	16 - 30

A pilot study was carried out for questionnaire validation phase. In this study, a pilot study conducted by distributing questionnaires to 10 respondents at random. Then, the questionnaires were collected and analyzed in terms of reliability in the form of a score of Alpha-Cronbach with the help of computerized statistical software SPSS version 16.0. Based on the analysis of 10 sets of questionnaires, score points for Alpha-Cronbach obtained for each domain and the entire item is shown in Table 3.3. Thirty items were analyzed.

**Table 3.3:** Decision analysis pilot study

No.	Domain Items	Alpha Score - Cronbach
1.	Cronbach A	0.947
2.	Cronbach B	0.906

Based on the score - the score Alpha - Cronbach obtained, is available score - the score exceeds minimum score of 0.7 as prescribed. The scores indicated that the questionnaire developed has good reliability and acceptable with a good level of consistency. Thus, the questionnaire has high reliability.

### 3.3 Method of Analyzing Items

Research results can be described using two types of tests, descriptive statistics and statistical inference (Mohamad Najib ,1999). In this study, descriptive statistics were used to describe the sample as the mean value, frequency and the percentage that can provide a clear statement about a matter under review. To interpret the mean value obtained, the researchers set up the interpretation of the mean value to reflect the high level, medium level and low level as shown in Table 3.4 on the side. Interpretation min is used for all research questions involving the use of Likert scale.

**Table 3.4:** Estimated value min

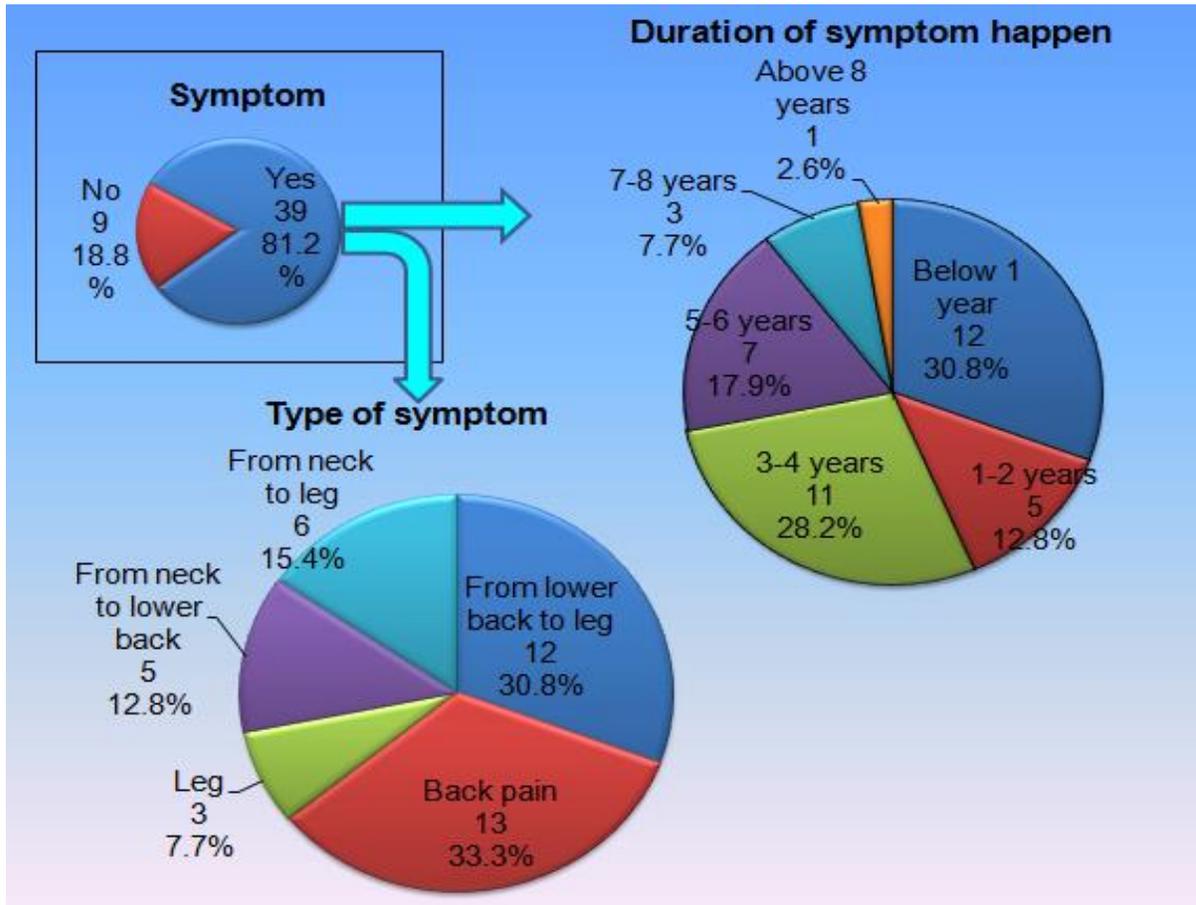
Min	Interpretation	Size
1.00 to 2.49	Strongly disagree & Disagree	Low
2.50 to 3.49	Neutral	Medium
3.50 to 5.00	Strongly agree & Agree	High

*Source: Landell (1977)*

### 4.0 Result

Figure 4.1 shows the differences of respondents' distribution according to symptom regarding MSD. It shows that 81.2% (39) of respondents say "Yes" that they are having a symptom, where, 16.8% (9) say "No" that they doesn't have any symptom regarding to MSD. Next, from the 81.9% (39) respondents who said yes, they were asked the question about the duration of symptom happened and type of symptom.

For the duration of symptom happened, 30.8% (12) have experienced that symptom below 1 years, 12.8% (5) between 1-2 years, 28.2% (11) between 3-4 years, 17.9% (7) between 5-6 years, 7.7% (3) between 7-8 years and lastly 2.6% (1) is more than 8 years. These data shows, most workers had MSD symptom 71.8% (28), which happened below 1 years to 3 – 4 years. Meanwhile , for type of symptom, 33.33% (13) of them have back pain, 30.8% (12) feel symptom from lower back to leg, 15.4% (6) have pain from neck to leg, where 12.8% (5) feel that symptom from neck to lower back and lastly 7.7% (3) feel pain at leg. These data shows, most workers have experienced waist and back pain 76.9% (30) which cover the pain symptom at lower back to leg, back pain and neck to lower back.



**Figure 4.1:** Respondents' distribution by symptom

#### 4.1 Perception of The Employee on The Factors That Cause MSD.

Part B has two (2) domains respond to each research question stated before. Every domain has 14 items related to the research question. The analysis being made based on each related domain.

#### 4.1.1 Workstation

The first domain has 14 items related to the information of existing workstations in the workplace. Each item in the first domain is to answer the research question "Does the existing design meet the needs of workers in reducing the problem of MSDs among workers?" Table 1 shows the items and the mean score was obtained.

Refer to Table 4.5, the results for the entire analysis domain of shows the majority of respondents answer low based on the value 2.84 of the overall mean score within scale 2.50 – 3.49. This domain also shows, the highest mean score of 3.33 on the first item and the lowest mean score of 2.23 on the item.

The highest mean scores 3.33 was first item is average which is the scale 2.50 – 3.49 shows the respondents have agree with all facilities available at the workstation. This mean the workers agree the company had provide all necessary equipment at workstation, but is it all the facilities really mate the opearator. Then, the lowest mean scores 2.23 was item fourtheen is low which is the scale 1.00 – 2.49 shows the respondents have to work either standing or sitting during a 12 working shift. This may cause highly stress among the workers and next can be occurs the MSD symptom like back and waist pain.

**Table 4.5:** Analysis item for workstations

No	Statement	Mean Scores
1.	There are facilities available at the workstation.	3.33
2.	Workstation is a comfortable place.	2.98
3.	Workstation does not cause back pain.	2.32
4.	I am satisfied with the conditions provided at the workstations.	3.31
5.	The equipment provided is adjustable to suit my work.	3.24
6.	I need to change the height of the desk.	2.35
7.	Higher appropriate work desk with myself.	2.34
8.	Repeated movements during work.	2.48
9.	Use of the machine is compatible with the way I work.	3.25
10.	Machine control systems are easily to achieve.	3.23
11.	The uses of technology in the workstation ease for me to do work.	3.25
12.	Personal protections equipment is provided in each workstation.	3.26
13.	I have space to seat or standing at the workstation.	2.26
14.	I can work either standing or sitting.	2.23
Overall Mean		2.84

Scale: 1.00 – 2.49 = Low; 2.50 – 3.49 = Medium; 3.5 – 5.00=High

#### 4.1.2 Musculoskeletal Disorder

The second domain also has 15 items related to information of MSD among the workers in CeramTec. Each item in the second domain will answer the research question on "How the attitude of the workers in industrial sector in order to practice the procedures and working steps that concerned of ergonomics factor regarding MSDs?" Table 4.6 shows the items and the mean score was obtained.

Table 4.6 shows the results for the entire analysis domain with the majority of respondents answer high based on the value 3.92 of the overall mean score within scale 3.50 – 5.00. This domain also shows, the highest mean score of 4.52 on the item eighteen and the lowest mean score of 3.43 on the item twenty five.

The highest mean scores 4.52 was item eighteen is high which is the scale 3.50 – 5.00 shows the respondents have suffer from back pain while performing work by standing. This mean most of workers were agree they have suffer from back pain while performing work by standing. These matter can affect the safety and health, productivity and skill on workers for the long period. Correction must done to avoid any MSD, such as put suitable ergonomic equipment which mate the physical of operator. Then, the lowest mean scores 3.43 was item twenty five is average which is the scale 2.50 – 3.49 shows the respondents' opinion the pain medication has little affect on their pain. This could be cause that the workers are not taking proper medical but they still have been repeating the same movements during work.

**Table 6:** Analysis item on musculoskeletal disorder

No	Statement	Mean Scores
15.	I have to stand all along I work in here.	3.56
16.	I not allowed to sit while on duty.	3.95
17.	I understand the cause of my back pain.	4.02
18.	I suffer from back pain while performing work by standing.	4.52
19.	Back pain limits my movements.	3.95
20.	I can stand as long as I want, but it increase pain.	3.98
21.	This pain makes me depressed.	3.69
22.	I had time off work in the past due to back pain.	3.68
23.	The pains that I experience interfere with my work performance.	3.67
24.	I can't do a good job because of the pain that I experienced.	4.23
25.	Pain medication has little affect on my pain.	3.43
26.	I can't tolerate the pain I have without having to	3.67

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	use pain medication.	
27.	I need support tools that can reduce back pain.	4.51
28.	The factory party concerned on workers health.	3.95
	Overall Mean	3.92

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Scale: 1.00 – 2.49 = Low; 2.50 – 3.49 = Medium; 3.5 – 5.00=High

## 5.0 Discussion

In developing countries, the scale of use of human resources in small-scale industries is enormous and it is a labor-intensive sector. In this situation, it is obviously that very small improvements in working conditions, implements, tool design or working methods can lead to large benefits (Sen, R.N., (1984). It is believed that the occupational health programs in developing countries should focus more on the informal sector where a large portion of workers are employed (Kromhout,H., 1999). Unfortunately, the traditional approach to occupational health has tended to concentrate mostly on factory and mine workers in urban industrial settings and has neglected the occupationally related health problems in the informal or unregulated sector where the majority of many developing countries' population lives and works (Christiani,D.C., et.al. 1990). This is so in spite of the fact that this sector is more vulnerable for musculoskeletal injuries, accidents and poisoning (Glass, B., 1998). This traditional approach should be changed as experience and evidence have proved the importance of small-scale industries in diverse socio-economical aspects and sustainable development (Chen, M., et.al., 1999).

The first domain involves facilities provided for employees at workstations. The findings of this study show the average of overall mean score was at a low level that is at 1.95 out of 5.00. The majority of ergonomics shortcomings and important factors for musculoskeletal symptoms in casting operation originated from designed workstation. It could, therefore, be concluded that any working conditions improvement program in this industry had to focus on designing ergonomics-oriented casting workstation (Choobineh A.R., 2004).

Through the findings of the first domain, it can be seen the items that need to be given more attention by the factory side in order to ensure that the workers are free from discomfort while doing the work. This can be seen on the item "I need to change the height of the desk" and "Seats are available on a workstation" with the Mean scores at 2.35 and 2.34 respectively. At the low mean score between 1.00-2.49, the researchers found that employees are comfortable with the height of the desk and there are a handful of employees are less satisfied with the facilities provided at the workstation. But it can be improved by providing a small crane that can help in lifting the mould.

In the second domain which involves work posture that causes MSD, it was identified that the working posture and task should be designed to avoid strain and damage to any part of the body such as the tendons,

muscles, ligaments and especially the back. Knowledge of the context and type of postures is necessary in order to examine their associations with health related outcomes (Taylor and Francis,1994) During work, employees subconsciously tend to accept and adapt to unsatisfactory working conditions. They may not realize that their body is under strain until they feel actual pain and even then they may not understand the causes. Manual tasks in different industries are performed in variety of ways where employees have to maintain basic body postures. There are three main working postures that exist in the common industries which are standing posture, standing posture, and sit – stand posture. A workstation can either be designed for tasks to be performed while standing or sitting postures.

Through the findings of study in the second domain, the overall mean scores is at the average 3.92 which is high. The egitheen item shows a high level at mean scores of 4.52 out of 5.00. This means that the workers know the cause of the back and waist pain they experience. On the item “ I can’t do a good job because of the pain that I experienced” and“ I need support tools that can reduce back pain” it also at high level of means scores at 4.23 and 4.51 respectively. The researchers found that the workers cannot stand too long without increasing their pain and they cannot sit during on duty. But it can be improved by providing a chair or tools that can support the body while they work by standing. For example like in figure 5.1 below. This design was created to support body posture and support leg muscle. Those tools can be adjusted to any position.



**Figure 5.1:** Chairless chair

Improper design of standing workstation may create risks the employee’s body system due to localized fatigue that can cause pain and discomfort to the muscles of the back, neck and shoulders, and the joints of the knees, ankles, hips, shoulder, and elbows (Dahalan J., et.al, 2003).

## 6.0 Conclusion

From the findings show employees at CeramTec aware about the factors that cause MSD. Therefore, it needs to have a guideline for factories that workstation adjustment and arrangement equipment condition and facilities for their workers may have an impact on workers' Musculoskeletal Disorder symptoms. There are items in research domain which show mean scores on moderate value, so, factories should improve the quality of workplaces and support equipment that can help workers at CeramTec to reduce their Musculoskeletal Disorder problems.

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