

## ORIGINAL ARTICLE

# Work-related Musculoskeletal Disorders Among Workers in Food Manufacturing Factories in Hulu Langat, Selangor, Malaysia

Mohd Asrul Ahmad<sup>1,2</sup>, Farah Ayuni Shafie<sup>1</sup>, Mohd Izwan Masngut<sup>1</sup>, Megat Azman Megat Mokhtar<sup>1</sup>, Abdul Mujid Abdullah<sup>1</sup>

<sup>1</sup> Centre of Environmental Health and Safety, Faculty of Health Sciences, Universiti Teknologi MARA Selangor, 42300 Puncak Alam Campus, Malaysia

<sup>2</sup> Hulu Langat District Health Office, Jalan Reko, 43000 Kajang, Selangor

## ABSTRACT

**Introduction:** In the food manufacturing sector, workers can be exposed to occupational hazards including work-related musculoskeletal disorders. This study was conducted at food manufacturing factories in Hulu Langat, Selangor with the objectives to identify prevalence and risk factors that contributed to musculoskeletal disorders (MSDs) occurrence among the workers. **Methods:** A number of 132 workers from ten food manufacturing factories were surveyed. From the survey, 65.2% of the workers were males and 34.8% were female, and 40.2% of them were between 28-35 years old and the majority (66%) of them were migrant workers. The self-administered questionnaire contain questions on socio-demography together with MSDs assessments and identification, namely the Nordic Musculoskeletal Questionnaires and Rapid Entire Body Assessment (REBA). The questionnaires basically evaluated which body parts were affected and determined the impacts of MSDs by referring to perceived scores. **Results:** The result shows that the highest prevalence of musculoskeletal disorders within the past 12 months was ankles/feet (46.2%), followed by wrist/hands (45.6%), elbow (40.9%), shoulders (31.1%), lower back (28%), neck (25%), knee (20.5%), hips/thighs (15.2%) and the lowest was the upper back (10.6%). There are associations between postural angles, age and sign and symptoms of work-related musculoskeletal disorders. **Conclusion:** Food manufacturing workers were highly exposed to MSDs since they were exposed to awkward postures, repetitive motion and manual lifting of heavy loads. Therefore, the employers are advised to take preventative steps such as modifications to existing equipment and changes to work practices to reduce the incidence of MSDs cases in food manufacturing setting.

**Keywords:** MSDs, food manufacturing, prevalence, REBA

## Corresponding Author:

Farah Ayuni Shafie, PhD  
Email: farahayuni@uitm.edu.my  
Tel: +6012-5542362

## INTRODUCTION

Musculoskeletal disorders (MSDs) present a significant threat to public health especially for working persons in many work sectors. Working in jobs that are not ergonomically sound can contribute to the development of pain, musculoskeletal disorders and even disability (1). Ergonomic related disorder has recently emerged as a near endemic trend in the workplace. Social Security Organization (SOCISO) had reported an exponentially increasing trend in reported MSDs cases (2). MSDs

even present a challenge to the medical professions for accurate diagnosis and treatments are often difficult (3). MSDs also represent a variety of possible underlying causes. Some consider MSDs an enigma, because they may develop silently and with seemingly non-localized symptoms. There are various factors that influence the occurrence of musculoskeletal disorder (MSDs) such as using forceful exertion, performing strenuous physical work or continuously performing repetitive task. Besides, the MSDs can also be caused by working in difficult postures or sustained and repeated postures (4). Physical working conditions related to sick leave caused by MSDs were awkward work posture and heavy lifting. Stretching and compression of tendons and nerves occur when parts of the body are near the limits of their range of motion. The longer it is maintained in a

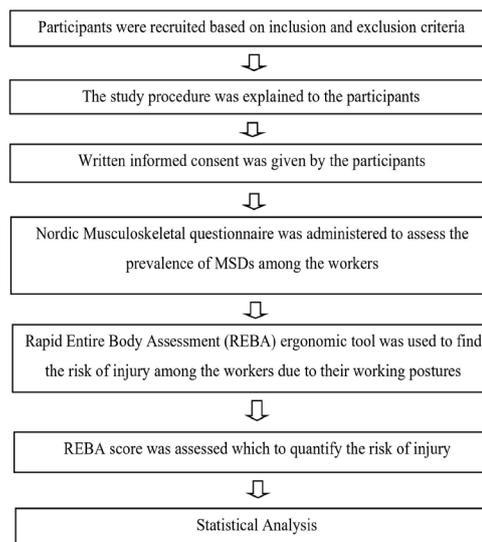
fixed or awkward body position, the more likely it is to develop MSDs. The contracted muscles squeeze the blood vessels, which restricts the flow of blood all the way down the working muscles (5).

In Malaysia, work-related MSDs in food processing industry is yet to be fully understood. The study in food processing factory stems from the fact that the manufacturing sector was one of the most affected by the occurrence of MSDs (6). Manual material handling, lifting, pushing or pulling heavy objects and also working with heavily bent or twisted trunk or hand and arms above shoulders were the example of physical factors and nature of work at the food manufacturing factories. The job task in processing involved preparation and manufacturing of food product as packaging task focuses on packaging and labelling of ready products while storing task focuses on storing of product in warehouse and transfer to transport for retail. This study focused on assessing the prevalence and the risk factors of work-related musculoskeletal disorder among workers in food processing factories in Hulu Langat, Selangor. This study would also like to determine the body parts of workers affected by the musculoskeletal disorders. Identifying variables in the workplace design or administrative processes that may lead to MSDs can be part of the initial evaluation. If reducing or eliminating ergonomic hazards becomes successful, the management of any organization or industry can reduce the loss time due to MSDs, injury and cost of compensation. An ergonomic tool called Rapid Entire Body Assessment (REBA) were used to assess the musculoskeletal injuries of the workers due to their faulty postures, over exertion and repetitive movements. REBA ergonomic tool has been found to be an appropriate method to assess the risk factors which were responsible for producing the entire body disorders on the workers who performed various tasks. The tool is a combination of posture and force assessment and thus provides a single score which quantified the risk among the workers. These assessments were used to assess the risk factors of work-related MSDs among workers in food processing factories.

**METHODS AND MATERIALS**

The study was carried out in ten food processing factories under the small and medium enterprises (SMEs) category in Hulu Langat, Selangor. Hulu Langat is establishing as yet another high-development area, as a peripheral agricultural supply zone that buffers core industrialisation in the Klang Valley. The factories were selected for being the top companies in manufacturing their products for domestic and export purposes according to Hulu Langat District Health Office. The factories produce coffee, flour, noodles, biscuits, chocolates, soy sauce, bread and others. The total number of workers were 200 people and 132 workers were required for the study according to the sample size calculation by Raosoft software. The workers selected

for this study must had worked for at least one year in the food manufacturing factories. Workers with trauma injury or precedence of MSDs prior to their current work were excluded. The participants were chosen from three main task groups that were processing, packaging and storing. They were briefed about the survey and assessment before written consent forms were taken. The social demographic information of the workers i.e. age, education background, race/nationality, height and weight and total working hours were surveyed before the ergonomic assessments.



**Fig 1: Procedure of the study**

This study comprised direct observation, interview with administered questionnaires, REBA assessment of body postural angles and data analysis (Fig. 1). The Nordic musculoskeletal questionnaires and REBA worksheet were used for assessment. REBA is one of the most extensively utilised validated and reliable observational ergonomic assessment tools across a wide range of industries and services introduced by two industrial ergonomists (7). The REBA assesses the entire body, including the upper and lower arms, the wrist, the neck, the back, and the legs during their work. Comparison of the position or postures of each body segment of the workers were made to those outlined on the REBA data collection form. Based on these postures, the REBA assigns a score to each body segment. The Nordic musculoskeletal questionnaire is a general questionnaire consisting of 40 forced-choice items designed to identify areas of the body that cause musculoskeletal problems. A body map aids completion by indicating nine symptom sites: neck, shoulders, upper back, elbows, low back, wrist/hands, hips/thighs, knees, and ankles/feet. Ethical approval and permission to conduct the study was granted by the UiTM ethics committee (reference number 600-IRMI (5/1/6)). Results were presented as descriptive analysis for demographic data. Chi square

independence analysis using crosstab was conducted on ergonomic data by using SPSS version 22.

## RESULTS

### Socio-demographic analysis

The analysis shows that out of 132 workers, 86 workers (65.2%) were males and 46 workers (34.8%) were female. The highest group of workers were between 28-35 years old (40.2%) while the highest height group (39.4%) was between 166-170 cm and the highest weight group (56.8%) was between 65-74 kg. Most of the workers were migrant workers (66%) and had at least primary and secondary school education. All respondents were full time workers and worked 8 hours a day. Some workers (22.7%) reported that they sometimes requested to work for over-time up to 12 hours. The workers had received food handlers training but did not have any specific training for ergonomics at the workplace. There were thirteen tasks from three main departments of the food processing factory that were processing, packaging and storing. The tasks such as processing involved preparation and manufacturing of food products, while packaging task focused on packaging and labeling of products while storing task was to store products in warehouses and transfer products for sale.

### Tasks with body posture analysis and REBA score

Table I shows the summary of the findings with 132 workers who were involved in the Rapid Entire Body Assessment (REBA) assessment. This tool provides the score that takes all the body parts (trunk, legs, neck, arms and wrists) into account. A number of 41 workers had the score (4-7) which indicate medium risk while 72 workers had the score (8-10) which indicated high risk. Lastly, 19 workers had the score (11-15) which indicated very high risk.

**Table I Summary of REBA score of critical task performed by workers**

Tasks	REBA score					Total (n=132)
	1 (neg- ligi- ble risk)	2-3 (low risk)	4-7 (medi- um risk)	8-10 (high risk)	11 + (very high risk)	
Process- ing	-	-	16	28	-	44
Packag- ing	-	-	19	25	-	44
Storing	-	-	6	19	19	44
Percent- age of workers (%)	-	-	31.1%	54.5%	14.4%	132

### Prevalence of musculoskeletal disorders among food handlers

The results obtained from the Standardized Nordic Musculoskeletal Disorder Questionnaire answered by the participants show that the highest prevalence of musculoskeletal disorders within 12 months was ankles/feet (46.2%), followed by wrist/hands (45.6%), elbow (40.9%), shoulders (31.1%), lower back (28%), neck (25%), knee (20.5%), hips/thighs (15.2%) and the lowest was upper back (10.6%). The highest prevalence of musculoskeletal disorders within 7 days was wrist/hands and elbows (100%), followed by ankles/feet (97.7%), shoulder (82.6%), lower back (78%), neck (73.5%), knee (71.9%) and hips/thigh (53%). The lowest affected areas were upper back which was with 37.1%.

**Table II Analysis between body postural angles, age and work-related musculoskeletal disorders for the past 12 months**

Musculoskeletal Disorders	Age	Task	Body Postural Angles					
			Neck Position	Trunk Position	Legs Position	Upper Arm Position	Lower Arm Position	Wrist Position
Neck	0.049*	0.100	0.009*	<0.001*	<0.001*	<0.001*	<0.001*	1.000
Shoulders	0.313	<0.001*	0.002*	<0.001*	0.823	0.003*	<0.001*	0.004*
Elbows	0.552	0.295	0.159	0.363	<0.001*	0.001*	0.636	0.003*
Wrists/Hands	0.002*	<0.001*	0.016*	<0.001*	0.025*	<0.001*	<0.001*	0.761
Upper Back	0.610	0.020*	0.182	<0.001*	0.079	0.021*	0.074	<0.001*
Lower Back	0.647	0.614	0.003*	0.627	0.521	0.041*	0.003*	0.002*
One or Both Hips/Thigh	0.728	0.001*	0.075	0.001*	<0.001*	<0.001*	0.008*	0.728
One or Both Knees	0.126	0.070	0.025*	0.002*	0.004*	<0.001*	0.001*	<0.001*
One or Both Ankles	0.167	0.017*	0.045*	0.305	<0.001*	<0.001*	0.146	0.062

\ \*significant at p-value<0.05

**Table III Analysis between body postural angles, age and work related musculoskeletal disorders for past 7 days**

Musculoskeletal Disorders	Age	Task	Body Postural Angles					
			Neck Position	Trunk Position	Legs Position	Upper Arm Position	Lower Arm Position	Wrist Position
Neck	0.414	<0.001*	<0.001*	<0.001*	0.001*	0.002*	<0.001*	0.042*
Shoulders	0.358	<0.001*	<0.001*	<0.001*	0.012*	0.038*	<0.001*	0.779
Elbows	Constant	Constant	Constant	Constant	Constant	Constant	Constant	Constant
Wrists/Hands	Constant	Constant	Constant	Constant	Constant	Constant	Constant	Constant
Upper Back	0.487	<0.001	0.258	0.001*	<0.001*	<0.001*	0.025*	1.000
Lower Back	0.978	0.254	0.026*	<0.001*	0.003*	<0.001*	0.297	0.342
One or Both Hips/Thigh	0.509	0.001*	0.083	<0.001*	<0.001*	0.052	<0.001*	0.096
One or Both Knees	0.594	0.081	0.166	<0.001*	<0.001*	<0.001*	<0.001*	0.493
One or Both Ankles	0.210	0.046*	0.001*	0.014*	0.822	0.267	0.024*	0.164

\*significant at p-value<0.05.

**Table IV Analysis on the postural angles of body part for all workers**

Position	Number of Respondents (n)	Mean	Median	Standard Deviation
<b>Neck</b>				
< 20°	21	1.84	2.00	0.367
> 20°	111			
<b>Trunk</b>				
< 20°	35	2.02	2.00	0.746
> 20°	97			
<b>Legs</b>				
30°- 60°	103	1.22	1.00	0.416
> 60°	29			
<b>Upper Arm</b>				
20°- 45°	71	2.64	2.00	0.773
45°- 90°	61			
<b>Lower Arm</b>				
60°- 100°	35	1.73	2.00	0.443
< 60° and > 100°	97			
<b>Wrist</b>				
< 15°	58	1.56	2.00	0.498
> 15°	74			

**Association between postural angles, age and work-related musculoskeletal disorders**

The Chi-square test of independence determines whether there is a statistically significant relationship between categorical variables. Table II shows the result of analysis between body postural angles, age and work related musculoskeletal disorders for the past 12 months. Most of the p-value shows significance which reflect association between angles, age and work-related musculoskeletal disorders. Table III shows the result of analysis between body postural angles, age and work related musculoskeletal disorders for the past 7 days. The elbows and wrists/hands disorder were experienced

by all the workers, hence the constant value. Table IV shows the analysis on the postural angles of the body parts during work. Neutral position is a comfortable position that the body can maintain with little effort. It should be maintained to provide the body with biomechanical advantages while performing the duties. The neutral position should relieve stress on the musculoskeletal system. Based on postural angles analysis, the findings show that workers are exposed to work-related disorders from excessive out of range motions due to repetitive tasks, awkward posture, excessive manual handling and the urgency to complete their task within time given.

## DISCUSSION

### Prevalence of musculoskeletal disorders among food manufacturing workers

The prevalence of work related musculoskeletal disorder among the workers in the last 12 month and 7 days may be caused by their routine task in processing, packaging and storing. Manual handling during transferring of raw materials, packaging and wrapping products, emptying and filling the conveyors and lifting products have the potential to cause work-related MSDs (6, 7). The highest prevalence of MSDs was for wrist/hand and elbow with 100% in last 7 days. Workers who were exposed to repetitive hand movement has higher chance of experiencing wrist/hand pain than workers than those who were not exposed to repetitive hand movement (8). Thetkathuek et al (9) also found workers perform routine tasks with poor posture for an extended period of time may develop MSD symptoms. The workers had symptoms such as neck pain, elbow pain, shoulder pain, low back pain, hip pain, knee pain, foot pain and hand pain. Manufacturing workers were known to be a high risk population for lower back pain (4, 10, 11, 12). Muscle fatigue and pain develop due to the exposure they receive from repetitive tasks, uncomfortable posture and long hours of work. Working in abnormal posture can cause injury and damage to body tissue from the overstretching of ligament, muscles and tendons (7). The awkward posture of the wrist like twisting and bending had been associated with MSDs in which the occurrence of wrist disorder is associated to the angles of wrist and the force applied (13). Besides, prolonged standing also can lead to MSDs (14, 15).

### Association between postural angles, age and work-related musculoskeletal disorders

There were relationships between age, gender and occupational group for the highest prevalence of MSDs symptoms in various manufacturing industries (8, 9, 10, 11, 16). This study concur with previous studies with the p-value <0.05, showing that there is association between age and musculoskeletal disorders (neck and wrists/hands), work tasks and musculoskeletal disorders (shoulders, wrists/hands, upper back, one or both hips/thighs and one or both ankles), neck position and musculoskeletal disorders (neck, shoulders, wrists/hands, lower back, one or both knees and one or both ankles), trunk position and musculoskeletal disorders (neck, shoulders, wrists/hands, upper back, one or both hips/thighs and one or both knees), legs position and musculoskeletal disorders (neck, elbows, wrists/hands, one or both hips/thighs, one or both knees and one or both ankles), upper arm position and all musculoskeletal disorders, lower arm position and musculoskeletal disorders (neck, shoulders, wrists/hands, lower back, one or both hips/thighs and one or both knees) and wrist position and musculoskeletal disorders (shoulders, elbows, upper back, lower back and one or both knees). Individual factors such as age

can be considered a factor which can be used for the diagnosis of disc degeneration, a disease that may cause low back pain (10). The effects of non-neutral joint angles on muscle strength can be seen from both a physiologic and a biomechanical standpoint. As a result of poor workplace ergonomics and personal work styles, workers automatically develop uncomfortable neck and shoulder posture. Forward flexion of the neck and protraction and internal rotation of the shoulders are common shoulder and neck positions. These positions have the potential to cause harm.

Modifications to existing equipment, changes to work practices, and the purchase of new tools or other devices to aid in the production process have all been part of these factories interventions. Injury prevention programs should consist of work practice and good working posture, administrative control, engineering control and safety committee. The way workers perform their daily routine should be changed with work practice controls such as postural improvement, proper body mechanics, pacing and timely rest stop. Workers should also be accessible to the use of suitable personal protective equipment such as padded gloves to reduce direct or stress contact with hard, sharp, or vibrating surfaces, facilitated movements with machinery and getting assistance from colleagues and job stretching exercises. Administrative controls, in the context of ergonomics are the changes in the way the work in a job is scheduled or assigned. As for administrative control, employee rotation, alteration of work space and alternative tasks can be instigated. The administrative controls that could be proposed in manufacturing settings include reducing the frequency, duration and exposure to ergonomic hazards. For example, workers should be allowed resting time if they are in pain to prevent further force on the affected body part on top of the normal break in place. The worker's upper body alignment is determined by the position of his or her feet and legs. Proper foot support allows for adequate space under the thighs and allows the worker to sit comfortably against the backrest. Workers who must stand constantly may also incur postural stress, chronic fatigue and musculoskeletal pain. Important factors to consider include footwear, standing surface, extent of body movement, predominant posture of the neck and trunk and nature of the work activity. A company's overall strategy to incorporate protection into all activities is reflected in the process safety committee.

## CONCLUSION

Musculoskeletal disorders are an emerging occupational health issue that can have serious implications for both the worker and the employer, including the food manufacturing factory. Acknowledging the problem within the industry could save the musculoskeletal disorder from becoming a major burden to the individual, society and services. Repeated activation of the same muscles without relaxation were evident among the food

manufacturing workers. Preventing musculoskeletal disorders in the workplace by prioritizing ergonomic framework is usually cost-effective and has the added benefit of reducing fatigue and increasing efficiency.

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