INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 12, Issue 10, (2022) E-ISSN: 2222-6990

An Investigation of Ergonomic Risk Factors and Occupational Safety and Health (OSH) Performance

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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v12-i10/15386 DOI:10.6007/IJARBSS/v12-i10/15386

Published Date: *03* October 2022

Abstract

In Malaysia, studies have shown that low employee performance occurs due to accidents, health problems and stress at work. This situation affects the performance of the organization, reduces the quality of work, increases the cost of workers' compensation and ultimately interferes with the development of the organization and the growth of the national economy. This study aims to examine the level of employee awareness of ergonomic risk factors and occupational safety and health performance. A total of one hundred and forty-five respondents from several manufacturing companies in the state of Selangor, Malaysia were analyzed through distributed questionnaires. Five dimensions are involved as independent variables to measure ergonomic risk factors, namely awkward posture, static work posture, repetitive movements, vibration and physical environment while safety and health performance as a dependent variable is measured through occupational pain, job stress and occupational accidents. The study found that ergonomic risk factors affect occupational safety and health performance in the workplace. The results of the study stated that the emphasis on ergonomic risk factors should be emphasized in order to improve occupational safety and health performance. This element is not only able to increase the productivity of the organization but is also able to provide benefits especially to the manufacturing sector as a guideline in implementing measures to prevent occupational accidents, occupational pain and occupational stress.

Keywords: Ergonomic, Risk Factors, Occupational Safety, Health Performance, Manufacturing Sector

Introduction

Referring to the industrial master plan in Malaysia, the development of the manufacturing sector has been carried out in the direction of activities with an import-substitution pattern. Based on the report, the sales value of Malaysia's manufacturing sector in April 2018 recorded a growth of 8.2% to RM 65.5 billion compared to RM 60.5 billion as reported in April last year.

The manufacturing sector in import-substitution is able to lead economic growth in Malaysia through exports based on the industrialization strategy and is still the main contributor to the country's economic growth until now. Even so, from another point of view related to the manufacturing industry, cases of occupational accidents also increase in line with economic growth. According to Suchman (1961), an event that occurs can be classified as an accident if it is unforeseeable, unavoidable and unintentional. According to data from Health & Safety Executive in 2020, more than 3.5 million people work as shift workers in the United States. They range from a variety of industries including emergency services, healthcare, utilities, transportation, manufacturing (including the oil, gas & chemical industries), entertainment and retail. The arrangement of shift work is one of the causes of accidents when long working hours and imbalanced rest periods can lead to fatigue, accidents, injuries and health problems. The situation becomes more troubling when most workers in the manufacturing sector involve repetitive movements or strong energy to perform job tasks. The presence of one or more ergonomic risk factors for employees increases the issue of stress and mental problems of an employee. This is because the amount of time required for muscles to recover from strenuous activity tasks is increasing. If the recovery time is insufficient, the presence of ergonomic risk factors will accelerate the state of stress, fatigue and create various effects related to health.

In this era of globalization, human factors and ergonomics (HFE) has become a core and profile issue for various fields that for years and now shows improvement in the industry. To ensure an ergonomic work environment, design needs to be given special attention (Butlewski, 2014; Selamat et al., 2020) and workplace evaluation (Lasota, 2017). Ergonomic risk factors are described in the form of work-related musculoskeletal disorders (WRMSDs) which are a common cause of health problems and ultimately result in absenteeism among workers (Lasota, 2020). Musculoskeletal disorders are a common issue and a serious problem in many industrial sectors (Sanjog, 2015; Lu, 2016; Lasota, 2016). The main ergonomic risk factors for WRMSD are awkward posture, repetition, excessive physical load, duration of movement and vibration. Some studies also report that disruption of these ergonomic risk factors can result in decreased productivity, work quality, and increased costs (Dunning, 2010; Bhattacharya, 2014; Selamat et al., 2020) and absenteeism (HSE, 2018; Selamat, 2016). Therefore, ergonomic risk factors need to be implemented and stated as a key element in the industry.

Based on the data of International Labor Organization (ILO) 2017 stated that almost 6300 people die every day due to occupational accidents or work-related diseases. This number accounts for more than 2.3 million deaths each year. The manufacturing sector is one of the most dangerous industries worldwide. According to Amirah et al (2013); Fatin and Selamat (2020); Selamat et al (2021) the existence of a safety culture in the manufacturing industry in Malaysia is still lacking. Although the manufacturing sector contributes expressively to the national income, this sector has the highest number of reported occupational accidents compared to other sectors. Therefore, the issue of workplace safety remains an area of interest for the manufacturing industry due to the increasing number of workplace accidents.

According to the National Statistics of Occupational Accidents and Diseases in 2019 by the Occupational Safety and Health Department of the Ministry of Human Resources, it shows a total of 40,811 occupational accidents which is equivalent to 112 cases in a day and the worker accident rate is 2.71 per 1,000 workers. The number of occupational deaths is 578 cases which is equivalent to two cases in a day and the occupational death rate is 3.83 per 100,000 workers. As for, the reporting of cases of illness and occupational poisoning is as many as 9,860 cases which is equivalent to 27 cases a day of illness have been reported. The number of reported death cases has shown a decrease of 8% from 2018 to 2019. However, the number of reported occupational accident cases has shown an increase of 13% compared in 2018 to 2019.

In addition, according to the National Occupational Accident and Disease Statistics in 2019 by the Occupational Safety and Health Department of the Ministry of Human Resources, the manufacturing sector showed the highest number of accident cases reported with 12 704 cases in a year followed by the service sector with 10 743 cases. The construction sector has shown the highest number of reported deaths with 144 cases followed by the manufacturing sector with 126 cases. Furthermore, the number of occupational illness and poisoning reports from 2016 to 2019 has shown a significant increase. Among the types of occupational diseases and poisonings reported in 2019 was occupational noise-related hearing impairment which recorded the highest number of cases with 8997 cases followed by occupational musculoskeletal disorders with 408 cases and occupational skin diseases with 137 cases. The causative factor of this disease is due to the lack of attention to the ergonomic elements implemented in the organization concerned. Occupational illness and poisoning are not only a burden to workers who may lose their source of income but also have a significant impact on the country's workforce in the long term if these problems are not identified and prevented at an early stage. Overall, the high number of accidents and occupational diseases that have shown a continuous increase is caused by the lack of attention to ergonomics in the workplace.

In this study, the ergonomic risk factor aspect uses the ergonomic risk assessment guide because it was found that ergonomic risk assessment is very important for all economic sectors in Malaysia, especially the manufacturing sector. The general purpose of this study is to identify the relationship of ergonomic risk factors in the workplace to the safety and health performance of workers. This study will also analyze the level of employee awareness of ergonomic risk factors and occupational safety and health performance in the workplace. In detail, among the elements that will be studied include studying the relationship between ergonomic risk factors (awkward posture, repetitive movements, static work posture, vibration and physical environment) with occupational safety and health performance (job stress, occupational accidents, and occupational health).

Literature Review

The most common ergonomic risks are repetitive/repetitive work activities, awkward body posture, cold/hot temperatures, contact pressure, lighting, force, static posture, and vibration. Exposure to one or more ergonomic risk factors can cause or contribute to musculoskeletal disorders (MSD) (Mahboobi, 2020). Ergonomic risk factors are studied in several elements such as awkward posture, repetitive movements, static work posture, vibration and physical environment. Ergonomic risk factors are elements in the workplace

that cause physical stress on the body, increasing the risk of musculoskeletal disorders (MSD). Ergonomic risk factors are aspects of work that can cause biomechanical stress on workers and are also situations that exist intentionally or unintentionally. It can contribute to results that are contrary to ergonomic principles and can harm the health and well-being of workers at work. Ergonomic risk factors involve attributes, characteristics or exposures that may cause or contribute to musculoskeletal injuries. Generally, two or more risk factors that exist at the same time will increase the risk of harm and injury to an individual.

In this study, awkward posture refers to the position of the body, which is the limbs, joints and back that bend significantly from the neutral position during work activities. When workers carry out tasks that involve a long period of time, they will be exposed to extreme awkward postures especially in the position of the shoulders, elbows or back significantly from the neutral position. Such a frequent body position while performing tasks will increase the pressure on the joints or discs of the spine. Therefore, the muscles do not work efficiently in awkward postures and those forces will contribute to muscle and tendon fatigue. For example, the shoulder can bend at least 90 degrees from its neutral position to retrieve an object. Examples of awkward postures are stooping, sprains and stooped postures.

In addition, repetitive movement elements are repetitive work activities that can mainly cause shoulder disorders in the tendons (Benard, 1997). Repetitive movement is also defined as the activity of repeating the same movement frequently and putting stress on one's muscles and joints. Static work posture refers to minimal, limited or no movement where the body is in a certain position for a long period of time. Prolonged fixed posture can cause fatigue, pain and injury resulting in various health disorders. Among the most common examples of activities are standing and sitting for long periods of time. Vibration is the result of the energy flow of the machine hand tool that is sent from the tool to the hand and arm expressed as hand transmission vibration (Griffin, 1996). Some studies have also shown that vibration is the energy transmitted through the worker's platform in the standing state and the contact point situation on the feet (Eger et al., 2014; House et al., 2017; Thompson et al., 2010). Hand tremors are caused by frequent exposure to high levels of vibration from tools and equipment used. Next, the elements of the ergonomic physical environment are closely related to the effects of sound, vibration, temperature, light and other components that make up the worker's environment regarding health and safety, comfort and a person's performance (Selamat, 2016). There is some empirical support for the physical interaction of environmental factors in relation to human comfort or task performance (Selamat et al., 2021: Selamat, 2013; Tiller et al., 2010).

Occupational safety and health performance refers to three main things, namely job stress or pressure, occupational accidents and occupational health aspects (Selamat, 2016). Stress is one of the unpleasant emotional feelings resulting from an individual's uncertainty about his ability to solve the challenge of achieving a goal. An accident during work is an event that cannot be expected to happen and can be categorized as either a serious accident or a minor accident. The element of occupational health is referred to as the activity of promoting and maintaining the physical, mental and social well-being of workers in all types of work at the highest level by performing disease prevention, treatment, rehabilitation and risk control activities (Selamat, 2016). Based on previous research, a study by Whittingham (2004) said that about 80% of accidents that occur are caused by mistakes made by individuals in the

organization. In addition, most fatal accidents that occur in the industrial sector are caused by the behavior of workers who are less sensitive during work (Selamat, 2016: Selamat et al., 2020). The Domino Theory by Heinrich (1931) has explained the understanding that the cause of an event is caused by factors - factors that are formed in the form of dominoes which are gradual in nature.

In addition, there are seven aspects in Beehr and Newman's (1978) general model of stress, namely personal aspects, environmental aspects, process aspects, human-caused aspects, organizational-caused aspects, adaptive response aspects and time aspects. Personal aspects and environmental aspects interact through process aspects to produce aspects of human and organizational consequences. Aspects of adaptive response further affect personal and environmental aspects. In addition, according to the ASSET Stress Model is related to job stress. The ASSET model which stands for An Organizational Stress Screening Tool by Cartwright and Cooper (2002) is a stress model used and adapted to study stress in the workplace (Viljoen & Rothmann, 2009). This model is influenced by the original pressure model studied by (Cooper and Marshall, 1978). In Beehr and Newman's (1978) model, the human consequences aspect includes the human aspects of physical and mental health. Stress affects commitment and health (Cartwright & Cooper, 2002). Therefore, employee commitment and health will be affected after experiencing stress. Stress or the effect of stress is a reaction to a stressful situation. According to the ASSET model of stress, the results of stress or effects include four aspects, namely commitment from the organization, commitment from employees, physical health and psychological well-being. Organizational commitment to individuals that is individuals hope to be trusted and respected by their organization (Cartwright & Cooper, 2002).

On the other hand, employers expect individual commitment to the organization where employees need to perform their duties as best as possible and expect them to be loyal and dedicated to the organization. Therefore, there are also problems other than stress at work that can affect the level of employee commitment. For example, industrial action occurs such as a union that feels threatened will hold a strike situation that affects the commitment of employees to the organization. Studies also show that there is a lot of evidence where job stress contributes to the effects of mental and physical well-being of employees (Kahn & Byosierre, 1992). With this, stressful conditions will further affect the health and physical well-being of employees. There are many factors affecting workload including workstation layout, job design, work tasks and methods, human-friendly tool design and employee anthropometric characteristics (Wern & Selamat, 2019; Azreen & Selamat, 2020; Selamat, 2016). Ergonomic risk factors manifest themselves in the form of work-related musculoskeletal disorders that are a common cause of health problems and pain. The issue of musculoskeletal disorders is common and a serious problem in many industrial sectors (Lasota & Hankiewicz, 2016). The main physical ergonomic risk factors for musculoskeletal disorders are awkward posture, repetitive movements, excessive physical load, duration of movement and vibration (Lasota & Hankiewicz, 2016). Studies also report that these distractions can result in decreased employee productivity, work quality, increased accident costs and absenteeism (Dunning et al., 2010). Therefore, the identification of ergonomic risk factors becomes a key element in the industry.

An ergonomic risk assessment for an organization can be carried out by considering the risks of each area and then combining the risks to implement preventive measures. Based on the study of Abdulrahman (2020), a methodology is proposed that consists of three main phases, namely identifying ergonomic risk factors, determining ergonomic risk scores and calculating and prioritizing ergonomic risks. In the first phase, based on process and task mapping techniques, the main factors that can cause ergonomic risks have been identified. In the second phase, score levels are determined for each ergonomic risk factor based on ergonomic standards developed by different organizations and researchers. In the third phase, ergonomic risks in the current workplace are calculated and prioritized so that high risks can be reduced by implementing the right action plan. The results of the study show that the proposed method can be used as a basis for identifying ergonomic risks and developing effective mitigation and control plans for each of those risks. Through this, ergonomic risk factors can be identified and can help the well-being of workers without disturbing the health and safety of workers.

In addition, in terms of occupational health, musculoskeletal disorders are a highly regarded work-related health issue worldwide. Musculoskeletal disorders account for a large proportion of work-related disorders (Punnett & Wegman, 2004) and it has been documented that musculoskeletal disorders carry enormous social costs (Buckle, 2005; Morken et al., 2003). There are several studies that report that exposure to ergonomic risk factors induces or worsens musculoskeletal disorders (Malchaire et al., 2001). Studies show that ergonomic risk factors have a significant association with back pain (Kee & Seo, 2007). In previous epidemiological studies, back pain was found to have a strong relationship with lifting movements, whole body vibration and a significant relationship with awkward posture and heavy physical work. Therefore, based on the study of Kim et al. in 2018 titled "Relationship between simultaneous exposure to ergonomic risk factors and work-related lower back pain: a cross-sectional study based on the fourth Korean working conditions survey" analyzed the relationship between ergonomic risk factors and related back pain with a job. This study aims to examine the relationship between concurrent exposure to ergonomic risk factors and work-related back pain (LBP) based on the fourth Korean Working Conditions Survey (KWCS). This study evaluated the relationship between five ergonomic risk factors and work-related back pain. The results showed that all five ergonomic risk factors, namely posture causing fatigue and pain, lifting or moving people, dragging, pushing or moving heavy objects, standing posture and repetitive hand or arm movements were correlated with work-related back pain. With this, the study shows that there is a strong relationship between exposure to each ergonomic risk factor and work-related back pain. However, when exposed to two ergonomic risk factors simultaneously, the relationship between exposure and work-related back pain was significantly weaker than when exposed to only one risk factor in this study. Therefore, an in-depth study related to ergonomic risk factors should be carried out so that workers' health is better protected and does not affect worker performance.

Overall, ergonomic risk factors play an important role in a worker's daily life. Every organization must implement ergonomic risk planning in order to be able to optimize human well-being and improve the overall performance of the organization. With this, the evaluation of ergonomic risk factors is the main step to take care of the well-being of employees in the organization, allowing for clearer work tasks, work cycles and identification of problems with the work environment. It is clear that the ergonomic risk factor is one of the needs of every

organization in order to ensure the well-being of employees and subsequently improve the effectiveness of employee performance.

Methodology

Chua (2006) stated that quantitative methods are associated with numerical data and accuracy, which is based on positive inquiry research that uses experimental studies and numerical data to be analyzed with statistical tests. In this study, a quantitative and correlational research design was used to examine the relationship between the independent variables, which are ergonomic risk factors consisting of awkward posture, repetitive movements, static work posture, vibration and physical environment with the dependent variable, which is occupational safety and health performance, which is the stress aspect, accidents and occupational health.

Data collection has been carried out around the state of Selangor. The selection of the study in Selangor is because the state of Selangor recorded the highest number of accident cases in 2019 according to statistics issued by the Department of Safety and Health, which are 9,710 cases. In this study, the selection of the manufacturing sector as the study population is due to the manufacturing sector recording the highest number of accident cases among other sectors, with a total of 12,704 accident cases in 2019. Sampling is easy to use because the researcher has easy access to the respondents. The study instrument includes three main aspects of the study, the first of which is the ergonomic risk factor which includes five aspects, namely awkward posture, repetitive movements, static work posture, vibration and physical environment. The second aspect is occupational safety and health performance which includes matters of job stress, occupational accidents, and health aspects. The following are the measurement elements used in this study involving three main parts and nine measurement elements of the study. Part A is information related to safety and health performance in the workplace, part B is related to ergonomic risk factors and part C is respondent demographic information.

Table 1
Items Measurement of Study

Section	ɛnsion	ɔach
A	*Occupational Health*	*.60*
	ıtress	.90
	pational Accident	.80
B	ʌard Posture	.68
	ɔ Posture	.75
	ıtitive Work	.66
	ıtion	.70
	ical Environment	.75
C	ographic	-

The collected data will be analyzed using Statistical Package for Social Sciences software (SPSS version 23.0). By using descriptive statistical methods, the main objective of the study is to identify the level of employee awareness of aspects of ergonomic risk factors and aspects of occupational health and safety performance at the workplace. Next, the inference method

is used to test the relationship between the variables in this study. The explanation of the strength of the relationship between the variables can be explained by the researcher by using the correlation coefficient index which is the relationship between these variables is evaluated between the ranges of -1.0 to +1.0.

Result and Discussion

Findings obtained from respondents describe demographic information such as gender, age, marital status, race, length of service and education level. A total of 145 respondents were involved in answering the questionnaire. Table 2 describes the variables and demographic distribution of the respondents as a whole in this study. The gender demographics of the respondents consisted of 82 (56.6%) males and 63 (43.4%) females. In terms of the age dimension, as many as 32 (22.0%) respondents are aged from 22 years to 26 years, as many as 55 (37.9%) respondents are between the ages of 27 to 31 years. Next, there are 26 (17.9%) respondents aged 32 to 36 and 14 (9.7%) respondents aged 37 to 41, 13 (9%) respondents aged 42 to 46. respondents and finally respondents who are 47 years old and above have the lowest number of respondents which is five (5) (3.5%) respondents.

Table 2
Demographic Descriptive Results Analysis

Items		Freq.	Percentage (%)
Gender	Men	82	56.6
	Women	63	43.4
Age	22 – 26	32	22.0
	27 – 31	55	37.9
	32 – 36	26	17.9
	37 – 41	14	9.7
	42 – 46	13	9.0
	47 and above	5	3.5
Marital Status	Single	73	50.3
	Married	72	49.7
Races	Melayu	56	38.6
	Cina	60	41.4
	India	26	17.9
	Others	3	2.1
Time Services (year)	1 – 7	89	61.5
	8 – 14	30	20.7
	15 – 21	12	8.4
	22 – 28	11	7.6
	29 and above	3	2.1
Education Level	Degree	84	57.9
	Diploma	49	33.8
	Secondary School	12	8.3

Next, it was found that the marital status of the respondents exceeded 50%, that is, 73 (50.3%) of the respondents were single and the marital status of the married respondents was 72 (49.7%) of the respondents. Furthermore, the study respondents according to the Malay race are 56 (38.6%) people, the Chinese race is 60 (41.4%) people and the Indian race is 26 (2.1%) respondents and other races are three (3) (2.1%) people. In addition, most respondents have a service period between 1 and 7 years which is 89 respondents equal to 61.5%. While the longest service period is 29 years and above, two (2) respondents equal to 1.4% have 25 years of service and three (3) respondents equal to 2.1% have 34 years of service. Respondents who have a service period of eight (8) to 14 years have 30 (20.7%) respondents. There are 12 (8.4%) respondents who have served between 15 to 21 years and 11 (7.6%) respondents who have served for 22 to 28 years. Finally, most of the study respondents have a Bachelor's level of education or higher which is 84 (57.9%) respondents and a Diploma study completion level which is 49 (33.8%) respondents. There are 12 (8.3%) respondents for the Secondary School education level.

Table 3
Overall Mean Averages for Ergonomic Risk Factors, Occupational Safety and Health Performance

Dimensions	Items	Min Average	Level of Awareness
Occupational Safety and Health Performance	40	3.28	**Average**
Occupational Pain	13	3.43	Average
Job Stress	13	3.51	Average
Occupational Accidents	14	2.92	Low
Ergonomic Risk Factors	33	2.84	**Low**
Awkward Posture	12	2.75	Low
Static Work Posture	4	3.20	Average
Repetitive Movement	5	3.03	Average
Vibration	4	2.41	Low
Physical Environment	8	2.90	Low

The occupational pain dimension showed an overall average mean value of 3.43. This shows that the level of employee awareness related to occupational pain is moderate. In addition, the job stress dimension showed an overall average mean value of 3.51. With this, the level of awareness for job stress is moderate. Next, the occupational accident dimension which shows an average mean value of 2.92. This shows a low level of awareness among respondents regarding the issue of occupational accidents. Moreover, the ergonomic risk factor variable consists of five main dimensions involved. For the first dimension, which is the dimension of awkward posture, it was found that the overall average mean was 2.75. This explains that the level of occupational awareness of awkward posture work tasks is low. For the second dimension, which is the dimension of static work posture, the overall average mean value for the four items is 3.20. While the repetitive movement dimension shows an overall average mean value of 3.03. These two dimensions show a moderate level of awareness. Next, the vibration dimension shows an overall average mean value of 2.41. While

the physical environment dimension shows a mean value of 2.90. It can be concluded that the level of employee awareness of these two dimensions is at a low level.

The correlation analysis used is Pearson's correlation. Pearson's correlation is a measure of the strength and direction of the relationship that exists between two continuous variables, namely intervals and ratios. This strength is known as Pearson's coefficient, the symbol r, is the line across most of the data between the variables. The value of r ranges from +1 to -1. The analysis shows the dimension of awkward posture with the occupational pain factor which is the value of Pearson's coefficient, r is .333, is a positive relationship and this value is significant ($p < .05$). Next, the static work posture dimension with the occupational pain factor shows the Pearson coefficient value, r is .348, a positive relationship and this value is significant ($p < .05$). The repetitive movement dimension with the occupational pain factor also produced a significant positive relationship, which is r is .415, ($p < .05$). The vibration dimension with the occupational pain factor shows the Pearson coefficient value, r is .287 which is a positive relationship and this value is significant ($p < .05$). The dimension of the physical environment with the occupational pain factor shows the value of the Pearson coefficient, r is .375, a positive relationship and a significant value ($p < .05$).

Table 4
Correlation results between Ergonomic Risk Factors and Occupational Safety And Health Performance

Dimensions	Occupational Pain	Job Stress	Occupational Accident
Awkward Posture	.333**	.213**	.358**
Static Work Posture	.348**	.324**	.434**
Repetitive Movement	.415**	.227**	.371**
Vibration	.287**	.241**	.276**
Physical Environment	.375**	.287**	.487**

Nota: ** = 0.01

In addition, the analysis shows the dimension of awkward posture with the job stress factor, which is the Pearson coefficient value, r is .213, which is a positive relationship and this value is significant ($p < .05$). Next, the static work posture dimension with the job stress factor shows the Pearson coefficient value, r is .324, a positive relationship and this value is significant ($p < .05$). Thus, the repetitive movement dimension with the job stress factor produces a Pearson coefficient value, r is .227 which shows a positive and significant relationship ($p < .05$). The vibration dimension with the job stress factor has a Pearson coefficient value, r is .241 which shows a significant positive relationship ($p < .05$). The dimension of the physical environment with the job stress factor shows a positive and significant relationship where the value of the Pearson coefficient, r is .287 ($p < .05$).

Findings show the dimension of awkward posture with the occupational accident factor which is the value of Pearson's coefficient, r is .358, is a positive relationship and this value is significant ($p < .05$). Next, the static work posture dimension with the occupational accident factor shows the Pearson coefficient value, r is .434, a positive relationship and this value is significant ($p < .05$). For the repetitive movement dimension with the occupational accident factor, the Pearson coefficient value, r is .371 which shows a positive and significant

relationship ($p < .05$). The vibration dimension with the occupational accident factor has a Pearson coefficient value, r is .276 which shows a significant positive relationship ($p < .05$). The dimension of the physical environment with the occupational accident factor shows a positive and significant relationship where the value of the Pearson coefficient, r is .487 ($p < .05$). Overall, all dimensions of the ergonomic risk factor variable showed a positive and significant relationship with occupational pain factors, stress factors and occupational accidents. For the occupational pain factor, the repetitive movement dimension shows the highest correlation value which is .415 while for the occupational stress factor, the static work posture dimension is the highest which is .324. Finally, the static work posture dimension and the physical environment dimension respectively show a high correlation value of .434 and .487 for the occupational accident factor.

Based on the findings of the level of awareness of ergonomic risk factors according to the dimensions studied, it was found that the dimension of static work posture and the dimension of repetitive movement are moderate. This study is supported by studies from Shaliza Azreen (2007); Selamat (2016) where the results on the level of awareness of employees towards ergonomic aspects in the workplace are moderate. In fact, this study is in line with a study by Jamil (2009) who found that the level of awareness of employees regarding ergonomic aspects in the workplace is moderate. The results of the study by Russo et al (2020) showed workers significantly exposed to biomechanical, ergonomic and VDU risks but not included in health surveillance programs for them had higher results for musculoskeletal disorders. Therefore, organizations should take steps to carry out interventions and training so that employees are more exposed to ergonomic risk factors faced when carrying out their tasks, especially for the manufacturing sector. In addition, the level of employee awareness of safety and health performance in the workplace is low. Based on Berhan's study (2020) concluded that workplace accidents are very high and mostly due to the absence and poor culture of PPE use which requires awareness and intervention from policy makers to improve the work environment. The findings of this study are also in line with the findings of Arif and Selamat (2020); Selamat et al (2020) where employees in the administrative department are still faced with the problem of a low level of knowledge regarding occupational safety and health performance, especially on legal information and occupational risks. A study by Yeow et al (2020) also proved that the manufacturing sector in Malaysia makes the highest claim from the total cost of accidents and injuries. This has shown that the level of employee awareness in Malaysia is still low. Through this understanding, it has been shown that when employees get information and knowledge about safety and health at work, employees will be more careful and take preventive measures when performing work tasks.

Based on the results of a correlation analysis study conducted by the researcher, it was found that all dimensions of ergonomic risk factors have a significant relationship with occupational safety and health performance. The findings from the results of the correlation analysis show that awkward posture has a positive and significant relationship with job pain among workers in the manufacturing sector ($r = 0.333$, $k < 0.01$). This study is in line with research studies that show that ergonomic risk factors have a significant relationship with back pain (Kee & Seo, 2007). Athirah and Nurul's (2020) study showed that the highest prevalence of musculoskeletal disorders among male workers in medical manufacturing companies was in the lower back (83.17%), upper back (4.38%), right shoulder (3.49%), and

left shoulder (3.49%) . Next, the results of the study show that the dimension of awkward posture also has a significant and positive relationship with job stress among workers in the manufacturing sector (r = 0.213, k < 0.01). While the results of the study show that the dimension of awkward posture also has a significant and positive relationship with occupational accidents among workers in the manufacturing sector (r = 0.358, k < 0.01). Athirah and Nurul's (2020) study also stated that 87.5 and 62.5% of participants were at high risk of injury and the risk of contributing to an accident based on the distance of their hands from the lower back and the grip of loads during duty.

Furthermore, the results of the study show that the dimension of static work posture also has a significant and positive relationship with job pain among workers in the manufacturing sector (r = 0.348, k < 0.01). Jusoh and Zahid's (2018) study proved that workers spend too much time with static postures while sitting at work leading to musculoskeletal disorders (MSD). The implication is that it is not only harmful to the human body but has also affected productivity. The results of the study show that the dimension of static work posture also has a significant and positive relationship with job stress among workers in the manufacturing sector (r = 0.324, k < 0.01). While the results of the study show that the dimension of static work posture also has a significant and positive relationship with occupational accidents among workers in the manufacturing sector (r = 0.434, k < 0.01). This study is consistent with the study of Yazuli et al (2019) stated that work postures such as prolonged standing are one of the important occupational risk factors that cause discomfort, fatigue, and long-term illness that can cause work-related musculoskeletal disorders (WMSD) among workers.

In addition, the results of the study show that the repetitive movement dimension has a significant and positive relationship with occupational pain among workers in the manufacturing sector (r = 0.415, k < 0.01). Kee and Seo's (2007) study also proved that all five ergonomic risk factors, namely posture causing fatigue and pain, lifting or moving people, dragging, pushing or moving heavy objects, standing posture and repetitive hand or arm movements are correlated with back pain. related to work. Next, the results of the study show that the repetitive movement dimension has a significant and positive relationship with job stress among workers in the manufacturing sector (r = 0.227, k < 0.01). Meanwhile, the results of the study show that the repetitive movement dimension has a significant and positive relationship with occupational accidents among workers in the manufacturing sector (r = 0.371, k < 0.01). The results of the study by Lop et al (2019) showed that ERF (i.e. repetitive movements, awkward postures, and physical contact stress) related to concrete work is one of the main contributors to muscle disorders in the body. These factors greatly affect the body muscles, nerves and tissues of the neck, shoulders, upper and lower back, upper and lower limbs and other parts of the body which in turn contribute to occupational accidents.

Thus, the study also shows that the vibration dimension has a significant and positive relationship with job pain among workers in the manufacturing sector (r = 0.287, k < 0.01). The results of the study are in line with Krajnak's study (2018) which states that occupational exposure to vibration activity is associated with an increased risk of musculoskeletal pain in the back, neck, hands, shoulders and hips. The results of the study prove that occupational exposure to vibration contributes to the development of peripheral and cardiovascular disorders and gastrointestinal problems. A study by Russo et al (2020) proved that workers

significantly exposed to biomechanical, ergonomic and VDU risks had higher results for musculoskeletal disorders. Next, the results of the study show that the vibration dimension also has a significant and positive relationship with job stress among workers in the manufacturing sector ($r = 0.287$, $k < 0.01$). Krajnak's study (2018) also states that occupational exposure to vibration can increase the risk of cancer which in turn contributes to worker stress. Furthermore, the results of the study also show that the vibration dimension also has a significant and positive relationship with occupational accidents among workers in the manufacturing sector ($r = 0.276$, $k < 0.01$).

The results of the study show that the dimensions of the physical environment have a significant and positive relationship with occupational pain among workers in the manufacturing sector ($r = 0.375$, $k < 0.01$). This study is supported by the study of Dianat et al. (2016) where environmental conditions such as noise, lighting and temperature in the environment can affect job satisfaction, occupational safety and health. Next, the physical environment dimension also has a significant and positive relationship with job stress among manufacturing sector workers ($r = 0.287$, $k < 0.01$). A study conducted by Zafir (2013) stated that stress at work nowadays is more significant than before and is one of the main causes of accidents and injuries at work. This study shows that the ergonomic workstation environment is one of the main causes of stress problems at work. Furthermore, the physical environment dimension also has a significant and positive relationship with occupational accidents among manufacturing sector workers ($r = 0.487$, $k < 0.01$). Berhan's study (2020) supports the results of this study which shows that workplace accidents in Addis Ababa are very high and mostly due to the absence and weak culture of PPE use which requires awareness and intervention from policy makers to improve the work environment. Overall, the evidence of the relationship shown by Selamat (2016) where, in order to balance the achievement of employee performance, employee job duties play a very important role in improving occupational safety and health performance, especially occupational stress and occupational health. This shows that the ergonomic risk factors faced by workers greatly affect occupational safety and health performance (Selamat & Mukhifun, 2018). Therefore, the aspects of ergonomic risk factors should be emphasized by every organization so that ergonomic risks can be mitigated and subsequently work more comprehensively.

Conclusion

The application of ergonomic risk factor assessment plays an important role for every organization to apply effectively to its employees. Management of ergonomic risk factors, especially awkward posture, static work posture, repetitive movements, vibration and physical environment are among the main factors to form effective work performance and have a positive impact on both parties involved, i.e. employees and the organization.

In addition, this study was conducted to provide knowledge about ergonomic risk factors to the industry in order to take preventive measures from being involved in occupational accidents in the organization. Stakeholders should take the opportunity to carry out an ergonomic risk assessment of employees to identify the risks that employees are facing so that remedial measures can be implemented.

There are various benefits that can be obtained for the organization and among them is an increase in the quality and quantity of the organization's output. When employees have knowledge about ergonomic risk factors through the assessment conducted, they are able to

improve their performance in the organization. Through this, employees will be equipped with awareness to prevent accidents from happening and also improve their performance while working.In addition, this study also benefits the Ministry of Human Resources because it is able to reduce the cost of employee accident expenses. This is because when employees are equipped with knowledge, then safety measures become important when they work. The government can create new policies related to the safety of workers at work. This is because the workers will gain knowledge in machine operation and safety in their organization. With this, accident cases in the organization can be reduced and further reduce occupational accident cases throughout the country as well as the cost of government spending.

Furthermore, this study can help organizations manage well-being in terms of mental and physical health of employees. The human resources department in an organization can carry out planning and arrange the type of training and development that is suitable for employees. In addition, among the recommendations of the study that would like to be proposed is that the researcher suggests that a mixed method of qualitative and quantitative methods be carried out in the future so that the data obtained is more accurate. In addition, a recommendation that organizations can use is to conduct more and extensive campaigns regarding occupational safety and health. Through the implementation of campaigns or training and development, awareness and safety reminders can be given to employees from time to time.

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