

# The relationship between potential ergonomic hazard with complaints of musculoskeletal disorders



Moch. Sahri<sup>1\*</sup>, Indira Ratu Felia<sup>2</sup>, Akas Yekti Pulih Asih<sup>2</sup>, Budhi Setianto<sup>2</sup>

## ABSTRACT

**Introduction:** The potential risk of ergonomics can cause musculoskeletal disorders (MSDs) is one of the causes of work accidents with complaints in various parts of the skeleton that are felt by a person, these complaints can be in the form of damage to joints, ligaments, and tendons. The purpose of this study was to develop potential ergonomic hazards and analyze complaints of Musculoskeletal disorders in thin plate, pipe, and machinery workshop workers of the commercial ship division of Shipbuilding.

**Methods:** This study used an observational research design with a cross-sectional design. The population used was 57 people from the thin plate, pipe, and machinery workshops in the merchant ship division, and used 50 people as samples by accidental sampling. The variables in this study were age, years of service, part of work, potential hazards of the ergonomics, and complaints of muscle disorders. The instruments used are questionnaire sheets and observation sheets contained in SNI 9011:2021. Analysis was carried out using the chi-square test using SPSS ver. 25.

**Results:** The results of this study indicate that all respondent workers are male with an age range of 21 to 45 years with a percentage (54%) aged 21-34 years, working period of 5 – 10 years a percentage (48%), and workers in the cutting or fit as much (42%). 38 respondents have a value of 7 potential ergonomic hazards which are dangerous. The neck, shoulders, lower back, and, calves are the parts that workers often complain about because they work in a sitting position with the lower back and looking down.

**Conclusion:** There is a significant relationship between the level of risk of musculoskeletal disorders and potential ergonomic hazards. Further studies with more comprehensive designs are needed to validate these findings so that can be used as protocol or in further analysis.

**Keywords:** *Ergonomic potential risk, musculoskeletal disorders, SNI 9011:2021.*

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<sup>1</sup>Department of Occupational Health and Safety, Faculty of Health, Universitas Nahdlatul Ulama Surabaya, 60237 Surabaya, East Java, Indonesia;

<sup>2</sup>Department of Public Health, Faculty of Health, Universitas Nahdlatul Ulama Surabaya, 60237 Surabaya, East Java, Indonesia.

\*Corresponding author:

Moch. Sahri;  
Department of Occupational Health and Safety, Faculty of Health, Universitas Nahdlatul Ulama Surabaya, 60237 Surabaya, East Java, Indonesia;  
[sahrimoses@unusa.ac.id](mailto:sahrimoses@unusa.ac.id)

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## INTRODUCTION

Activities carried out at shipbuilding includes the production of commercial ships, warships, and submarines as well as ship maintenance and repair. Ship production cannot be separated from human and machine labor, such as the activities carried out in thin plate workshops, machinery workshops, and pipe repair shops in the Commercial Ship Division, namely welding, cutting, and machine operators. At work, workers are required to adjust their work posture to the work they do. Unnatural work postures can cause Musculoskeletal disorders.<sup>1</sup>

Musculoskeletal disorders (MSDs) and one of the factors causing work accidents with complaints in various parts of the musculoskeletal that are felt by a person,

these complaints can be in the form of joint, ligament, and tendon damage. MSDs can range from very mild to very severe.<sup>1</sup> Musculoskeletal disorders (MSDs) are work and work performance such as unnatural posture, load, duration, and frequency as well as individual factors.<sup>2</sup> Another theory states that unnatural work positions such as too bent back, raised hand movements, and so on. The farther the position of the part from the center of gravity of the body, the higher the risk of Musculoskeletal disorders complaints. This unnatural work position is generally because the characteristics of the demands of the task, work tools, and workstations are not by the abilities and limitations of workers.<sup>3</sup> This is in line with the results of research conducted on manual handling

workers in the rolling mill section, there is a close relationship between work posture factors and the incidence of Musculoskeletal disorders (MSDs).<sup>2</sup>

Prevention and minimizing the emergence of MSDs are very necessary in the work environment. MSD prevention will benefit in the form of cost savings, increased productivity and work quality, reduced work accidents, and increased health, welfare, and job satisfaction for employees.<sup>4</sup> Therefore, this study aimed to evaluate the potential for ergonomic hazards and complaints of Musculoskeletal disorders based on SNI 9011:2021 on thin plate workshop workers, machinery workshops, and pipe repair shops, Commercial Ship Division of Shipbuilding

## METHODS

### Study Design

This study used an observational research design with a cross-sectional design. The population used was 57 people from the thin plate, pipe, and machinery workshops in the merchant ship division, and used 50 people as samples by accidental sampling

### Data collection procedures

The materials in this research are 5 variables: Age, Years of work, Section of work, Potential ergonomic hazards, and Complaints of Musculoskeletal disorders. The research sample was 50 people as samples by accidental sampling. The instruments used are questionnaire sheets and observation sheets contained in SNI 9011:2021.

### Data analysis

Data were obtained directly as primary data, then collected and analyzed using univariate and bivariate analysis. The relationship between them was analyzed using *paired t-tests*. The accepted significance value was  $p < 0.05$ . All data were analyzed using SPSS ver.20

## RESULTS

### Baseline characteristics

Based on Table 1, it is known that respondents most of them are 21-34 years old a percentage of 27 people (54%), and age 35-45 years as many as 23 people with a percentage (46%). The service period data can be seen that there are no respondents who have a working period of less than 3 months and respondents dominate the tenure of 5-10 years with a percentage (48%). In the working part variables, it is known that respondents as many as 21 respondents worked as fitters with a percentage (42%), welder workers as many as 17 respondents with a percentage (34%), and machine operators with a percentage of 12 people (24%).

### Ergonomic hazard potential data

Based on Table 2 it is known that as many as 38 respondents have the potential for dangerous ergonomics with a percentage (76%), as many as 2 respondents further observations need to be made with a percentage (4%), and as much as 10

**Table 1.** Frequency Distribution of Respondent's General Data

Characteristics	Frequency	Percentage (%)
<b>Age</b>		
21-34	27	54
35-45	23	46
<b>Years of service</b>		
< 3 months	0	0
3 months-1 year	3	6
1-5 years	7	14
5-10 years	24	48
> 10 years	16	32
<b>Work Section</b>		
Welder	17	34
Fitter	21	42
Machine operator	12	24

**Table 2.** Frequency distribution of ergonomic hazard potential data results and discussion

Potential ergonomic hazards	Frequency	Percentage (%)
Safe working conditions	10	20
Need further observation	2	4
Dangerous	38	76

**Table 3.** Frequency distribution of data risk level for musculoskeletal disorders complaints

	Risk Level							
	low		currently		tall		Total	
	n	%	n	%	n	%	n	%
Neck	32	64	5	10	13	26	50	100
Shoulder	35	70	6	12	9	18	50	100
Elbow	49	98	0	0	1	2	50	100
Arm	44	88	4	8	2	4	50	100
Hand	48	96	0	0	2	4	50	100
Upper back	48	96	0	0	2	4	50	100
lower back	20	40	18	36	12	24	50	100
Hips	48	96	2	4	0	0	50	100
Thigh	48	96	2	4	0	0	50	100
Knee	45	90	3	6	2	4	50	100
Calf	34	68	4	8	12	24	50	100
Foot	48	96	2	4	0	0	50	100

respondents in safe conditions with presentation (20%).

have a low-risk level.

### Data on the risk level for complaints of musculoskeletal disorders

Based on Table 3 as many as 13 respondents have a high level of risk of Musculoskeletal disorders in the neck with a percentage (26%), 9 respondents (18%) in the shoulder, lower back, and calves as many as 12 respondents with a percentage (24%) and 18 respondents a percentage (36%) have a moderate risk of lower back Musculoskeletal disorders and 49 respondents with a percentage (98%)

### Cross-tabulation of ergonomic hazards and work parts

Table 4 data can be seen that the ergonomic hazard potential variable affects the work section. The test results show a significance value of  $0.000 < 0.05$ .

### Cross-tabulation of musculoskeletal disorders risk levels and individual characteristics

Table 5 data can be seen that the age variable has no effect on the level of risk of musculoskeletal disorders because the test

**Table 4. Cross-tabulation of ergonomic hazards and work parts**

Effect of the Potential Hazard To The Work Section		Work Section							
		Welder		Fitter		Operator machine		Total	
		n	%	n	%	n	%	n	%
Potential ergonomic hazards	Safe working conditions	0	0	0	0	10	20	10	20
	Need further observation	0	0	0	0	2	4	2	4
	Dangerous	17	34	21	43	0	0	38	76
<b>Total</b>		<b>17</b>	<b>34</b>	<b>21</b>	<b>42</b>	<b>12</b>	<b>24</b>	<b>50</b>	<b>100</b>

**p-value: 0.000<0.05**

\*Analysis was carried out using a chi-square test. The result was considered significant if the p-value $\leq$ 0.05.

**Table 5. Cross-tabulation of risk level for musculoskeletal disorders and age**

	Age							Total	p-value	
	21-34 years old			35-45 years old			n			Percent
	low	currently	tall	low	currently	tall				
Neck	18	2	7	14	3	6	50	100.0%	0.795	
Shoulder	19	4	4	16	2	5	50	100.0%	0.698	
Elbow	26	0	1	23	0	0	50	100.0%	0.351	
Arm	22	3	2	22	1	0	50	100.0%	0.260	
Hand	26	0	1	22	0	1	50	100.0%	0.908	
Upper back	27	0	0	21	0	2	50	100.0%	0.118	
Lower back	10	12	5	10	6	7	50	100.0%	0.363	
Hips	27	0	0	21	0	2	50	100.0%	0.118	
Thigh	25	0	2	23	0	0	50	100.0%	0.183	
Knee	23	2	2	21	1	0	50	100.0%	0.359	
Calf	18	2	7	16	2	5	50	100.0%	0.936	
Foot	26	0	1	22	0	1	50	100.0%	0.908	

\*Analysis was carried out using a chi-square test. The result was considered significant if the p-value $\leq$ 0.05.

results do not show a significance value below 0.05.

Table 6 data shows that the working period has no effect on the level of risk of musculoskeletal disorders because none of the test results showed a significance value below 0.05.

Table 7 data shows that the results of the work variable test affect the level of risk of Musculoskeletal disorders showing a significant value of neck 0.001, arms 0.015, hips 0.037, and calves 0.037.

### **The cross-tabulation risk level of musculoskeletal disorders and potential ergonomics hazards**

Table 8 data shows that the results of the test show that the potential for ergonomic hazards has a significant value for the shoulder 0.022, arm 0.000, and hip 0.016.

## **DISCUSSION**

Every employment has some level of danger, both to one's health and to one's workplace. These dangers are all

connected to the kind of job you do and the environment in which you do it. Musculoskeletal problems are one of the health concerns that employees most frequently express concern about.<sup>5</sup> Musculoskeletal complaints are aches and pains that a person experiences in their skeletal muscles, which can range in intensity from very minor to quite intense. Musculoskeletal issues may develop as a result of incorrect working posture, too frequent repetitive motions, and extended workdays.<sup>2</sup>

The results of the chi-square cross-tabulation test carried out on the potential hazards of ergonomics and the work department stated that it had an effect, the test of the risk level for complaints of Musculoskeletal disorders with the work section stated that it had an effect on the neck, arms, hips, and calves, the test of the level of risk of complaints of Musculoskeletal disorders with the potential for ergonomic hazards stated that it had an effect on the shoulders, arms,

hips, and the test of the level of risk for complaints of Musculoskeletal disorders with years of service and age stated that there was no effect. In general, complaints of musculoskeletal disorders begin to be felt at working age, which is 25-65 years. The first complaint is usually felt at the age of 35 years and the level of complaints will continue to increase with age. This happens because, in middle age, muscle strength and endurance begin to decrease so that the risk of muscle complaints increases.<sup>6</sup> Based on the results of this study, it is in line with the theory explained that respondents are not at risk of experiencing complaints of musculoskeletal disorders.

A similar study conducted on labor market workers obtained a p-value of 0.022. This suggests that there is a meaningful relationship between age and MSD complaints but that is less strong in nature. The results of data collection can be known frequency age category with the emergence of MSDs complaints is the majority of respondents over the age of 30

**Table 6. Cross-tabulation of risk level for musculoskeletal disorders and working period**

	Years of service												p-value		
	3 months-1 year			1-5 years			5-10 years			>10 years				Total	
	low	currently	tall	low	currently	tall	low	currently	tall	low	currently	tall		n	Percent
Neck	1	0	2	4	2	1	17	2	5	10	1	5	50	100.0%	0.383
Shoulder	3	0	0	3	2	2	17	3	4	12	1	3	50	100.0%	0.597
Elbow	3	0	0	6	0	1	24	0	0	16	0	0	50	100.0%	0.099
Arm	3	0	0	6	1	0	20	3	1	15	0	1	50	100.0%	0.777
Hand	3	0	0	7	0	0	24	0	0	14	0	2	50	100.0%	0.219
Upper back	3	0	0	7	0	0	23	0	1	15	0	1	50	100.0%	0.890
lower back	1	2	0	3	2	2	11	7	6	5	7	4	50	100.0%	0.830
Hips	3	0	0	7	0	0	23	0	1	15	0	1	50	100.0%	0.890
Thigh	3	0	0	7	0	0	23	0	1	15	0	1	50	100.0%	0.890
Knee	3	0	0	7	0	0	20	2	2	15	1	0	50	100.0%	0.778
Calf	2	1	0	4	1	2	17	1	6	11	1	4	50	100.0%	0.649
Foot	3	0	0	7	0	0	22	0	2	16	0	0	50	100.0%	0.521

\*Analysis was carried out using a chi-square test. The result was considered significant if the p-value≤0.05.

**Table 7. Cross-tabulation of the level of risk of musculoskeletal disorders and working parts**

	work section												p-value		
	Welder			Fitter			Machine Operator			Total					
	low	currently	tall	low	currently	tall	low	currently	tall	low	currently	tall		n	Percent
Neck	5	5	7	19	0	0	2	8	0	0	4	4	50	100.0%	0.001
Shoulder	10	4	3	17	2	2	2	8	0	0	4	4	50	100.0%	0.164
Elbow	16	0	1	21	0	0	0	12	0	0	0	0	50	100.0%	0.371
Arm	17	0	0	17	4	0	0	10	0	0	2	2	50	100.0%	0.015
Hand	15	0	2	21	0	0	0	12	0	0	0	0	50	100.0%	0.132
Upper back	17	0	0	19	0	0	2	12	0	0	0	0	50	100.0%	0.237
Lower back	6	6	5	8	6	7	7	6	6	6	0	0	50	100.0%	0.264
Hips	17	0	0	21	0	0	0	10	0	0	2	2	50	100.0%	0.037
Thigh	17	0	0	19	0	0	2	12	0	0	0	0	50	100.0%	0.237
Knee	16	1	0	17	2	2	2	12	0	0	0	0	50	100.0%	0.370
Calf	12	2	3	12	0	0	9	10	2	10	0	0	50	100.0%	0.037
Foot	17	0	0	19	0	0	2	12	0	0	0	0	50	100.0%	0.237

\*Analysis was carried out using a chi-square test. The result was considered significant if the p-value≤0.05.

**Table 8.** Cross-tabulation of the level of risk of musculoskeletal disorders and potential ergonomics hazards

	Potential ergonomic hazards									N	Percent	p-value
	Safe working conditions			Need further observation			Dangerous					
	low	currently	tall	low	currently	tall	low	currently	tall			
Neck	6	0	4	2	0	0	24	5	9	50	100.0%	0.449
Shoulder	8	0	2	0	0	2	27	6	5	50	100.0%	0.022
Elbow	10	0	0	2	0	0	37	0	1	50	100.0%	0.851
Arm	10	0	0	0	0	2	34	4	0	50	100.0%	0.000
Hand	10	0	0	2	0	0	36	0	2	50	100.0%	0.720
Upper back	10	0	0	2	0	0	36	0	2	50	100.0%	0.720
lower back	6	4	0	0	2	0	14	12	12	50	100.0%	0.084
Hips	8	0	2	2	0	0	38	0	0	50	100.0%	0.016
Thigh	10	0	0	2	0	0	36	0	2	50	100.0%	0.720
Knee	10	0	0	2	0	0	33	3	2	50	100.0%	0.781
Calf	8	2	0	2	0	0	24	2	12	50	100.0%	0.150
Foot	10	0	0	2	0	0	36	0	2	50	100.0%	0.720

\*Analysis was carried out using a chi-square test. The result was considered significant if the p-value $\leq$ 0.05.

years is 21 workers (84%).<sup>7</sup> Other research carried out in the polishing part workers obtained p-value results of 0.030, it can be concluded that there is a significant relationship between age and MSD complaint in the Surya Toto Indonesia polishing section workers in 2011.<sup>8</sup>

Research that has been done states that there is no relationship between years of service and complaints of musculoskeletal disorders because most of the respondents have a working period of <5 years as many as 30 people with the category of the working period are not at risk.<sup>6</sup> The results of this study are also in line with research conducted on gold miners who also stated that there was no significant relationship between the length of service and complaints of Musculoskeletal disorders.<sup>9,10</sup> Based on the results of this study, it is in line with previous research that most respondents are not at risk of experiencing complaints of musculoskeletal disorders. This study still consists of several limitations such as compounding variables that were not controlled yet, either by analysis or design.

## CONCLUSION

There is a significant relationship between the level of risk of musculoskeletal disorders and potential ergonomic hazards. Further studies with more comprehensive designs are needed to validate these findings so that can be used as protocol or in further analysis.

## FUNDING

The authors declare no funding in this study.

## CONFLICT OF INTEREST

The authors declare no conflict of interest in this study.

## ETHICAL STATEMENT

This research has been declared to have received an ethical certificate from the Ethical Committee of Faculty of Health, Universitas Nahdlatul Ulama, Indonesia No: 400/EC/KEPK/UNUSA/2021.

## AUTHOR CONTRIBUTION

All authors contributed equally to this study.

## REFERENCES

1. Kurnianingtyas CD, Adiatmika IPG, Tirtayasa K, Surata IW. Ergonomic workstation reduces electrical activity of upper trapezius muscles, erector spinal muscles, and musculoskeletal complaints in agel fiber twisting process. *Bali Med J*. 2021;10(1):151–5.
2. Rahayu PT, Arbitera C, Amrullah AA. Hubungan Faktor Individu dan Faktor Pekerjaan terhadap Keluhan Musculoskeletal Disorders pada Pegawai. *J Kesehat*. 2020;11(3):449.
3. Tuncer S, Erden I, Aydin N, Öge D. Acute spinal cord compression in hereditary multiple exostoses: A case report. *Vol. 27, Paraplegia*. 1989. 402–405 p.
4. Bukhori E. Hubungan Faktor Risiko Pekerjaan Dengan Terjadinya Keluhan Musculoskeletal

Disorders (MSDs) Pada Tukang Angkut Beban Penambang Emas Di Kecamatan Cilograng Kabupaten Lebak Tahun 2010. *Hub Fakt RISIKO Pekerj DENGAN TERJADINYA KELUHAN Musculoskelet Disord PADA TUKANG ANGKUT BEBAN PENAMBANG EMAS DI Kec CILOGRANG KABUPATEN LEBAK TAHUN 2010*. 2010;1–93.

5. Tjahjuningtyas A. Faktor yang mempengaruhi keluhan musculoskeletal disorders (MSDs) pada pekerja informal. *Indones J Occup Saf Heal*. 2019;8(1):1.
6. Sari EN, Handayani L, Saufi A. Hubungan Antara Umur dan Masa Kerja dengan Keluhan Musculoskeletal Disorders (MSDs) pada Pekerja Laundry. *J Kedokt dan Kesehat*. 2017;13(2):183.
7. Rahayu W. Faktor-faktor yang Berhubungan dengan Keluhan Muskuloskeletal pada Pekerja Angkat-angkut Industri Pemecahan Batu di Kecamatan Karangnongko Kabupaten Klaten. *J Kesehat Masy Univ Diponegoro*. 2012;1(2):18728.
8. Handayani W. Faktor-faktor yang berhubungan dengan keluhan. 2011;12(November):44.
9. Das D, Kumar A, Sharma M. A systematic review of work-related musculoskeletal disorders among handicraft workers. *Int J Occup Saf Ergon*. 2020;26(1):55–70. Available from: <https://doi.org/10.1080/10803548.2018.1458487>
10. Choobineh A, Lahmi M, Khani Jazani R, Hosseini M, Shahnava H. Musculoskeletal symptoms as related to ergonomic factors in Iranian hand-woven carpet industry and general guidelines for workstation design. *Int J Occup Saf Ergon*. 2004;10(2):157–68.



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