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RESEARCH ARTICLE

Analysis Musculoskeletal Disorders (MSDs) Complaints in Workers at Sulawesi Utara Provincial Health Office

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ABSTRACT

Musculoskeletal Disorders (MSDs) are common among office workers globally due to repetitive static loads that strain joints, ligaments, and tendons. This study examines factors influencing MSDs complaints among North Sulawesi provincial health office workers. Using a quantitative observational approach with a cross-sectional design, data were collected from 147 out of 233 employees through random sampling in May–June 2024. Statistical analyses included the Chi-square test and logistic regression. Results indicated no significant association between gender, BMI, or exercise habits with MSDs ($p > 0.05$). However, smoking habits ($p = 0.040$), length of service ($p = 0.027$), job satisfaction ($p = 0.022$), job demands ($p = 0.012$), and work posture ($p = 0.000$) showed significant relationships with MSDs complaints. Logistic regression identified work posture as the most influential risk factor, with those in unergonomic postures having a 12.4 times greater risk of developing MSDs compared to those with ergonomic postures (Adj-OR = 12.388; 95% CI = 4.883–31.425). In conclusion, while BMI and exercise habits were not linked to MSDs, factors like smoking, service length, job satisfaction, job demands, and mainly work posture were closely associated with MSD complaints, highlighting posture as the most critical risk factor.

INTRODUCTION

Over The main Musculoskeletal disorders (MSDs) are complaints about the skeletal muscle parts a person feels, ranging from very mild to very painful. If the muscles receive static loads repeatedly and for a long time, it can cause complaints in the form of damage to the joints, ligaments, and tendons (Hout & Ryu, 2025). Complaints of damage are usually termed MSDs or musculoskeletal system injuries (Tarwaka et al., 2004). MSDs are commonly reported by office workers worldwide (Rahayu et al., 2020).

The risk of MSDS disorders is also caused by staff being unable to adapt to their workspace when using work facilities and equipment such as tables, chairs, computer devices, etc.; the presence of non-ergonomic equipment; and constraints from the workspace, such as lighting and temperature, which cause the risk of MSDs to be high (Suryani et al., 2024) (Dropkin et al., 2021).

Based on data from the Labor Force Survey (LFS) in the Health and Safety Executive (2020), it was

recorded that as many as 480,000 workers experienced musculoskeletal disorders due to work (Mallapiang et al., 2021). In Indonesia itself, as many as 40.5% of diseases involve work. A study involving 9,482 workers in 12 districts/cities in Indonesia showed that MSDs had the highest 16% (Badan Pusat Statistik, 2019). In Sulawesi Utara Province, statistical data related to MSDs still need to be adequately available.

The Regional Health Service of Sulawesi UtaraProvince is an office agency owned by the regional government that operates in the service sector; all activities in completing work use computers; working hours are 9 hours per day, with working hours from Monday to Friday.

Based on the results of observations conducted by researchers, some workers work with awkward postures and need to learn the workstation, which includes the arrangement of chairs and screen monitors. In addition, almost all chairs used for work need to be more ergonomic. Based on the results of interviews with some respondents, it is more comfortable to sit statically for> 4 hours. Based on the description above, from the results of interviews with internal parties managing the Occupational Safety program that previously there had never been an assessment of MSDs complaint factors, and for the past 10 years, there had never been an inspection of occupational safety and health at the Sulawesi UtaraProvincial Health Office. Therefore, research is needed on the Analysis of Musculoskeletal Disorders (MSDS) Complaints in Workers at the Sulawesi Utara Provincial Health Office so that it becomes the initial basis for formulating the proper control method.

METHODS

This quantitative study uses an analytical observational method and a cross-sectional design. The independent variables include BMI, length of service, exercise habits, smoking habits, work posture, work duration, and job satisfaction, while the dependent variable is Musculoskeletal Disorders (MSDs) Complaints. The study was conducted at the Sulawesi Utara Provincial Health Office during May–June 2024, with a study population consisting of 233 employees (both permanent employees and casual daily workers) who work in front of computers. The sample was taken using a random sampling method based on the Slovin formula, with 147 people. The statistical test used was Chi-square for the relationship between variables and multivariate analysis with logistic regression to determine the independent variables that most influence the risk of MSDS complaints.

RESULTS

Univariate Analysis

Table 1: Characteristics of Research Respondents

Respondent Characteristics		Frequency	
		n	%
Division/Field	Secretariat	49	33.3
	Public Health	30	20.4
	Yankes	19	12.9
	P2P	28	19.0
	SDK Farmalkes	21	14.3
Body Mass Index	Thin	21	14.3
	Normal	76	51.7
	Overweight	40	27.2
	Obesity	10	6.8
Exercise Habits	Routine	71	48.3
	Not Routine	76	51.7

Respondent Characteristics		Frequency	
		n	%
Smoking Habit	Smoke	31	21.1
	Do not smoke	116	78.9
Years of service	New	40	27.2
	Long	107	72.8
Work Posture	> action (high risk)	62	44.2
	≤action level (low risk)	85	57.8
Job satisfaction	Satisfied	131	89.1
	Not satisfied	16	10.9
Job demands	Tall	108	73.5
	Low	39	26.5
MSDs Complaints	There are complaints	46	31.3
	No complaints	101	68.7

Source: Primary Data, 2024

Based on Table 1 above, Viewed based on length of service, most respondents have worked for more than 6 years, amounting to 107 people (72.8%), and some less than 5 years, amounting to 40 people (27.2%). Viewed from the division/field, most respondents came from the secretariat division/field, namely 49 people (33.3%); the rest came from the Public Health, Health Services, P2P, and SDK Farmalkes divisions/fields. Based on BMI, most respondents had a normal BMI, namely 76 people (51.7 %). This shows that most of the study participants have a healthy weight. Viewed based on exercise habits, the majority of respondents have a habit of exercising less than 2 times a week, namely 76 people (51.7 %). Based on job satisfaction, the majority of respondents were satisfied with their jobs, namely 131 people (89.1%). Viewed based on job demands, most respondents felt high with the work demands given, namely 108 people (73.5 %). Based on the respondents' work posture, with an assessment using ROSA while working using VDU in the workplace, it is divided into two, namely no risk (<action level) and risky (> action level), the majority of respondents who have a work posture value <action level are 85 people (57.8 %). Based on the level of MSDS complaints of respondents when using VDU based on the NBM questionnaire, the majority of respondents did not have MSDS complaints, namely 101 people (68.7 %).

Bivariate Analysis

Table 2: Bivariate

Variable	MSDs Complaints				p-value
	There is		There isn't any		
	n	%	n	%	
BMI					
Thin	10	6.8	11	7.5	0.380
Normal	22	15.0	54	36.7	
Overweight	11	7.5	29	19.7	
Obesity	3	2.0	7	4.8	
Exercise Habits					
Routine	22	15.0	49	33.3	0.938
Not Routine	24	16.2	52	35.4	
Smoking habit					

Variable	MSDs Complaints				p-value
	There is		There isn't any		
	n	%	n	%	
Smoke	5	3.4	26	17.7	0,040
Do not smoke	41	27.9	75	51.0	
Years of service					
New	7	4.8	33	22.4	0,027
Long	39	26.5	68	46.3	
Job satisfaction					
Satisfied	45	30.6	86	58.5	0,022
Not satisfied	1	0.7	15	10.2	
Job Demands					
Tall	40	27.2	68	46.3	0,022
Low	6	4.1	33	22.4	
Work Posture					
<action level (low risk)	8	5.4	77	52.4	0,000
>action level (high risk)	38	25.9	24	16.3	

Source: Primary Data, 2024

Based on Table 2, most respondents have average body weight (36.7%) without MSDs complaints, with the chi-square test results showing no relationship between gender and MSDs complaints (p = 0.452). Most respondents do not exercise regularly (35.4%) and do not experience MSDs complaints, and there is no relationship between exercise habits and MSDs complaints (p = 0.613). On the other hand, 51.0% of respondents do not smoke and do not experience MSDs complaints, but there is a significant relationship between smoking habits and MSDs complaints (p = 0.021). Respondents with a work period of > 6 years (46.3%) and without MSDs complaints also show a relationship between a work period and MSDs complaints (p = 0.034). The majority of respondents who are satisfied with their jobs (58.5%) do not experience MSDs complaints, and there is a significant relationship between job satisfaction and MSDs complaints (p = 0.018). High work demands were experienced by 46.3% of respondents without MSDs complaints, but the chi-square test showed a relationship between work demands and MSDs complaints (p = 0.029). Finally, the majority of respondents with a work posture ≤ action level (52.4%) did not experience MSDs complaints, but a relationship was found between work posture and MSDs complaints (p = 0.041).

Multivariate Analysis

Based on the summary results of the chi-square test, variables were obtained that were candidates for multivariate analysis with the variables of work posture, smoking habits, social support, work demands, and length of service, which are presented in the following table:

Table 3: The Dominant Influence of Independent Variables on MSDs Complaints

Variables	B	W	Adj - OR	95%Cl	P-value
Job satisfaction					
Not satisfied	1,660	1,953	5.262	0.512-54.022	0.162
Satisfied					
Years of service					
< 5 years	-0.823	2.175	0.439	0.147-1.311	0.140
> 5 years					

Variables	B	W	Adj - OR	95%Cl	P-value
Job demands					
Low	0.778	1,770	2.178	0.692-6.856	0.183
Tall					
Work Posture					
< action level	2,517	28,077	12,388	4,883-31,425	0.000
> action level					
Smoking Habit					
Do not smoke	-1.314	4.467	0.701	0.079-0.909	0.035
Smoke					
Tall					

Source: Data Processing Results, 2024

Multivariate analysis with multiple logistic regression tests in Table 3 indicates that workers with unsatisfied job satisfaction have 5,262 times to experience MSDs complaints compared to satisfied workers (Adj -OR = 5,262; 95%Cl = 0.512-54,022; p-value = 0.162 < 0.05). Workers who have a length of service > 5 years have 0.439 times to experience MSDs complaints compared to < 5 years (Adj -OR = 0.439; 95%Cl = 0.147-1.311; p-value = 0.140 > 0, 05). Workers with high work demands have 2,178 times more MSDS complaints than low risk (Adj -OR = 2,178; 95%Cl = 0.692-6,856; p-value = 0.183 > 0.05). Workers with work posture > action level have 12,388 times more MSDS complaints compared to < action level (Adj -OR = 12,388; 95%Cl = 4,883-31,425; p-value = 0.000 <0,05). Table 9 also shows that the work posture variable is the most dominant independent variable in influencing MSDS complaints, with an Adj -OR value of 12,388.

DISCUSSION

Relationship between Body Mass Index (BMI) and MSDS complaints

The hypothesis test results show that BMI has no ties to MSDS complaints. BMI is a measure that estimates a person's ideal body weight based on a comparison of body weight and height. Skeletal muscle complaints are caused by the balance of the skeletal structure when receiving the load, both body weight and other additional loads (Tarwaka, 2015).

The absence of a relationship between BMI and MSDs complaints in workers at the Sulawesi Utara Provincial Health Service is likely because workers with the highest BMI are in the normal category. In addition, the work posture factor is awkward, and their body parts move away from their natural position, which is done continuously and for a long time because the work environment is in a closed and narrow room so that the space for movement is limited and the work station is less ergonomic, which also has an influence.

These findings align with research that states no relationship exists between body mass index and Musculoskeletal disorders (MSDs) complaints in furniture workers. It is known that the p-value is 0.486, which indicates that body mass index is not related to Musculoskeletal disorders (MSDs) complaints (Minna Rika, 2022) (Thamrin et al., 2021b).

The relationship between exercise habits and MSDs complaints

Sports are all forms of physical activity that are competitively or casually. Exercising can also reduce the risk of someone experiencing musculoskeletal disorders, and regular exercise habits can improve the quality of life and prevent osteoporosis and other bone diseases. Based on the results of the study, the majority of respondents do not exercise regularly. Based on the results of interviews and observations of workers at the Sulawesi Utara Provincial Health Office, they only exercise regularly

because office activities are shorter, starting at 07.45 to 17.00, so workers do not have time to exercise after work.

The relationship between exercise habits and MSDS complaints is insignificant (p-value = 0.938 > 0.05). It can be concluded that not exercising regularly results in MSDS complaints. The findings are in line with the research obtained. The results of statistical tests obtained a p-value of 0.708 odd ratios (OR) of 0.635 (95%CI: 0.138-2.912) (Suryanto et al., 2020). Respondents who are included in physical fitness and who do not exercise regularly will experience a 0.635 times greater risk of experiencing MSDS complaints compared to respondents who are included in physical fitness and who exercise regularly. This theory aligns with research conducted by Annisa Septiani (2017), which obtained a p-value of 0.227 OR 0.495, meaning that there is no significant relationship between physical fitness and MSDS complaints. Based on the statistical test results, a p-value of 0.708 was obtained where (p-value> 0.05) means no significant relationship exists between physical fitness and MSDs complaints.

The relationship between smoking habits and MSDS complaints

Based on the findings of the hypothesis test results, smoking habits are not related to MSDS complaints. Smoking habits are the activity of sucking or inhaling cigarette smoke using a pipe or cigarette. According to the Indonesian Ministry of Health, a cigarette has approximately 4000 chemical compounds and three main components: nicotine, tar, and carbon monoxide. The effect of smoking habits on MSDs is still debated by experts (Putra, 2023). However, several existing studies have found a relationship between smoking habits and MSDS complaints.

Smoking habits are used as variables in this study because they are based on factors in individual factors that can affect the risk of MSDs. From the statistical test results, the value taken in the chi-square test is the p-value = 0.040 <0.05. It can be concluded in this study that smoking habits have a significant relationship with MSDs complaints in workers. A direct effect on the muscles likely causes the relationship between smoking habits and MSDS complaints in this study; some chemicals in cigarettes can directly damage muscle fibers and interfere with muscle function (Thamrin et al., 2021a). The results of the study show a relationship between smoking habits and MSDS complaints. The relationship between smoking habits and MSDS complaints is in line with research. The results of statistical tests using the Spearman test showed that there was a relationship between smoking habits and MSDS complaints. The majority of respondents did not smoke and experienced MSDs complaints in the moderate category (Afro & Paskarini, 2022).

Relationship between length of service and MSDs Complaints

Based on the hypothesis test results, the service length is related to MSDs Complaints. Length of service is when a person works continuously in a company or organization; this refers to the total duration of a person being an employee in a workplace. They are based on the statistical test data using a 2x2 table where the p-value = 0.027 <0.05. It can be concluded that there is a significant relationship between length of service and MSDS complaints among workers at the Sulawesi Utara Provincial Health Office. The study results align with existing theories, which state that length of service is an individual factor affecting MSDs. The relationship between length of service and MSDS complaints in this study is likely caused by the respondents' length of service having a longer working period than others. Where they are exposed to potential hazards longer when doing work. Many workers work in unnatural positions because the workstation and work position are not ergonomic and are not considered (Tarwaka, 2015) (Boschman et al., 2015). This study is in line with the theory that complaints of Musculoskeletal Disorders (MSDs) will increase as a person's working period increases. The longer the working time or the longer a person is exposed to MSDS risk factors, the greater the risk of experiencing Musculoskeletal Disorders (Aprillia & Rifai, 2022).

Relationship between Job Satisfaction and MSDs Complaints

Based on the findings of the hypothesis test results, there is a relationship between job satisfaction and MSDs complaints. Job satisfaction is a positive feeling or attitude experienced by an employee towards their job, with a subjective assessment of how happy or satisfied a person is with various aspects of the job. Job satisfaction has a positive effect if workers are satisfied with their work. Based on the previous theory, job satisfaction is one of the work factors that can affect MSDs. As in several research results that have been conducted, job satisfaction is used as one of the research variables and a relationship between job satisfaction and MSDS complaints in workers.

Based on the statistical test data, the p-value = 0.022 <0.05. It can be concluded that there is a significant relationship between job satisfaction and MSDs complaints among workers at the Sulawesi Utara Provincial Health Office. The study results align with existing theories, that job satisfaction is one of the work factors that can affect MSDs. The relationship between job satisfaction and MSDs complaints in this study is likely due to the majority of respondents who are satisfied with their jobs compared to those who are dissatisfied with their jobs.

This finding is in line with the research results which obtained research results that showed that there was a significant relationship between complaints of lower back pain and job satisfaction (p = 0.008) in employees of Perum Bulog, Sub-Division 6, Pekalongan area. This is due to several factors, including different focuses, where job satisfaction focuses more on psychological and work environment conditions. In contrast, MSDs concentrate on information and work safety in several sectors, prioritizing good work safety (Fahmiprimanti et al., 2015) (Bazazan et al., 2019).

Relationship between job demands and MSDS complaints

Based on the findings of the hypothesis test, job demands are related to MSDS complaints. Job demands require a person to put effort or energy into their work. It is common knowledge that in companies experiencing a decline in production, many changes can occur, such as changes in social support and worker behavior due to anxiety about the uncertainty of job continuity and increased physical work demands that trigger an increase in sick absences (L. Meily Kurniawidjaja, Suharnyoto Martomulyono, 2020) (Lee et al., 2022).

The results of researchers' observations show that workers in the Sulawesi UtaraProvincial Health Office, on average, work with repetitive work every day, and lack of rest time are factors causing the relationship between work demands and MSDS complaints in workers in the Sulawesi UtaraProvincial health office. Work demands and MSDS complaints have a significant relationship (p-value = 0.012 <0.05). It can be concluded that high work demands result in MSDS complaints.

This finding is in line with the research conducted, which obtained statistical test results p = 0.018, which concluded that there was a relationship between work demands and MSDS complaints. High work demands, both physical and mental, have a significant relationship with an increased risk of musculoskeletal disorders (MSDs) (Dinar, 2017).

Relationship between Work Posture and MSDs complaints

Based on the hypothesis test results, work posture is related to MSDS complaints. Work posture is the position of the body when performing work activities. Position affects comfort and health, especially in the spine, muscles, and joints. Researchers obtained data on the work posture of workers at the Sulawesi Utara Provincial Health Office by observing and measuring body posture using the Rapid Office Strain Assessment (ROSA) questionnaire on workers when doing activities in front of the VDU, Worker's arm posture against the armrest when doing VDU activities, Worker's spine posture against the backrest when doing physical activities in front of the VDU, Worker's neck and eye posture when using a computer/laptop screen monitor, Worker's neck posture when using

a telephone, Hand posture when using a keyboard and Shoulder, arm and wrist posture when using a mouse. After that, calculate the score value of section A with section B + C to get the ROSA score.

Awkward working postures over long periods can increase the risk of musculoskeletal disorders (MSDs). When working in ergonomics, there are two types of working postures: neutral and awkward. A neutral position is a body position in which each body part is by the body's anatomy so that there is no excessive muscle contraction, shifting, or pressure on body parts (Putra, 2023).

Work posture has a positive effect if the work posture gets a value of <6 action level, which means low work posture. Conversely, work posture negatively impacts if the value is >6 action level, which means high posture. As in several research results that have been conducted, work posture is used as one of the research variables and a relationship between work posture and MSDS complaints in workers. Work posture in this study is divided into 2 categories: <action level or low risk and> action level or high risk. Based on the research results, most workers have a work posture <action level or low risk (Mallapiang et al., 2021).

Based on observations during the study, workers at the Sulawesi Utara Provincial Health Office tend to have a habit of working less ergonomically, such as working with folded legs, facing the laptop layer with a very close viewing distance, having a habit working forward while sitting in the wrong position. In addition, based on observations of researchers at the Sulawesi Utara Provincial Health Office, most of them have chairs that are not ergonomic for use in working, and some chairs cannot adjust the chair's height.

Based on the results of statistical tests, in the crosstab table using a 2x2 table using the chi-square test, Work posture with MSDs complaints has a significant relationship (p-value = 0.000 <0.05), it can be concluded that low work posture (<action level) results in MSDs complaints. It can be concluded that this study shows that work posture has a significant relationship with MSDS complaints in workers at the Sulawesi Utara Provincial Health Office. This study aligns with research proving a substantial relationship between work posture and MSDS complaints in batik makers at Batik Giriloyo, Bantul Regency, with a p-value of 0.049 (p-value <0.05) (Fitri et al., 2022).

Analysis of the most influential variables

The results of multivariate analysis using multiple logistic regression tests show that the work posture variable is the most dominant compared to other independent variables with an adj OR value of 12,388 with a p-*value* = 0.000. The logistic regression analysis results show that work posture is the most significant risk factor associated with musculoskeletal complaints in workers. Workers with non-ergonomic working postures have a much higher risk of experiencing these complaints than workers who maintain good working postures. These findings are consistent with previous research showing that poor work posture can cause excessive stress on muscles, joints, and soft tissues, increasing the risk of injury.

Although high work demands can increase the risk of MSDs, the direct influence could be better than work posture. Job demands are more related to psychological factors and work organization, while work posture is directly related to the physical load on the body. Long working hours can increase the risk of MSDs due to the accumulation of microtrauma. However, these factors do not necessarily explain why someone with a short working period experiences MSDs. Poor working posture can accelerate the occurrence of MSDs, even in new workers. Smoking can affect blood circulation and slow the healing process, but it is not a direct cause of MSDs. Job satisfaction is more related to work motivation and productivity and does not directly affect the physical burden on the body. Based on the explanation above, work posture is the most dominant risk factor for MSDs.

CONCLUSION

There is no relationship between Body Mass Index and exercise habits and complaints of Musculoskeletal Disorders (MSDs) in workers. However, there is a relationship between smoking habits, length of work, work satisfaction, work demands, and work posture with complaints of Musculoskeletal Disorders (MSDs) in workers. Based on the variable analysis, work posture is identified as the most dominant risk factor for MSDs.

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REFERENCES

Afro, H. S., & Paskarini, I. (2022). Hubungan Antara IMT dan Kebiasaan Merokok Dengan Keluhan Musculoskeletal Disorders Pada Petani Padi di Desa Doho, Kabupaten Madiun, Jawa Timur. *Preventif : Jurnal Kesehatan Masyarakat*, *13*(1), 98–111. https://doi.org/10.22487/preventif.v13i1.249

Aprillia, P., & Rifai, M. (2022). Hubungan masa kerja, postur kerja dan beban kerja fisik dengan keluhan musculoskeletal disorders (MSDs) pada pekerja industri genteng di desa Sidoluhur Sleman. *Periodicals of Occupational Safety and Health*, *1*(1), 31–40. https://doi.org/10.12928/posh.v1i1.6401

Badan Pusat Statistik. (2019). *Profil Statistik Kesehatan 2019*.

Bazazan, A., Dianat, I., Bahrampour, S., Talebian, A., Zandi, H., Sharafkhaneh, A., & Maleki-Ghahfarokhi, A. (2019). Association of musculoskeletal disorders and workload with work schedule and job satisfaction among emergency nurses. *International Emergency Nursing*, *44*, 8–13. https://doi.org/10.1016/j.ienj.2019.02.004

Boschman, J. S., Frings-Dresen, M. H. W., & van der Molen, H. F. (2015). Use of Ergonomic Measures Related to Musculoskeletal Complaints among Construction Workers: A 2-year Follow-up Study. *Safety and Health at Work*, *6*(2), 90–96. https://doi.org/10.1016/j.shaw.2014.12.003

Dinar, A. (2017). *Analisa faktor faktor risiko ergonomi dengan keluhan gejala muscoloskeletal disorders (MSDs) pada pekerja perkantoran PT X tahun 2017*. Universitas Indonesia.

Dropkin, J., Roy, A., Szeinuk, J., Moline, J., & Baker, R. (2021). A primary care team approach to secondary prevention of work-related musculoskeletal disorders: Physical therapy perspectives. *Work*, *70*(4), 1195–1217. https://doi.org/10.3233/WOR-205139

Fahmiprimanti, A., Jayanti, S., & Ida, W. (2015). Hubungan Kepuasan Kerja dengan Keluhan Nyeri Punggung Bawah Pada Karyawan Perum Bulog Kantor Sub Divre VI Wilayah Pekalongan. *Journal of Pharmaceutical Sciences*, *2*(2), 145–165.

Fitri, S., Wardiati, W., & Santi, T. D. (2022). Faktor-Faktor Yang Berhubungan Dengan Musculoskeletal Disorders Pada Pekerja Pembuat Batu Bata Di Desa Kajhu Kecamatan Baitussalam Aceh Besar Tahun 2022. *Journal of Health and Medical Science*, 29–36. https://doi.org/10.51178/jhms.v2i1.989

Hout, J. D., & Ryu, J. (2025). The association between musculoskeletal disorders and lead apron use in healthcare workers: A systematic review and meta-analysis. *Safety Science*, *181*, 106669. https://doi.org/10.1016/j.ssci.2024.106669

L. Meily Kurniawidjaja, Suharnyoto Martomulyono, I. H. S. (2020). *Teori dan aplikasi promosi kesehatan di tempat kerja meningkatkan produktivitas [sumber elektronis]*.

Lee, W., Yragui, N. L., Anderson, N. J., Howard, N., Lin, J.-H., & Bao, S. (2022). The job demand-control-support model and work-related musculoskeletal complaints in daytime and nighttime janitors: The mediating effect of burnout. *Applied Ergonomics*, *105*, 103836. https://doi.org/10.1016/j.apergo.2022.103836

Mallapiang, F., Azriful, Nildawati, Syarfaini, Muis, M., & Adriansyah. (2021). The relationship of posture working with musculoskeletal disorders (MSDs) in the weaver West Sulawesi Indonesia. *Gaceta Sanitaria*, *35*, S15–S18. https://doi.org/10.1016/j.gaceta.2020.12.005

Minna Rika, A. K. (2022). Hubungan Antara Indeks Masa Tubuh Dengan Keluhan Muskuloskeletal Disorders (Studi Kasus pada Pekerja Operator Container Crane PT. X Surabaya). *Media Gizi Kesmas*, *11*(2), 365–370. https://doi.org/10.20473/mgk.v11i2.2022.365-370

Putra, I. S. (2023). *Faktor Yang Mempengaruhi Musculoskeletal Disorders Pada Nelayan Di Pos Upaya Kesehatan Kerja Nelayan Kabupaten Maros*. Universitas Hasanuddin.

Rahayu, P. T., Setyawati, M. E., Arbitera, C., & Amrullah, A. A. (2020). Hubungan Faktor Individu dan Faktor Pekerjaan terhadap Keluhan Musculoskeletal Disorders pada Pegawai. *Jurnal Kesehatan*, *11*(3), 449–456. https://doi.org/10.26630/jk.v11i3.2221

Suryani, E., Yulius, M. N., Noviyarsi, ., & Warsito, D. P. (2024). Penilaian Faktor-Faktor Resiko Musculoskeletal Disordes Pada Pegawai Kantor PT. X Di Kota Padang. *JISI: Jurnal Integrasi Sistem Industri*, *11*(1), 1. https://doi.org/10.24853/jisi.11.1.1-8

Suryanto, D., Ginanjar, R., & Fathimah, A. (2020). Hubungan Risiko Ergonomi Dengan Keluhan Musculoskeletal Disorders (MSDs) Pada Pekerja Informal Bengkel Las Di Kelurahan Sawangan Baru Dan Kelurahan Pasir Putih Kota Depok Tahun 2019. *PROMOTOR*, *3*(1), 41–49. https://doi.org/10.32832/pro.v3i1.3143

Tarwaka. (2015). *Ergonomi Industri: Dasar-Dasar Pengetahuan Ergonomi Dan Aplikasi Di Tempat Kerja*. Harapan Press Solo.

Tarwaka, Solikhul, H., & Sudiajeng, L. (2004). *Ergonomi untuk keselamatan, kesehatan kerja dan produktivitas*. UNIBA.

Thamrin, Y., Pasinringi, S., Darwis, A. M., & Putra, I. S. (2021a). Musculoskeletal disorders problems and its relation to age, working periods, and smoking habit among fishermen. *Gaceta Sanitaria*, *35*, S417–S420. https://doi.org/10.1016/j.gaceta.2021.10.065

Thamrin, Y., Pasinringi, S., Darwis, A. M., & Putra, I. S. (2021b). Relation of body mass index and work posture to musculoskeletal disorders among fishermen. *Gaceta Sanitaria*, *35*, S79–S82. https://doi.org/10.1016/j.gaceta.2020.12.022