Original Article

Prevalence of work-related musculoskeletal disorders among laundry workers in North Sulawesi Province, Indonesia

Suarjana IWG[1], Negara NLGAM[2]

[1]Department of Public Health, Faculty of Sport Science and Public Health, Universitas Negeri Manado, Tondano, North Sulawesi 95618, Indonesia

[2]Department of Occupational Health and Safety, Faculty of Health Sciences, Bali International University, Bali 80239, Indonesia

Corresponding author:

I Wayan Gede Suarjana, M.Erg
Department of Public Health,
Faculty of Sport Science and
Public Health,
Universitas Negeri Manado,
Tondano, North Sulawesi 95618,
Indonesia
Jl. Kampus Unima, Tonsaru, Kec.
Tondano Sel., Kabupaten
Minahasa, Sulawesi Utara 95618,
Indonesia
Tel.: +62 897 099 103 33,
E-mail:iwg.suarjana@unima.ac.id
ORCID ID:
https://orcid.org/0000-0002-4072-6813

ABSTRACT

Introduction: Work-related musculoskeletal disorders (WMSDs) are a serious problem that can affect the health and productivity of laundry workers. Workers who experience such disorders may experience pain, muscle stiffness, joint inflammation, and even serious injury. This study aimed to investigate the prevalence of work-related musculoskeletal disorders among laundry workers in North Sulawesi.

Methods: This study is a quantitative descriptive cross-sectional survey conducted in March 2023 – April 2023 in Minahasa District North Sulawesi Province, specifically Tondano-Tomohon City. A total sample of 225 laundry workers was taken using the convenient sampling technique. The questionnaire used to assess WMSDs was the Nordic Body Map. The chi-square test was applied to find the association between age and musculoskeletal disorders among laundry workers.

Results: 5.38% of participants categorized pain felt in all parts of the body as very painful, 17.81% as painful, 36.39% as rather painful, and 39.67% as not painful. The body part that experienced the most complaints of severe pain was back at 10.2%, feeling pain was the waist at 37.3%, feeling rather pain was the right arm at 47.1%, and no pain was the left elbow at 71.6%.

Conclusion: The prevalence of work-related musculoskeletal disorders among the study population was significantly associated with age, sex, nutritional status, and work experience with musculoskeletal complaints (p<0.05). While there is no relationship between work duration and education level with musculoskeletal complaints (p>0.05). Appropriate interventions may be needed to improve working conditions, protect workers' health, and minimize the risk of work-related musculoskeletal disorders in the laundry industry.

Keywords: Laundry Workers, Nordic Body Map, North Sulawesi, Risk Factors, Work Related Musculoskeletal Disorders (WMSDs)

Introduction

Musculoskeletal Disorders (MSDs) related to work also referred to as Work-Related Musculoskeletal Disorders (WMSDs) have become a serious problem in various work environments around the world. These diseases are associated with abnormalities in the musculoskeletal system, which includes muscles, tendons, ligaments, and bones. In recent years, attention to WMSDs has increased rapidly due to their detrimental impact on worker well-being

Int. J. Occup. Safety Health, Volume 14, No 2 (2024), 237-246

https://www.nepjol.info/index.php/IJOSH

and work productivity. Some of the common symptoms of WMSDs are pain, stiffness, numbness, tingling, and reduced range of motion in the affected body parts. The most frequently reported locations of WMSDs are the lower back, neck, wrist, ankle, shoulder, and knee. According to a study conducted on 408 domestic workers in India, WMSDs were reported as knee pain (38.2%), upper back pain (31.9%), lower back pain (27.5%), ankle pain (26.0%), shoulder pain (23.8%) and neck pain (19.6%).[1] In Indonesia, a study by Yosineba et al. in 2020 found that the prevalence of WMSDs among orthopedic surgeons was 50% for the lower back, 46.5% for neck, 28.6% for wrist and ankle, 21.4% for shoulder, 10.7% for knee, thigh, and buttocks, 7.1% for upper back, and 0% for elbow.[2] WMSDs can affect the quality of life and work performance of the workers, as well as increase the health care costs and compensation claims for the employers. Therefore, prevention and management of WMSDs are essential for both workers and employers.

According to the World Health Organisation (WHO), musculoskeletal disorders (MSDs) are disorders of the muscles, tendons, ligaments, and nerves that can be caused by work, lifestyle, or a combination of both. Work-related MSDs are disorders caused by factors in the workplace, such as repetitive movements, unergonomic postures, heavy loads, and vibrations, hot or cold working environments, and work stress.[3,4] Based on WHO data in 2019, MSDs are the second leading cause of disability in the world, after heart disease. WMSDs are estimated to cause 3.5% of all years of life lost due to disability (YLDs). According to WHO, there were an estimated 264 million cases of work-related MSDs in the world in 2019.[5] The most common types of work-related MSDs are low back pain, neck pain, shoulder pain, wrist and hand pain, and foot pain. One group of workers who are vulnerable to WMSDs are workers in the laundry section.[6,7]

Laundry workers, both in commercial laundries and hospitals, are often involved in tasks that involve heavy lifting, repetitive movements, and prolonged standing. However, research on the frequency and risk factors of WMSDs among laundry workers is limited. Laundry workers are workers who have a high risk of developing musculoskeletal disorders (MSDs) because the tasks they perform routinely involve physical activities that can cause excessive stress on their musculoskeletal system. Some of the job tasks that pose a high risk of MSDs in laundry workers include: Heavy lifting, one of the main tasks of laundry workers is lifting and moving linen that is often wet and heavy, such as sheets and large towels. Heavy lifting without the use of appropriate assistive equipment can cause stress to the lower back, shoulders, and arms, increasing the risk of musculoskeletal injuries and complaints.[8] Repetitive Motion, laundry workers often have to perform repetitive motions such as folding clothes, rolling linen, or sewing. These repetitive motions can cause excessive stress on joints, tendons, and muscles, which can eventually lead to disorders such as tendinitis or carpal syndrome.[9] Unergonomic body positions, some laundry work tasks require workers to stand for long periods or operate in unergonomic body positions. This can result in strain on the back, legs, and neck, which in turn can cause complaints such as back pain, leg pain, and neck discomfort.[10] Use of heavy equipment, laundry workers often use heavy equipment such as commercial washing machines, dryers, and irons. Operating this equipment repetitively or for long periods can affect their joints and muscles. Sorting and Sifting, linen sorting and sorting tasks often require careful and precise hand movements.[11] Laundry workers have to carefully select, roll, and organize linen, which can result in stress on their wrists and fingers. Work environment discomfort, some laundry workers may have to operate in uncomfortable work environments, such as cramped spaces or with extreme temperatures. This discomfort can affect their physical well-being.

Previously, many studies have been conducted in various work sectors to understand and identify the risk factors associated with WMSDs. These studies cover the manufacturing industry,

healthcare, and transport sectors, and the results have revealed that the risk of WMSDs can be found in various work environments. Research conducted by Purwati et al.[11] showed that there is a significant relationship between work posture and musculoskeletal disorders (MSDs) complaints among laundry workers in Batam City, Indonesia. The majority of respondents were under 35 years old. WMSDs are a common occupational risk for laundry workers, and factors such as excessive muscle stretching, repetitive activities, and unnatural work postures contribute to the development of these disorders. Research conducted by Gumilang, et al.[12] stated that the majority of laundry workers in Denpasar, Bali have a moderate level of risk of developing Musculoskeletal Disorders (MSDs) during the ironing process. Factors contributing to the moderate risk level include female sex, age greater than or equal to 30 years, duration of work per day greater than 8 hours, tenure greater than or equal to 4 years, and adequate nutritional status. [12]

However, although many previous studies have provided important insights into WMSDs in various occupational sectors, research on these conditions among laundry workers is still very limited and has not been widely discussed.[13–15] This can increase the risk of developing WMSDs, especially on body parts such as the lower back, shoulders, and wrists. This study aims to fill this knowledge gap by investigating the extent of WMSDs among laundry workers in North Sulawesi Province. Specifically, this study focuses on laundry workers from two cities in North Sulawesi, namely Tondano and Tomohon. These two cities were chosen because they have a large number of laundry businesses and workers, as well as a high demand for laundry services.

Methods

This study is cross-sectional, carried out in some of the largest laundry places in Tomohon and Tondano City, North Sulawesi, from March to April 2023. The subjects of this study were laundry workers who met the following inclusion criteria: They worked in the Tomohon and Tondano areas of North Sulawesi Province. They were between 20 and 60 years old. They had at least one year of work experience. They agreed to participate in the study and signed the informed consent form. The following exclusion criteria: They had muscle injuries, ligament tears, or joint problems.

The sampling technique used is convenience sampling. The calculation of the sample size using the incidental sampling technique is a technique based on chance, that is, anyone who happens to meet the researcher can be used as a sample if it is deemed that the person is suitable as a data source. This technique is usually used if the population is unknown or difficult to reach. The formula that can be used is as follows:

$$n = \frac{Z^2 \times p \times q}{d^2}$$

$$n = \frac{1.645^2 \times 0.5 \times 0.5}{0.1^2}$$

$$n = 225$$

Notes:

Z = 1.645 (z-score value for 90% confidence level)
p = 0.5 (expected population proportion)
q = 0.5 (1 - p)
d = 0.1 (margin of error)

Therefore, the minimum sample size was 225 respondents who met the inclusion criteria and were willing to participate.

The sample was recruited based on the availability and accessibility of laundry workers in the two cities, inviting laundry workers to participate in the study, with inclusion and exclusion criteria to determine who can become respondents: laundry workers aged 20-60 years, have at least 1 year of work experience, and are willing to fill out the questionnaire. Sample data collected in Tondano City can be recorded and meet the criteria of as many as 91 workers, while in Tomohon City as many as 134 workers, so the total data and sample is 225 workers.

This research data is in the form of primary data collected using the Nordic Body Map questionnaire to measure complaints of musculoskeletal disorders.[16] In addition, demographic data taken were age, sex, nutritional

status, education level, marital status, work experience, and work duration.

Statistical data analysis using SPSS v.25 for macOS software and presented in the form of narratives, graphs and tables to describe the characteristics of subjects, the distribution of WMSDs risk levels, as well as the distribution of WMSDs risk levels on each variable.

This research has been approved by the Bali International University Research Ethics Commission with permit number 01.036/UNBI/EC/IV/2022, dated 09 January 2023.

Results

The results of data collection in this study have been organized into two groups, namely demographic data and skeletal muscle complaints data. The participants in this study consisted of 225 laundry workers. Data on the distribution of subject characteristics are presented in Table 1 below.

Table 1: Distribution of Respondent Characteristics

Socio-Demographic Variable	Subcategory	Number (n) N = Total 225
Age (year)	19-27	87 (38.7%)
	28-36	67 (29.8%)
	37-45	40 (17.8%)
	46-54	19 (8.4%)
	>54	12 (5.3%)
Sex	Female	155 (69.9%)
	Male	70 (31.1%)
BMI (Kg/m²)	Very Underweight: <17	7 (3.1%)
	Underweight: 17 - <18.5	13 (5.8%)
	Normal 18.5 – 25.0	170 (75.6%)
	Overweight >25 - 27	35 (15.6%)
	Obese >27	0 (0%)
Education Level	Primary School	7 (3.1%)
	Junior High School	11 (4.9%)
	High School / Vocational School	182 (80.9%)
	Bachelor	25 (11.1%)
Marital Status	Single	104 (46.2%)
	Married	121 (53.8%)
Work Experience	New	178 (79.1%)
	Old	47 (20.9%)
Work Duration	< 8hr	200 (88.9%)
	> 8hr	25 (11.1%)

The majority of respondents are relatively young individuals, with 38.7% of them being in the age group of 19 to 27 years old and 29.8% being between 28 to 36 years old. In this study, the total number of respondents was 225 respondents, with 155 female respondents and 70 male respondents. Whereas, sex also played an important role in this sample, with females dominating the respondent population at 69.9%. Regarding physical health, the majority of respondents had a Body Mass Index (BMI) within the normal range of 170 (75.6%), indicating a good level of health in this sample. In terms of education, most of the respondents (80.9%) had a high school or vocational school level of education at 182 (80.9%), which may have resulted in a better understanding of the issues under study. Meanwhile, in terms of marital status, there was a fairly balanced difference between married at 121 (53.8%) and single at 104 (46.2%) respondents.

In addition, most of the respondents had recent work experience of less than 2 years (79.1%), and most of them worked less than 8 hours a day (88.9%).

The results of data collection on musculoskeletal complaints in 225 laundry workers using the Nordic Body Map questionnaire with 4 Likert Scales, namely Score 1 (No Pain), Score 2 (Rather Pain), Score 3 (Pain), Score 4 (Very Pain). Data collection was carried out on 28 body areas and more details are presented in table 2.

Table 2: Prevalence of Work-related Musculoskeletal Disorders of Laundry Workers with Nordic Questionnaire

Body Areas	Complaints			
	No Pain (%)	Rather Pain (%)	Pain (%)	Very Pain (%)
Upper Neck	21.8	59.1	14.2	4.9
Lower Neck	38.2	41.3	16.0	4.4
Left Shoulder	36.0	40.9	16.0	7.1
Right Shoulder	21.3	44.9	24.0	9.2
Left Upper Arm	40	37.3	17.8	4.9
Back	19.6	40.9	29.3	10.2
Right Upper Arm	20	20.4	32.0	7.6
Waist	19.6	35.1	37.3	7.6
Hip	37.3	39.1	18.7	4.9
Buttocks	58.7	27.6	9.8	4.0
Left Elbow	71.6	22.2	2.7	3.6
Right Elbow	54.7	27.1	13.3	4.9
Left Forearm	48	36.4	11.6	4.0
Right Forearm	29.3	47.1	14.2	9.3
Left Wrist	46.2	35.1	15.6	3.1
Right Wrist	25.8	42.7	26.2	5.3
Left Hand	40.9	39.1	15.1	4.9
Right Hand	24.9	41.8	23.6	9.8
Left Thigh	54.2	31.6	12.9	1.3
Right Thigh	47.6	41.3	8.0	3.1
Left Knee	58.2	29.3	7.6	4.9
Right Knee	51.6	36.9	7.1	4.4
Left Leg	37.8	36.4	18.7	7.1
Right Leg	26.2	40.9	24.9	8.0
Left Ankle	49.3	31.1	16.9	2.7
Right Ankle	42.2	39.1	15.1	3.6
Left Foot	47.6	24.4	25.3	2.7
Right Foot	42.2	29.8	24.9	3.1

Based on the data results in Table 2. shows the prevalence of work-related musculoskeletal disorders in laundry workers. The prevalence of WMSDs complaints in 28 body areas is based on the level of complaints felt, where Most of the complaints (71.6%) were about the left elbow, which did not cause any pain. The right forearm was the second most common complaint (47.1%), which caused some pain. The waist was the third most common complaint (37.3%), which also caused pain. The back was the least common complaint (10.2%), but it caused the most pain.

The results of the chi-square test between the characteristics of respondents and complaints of musculoskeletal disorders in laundry workers can be seen in Table 3 below.

Table 3: Chi-Square Test Results Characteristics of Respondents of WMSDs

Characteristics	No WMSDs	WMSDs	p-value
	n (%)	n(%)	
Age			
19-27	58 (66.7%)	29 (33.3%	
28-36	40 (59.7%)	27 (40.3%)	
37-45	18 (45%)	22 (55%)	0.018*
46-54	6 (31.6%)	13 (68.4%)	
>54	5 (41.7%)	7 (58.3%)	
Gender			
Female	52 (74.3%)	18 (25.7%)	0.001*
Male	75 (48.4%)	80 (51.6%)	
Body Mass Index (Kg/m²)			
Very Underweight <17	7 (100%)	0 (0%)	
Underweight: 17 -<18.5	10 (76.9%)	3 (23.1%)	
Normal 18.5 – 25.0	90 (52.9%)	80 (47.1%)	0.037*
Overweight >25 - 27	20 (57.1%)	15 (42.9%)	
Obese >27	0 (0%)	0 (0%)	
Education Level			
Primary School	5 (71.4%	2 (28.6%)	
Junior High School	2 (18.2%)	9 (81.8%)	
High School/Vocational School	105 (57.7%)	77 (42.3%)	0.059
Bachelor	15 (60%)	10 (40%)	
Marital Status			
Single	73 (70.2%)	31 (29.8%)	0.001*
Married	54 (44.6%)	67 (55.4%)	
Work Experience			
Not at risk	111 (62.3%)	67 (37.7%)	0.001*
At risk	16 (34.1%)	31 (65.9%)	
Work Duration			
< 8 hr	117 (58.5%)	83 (41.5%)	0.090
> 8 hr	10 (40%)	15 (60%)	

Several characteristics have a significant relationship with WMSDs, namely age, sex, BMI, marital status, and work experience.

The 19-27 years age group had the largest proportion of those without WMSDs (66.7%), while the 46-54 years age group had the smallest proportion (31.6%). Females had a significantly greater proportion of no WMSDs (74.3%) compared to males (48.4%). Respondents who had a very lean BMI (<17 kg/m²) all did not experience WMSDs (100%), while respondents who had a normal BMI (18.5-25 kg/m²) were almost equal between those who experienced and those who did not experience WMSDs (52.9% and 47.1%).

Single living had a greater proportion who did not experience WMSDs (70.2%) compared to those who were married (44.6%). Respondents who were not at risk of MSDs had a greater proportion who did not experience WMSDs (62.3%) compared to those at risk (34.1%).

Discussion

In this study, it is known that the age category is dominated by young age >19 years as many as 87 respondents. Based on age characteristics, it

shows that age has a significant relationship with the incidence of musculoskeletal complaints in laundry workers with a significance value of 0.018. According to Thetkathuek et al. (2016) in the age range of 35-55 years, the problem of pain caused by musculoskeletal disorders increases to 70%. Meanwhile, according to research conducted by Shobur, et al, one of the things that affects muscle work is age, because the increasing age of a person in this condition reduces muscle strength, this shows that there is a relationship between age and musculoskeletal complaints with workers aged $\geq$ 30 years because they are at risk of 4.4 times experiencing high levels of musculoskeletal complaints compared to workers aged <30 years.[17]

According to sex in this study, was dominated by respondents with female sex as many as 155 respondents than male respondents. Based on the results of the chi-square test, there is a significant relationship between sex and complaints of musculoskeletal disorders with a significance value of 0.001. Sex is a factor related to muscle endurance between women and men. Related to that, sex is related to complaints of musculoskeletal disorders this is because physiologically the ability of male muscles is stronger than the ability of female muscles. Women's muscle ability is only about two-thirds of men's muscle strength, so women's muscle capacity is lesser when compared to men's muscle capacity.[18]

Based on the nutritional status in this study, the majority were in the normal category as many as 170 respondents. Based on the results of the chi-square test, there is a significant relationship between nutritional status and complaints of musculoskeletal disorders with a significance value of 0.037. This is in accordance with another study conducted by Zhang et al.[19] who found that nutrition-related disorders, such as metabolic syndrome, diabetes, hypertension, hypertriglyceridemia, and obesity, may increase the risk of or exacerbate musculoskeletal disorders, such as osteoarthritis, tendinopathy, intervertebral disc degeneration, and sarcopenia1. Our research is also in line with research by Calvo-

Lobo, César, et al.[20] which provides information on how nutrients, especially vitamin D, calcium, magnesium, and protein, can help prevent musculoskeletal disorders by increasing bone strength and reducing inflammation. Excess body mass index tends to lead to increased mechanical stress on the body structures responsible for supporting body mass. When viewed from biomedical dynamics, the greatest pressure will be received by the body parts and joints that support the human body, especially the lower extremities and back.[21]

The period of employment is the time when individuals work, which is calculated from the start of employment until the time of the study. The longer the working time, the longer the worker is exposed to the workplace's increased musculoskeletal complaints.[22] Physical work that is carried out continuously and repeatedly over a long period will affect the mechanisms in the body (circulatory, digestive, muscular, nervous, and respiratory systems).[23]

The results of the chi-square statistical test show a relationship between work experience or tenure and musculoskeletal complaints. This is because the longer the working period, the longer the exposure in the workplace which results in a higher risk of musculoskeletal complaints.[24] Periods of working can affect workers both positively and negatively. The positive influence is seen in the increase in experience and expertise in accordance with the length of work. Conversely, a long working period will also have a negative effect because it causes fatigue and boredom.

Based on the results of the study, it is known that laundry workers have a long working period of more than 2 years and a new working period of less than 2 years. The data shows that 65.9% of laundry workers with a working period of >2 years are at risk of musculoskeletal complaints. The longer laundry workers work with non-ergonomic work attitudes, the higher the risk of musculoskeletal complaints. This is because musculoskeletal complaints will increase as work experience increases.[11] Previous research also found that the majority of respondents with a

working period of >2 years had a risk of experiencing musculoskeletal complaints. A long working period will provide accumulated work pressures so that over a long time it will result in clinical or chronic fatigue.[22]

Work duration is the amount of time spent by workers to perform work activities in one day or one week. Work duration can affect musculoskeletal complaints, which are pain or discomfort in the human skeletal and muscular systems.[25]

The results of the chi-square statistical test showed no relationship between work duration and musculoskeletal complaints. This is because the workers are still within the normal working duration range of around 88.8% working <8 hours. Prolonged work duration can cause static loads on muscles and joints, which can lead to fatigue, strain, and inflammation. Long work duration can also reduce rest and muscle recovery time, which can worsen musculoskeletal conditions. Work duration that is too long can increase the risk of musculoskeletal disorders, especially in body parts that are often used in work, such as the neck, shoulders, back, hands, and feet. The results of research conducted by Zulhijjah found that there was no significant relationship between work duration (p = 0.250) and musculoskeletal complaints. Work duration is not associated with musculoskeletal complaints because work duration does not affect the physical burden experienced by workers. The physical burden experienced by workers is more influenced by other factors such as length of service, workload, and work posture.[26] The duration of working time can lead to a decrease in muscle and joint function. High workloads can cause muscle and joint

fatigue. Unergonomic work postures can cause muscle and joint strain. Therefore, work duration was not a major risk factor for musculoskeletal complaints in PT PLN (Persero) Jeneponto Transmission Service Unit and Substation workers.[26]

Conclusions

The majority of respondents' characteristics were based on age 19-29 years (38.7%), female 155 workers (69.9%), nutritional status in the normal category as many as 170 workers (75.6%), high school education level as many as 182 workers (80.9%), marital status as many as 121 workers (53.8%), work experience <2 years as many as 178 workers (79.1%), and work duration <8 hours as many as 200 workers (88.9%). The prevalence of musculoskeletal complaints in 28 body parts was felt to be very painful with a percentage of 10.2% felt in the back, 37.3% felt pain in the waist, 47.1% felt somewhat pain in the right forearm, and 71.6% felt no pain in the left elbow. Based on the chi-square statistical test, there was a relationship between age, sex, nutritional status, and work experience with musculoskeletal complaints (p<0.05). While there is no relationship between work duration and education level with musculoskeletal complaints (p>0.05). Therefore, appropriate interventions need to be made to improve working conditions, protect workers' health, and minimize the risk of work-related musculoskeletal disorders in the laundry industry.

Acknowledgments

References

1. Gibran K, Dewi WN, Damanik SRH. Identifikasi Masalah Muskuloskeletal Pada Pengendara Transportasi Umum. J Ners Indones. 2020 Mar 31;10(2):216. Available from: https://doi.org/10.31258/jni.10.2.216-228

2. Deviandri R, Ismiarto YD. The Prevalence of Musculoskeletal Disorders among Orthopaedic and Traumatology Residents in Indonesia. J Ilmu Kedokt J Med Sci. 2021 Dec 14;15(2):87. Available from: https://doi.org/10.26891/JIK.v15i2.2021.87-90

3. Instituto de Ciências da Saúde, Soares CO, Universidade Federal do Pará, Pereira BF, Instituto de Ciências da Saúde, Universidade Federal do Pará, et al. Preventive factors against work-related

musculoskeletal disorders: narrative review. Rev Bras Med Trab. 2019;17(3):415–30. Available from: https://doi.org/10.5327/Z1679443520190360

4. Murtoja Shaikh A, Bhusan Mandal B, Mangani Mangalavalli S. Causative and risk factors of musculoskeletal disorders among mine workers: A systematic review and meta-analysis. Saf Sci. 2022 Nov 1;155:105868. Available from: https://doi.org/10.1016/j.ssci.2022.105868

5. Dagne D, Abebe SM, Getachew A. Work-related musculoskeletal disorders and associated factors among bank workers in Addis Ababa, Ethiopia: a cross-sectional study. Environ Health Prev Med. 2020 Dec;25(1):33. Available from: https://doi.org/10.1186/s12199-020-00866-5

6. Wami SD, Abere G, Dessie A, Getachew D. Work-related risk factors and the prevalence of low back pain among low wage workers: results from a cross-sectional study. BMC Public Health. 2019;19(1):1–9. Available from: https://doi.org/10.1186/s12889-019-7430-9

7. Arcangeli G, Montalti M, Sderci F, Giorgi G, Mucci N. Risk Assessment in an Industrial Hospital Laundry. In Springer; 2019. p. 438–45. Available from: https://doi.org/10.1007/978-3-319-96083-8_57

8. Mahestri S, Jayanti S, Wahyuni I. Hubungan Berat Beban, Frekuensi Angkat, Postur Kerja Dengan Keluhan Thoracic Outlet Syndrome Pada Penambang Pasir Tradisional Desa Banjarparakan. J Kesehat Masy. 2021 Jan 6;9(1):72–8. Available from: https://ejournal3.undip.ac.id/index.php/jkm/article/view/28596

9. Descatha A, Evanoff BA, Leclerc A, Roquelaure Y. Occupational Determinants of Musculoskeletal Disorders. In: Bültmann U, Siegrist J, editors. Handbook of Disability, Work and Health [Internet]. Cham: Springer International Publishing. 2020;169–88. (Handbook Series in Occupational Health Sciences). Available from: https://doi.org/10.1007/978-3-030-24334-0_8

10. Chaitanya MK. Designing and Evaluating an Ergonomic Intervention to Minimise Risk of Musculoskeletal Disorders in Indian Small and Medium Scale Cashew Nut Processing Mills [Internet] [Thesis]. 2022 [cited 2023 Sep 11]. Available from: https://shodhganga.inflibnet.ac.in/bitstream/10603/424833/1/01_fulltext.pdf

11. Purwati K, Ipaljri Saputra A, Taolin A. Hubungan Antara Postur Kerja Dengan Keluhan Musculoskeletal Disorders Pada Pekerja Laundry Di Kecamatan Batam Kota Kota Batam 2023. Zona Kedokt Program Studi Pendidik Dr Univ Batam. 2023 Jul 22;13(2):392–401. Available from: https://doi.org/10.37776/zked.v13i2.1180

12. Gumilang PGA. Gambaran Tingkat Risiko Musculoskeletal Disorders (MSDs) Berdasarkan Metode Reba Saat Proses Menyetrika Pada Pekerja Laundry Di Denpasar, Bali. 2020. Available from: https://jurnal.harianregional.com/eum/full-71943

13. Oranye NO, Bennett J. Prevalence of work-related musculoskeletal and non-musculoskeletal injuries in health care workers: the implications for work disability management. Ergonomics. 2018;61(3):355–66. Available from: https://doi.org/10.1080/00140139.2017.1361552

14. Urban E. The condition of female laundry workers in Ireland 1922-1996: A case of labour camps on trial. Études Irl. 2012;(37–2):49–64. Available from: https://doi.org/10.4000/etudesirlandaises.3143

15. Tamene A, Afework A, Mebratu L. A qualitative study of barriers to personal protective equipment use among laundry workers in government hospitals, Hawassa, Ethiopia. J Environ Public Health. 2020;2020:1–8. Available from: https://doi.org/10.1155/2020/5146786

16. Kuorinka I, Jonsson B, Kilbom A, Vinterberg H, Biering-Sørensen F, Andersson G, et al. Standardised Nordic questionnaires for the analysis of musculoskeletal symptoms. Appl Ergon. 1987 Sep 1;18(3):233–7. Available from: https://doi.org/10.1016/0003-6870(87)90010-X

17. Shobur S, Maksuk M, Sari FI. Faktor Risiko Musculoskeletal Disorders (MSDs) Pada Pekerja Tenun Ikat Di Kelurahan Tuan Kentang Kota Palembang. J Med Media Inf Kesehat. 2019 Nov 30;6(2):113–22. Available from:

https://doi.org/10.36743/medikes.v6i2.188

18. Tarwaka, Solikhul HA, Sudiajeng L. Ergonomi untuk Keselamatan, Kesehatan dan Produktivitas. Surakarta: UNIBA Press; 2004. Available from: https://library.uniba-bpn.ac.id/index.php?p=show_detail&id=13519

19. Zhang M, Shan B, Lin S, Xu J, Zhang N. Nutrition and metabolism in musculoskeletal disorders. Front Nutr. 2023;10:1269939. Available from: https://doi.org/10.3389/fnut.2023.1269939

20. Calvo-Lobo C, Becerro-de-Bengoa-Vallejo R, Losa-Iglesias ME, Rodríguez-Sanz D, López-López D, San-Antolín M. Biomarkers and Nutrients in Musculoskeletal Disorders. Nutrients. 2021;13(2):283. Available from: https://doi.org/10.3390/nu13020283

21. Tandirerung FJ, Male HDC, Mutiarasari D. Hubungan Indeks Massa Tubuh Terhadap Gangguan Muskuloskeletal Pada Pasien Pralansia dan Lansia di Puskesmas Mamonji Palu. J Kesehat Tadulako. 2019;5(2):9–17. Available from: https://jurnal.fk.untad.ac.id/index.php/htj/article/view/115

22. To KE, Berek NC, Setyobudi A. Hubungan Masa Kerja, Jenis Kelamin dan Sikap Kerja dengan Keluhan Muskuloskeletal pada Operator SPBU di Kota Kupang. Media Kesehat Masy. 2020 Nov 20;2(2):42–9. Available from:

https://media.neliti.com/media/publications/330953-hubungan-masa-kerja-jenis-kelamin-dan-si-c0e025a8.pdf

23. Wulan M, Hilal S. Perbandingan Keluhan Low Back Pain pada Pekerja Batik Tulis dan Cap di Kecamatan Danau Teluk Kota Jambi Tahun 2020. 2020. Available from: https://e-journal.ivet.ac.id/index.php/ijheco/article/download/1391/1037

24. Saputra A. Sikap Kerja, Masa Kerja, dan Usia terhadap Keluhan Low back pain pada Pengrajin Batik. HIGEIA J Public Health Res Dev. 2020 Oct 1;4(Special 1):147–57. Available from: https://journal.unnes.ac.id/sju/higeia/article/view/36828

25. Mourad BH. Prevalence of work-related musculoskeletal disorders among Egyptian printing workers evidenced by using serum biomarkers of inflammation, oxidative stress, muscle injury, and collagen type I turnover. Toxicol Ind Health. 2021 Jan 1;37(1):9–22. Available from: https://doi.org/10.1177/0748233720977399

26. Zulhijjah A. Faktor Yang Berhubungan Dengan Keluhan Musculoskeletal Disorders Pada Pekerja PT. PLN (Persero) Unit Layanan Transmisi Dan Gardu Induk Jeneponto. [Makassar]: Universitas Hasanuddin; 2021. Available from: http://repository.unhas.ac.id:443/id/eprint/6009