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Analysis Of Factors Affecting Musculoskeletal Disorders (MSDs) On Nurses At Nunukan Regional General Hospital

Aida Ummul Ainun Musdalifah[1*], Yahya Thamrin[1], Ridwan Amiruddin[1#], Syamsiar S Russeng[1], Atjo Wahyu[2], Ummu Salma[3]

[1]Department of Occupational Health and Safety, Faculty of Public Health, Hasanuddin University, Indonesia

[#1]Department of Epidemiology, Faculty of Public Health, Hasanuddin University, Indonesia

[2]Departement of Occupational Health and Safety, Faculty of Public Health, Hasanuddin University, Indonesia

[3]Department of Biostatistics, Faculty of Public Health, Hasanuddin University, Indonesia

[1,2,3] Departement of Occupational Health and Safety, Faculty of Public Health, Hasanuddin University, 90245 Tamalanrea, Makassar, Indonesia

[*]**Corresponding author:**

Email ID: aidaummulainun30@yahoo.com

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ABSTRACT

Background. Musculoskeletal disorders (MSDs) are disorders of the muscoleskeletal system including muscles, tendons, ligaments, nerves, joints and bones. Factors that affect MSDs are age, BMI, work period, workload and fatigue. **Aims**. This study is to analyze the relationship between age, BMI, tenure, workload and fatigue to the occurrence of MSDs complaints in nurses at RSUD Nunukan. **Methods**. This study used a cross-sectional design with a quantitative approach. The study sample consisted of 150 nurses selected using simple random sampling technique. Data were collected through Nordic Body Map (NBM) questionnaire to measure MSDs complaints, as well as NASA-TLX and KAUPK2 questionnaires to measure mental workload and job fatigue. Data were analyzed using chi-square test and logistic regression. **Results**. The results showed that there was a significant relationship between BMI (p=0.027), length of service (p=0.035), physical workload (p=0.018), mental workload (p=0.039) and job fatigue (p=0.028) with the incidence of MSDs in nurses. The age factor (p=0.498) did not have a significant relationship with MSDs. **Conclusion**. BMI, length of service, physical workload, mental workload and job fatigue are factors that influence the incidence of MSDs in nurses at RSUD Nunukan. Preventive efforts such as the implementation of work ergonomics, workload management, and physical health promotion need to be improved to reduce MSDs complaints among nurses.

Keywords: *MSDs, nurses, workload, ergonomics, occupational health*

1. INTRODUCTION

Musculoskeletal Disorders (MSDs) is a term that refers to a variety of conditions that affect the musculoskeletal system, including muscles, tendons, ligaments, nerves, joints, and bones. MSDs can arise as a result of a variety of factors, including repetitive physical activity, unergonomic work postures, and excessive workloads. These disorders can cause pain, discomfort, and even disability, which in turn can affect an individual's work productivity and quality of life (1–3).

Musculoskeletal disorders (MSDs) are a major global health problem, characterized by pain and dysfunction in muscles, tendons, ligaments, and nerves. The incidence of MSDs varies across population groups and occupations, with a high incidence in healthcare workers, manual laborers, and office workers. Internationally, studies have shown that the prevalence of work-related musculoskeletal disorders (WRMSDs) ranges from 35% to 74.5% across occupational sectors, indicating how common these conditions are (4,5). One of the most commonly reported types of MSD is low back pain (LBP), with an estimated 60-70% of the population in industrialized countries experiencing LBP at some point in their lives (6).

Musculoskeletal Disorders (MSDs) have become a significant health problem globally and nationally. According to the World Health Organization (WHO), MSDs are the leading cause of disability in most countries, with an estimated 1.71 billion individuals affected worldwide (7,8). These conditions are the largest contributor to years lived with disability (YLD),

accounting for 16% of all YLDs globally (7). Globally, the distribution of MSDs varies by region, with high-income countries accounting for 441 million cases, followed by the WHO Western Pacific Region with 427 million cases, and Southeast Asia with 369 million cases (8). Low back pain is the leading contributor with 570 million cases worldwide, followed by osteoarthritis (528 million cases) and neck pain (222 million cases) (8).

In Indonesia, MSD prevalence data shows quite high numbers, with 11.9% of cases based on health worker diagnosis and 24.7% based on diagnosis or symptoms felt. The Bureau of Labor Statistics (BLS) recorded 365,580 cases of MSD disorders, with the majority of cases being sprains or strains due to fatigue from lifting objects. At the provincial level, South Sumatra recorded a prevalence of MSDs of 15.6%, with the highest prevalence found in groups of farmers, fishermen, or laborers reaching 31.2% (9). In industrial environments, the prevalence of MSDs also varies significantly. For example, research among process industry workers in Iran showed prevalence rates of MSD symptoms of 71.7% and 74%, emphasizing the need for improved ergonomics in the workplace (10). In the agricultural sector, especially among oil palm harvesters in Thailand, the prevalence of MSDs in the lower back reached 59%, accompanied by disorders in the shoulders and neck (11). This shows that the work environment and physical demands faced by workers are the main factors influencing the incidence of MSDs.

Furthermore, the Global Burden of Disease study revealed that the prevalence of MSDs has increased over time, especially for disorders such as low back pain, which is the most common complaint across various demographic groups (12). This trend underscores the importance of addressing MSD risk factors, including ergonomic hazards, psychosocial aspects, and physical demands in certain jobs.

Data from Nunukan Regional Hospital 2024 stated that nurses totaling 245 people (36 men and 209 women) had various characteristics, including age, body mass index (BMI), length of service, and physical and mental workload. They work in a three-shift system: morning (08.00-14.00), afternoon (14.00-21.00), and night (21.00-08.00). Variations in work shifts have the potential to increase the workload, especially in night shifts, which can worsen physical conditions. This fatigue, both physical and mental, has the potential to trigger MSD complaints.

Risk factors for MSDs include age, Body Mass Index (BMI), length of service, workload, and fatigue. Age can affect the body's resistance to physical stress, and older workers tend to be more susceptible to MSDs (9,13,14). In addition, high BMI can put an additional burden on the musculoskeletal system, increasing the risk of injury (15,16). However, several studies have also shown that BMI is not the only factor that influences MSDs but needs to be considered together with other factors such as physical work intensity, work duration, and work posture (17).

Long working hours with repetitive physical tasks increase the accumulation of muscle and joint tension, while heavy workloads force muscles and joints to work beyond their capacity, which can accelerate tissue damage (2,3). Fatigue caused by long working hours without adequate rest also contributes to the risk of MSDs, making the body less able to cope with repetitive physical loads and causing chronic muscle tension (1). This is believed to be due to the accumulation of physical stress resulting from awkward postures, repetitive activities, and lifting loads over many years, resulting in muscle fatigue and decreased joint function. Thus, MSDs are often considered a form of cumulative trauma that develops gradually due to continuous exposure to biomechanical risks in the workplace (18).

The study found that nurses with long working experience more often experience complaints in certain body parts such as the back, neck, and waist. This study also shows that the accumulation of static work postures, repetitive movements, and heavy physical activities over the years contributes to the high incidence of MSDs in workers with long working experience (15,19). High physical workload, which includes heavy and repetitive physical tasks, has been shown to contribute to an increased risk of musculoskeletal disorders (MSDs). Repetitive physical activities, such as lifting weights or maintaining a certain posture for a long time, can cause an accumulation of biomechanical stress on the musculoskeletal system (20,21).

High mental workload plays a significant role in increasing the risk of musculoskeletal disorders (MSDs), especially in the lower back, neck, and shoulder areas. Studies have shown that workers who experience high mental workload in their jobs tend to report more musculoskeletal symptoms. Mental factors such as time pressure, high responsibilities, and lack of rest time put a strain on the musculoskeletal system, increasing susceptibility to injury, especially in areas of the body that frequently support postural loads or experience repetitive strain. Thus, there is a strong correlation between high mental workload and the prevalence of MSDs, which worsen physical conditions through the effects of prolonged stress (22).

Work fatigue has a significant impact on musculoskeletal conditions, especially by reducing the body's ability to recover from physical stress experienced during work (23). Studies on workers in various sectors show that those who experience fatigue tend to report more frequent complaints of MSDs in areas such as the neck, back, and shoulders. In addition, the results of the Swedish Occupational Fatigue Inventory (SOFI) in workers showed that fatigue is closely related to increased symptoms of MSDs because decreased physical condition due to fatigue exacerbates the biomechanical load on the body (18,24).

Based on the description above, various factors such as age, Body Mass Index (BMI), length of service, physical workload, mental workload, and work fatigue have been proven to significantly contribute to the risk of musculoskeletal disorders

(MSDs) in workers, including health workers. Nurses, as one of the high-risk professional groups, are often exposed to various physical and mental pressures in carrying out their daily tasks, especially in the hospital environment. Given the potential negative impact of MSDs on the quality of life and productivity of nurses, this study aims to analyze the factors associated with the occurrence of MSDs in nurses at Nunukan Regional Hospital. This study can provide new insights for the development of more effective preventive measures and ergonomic interventions for nurses at Nunukan Regional Hospital.

2. MATERIALS AND METHODS

2.1. Type and Design of Research

This study uses a quantitative approach. Quantitative research is a method used to test a theory by examining the relationship between the variables involved. These variables are measured using research tools or instruments so that the numerical data obtained can be analyzed using statistical procedures (25). The type of research is analytical observational, namely research that seeks relationships between variables and then analyzes the data collected. The approach uses a cross-sectional study design, namely research where researchers observe or measure variables at once at one time (point time approach) (26).

2.2. Population and Sample

The population in this study were all nurses at Nunukan Regional Hospital, totaling 245 people. The sample in this study was obtained using a sample calculation method to ensure that the number of respondents involved was representative enough to describe the factors related to musculoskeletal disorders (MSDs) in nurses at Nunukan Regional Hospital. The sample calculation method used was the Lemeshow formula which is commonly used to determine sample size in epidemiological and public health research.

2.3. Research Instruments

Research instruments are tools or means used by researchers to collect data, thus facilitating the data collection process and producing more accurate, complete, and systematic data, that and easier to analyze (25). The research instruments used in this study are the questionnaire, Body Weight Scales, Microtoise, Oximeter, Camera, and Stationery.

3. RESULT AND DISCUSSION

3.1. Research location

This research was conducted at Nunukan Regional Hospital, Nunukan Regency, North Kalimantan Province, Indonesia. Nunukan Regional Hospital has excellent services, namely medical services, paramedical services, and medical support. Medical services consist of services provided by specialist doctors and general practitioners. Paramedical services and medical support include services provided by nurses, midwives, health analysts, nutritionists, pharmacists, radiologists, and medical gas in providing oxygen for patient needs. This hospital is a referral center for public health from health centers in the Nunukan area.

3.2. Respondent characteristics

Respondents in this study amounted to 150 people. Respondents were nurses working at Nunukan Regional Hospital. The distribution of respondents can be seen in the following table:

Table 3.1 Distribution of Characteristics of Respondents of Nurses at Nunukan Regional Hospital in 2025

characteristics	n	%
Gender		
Man	47	31.3
Women	103	68.7
Age		
Old (≥ 35 years)	85	56.7
Young (< 35 years)	65	43.3
Weight		
46-56 kg	71	47.3
57-66 kg	76	50.7

67-76 kg	3	2
Height		
150-160 cm	68	45.3
161-170 cm	55	36.7
171-179 cm	27	18
Body Mass Indeks (BMI)		
Not normal	86	57.3
Normal	64	42.7
Years of service		
Long	96	64
New	54	36
Physical workload		
Fatigue occurs	118	78.7
No fatigue occurs	32	21.3
Mental workload		
Heavy workload	68	45.3
Light workload	82	54.7
Fatigue		
Fatigue occurs	107	71.3
No fatigue	43	28.7

Table 3.1 shows the number of respondents in this study as many as 150 respondents. The respondents in this study were mostly female (68.7%), in the age group the most were old (≥ 35 years) (56.7%). In the weight group, the most were 57-66 kg (50.7%) and the most were 150-160 cm (45.3%). In the BMI group, most respondents had a not normal BMI (57.3%), the most respondents had long working periods (64%). In the physical workload group, the most respondents fatigue occurs (78.7%), the most mental workload was light workload (54.7%) and the most respondents in the fatigue category has fatigue occurs (71.3%).

3.2. Bivariate Analysis

Table 3.2 Relationship between Age, BMI, Years of Service, Physical Workload, Mental Workload, and Work Fatigue with the Risk of MSDs in Nurses at Nunukan Regional Hospital in 2025

Variable	MSDs Complaints				*P Value*
	There is complaints		No complaints		
	n	%	n	%	
Age					
Old (≥ 35 years)	53	35.3	32	21.3	0.498
Young (< 35 years)	44	29.3	21	14	
Body Mass Indeks (BMI)					
Not normal	62	41.3	24	16	0.027

Normal	35	23.3	29	19.3	
Years of service					
Long	68	45.3	28	18.7	0.035
New	29	19.3	25	16.7	
Physical workload					
Fatigue occurs	82	54.7	36	24	0.018
No fatigue occurs	15	10	17	11.3	
Mental workload					
Heavy workload	50	33.3	18	12	0.039
Light workload	47	31.3	35	23.3	
Fatigue					
Fatigue occurs	75	50	32	21.3	0.028

Table 3.2 shows the relationship between age and the MSDs complaints. The p value obtained is 0.408 > α (0.05), which means that there is no relationship between age and the risk of MSDs in nurses. The relationship between BMI and the MSDs complaints in nurses obtained a p value = 0.027 <α (0.05) which means that there is a relationship between BMI and MSDs complaints, The relationship between years of service and MSDs complaints in nurses obtained a p value = 0.035 <α (0.05) which means that there is a relationship between length of service and the MSDs complaints, The relationship between physical workload and the MSDs complaints in nurses obtained a p value = 0.018 <α (0.05) which means that there is a relationship between physical workload and the MSDs complaints, the relationship between mental workload and the MSDs complaints in nurses obtained a p value = 0.039 <α (0.05) which means that there is a relationship between mental workload and MSDs complaints. The relationship between work fatigue and the MSDs complaints in nurses obtained a p value = 0.028 < α (0.05), which means that there is a relationship between work fatigue and the MSDs complaints in nurses at Nunukan Regional Hospital.

3.2. Multivariate Analysis

Table 3.3 Multivariate Analysis Results

Variable	B	S.E	Wald	df	Sig.	Exp(B)
BMI	0.455	0.418	1.189	1	0.276	1.577
Years of service	0.480	0.416	1.335	1	0.248	1.617
Physical workload	0.779	0.439	3.143	1	0.076	2.179
Mental workload	0.713	0.376	3.585	1	0.058	2.039
Work fatigue	0.841	0.392	4.594	1	0.032	2.319

Table 3.3 shows that the work fatigue variable has the greatest impact on MSD complaints among nurses at the Nunukan Regional Hospital with a significance value of 0.032.

3.3 MSDs Risk Management for Nurses

Table 3.4 table of the MSDs Risk Management Matrix for nurses at RSUD Nunukan in 2025

Risk factor	Number of workers	Risk level	Risk category	Risk description
BMI not normal	86	Currently	Serious	Being overweight puts pressure on the joints and increases the risk of muscle and joint pain.

Working period ≥ 5 years	96	High	Catastrophic	Accumulation of exposure to non-ergonomic postures and physical load over the long term
Heavy physical workload	118	High	Catastrophic	Repeated and heavy physical activities cause muscle fatigue, back pain, and injuries that lead to MSDs.
High mental workload	68	Currently	Moderate	Psychological pressure triggers muscle tension and worsens musculoskeletal conditions.
Work fatigue	107	High	Serious	Chronic fatigue reduces muscle recovery ability and increases the risk of injury.

Based on the risk matrix table, the risk factors of abnormal BMI and high mental workload are categorized as moderate risk. Risk factors for work experience ≥ years, heavy physical workload, and work fatigue are categorized as high risk. The risk factors of abnormal BMI and high mental workload fall into the serious risk category, work experience ≥ 5 years and heavy physical workload fall into the catastrophic risk category, and high mental workload falls into the moderate risk category

4. DISCUSSION

Relationship between Age and Risk of MSDs in Nurses

Based on the research results, it was found that there is no relationship between age and MSD complaints among nurses at RSUD Nunukan. The analysis yielded a p-value of 0.498.

As age increases, especially after reaching the age of 35, a person tends to experience various physical complaints. This is due to a decrease in endurance and muscle strength that occurs naturally with age. As a result, the risk of muscle disorders becomes higher (27). This study found that nurses with a young age (<35 years) experienced more moderate MSDs compared to older nurses (≥ 35 years) who experienced more low MSDs.

The results of interviews conducted with respondents showed that nurses aged ≥ 35 years felt that they were used to doing their work activities so the complaints they felt were not much compared to the complaints felt by nurses aged < 35 years. From this statement, it can be said that nurses aged ≥ 35 years who have had long work experience feel that they are used to the workload and work activities that have been carried out.

This study is in line with that conducted by (Supardi et al., 2022) on nurses in the emergency room and operating room of Prambanan Hospital. The results of the study showed that there was no relationship between age and musculoskeletal complaints with a p-value of 0.179 (28). Another supporting study was conducted by (Ajhara et al., 2022) on workers at PT. X which found that there was no relationship between worker age and MSDs complaints. The p-value obtained was 0.057 (29).

The Relationship between BMI and the Risk of MSDs in Nurses

Based on the research results, it was found that there is a relationship between BMI and MSD complaints among nurses at RSUD Nunukan. The analysis yielded a p-value of 0.027.

Body mass index (BMI) is the ratio of body weight in kilograms squared to height in meters (30). Based on the results of the study, the respondents who experienced the most severe MSDs were respondents in the thin BMI category. The results of the statistical test showed that there was no relationship between BMI and the risk of MSDs in nurses.

This study is in line with that conducted by (Sophia et al., 2022) on nurses at Prambanan Regional Hospital with a p-value of 0.338. The results of the study found that respondents experienced the most musculoskeletal complaints with an ideal BMI (30). Another supporting study was conducted by (Ajhara et al., 2022) on workers at PT. X with a p-value of 0.984. The results of the study showed that the majority of workers had good nutritional status and a load that could still be supported or did not exceed the maximum muscle capacity (29).

Although statistically there is no relationship between BMI and MSD complaints, the results of the study showed that nurses with a thin BMI category experienced more severe MSD complaints. From the results of observations conducted by researchers, this condition is caused by limited rest time during working hours which only get one hour of rest. As a result, the amount of food intake consumed is limited and the fulfillment of nutritional needs is not optimally considered.

Research conducted by (Sartono et al., 2016) on work fatigue supports these findings by stating that if someone experiences nutritional deficiencies for a long period, the body will utilize stored nutritional reserves. This condition can result in the degradation of body tissue, which ultimately has the potential to cause impaired body function such as fatigue, weakness, dizziness, and shortness of breath (31).

Relationship between length of service and the risk of MSDs in nurses

Based on the research results, it was found that there is a relationship between years of service and MSD complaints among nurses at RSUD Nunukan. The statistical analysis yielded a p-value of 0.035. The analysis results indicated that nurses with longer years of service reported more MSD complaints compared to those with shorter years of service.

This study is in line with that conducted by (Indah et al., 2023) on nurses at Langsa General Hospital with a p-value of 0.006. Nurses who experience many MSD complaints are those with a long work period of more than 5 years (32). Another supporting study was conducted (Balaputra., 2020) on nurses at Dr. H. Koesnadi Hospital with a p-value of 0.034. Nurses with a work period of 2-6 years experience many MSD complaints from the results of this study (33).

Nurses with long working periods and monotonous work routines have a high risk of experiencing fatigue and injury during work. Musculoskeletal disorders (MSDs) have a positive relationship with the length of a person's working period, where the longer a person works in the same place, the higher the risk of developing MSDs. In the nursing profession, longer working periods are associated with increased physical complaints due to tasks that are carried out repeatedly in large numbers every day (34).

Long working hours can contribute to the emergence of musculoskeletal disorders in individuals. The longer a person works, the higher the likelihood of experiencing negative impacts related to muscle health. Muscle disorders generally begin to appear after two years of working with the same type of job. The work in question is an activity that involves the use of the same muscles for a long period, namely more than two hours continuously (32).

The study found that nurses with longer working experience experienced MSDs more often than nurses with new work experience. This means that the longer workers do the same job repeatedly, the more likely they are to experience MSDs. Working period is a risk factor that can affect individuals at risk of musculoskeletal disorders, and if workers are in awkward positions for a long time, they are at risk of experiencing musculoskeletal disorders because the muscles get static loads for a long time.

The relationship between physical workload and the risk of MSDs in nurses

Based on the research results, it was found that there is a relationship between physical workload and MSD complaints among nurses at RSUD Nunukan. The statistical analysis yielded a p-value of 0.018. The analysis results indicated that nurses with MSD complaints often experience complaints related to physical workload.

This study is in line with that conducted by (Aprilia & Rifai., 2022) on tile industry workers in Sleman who found that there was a relationship between physical workload and MSD complaints with a p-value of 0.000 (35). Another supporting study was conducted by (Pratiwi et al., 2020) on nurses at Buleleng Regional Hospital who found that there was a relationship between physical workload and musculoskeletal complaints, the p-value obtained was 0.000 (36).

The structure of the human body is designed to allow individuals to carry out various daily activities. Human muscle mass accounts for almost half of the total body weight, allowing movement and carrying out various jobs. This condition also causes the body to be exposed to external pressure both physically and psychologically. Workload refers to any task that requires the physical strength and thinking of the individual carrying it out. The workload must adjust the physical and psychological capacity of the worker to maintain the health of the worker (37).

Each individual has a different lifting capacity, which is around 40 kg for men and 20 kg for women. Using muscles for more than an hour can accelerate the onset of musculoskeletal complaints. Muscle contractions up to 20% of their maximum strength do not cause muscle pain. When contractions exceed 20%, blood flow to the muscles decreases, which results in reduced oxygen supply and causes lactic acid accumulation in the muscles (36)

In general, nurses not only face physical workloads but also face social and mental workloads. Various types of patients, both male and female, with various ages and weights, have different workloads faced by nurses in hospitals. Women's limited physical abilities are only two-thirds of men's so the workload of female nurses is more difficult than that of men. In addition, other supporting factors such as age, gender, nutritional status, physical fitness, and body size of nurses increasingly affect the physical workload of nurses. High work demand conditions are unavoidable, causing pain in the worker's limbs (38).

The relationship between mental workload and the risk of MSDs in nurses

Based on the research results, it was found that there is a relationship between mental workload and MSD complaints among nurses at RSUD Nunukan. The statistical analysis yielded a p-value of 0.039. The analysis results showed that many nurses with MSD complaints experienced a light category of mental workload.

This study is not in line with that conducted by (Laksono & Asyfiradayati., 2023) at Dr. Moewardi Solo Regional Hospital which found that there was no relationship between mental workload and MSD complaints, the p-value obtained was 0.111 (39). This study is in line with that conducted by (Rahmawati et al., 2024) which was conducted on nurses at Panti Waluyo Sawahan Hospital Malang and found that there was a relationship between mental workload and MSDs complaints with a p-value of 0.000. The study found that the higher the mental workload, the higher the musculoskeletal disorders felt by nurses

(40).

Workload refers to the responsibilities that must be borne by workers according to the type of work, which includes physical, mental, and social aspects. Nurses often face high physical workloads due to the physical demands of carrying out patient care tasks. This condition can cause muscle stiffness and potentially cause spinal injury. The physical workload for nurses is more dominant than the mental workload, considering that the activities carried out involve tasks that are at risk of causing muscle pain, such as lifting or moving patients or heavy loads, bending and standing for long periods, walking long distances, and making pulling movements, pushing, and sudden changes in body posture in less ergonomic positions (41)

MSDs often occur due to physical activities such as lifting patients, bending over, or performing tasks with non-ergonomic postures (39). The results of the study found that there was no relationship between mental workload and the risk of MSDs. However, nurses need to protect their souls from anxiety and depression to avoid things that make mental health bad so that they can focus on work and be more productive.

The relationship between work fatigue and the risk of MSDs in nurses

Based on the research results, it was found that there is a relationship between work fatigue and MSDs complaints among nurses at Nunukan Regional Hospital. The statistical analysis yielded a p-value of 0.028. The analysis results showed that MSDs complaints are commonly experienced by nurses who suffer from work fatigue.

This study is not line with that conducted by (Fitrah et al., 2025) on employees of PT. X which stated that there was no relationship between work fatigue and MSD complaints with a p value of 0.145 (42). This study is in line with that conducted by (Maudy et al., 2021) on teachers in Kendari City which stated that there was a relationship between work fatigue and MSD complaints with a p-value of 0.03. This is due to the wrong sitting and standing positions of the respondents which causes fatigue in the limbs (43).

The body needs rest time to prevent fatigue, a condition in which the body's ability to carry out activities decreases. Fatigue can occur due to monotonous work and is carried out for a long duration (43).

The absence of a relationship between work fatigue and the risk of MSDs in nurses is because during work activities nurses take a break of one to two hours for the next working hour. There is a break for nurses to rest. Based on the results of interviews with nurses, they stated that they were accustomed to the physical activities they did so that they did not easily experience fatigue.

The most influential factors on the risk of MSD complaints in nurses

Based on the results of multivariate analysis, the factor that most influences MSD complaints among nurses is work fatigue with a significance value of 0.032.

This research is in line with that conducted by (Sorour & Maksoud., 2022) where the most dominant factor influencing MSDs is the variable of work fatigue. Their research results show that nurses working in the emergency unit experience a lot of work fatigue, resulting in a high risk of musculoskeletal disorders, especially in the lower back, neck, and shoulder areas (44).

Work fatigue arises due to the workload experienced by nurses, both continuously in terms of physical workload and mental workload. Physical workload refers to activities that require muscle energy as the main source of power. This workload is often associated with heavy, rough, or muscle-based work, as these physical activities demand significant physical effort throughout the work duration (45).

MSDs and fatigue are variables that can lead to a decline in work quality, loss of workdays, expensive medical and material expenses, and decreased productivity. Long working hours in hospitals can accelerate the onset of fatigue and musculoskeletal problems, as well as reduce work accuracy, speed, and precision (46).

The high workload is one of the significant factors that affect the level of fatigue among nurses. When the number of tasks that need to be completed increases, more time and physical as well as mental energy are required, which can ultimately lead to work fatigue. The complex tasks of nurses, such as providing nursing care based on the nursing process, performing medical actions according to patient needs, communicating effectively with patients and their families, accompanying doctors during visits, and reporting on patient conditions, demonstrate a high intensity of physical activity. Moreover, this physical workload is exacerbated by administrative demands such as preparing daily reports during shift changes and involvement in room management (45).

This excessive workload has the potential to cause psychological stress and emotional reactions such as headaches and irritability, as well as contribute to musculoskeletal disorders (MSDs) due to continuous physical strain and non-ergonomic work postures (47).

Risk Management of MSDs in Nurses

Musculoskeletal Disorders (MSDs) are one of the main occupational health risks experienced by nurses due to high physical

and mental workloads, non-ergonomic work postures, and continuous work fatigue. The results of the study at RSUD Nunukan indicate that significant variables contributing to the occurrence of MSDs are BMI, length of service, physical workload, mental workload, and work fatigue.

Based on Law Number 23 of 1992 concerning Health, Article 23 states that every workplace is required to implement occupational health efforts, especially in work environments with high potential health hazards. This aims to ensure that workers can work healthily without endangering themselves or the surrounding community, and to support the optimal increase in work productivity within the framework of labor protection programs. Furthermore, the Minister of Health Regulation Number 66 of 2016 concerning Occupational Safety and Health in Hospitals in Chapter III stipulates that one of the potential ergonomic hazards is improper body posture and repetitive work activities.

Based on Law Number 1 of 1970 concerning Occupational Safety, specifically in Chapter III Article 3 regarding occupational safety requirements, as well as the Decree of the Minister of Health of the Republic of Indonesia Number 432/MENKES/SK/IV/2007 concerning Guidelines for Occupational Health and Safety Management, it is stated that activities in the hospital environment have the potential to cause various types of hazards, including physical, chemical, biological, ergonomic, and psychosocial hazards, which can threaten the safety and health of workers, patients, visitors, and the surrounding community.

MSD complaints experienced by nurses at RSUD Nunukan are due to muscle loads receiving static loads repeatedly and continuously over a long period, which will cause complaints such as damage to joints, ligaments, and tendons (35). Based on the characteristics of their work, nurses have responsibilities towards various important tasks, including the provision of physical and psychological care that demands long-term flexibility. In this context, flexibility refers to the ability to adapt to various activities performed. The workload faced by nurses includes activities such as moving patients, assisting patients to the bathroom, bathing patients, tidying beds, pushing stretchers, pushing medical equipment trolleys, as well as various other activities that involve movement or support for patients, such as carrying, pressing, pulling, lifting, and performing movements using the waist muscles (36).

Risk control is an effort made to reduce negative impacts or increase the likelihood of positive outcomes. These actions can be implemented through adjustments to work processes, policies, standard operating procedures (SOPs), or by providing adequate implementation facilities. Based on international standards, risk control strategies in the workplace include five stages: elimination, substitution, engineering control, administrative control, and the use of personal protective equipment (PPE). Elimination refers to the action of directly removing the source of danger. Substitution involves replacing high-risk tools, materials, or procedures with safer alternatives. Technical control includes engineering or modifying systems and equipment to reduce potential hazards. Administrative controls include the formulation of policies, training, and work arrangements that support safety. If the four methods have not yet optimally addressed the risks, then the use of personal protective equipment becomes the last step that must be implemented (48).

Efforts to control OHS risks for nurses are carried out by following the principles of the OHS hierarchy of control, adjusted to the type of nursing actions performed. In the work actions performed by nurses, control efforts are implemented through elimination/substitution measures (such as reducing heavy manual tasks like moving patients using assistive devices and eliminating extreme work shifts to prevent fatigue); engineering control measures (such as proper lighting arrangements and adequate space, providing ergonomic assistive devices like adjustable-height patient beds, adjustable-height work chairs, and arranging the layout of workspaces to prevent nurses from having to reach, bend, or twist excessively); and administrative control measures (such as developing hospital OHS policies and organizing various ergonomic training programs, work rotation, and rotating shifts to prevent both physical and mental fatigue, providing leave or rest time, routine IMT and work fatigue screenings using questionnaires like KAUPK2 and Nordic Body Map, and periodically evaluating mental and physical workload using NASA-TLX) (49).

5. CONCLUSION

From the results of the research conducted, researchers can draw the following conclusions:

1. There is no relationship between age and MSDs complaints in nurses at Nunukan Regional Hospital
2. There is a relationship between BMI and MSD complaints in nurses at Nunukan Regional Hospital
3. There is a relationship between work period and MSD complaints in nurses at Nunukan Regional Hospital
4. There is a relationship between physical workload and MSD complaints in nurses at Nunukan Regional Hospital
5. There is a relationship between mental workload and MSD complaints in nurses at Nunukan Regional Hospital
6. There is a relationship between work fatigue and MSD complaints in nurses at Nunukan Regional Hospital
7. The most influential factor in the risk of MSDs in nurses at Nunukan Regional Hospital is physical workload.

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